UNITED STATES GOVERNMENT
MEMORANDUM

January 3, 2012

To: Public Information (MS 5030)

From: Plan Coordinator, FO, Plans Section (MS 5231)

Subject: Public Information copy of plan

Control # - S-07525

Type - Supplemental Development Operations Coordinations Document

Lease(s) - OCS-G09866 Block - 776 Mississippi Canyon Area
OCS-G09867 Block - 777 Mississippi Canyon Area

Operator - BP Exploration & Production Inc.

Description - Waterflood Injection Wells WA,WB,WC,WD,WE,WF,WG and WH

Rig Type - DRILLSHIP

Attached is a copy of the subject plan.

It has been deemed submitted as of this date and is under review for approval.

Michelle Griffitt
Plan Coordinator

Site Type/Name	Botm Lse/Area/Blk	Surface Location	Surf Lse/Area/Blk
WELL/WA	G09867/MC/777	7180 FNL, 4790 FEL	G09867/MC/777
WELL/WB	G09867/MC/777	7336 FNL, 4678 FEL	G09867/MC/777
WELL/WC	G09867/MC/777	7242 FNL, 4831 FEL	G09867/MC/777
WELL/WD	G09867/MC/777	7272 FNL, 4640 FEL	G09867/MC/777
WELL/WE	G09866/MC/776	6080 FSL, 3700 FEL	G09866/MC/776
WELL/WF	G09867/MC/777	6109 FSL, 3528 FEL	G09866/MC/776
WELL/WG	G09866/MC/776	6037 FSL, 3513 FEL	G09866/MC/776
WELL/WH	G09866/MC/776	6006 FSL, 3691 FEL	G09866/MC/776

Gulf of Mexico Exploration & Production Inc.

Gulf of Mexico

Supplemental Exploration Plan

Thunder Horse

Mississippi Canyon Blocks:

MC 775, OCS-G 19997
MC 776, OCS-G 09866
MC 777, OCS-G 09867
MC 778, OCS-G 09868
MC 821, OCS-G 14657
MC 822, OCS-G 14658
MC 777 Unit, Agreement No. 754398003

PUBLIC INFORMATION COPY

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Rev	**Date**	**Document Status**	**Custodian/Owner**	**Authority**

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AMENDMENT RECORD

Amendment Date	Revision Number	Amender Initials	Amendment

TABLE OF CONTENTS

1 Plan Contents 6
1.1 History of Unit Leases 6
1.2 Description of Activities 7
1.3 Location 8
1.4 Safety and Pollution Prevention Features 8
1.5 Storage Tanks and Production Vessels 8
1.5.1 Storage Tanks - Discoverer Enterprise 9
1.5.2 Storage Tanks - Thunder Horse PDQ 9
1.6 Additional Measures 10
2 General Information 11
2.1 Applications and Permits 11
2.2 Drilling Fluids 11
2.3 Production 11
2.4 Oil Characteristics 12
2.5 New or Unusual Technologies 12
2.6 Bonding Information 12
2.7 Oil Spill Financial Responsibility 12
2.8 Deepwater Well Control Statement 12
2.9 Suspension of Production 13
2.10 Blowout Scenario 13
3 Geological and Geophysical Information 14
3.1 Geological Description 14
3.2 Structure Contour Maps 14
3.3 Interpreted 2-D and/or 3-D Seismic Lines 14
3.4 Geological Structure Cross-sections 14
3.5 Shallow Hazards Report 14
3.6 Shallow Hazards Assessment 14
3.7 High-resolution Seismic Lines 14
4 Hydrogen Sulfide (H_2S) Information 16
4.1 Concentration 16
4.2 Classification 16
4.3 H_2S Contingency Plan 16
4.4 Modeling Report 16
5 Mineral Resource Conservation Information 17
5.1 Technology and Reservoir Engineering Practices and Procedures 17
5.2 Technology and Recovery Practices and Procedures 17

5.3 Reservoir Development 17
6 Biological and Physical Information 18
6.1 Benthic Communities Report 18
6.2 Topographic Features Map 18
6.3 Live Bottoms (Pinnacle Trend) Map 18
6.4 Live Bottoms (Low Relief) Map 18
6.5 Potentially Sensitive Biological Features 18
6.6 Remotely Operated Vehicle (ROV) Monitoring Survey Plan 19
6.7 Threatened or Endangered Species, Critical Habitat, and Marine Mammal Information 19
6.8 Archaeological Report 20
7 Waste and Discharge Information 21
7.1 Projected Generated Wastes 21
7.2 Projected Ocean Discharges 21
8 Air Emissions Information 22
8.1 Screening Questions 22
8.2 Emissions Worksheets 22
8.3 Emission Reductions Measures 22
8.4 Verification of Non-Default Emission Factors 23
8.5 Non-Exempt Activities 23
8.6 Modeling 24
9 Oil Spill Information 25
9.1 Oil Spill Response Planning 25
9.1.1 Regional Oil Spill Response Plan (OSRP) Information 25
9.1.2 Spill Response Sites 26
9.1.3 OSRO Information 26
9.1.4 Worst-case Scenario Determination 26
9.2 Oil Spill Response Discussion 27
10 Environmental Monitoring and Mitigation Measures 28
10.1 Monitoring Systems 28
10.2 Incidental Takes 28
10.3 Flower Garden Banks National Marine Sanctuary 28
11 Lease Stipulation Information 29
12 Related Facilities and Operations Information 30
12.1 Related OCS Facilities and Operations 30
12.2 Produced Liquid Hydrocarbons Transportation Vessels 30
13 Support Vessels and Aircraft Information 31
13.1 General 31

13.2 Diesel Oil Supply Vessels 31
13.3 Solid and Liquid Wastes Transportation & Disposal....31
13.4 Vicinity Map 31
14 Onshore Support Facilities Information 32
14.1 General 32
14.2 Support Base Construction or Expansion....32
14.3 Waste Disposal 32
15 Coastal Zone Management Act (CZMA) Information....33
15.1 Consistency Certification 33
15.2 Other information 33
16 Environmental Impact Analysis (EIA) 34
17 Administrative Information 35
17.1 Exempted Information Description 35
17.2 Bibliography 35
17.3 Recovery Fees 35
Appendix A: Plan Information Forms 36
Appendix B: Vicinity Plat and Location Plat 47
Appendix C: Shallow Hazard Assessments 54
Appendix D: Air Quality Report 121
Appendix E: Waste Tables 173
Appendix F: Environmental Impact Analysis (EIA) 176
Appendix G: Alabama CZM 245
Appendix H: Fee Recovery 249

1 Plan Contents

1.1 History of Unit Leases

Mississippi Canyon Block 777 Unit, Agreement No. 754398003, includes Mississippi Canyon Blocks 775, 776, 777, 778, 821, and 822, OCS-G 19997, 9866, 9867, 9868, 14657, and 14658, respectively. BP Exploration & Production Inc. holds a 75% working interest in the unit and ExxonMobil owns the remaining 25% interest. BP is designated operator.

The Thunder Horse Project consists of two separate but related accumulations referred to as Thunder Horse North (THN) and Thunder Horse South (THS). Thunder Horse South (Mississippi Canyon 778 Field) structure is comprised of Mississippi Canyon Blocks 777, the south half of 778, and all of 821, and 822. Thunder Horse North (Mississippi Canyon 776 Field) structure includes Mississippi Canyon Blocks 775, 776 and the north half of 778.

The Thunder Horse Semi-Submersible Production, Drilling and Quarters (PDQ) platform was installed on May 11, 2005 over the Thunder Horse South Drill Center (DC) – DC 41 near the southern boundary of MC 778. Production commenced June 14, 2008.

Thunder Horse South includes:

DC 41 (MC 778) - 22 wells

- Two 10-slot manifolds (DC 41-W, DC-41E) with five wells on production (MC 822 TA001, MC 822 TA002, MC 822 TA004, MC 822 TA003, MC 778 TA005);
- Two wells drilled to TD waiting on completions to commence production (MC 822 #10 BP01, MC 822 #5);
- Two wells drilled to TD and temporarily abandoned (MC 822 #6, MC 778 #1BP01);
- Eight top holes drilled with future plans to deepen to TD (MC 778 #7, 8, 12, 14, 15, 16, 17 and 18);
- Three previously approved wells yet to be drilled.

DC 45 (MC 822) - One well on production (MC 822 TD001)

DC 42 (MC 822) - Two previously approved water injection wells yet to be drilled

Thunder Horse North includes:

DC 30 (MC 775) - 2 wells

- One well drilled and on production (MC 775 TG001);
- One previously approved well yet to be drilled (MC 776 #6)

DC 31 (MC 776) – 5 wells

- One well drilled and temporarily abandoned (MC 776 #2ST01);
- Four previously approved wells yet to be drilled

DC 32 (MC 776) - 4 wells

- One well on production (MC 776 TC002);
- One well formerly producing and currently shut-in pending permanent abandonment (MC 776 TC001);

- One top hole drilled with future plans to deepen (MC 776 #3);
- One well drilled and temporarily abandoned (MC 776 #4 ST01)

DC 33 (MC 777) – 4 wells

- Two wells on production (MC 777 TB001, MC 777 TB002);
- One top hole drilled with future plans to deepen to TD (MC 777 #2);
- One previously approved well yet to be drilled (MC 777 #6)

DC 34 (MC 778) – 2 wells

- One well on production (MC 777 TF001);
- One well drilled waiting on completions to commence production (MC 778 #22)

BP Exploration & Production Inc. (BP) received approval of the Initial Development Operations Coordination Document (DOCD) N-07469 on April 25, 2003.

BP received approval of Revised DOCD's:

- R-03985 on October 8, 2003;
- R-04175 on June 13, 2005;
- R-04665 on June 20, 2007;
- R-04701 on August 22, 2007;
- R-04710 on October 29, 2007;
- R-04818 on May 9, 2008;
- R-04822 on July 2, 2008;
- R-04885 on February 11, 2009;
- R-04929 on June 16, 2009.

BP received approval of Supplemental DOCD S-7263 on February 26, 2009.

A Programmatic Environmental Assessment for Grid 16 - Site-Specific Evaluation of BP Exploration and Production Inc.'s Initial DOCD (N-7469) Thunder Horse Project was issued in December 2002 (OCS EIS/EA MMS 2002-081).

1.2 Description of Activities

The initial DOCD (N-7469) included a water injection system for Thunder Horse North that consisted of a single pipeline supplying water to two water injection wells in the vicinity of DC 33 and two water injection wells in the vicinity of DC 31.

This plan proposes revising the locations of the four proposed THN water injection wells and drilling an additional four water injection wells. The revised Thunder Horse North Water Injection System will be comprised of eight water injection wells from two proposed drill centers in Thunder Horse North (DC33WI in MC 777 and DC32WI in MC 776). It will also include the installation of two 4-slot single header manifolds, two 10-in. pipelines and one 12-in. pipeline, and the associated plets, sleds, jumpers and infield umbilicals. The proposed drill centers will be tied into the MC 778 "A" Platform (Thunder Horse PDQ) via the proposed pipelines.

The PDQ is an existing floating production system (semi-submersible) with a maximum capacity of 250,000-BOPD and 200-MMSCFD with a maximum water injection capacity of

300,000-BWPD. The proposed wells will be drilled by Transocean's dynamically positioning *Discoverer Enterprise* rig.

OCS Plan Information Forms (Form MMS-137), which provide details concerning the activities proposed in this plan, are included as **Appendix A**.

1.3 Location

Well Location Plats at a scale of 1-in. = 2,000-ft. on an 8.5-in. X 11-in. sheet of paper that depict the surface locations and water depths of the proposed wells are included in **Appendix B**.

1.4 Safety and Pollution Prevention Features

Safety and pollution prevention features utilized during drilling and plugging operations will include the use of appropriately designed casing and cement programs; appropriate blowout preventers, diverters, and other associated well equipment; and appropriate mud monitoring equipment. Other safety and pollution prevention features are sufficient mud volumes for well control and properly trained personnel as described in 30 CFR Part 250, Subparts C, D, E, F and O and as further clarified by Notices to Lessees.

The platform structure was designed according to 30 CFR250, Subpart I, and subsea pipeline architecture according to requirements in Subpart J.

Pollution prevention systems include curbs, gutters, drip pans, and drains in deck areas to collect contaminants and oil drainage is piped to sump systems to reduce the risk of discharge of oil into offshore waters. The platform is protected by an automated shutdown system including SCSSV, and USV integrated with pipeline SDVs. The system is designed to shut in a well following a system shutdown signal. The well and pipelines will be monitored by pressure sensors and automatic shut in systems. Wells will be monitored for casing pressure according to BSEE guidelines.

Production Safety Systems are designed and installed according to 30 CFR Part 250, Subpart H, as further clarified by Notices to Lessees. The systems include the safety and environmental analysis procedures afforded by SAFDs and SAFE Charts developed according to requirements of API RP 14 C, and other API Recommended Practices. Pollution prevention systems are developed to adhere to EPA NPDES permit discharge requirements and 30 CFR Part 250 Subpart C.

Drilling and operations personnel are trained according to requirement of Subpart O. Appropriate fire and abandon drills will be conducted, and navigational aids, lifesaving equipment, and other safety equipment will be installed and maintained as mandated by the U.S. Coast Guard regulations contained in 33 CFR Part 144.

1.5 Storage Tanks and Production Vessels

Information regarding the storage tanks and production vessels located on the drilling rig, support vessels, and existing production facility (Thunder Horse PDQ) that will store oil, as defined at 30 CFR 250.6 is provided in the table below. Only those tanks with a capacity of 25-barrels or more are included.

1.5.1 Storage Tanks - Discoverer Enterprise

Type of Storage Tank	Type of Facility	Tank Capacity (bbls)	No. of Tanks	Total Capacity (bbls)	Fluid Gravity (API)
Fuel (Diesel) Oil	Drill Ship	33,252	1	33,252	31.14
Fuel Oil Settling	Drill Ship	836.5	2	1673	31.14
Fuel Oil Day Tank	Drill Ship	836.5	2	1673	31.14
Lube Oil Storage	Drill Ship	66	1	66	34.97
Waste Oil	Drill Ship	353	1	353	34.97
Hydraulic Oil	Drill Ship	183.5	2	367	34.97
Active Mud/Completion Fluids	Drill Ship	500	12	6,000	-72.05
Reserve Mud/Completion Fluids	Drill Ship	1,500	5	7,500	-72.05
Slugging Tanks	Drill Ship	100	4	400	-72.05

1.5.2 Storage Tanks - Thunder Horse PDQ

Type of Storage Tank	Type of Facility	Tank Capacity (bbls)	No. of Tanks	Total Capacity (bbls)	Fluid Gravity (API)
Diesel Fuel Tank	FOI	6,888	2	13,776	25.72
Base Oil Tank	FOI	3,477	1	3,477	25.72
Fuel Oil Storage Tank	FOI	348	1	348	25.72
Fuel Oil Service Tank	FOI	347	1	347	25.72
Fuel Oil Day Tank	FOI	81	1	81	25.72
Fuel Oil Day Tank	FOI	34	2	68	25.72
Fuel Oil Day Tank	FOI	58	1	58	25.72
Lube Oil Storage	FOI	174	1	174	25.72
Lube Oil Renovation Tank	FOI	44	2	88	25.72

Recovered Oil Tanks	FOI	412	2	824	29.30
Diesel Oil Tank	FOI	89	1	89	25.72

1.6 Additional Measures

In addition to the safety, pollution prevention and early spill detection measures proposed in 30 CFR Part 250, BP will rely on its Operating Management System (OMS) to help deliver safe and reliable operations. OMS is a system of interdependent activities that drive how BP will actually perform work and comply with internal and external standards and regulations. BP has also implemented an Environmental Management System (EMS) which provides a systematic way to identify risks, potential impacts, and compliance requirements that need to be managed. BP has also presented to the BOEMRE a report entitled ***Deepwater Horizon Containment and Response: Harnessing Capabilities and Lessons Learned***. This document helps assess the capabilities that are now available to respond to oil spills in the GoM.

BP has adopted additional voluntary performance standards as outlined in a letter to Director Bromwich, dated July 15, 2011:

1. BPXP will use, and will require its contractors involved in drilling operations to use, subsea blowout preventers (BOPs) equipped with no fewer than two blind shear rams and a casing shear ram on all drilling rigs under contract to BPXP for deepwater service operating in dynamic position mode. With respect to moored drilling rigs under contract to BPXP for deepwater drilling service using subsea BOPs, the subsea BOP will be equipped with two shear rams, which will include at least one blind shear ram and either an additional blind shear ram or a casing shear ram.
2. Each time a subsea BOP from a moored or dynamically positioned drilling rig is brought to the surface and testing and maintenance on the BOP are conducted, BPXP will require that a third party verify that the testing and maintenance of the BOP were performed in accordance with manufacturer recommendations and API RP 53.
3. BPXP will require that lab testing of cement slurries for primary cementing of casing and exposed hydrocarbon bearing zones relating to drilling operations of deepwater wells be conducted or witnessed by a BPXP engineer competent to evaluate such lab testing, or a competent third party independent of the cement provider. BPXP will provide lab results to the applicable BOEMRE field office within a reasonable period of time.

2 General Information

2.1 Applications and Permits

Application/Permit	Issuing Agency	Status
Application for a Permit to Drill (APD)	BSEE	Pending Submittal
Deepwater Operations Plan Revision	BSEE	Pending Submittal
Production Safety System Modification	BSEE	Pending Submittal
Lease Term Pipeline Application	BSEE	Pending Submittal
Enhanced Oil Recovery Applications (Water Injection Permit)	BSEE	Pending Submittal

2.2 Drilling Fluids

This information is not required. The requirements of NTL 2008-G04 for this information are not applicable to a supplemental DOCD for the activities as proposed in this SDOCD. Reference the BOEMRE guidance document entitled "Approval Requirements for Activities that Involve the Use of a Subsea Blowout Preventer (BOP) or a Surface BOP On a Floating Facility." The document specifically provides that "clarifying guidance in Appendix A regarding the submission of information to be used in connection with an EA does not apply to EPs and DOCDs that propose to conduct the following activities … b. drilling a waterflood, gas injection, or a disposal well …". As this SDOCD relates to the drilling of waterflood injection wells, the requirements of that guidance do not apply.

2.3 Production

There is no new production associated with this SDOCD. The new wells proposed are water injection wells. Each injection well is forecasted as follows:

Well	Type	Average Injection Rate	Peak Injection Rate	Life of Well
WA	Water	20,000-bbls/day	45,000-bbls/day	20-years
WB	Water	20,000-bbls/day	45,000-bbls/day	20-years
WC	Water	20,000-bbls/day	45,000-bbls/day	20-years
WD	Water	20,000-bbls/day	45,000-bbls/day	20-years

WE	Water	20,000-bbls/day	45,000-bbls/day	20-years
WF	Water	20,000-bbls/day	45,000-bbls/day	20-years
WG	Water	20,000-bbls/day	45,000-bbls/day	20-years
WH	Water	20,000-bbls/day	45,000-bbls/day	20-years

2.4 Oil Characteristics

This information is not required. The requirements of NTL 2008-G04 for this information are not applicable to a supplement DOCD for the activities related to water injection wells, as proposed in this SDOCD. Reference the BOEMRE guidance document entitled "Approval Requirements for Activities that Involve the Use of a Subsea Blowout Preventer (BOP) or a Surface BOP On a Floating Facility." The document specifically provides that "clarifying guidance in Appendix A regarding the submission of information to be used in connection with an EA does not apply to EPs and DOCDs that propose to conduct the following activities … b. drilling a waterflood, gas injection, or a disposal well …". As this SDOCD relates to the drilling of waterflood injection wells, the requirements of that guidance do not apply.

2.5 New or Unusual Technologies

Development activities in Mississippi Canyon Area Blocks 776 and 777 are not expected to utilize new or unusual technology within the meaning of 30 CFR §550.200.

2.6 Bonding Information

The bonding requirements for the activities proposed in this Supplemental DOCD are satisfied by an area-wide bond, furnished and maintained according to 30 CFR Part 556, Subpart I; NTL No. 2000-G16, "Guidelines for General Lease Surety Bonds"; and additional security under 30 CFR 556.53(d) and National NTL No.2008-N07, "Supplemental Bond Procedures".

2.7 Oil Spill Financial Responsibility

BP (Operator No. 02481) has demonstrated oil spill financial responsibility for the facilities proposed in this Supplemental DOCD according to 30 CFR Part 553, and NTL No. 2008-N05, "Guidelines for Oil Spill Financial Responsibility for Covered Facilities."

2.8 Deepwater Well Control Statement

BP (Operator No. 02481) has the financial capability to drill a relief well and conduct other emergency well control operations.

2.9 Suspension of Production

There are no approved suspensions of production in existence, or that BP will seek, to hold the leases or unit involved with the proposed DOCD activities.

2.10 Blowout Scenario

This information is not required. The requirements of NTL 2008-G04 for this information are not applicable to a supplement DOCD for the activities related to water injection wells, as proposed in this SDOCD. Reference the BOEMRE guidance document entitled "Approval Requirements for Activities That Involve the Use of a Subsea Blowout Preventer (BOP) or a Surface BOP On a Floating Facility." The document specifically provides that "clarifying guidance in Appendix A regarding the submission of information to be used in connection with an EA does not apply to EPs and DOCDs that propose to conduct the following activities … b. drilling a waterflood, gas injection, or a disposal well …". As this SDOCD relates to the drilling of waterflood injection wells, the requirements of that guidance do not apply.

3 Geological and Geophysical Information

3.1 Geological Description

A brief description of geological objectives and hydrocarbon trapping elements is included in **Appendix C** in the "Proprietary Information" copies of this Supplemental DOCD.

3.2 Structure Contour Maps

Current structure contour maps are included in **Appendix C** in the "Proprietary Information" copies of this Supplemental DOCD.

3.3 Interpreted 2-D and/or 3-D Seismic Lines

3-D arbitrary seismic sections through each of the proposed water injector locations are included in **Appendix C.**

3.4 Geological Structure Cross-sections

Interpreted geological structure cross-sections through each of the proposed water injector locations are included in **Appendix C** in the "Proprietary Information" copies of this Supplemental DOCD.

3.5 Shallow Hazards Report

C&C Technologies prepared a report entitled "Hazard Report for Thunder Horse Field Area" dated January 2002. This report provides detailed information on the acquisition and interpretation of the AUV multibeam bathymetry, sonar, and subbottom profiler data, copies of which were submitted with the previously approved Initial DOCD (N-07469).

3.6 Shallow Hazards Assessment

Shallow hazards assessments that evaluate the seafloor and subsurface geologic and manmade features and conditions, prepared in accordance with NTL 2008-G05, for the proposed surface locations of the proposed well sites "WA" in MC 777 and "WE" in MC 776 are included in **Appendix C** of this Supplemental DOCD. Surface locations for wells "WB", "WC", and "WD" will be within 200-ft of the proposed MC777-WA location (DC33WI) and Wells "WF", "WG" and "WH" will be within 200-ft of the proposed MC776-WE location (DC32WI). The assessments cover a surface and subsurface area of 2,000-ft around the proposed wells. Seafloor and subsurface conditions are expected to be similar for the additional wells at each location.

3.7 High-resolution Seismic Lines

Migrated and annotated (shot points, time lines, well paths) 3-D seismic lines within 152-meters (500-feet) of the proposed surface locations are included within the Shallow Hazards

Assessments found in **Appendix C** of the "Proprietary Information" copies of this Supplemental DOCD.

4 Hydrogen Sulfide (H_2S) Information

4.1 Concentration

It is not expected that H_2S will be encountered during the operations proposed in this plan.

4.2 Classification

Pursuant to Title 30 CFR 250.490 (c), the MC 777 Unit Blocks have been previously determined "H_2S absent."

4.3 H_2S Contingency Plan

Based on previous drilling, no H_2S is known to occur in the unit area. Based on earlier drilling and previous MMS "H_2S absent" classification, a H_2S Contingency Plan prepared according to 30 CFR §250.490 (f) is not required for the proposed activities.

4.4 Modeling Report

H_2S concentrations greater than 500-parts per million (ppm) are not expected in the operations proposed in this plan, therefore, a modeling report is not required.

5 Mineral Resource Conservation Information

5.1 Technology and Reservoir Engineering Practices and Procedures

BP Exploration & Production acquired the Wide Azimuth Towed Streamer (WATS) seismic survey and merged it with two existing Narrow Azimuth Towed Streamer surveys. The merged survey was processed using anisotropic migration technology to improve seismic imaging of the Thunder Horse field. We are monitoring and analyzing individual well pressure drawdown and buildup data to get a better understanding of the reservoir. We are integrating the latest drilling results, seismic interpretations from reprocessed data sets, and individual well production and pressure data to refine reservoir simulation models to better forecast future field performance. We are planning to drill water injectors to provide pressure support and increase ultimate recovery of our reservoirs.

5.2 Technology and Recovery Practices and Procedures

To further achieve optimum recovery of the Thunder Horse field, BP is planning to drill eight water injection wells to provide pressure support for the reservoir and increase ultimate recovery. The water injection plan is divided to three different phases to address different stages of production development. We have an active base management plan to ensure wells are capable of delivering their production potential in the near-term, and are fit to recover the reserves in the long-term, such as: surveillance, sand management, vibration, flow assurance, and well integrity managements. For water injection wells, we will have a formal updated surveillance plan, a scale management strategy, and monitor system fully integrated with existing production system to ensure operation efficiency. We will have a plan to manage voidage replacement to minimize pressure depletion and maximize ultimate recovery.

5.3 Reservoir Development

Drilling results on Mississippi Canyon Blocks 775, 776 and 777 along with 3-D seismic data indicate that the blocks have strong potential for commercial hydrocarbons. The MC 777 TF001 and MC 778-22 wells penetrated oil bearing sands in the Pink 6.5L and Pink 6.5LL reservoirs seen in the Thunder Horse North field. This result extended the area of the Thunder Horse North reservoir across block MC 777 and MC 778 based on current structure maps. The MC 775 TG001 well penetrated oil-bearing sands in the Pink 5.0L and Pink 6.5L horizons seen in the Thunder Horse North Fields and MC 819 #1 well, extending the field west from the sands seen in the 776 #1 TC001.

To date, six wells have been drilled and produced in the North. BP is planning to drill an additional five producers and eight injectors over the course of ten years to fully develop the Thunder Horse North field. The wells will use sand controlled completions with sliding sleeves or smart well technology to capture the reserves.

6 Biological and Physical Information

6.1 Benthic Communities Report

Features or areas that could support high-density benthic communities are not located within 2,000-feet of each proposed muds and cuttings discharge location. The proposed wells will be drilled utilizing a dynamically positioned semi-submersible rig; therefore, physical disturbance of the seafloor will not occur due to anchor emplacements.

The seafloor surrounding all drill centers in the Thunder Horse Area have been assessed for the presence of chemosynthetic communities. There is no topographic or seafloor amplitude evidence to indicate the existence of chemosynthetic communities within the cleared areas around the drill centers. The pipelines and associated equipment will be installed by dynamically positioned vessels; therefore, physical disturbance of the seafloor will not occur due to anchor emplacements.

A Shallow Hazards Assessment has been prepared by a BP geohazards geophysicist relative to the detection of chemosynthetic communities. It is included in **Appendix C** and concludes that the conditions capable of supporting chemosynthetic communities are not expected at, or within 2,000-ft of, the proposed locations.

6.2 Topographic Features Map

All proposed bottom-disturbing activities will occur outside 305-meters (1,000-feet) of the "No Activity Zone" of an identified topographic feature.

6.3 Live Bottoms (Pinnacle Trend) Map

Live Bottom (Pinnacle Trend) Stipulation does not apply to these leases; therefore, a map is not required.

6.4 Live Bottoms (Low Relief) Map

Live Bottom (low relief) Stipulation does not apply to these leases; therefore, a map is not required.

6.5 Potentially Sensitive Biological Features

The intent of NTL No. 2009-G39 is to protect biologically sensitive features and areas in water depths less then 300-meters (984-feet). All proposed bottom-disturbing activities will occur outside 30-meters (100-feet) of any potentially sensitive biological features.

6.6 Remotely Operated Vehicle (ROV) Monitoring Survey Plan

Mississippi Canyon Area Blocks 776 and 777 fall within Grid 16. It has been determined by the MMS that sufficient remotely operated vehicle (ROV) information has been gathered in Grid 16; therefore, no ROV monitoring survey is required.

6.7 Threatened or Endangered Species, Critical Habitat, and Marine Mammal Information

Twenty-nine species of marine mammals occur in the GOM. There are 28 species of cetaceans (7 mysticete and 21 odontocete species) and 1 sirenian species, the manatee.

Five baleen whale species, one toothed whale species, and one sirenian species occur in the GOM and are listed as endangered under the Endangered Species Act (ESA) (USDOI, BOEMRE Final S-EIS WPA 2011-34):

- The Northern Right Whale (*Eubalaena glacialis*)
- The Blue Whale (*B. musculus*)
- The Fin Whale (*Balaenoptera physalus*)
- The Sei Whale (*B. borealis*)
- The Humpback Whale (*Megaptera novaeangliae*)
- The Sperm Whale (*Physeter macrocephalus*)
- The West Indian Manatee (*Trichechus manatus*)

Five species of sea turtle are known to inhabit the waters of the Gulf of Mexico:

- The Leatherback (*Dermochelys coriacea*),
- The Green (*Chelonia mydas*),
- The Hawksbill (*Eretmochelys imbricata*),
- The Kemp's ridley (*Lepidochelys kempii)*
- The Loggerhead (*Caretta caretta*).

The Gulf sturgeon (*Ancipenser oxyrincus desotoi*) and the smalltooth sawfish (*Pristus pectinata*) are the only listed threatened and endangered fish species in the Gulf of Mexico.

Mississippi Canyon Area Blocks 776 and 777 are not designated as critical habitat for any of these species.

Additional information can be found in the Environmental Impact Analysis attached as **Appendix F.**

6.8 Archaeological Report

C&C Technologies, Inc. completed an Archaeological Assessment Study in Block 777, Mississippi Canyon Area in May 2006. Three copies of the report were submitted with the Revised Exploration Plan (R-4318) approved July 11, 2006.

C&C Technologies, Inc. completed a Cultural Resources Assessment Study in Block 776, Mississippi Canyon Area in July 2006. Enclosed please find three copies of the report.

7 Waste and Discharge Information

7.1 Projected Generated Wastes

A table providing information on the projected solid and liquid wastes likely to be generated by the proposed activities is included in **Appendix E**.

7.2 Projected Ocean Discharges

A table providing information on the projected ocean discharges likely to be generated during the proposed activities is included in **Appendix E**.

8 Air Emissions Information

8.1 Screening Questions

Yes	No	Screening Questions for DOCD's
X		Is any calculated Complex Total (CT) Emission amount (tons) associated with your proposed development and production activities more than 90% of the amounts calculated using the following formulas: CT = 3400D2/3 for CO, and CT = 33.3D for the other air pollutants (where D = distance to shore in miles)?
X		Do your emission calculations include any emission reduction measures or modified emission factors?
X		Does or will the facility complex associated with your proposed development and production activities process production from eight or more wells?
	X	Do you expect to encounter H2S at concentrations greater than 20 parts per million (ppm)?
	X	Do you propose to flare or vent natural gas in excess of the criteria set forth under 30 CFR 250.1160?
	X	Do you propose to burn produced hydrocarbon liquids?
	X	Are your proposed development and production activities located within 25 miles (40 kilometers) from shore?
X		Are your proposed development and production activities located within 124 miles (200 kilometers) of the Breton Wilderness Area?

8.2 Emissions Worksheets

Emission Worksheets (MMS-139) showing calculated Plan and Complex Total Emissions associated with the activities proposed in this Supplemental Developmental Operations Coordination Document are found in **Appendix D**.

8.3 Emission Reductions Measures

Emission source	Reduction Control Method	Highest Year Amount of NOX Reduction and Monitoring System (Worksheet = "Emissions6")
MODU Engines	Actual Fuel Usage	6267 tpy, monitoring system MODU Fuel Usage Logs
Core Fleet Vessel Engines (OSVs, FSVs, Multi-Service vessels)	Actual Fuel Usage	918 tpy, monitoring system Core Fleet Fuel Usage Database

8.4 Verification of Non-Default Emission Factors

The default emission factors provided in Form MMS 139 were used, with the following exceptions:

- Natural Gas Turbines use newest available factors from AP-42, Supplement F (4/00) vs. Supplement B (10/96), except for NOx. NOx uses a vendor (GE) supplied factor which is higher than either the Supplement B or Supplement F factor. For other pollutants, the change to Supplement F factors means SOx remains constant, VOC is slightly lower (7%), CO significantly lower (57%) and a factor is provided for total PM (no factor provided in stock form 139)
- Liquid fired turbines use Supplement F factors except for NOx which uses a vendor (GE) supplied factor. The GE factor is higher than Supplement F.

All of the exceptions for NOx result in higher projected emissions, so further verification is not required. Verification of the most current AP-42 Supplement available at:

http://www.epa.gov/ttn/chief/ap42/suppchga-f.html

8.5 Non-Exempt Activities

In compliance with 30 CFR § 550.303(e) through (i): an approved air quality model was used to demonstrate whether worst case total complex modeled impacts of NOx/NO_2 exceed relevant thresholds (i.e.- Significant Impact Levels (SILs) and/or National Ambient Air Quality Standards (NAAQS)). For the annual averaging period, modeled impacts were compared to applicable SILs (1 μg/m^3 NO_2 at closest point of landfall and 0.1 μg/m^3 NO_2 at the Breton Sound Class I area). Since no SILs have been finalized for the 1 hour NAAQS, compliance with that standard was demonstrated by adding worst case modeled total complex impacts to the closest available NO_2 ambient monitoring data (Kenner, LA). That demonstration resulted in impacts less than the 1 hour NAAQS of 188 μg/m^3 NO_2.

Modeling results confirmed that projected emissions of NO_2 do not significantly affect the air quality of the onshore area at either the closest point of landfall, or at the Breton Sound Class I area.

Neither application of Best Available Control Technology (BACT) nor offsets are required for this project. This applies to both permanent and temporary facilities.

No modeled concentration of an air pollutant exceeded relevant primary or secondary ambient air quality standards, at either the closest point of land fall, or at the Breton Sound Class I area.

8.6 Modeling

Dispersion modeling as described above was conducted to evaluate potential air quality impacts against established Significant Impact Levels (SILs) and/or relevant National Ambient Air Quality Standards (NAAQS) at the nearest shore line and at Breton National Wildlife Refuge Class I area. A modeling protocol was developed consistent with 40 CFR 51 Appendix W and BOEM guidance for evaluating offshore drilling and production operations and their impact to coastal air quality. It should be noted that emissions quantities/rates used in modeling (in pounds per hour) are extremely conservative, and do not reflect any reductions described in the Emissions Reductions Measures section above.

Based on distance to shore, maximum emissions rates, meteorological conditions and other protocol considerations, the modeling predicts that the activities in the Thunder Horse unit result in air quality impacts less than established SILs and or NAAQS.

A modeling report may be found in **Appendix D**.

A CD has been compiled that consolidates the following relevant information:

- AQR spreadsheets (Plan and Complex total) in Excel format;
- AQR spreadsheets (Plan and Complex total) in Acrobat format;
- Actual fuel consumption records for the MODU and Core Fleet vessels;
- TRC modeling report;
- OCD modeling files;
- CALPUFF modeling files;
- CALMET meteorological files.

A copy of this CD has been provided in **Appendix D**.

9 Oil Spill Information

9.1 Oil Spill Response Planning

9.1.1 Regional Oil Spill Response Plan (OSRP) Information

All of the existing and proposed activities and facilities proposed by this Supplemental DOCD for BP Exploration & Production Inc. (Operator No. 2481) will be covered by the OSRP filed by BP America Inc. (Operator No. 21591) in accordance with 30 CFR Part 254 and approved on July 21, 2009. A revised Regional OSRP was submitted to the BSEE on October 20, 2011 and is awaiting approval.

In a letter submitted to Mr. Michael J. Saucier dated October 19, 2011, BP Exploration & Production Inc. provided a certification statement of the kind described in 30 CFR 254.2 covering its operations in the Gulf of Mexico.

BP has adopted additional voluntary performance standards as outlined in a letter to Director Bromwich, dated July 15, 2011:

4. BPXP's Oil Spill Response Plan (OSRP) will include information about enhanced measures for responding to a spill in open water, near shore response and shoreline spill response based on lessons learned from the *Deepwater Horizon* oil spill. In complying with the requirements of 30 CFR Part 254 and related Notices to Lessees, BPXP's OSRP will include:

   - Provisions to maintain access to a supply of dispersant and fireproof boom for use in the event of an uncontrolled long-term blowout for the length of time required to drill a relief well.
   - Contingencies for maintaining an ongoing response for the length of time required to drill a relief well.
   - A description of the measures and equipment necessary to maximize the effectiveness and efficiency of the response equipment used to recover the discharge on the water's surface. The discussion must include methods to increase encounter rates, the use of vessel tracking, and the use of remote sensing technologies.
   - Information on remote sensing technology and equipment to be used to track oil slicks, including oil spill detection systems and remote thickness detection systems (such as X-band/infrared systems).
   - Information pertaining to the use of vessel tracking systems and communication systems between response vessels and spotter personnel.
   - A shoreline protection strategy that is consistent with applicable area contingency plans (ACP).
   - For operations using a subsea BOP or a surface BOP on a floating facility, a discussion regarding strategies and plans related to source abatement and control for blowouts from drilling.

9.1.2 Spill Response Sites

Primary Response Equipment Location	Preplanned Staging Location(s)
Houma, LA.; Lake Charles, LA.; Galveston, Texas	Fourchon, LA.

9.1.3 OSRO Information

BP is a member of the Marine Spill Response Corporation (MSRC), Clean Gulf Associates (CGA), and the National Response Corporation (NRC). BP would utilize the OSROs' personnel and equipment in the event of an oil spill at Mississippi Canyon Area Block 777 unit area. CGA is an oil spill cooperative, which owns a large inventory of oil spill clean-up equipment that is supported by the Marine Spill Response Corporation (MSRC). The MSRC is responsible for storing, inspecting, maintaining and dispatching the CGA's equipment. The MSRC will also provide personnel to supervise and operate the equipment.

9.1.4 Worst-case Scenario Determination

Category	Regional OSRP Approved July 2009	Regional OSRP Submitted October 20, 2011	Water Injection SDOCD
Type of Activity	> 10-miles	> 10-miles	> 10-miles
Facility Location	MC 778	MC 775 (SL)	MC 776 / MC 777
Facility Designation	MC 778 PDQ	MODU – MC 776-6 Development Well	MC 776 WI / MC 777 WI
Distance to Nearest Shoreline	68-miles	63-miles	64-miles
Volume Facility Storage Tanks:			
Max Tanks / Vessels	21,400-bbls	0-bbls	0-bbls
Flowlines	2,000-bbls	0-bbls	0-bbls
Lease Term pipelines	13,000-bbls	5,000-bbls	0-bbls
Daily Production Volume Max Well	141,000-bbls	0-bbls	0-bbls
Volume Uncontrolled Blowout (Day 1)	0-bbls	295,000-bbls	0-bbls
Total Volume	177,400-bbls	300,000-bbls	0-bbls

Type of Oil(s) – (Crude Oil, Condensate, Diesel)	Crude / Diesel	Crude	Water Injection Wells
API Gravity(s)	-	30.8	NA

The wells proposed under this plan are water injection wells and will be targeted in the aquifer; therefore, we do not anticipate a worst case discharge associated with the activities proposed in this plan. BP has determined that the worst case scenario from the activities proposed in this plan does not supersede the worst cast scenario in BP's Regional July 2009 OSRP or the Revised OSRP submitted on October 20, 2011. Pursuant to NTL No. 2008-G04, BP makes the following statement:

Since BP Exploration & Production Inc. has the capability to respond to the worst-case spill scenario included in its regional Oil Spill Response Plan approved on July 21, 2009 and resubmitted in revised form in October 20, 2011, and since the worst-case scenario determined for our SDOCD does not replace the worst-case scenario in our regional or sub-regional OSRP, BP certifies that it has the capability to respond, to the maximum extent practicable, to a worst-case discharge, or a substantial threat of such a discharge, resulting from the activities proposed in our SDOCD

9.2 Oil Spill Response Discussion

This information is not required. The requirements of NTL 2008-G04 for this information are not applicable to a supplemental DOCD for the activities related to waterflood injection wells, as proposed in this SDOCD. Reference the BOEMRE guidance document entitled "Approval Requirements for Activities that Involve the Use of a Subsea Blowout Preventer (BOP) or a Surface BOP On a Floating Facility." The document specifically provides that "clarifying guidance in Appendix A regarding the submission of information to be used in connection with an EA does not apply to EPs and DOCDs that propose to conduct the following activities … b. drilling a waterflood, gas injection, or a disposal well …". As this SDOCD relates to the drilling of waterflood injection wells, the requirements of that guidance do not apply.

10 Environmental Monitoring and Mitigation Measures

10.1 Monitoring Systems

Operational personnel have been instructed to check for pollution frequently during their tour of duty and, in the event pollution is spotted, to identify and shut-off the source, and make immediate notifications as per instructions provided in Section 2 and 3 of BP's approved OSRP, Volume II.

In accordance with the provisions of Title 30 CFR § 250.417 (e) and NTL 2009-G02 *"Deepwater Ocean Current Monitoring on Floating Facilities"* dated January 27, 2009, the MODU will be equipped with an Acoustic Doppler Current Profile (ADCP) current monitoring system onboard to allow continuous monitoring and gathering of ocean current data on a real-time basis in the upper 1,000-meters.

BP participates in the SERPENT program that provides opportunistic monitoring of animals that swim or float in the deep waters of the GOM.

10.2 Incidental Takes

To avoid incidental takes, all activities will be conducted in adherence to NTL 2007-G03 "Marine Trash and Debris Awareness Training and Elimination" and NTL 2007-G04 "Vessel Strike Avoidance and Injured/Dead Protected Species Reporting." As required by NTL 2007-G03, BP submits an annual "certification" letter for its Marine Debris Awareness Training Process. The marine debris awareness training is required annually as identified on "*BP's Gulf of Mexico (GoM) Environmental Training Matrix"* and *"BP's GoM Health, Safety, and Environmental (HSE) Training Needs Assessment",* both of which are located on BP's GoM HSE website. Monitoring activities are conducted by all personnel on rigs and platforms to prevent accidental loss of materials overboard and to report sightings of injured / dead protected species. Reporting of dead / injured protected species is addressed in BP's "*Incident Notification and Investigation Procedure*" - Attachment 1.

10.3 Flower Garden Banks National Marine Sanctuary

All proposed activities will occur outside of the protective zones of the Flower Garden Banks and Stetson Bank.

11 Lease Stipulation Information

Oil and gas exploration activities on the OCS are subject to stipulations developed before the lease sale and would be attached to the lease instrument, as necessary, in the form of mitigating measures.

Stipulation No. 1 – Protection of Archaeological Resources is attached to MC 776 OCS-G 09866 and MC 777 OCS-G 9867.

As required by Stipulation No. 1 and in accordance with NTL 2005-G07 "Archaeological Resources Surveys and Reports," C&C Technologies, Inc. completed an Archaeological Assessment Study in Mississippi Canyon Area Block 777 in May 2006.

C&C Technologies, Inc. also completed a Cultural Resources Assessment Study in Mississippi Canyon Block Area 776 in July 2006.

If an archaeological resource is discovered while conducting operations on the lease area, it will be reported immediately to the BOEM and every reasonable effort to preserve the archaeological resource will be made until the BOEM directs how to protect it.

12 Related Facilities and Operations Information

12.1 Related OCS Facilities and Operations

The Thunder Horse Semi-Submersible PDQ platform was installed over the Thunder Horse South Drill Center (DC) – DC 41 near the southern boundary of MC 778. This project will utilize the existing structure in conjunction with the subsea infrastructure proposed in this plan for the water injection system.

The revised Thunder Horse North Water Injection System will be comprised of eight waterflood injection wells from two proposed drill centers in Thunder Horse North (DC32WI in MC 776 and DC33WI in MC 777). It will also include the installation of two 4-slot single header manifolds, two 10-in. pipelines (7,471-ft and 14,916-ft) and one 12-in (21,000-ft) pipeline and the associated plets, sleds, jumpers and infield umbilicals. The proposed drill centers will be tied into the MC 778 "A" Platform (Thunder Horse PDQ) via the proposed pipelines.

12.2 Produced Liquid Hydrocarbons Transportation Vessels

The proposed wells are waterflood injection wells. There are no produced liquid hydrocarbons associated with this plan.

13 Support Vessels and Aircraft Information

13.1 General

Type	Maximum Fuel Tank Storage Capacity	Maximum No. in Area at Any Time	Trip Frequency or Duration
Helicopter – Sikorsky S-92	760-gals	1	7 / week
Crew Boats	1,000-bbls	1	4 / week
Supply Boats	5,000-bbls	1	2 / week

13.2 Diesel Oil Supply Vessels

Size of Fuel Supply Vessel	Capacity of Fuel Supply Vessel	Frequency of Fuel Transfers	Route Fuel Supply Vessel Will Take
280-ft	16,667-bbls	Once every 3-months	From New Orleans, LA to MC 776 or MC 777

13.3 Solid and Liquid Wastes Transportation & Disposal

A table providing information on the transportation of solid and liquid wastes and the onshore facilities used for disposal of solid and liquid wastes generated by the proposed activities is included in **Appendix E**.

13.4 Vicinity Map

A vicinity map depicting the location of the proposed activities relative to the shoreline, the distance of the proposed activities from the shoreline, and the primary route(s) of the support vessels and aircraft when traveling between the onshore support facilities and the project areas is included in **Appendix B.**

14 Onshore Support Facilities Information

14.1 General

The following table provides information of the onshore facility that will be used to provide supply and service support for the activities proposed in this plan.

Name	Location	Existing/New/Modified
C-port	Fourchon, LA	Existing
Core	Theodore, AL	Existing

The C-Port facility provides a vehicle parking lot, office space, radio communication equipment, outside and warehouse storage space, crane, forklifts, water and fueling facilities, and boat dock space. The base is owned by Chouest and is leased by BP. The base is in operation 24-hours each day.

In addition, BP will utilize the Core yard in Theodore, Alabama, for a portion of the pipeline installation activities. CZM Certification for the State of Alabama is included in **Appendix G**.

Consistency Certifications for Louisiana and Mississippi are not required for a Supplemental DOCD that does not propose a new multi-well structure.

A small amount of vessel and helicopter traffic may originate from bases other those described above in order to address changes in weather, market, and operational conditions. It is expected that this vessel traffic will originate from bases and locations that are in the near vicinity of the base previously described.

14.2 Support Base Construction or Expansion

BP will utilize existing support bases for these development activities in Mississippi Canyon Area Blocks 776 and 777 and therefore will not require the construction or expansion of additional support bases.

14.3 Waste Disposal

Onshore facilities used to store or dispose of any solid or liquid wastes generated by the proposed activities are included in Table 2 located in **Appendix E**.

15 Coastal Zone Management Act (CZMA) Information

15.1 Consistency Certification

Copies of Coastal Zone Management Act consistency certificates and corresponding requests furnished to Alabama for State CZM Consistency Reviews have been included with this Supplemental Plan in **Appendix G.**

15.2 Other information

This SDOCD includes evaluations that include findings relating the coastal effects of proposed activities and their associated facilities to each of the relevant enforceable policies of the Alabama state management programs. BP considered enforceable polices and identified the impacts of its activities on each of the relevant enforceable polices of the state's management program. BP discussed measures taken to avoid or mitigate the probable impacts to assure compliance with existing regulations and resultant enforceable program polices in each affected state's CZMP. The evaluations for Alabama are found in **Appendix G**.

16 Environmental Impact Analysis (EIA)

Attached as **Appendix F** is an environmental impact analysis (EIA) prepared for the proposed project by Continental Shelf Associates, 8502 SW Kansas Avenue, Stuart, Florida, 34997.

This EIA analyzed potential impacts from eight waterflood injection wells and the installation of two 4-slot single-header manifolds, two 10-in pipelines and one 12-in pipeline along with the associated plets, sleds, jumpers, and infield umbilicals.

BOEM (or its predecessor, the Minerals Management Service) has conducted extensive environmental analyses examining the possible impacts produced by oil and gas exploration and production activities, which evaluated impacts from similar activities on the areas in the Gulf of Mexico covered by the present plan.

This EIA, in addressing the project-specific environmental impacts of the present plan, contains conclusions and supporting analyses that are consistent with the extensive prior environmental analyses discussed above.

17 Administrative Information

17.1 Exempted Information Description

In accordance with 43 CFR Part 2, Appendix E, sections (4) and (9), the following information has been determined by the BOEM to be exempt from public disclosure:

- Geologic Objectives (BHL, TVD and MD)
- Geological and Geophysical Information (except for non-proprietary version of Shallow Hazard Assessment)

This information is excluded from the "Public Information" copies of the submitted plan.

17.2 Bibliography

MC 777 Unit Initial Development Operations Coordination Document (N-07469), approved April 2003

Deepwater Horizon Containment and Response: Harnessing Capabilities and Lessons Learned.

Gulf of Mexico OCS Oil and Gas Lease Sale: 2011 Western Planning Area Lease Sale 218 Final Supplemental Environmental Impact Statement (BOEMRE 2011-34)

17.3 Recovery Fees

We have included a receipt in **Appendix H** showing the payment of $31,768.00 for the service processing fee required by 30 CFR § 550.125, based on the eight proposed new waterflood injection wells (WA - WH).

Appendix A: Plan Information Forms

OCS Plan Information Form

Well / Structure Location Forms for wells WA - WH

U.S. Department of the Interior **OMB Control Number: 1010-0151**

Bureau of Ocean Energy Management **OMB Approval Expires: 12/31/2011***

OCS PLAN INFORMATION FORM

General Information

Type of OCS Plan		Exploration Plan (EP)	**X**	Development Operations Coordination Document (DOCD)
Company Name: **BP Exploration & Production, Inc.**			BOEM Operator Number: **02481**	
Address: **200 Westlake Park Blvd WL 4 1792A**			Contact Person: **Bekki Winfree**	
Houston, TX 77079			Phone Number: **281-366-8372**	
			E-Mail Address: **Bekki.Winfree@bp.com**	

Lease(s): **OCS-G 09866 and OCS-G09867**	Area: **MC**	Block(s): **776, 777**	Project Name (If Applicable): **Thunder Horse**

Objective(s):		Oil		Gas		Sulphur		Salt	Onshore Base: Fourchon, LA	Distance to Closes Land (Miles): **64**

Description of Proposed Activities (Mark all that apply)

	Exploration drilling	X	Development drilling
X	Well completion		Installation of production platform
	Well test flaring (for more than 48 hours)		Installation of production facilities
	Installation of caisson or platform as well protection structure		Installation of satellite structure
X	Installation of subsea wellheads and/or manifolds		Commence production
X	Installation of lease term pipelines	X	Other (Specify and describe) Waterflood Injection Wells

Have you submitted or do you plan to submit a Conservation Information Document to accompany this plan? **(the wells are already covered in the TH CID)**		Yes	X	No
Do you propose to use new or unusual technology to conduct your activities?		Yes	X	No
Do you propose any facility that will serve as a host facility for deepwater subsea development?		Yes	X	No
Do you propose any activities that may disturb a BOEM-designated high-probability archaeological area?		Yes	X	No
Have all of the surface locations of your proposed activities been previously reviewed and approved by BOEM?		Yes	X	No

Tentative Schedule of Proposed Activities

Proposed Activity	Start Date	End Date	No. of Days
Drill , Sidetrack and Complete Well "WA" (Revised "D" Location)	06/01/2012	11/28/2012	180 days
Drill , Sidetrack and Complete Well "WB"	08/01/2016	01/28/2017	180 days
Drill , Sidetrack and Complete Well "WC"	03/01/2017	08/28/2017	180 days
Drill , Sidetrack and Complete Well "WD"	01/01/2020	06/29/2020	180 days

Drill , Sidetrack and Complete Well "WE" (Revised "B" Location)	03/01/2013	08/28/2013	180 days
Drill , Sidetrack and Complete Well "WF" (Revised "C" Location)	03/01/2018	08/28/2018	180 days
Drill , Sidetrack and Complete Well "WG"	01/01/2015	06/29/2015	180 days
Drill , Sidetrack and Complete Well "WH" (Revised "A" Location)	01/01/2016	06/29/2016	180 days
DC33WI – installation of pile, pipeline, manifold, jumpers, umbilical and associated plets, sleds and flying leads	01/01/2013	01/28/2013	28 days
DC32WI – installation of pile, pipeline, manifold, jumpers, umbilical and associated plets, sleds and flying leads	03/01/2013	03/28/2013	28 days
DC32WI-Phase II – installation of pile, pipeline, jumpers, associated plets, sleds and flying leads	09/01/2015	09/28/2015	28 days

Description of Drilling Rig				Description of Production Platform			
	Jackup	X	Drillship		Caisson		Tension Leg Platform
	Gorilla Jackup		Platform rig		Well protector		Compliant tower
	Semi-submersible		Submersible		Fixed Platform		Guyed tower
	DP Semi-submersible		Other (Attach description)		Subsea manifold	X	Floating production system – Semi-Submersible
Drilling Rig Name (if known): **Discoverer Enterprise**					Spar		Other (Attach Description)

Description of Lease Term Pipelines

From (Facility/Area/Block)	To (Facility/Area/Block)	Diameter (Feet)	Length (Feet)
DC32WI/MC 776	**DC33WI/MC 777**	**10"**	**14,916'**
DC33WI/MC 777	**Plet/MC 778**	**10"**	**7,741'**
DC 32WI/MC 777	**Plet/MC 778**	**12"**	**21,000'**

FORM BOEM-0137 (October 2011 – Supersedes all previous editions of form BOEM-0137, which may not be used.
*Collection has been submitted to OMB and is automatically renewed each month until approved.)

OCS PLAN INFORMATION FORM (CONTINUED)

Proposed Well/Structure Location					
Well or Structure Name/Number (If renaming well or structure, reference previous name): **WA (Revised "D" Location)**			Subsea Completion		
Anchor Radius (if applicable) in feet: **Dynamically Positioned**			X	Yes	No
	Surface Location		**Bottom-Hole Location (For Wells)**		
Lease No.	OCS-G 09867		OCS-G 09867		
Area Name	MC		MC		
Block No.	777		777		
Blockline Departures (in feet)	N/S Departure 7,180.00' F_N_L		N/S Departure		
	E/W Departure 4,790.00' F_E_L		E/W Departure		
Lamber X-Y coordinates	X: 1,151,530.00'		X:		
	Y: 10,241,300.00'		Y:		
Latitude / Longitude	Latitude 28° 12' 46.659" N		Latitude		
	Longitude 88° 31' 06.313" W		Longitude		
	TVD (Feet):	MD (Feet):	Water Depth (Feet): 5,722'		

Anchor Locations for Drilling Rig or Construction Barge (If anchor radius supplied above, not necessary)

Anchor Name or No.	Area	Block	X Coordinate	Y Coordinate	Length of Anchor Chain on Seafloor
1 NA			X=	Y=	
2			X=	Y=	
3			X=	Y=	
4			X=	Y=	
5			X=	Y=	
6			X=	Y=	
7			X=	Y=	
8			X=	Y=	

Paperwork Reduction Act of 1995 Statement: The Paperwork Reduction Act of 1995 (44 U.S.C. Chapter 35) requires us to inform you that BOEM collects this information as part of an applicant's Exploration Plan or Development Operations Coordination Document submitted for BOEM approval. We use the information to facilitate our review and data entry for OCS plans. We will protect proprietary data according to the Freedom of Information Act and 30 CFR 550.197. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid Office of Management and Budget Control Number. The use of this form is voluntary. The public reporting burden for this form is included in the burden for preparing Exploration Plans and Development Operations Coordination Documents. We estimate that burden to average 600 hours per response, or 640 with an accompanying EP (1,000 hours in AKOCSR), or 690 (1,700 in AKOCSR) with an accompanying DPP or DOCD, including the time for reviewing instructions, gathering and maintaining data, and completing and reviewing the forms associated with subpart B. Direct comments regarding the burden estimate or any other aspect of this form to the Information Collection Clearance Officer, Bureau of Ocean Energy Management, 281 Herndon, VA 20170.

FORM BOEM-0137 (October 2011 – Supersedes all previous editions of form BOEM-0137, which may not be used.)

OCS PLAN INFORMATION FORM (CONTINUED)

Well/Structure Location					
Well or Structure Name/Number (If renaming well or structure, reference previous name): **WB**			Subsea Completion		
Anchor Radius (if applicable) in feet: **Dynamically Positioned**			X	Yes	No

	Surface Location	Bottom-Hole Location (For Wells)
Lease No.	OCS-G 09867	OCS-G 09867
Area Name	MC	MC
Block No.	777	777
Blockline Departures (in feet)	N/S Departure 7,335.83' F_N_L	N/S Departure
	E/W Departure 4,677.58' F_E_L	E/W Departure
Lamber X-Y coordinates	X: 1,151,642.42'	X:
	Y: 10,241,144.17'	Y:
Latitude / Longitude	Latitude 28° 12' 45.130" N	Latitude
	Longitude 88° 31' 05.035" W	Longitude
	TVD (Feet): MD (Feet):	Water Depth (Feet): 5,728'

Anchor Locations for Drilling Rig or Construction Barge (If anchor radius supplied above, not necessary)

Anchor Name or No.	Area	Block	X Coordinate	Y Coordinate	Length of Anchor Chain on Seafloor
1 NA			X=	Y=	
2			X=	Y=	
3			X=	Y=	
4			X=	Y=	
5			X=	Y=	
6			X=	Y=	
7			X=	Y=	
8			X=	Y=	

Paperwork Reduction Act of 1995 Statement: The Paperwork Reduction Act of 1995 (44 U.S.C. Chapter 35) requires us to inform you that BOEM collects this information as part of an applicant's Exploration Plan or Development Operations Coordination Document submitted for BOEM approval. We use the information to facilitate our review and data entry for OCS plans. We will protect proprietary data according to the Freedom of Information Act and 30 CFR 550.197. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid Office of Management and Budget Control Number. The use of this form is voluntary. The public reporting burden for this form is included in the burden for preparing Exploration Plans and Development Operations Coordination Documents. We estimate that burden to average 600 hours per response, or 640 with an accompanying EP (1,000 hours in AKOCSR), or 690 (1,700 in AKOCSR) with an accompanying DPP or DOCD, including the time for reviewing instructions, gathering and maintaining data, and completing and reviewing the forms associated with subpart B. Direct comments regarding the burden estimate or any other aspect of this form to the Information Collection Clearance Officer, Bureau of Ocean Energy Management, 281 Herndon, VA 20170.

FORM BOEM-0137 (October 2011 – Supersedes all previous editions of form BOEM-0137, which may not be used.

OCS PLAN INFORMATION FORM (CONTINUED)

Well/Structure Location					
Well or Structure Name/Number (If renaming well or structure, reference previous name): **WC**			Subsea Completion		
Anchor Radius (if applicable) in feet: Dynamically Positioned			X	Yes	No

	Surface Location	Bottom-Hole Location (For Wells)
Lease No.	OCS-G 09867	OCS-G 09867
Area Name	MC	MC
Block No.	777	777
Blockline Departures (in feet)	N/S Departure 7,241.98' F_N_L	N/S Departure
	E/W Departure 4,831.03' F_E_L	E/W Departure
Lamber X-Y coordinates	X: 1,151,488.97'	X:
	Y: 10,241,238.02'	Y:
Latitude / Longitude	Latitude 28° 12' 46.040" N	Latitude
	Longitude 88° 31' 06.763" W	Longitude
	TVD (Feet): MD (Feet):	Water Depth (Feet): 5,724'

Anchor Locations for Drilling Rig or Construction Barge (If anchor radius supplied above, not necessary)

Anchor Name or No.	Area	Block	X Coordinate	Y Coordinate	Length of Anchor Chain on Seafloor
1 NA			X=	Y=	
2			X=	Y=	
3			X=	Y=	
4			X=	Y=	
5			X=	Y=	
6			X=	Y=	
7			X=	Y=	
8			X=	Y=	

Paperwork Reduction Act of 1995 Statement: The Paperwork Reduction Act of 1995 (44 U.S.C. Chapter 35) requires us to inform you that BOEM collects this information as part of an applicant's Exploration Plan or Development Operations Coordination Document submitted for BOEM approval. We use the information to facilitate our review and data entry for OCS plans. We will protect proprietary data according to the Freedom of Information Act and 30 CFR 550.197. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid Office of Management and Budget Control Number. The use of this form is voluntary. The public reporting burden for this form is included in the burden for preparing Exploration Plans and Development Operations Coordination Documents. We estimate that burden to average 600 hours per response, or 640 with an accompanying EP (1,000 hours in AKOCSR), or 690 (1,700 in AKOCSR) with an accompanying DPP or DOCD, including the time for reviewing instructions, gathering and maintaining data, and completing and reviewing the forms associated with subpart B. Direct comments regarding the burden estimate or any other aspect of this form to the Information Collection Clearance Officer, Bureau of Ocean Energy Management, 281 Herndon, VA 20170.

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OCS PLAN INFORMATION FORM (CONTINUED)

Well/Structure Location					
Well or Structure Name/Number (If renaming well or structure, reference previous name): **WD**			Subsea Completion		
Anchor Radius (if applicable) in feet: Dynamically Positioned			X	Yes	No

	Surface Location	Bottom-Hole Location (For Wells)
Lease No.	OCS-G 09867	OCS-G 09867
Area Name	MC	MC
Block No.	777	777
Blockline Departures (in feet)	N/S Departure 7,271.60' F_N_L	N/S Departure
	E/W Departure 4,640.27' F_E_L	E/W Departure
Lamber X-Y coordinates	X: 1,151,679.73'	X:
	Y: 10,241,208.40'	Y:
Latitude / Longitude	Latitude 28° 12' 45.770" N	Latitude
	Longitude 88° 31' 04.627" W	Longitude
	TVD (Feet): MD (Feet):	Water Depth (Feet): 5,725'

Anchor Locations for Drilling Rig or Construction Barge (If anchor radius supplied above, not necessary)

Anchor Name or No.	Area	Block	X Coordinate	Y Coordinate	Length of Anchor Chain on Seafloor
1 NA			X=	Y=	
2			X=	Y=	
3			X=	Y=	
4			X=	Y=	
5			X=	Y=	
6			X=	Y=	
7			X=	Y=	
8			X=	Y=	

Paperwork Reduction Act of 1995 Statement: The Paperwork Reduction Act of 1995 (44 U.S.C. Chapter 35) requires us to inform you that BOEM collects this information as part of an applicant's Exploration Plan or Development Operations Coordination Document submitted for BOEM approval. We use the information to facilitate our review and data entry for OCS plans. We will protect proprietary data according to the Freedom of Information Act and 30 CFR 550.197. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid Office of Management and Budget Control Number. The use of this form is voluntary. The public reporting burden for this form is included in the burden for preparing Exploration Plans and Development Operations Coordination Documents. We estimate that burden to average 600 hours per response, or 640 with an accompanying EP (1,000 hours in AKOCSR), or 690 (1,700 in AKOCSR) with an accompanying DPP or DOCD, including the time for reviewing instructions, gathering and maintaining data, and completing and reviewing the forms associated with subpart B. Direct comments regarding the burden estimate or any other aspect of this form to the Information Collection Clearance Officer, Bureau of Ocean Energy Management, 281 Herndon, VA 20170.

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OCS PLAN INFORMATION FORM (CONTINUED)

Well/Structure Location					
Well or Structure Name/Number (If renaming well or structure, reference previous name): **WE (Revised "B" Location)**			Subsea Completion		
Anchor Radius (if applicable) in feet: **Dynamically Positioned**			X	Yes	No

	Surface Location	Bottom-Hole Location (For Wells)
Lease No.	OCS-G 09866	OCS-G 09866
Area Name	MC	MC
Block No.	776	776
Blockline Departures (in feet)	N/S Departure 6,080.00' F_S_L	N/S Departure
	E/W Departure 3,700.00' F_E_L	E/W Departure
Lamber X-Y coordinates	X: 1,136,780.00'	X:
	Y: 10,238,720.00'	Y:
Latitude / Longitude	Latitude 28° 12' 19.254" N	Latitude
	Longitude 88° 33' 50.813" W	Longitude
	TVD (Feet): MD (Feet):	Water Depth (Feet): 5,736'

Anchor Locations for Drilling Rig or Construction Barge (If anchor radius supplied above, not necessary)

Anchor Name or No.	Area	Block	X Coordinate	Y Coordinate	Length of Anchor Chain on Seafloor
1 NA			X=	Y=	
2			X=	Y=	
3			X=	Y=	
4			X=	Y=	
5			X=	Y=	
6			X=	Y=	
7			X=	Y=	
8			X=	Y=	

Paperwork Reduction Act of 1995 Statement: The Paperwork Reduction Act of 1995 (44 U.S.C. Chapter 35) requires us to inform you that BOEM collects this information as part of an applicant's Exploration Plan or Development Operations Coordination Document submitted for BOEM approval. We use the information to facilitate our review and data entry for OCS plans. We will protect proprietary data according to the Freedom of Information Act and 30 CFR 550.197. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid Office of Management and Budget Control Number. The use of this form is voluntary. The public reporting burden for this form is included in the burden for preparing Exploration Plans and Development Operations Coordination Documents. We estimate that burden to average 600 hours per response, or 640 with an accompanying EP (1,000 hours in AKOCSR), or 690 (1,700 in AKOCSR) with an accompanying DPP or DOCD, including the time for reviewing instructions, gathering and maintaining data, and completing and reviewing the forms associated with subpart B. Direct comments regarding the burden estimate or any other aspect of this form to the Information Collection Clearance Officer, Bureau of Ocean Energy Management, 281 Herndon, VA 20170.

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OCS PLAN INFORMATION FORM (CONTINUED)

Well/Structure Location					
Well or Structure Name/Number (If renaming well or structure, reference previous name): **WF (Revised "C" Location)**			Subsea Completion		
Anchor Radius (if applicable) in feet: **Dynamically Positioned**			X	Yes	No

	Surface Location	Bottom-Hole Location (For Wells)
Lease No.	OCS-G 09866	OCS-G 09867
Area Name	MC	MC
Block No.	776	777
Blockline Departures (in feet)	N/S Departure 6,109.24' F_S_L	N/S Departure
	E/W Departure 3,528.32' F_E_L	E/W Departure
Lamber X-Y coordinates	X: 1,136,951.68'	X:
	Y: 10,238,749.24'	Y:
Latitude / Longitude	Latitude 28° 12' 19.565" N	Latitude
	Longitude 88° 33' 48.899" W	Longitude
	TVD (Feet): MD (Feet):	Water Depth (Feet): 5,734'

Anchor Locations for Drilling Rig or Construction Barge (If anchor radius supplied above, not necessary)

Anchor Name or No.	Area	Block	X Coordinate	Y Coordinate	Length of Anchor Chain on Seafloor
1 NA			X=	Y=	
2			X=	Y=	
3			X=	Y=	
4			X=	Y=	
5			X=	Y=	
6			X=	Y=	
7			X=	Y=	
8			X=	Y=	

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OCS PLAN INFORMATION FORM (CONTINUED)

Well/Structure Location					
Well or Structure Name/Number (If renaming well or structure, reference previous name): **WG**			Subsea Completion		
Anchor Radius (if applicable) in feet: **Dynamically Positioned**			X	Yes	No

	Surface Location	Bottom-Hole Location (For Wells)
Lease No.	OCS-G 09866	OCS-G 09866
Area Name	MC	MC
Block No.	776	776
Blockline Departures (in feet)	N/S Departure 6,036.54' F_S_L	N/S Departure
	E/W Departure 3,512.85' F_E_L	E/W Departure
Lamber X-Y coordinates	X: 1,136,967.15'	X:
	Y: 10,238,676.54'	Y:
Latitude / Longitude	Latitude 28° 12' 18.848" N	Latitude
	Longitude 88° 33' 48.715" W	Longitude
	TVD (Feet): MD (Feet):	Water Depth (Feet): 5,737'

Anchor Locations for Drilling Rig or Construction Barge (If anchor radius supplied above, not necessary)

Anchor Name or No.	Area	Block	X Coordinate	Y Coordinate	Length of Anchor Chain on Seafloor
1 NA			X=	Y=	
2			X=	Y=	
3			X=	Y=	
4			X=	Y=	
5			X=	Y=	
6			X=	Y=	
7			X=	Y=	
8			X=	Y=	

Paperwork Reduction Act of 1995 Statement: The Paperwork Reduction Act of 1995 (44 U.S.C. Chapter 35) requires us to inform you that BOEM collects this information as part of an applicant's Exploration Plan or Development Operations Coordination Document submitted for BOEM approval. We use the information to facilitate our review and data entry for OCS plans. We will protect proprietary data according to the Freedom of Information Act and 30 CFR 550.197. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid Office of Management and Budget Control Number. The use of this form is voluntary. The public reporting burden for this form is included in the burden for preparing Exploration Plans and Development Operations Coordination Documents. We estimate that burden to average 600 hours per response, or 640 with an accompanying EP (1,000 hours in AKOCSR), or 690 (1,700 in AKOCSR) with an accompanying DPP or DOCD, including the time for reviewing instructions, gathering and maintaining data, and completing and reviewing the forms associated with subpart B. Direct comments regarding the burden estimate or any other aspect of this form to the Information Collection Clearance Officer, Bureau of Ocean Energy Management, 281 Herndon, VA 20170.

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OCS PLAN INFORMATION FORM (CONTINUED)

Well/Structure Location					
Well or Structure Name/Number (If renaming well or structure, reference previous name): **WH (Revised "A" Location)**			Subsea Completion		
Anchor Radius (if applicable) in feet: **Dynamically Positioned**			X	Yes	No

	Surface Location	Bottom-Hole Location (For Wells)
Lease No.	OCS-G 09866	OCS-G 09866
Area Name	MC	MC
Block No.	776	776
Blockline Departures (in feet)	N/S Departure 6,006.17' F_S_L	N/S Departure
	E/W Departure 3,691.41' F_E_L	E/W Departure
Lamber X-Y coordinates	X: 1,136,788.59'	X: 1,132,587.25'
	Y: 10,238,646.17'	Y: 10,240,092.00'
Latitude / Longitude	Latitude 28° 12' 18.524" N	Latitude
	Longitude 88° 33' 50.707" W	Longitude
	TVD (Feet): MD (Feet):	Water Depth (Feet): 5,739'

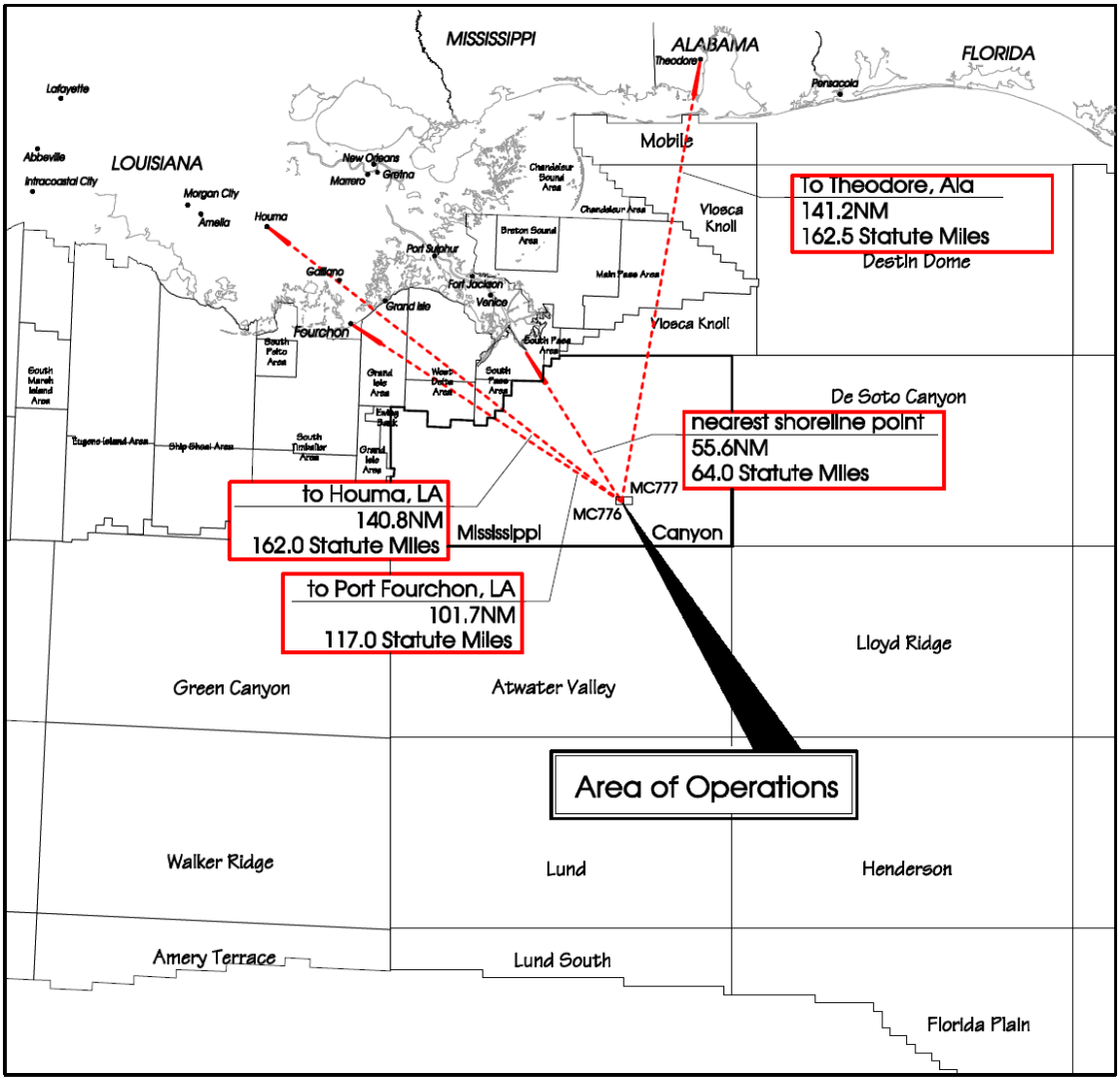
Anchor Locations for Drilling Rig or Construction Barge (If anchor radius supplied above, not necessary)

Anchor Name or No.	Area	Block	X Coordinate	Y Coordinate	Length of Anchor Chain on Seafloor
1 NA			X=	Y=	
2			X=	Y=	
3			X=	Y=	
4			X=	Y=	
5			X=	Y=	
6			X=	Y=	
7			X=	Y=	
8			X=	Y=	

Paperwork Reduction Act of 1995 Statement: The Paperwork Reduction Act of 1995 (44 U.S.C. Chapter 35) requires us to inform you that BOEM collects this information as part of an applicant's Exploration Plan or Development Operations Coordination Document submitted for BOEM approval. We use the information to facilitate our review and data entry for OCS plans. We will protect proprietary data according to the Freedom of Information Act and 30 CFR 550.197. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid Office of Management and Budget Control Number. The use of this form is voluntary. The public reporting burden for this form is included in the burden for preparing Exploration Plans and Development Operations Coordination Documents. We estimate that burden to average 600 hours per response, or 640 with an accompanying EP (1,000 hours in AKOCSR), or 690 (1,700 in AKOCSR) with an accompanying DPP or DOCD, including the time for reviewing instructions, gathering and maintaining data, and completing and reviewing the forms associated with subpart B. Direct comments regarding the burden estimate or any other aspect of this form to the Information Collection Clearance Officer, Bureau of Ocean Energy Management, 281 Herndon, VA 20170.

FORM BOEM-0137 (October 2011 – Supersedes all previous editions of form BOEM-0137, which may not be used.

Appendix B: Vicinity Plat and Location Plat

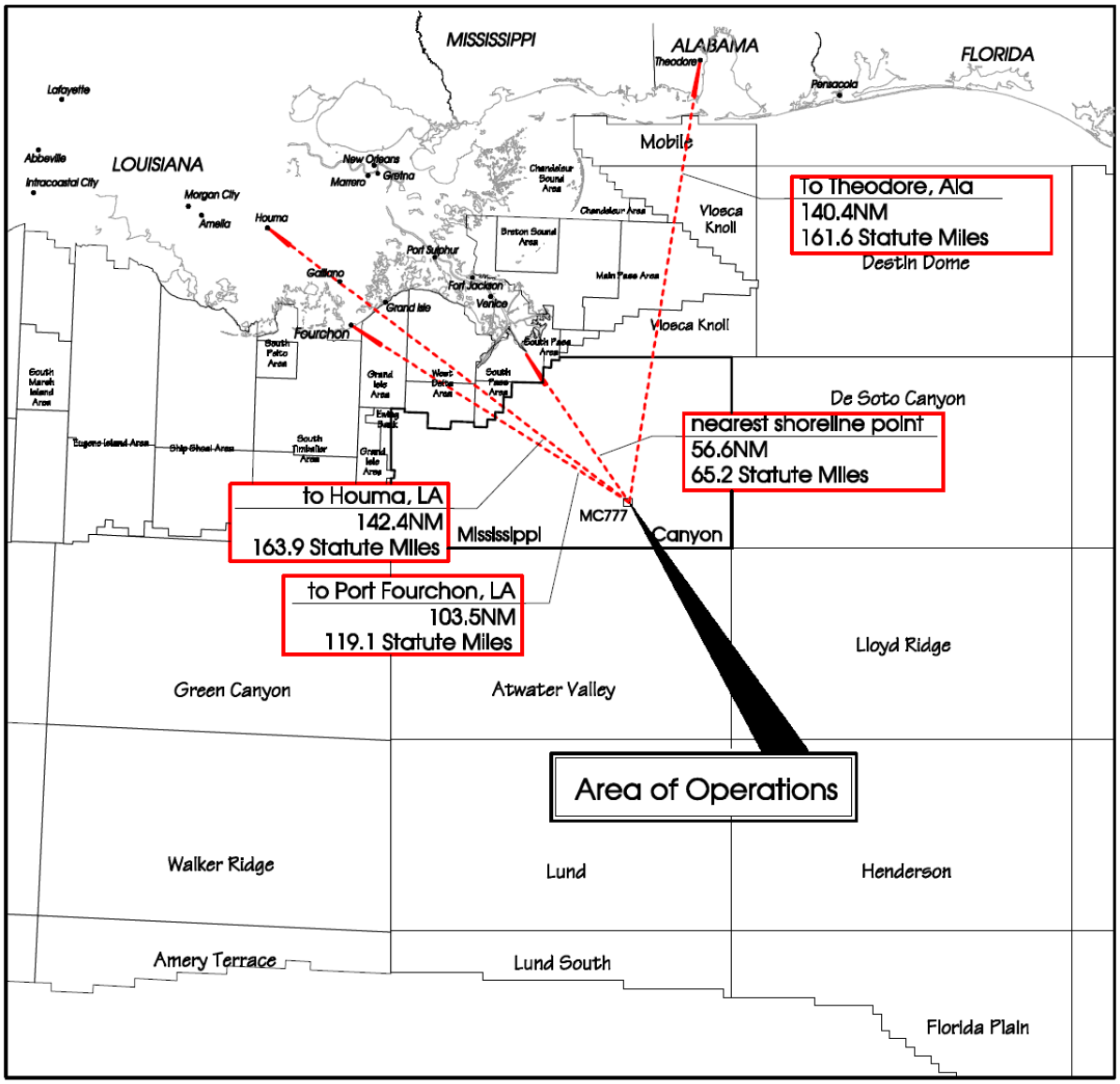


Projection: UTM Zone 16 North
Datum: NAD27
Distance Units: US Survey Feet

"VICINITY CHART"

Sheet 1 of 2

bp	BP EXPLORATION AND PRODUCTION SDOCD Locations Thunder Horse Drill Center 32 WI Mississippi Canyon Area (OPD# NH16-10) Blocks 776&777 Offshore Federal Plat prepared by: Brian D. Autio BP GoM GPO - Subsea Survey	Scale 1" = 50 miles Date: 18July2011 REV01 Date: 4AUG2011



Projection: UTM Zone 16 North
Datum: NAD27
Distance Units: US Survey Feet

"VICINITY CHART"

Sheet 1 of 2

bp	BP EXPLORATION AND PRODUCTION SDOCD Locations Thunder Horse Drill Center 33 WI Mississippi Canyon Area (OPD# NH16-10) Block 777 Offshore Federal Plat prepared by: Brian D. Autio BP GoM GPO - Subsea Survey	Scale 1" = 50 miles Date: 4AUG2011

Title of Document:	Supplemental Development Operations Coordination Document - Thunder Horse	**Document Number:**	1410-10-RG-PN-0001
Authority:	James Grant	**Revision:**	0
Custodian/Owner:	Bekki Winfree	**Issue Date:**	October 26, 2011
Retention Code:		**Next Review Date (if applicable):**	
Security Classification:	Public Information Copy	**Page:**	49 of 250

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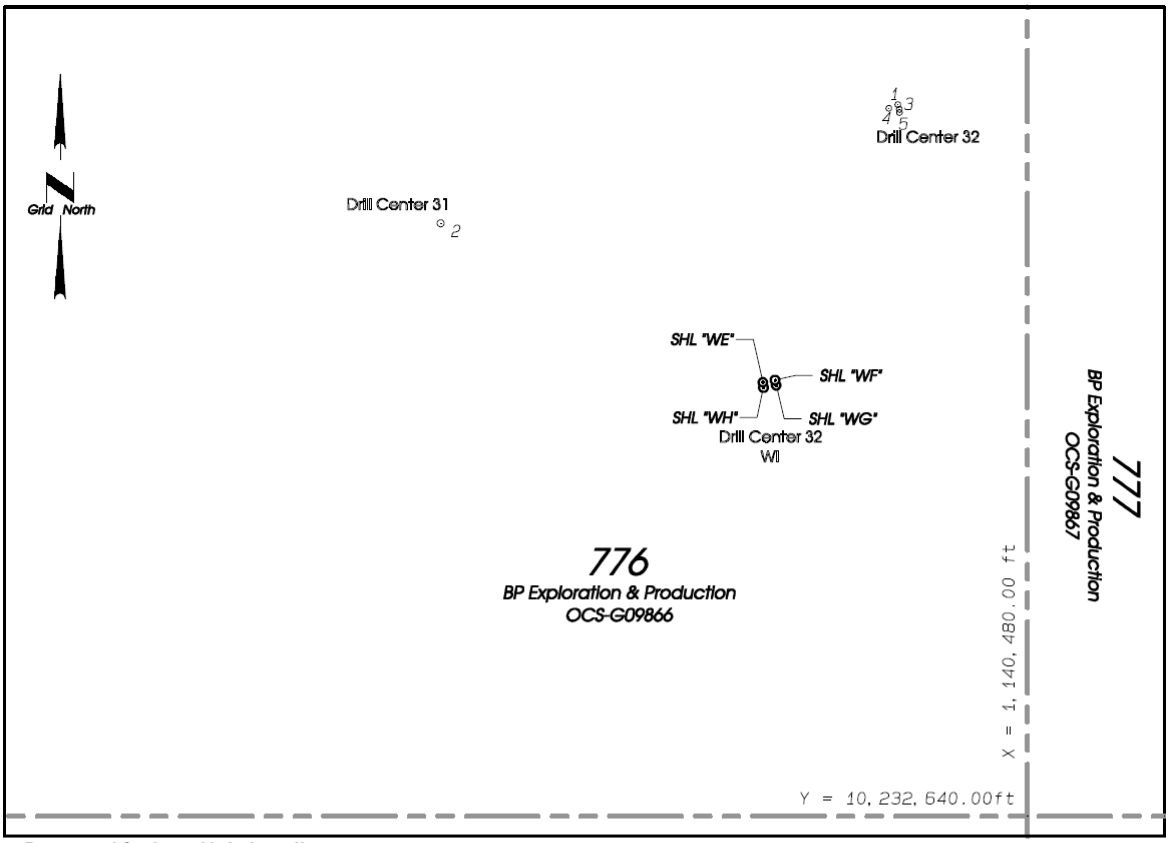

Proposed Surface Hole locations:

PSHL WELL	MC Blk	Block Ties (feet)		UTM Zone 16 North NAD27 - US Survey Feet Northing (Y)	Easting (X)	NAD27 Lat/Long Latitude (N)	Longitude (W)	NAD83 Lat/Long Latitude (N)	Longitude (W)
WE	776	6080.00 FSL	3700.00 FEL	10238720.00	1136780.00	28°12'19.254"	88°33'50.813"	28°12'20.166"	88°33'50.827"
WF	776	6109.24 FSL	3528.32 FEL	10238749.24	1136951.68	28°12'19.565"	88°33'48.899"	28°12'20.477"	88°33'48.912"
WG	776	6036.54 FSL	3512.85 FEL	10238676.54	1136967.15	28°12'18.848"	88°33'48.715"	28°12'19.759"	88°33'48.729"
WH	776	6006.17 FSL	3691.41 FEL	10238646.17	1136788.59	28°12'18.524"	88°33'50.707"	28°12'19.436"	88°33'50.721"

PSHL WELL	WATER DEPTH
WE	-5,736ft
WF	-5,734ft
WG	-5,737ft
WH	-5,739ft

NOTES:
1) All data: North American Datum of 1927 (NAD27);
2) All geodetic conversions tranformed using NADCON version 2.0 or better, equivalent software.
3) Well data based upon BOEMRE database for July2011

"Public Information"

BP EXPLORATION AND PRODUCTION

SDOCD Locations Thunder Horse Drill Center 32 WI

Mississippi Canyon Area (OPD# NH16-10) Blocks 776 & 777 Offshore Federal

Plat prepared by: Brian D. Autio, BP GoM GPO - Subsea Survey

Scale 1" = 2000 ft

Date: 4AUG2011

by: BDA

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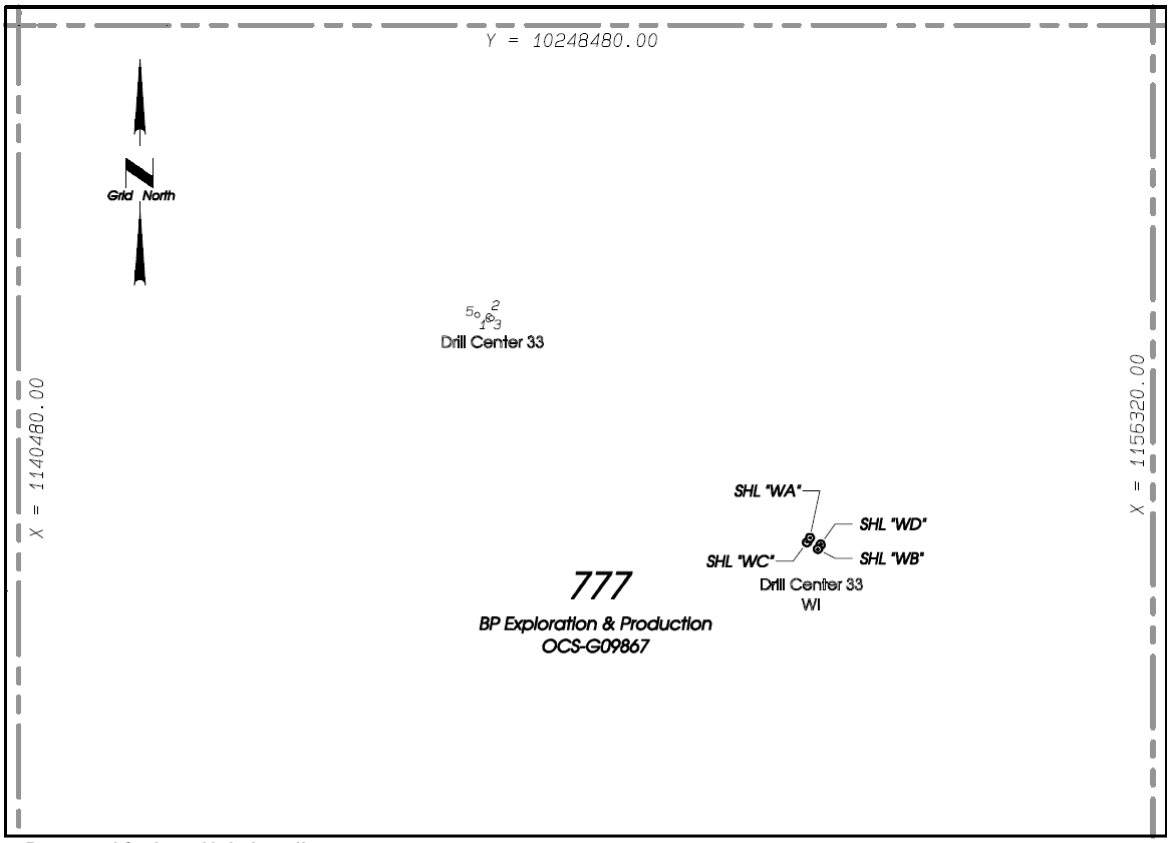

Proposed Surface Hole locations:

PSHL WELL	MC Blk	Block Ties (feet)		UTM Zone 16 North NAD27 - US Survey Feet Northing (Y)	Easting (X)	NAD27 Lat/Long Latitude (N)	Longitude (W)	NAD83 Lat/Long Latitude (N)	Longitude (W)
WA	777	7180.00 FNL	4790.00 FEL	10241300.00	1151530.00	28°12'46.659"	88°31'06.313"	28°12'47.569"	88°31'06.321"
WB	777	7335.83 FNL	4677.58 FEL	10241144.17	1151642.42	28°12'45.130"	88°31'05.035"	28°12'46.040"	88°31'05.043"
WC	777	7241.98 FNL	4831.03 FEL	10241238.02	1151488.97	28°12'46.040"	88°31'06.763"	28°12'46.951"	88°31'06.771"
WD	777	7271.60 FNL	4640.27 FEL	10241208.40	1151679.73	28°12'45.770"	88°31'04.627"	28°12'46.681"	88°31'04.635"

PSHL WELL	WATER DEPTH
WA	-5722ft
WB	-5728ft
WC	-5724ft
WD	-5725ft

NOTES:
1) All data: North American Datum of 1927 (NAD27);
2) All geodetic conversions tranformed using NADCON version 2.0 or better, equivalent software.
3) Well data based upon BOEMRE database for July2011

"Public Information"

bp	BP EXPLORATION AND PRODUCTION	Scale 1" = 2000 ft
	SDOCD Locations Thunder Horse Drill Center 33 WI	Date: 4AUG2011
	Mississippi Canyon Area (OPD# NH16-10) Block 777 Offshore Federal	by: BDA
	Plat prepared by: Brian D. Autio, BP GoM GPO - Subsea Survey	

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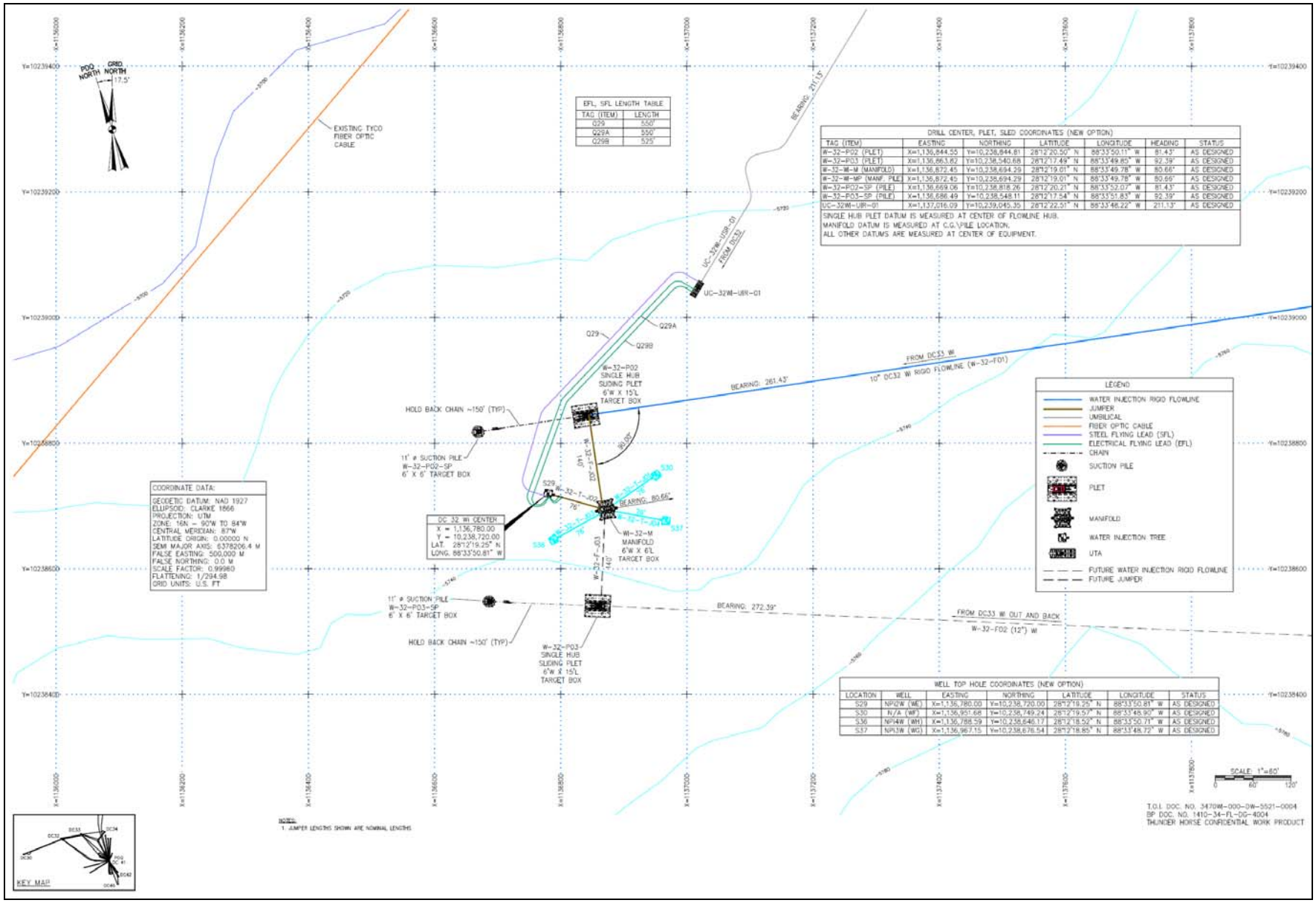

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Authority:	James Grant	**Revision:**	0
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Retention Code:		**Next Review Date (if applicable):**	
Security Classification:	BP Confidential	**Page:**	52 of 250

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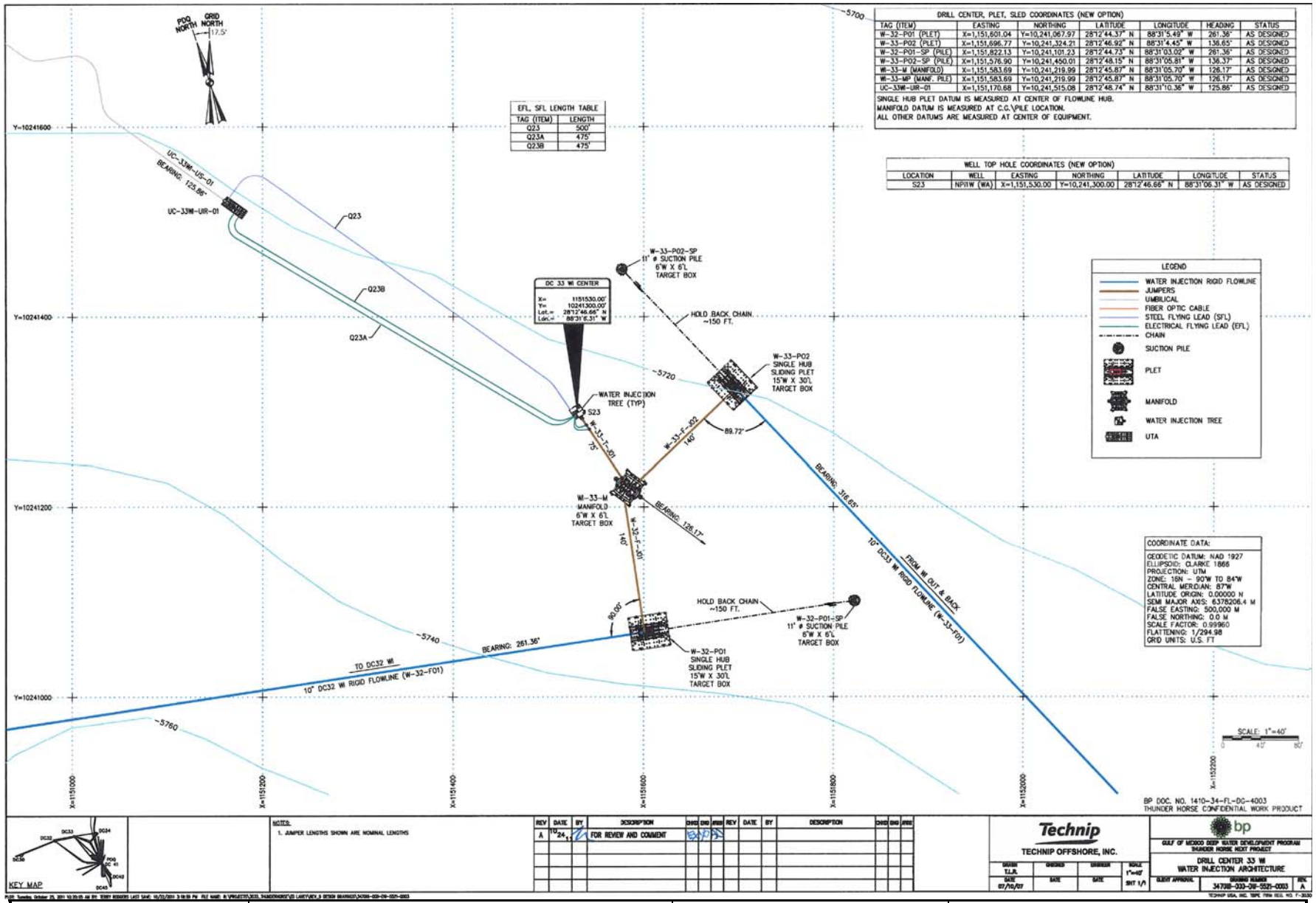

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Retention Code:		**Next Review Date (if applicable):**	
Security Classification:	BP Confidential	**Page:**	53 of 250

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Appendix C: Shallow Hazard Assessments

Other contents are Proprietary

SHALLOW HAZARDS ASSESSMENT

PROPOSED WELL LOCATION MC776-WE
(DC32 WATER INJECTION WELL)

THUNDER HORSE FIELD
BLOCK 776, OCS-G-09866

MISSISSIPPI CANYON AREA

PROPOSED SURFACE LOCATION MC776-WE	
28° 12' 19.254" N	88° 33' 50.813" W
X = 1,136,780.00 ft E	Y = 10,238,720.00 ft N
6,080 ft FSL	3,700 ft FEL

X and Y Coordinates in UTM Zone 16N (US ft)
Geodetic Datum: NAD 1927
Spheroid: Clarke 1866

SHALLOW HAZARDS ASSESSMENT
MISSISSIPPI CANYON BLOCK MC776 (OCS-G-09866)
PROPOSED WELL MC776-WE
(DC32WI WELL)

This Shallow Hazards Assessment defines the location of the proposed water injection well MC776-WE, with surface hole location situated in offshore block MC776 (Thunder Horse Field) in the Mississippi Canyon Protraction Area of the Northern Gulf of Mexico (Plate 1). This will be the first of 4 planned water injection (WI) wells from a new drill center, DC32WI, and it is anticipated that all future WI wells will be within 200 ft of the proposed MC776-WE well. This clearance letter, which covers a surface area of 2,000 ft around the proposed well, refers specifically to the MC776-WE location, although seafloor and subsurface conditions are expected to be similar for the three future DC32WI wells.

This document supplements the Supplemental Development Operations Coordination Document (SDOCD) to be submitted to the Bureau of Ocean Energy Management, (BOEM) and complies with the BOEM (formerly BOEMRE) guidelines provided in: NTL Nos. 2005-G07 and 2008-G20 (Archaeological Resource Surveys and Reports); NTL No. 2008-G05 (Shallow Hazards Program); NTL No. 2009-G40 (Deepwater Benthic Communities); and the Pre-Seabed Disturbance Survey Mitigation established by the BOEMRE in March 2011. This assessment discusses the seafloor, shallow geological conditions and any geohazards, in the vicinity of the proposed location, based on detailed review of: high-resolution 2-D (HR2D) geophysical data (echosounder, sidescan sonar, subbottom profiler and multi-channel seismic) acquired by John E. Chance and Associates (JECA, now part of FUGRO) in 1996, and the interpreted Shallow Hazards Report (JECA, 1997); high resolution 3D (HR3D) seismic data (multi-channel only) acquired by FUGRO in 2000/2001; AUV data (swath bathymetry, sidescan sonar and subbottom profiler) acquired by C&C Technologies, Inc. (C&C) in 2001, and the interpreted Shallow Hazards Report (C&C, 2002); and the Cultural Resources Assessment Study for MC 776 (C&C, 2006) prepared from the 2001 AUV data. Information was also taken from EP submissions, well logs and internal BP Exploration reports for well locations MC775#1, MC776#1, #2 and #5, MC777#1, #2, #3, #4 and #5, MC778#1 and #13, and MC822#2, and from Fugro-McClelland Marine Geosciences, Inc. geotechnical reports (FMMGI 2001a and 2001b). Attachments to this document include geophysical Data Examples (21 page-sized plates).

The proposed MC776-WE surface location is in the southeast-central portion of Mississippi Canyon Block 776, Gulf of Mexico, and is defined as:

MC776-WE	**6,080 ft FSL** **3,700 ft FEL** **X = 1,136,780.00 ft E** **Y = 10,238,720.00 ft N**
UTM Zone 16 N (US Feet) **Datum: NAD 1927**	**Spheroid: Clarke 1866**

The proposed MC776-WE surface location is 100 ft to the northeast of SP 34.6 of line 31 of the C&C 2001 AUV survey (Plate 2), 110 ft north of SP 450 on line 11 of the JECA 1996 HR2D survey (Plate 8), and at trace 1388 of line 1424 of the Fugro 2000/2001 HR3D survey. The well will be drilled vertically down into salt at a depth of ~8,096 ft True Vertical Depth Sub-Sea (TVDSS). The first pressure containment string (20" casing) is currently planned to be set approximately 2,000 ft below the top of salt at a depth of ~4,360 ft below mudline (bml). The depth of investigation in this supplement is the top-of-salt reflector identified at a depth of ~2,360 ft bml at the proposed wellsite.

The key findings from the review of the available data are as follows:

Proposed Well Location MC776-WE:

Water Depth: From the 2001 AUV data the water depth at the proposed well location is estimated at 5,736 ft (Plates 2 and 4). The seafloor has an average slope of ~2.7° down to the south (Plates 3 and 4).

Seafloor Morphology and Shallow Sediments: The proposed well location is located within an area of hummocky seafloor (Plates 4 and 5). These mound-like features, which range from 20 to 40 ft in height and up to 2,000 ft across, are believed to be the result of a uniform, parallel-bedded sediment drape over the irregular surface of an underlying regional mass transport complex or buried landslide. At the proposed location the buried landslide is clay-prone and is first encountered at a depth of about 185 ft bml (Plate 6).

Soil borings collected within the Thunder Horse Field show the seafloor and near-surface sediments to comprise very soft olive gray clays to depths of about 20 ft bml underlain by very soft to firm clays to a depth of about 100 ft bml. Stiff clays then continue down to depths of about 225 ft bml, and stiff to very stiff clays to in excess of 300 ft bml (Fugro-McClelland Marine Geosciences, Inc., 2001 a and b).

Seafloor Obstructions: BP's MC776#2 and MC775#1 wells are ~4,950 ft to the NW and ~2.75 miles to the WSW, respectively, the DC32 wells (MC776#1, #3, #4 and #5) are ~4,300 ft to the NNE, umbilicals and a flowline connecting DC32 with DC30 in block MC775 run ~2,450 ft to the NNW and a fiber optic cable, which runs to the SW from DC32, is ~600 ft to the NW of the proposed location (Plates 3, 4 and 5).

Chemosynthetic Communities: The sidescan sonar data from the 2001 AUV survey (Plate 7) shows the seafloor within a 2,000 ft radius of the proposed well location to comprise of uniform soft clays and possible silts. Areas of higher reflectivity indicating possible gas-saturated soils and/or hard seafloor are not evident in the vicinity of the proposed well. Furthermore, the 2001 AUV subbottom profiler data (Plate 6) shows a uniform, undisturbed drape of soft clays and possible silts within the cleared area, with no evidence for authigenic carbonates or hardgrounds. ***Therefore, seafloor conditions capable of supporting chemosynthetic communities are not expected at, or within 2,000 ft of, the proposed well location***.

Archaeological Stipulations: A cultural resources assessment for MC776 was completed in July 2006 by C&C based on the 2001 AUV data (C&C, 2006). ***No evidence of shipwreck debris or sites of archaeological significance were reported at or within 2,000 ft of the proposed well location.*** The nearest observed seafloor sonar contact (C55) is about 5,400 ft to the NE of the proposed location (shown at the extreme NE corner of Plate 2). This target is interpreted as a 72 ft x 16 ft piece of man-made debris with no measurable height above the seafloor.

Shallow Geology: Thirteen units of hemipelagic sediments and midslope turbidites with evidence of channeling and rotated internal slump blocks, comprised predominantly of clays with some silts and sands are identified in the salt overburden within the Thunder Horse Field (EP submissions and internal BP Exploration reports for proposed well locations MC776#2, MC777#1, MC777#4 and MC822 #2). These units are listed on the Tophole Formation and Geohazards Summary Sheet, Plate 20, together with their depths at the proposed MC776-WE well location, and the units and horizons are shown on the HR3D seismic sections (Plates 11 to 14). Six of the horizons (Seafloor, Horizons B, D, E, H, and Top-of-Salt) were mapped through the proposed wellsite area using the HR3D data, whilst the remaining horizons were extrapolated from offset wells. Units 7 and 12, which are mapped elsewhere within the Thunder Horse Field appear absent in this area due to either pinch-out or erosion.

Drilling Hazards: **Faults**: No seafloor or shallow-buried faults are identified on the HR3D or AUV data within the 2,000 ft clearance radius of the proposed well location (Plates 2, 6, 7, 8, 9, and 11 to 14).

Deeper faults, some of which may be rooted in the salt, appear below Horizon E and affect the well-bedded strata of Unit 8 thru Unit 13. Extensive minor faulting is apparent within Unit 13, as evidenced by the abrupt terminations of the moderate amplitude reflectors. One of these faults appears to intersect the proposed wellbore at a depth of ~1,949 ft bml (Plates 12 and 14).

Shallow Gas: Negative amplitude extractions were constructed for the MC776 area using the Seafloor, Top-of-Salt, and mapped Horizons B, D, E, and H.

The amplitude extraction map for the section between the Seafloor and Horizon B, Units 1 thru 3, is shown on Plate 15. The proposed location is situated within a broad NW-SE trending belt of anomalous amplitudes occurring within the upper and middle portions of Unit 2 (Plates 12 and 14). These anomalies are believed due to organic material and trapped biogenic gas within predominantly clayey soils and because of their shallow depth are not considered to contain gas at any significant pressure. The proposed MC776 WE location was selected to avoid the brightest of these anomalous amplitudes (ranging in distance from ~550 ft to the NNE, to ~1,200 ft to the WSW, to ~1,400 ft to the NNW) as they may affect the geotechnical properties of the soils and cause problems during conductor jetting and cementing.

Units 4 and 5, between Horizons B and D are clay-prone in the vicinity of the proposed location, with sand layers and potential gas occurring within Unit 5 ~4,000 ft to the N, ~5,500 ft to the NW and ~10,000 ft to the WSW (Plate 16).

Unit 6, between Horizons D and E is also predominantly clay-prone at the proposed wellsite (Plate 17). Extensive shallow gas silts and sands at the top of Unit 6 ring the proposed wellsite at distances ranging from ~2,500 ft to ~8,500 ft to ~3,500 ft to the north, west and south, respectively (left hand side of Plates 13 and 14). These sands appear to pinch out or have been removed by channeling before they reach the vicinity of the proposed location. Small, scattered sands within the lower section of Unit 6 are ~300 – 800 ft to the NW, ~600 ft to the S and ~1,300 ft to the N of the proposed location (Plate 17).

Anomalous amplitudes within the Horizon E to H interval (Units 8 and 9) are present to the north of the proposed well (Plate 18). The closest potential gas, which is associated with silty or sandy horizons in the upper portion of Unit 9 and along Horizon G, is ~1,500 ft to the NNW.

The amplitude extraction for the interval from Horizon H to the Top-of-Salt (Units 10 thru 13) shows numerous areas of scattered anomalies surrounding the proposed location on all sides (Plate 19). The majority of the anomalies to the north are associated with continuous sandy strata of Unit 10 (Plates 12

and 14) with the nearest being ~1,100 ft to the N, 1,250 ft to the W and ~1,700 ft to the NE of the proposed location. Smaller scattered, potential shallow gas anomalies to the south, with the closest at distances of ~1,100 ft to the SE and ~2,000 ft to the SSE are associated with moderate amplitude, discontinuous reflectors within Units 10, 11 and 13 (Plates 12 and 14).

Shallow gas was encountered in the MC775#1 well, ~2.75 miles to the WSW, within sands in Unit 10 thru Unit 13. No gas was encountered in the same interval in the nearest offset well, MC776#5 (Plate 21).

Based on the amplitude extractions and offset well data, the risk of encountering shallow gas at the proposed wellsite is therefore considered: **Low** for Units 10 and 11, between depths of ~1,384 ft to ~1,630 ft bml, and for prominent sand horizons within Unit 13 between depths of ~1,752 ft and ~1,900 ft bml; **Negligible to Low** for Unit 6 between depths of ~982 to ~1,277 ft bml; and **Negligible** for all remaining units (Plate 20).

Shallow Water Flow (SWF): Drilling reports for offset wells in the Thunder Horse Field and nearby Mensa Field (MC731) have documented several instances of SWF. These vary from: *low to moderate intensity* flows in the Unit 10 to 13 equivalent at the MC775#1 well (a severe flow was experienced from the same interval when the riserless salt section was drilled and a slight reduction in ECD allowed formation intrusion); to a *moderate* flow in the equivalent to Unit 3 at the Mensa Field in MC731; to *slight* flows within Units 8 and 9 at wells MC776#1 and #2, within Unit 13 at MC777#4 and #5, and immediately above the Top-of-Salt at the base of Unit 13 in wells MC778#1 and #13.

SWF was not encountered in the nearest offset well, MC776#5, but low to moderate SWF was encountered in the MC775#1 well further to the west (Plate 21). Signal attenuation due to shallow gas amplitudes within Unit 6 in the southeast of MC775 has prevented correlation of horizons deeper than Horizon H from being reliably mapped between the proposed well and the MC775#1 offset well. However, there does appear to be an increase in sand content within the Horizon H to Top Salt interval westwards through the tie-line section (Plate 21) and therefore at the proposed location a **Low** risk of SWF is assigned to Units 10 and 11, between depths of ~1,384 ft to ~1,630 ft bml, and for prominent sand horizons within Unit 13 between depths of ~1,752 ft and ~1,900 ft bml.

The remaining units, Units 1, 2, 4, 5, 6, 8, 9 and most of Unit 13 at the proposed MC776-WE well location are interpreted as predominantly clay-prone sequences from the seismic data, and assessed a **Negligible** risk for SWF.

Gas Hydrates: Within the north of MC776 (left hand side of

Plate 14), the northwest and northeast of MC777 and the northwest of MC778, Horizon D is a high amplitude reflector with a pronounced cross-cutting relationship to the adjacent strata, and appears to delimit an area of anomalous amplitudes (shallow gas) within the top of Unit 6 (EP submission for MC777#4). Furthermore, there is a definite southern termination of the anomalous amplitude zone at the top of Unit 6 as seen on the amplitude extraction for the unit (Plate 17). Throughout the south and central parts of MC776 and 777, Horizon D appears as a low amplitude reflector separating equally low amplitude strata within the overlying and underlying units, Unit 5 and Unit 6, respectively.

As a result, Horizon D is interpreted as a possible BSR (Bottom-Simulating Reflector) marking the Base of the Gas Hydrate Stability Zone and top of entrapped gas in the northern portion of the study area. Pressure-Volume-Temperature modeling studies in the Thunder Horse area have indicated that gas hydrates would be stable in the supra-salt section in the upper 1,300 ft BML in the vicinity of the MC776#1 well, ~4,300 ft to the NNE in a water depth of 5,636 ft (K. Horkowitz, BP, 2003).

Horizon D is at a depth of ~982 ft bml at the proposed wellsite, within the theoretical depth for gas hydrate formation. However, because the proposed wellbore will pass ~2,500 ft to the south and down-dip of the gas accumulation at the top of Unit 6, and is in an area apparently free from large shallow gas accumulations, the risk for encountering gas hydrates at the proposed wellsite is assessed as **Negligible to Low** above ~982 ft bml and **Negligible** below that depth (Plate 20).

CONCLUSIONS

This Shallow Hazards Assessment for location MC776-WE supplements the SDOCD to be submitted to the BOEM. This report defines the proposed location and documents the anticipated top-hole drilling conditions and is accompanied by a set of 21 geophysical data examples. Copies of the 2006 C&C Archaeological Assessment referred to in this assessment will accompany the SDOCD. The 1997 JECA Geohazard Survey Report and the 2002 C&C Shallow Hazards Report have been submitted with previous EP/DOCD documents.

Conditions at the drilling location have been evaluated on the basis of (i) high-resolution 2-D (HR2D) geophysical data (echosounder, sidescan sonar, subbottom profiler and multi-channel seismic) acquired by John E. Chance and Associates (JECA, now part of FUGRO) in 1996, and the interpreted Shallow Hazards Report (JECA, 1997), (ii) high resolution 3D (HR3D) seismic data (multi-channel only) acquired by FUGRO in 2000/2001, (iii) AUV data (swath bathymetry, sidescan sonar and subbottom profiler) acquired by C&C Technologies, Inc. (C&C) in 2001, and the interpreted Shallow Hazards Report (C&C, 2002), and (iv) the Cultural Resources Assessment Study for MC776 prepared by C&C in 2006 from the 2001 AUV data. Information was also taken from EP submissions, well logs and internal BP Exploration reports for well locations MC775#1, MC776#1, #2 and #5, MC777#1, #2, #3, #4 and #5, MC778#1 and #13, and MC822#2, and from Fugro-McClelland Marine Geosciences, Inc. geotechnical reports (FMMGI 2001a and 2001b).

The proposed MC776-WE well location is in an area of smooth, hummocky, gently southeasterly-dipping seafloor. A review of the AUV data has shown that ***seafloor conditions capable of supporting chemosynthetic communities are not expected at, or within 2,000 ft of, the proposed well location,*** and the Archaeological Assessment carried out by C&C has revealed ***no evidence of shipwreck debris or sites of archaeological significance at or within 2,000 ft of the proposed well location.***

Results of the shallow gas and SWF review are summarized on the Tophole Formation and Geohazards Summary Sheet (Plate 20). We assess a **Negligible** risk for encountering shallow gas along the well trajectory between Seafloor and Top-of Salt, except for Units 10 and 11, between depths of ~1,384 ft to ~1,630 ft bml, and for prominent sand horizons within Unit 13 between depths of ~1,752 ft and ~1,900 ft bml where the risk is assessed as **Low**; and for Unit 6 (from ~982 to ~1,277 ft bml), which is risked as **Negligible to Low**.

SWF has been reported from several sandy intervals at offset wells within the Thunder Horse Field. The majority of these intervals can be correlated to units at the proposed well location. No SWF was encountered in the nearest offset well to the northeast, MC776#2, but a low to moderate SWF was experienced at the MC775#1 well a little further to the west. However, no direct unit correlation between the proposed well and the MC775#1 well could be made due to signal attenuation within shallow gas strata of Unit 6 in the southeast of MC775, and as a result we assess a **Low** risk for encountering SWF within Units 10 and 11 (~1,384 ft to ~1,630 ft bml), and for prominent silty to sandy intervals within Unit 13 (~1,752 ft to ~1,900 ft bml), and a **Negligible** risk of SWF for all the remaining, apparently clay-prone, intervals.

The presence of a possible BSR, with underlying trapped shallow gas, coincident with Horizon D to the northwest and northeast of the proposed location has resulted in a **Negligible to Low** risk for encountering gas hydrates between the seafloor and a depth of ~982 ft bml, and **Negligible** below that depth.

The proposed well trajectory will intersect a minor fault within Unit 13 at a depth of ~1,949 ft bml. Other minor faults are possible within the poorly-imaged Unit 13 between depths of ~1,630 ft and ~2,360 ft bml.

The potential shallow gas and shallow water intervals will be drilled riserless, as the first pressure containment string is currently planned to be set approximately 2,000 ft below the Top-of-Salt at a depth of about 4,360 ft bml. We therefore advise caution, but believe that the risk of danger to personnel and damage to the borehole, equipment and environment is **Low**, provided strict adherence to proper drilling and cementing procedures is followed concerning these hazards until the first pressure containment string is in place.

Bernie Care
Shallow Hazards Geoscientist
GoM Resource, NWD Tiger Team

07 June 2011

Richard Weiland
Shallow Hazards Geoscientist
GoM Resource, NWD Tiger Team

05 July 2011

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ATTACHMENTS:

Plate 1: Location Map and Regional Seafloor Morphology
Plate 2: Bathymetry Map – C&C AUV Data
Plate 3: Seafloor Slope Map
Plate 4: 3-D Detail Views of Seafloor Relief and Slope
Plate 5: Seafloor Morphology and Existing Field Infrastructure
Plate 6: NW-SE Subbottom Profiler Data Example Line 31
Plate 7: Sidescan Sonar Data Example Line 31
Plate 8: Hazard Map – JECA HR2D Survey
Plate 9: Hazards Map – C&C AUV Survey
Plate 10: Seafloor Edge Map Showing Location of Annotated Seismic Lines
Plate 11: HR3D Seismic Trace 1388 Through Proposed Location
Plate 12: Interpreted HR3D Seismic Trace 1388 Through Proposed Location
Plate 13: HR3D Seismic Line 1424 Through Proposed Location
Plate 14: Interpreted HR3D Seismic Line 1424 Through Proposed Location
Plate 15: Shallow Gas Amplitude Extraction Between Seafloor and Horizon B (Units 1 thru 3)
Plate 16: Shallow Gas Amplitude Extraction Between Horizons B and D (Units 4 and 5)
Plate 17: Shallow Gas Amplitude Extraction Between Horizons D and E (Unit 6)
Plate 18: Shallow Gas Amplitude Extraction Between Horizons E and H (Units 8 and 9)
Plate 19: Shallow Gas Amplitude Extraction Between Horizons H and Top Salt (Units 10, 11 and 13)
Plate 20: Tophole Formation and Geohazards Summary Sheet
Plate 21: Arbitrary HR3D Tie-Line Through Offset Wells and Proposed Location

Proposed MC776-WE Well
Mississippi Canyon Area
Shallow Hazards Assessment
Geophysical Data Examples

CONTENTS

Plate 1: Location Map and Regional Seafloor Morphology
Plate 2: Bathymetry Map – C&C AUV Data
Plate 3: Seafloor Slope Map
Plate 4: 3-D Detail Views of Seafloor Relief and Slope
Plate 5: Seafloor Morphology and Existing Field Infrastructure
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Plate 7: Sidescan Sonar Data Example Line 31
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Plate 9: Hazards Map – C&C AUV Survey
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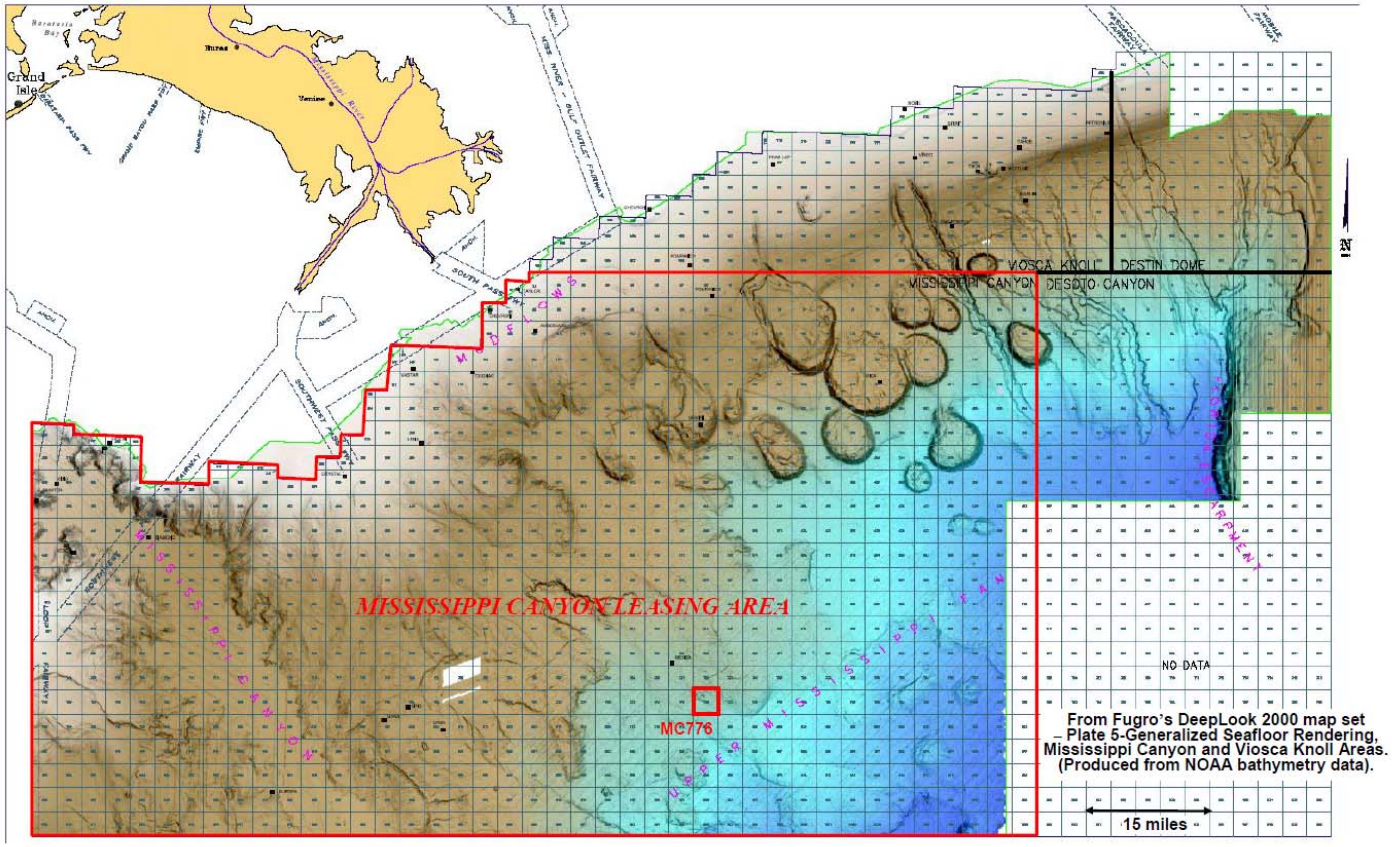
Bernie Care, June 2011

LOCATION MAP AND REGIONAL SEAFLOOR MORPHOLOGY

PROPOSED MC776-WE WELL

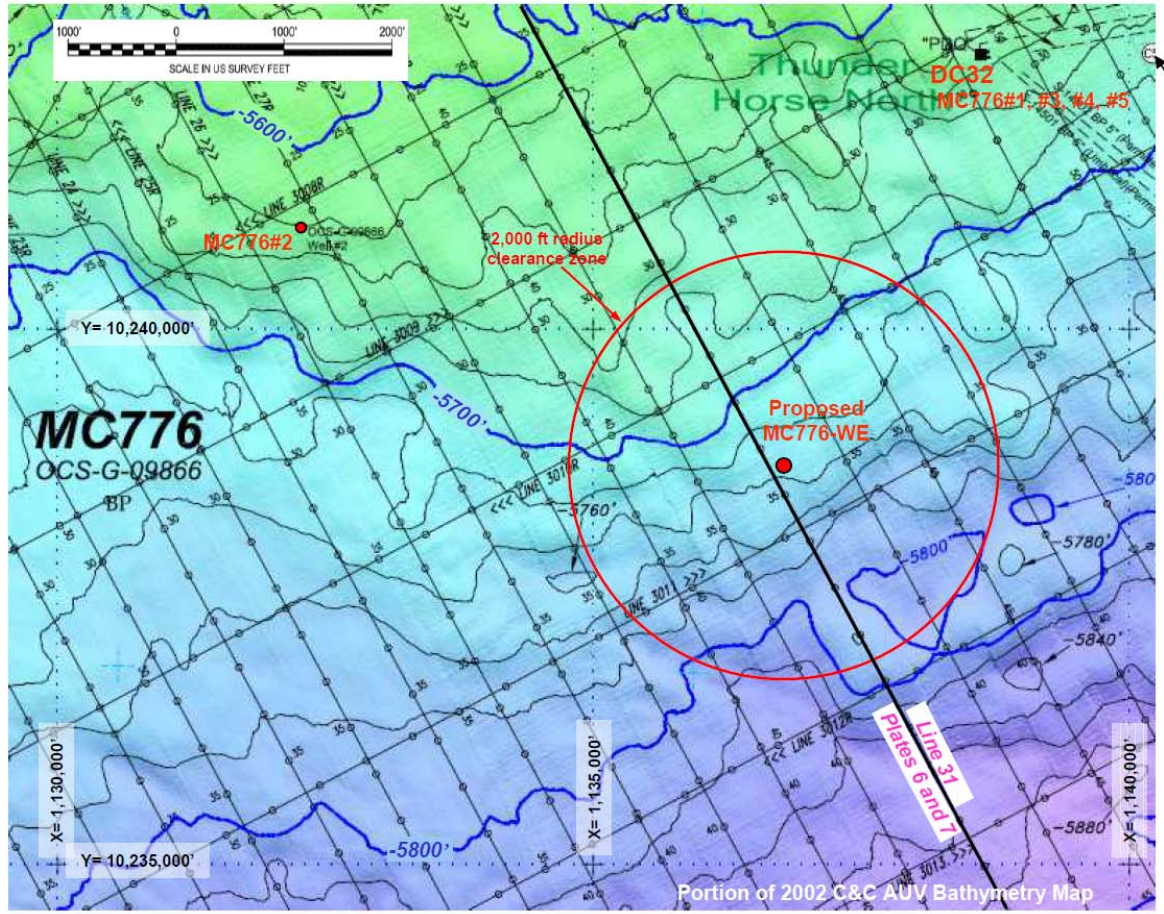


From Fugro's DeepLook 2000 map set – Plate 5-Generalized Seafloor Rendering, Mississippi Canyon and Viosca Knoll Areas. (Produced from NOAA bathymetry data).

Plate 1

BATHYMETRY MAP – C&C AUV DATA

PROPOSED MC776-WE WELL



Sonar contact (C55)

N
W GRID E
S

Water depths in feet.
C.I. = 20 feet

AUV survey Line

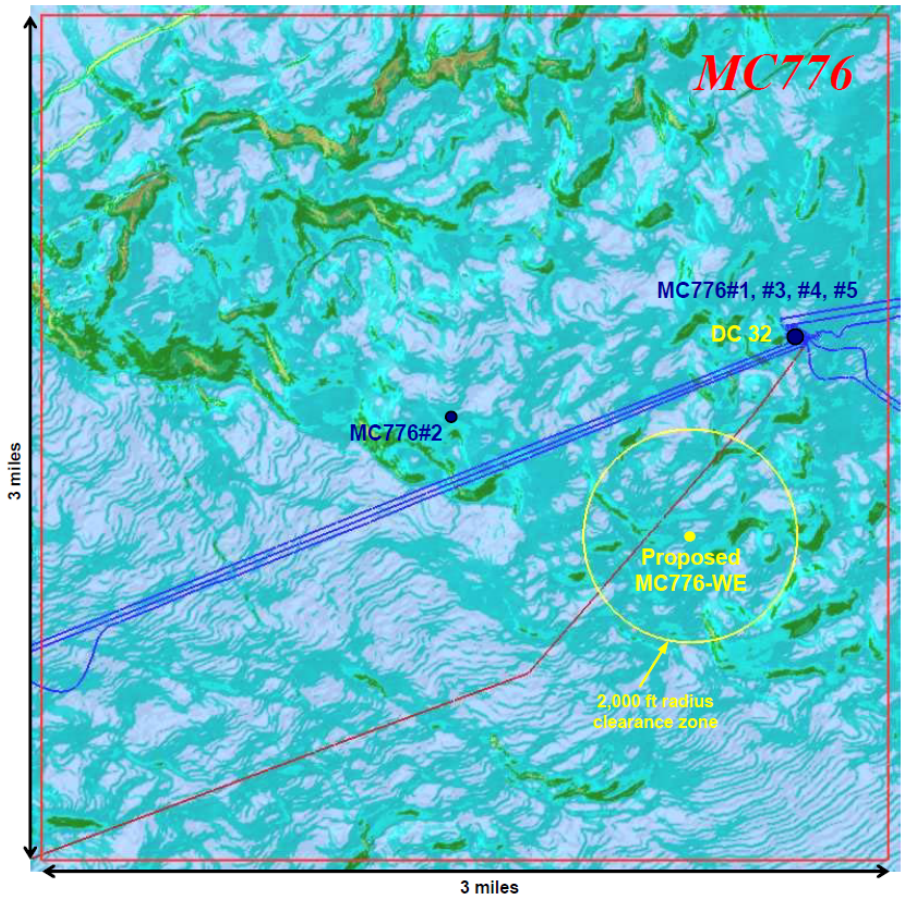
Permitted pipeline and (umbilical) routes

Plate 2

Title of Document:	Supplemental Development Operations Coordination Document - Thunder Horse	**Document Number:**	1410-10-RG-PN-0001
Authority:	James Grant	**Revision:**	0
Custodian/Owner:	Bekki Winfree	**Issue Date:**	October 26, 2011
Retention Code:		**Next Review Date (if applicable):**	
Security Classification:	Public Information Copy	**Page:**	69 of 250

Warning: Check DW Docs revision to ensure you are using the correct revision.

SEAFLOOR SLOPE MAP
PROPOSED MC776-WE WELL



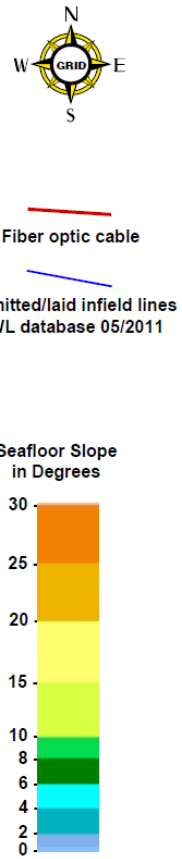
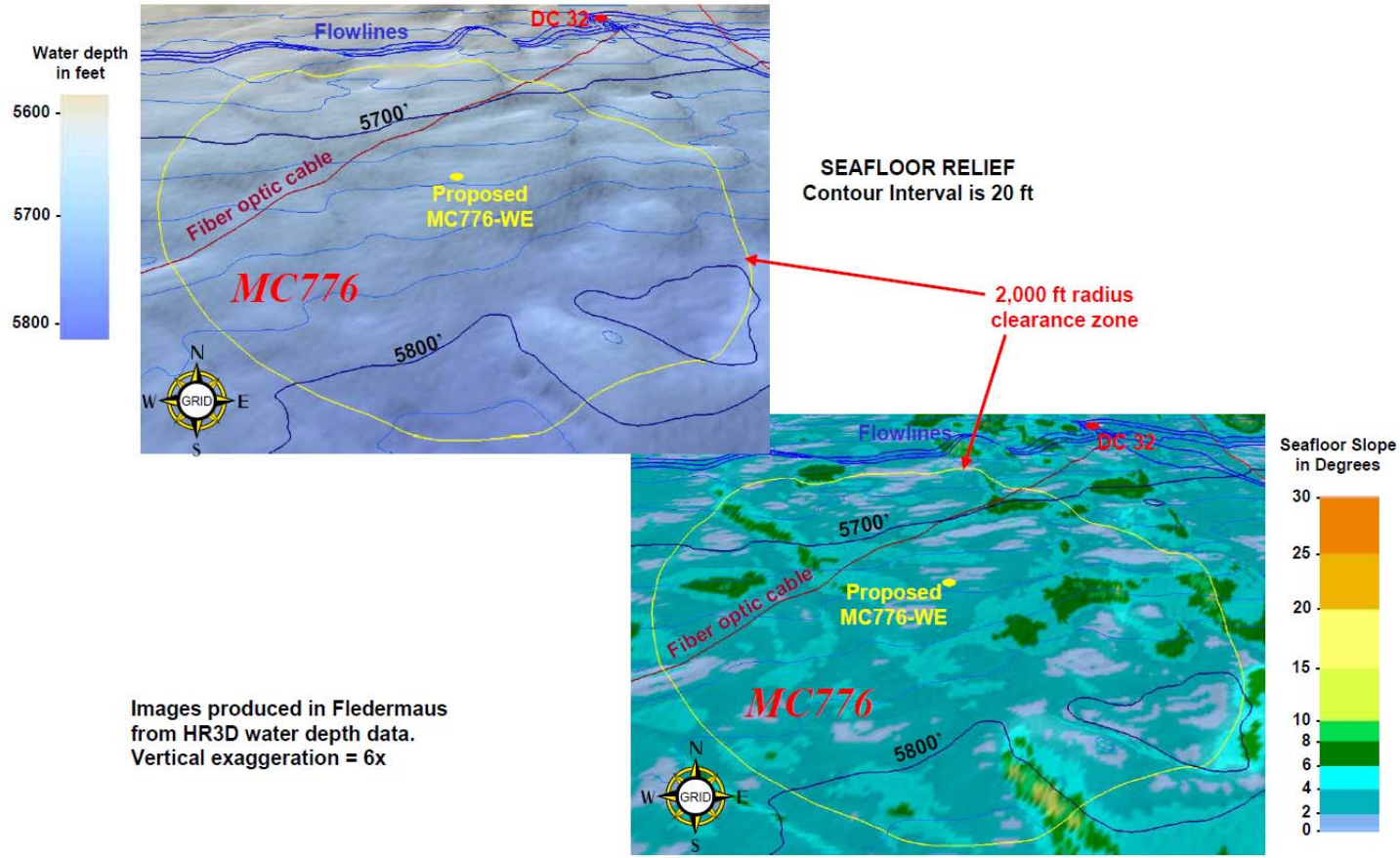


Plate 3

Image produced in Fledermaus from HR3D water depth data: seafloor gradients overlain on seafloor relief map

3-D DETAIL VIEWS OF SEAFLOOR RELIEF AND SLOPE

PROPOSED MC776-WE WELL



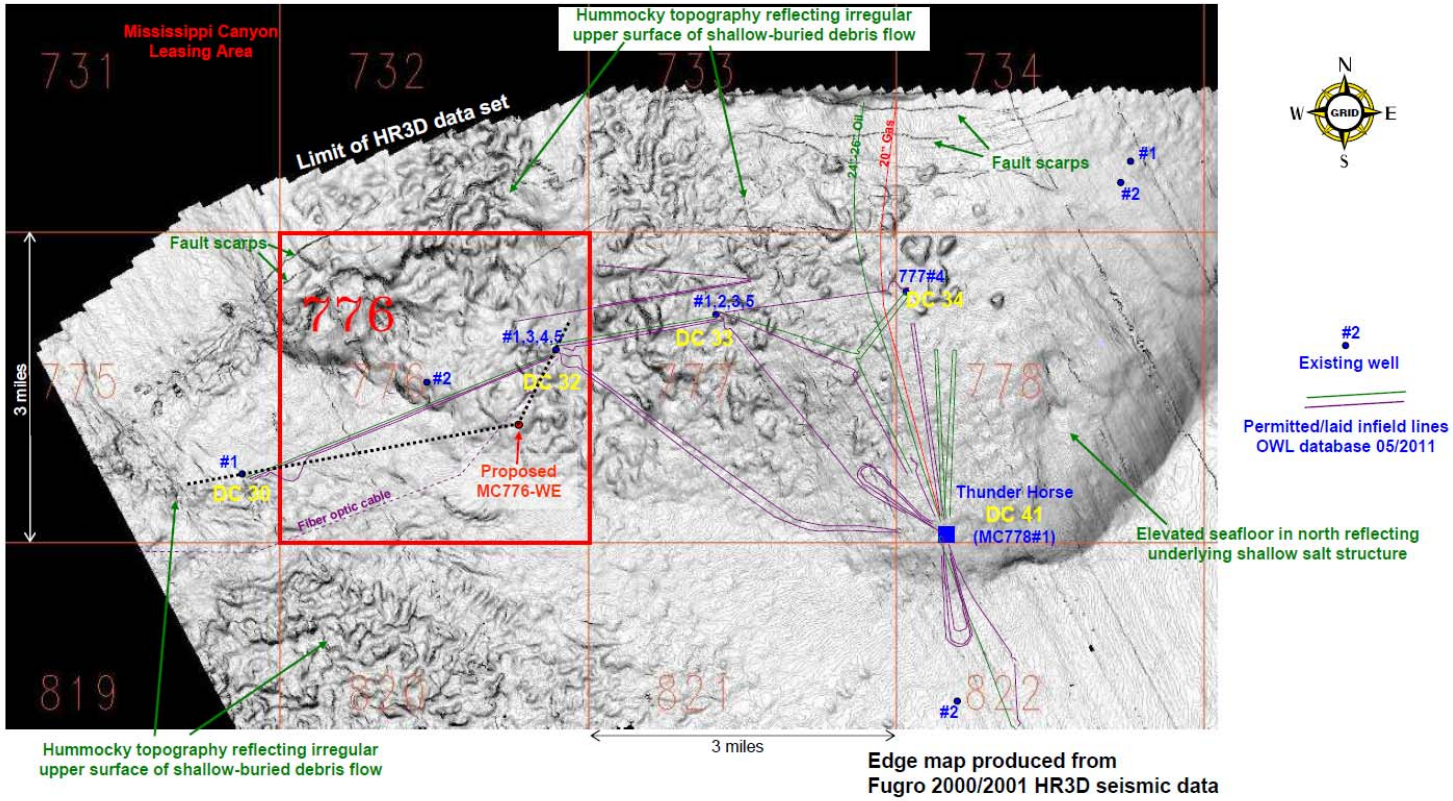
Images produced in Fledermaus from HR3D water depth data. Vertical exaggeration = 6x

SEAFLOOR SLOPE

Plate 4

SEAFLOOR MORPHOLOGY AND EXISTING FIELD INFRASTRUCTURE

PROPOSED MC776-WE WELL

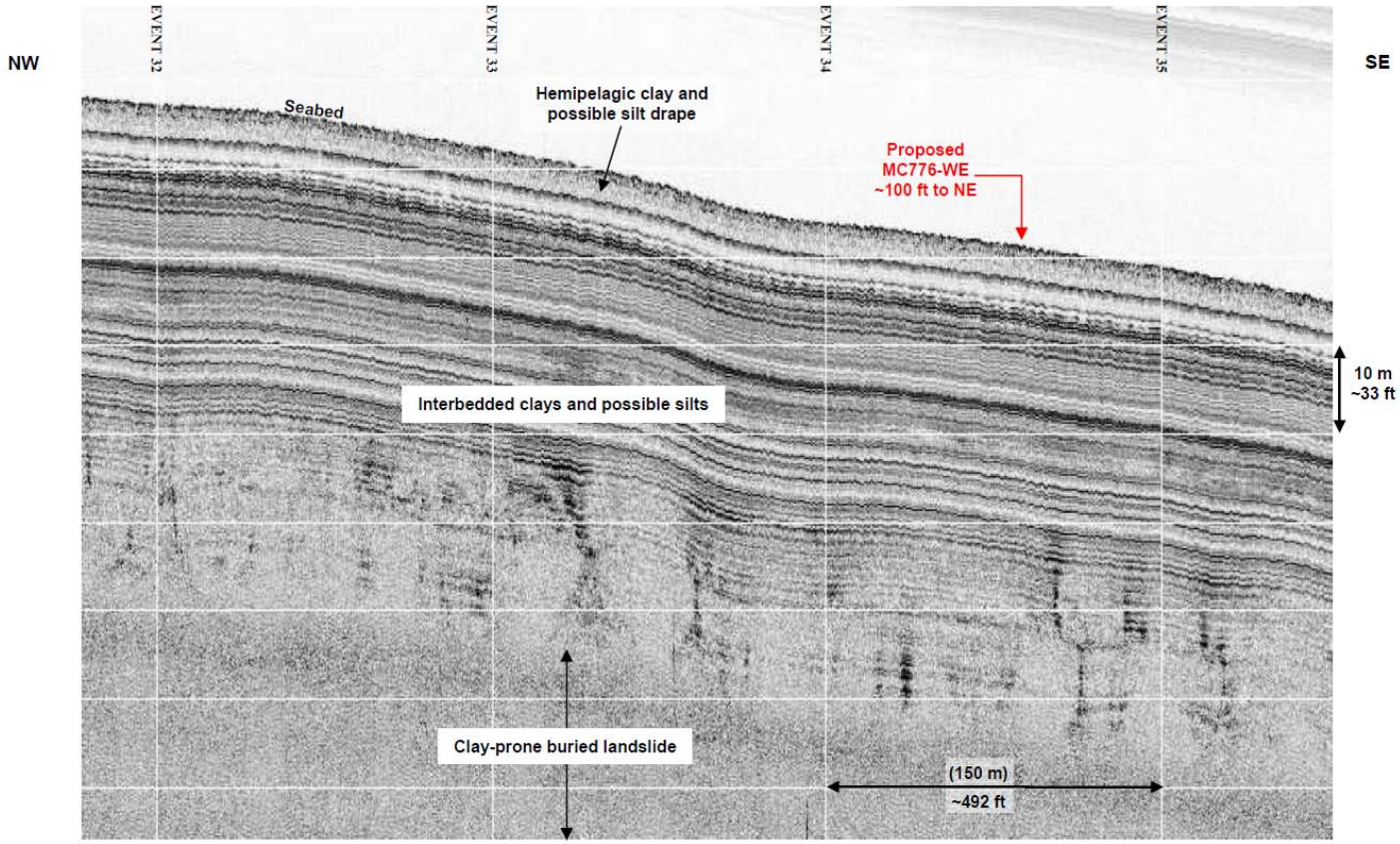


Edge map produced from
Fugro 2000/2001 HR3D seismic data

Plate 5

NW-SE SUBBOTTOM PROFILER DATA EXAMPLE LINE 31

PROPOSED MC776-WE WELL

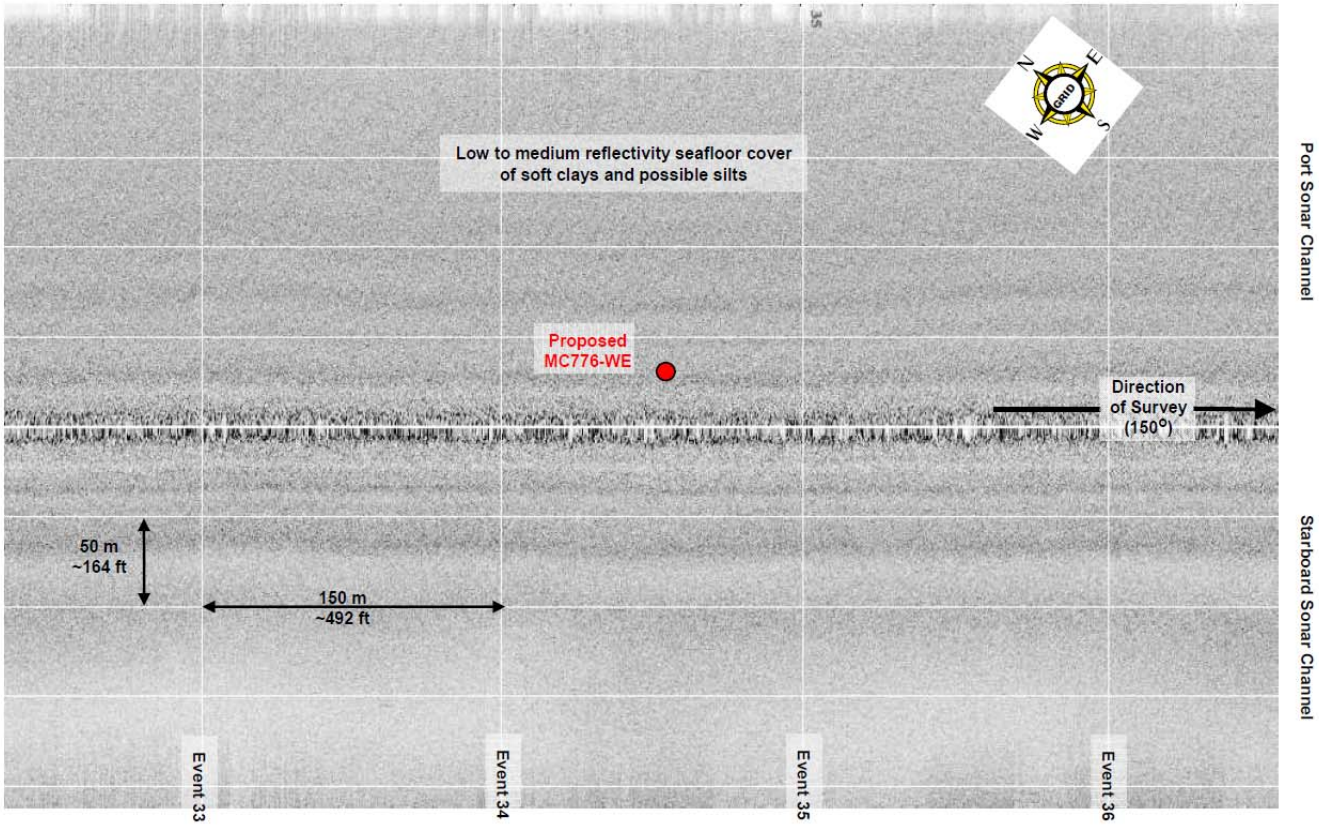


Portion of Line 31 from C&C 2001 AUV survey (see Plate 2 for location)

Plate 6

SIDESCAN SONAR DATA EXAMPLE LINE 31

PROPOSED MC776-WE WELL



Portion of Line 31 from C&C 2001 AUV survey (see Plate 2 for location)

Plate 7

HAZARD MAP - JECA HR2D SURVEY

PROPOSED MC776-WE WELL

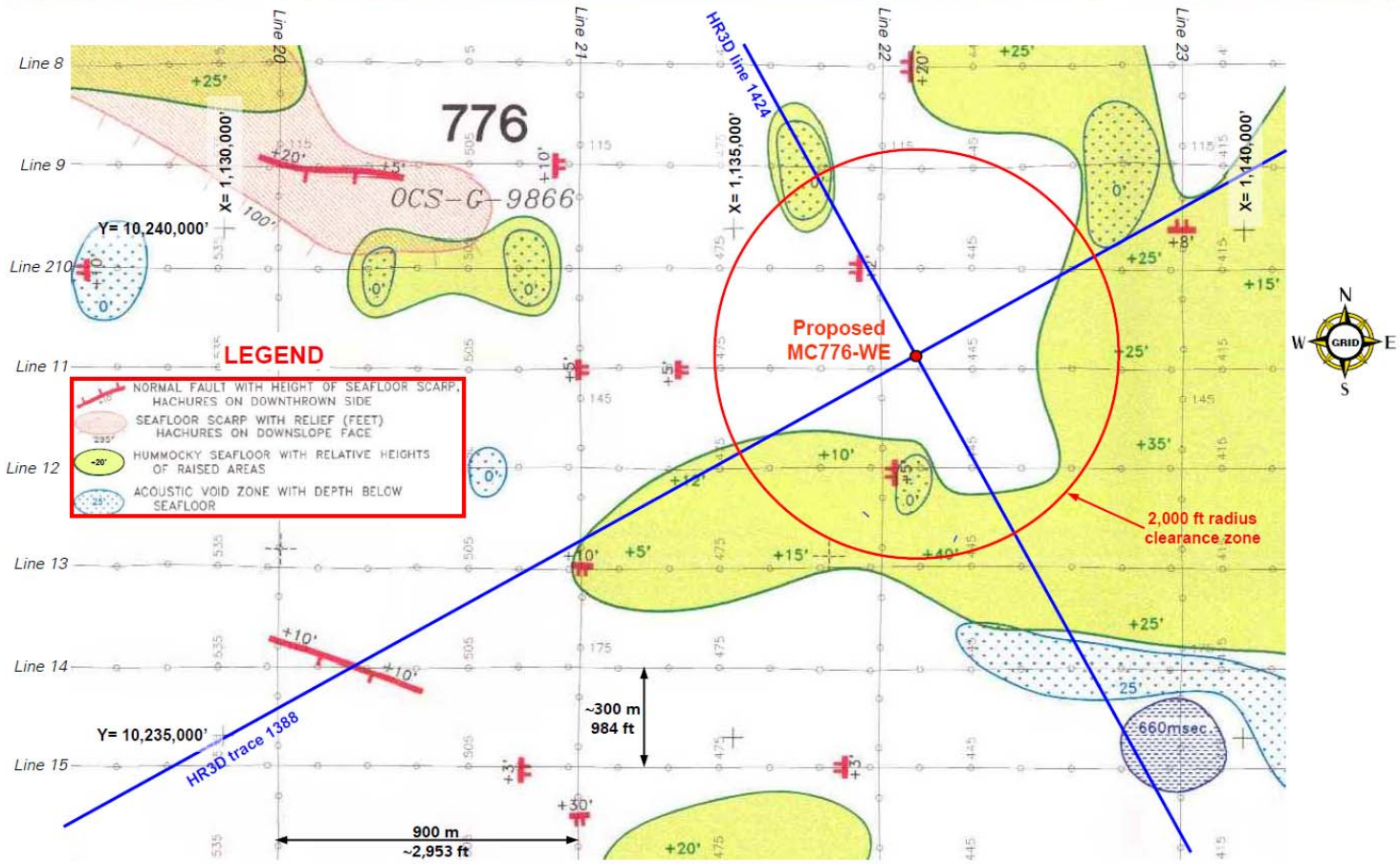
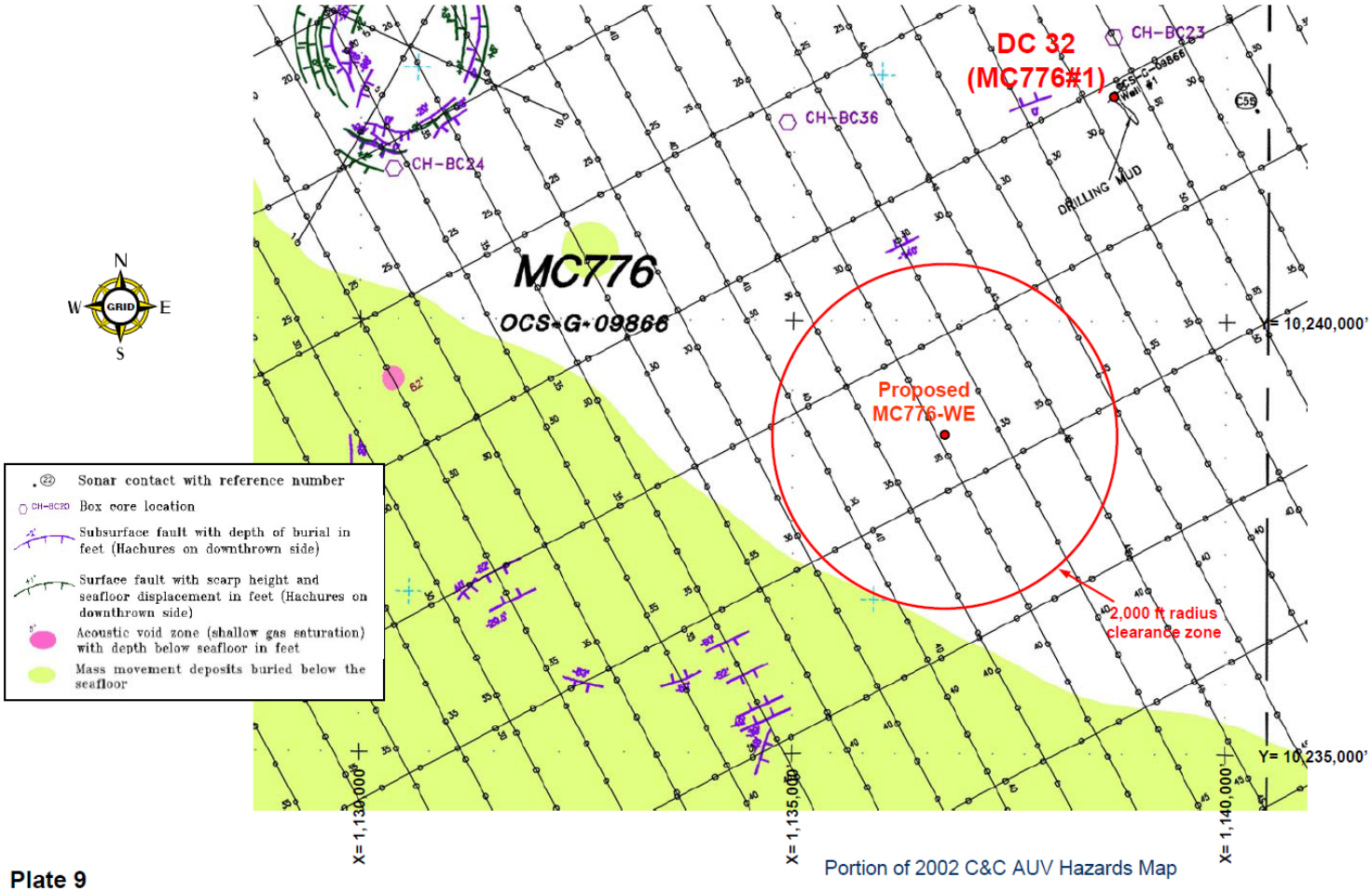


Plate 8

Portion of 1997 JECA HR2D Hazard Map

HAZARDS MAP - C&C AUV SURVEY

PROPOSED MC776-WE WELL



Portion of 2002 C&C AUV Hazards Map

Plate 9

SEAFLOOR EDGE MAP SHOWING LOCATION OF ANNOTATED SEISMIC LINES
PROPOSED MC776-WE WELL

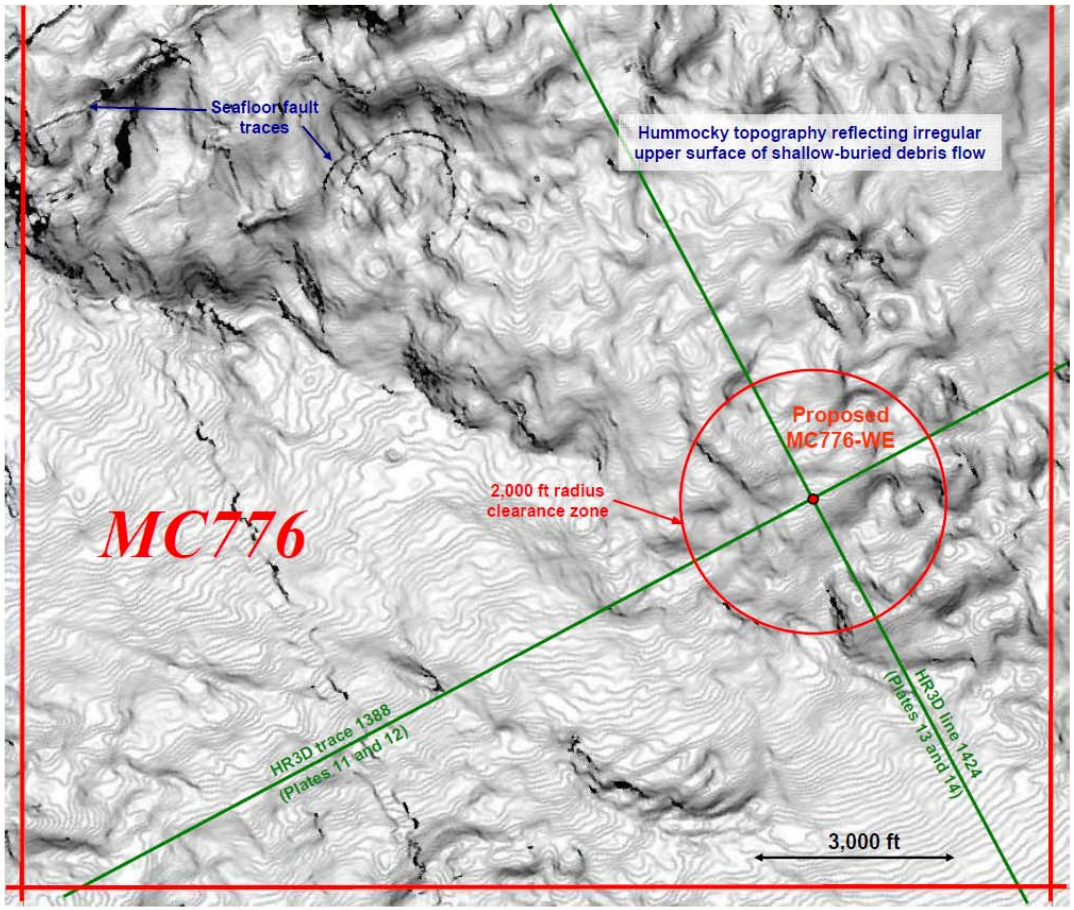


Plate 10

HR3D SEISMIC TRACE 1388 THROUGH PROPOSED LOCATION

PROPOSED MC776-WE WELL

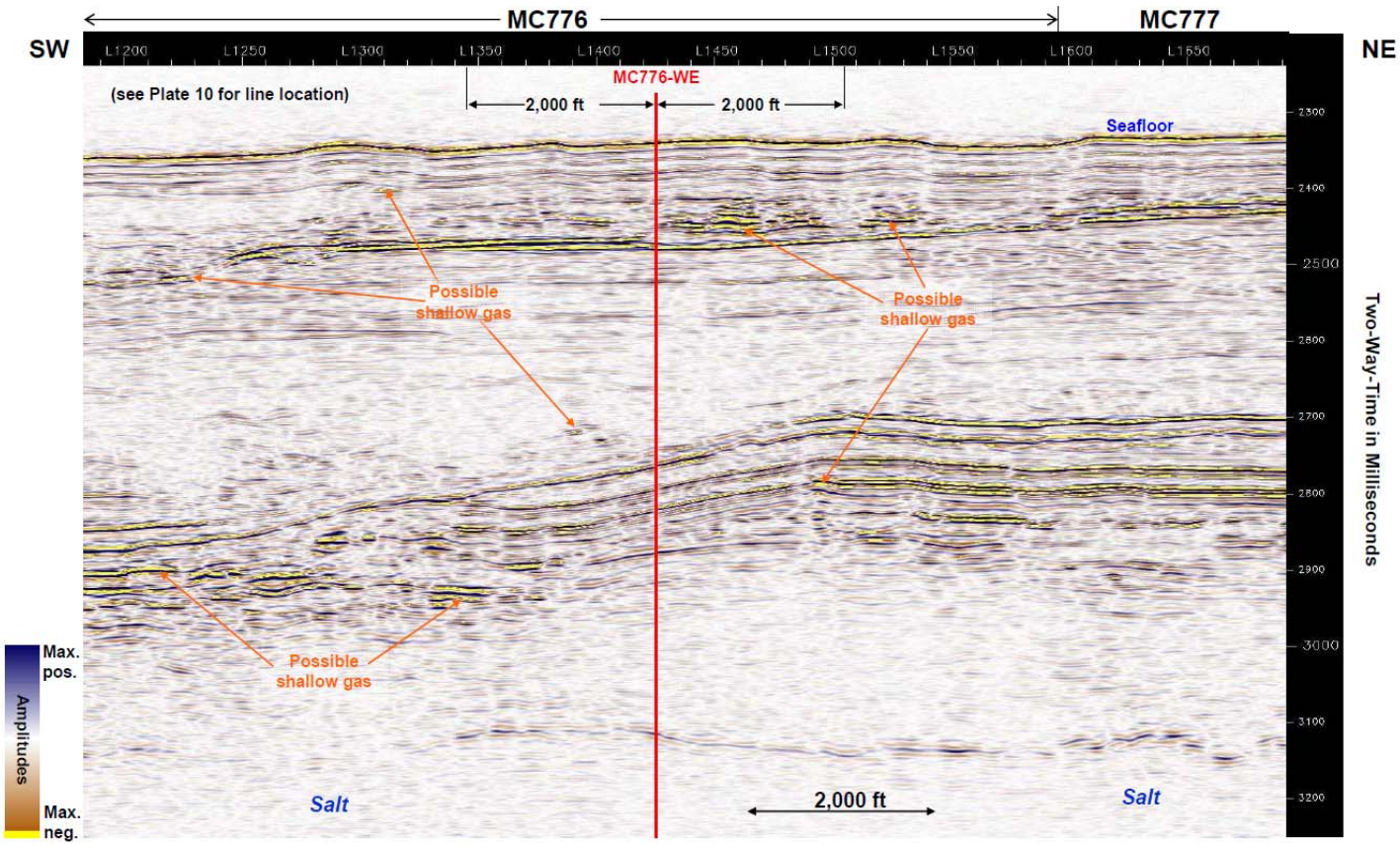
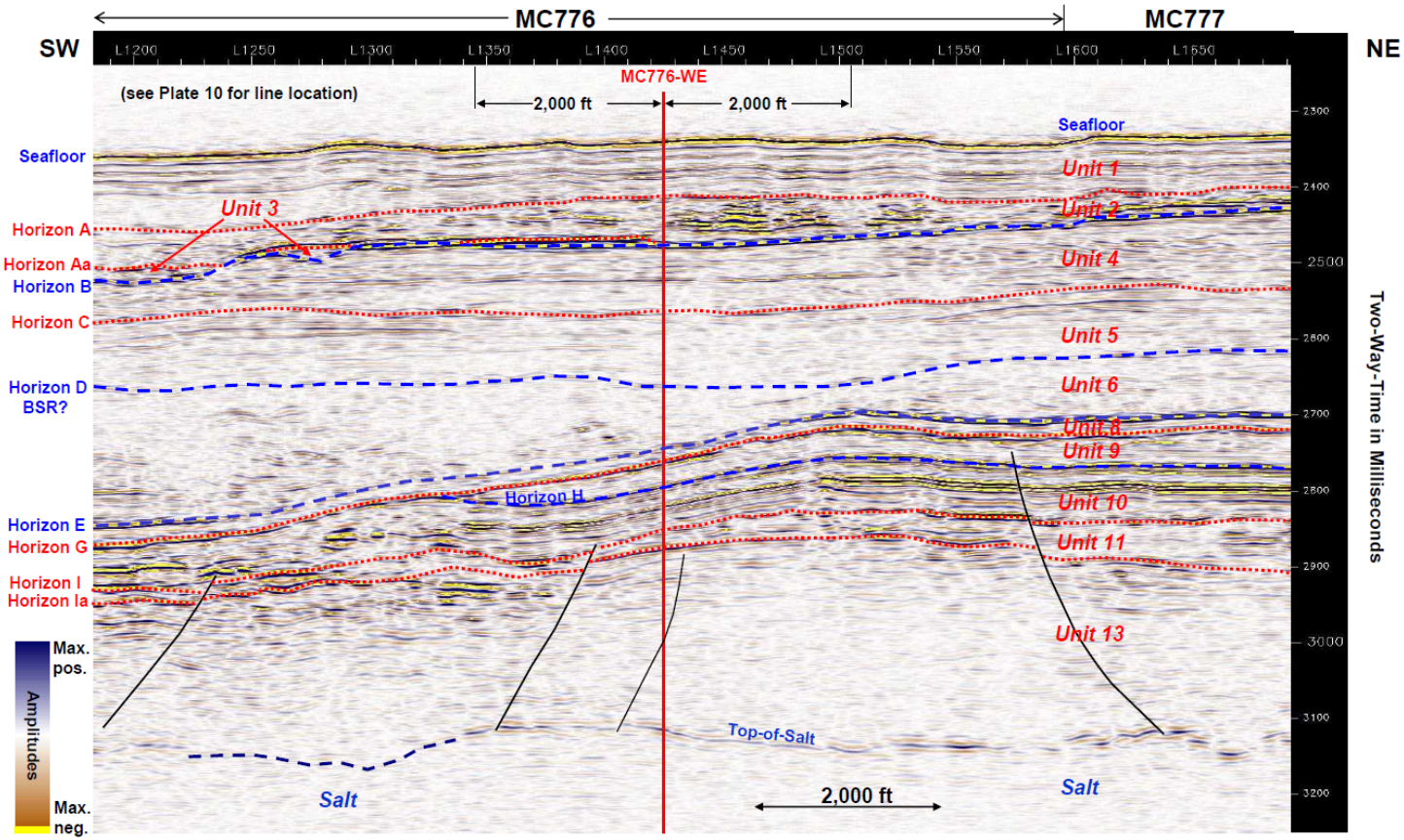


Plate 11

INTERPRETED HR3D SEISMIC TRACE 1388 THROUGH PROPOSED LOCATION

PROPOSED MC776-WE WELL



Note: Units 3, 7 and 12 mapped elsewhere in Thunder Horse Field are absent at MC776-WE location
Proposed 20-inch casing shoe to be set ~2,000 ft below Top-of-Salt

Red horizons and units are interpolated from offset well interpretations.
Blue horizons are mapped within MC776 for this study.

Plate 12

HR3D SEISMIC LINE 1424 THROUGH PROPOSED LOCATION

PROPOSED MC776-WE WELL

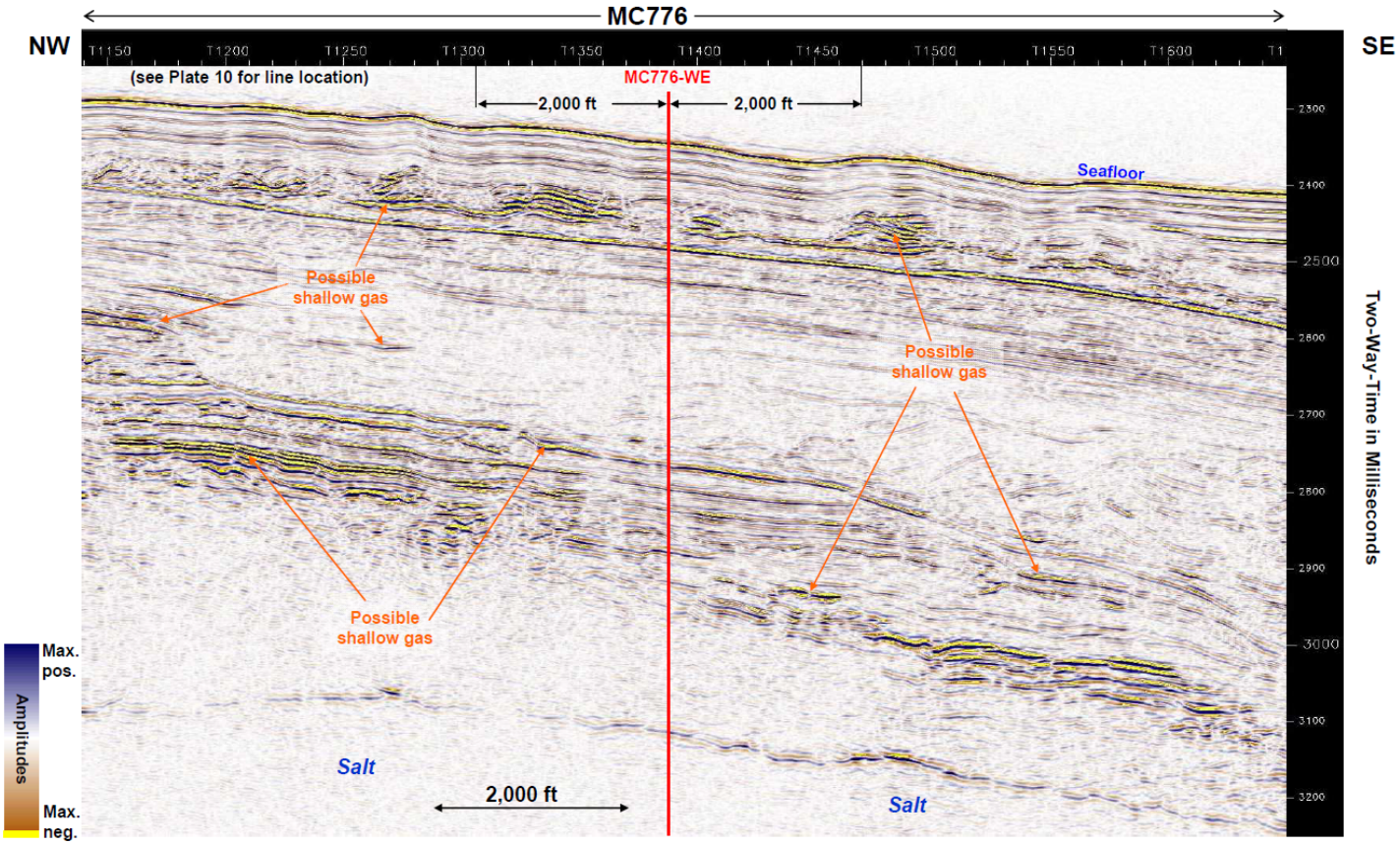
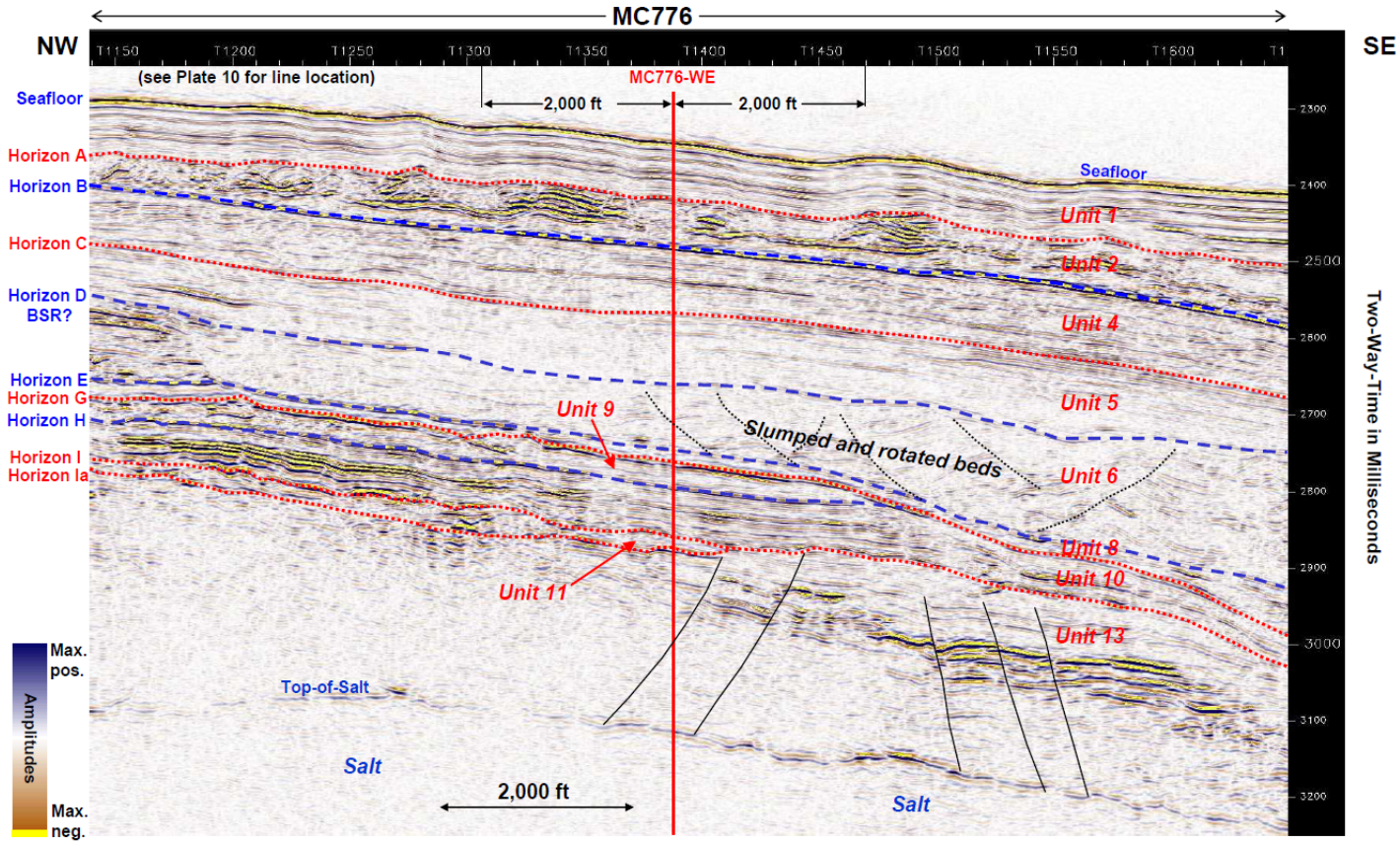


Plate 13

INTERPRETED HR3D SEISMIC LINE 1424 THROUGH PROPOSED LOCATION

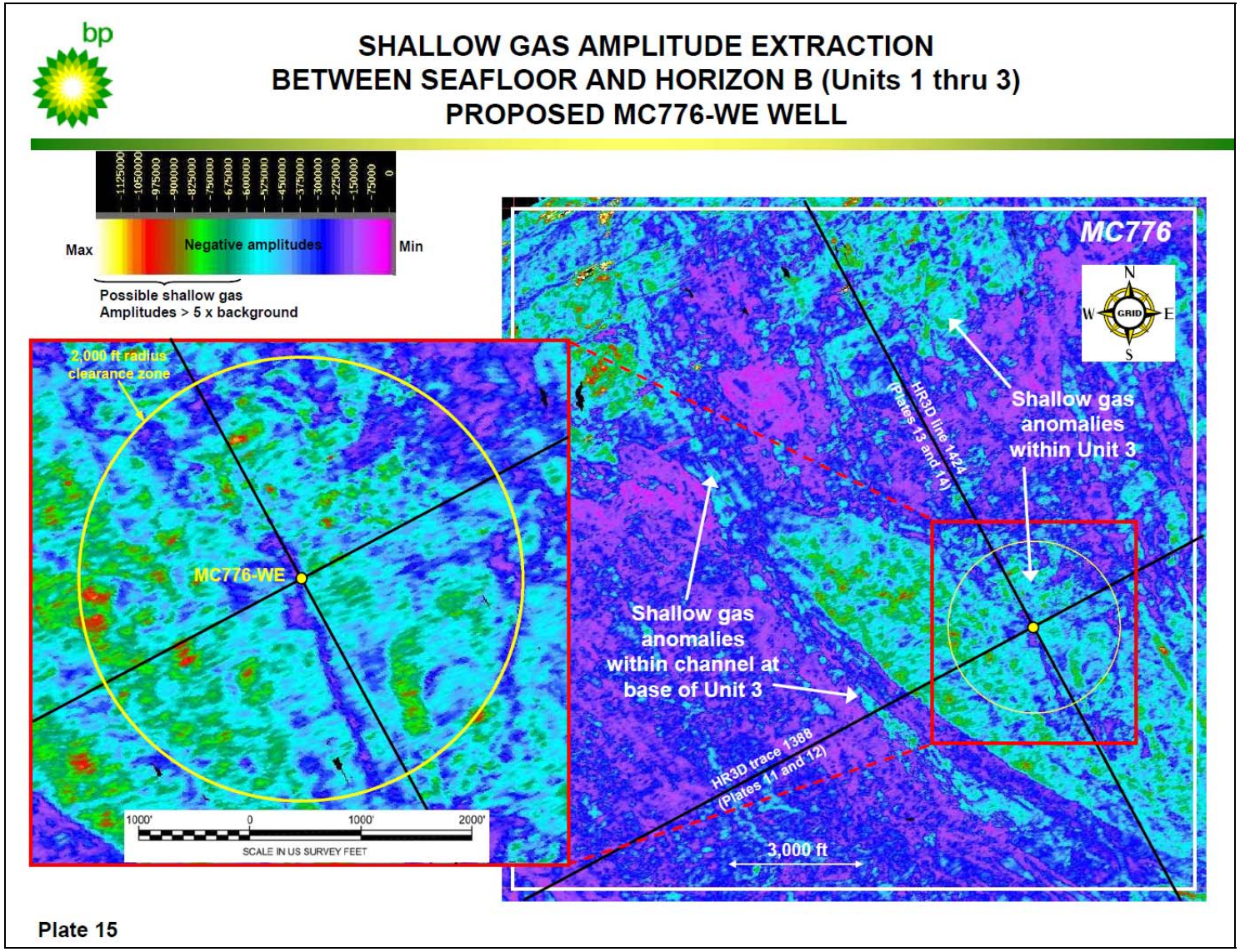
PROPOSED MC776-WE WELL

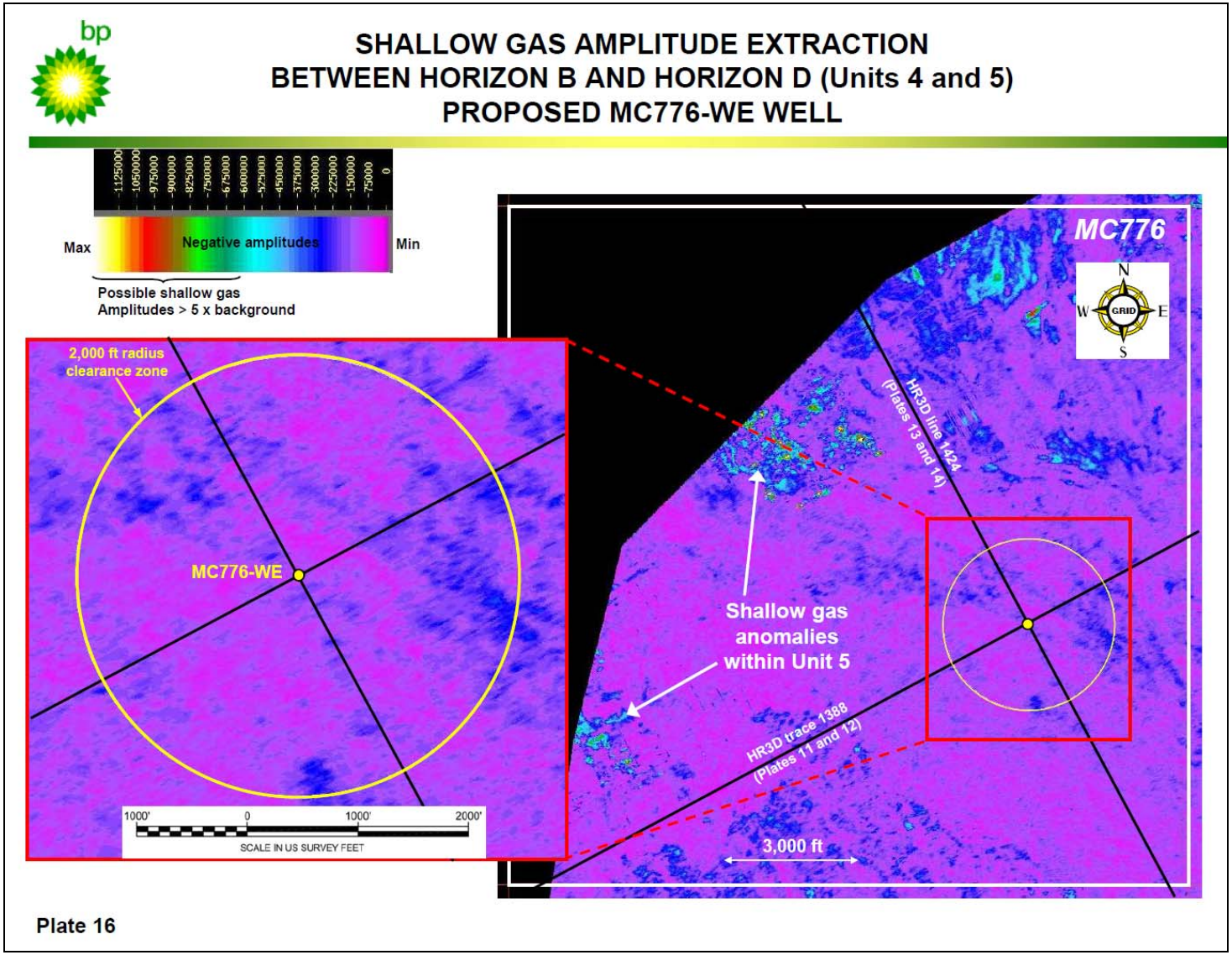


Note: Units 3, 7 and 12 mapped elsewhere in Thunder Horse Field are absent at MC776-WE location
Proposed 20-inch casing shoe to be set ~2,000 ft below Top-of-Salt

Red horizons and units are interpolated from offset well interpretations.
Blue horizons are mapped within MC776 for this study.

Plate 14


SHALLOW GAS AMPLITUDE EXTRACTION
BETWEEN SEAFLOOR AND HORIZON B (Units 1 thru 3)
PROPOSED MC776-WE WELL
-1125000
-1050000
-975000
-900000
-825000
-750000
-675000
-600000
-525000
-450000
-375000
-300000
-225000
-150000
-75000
0
Max
Negative amplitudes
Min
Possible shallow gas
Amplitudes > 5 x background
2,000 ft radius
clearance zone
MC776-WE
1000'
0
1000'
2000'
SCALE IN US SURVEY FEET
MC776
N
W
GRID
E
S
HR3D line 1424
(Plates 13 and 14)
Shallow gas
anomalies
within Unit 3
Shallow gas
anomalies
within channel at
base of Unit 3
HR3D trace 1388
(Plates 11 and 12)
3,000 ft
Plate 15


SHALLOW GAS AMPLITUDE EXTRACTION
BETWEEN HORIZON B AND HORIZON D (Units 4 and 5)
PROPOSED MC776-WE WELL
Max
Negative amplitudes
Min
Possible shallow gas
Amplitudes > 5 x background
2,000 ft radius
clearance zone
MC776-WE
1000'
0
1000'
2000'
SCALE IN US SURVEY FEET
MC776
N
W
GRID
E
S
HR3D line 1424
(Plates 13 and 14)
Shallow gas
anomalies
within Unit 5
HR3D trace 1388
(Plates 11 and 12)
3,000 ft
Plate 16

SHALLOW GAS AMPLITUDE EXTRACTION BETWEEN HORIZON D AND HORIZON E (Unit 6) PROPOSED MC776-WE WELL

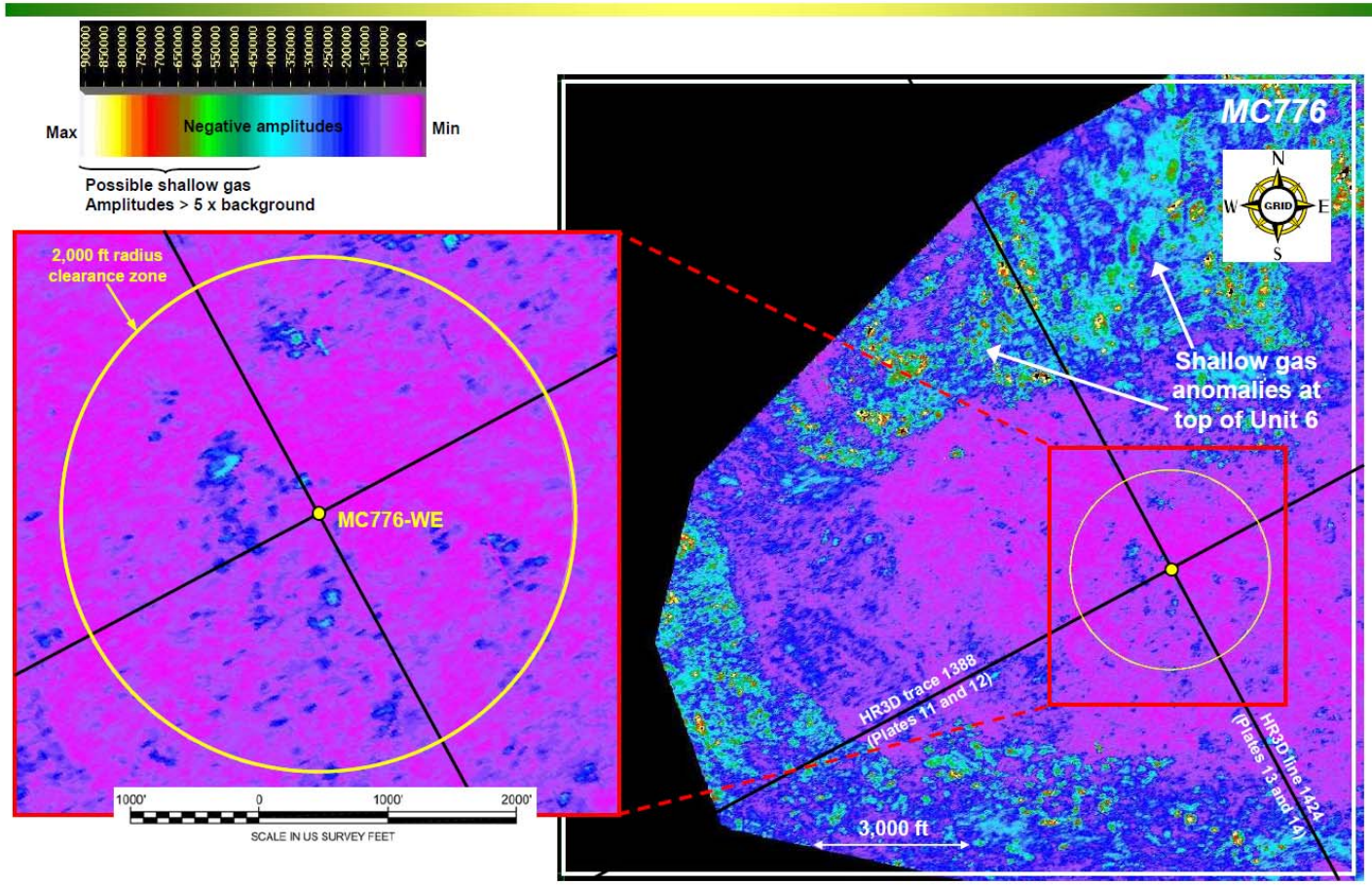


Plate 17

SHALLOW GAS AMPLITUDE EXTRACTION BETWEEN HORIZON E AND HORIZON H (Units 8 and 9) PROPOSED MC776-WE WELL

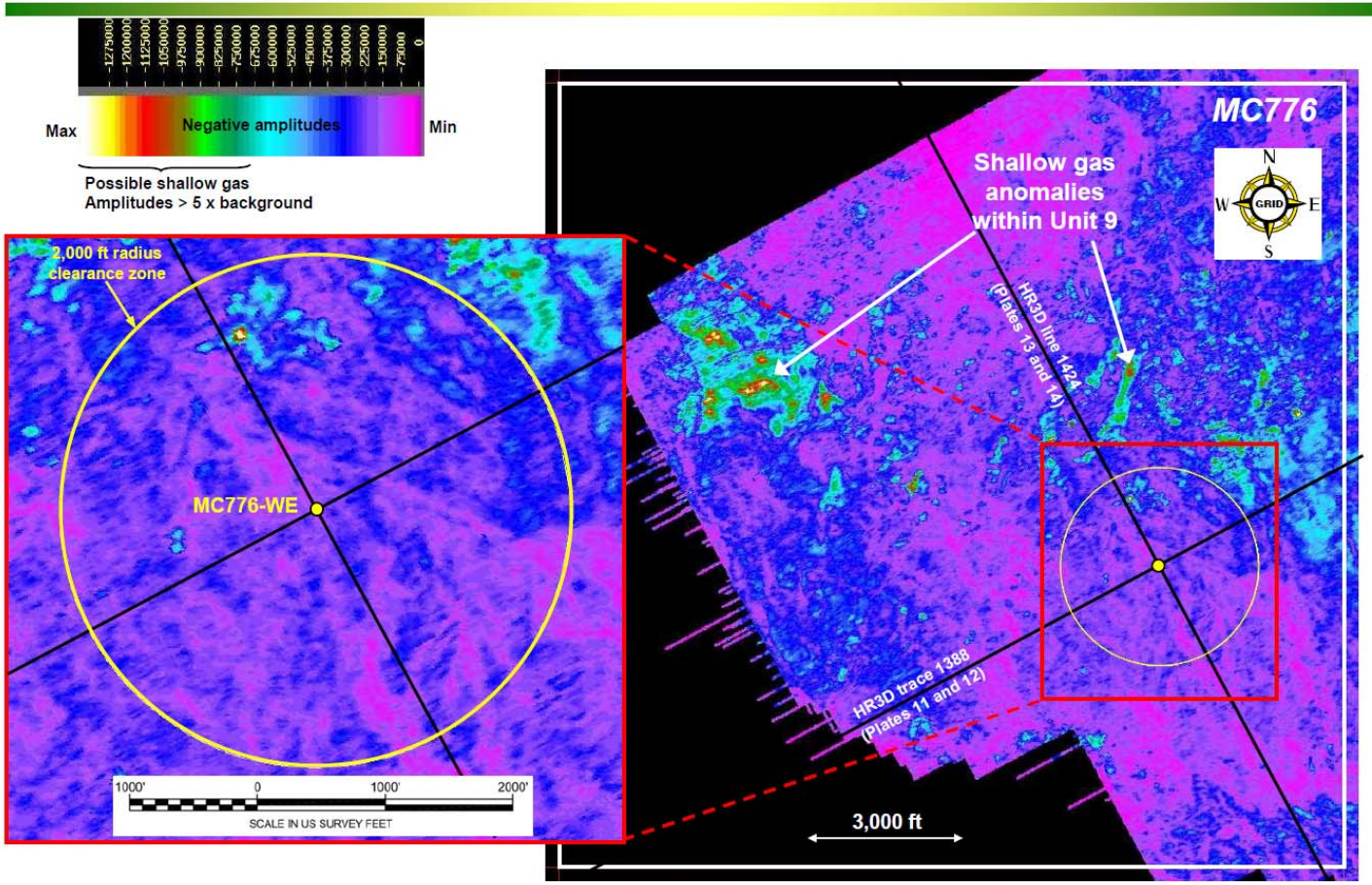


Plate 18

SHALLOW GAS AMPLITUDE EXTRACTION BETWEEN HORIZON H AND TOP SALT (Units 10, 11 and 13) PROPOSED MC776-WE WELL

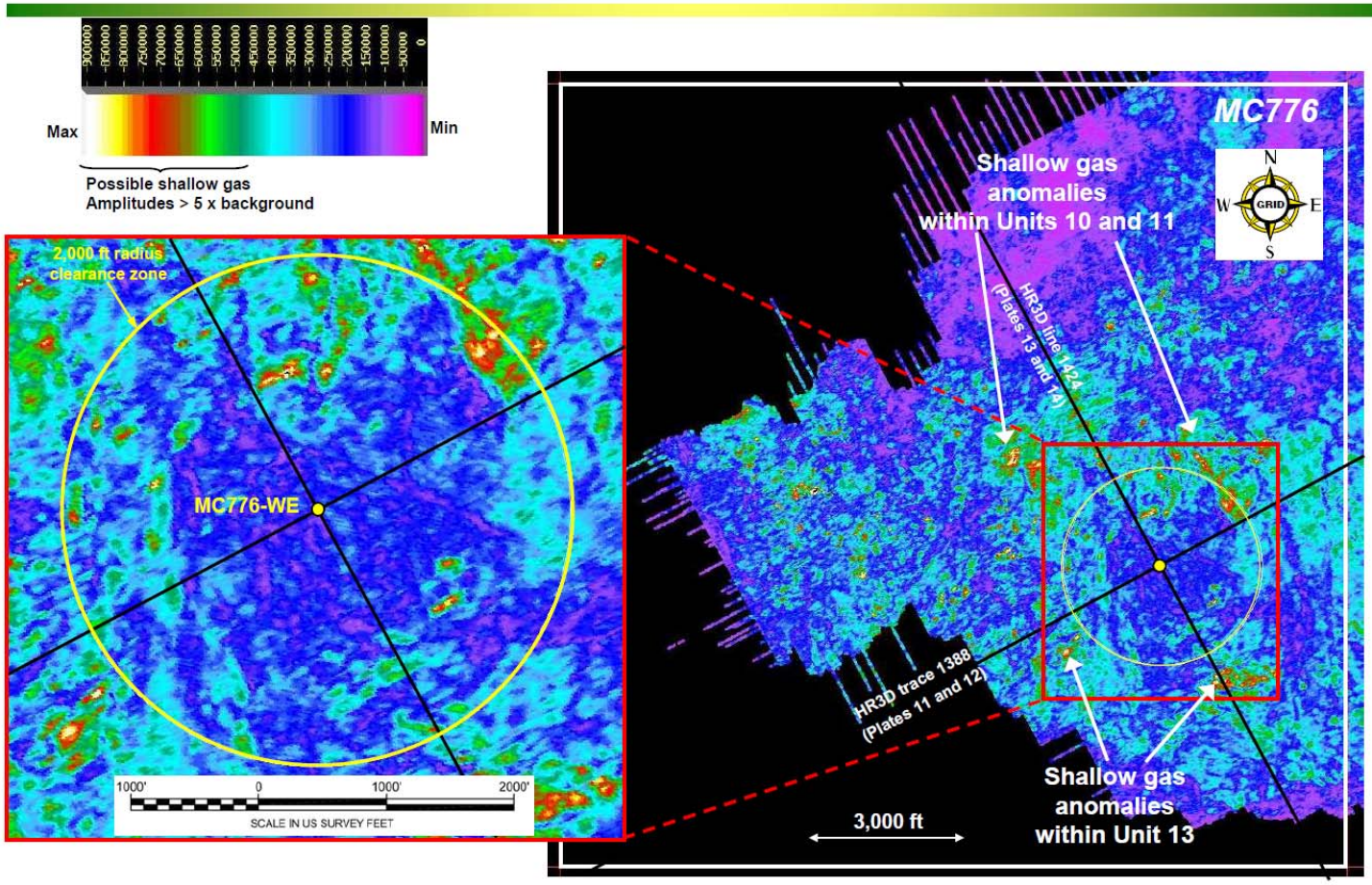
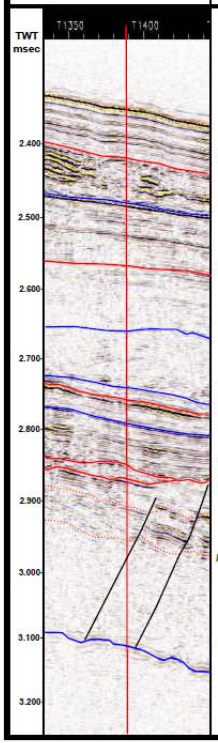


Plate 19

TOPHOLE FORMATION AND GEOHAZARDS SUMMARY SHEET
PROPOSED MC776-WE WELL



MC776-WE Mississippi Canyon 776 (OCS-G-09866)	Interpretation: Stratigraphy	Interpretation: Lithology	Depth BML (ft)	Depth BSL (ft)	TWT BSL (sec)	Interval Thickness (ft)	Comments	Hazards Risk: Hydrates	Hazards Risk: Shallow Gas	Hazards Risk: Shallow Water Flow
			Depth uncertainty ranges from ±29 ft at Seafloor to ±103 ft at Top-of-Salt							
	Seafloor		0	5,736	2.341		Relatively smooth, hummocky seafloor, slopes ~1.7° down to the south			
	Unit 1	Hemipelagic clays with slumps/debris flows at base				246	Approx 160-ft thick debris flow at base of Unit A in vicinity of proposed location resulting in hummocky topography at seafloor			
	Horizon A		246	5,982	2.421					
	Unit 2	Slumped hemipelagic clays				138	N-S trending erosional channel in Horizon B containing sands with shallow gas is ~5,200 ft to W			
	Horizon B		384	6,120	2.466					
	Unit 4	Clay/silt/sand turbidites				307	Unit 3 is absent at proposed location, but is present ~5,200 ft to the W and contains sands with shallow gas			
	Horizon C		691	6,427	2.566					
	Unit 5	Clay/silt turbidites with channeling				291	Horizon D corresponds to a prominent BSR in the N of MC777 and MC778			
	Horizon D BSR?		982	6,718	2.661					
	Unit 6	Clay/silt/sand turbidites with basal slumps				295	Continuous sands with shallow gas and SWF risk at top of Unit 6 in the N of MC777 terminate ~4,700 ft to N of wellbore. Scattered minor sands/gas anomalies are 1,000 ft to N and 1,500 ft to NE			
	Horizon E		1,277	7,013	2.757					
	Unit 8	Clay/silt turbidites				27	Slight to low instances of SWF recorded from sandy intervals within			
	Horizon G		1,304	7,040	2.766					
	Unit 9	Clay/silt turbidites with some channeling				80	Units 8 and 9 at offset wells MC776#1 and #2, and MC822#1			
	Horizon H		1,384	7,120	2.792					
	Unit 10	Clay/silt turbidites				190	Scattered shallow gas anomalies within Unit 10 ~500 ft to W and S, ~1,200 ft to N and ~1,900 ft to SE			
	Horizon I		1,574	7,310	2.854					
	Unit 11	Sand-prone turbidites				56				
	Horizon Ia		1,630	7,366	2.872					
			1,752	*7,488*	*2.912*		Shallow gas and low to moderate SWF experienced in Horizon Ia to TOS interval at MC775#1			
		Sand-prone turbidites								
			1,900	*7,636*	*2.960*					
	Fault		***1,949***	***7,685***	***2.976***					
	Unit 13	Clay, silt/sand turbidites w/ rotated slump blocks				730	Three sands identified within this interval in MC777#5 with slight SWF			
	Top-of-Salt	Top-of-Salt	2,360	8,096	3.110					
		Salt								

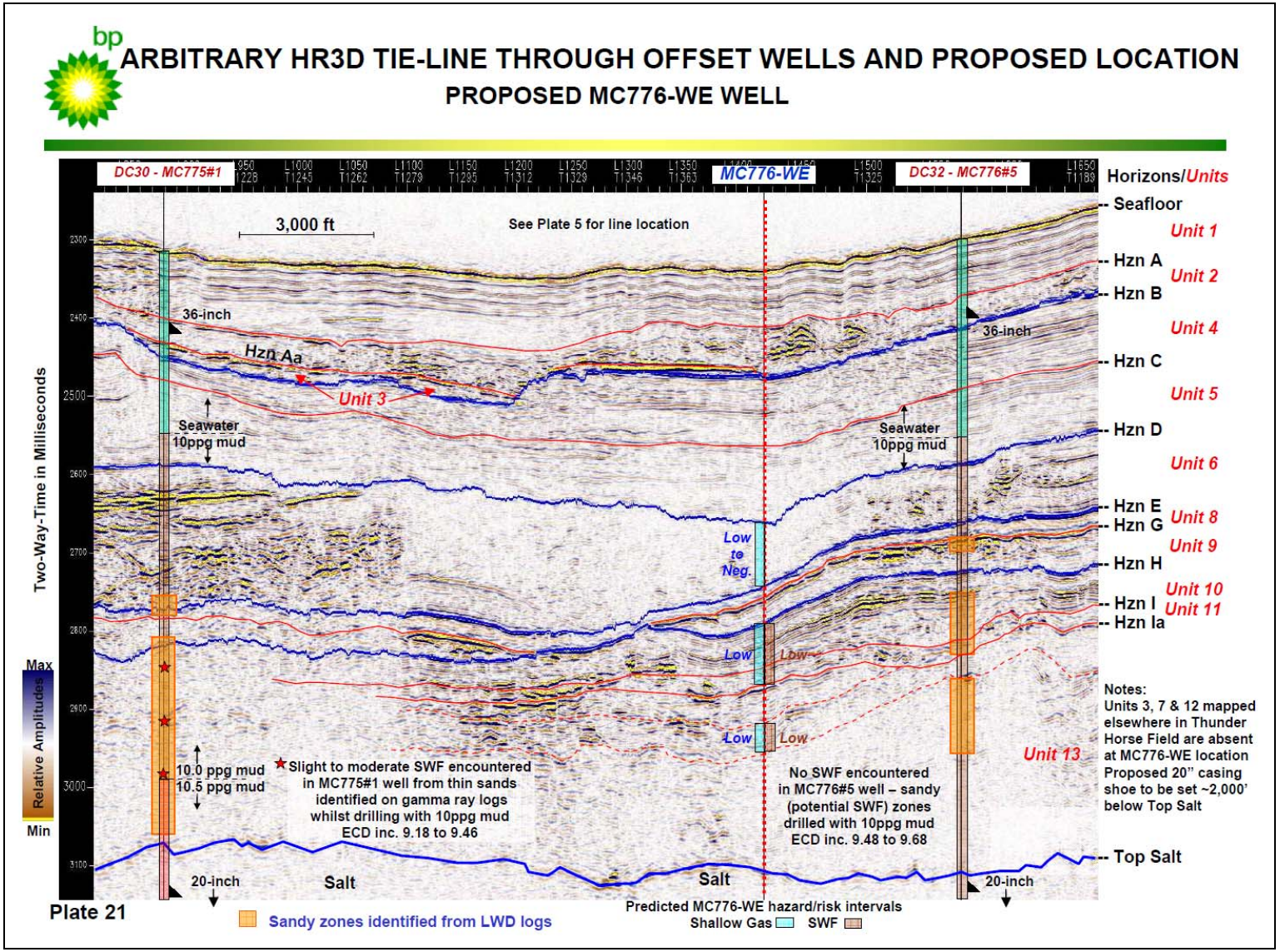
Risk level: Negligible | Low | Moderate | High

Time-Depth conversions based on an overburden velocity of 6,138 ft/sec derived from SF and TOS picks at MC776#5

Red horizons are interpolated from offset well interpretations.
Blue horizons are mapped within proposed well area and used for interval amplitude analysis

Note: Units 3, 7 and 12 mapped elsewhere in Thunder Horse Field are absent at MC776-WE location
Proposed 20-inch casing shoe to be set ~2,000 ft below Top-of-Salt

Plate 20



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Authority:	James Grant	**Revision:**	0
Custodian/Owner:	Bekki Winfree	**Issue Date:**	October 26, 2011
Retention Code:		**Next Review Date (if applicable):**	
Security Classification:	Public Information Copy	**Page:**	88 of 250

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SHALLOW HAZARDS ASSESSMENT

PROPOSED WELL LOCATION MC777-WA
(DC33 WATER INJECTION WELL)

THUNDER HORSE FIELD
BLOCK 777, OCS-G-09867

MISSISSIPPI CANYON AREA

PROPOSED SURFACE LOCATION MC777-WA	
28° 12' 46.659" N	88° 31' 06.313" W
X = 1,151,530.00 ft E	Y = 10,241,300.00 ft N
7,180 ft FNL	4,790 ft FEL

X and Y Coordinates in UTM Zone 16N (US ft)
Geodetic Datum: NAD 1927
Spheroid: Clarke 1866

SHALLOW HAZARDS ASSESSMENT
MISSISSIPPI CANYON BLOCK MC777 (OCS-G-09867)
PROPOSED WELL MC777-WA
(DC33WI WELL)

This Shallow Hazards Assessment defines the location of the proposed water injection well MC777-WA, with surface hole location situated in offshore block MC777 (Thunder Horse Field) in the Mississippi Canyon Protraction Area of the Northern Gulf of Mexico (Plate 1). This will be the first of 4 planned water injection (WI) wells from a new drill center, DC33WI, and it is anticipated that all future WI wells will be within 200 ft of the proposed MC777-WA well. This clearance letter, which covers a surface area of 2,000 ft around the proposed well, refers specifically to the MC777-WA location, although seafloor and subsurface conditions are expected to be similar for the three future DC33WI wells.

This document supplements the Supplemental Development Operations Coordination Document (SDOCD) to be submitted to the Bureau of Ocean Energy Management, (BOEM formerly BOEMRE) and complies with the BOEMRE guidelines provided in: NTL Nos. 2005-G07 and 2008-G20 (Archaeological Resource Surveys and Reports); NTL No. 2008-G05 (Shallow Hazards Program); NTL No. 2009-G40 (Deepwater Benthic Communities); and the Pre-Seabed Disturbance Survey Mitigation established by the BOEMRE in March 2011. This assessment discusses the seafloor, shallow geological conditions and any geohazards, in the vicinity of the proposed location, based on detailed review of: high-resolution 2-D (HR2D) geophysical data (echosounder, sidescan sonar, subbottom profiler and multi-channel seismic) acquired by John E. Chance and Associates (JECA, now part of FUGRO) in 1996, and the interpreted Shallow Hazards Report (JECA, 1997); high resolution 3D (HR3D) seismic data (multi-channel only) acquired by FUGRO in 2000/2001; AUV data (swath bathymetry, sidescan sonar and subbottom profiler) acquired by C&C Technologies, Inc. (C&C) in 2001, and the interpreted Shallow Hazards Report (C&C, 2002); and the Archaeological Assessment Study for MC777 and MC778 (C&C, 2006) prepared from the 2001 AUV data. Information was also taken from EP submissions, well logs and internal BP Exploration reports for well locations MC775#1, MC776#1 and #2, MC777#1, #2, #3, #4 and #5, MC778#1 and #13, and MC822#2, and from Fugro-McClelland Marine Geosciences, Inc. geotechnical reports (FMMGI 2001a and 2001b). Attachments to this document include geophysical Data Examples (20 page-sized plates).

The proposed MC777-WA surface location is in the east-central portion of Mississippi Canyon Block 777, Gulf of Mexico, and is defined as:

MC777-WA	**7,180 ft FNL** **4,790 ft FEL** **X = 1,151,530.00 ft E** **Y = 10,241,300.00 ft N**
UTM Zone 16 N (US Feet) **Datum: NAD 1927**	**Spheroid: Clarke 1866**

The proposed MC777-WA surface location is 100 ft to the southwest of SP 44 of line 53R.1 of the C&C 2001 AUV survey (Plate 2), 300 ft south of SP 272 on line 8 of the JECA 1996 HR2D survey (Plate 8), and at trace 1617 of line 2002 of the Fugro 2000/2001 HR3D survey. The well will be drilled vertically down into salt at a depth of ~8,390 ft True Vertical Depth Sub-Sea (TVDSS). The first pressure containment string (20" casing) is currently planned to be set approximately 2,000 ft below the top of salt at a depth of ~4,668 ft below mudline (bml). The depth of investigation in this supplement is the top-of-salt reflector identified at a depth of ~2,668 ft bml at the proposed wellsite.

The key findings from the review of the available data are as follows:

Proposed Well Location MC777-WA:

Water Depth: From the 2001 AUV data the water depth at the proposed well location is estimated at 5,722 ft (Plates 2 and 4). The seafloor has an average slope of ~1.7° down to the south (Plates 3 and 4).

Seafloor Morphology and Shallow Sediments: The proposed well location is located within an area of hummocky seafloor (Plates 4 and 5). These mound-like features, which range from 20 to 40 ft in height and up to 2,000 ft across, are believed to be the result of a uniform, parallel-bedded sediment drape over the irregular surface of an underlying regional mass transport complex or buried landslide. At the proposed location the buried landslide is clay-prone and is first encountered at a depth of about 150 ft bml (Plate 6).

Soil borings collected within the Thunder Horse Field show the seafloor and near-surface sediments to comprise very soft, olive gray clays to depths of about 20 ft bml underlain by very soft to firm clays to a depth of about 100 ft bml. Stiff clays then continue down to depths of about 225 ft bml, and stiff to very stiff clays to in excess of 300 ft bml (Fugro-McClelland Marine Geosciences, Inc., 2001 a and b).

Seafloor Obstructions: BP's DC33 (MC777#1, #2, #3 and #5 wells are ~5,500 ft to the NW, the MC777#4 well (with surface location in MC778) is ~6,800 ft to the NE, and an umbilical and flowline run ~1,400 ft to the SW and ~1,200 ft to the NNE, respectively (Plates 3, 4 and 5).

Chemosynthetic Communities: The sidescan sonar data from the 2001 AUV survey (Plate 7) shows the seafloor within a 2,000 ft radius of the proposed well location to comprise of uniform soft clays and possible silts. Areas of higher reflectivity indicating possible gas-saturated soils and/or hard seafloor are not evident in the vicinity of the proposed well. Furthermore, the 2001 AUV subbottom profiler data (Plate 6) shows a uniform, undisturbed drape of soft clays and possible silts within the cleared area, with no evidence for authigenic carbonates or hardgrounds. ***Therefore, seafloor conditions capable of supporting chemosynthetic communities are not expected at, or within 2,000 ft of, the proposed well location***.

Archaeological Stipulations: An archaeological assessment for MC777 and MC778 was completed in May 2006 by C&C based on the 2001 AUV data (C&C, 2006). ***No evidence of shipwreck debris or sites of archaeological significance were reported at or within 2,000 ft of the proposed well location.*** The nearest observed seafloor sonar contact (C18) is about 3,350 ft to the SE of the proposed location (Plate 2). This target is interpreted as a 25 ft x 10 ft piece of man-made debris with no measurable height above the seafloor.

Shallow Geology: Thirteen units of hemipelagic sediments and midslope turbidites with evidence of channeling and rotated internal slump blocks and comprising predominantly of clays with some silts and sands are identified in the salt overburden within the Thunder Horse Field (EP submissions and internal BP Exploration reports for proposed well locations MC776#2, MC777#1, MC777#4 and MC822 #2). These units are listed on the Tophole Formation and Geohazards Summary Sheet, Plate 19, together with their depths at the proposed MC777-WA well location, and the units and horizons are shown on the HR3D seismic sections (Plates 11 to 14). Five of the horizons (Seafloor, Horizons D, E, H, and Top-of-Salt) were mapped through the proposed wellsite area using the HR3D data, whilst the remaining horizons were extrapolated from offset wells. Unit 3, which is mapped elsewhere within the Thunder Horse Field appears absent at the MC 777-WA location due to either pinch-out or erosion.

Drilling Hazards: **Faults**: No seafloor or shallow-buried faults are identified on the HR3D or AUV data within the 2,000 ft clearance radius of the proposed well location (Plates 2, 6, 7, 8, 9, and 11 to 14).

Deeper faults, some of which may be rooted in the salt, appear below Horizon E and affect the well-bedded strata of Units 7 thru 13 (Plates 12 and 14). Extensive minor faulting is apparent within

Unit 13, as evidenced by the abrupt terminations of the moderate amplitude reflectors, and one of these faults appears to intersect the proposed well at a depth of ~2,185 ft bml (Plates 12 and 14).

Shallow Gas: Negative amplitude extractions were constructed for the MC777 area using the Seafloor, Top-of-Salt, and mapped Horizons D, E, and H.

The amplitude extraction map for the predominantly clay-prone section between the Seafloor and Horizon D, Units 1 thru 5, is shown on Plate 15. No anomalous amplitudes are present within 2,000 ft of the proposed well. Potential shallow gas, associated with a narrow, north-south trending, possible sand-filled channel (Unit 3) within Horizon B is ~5,200 ft to the west of the proposed well (Plates 12 and 15).

Unit 6, between Horizons D and E is clay-prone at the proposed wellsite (Plate 16). Extensive shallow gas sands at the top of Unit 6 in the north of MC777 appear to pinch out about 4,700 ft to the N of the proposed location (Plates 13, 14 and 16). Small, scattered gas anomalies within the base of Unit 6 are 1,000 ft to the N and 1,500 ft to the NE (Plates 11, 12 and 16).

No anomalous amplitudes within the Horizon E to H interval (Units 7, 8, and 9) are present in the vicinity of the proposed well. The closest potential gas is associated with sandy horizons, Horizons F and G, about 4,500 ft to the NW (Plate 17).

The amplitude extraction for the interval from Horizon H to the Top-of-Salt (Units 10 thru 13) shows a large area of numerous scattered anomalies to the SW of the proposed location, which are associated with the sandy strata of Unit 10 (Plates 12 and 18). Smaller scattered, potential shallow gas anomalies at distances of ~500 ft to the W and S, 1,200 ft to the N, and 1,900 ft to the SE of the proposed location are associated with moderate amplitude, discontinuous reflectors within Unit 13 (Plates 11 and 13).

Shallow gas was encountered in the MC776#1 well, ~1.7 miles to the W, within Units 8 and 9, and within Unit 12 at the MC775#1 well, ~4.9 miles to the WSW (Plate 5). Sands with no reported gas were encountered in the MC777#1, #2, #3, #4 and #5 wells correlating to Units 8, 10, 12 and 13 at the proposed well (Plate 20).

Based on the amplitude extractions and offset well data, the risk of encountering shallow gas at the proposed wellsite is therefore considered **Negligible to Low** for Unit 6, between depths of ~862 ft to ~1,077 ft bml, for Units 10 and 11, between depths of ~1,429 ft to ~1,681 ft bml, and for prominent silty to sandy turbidites within Unit 13 between depths of ~1,791 ft to ~1,842 ft, ~2,040 ft to ~2,070 ft and ~2,240 ft to ~2,294 ft bml. All other units are rated **Negligible** for shallow gas.

Shallow Water Flow (SWF): Drilling reports for offset wells in the Thunder Horse Field and nearby Mensa Field (MC731) have documented several instances of SWF. These vary from: a severe flow in Unit 13 at the MC775#1 well; to a moderate flow in the equivalent to Unit 3 at the Mensa Field in MC731; to a low flow within Unit 8 at well MC822#1, and slight flows within Units 8 and 9 at wells MC776#1 and #2; within Unit 13 at MC777#4 and #5; and immediately above the Top-of-Salt at the base of Unit 13 in wells MC778#1 and #13.

No SWF was encountered in the nearest offset wells, MC777#1, #2, and #3, although slight flows were encountered in MC777#5 in Unit 13, and the SWF risk implied by offset wells further afield is therefore downgraded to **Negligible to Low** for Unit 8 (~1,205 ft to ~1,278 ft bml), and **Low** for Units 10 and 11 (~1,429 ft to ~1,681 ft bml) and for prominent silty or sandy turbidites within Unit 13 (~1,791 ft to ~1,842 ft, ~2,040 ft to ~2,070 ft and ~2,240 ft to ~2,294 ft bml).

Unit 3 is absent at the proposed MC777-WA well location, and Units 1, 2, 4 to 7, 9, 12, and most of Unit 13 are interpreted as predominantly clay-prone sequences from the seismic data, and assessed a **Negligible** risk for SWF.

Gas Hydrates: Within the northwest and northeast of MC777 and northwest of MC778, Horizon D is a high amplitude reflector with a pronounced cross-cutting relationship to the adjacent strata (Plate 14), and appears to delimit an area of anomalous amplitudes (shallow gas) within the top of Unit 6 (EP submission for MC777#4). Furthermore, there is a definite southern termination of the anomalous amplitude zone at the top of Unit 6 as seen on the amplitude extraction for the unit (Plate 16). Throughout the south and central parts of MC777, Horizon D appears as a low amplitude reflector separating equally low amplitude strata within the overlying and underlying units, Unit 5 and Unit 6, respectively.

As a result, Horizon D is interpreted as a possible BSR (Bottom-Simulating Reflector) marking the Base of the Gas Hydrate Stability Zone and top of entrapped gas in the northern portion of the study area. Pressure-Volume-Temperature modeling studies in the Thunder Horse area have indicated that gas hydrates would be stable in the supra-salt section in the upper 1,300 ft BML in the vicinity of the MC776#1 well, ~1.55 miles to the west in a water depth of 5,636 ft (K. Horkowitz, BP, 2003).

Horizon D is at a depth of ~862 ft bml at the proposed wellsite, within the theoretical depth for gas hydrate formation. However, because the proposed wellbore will pass ~4,700 ft to the south and down-dip of the gas accumulation at the top of Unit 6, and is in an area apparently free from large shallow gas accumulations,

the risk for encountering gas hydrates at the proposed wellsite is assessed as **Negligible to Low** above ~862 ft bml and **Negligible** below that depth.

CONCLUSIONS

This Shallow Hazards Assessment for location MC777-WA supplements the SDOCD to be submitted to the BOEM. This report defines the proposed location and documents the anticipated top-hole drilling conditions and is accompanied by a set of 20 geophysical data examples. Copies of the 1997 JECA Geohazard Survey Report, the 2002 C&C Shallow Hazards Report and the 2006 C&C Archaeological Assessment referred to in this assessment have been submitted with previous EP/DOCD documents.

Conditions at the drilling location have been evaluated on the basis of (i) high-resolution 2-D (HR2D) geophysical data (echosounder, sidescan sonar, subbottom profiler and multi-channel seismic) acquired by John E. Chance and Associates (JECA, now part of FUGRO) in 1996, and the interpreted Shallow Hazards Report (JECA, 1997), (ii) high resolution 3D (HR3D) seismic data (multi-channel only) acquired by FUGRO in 2000/2001, (iii) AUV data (swath bathymetry, sidescan sonar and subbottom profiler) acquired by C&C Technologies, Inc. (C&C) in 2001, and the interpreted Shallow Hazards Report (C&C, 2002), and (iv) the Archaeological Assessment Study for MC777 and MC778 prepared by C&C in 2006 from the 2001 AUV data. Information was also taken from EP submissions, well logs and internal BP Exploration reports for well locations MC775#1, MC776#1 and #2, MC777#1, #2, #3, #4 and #5, MC778#1 and #13, and MC822#2, and from Fugro-McClelland Marine Geosciences, Inc. geotechnical reports (FMMGI 2001a and 2001b).

The proposed MC777-WA well location is in an area of smooth, hummocky, gently southeasterly-dipping seafloor. A review of the AUV data has shown that ***seafloor conditions capable of supporting chemosynthetic communities are not expected at, or within 2,000 ft of, the proposed well location,*** and the Archaeological Assessment carried out by C&C has revealed ***no evidence of shipwreck debris or sites of archaeological significance at or within 2,000 ft of the proposed well location.***

Results of the shallow gas and SWF review are summarized on the Tophole Formation and Geohazards Summary Sheet, Plate 19. We assess a **Negligible** risk for encountering shallow gas along the well trajectory between Seafloor and Top-of Salt, except within interpreted sandy strata of Unit 6 (from ~862 ft to ~1,077 ft bml), Units 10 and 11 (from ~1,429 ft to ~1,681 ft bml), and Unit 13 (from ~1,791 ft to ~1,842 ft, ~2,040 ft to ~2,070 ft and ~2,240 ft to ~2,294 ft bml) where the risk is assessed as **Negligible to Low**.

SWF has been reported from several sandy intervals at offset wells within the Thunder Horse Field. The majority of these intervals can be correlated to units at the

proposed well location. However, because either no or only slight instances of SWF encountered at the nearest offset wells, we assess only a **Low** risk for encountering SWF within Units 10 and 11 (~1,429 ft to ~1,681 ft bml), and three sandy intervals within Unit 13 (~1,791 ft to ~1,842 ft, ~2,040 ft to ~2,070 ft and ~2,240 ft to ~2,294 ft bml) and a **Negligible to Low** risk of SWF for Unit 8 (~1,205 ft to ~1,278 ft bml). All other intervals appear clay-prone and are assessed as **Negligible** risks for SWF.

The presence of a possible BSR, with underlying trapped shallow gas, coincident with Horizon D to the northwest and northeast of the proposed location has resulted in a **Negligible to Low** risk for encountering gas hydrates between the seafloor and a depth of ~862 ft bml, and **Negligible** below that depth.

The proposed well trajectory will intersect a minor fault within Unit 13 at a depth of ~2,185 ft bml. Other minor faults are possible within the poorly-imaged Unit 13 between depths of ~1,791 ft and ~2,668 ft bml.

The potential shallow gas and shallow water intervals will be drilled riserless, as the first pressure containment string is currently planned to be set approximately 2,000 ft below the Top-of-Salt at a depth of about 4,668 ft bml. We therefore advise caution, but believe that the risk of danger to personnel and damage to the borehole, equipment and environment is **Low**, provided strict adherence to proper drilling and cementing procedures is followed concerning these hazards until the first pressure containment string is in place.

Bernie Care
Shallow Hazards Geoscientist
GoM Resource, NWD Tiger Team

26 May 2011

Richard Weiland
Shallow Hazards Geoscientist
GoM Resource, NWD Tiger Team

06 July 2011

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C&C, 2002, "Geohazard Assessment "Thunder Horse" Prospect in the vicinity of Block 778, Mississippi Canyon Area". Report comprises 3 volumes: Volume I is the text; Volumes II and III contain maps. Report submitted to BP Exploration Inc., May 2002.

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Horkowitz, K., 2003, "Geohazard Assessment for Gas Hydrate in the suprasalt sediment column at Thunder Horse for portions of Blocks 776, 777, and 778, Mississippi Canyon Area, Gulf of Mexico". Internal BP report no. R02.162.

United States Department of Interior, Bureau of Ocean Energy Management, Regulation and Enforcement (aka BOEMRE), 2005, NTL No. 2005-G07, "Archaeological Resource Surveys and Reports".

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United States Department of Interior, BOEMRE, 2011, "Pre-Seabed Disturbance Survey Mitigation".

ATTACHMENTS:

Plate 1: Location Map and Regional Seafloor Morphology
Plate 2: Bathymetry Map – C&C AUV Data
Plate 3: Seafloor Slope Map
Plate 4: 3-D Detail Views of Seafloor Relief and Slope
Plate 5: Seafloor Morphology and Existing Field Infrastructure
Plate 6: NW-SE Subbottom Profiler Data Example Line 53R.1
Plate 7: Sidescan Sonar Data Example Line 53R.1
Plate 8: Hazard Map – JECA HR2D Survey
Plate 9: Hazards Map – C&C AUV Survey
Plate 10: Seafloor Edge Map Showing Location of Annotated Seismic Lines
Plate 11: HR3D Seismic Trace 1617 Through Proposed Location
Plate 12: Interpreted HR3D Seismic Trace 1617 Through Proposed Location
Plate 13: HR3D Seismic Line 2002 Through Proposed Location
Plate 14: Interpreted HR3D Seismic Line 2002 Through Proposed Location
Plate 15: Shallow Gas Amplitude Extraction Between Seafloor and Horizon D (Units 1 thru 5)
Plate 16: Shallow Gas Amplitude Extraction Between Horizons D and E (Unit 6)
Plate 17: Shallow Gas Amplitude Extraction Between Horizons E and H (Units 7, 8 and 9)
Plate 18: Shallow Gas Amplitude Extraction Between Horizons H and Top Salt (Units 10 thru 13)
Plate 19: Tophole Formation and Geohazards Summary Sheet
Plate 20: Arbitrary HR3D Tie-Line Through Offset Wells and Proposed Location

Proposed MC777-WA Well
Mississippi Canyon Area
Shallow Hazards Assessment
Geophysical Data Examples

CONTENTS

Plate 1: Location Map and Regional Seafloor Morphology
Plate 2: Bathymetry Map – C&C AUV Data
Plate 3: Seafloor Slope Map
Plate 4: 3-D Detail Views of Seafloor Relief and Slope
Plate 5: Seafloor Morphology and Existing Field Infrastructure
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Plate 12: Interpreted HR3D Seismic Trace 1617 Through Proposed Location
Plate 13: HR3D Seismic Line 2002 Through Proposed Location
Plate 14: Interpreted HR3D Seismic Line 2002 Through Proposed Location
Plate 15: Shallow Gas Amplitude Extraction Between Seafloor and Horizon D (Units 1 thru 5)
Plate 16: Shallow Gas Amplitude Extraction Between Horizons D and E (Unit 6)
Plate 17: Shallow Gas Amplitude Extraction Between Horizons E and H (Units 7, 8, and 9)
Plate 18: Shallow Gas Amplitude Extraction Between Horizons H and Top Salt (Units 10 thru 13)
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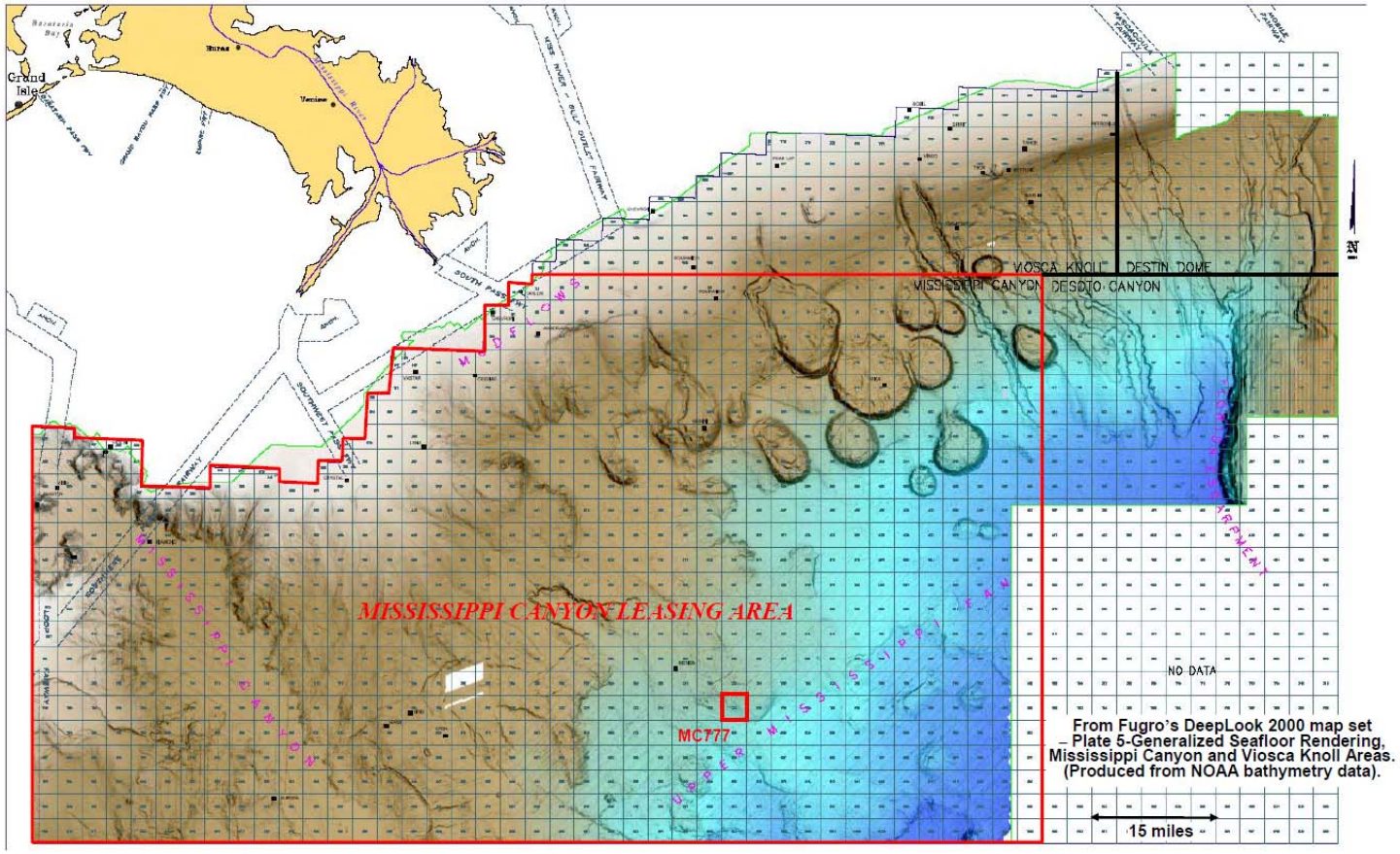
Bernie Care, May 2011

LOCATION MAP AND REGIONAL SEAFLOOR MORPHOLOGY

PROPOSED MC777-WA WELL



From Fugro's DeepLook 2000 map set – Plate 5-Generalized Seafloor Rendering, Mississippi Canyon and Viosca Knoll Areas. (Produced from NOAA bathymetry data).

Plate 1

BATHYMETRY MAP – C&C AUV DATA

PROPOSED MC777-WA WELL

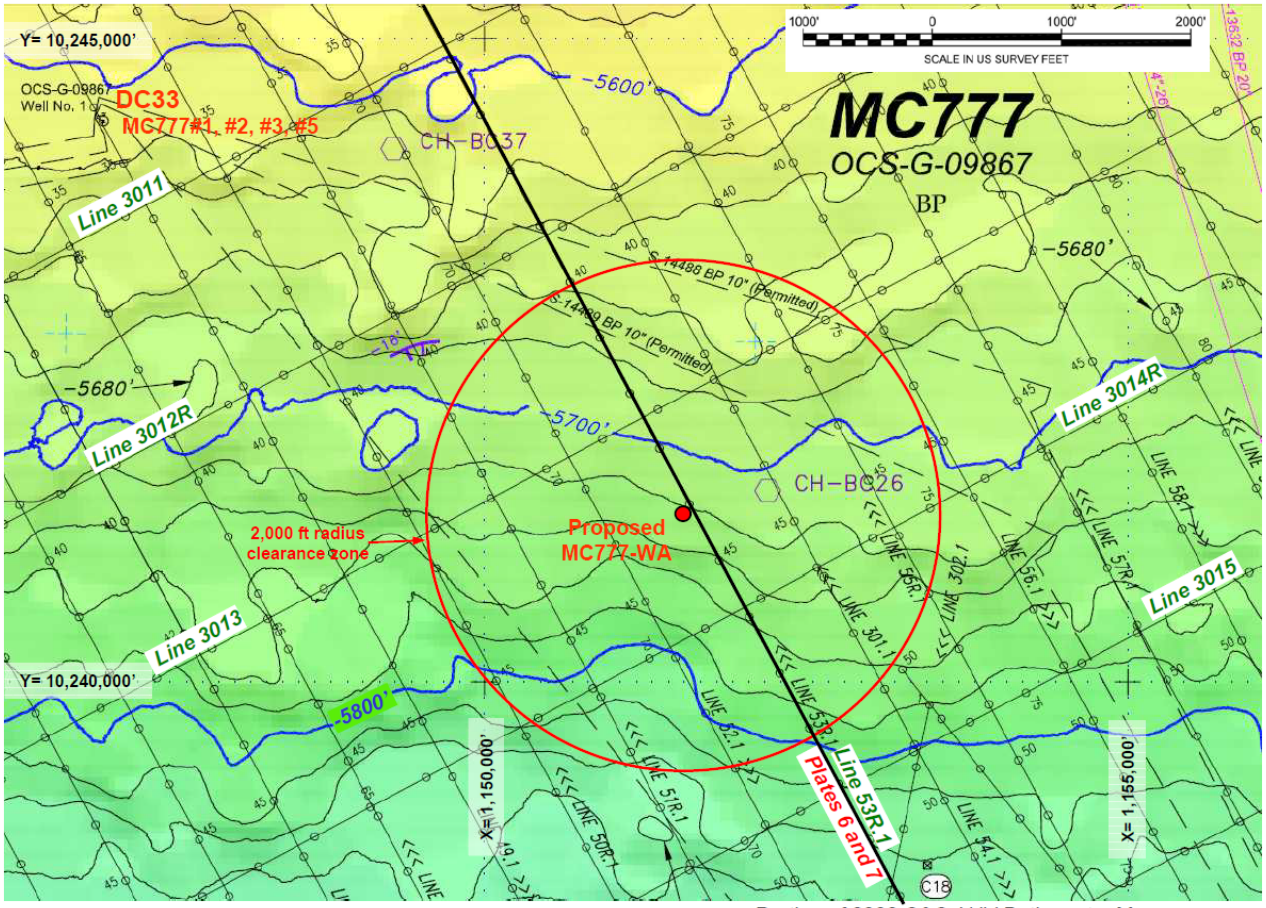
Water depths in feet.
C.I. = 20 feet

CH-BC26
Box core soil sample

AUV survey Line

Permitted pipeline and (umbilical) routes

Sidescan sonar target



Portion of 2002 C&C AUV Bathymetry Map

Plate 2

SEAFLOOR SLOPE MAP
PROPOSED MC777-WA WELL

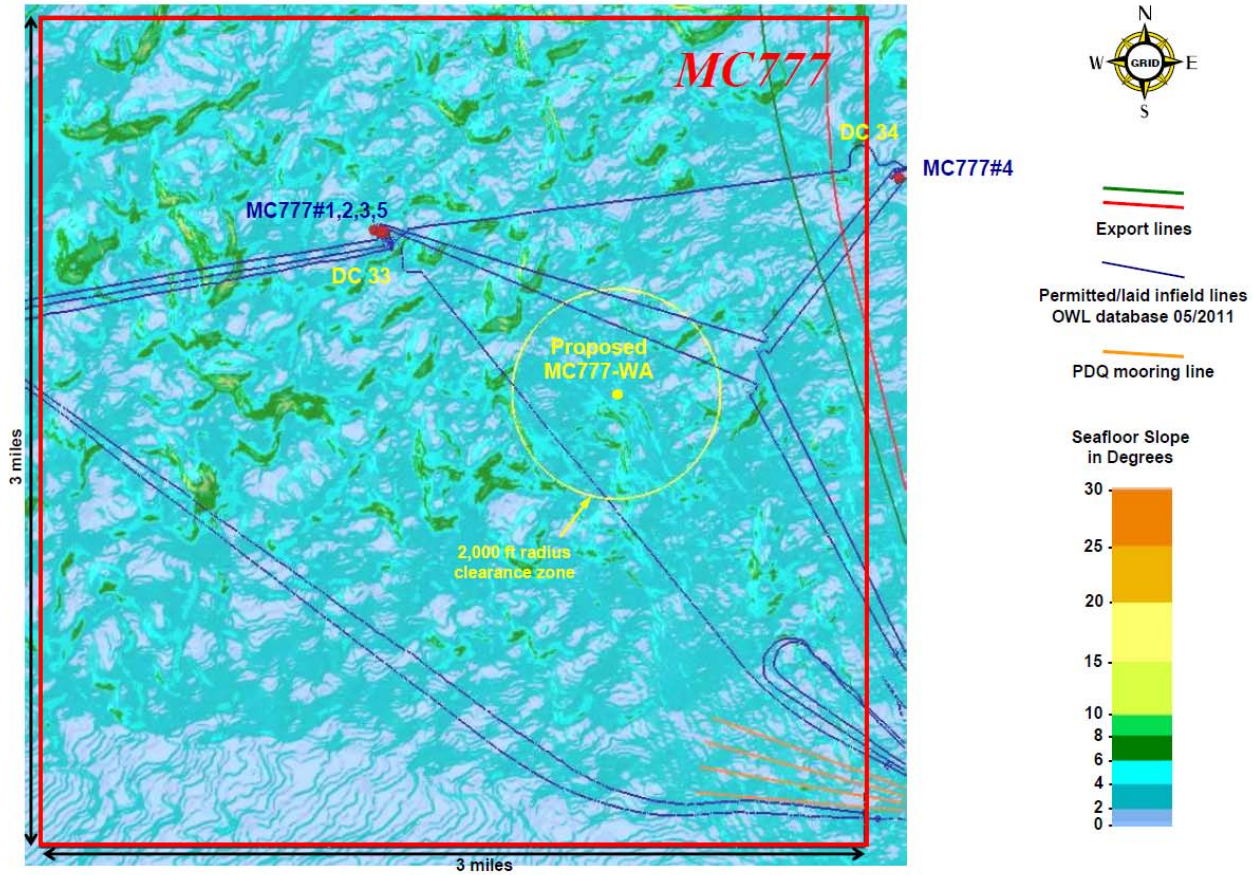
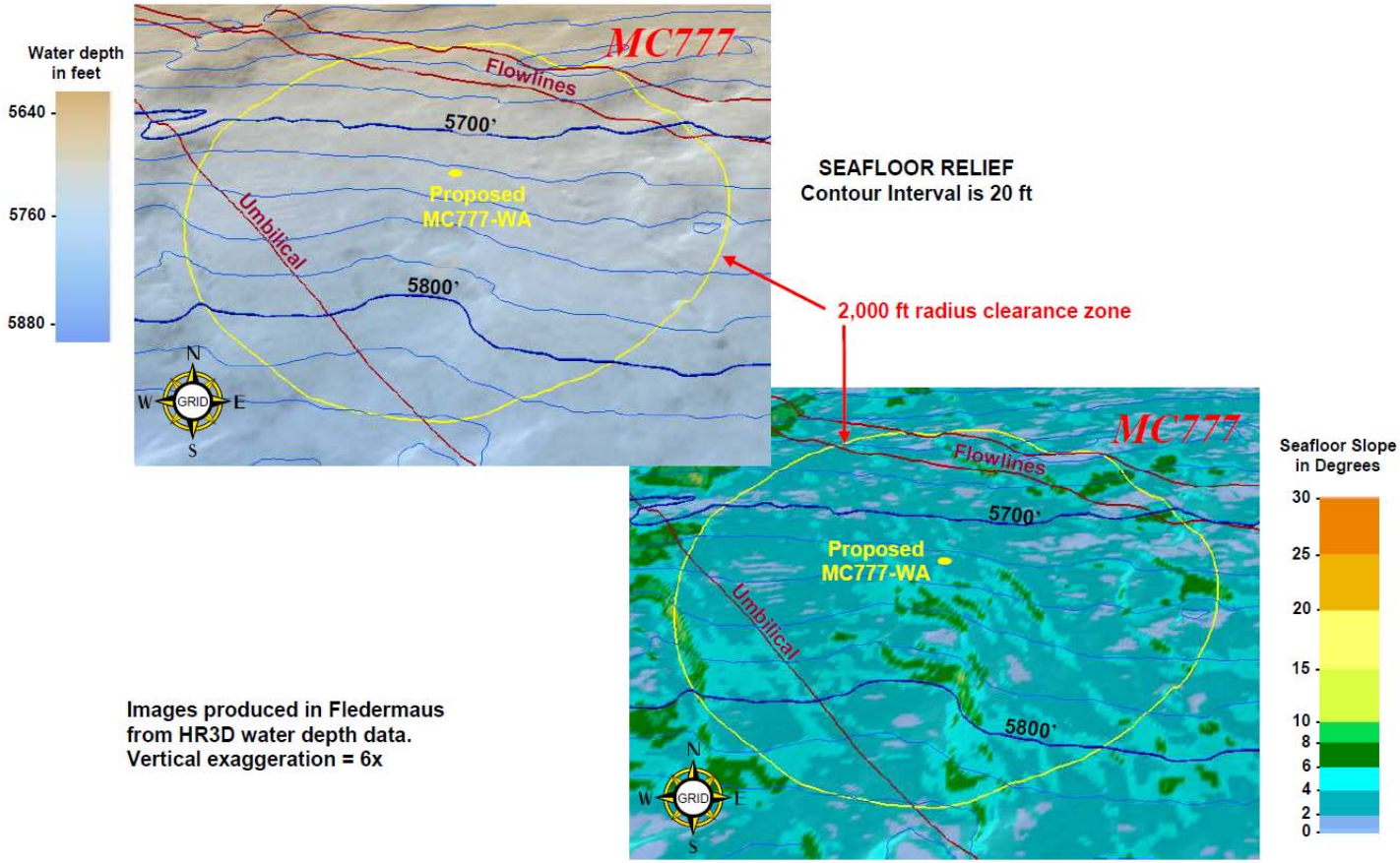


Plate 3

Image produced in Fledermaus from HR3D water depth data: seafloor gradients overlain on seafloor relief map

3-D DETAIL VIEWS OF SEAFLOOR RELIEF AND SLOPE

PROPOSED MC777-WA WELL



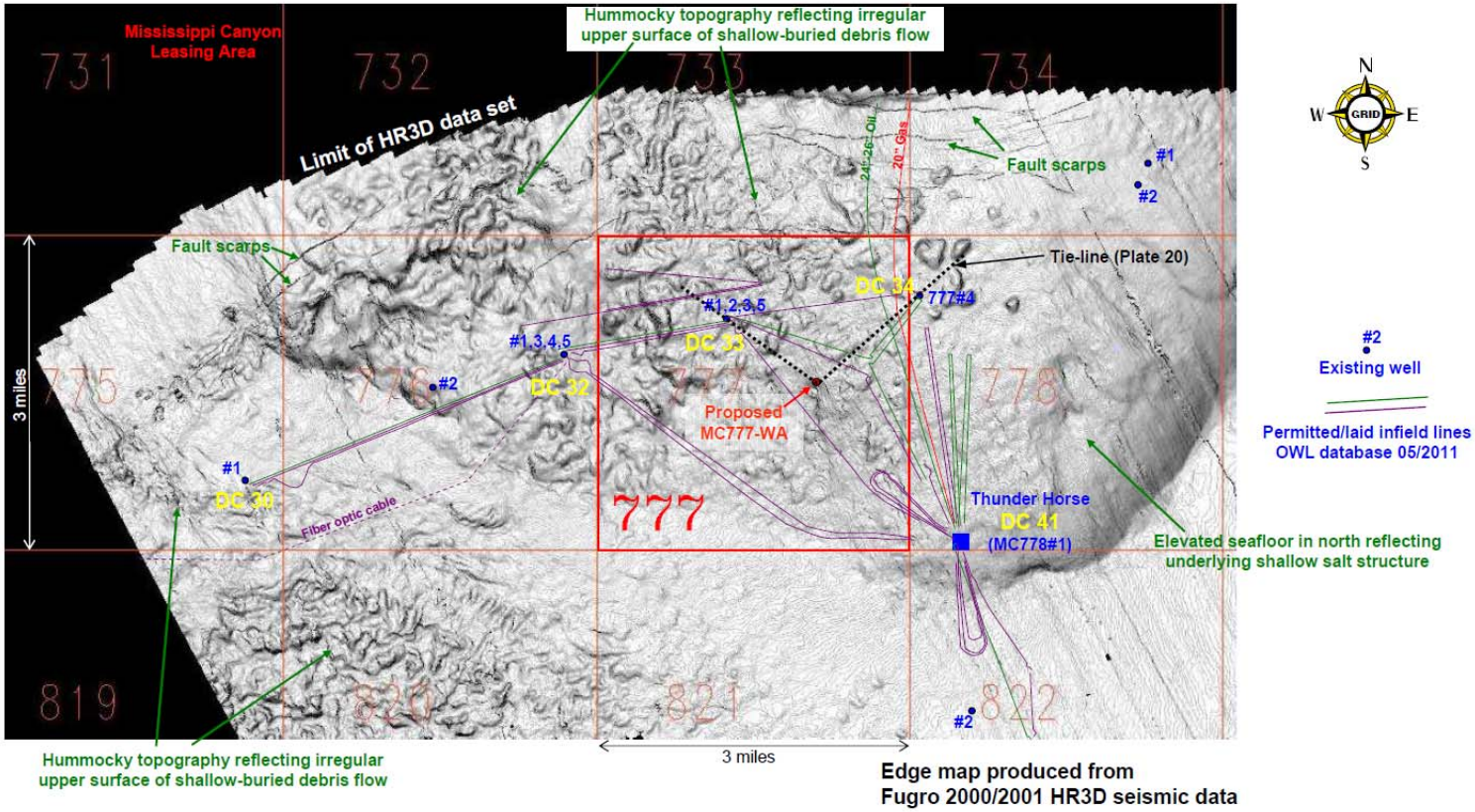
Images produced in Fledermaus from HR3D water depth data. Vertical exaggeration = 6x

SEAFLOOR SLOPE

Plate 4

SEAFLOOR MORPHOLOGY AND EXISTING FIELD INFRASTRUCTURE

PROPOSED MC777-WA WELL

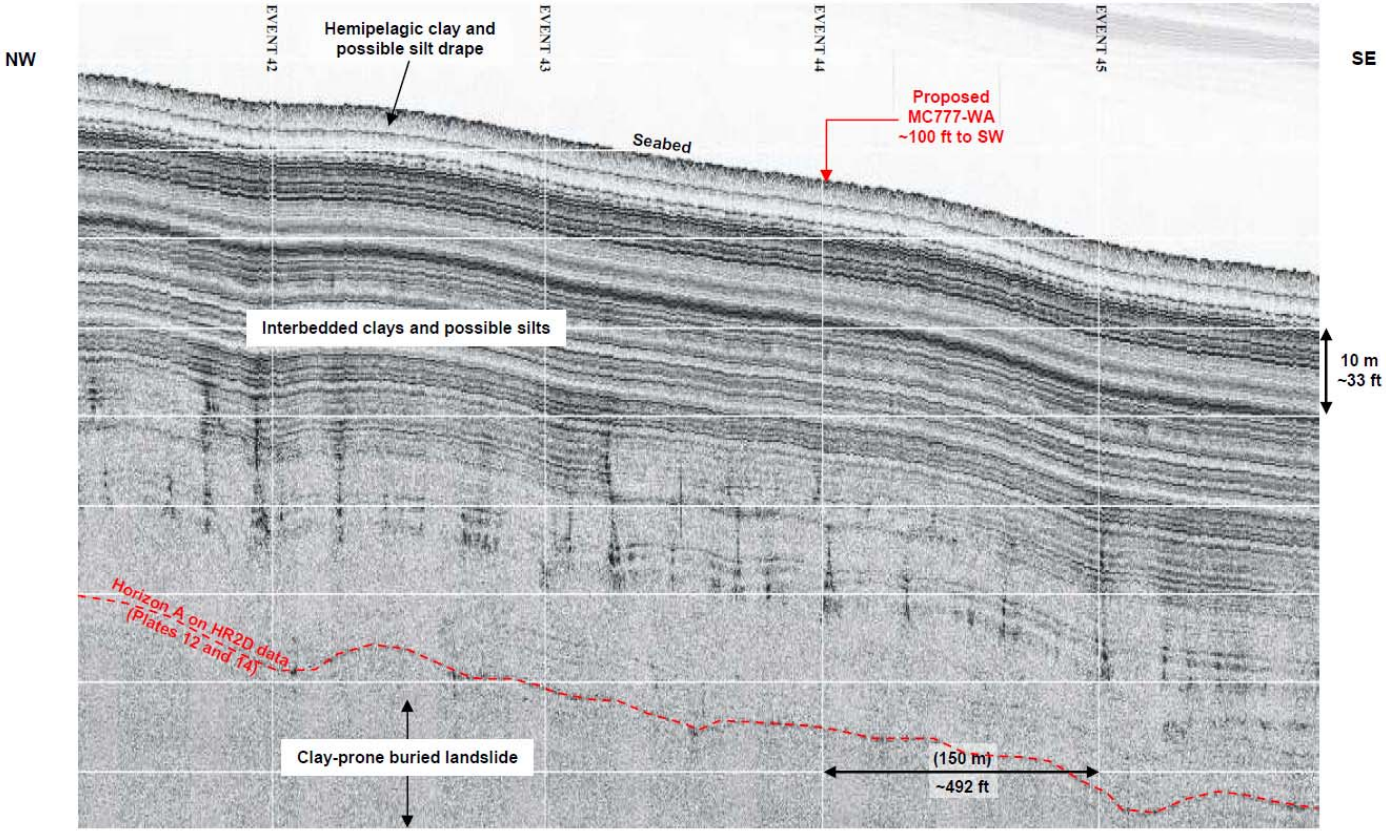


Edge map produced from
Fugro 2000/2001 HR3D seismic data

Plate 5

NW-SE SUBBOTTOM PROFILER DATA EXAMPLE LINE 53R.1

PROPOSED MC777-WA WELL

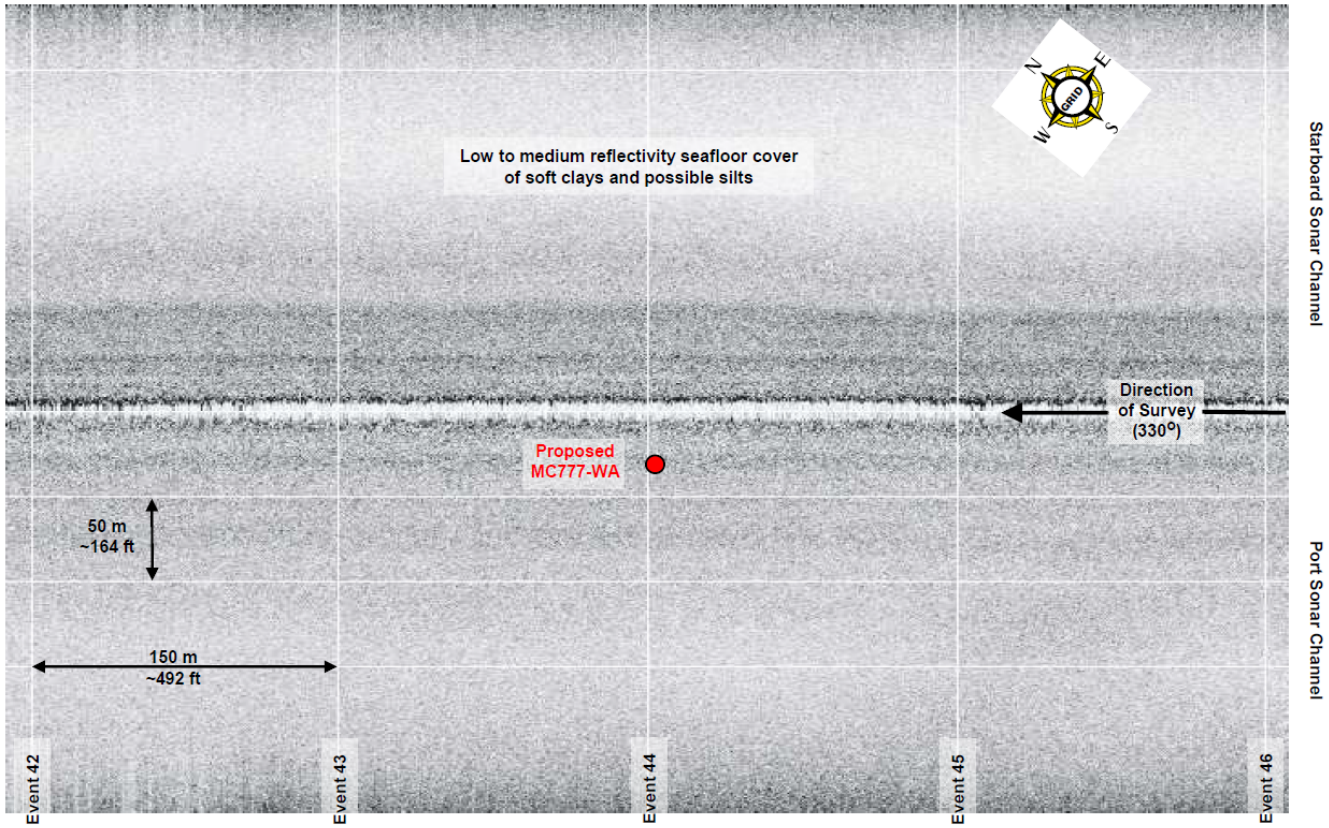


Portion of Line 53R.1 from C&C 2001 AUV survey (see Plate 2 for location)

Plate 6

SIDESCAN SONAR DATA EXAMPLE LINE 53R.1

PROPOSED MC777-WA WELL



Portion of Line 53R.1 from C&C 2001 AUV survey (see Plate 2 for location)

Plate 7

HAZARD MAP - JECA HR2D SURVEY

PROPOSED MC777-WA WELL

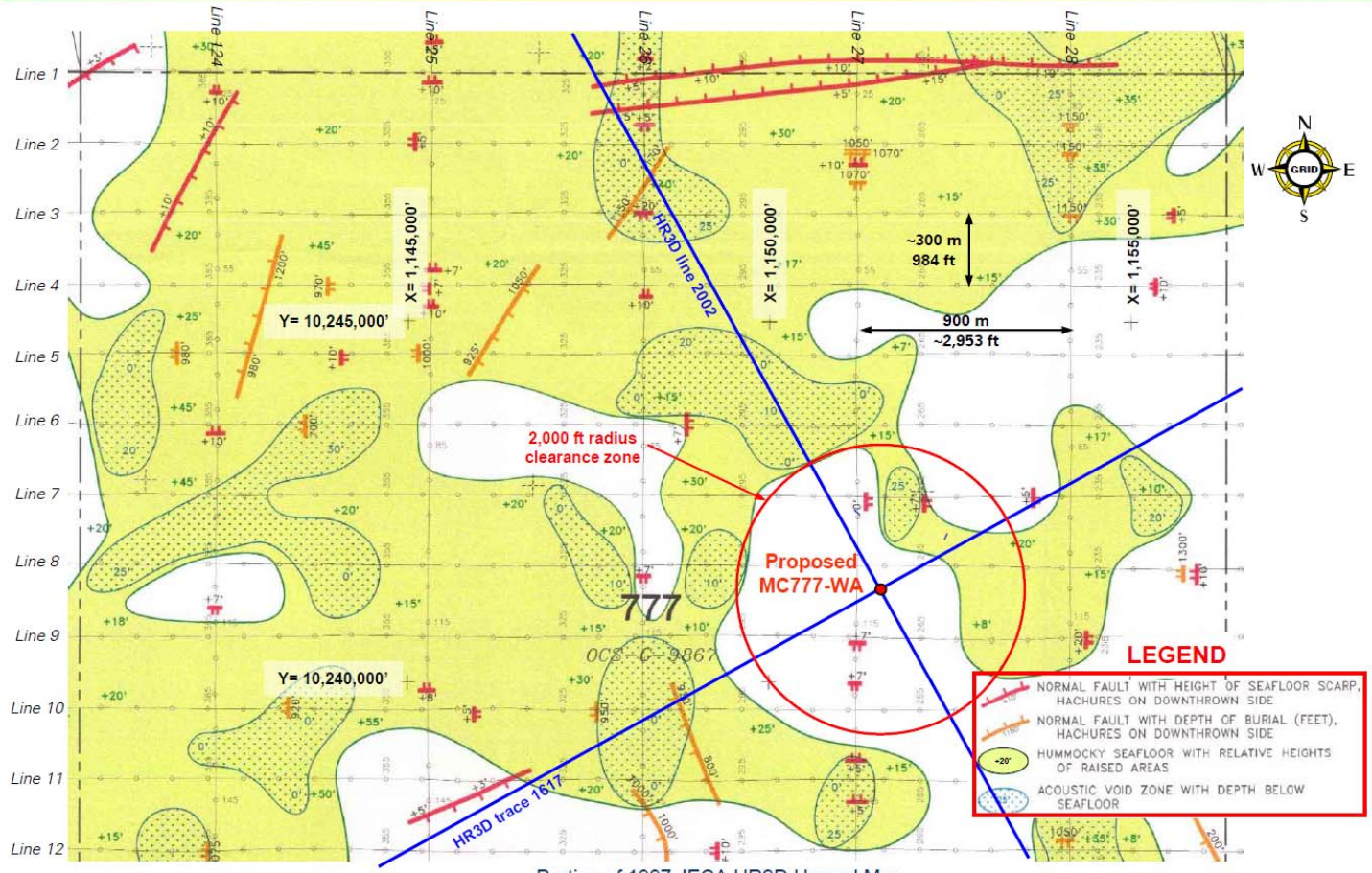


Plate 8

Portion of 1997 JECA HR2D Hazard Map

HAZARDS MAP - C&C AUV SURVEY

PROPOSED MC777-WA WELL

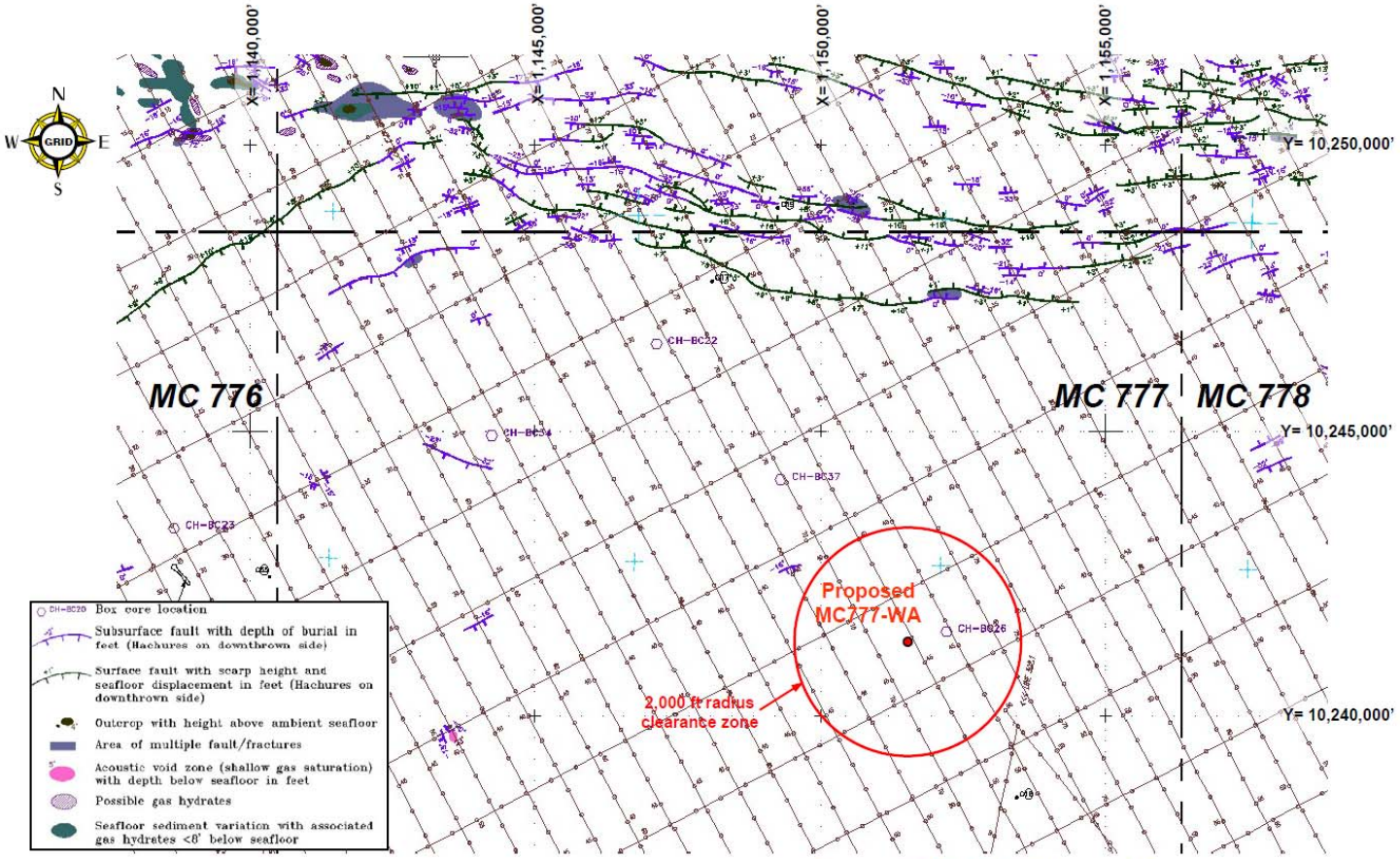


Plate 9

Portion of 2002 C&C AUV Hazards Map

SEAFLOOR EDGE MAP SHOWING LOCATION OF ANNOTATED SEISMIC LINES
PROPOSED MC777-WA WELL

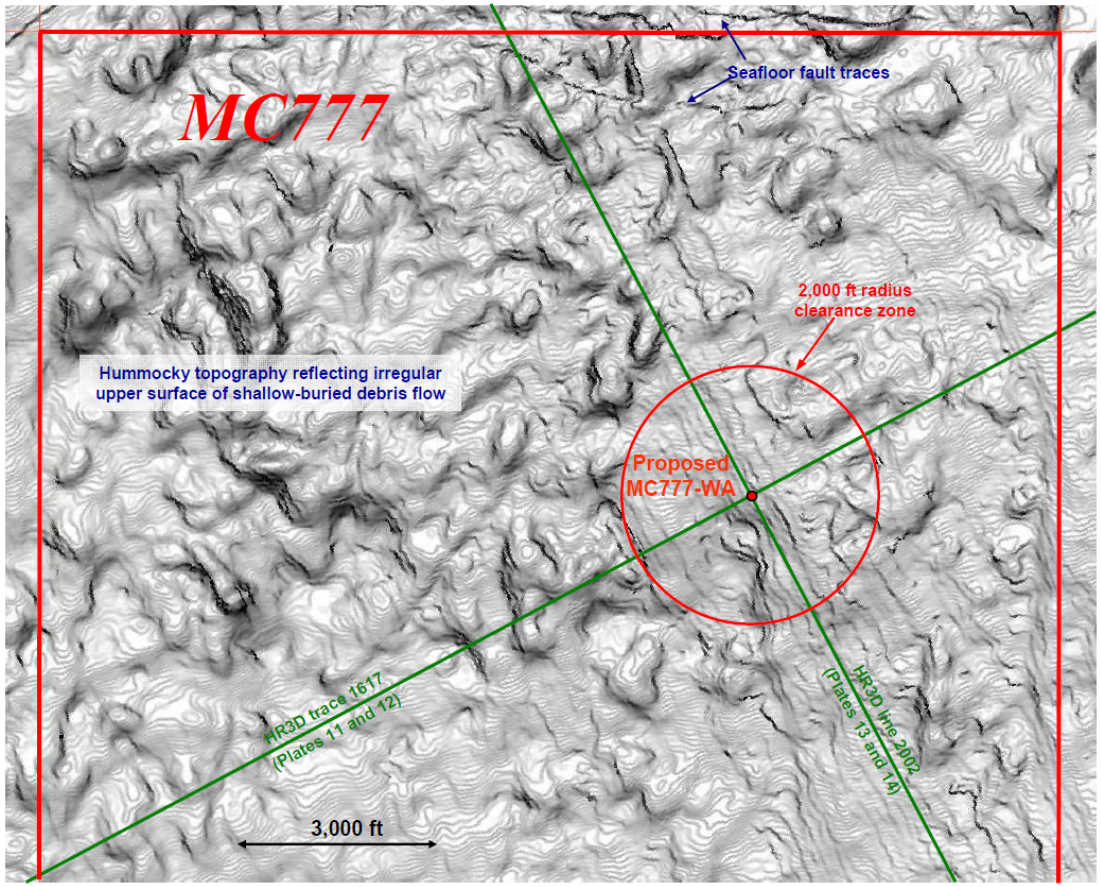


Plate 10

HR3D SEISMIC TRACE 1617 THROUGH PROPOSED LOCATION

PROPOSED MC777-WA WELL

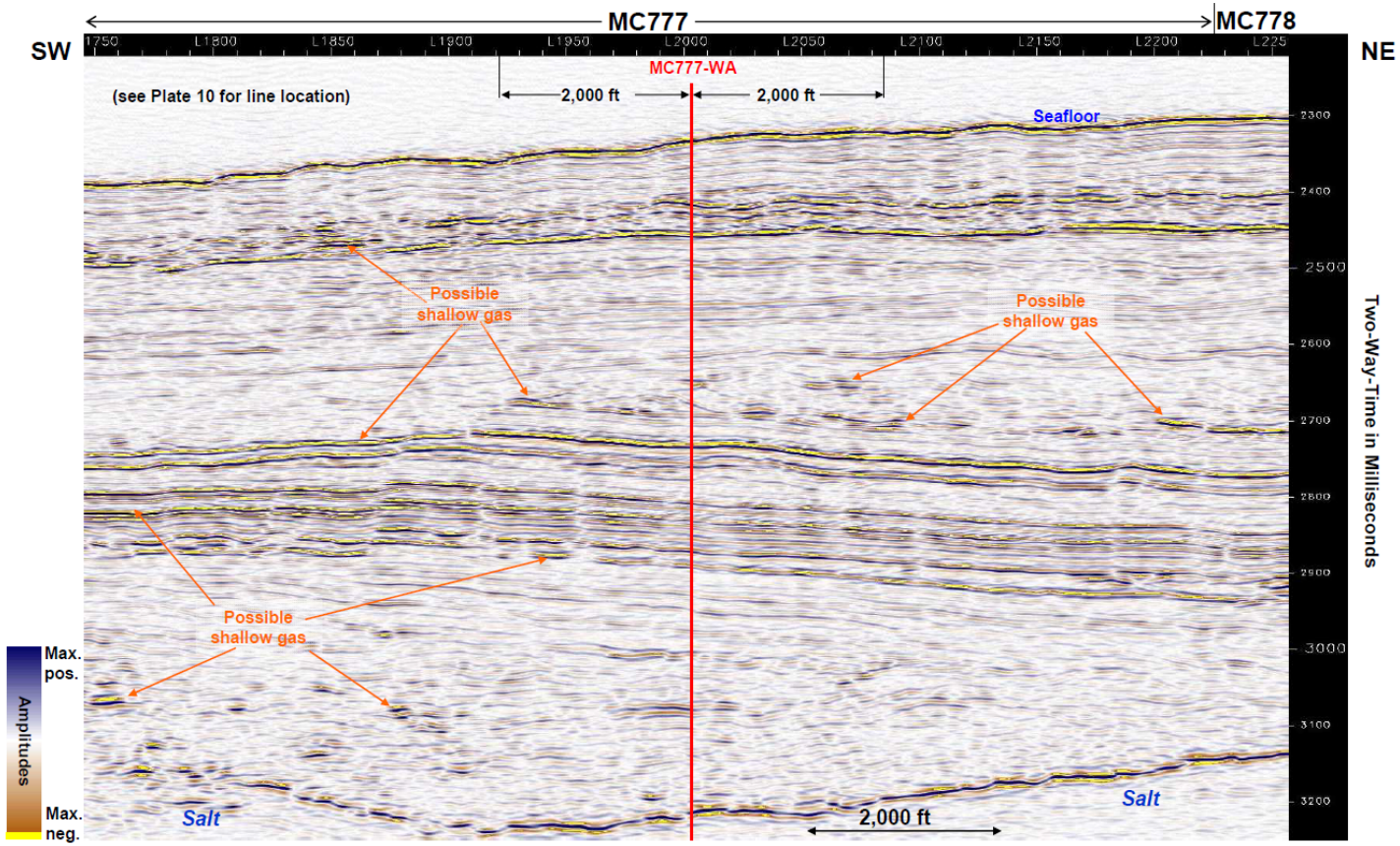
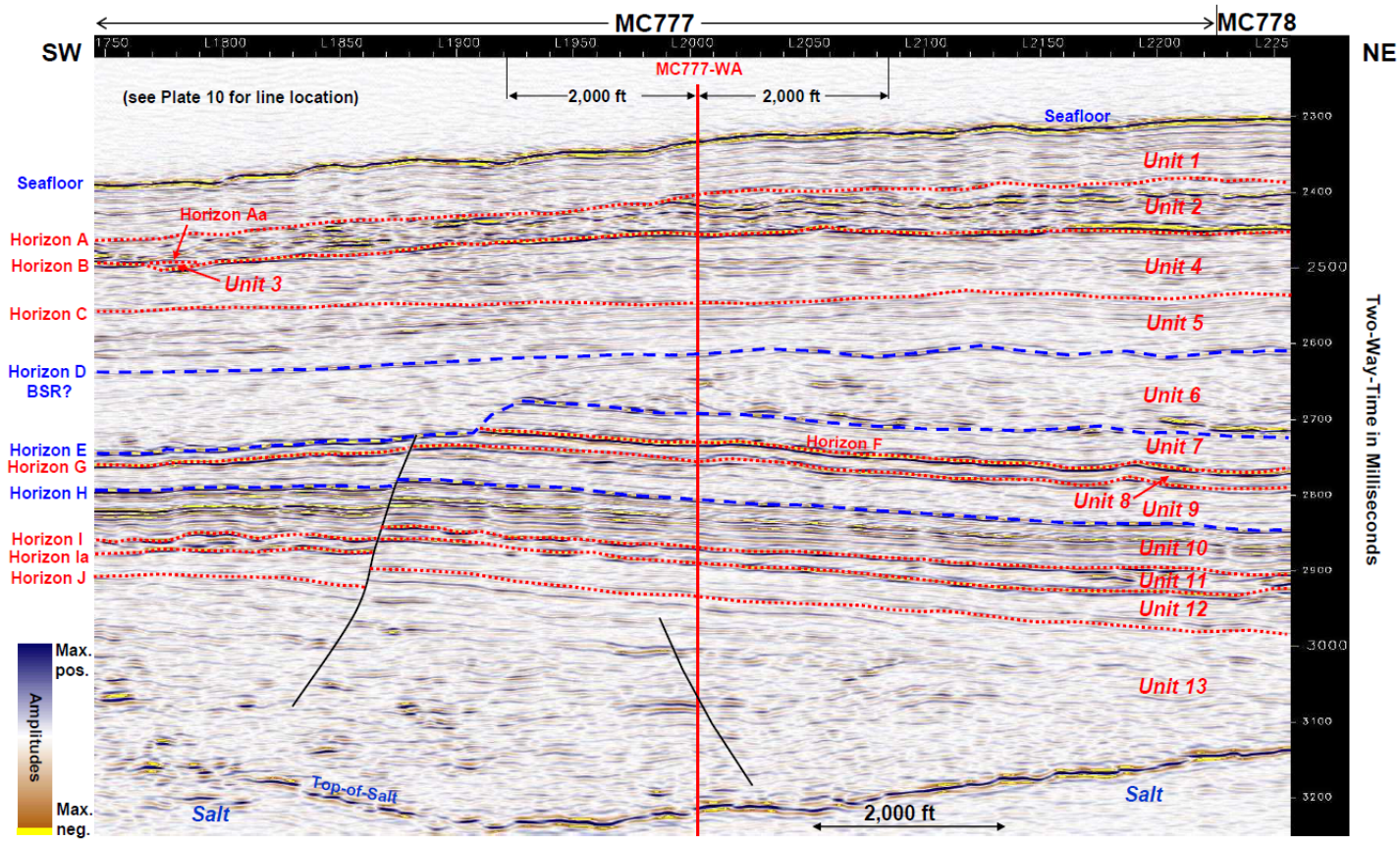


Plate 11

INTERPRETED HR3D SEISMIC TRACE 1617 THROUGH PROPOSED LOCATION

PROPOSED MC777-WA WELL



Note: Proposed 20-inch casing shoe to be set ~2,000 ft below Top-of-Salt

Red horizons and units are interpolated from offset well interpretations.
Blue horizons are mapped within MC777 for this study.

Plate 12

HR3D SEISMIC LINE 2002 THROUGH PROPOSED LOCATION

PROPOSED MC777-WA WELL

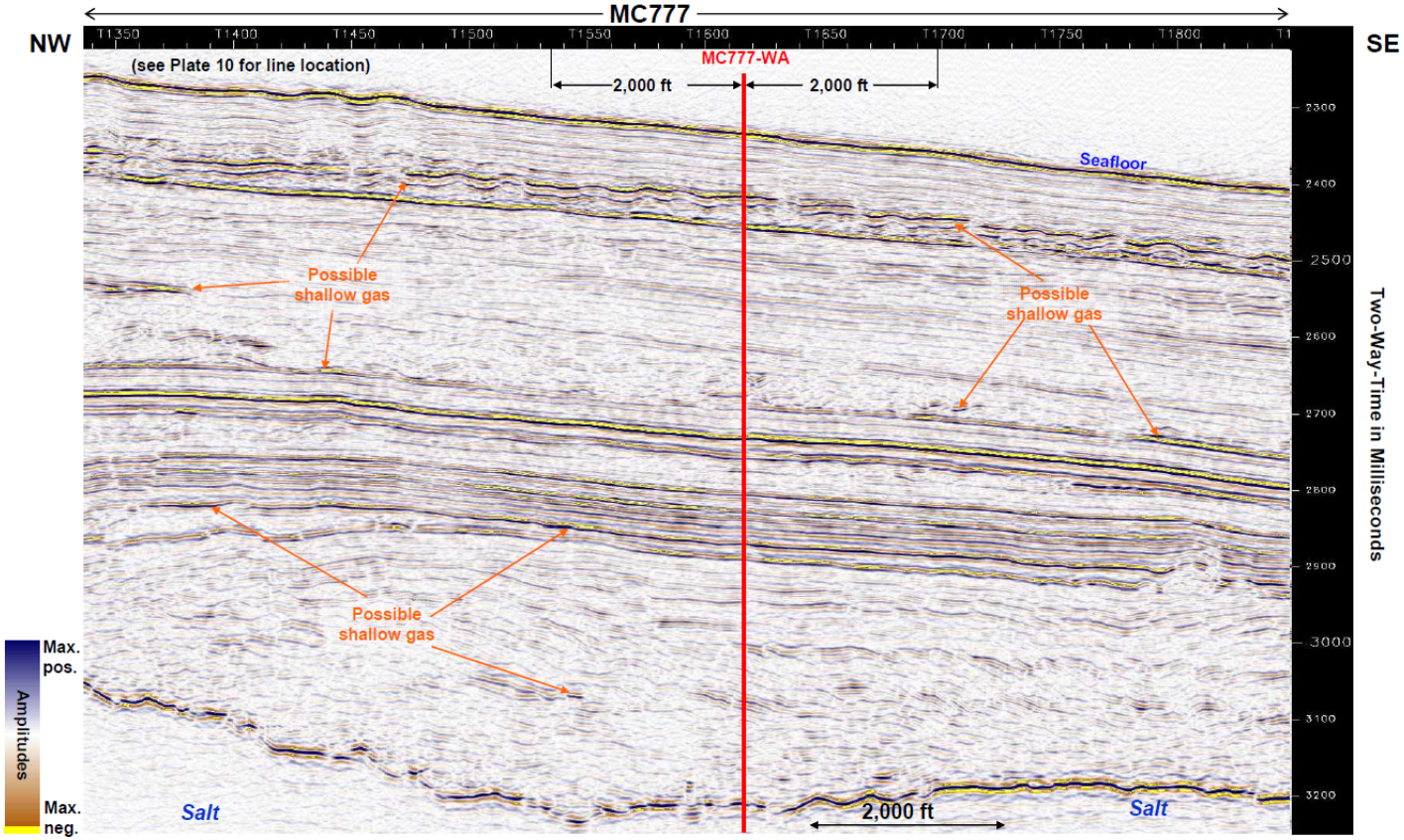
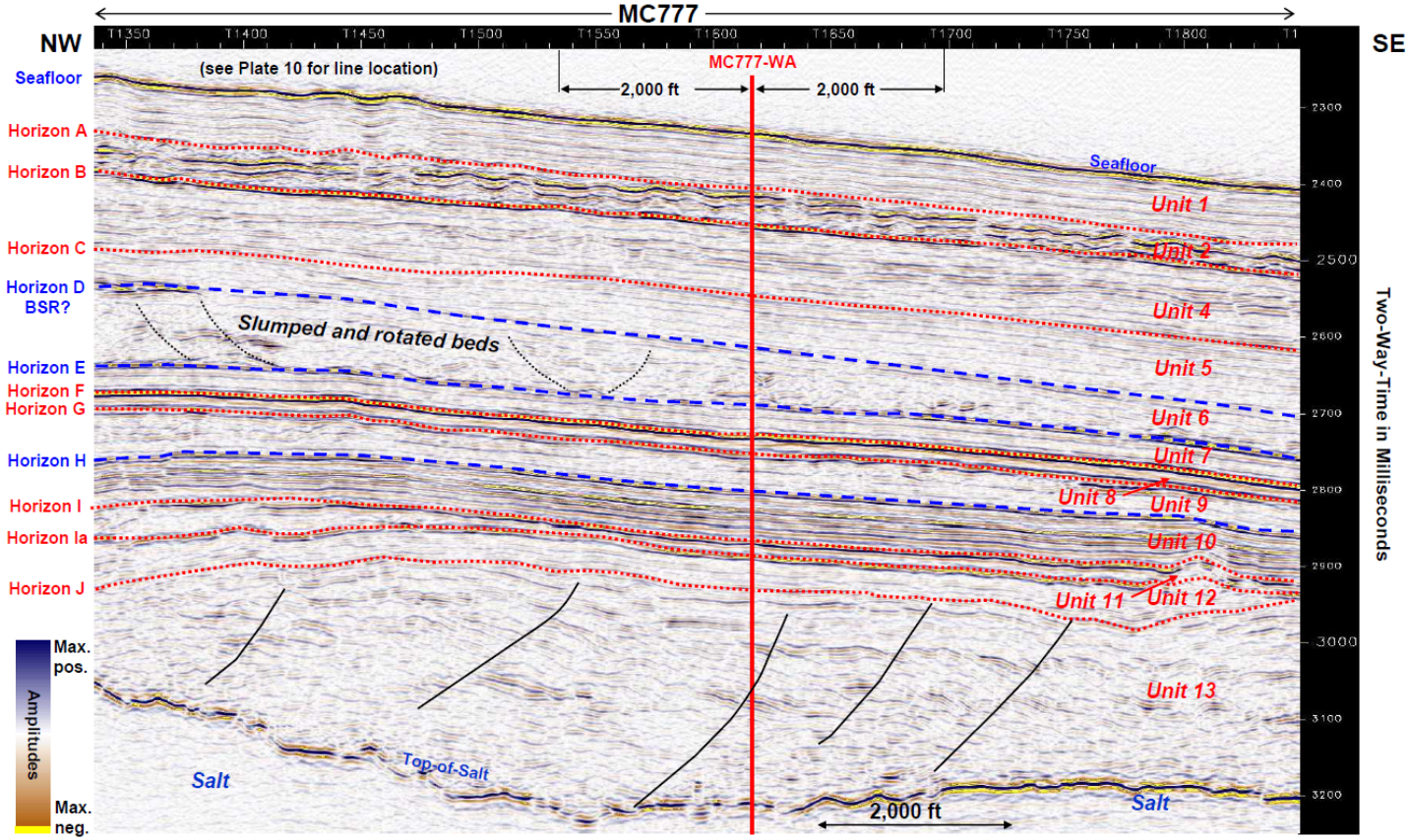


Plate 13

INTERPRETED HR3D SEISMIC LINE 2002 THROUGH PROPOSED LOCATION

PROPOSED MC777-WA WELL



Note: Proposed 20-inch casing shoe to be set ~2,000 ft below Top-of-Salt

Red horizons and units are interpolated from offset well interpretations.
Blue horizons are mapped within MC777 for this study.

Plate 14

SHALLOW GAS AMPLITUDE EXTRACTION BETWEEN SEAFLOOR AND HORIZON D (Units 1 thru 5) PROPOSED MC777-WA WELL

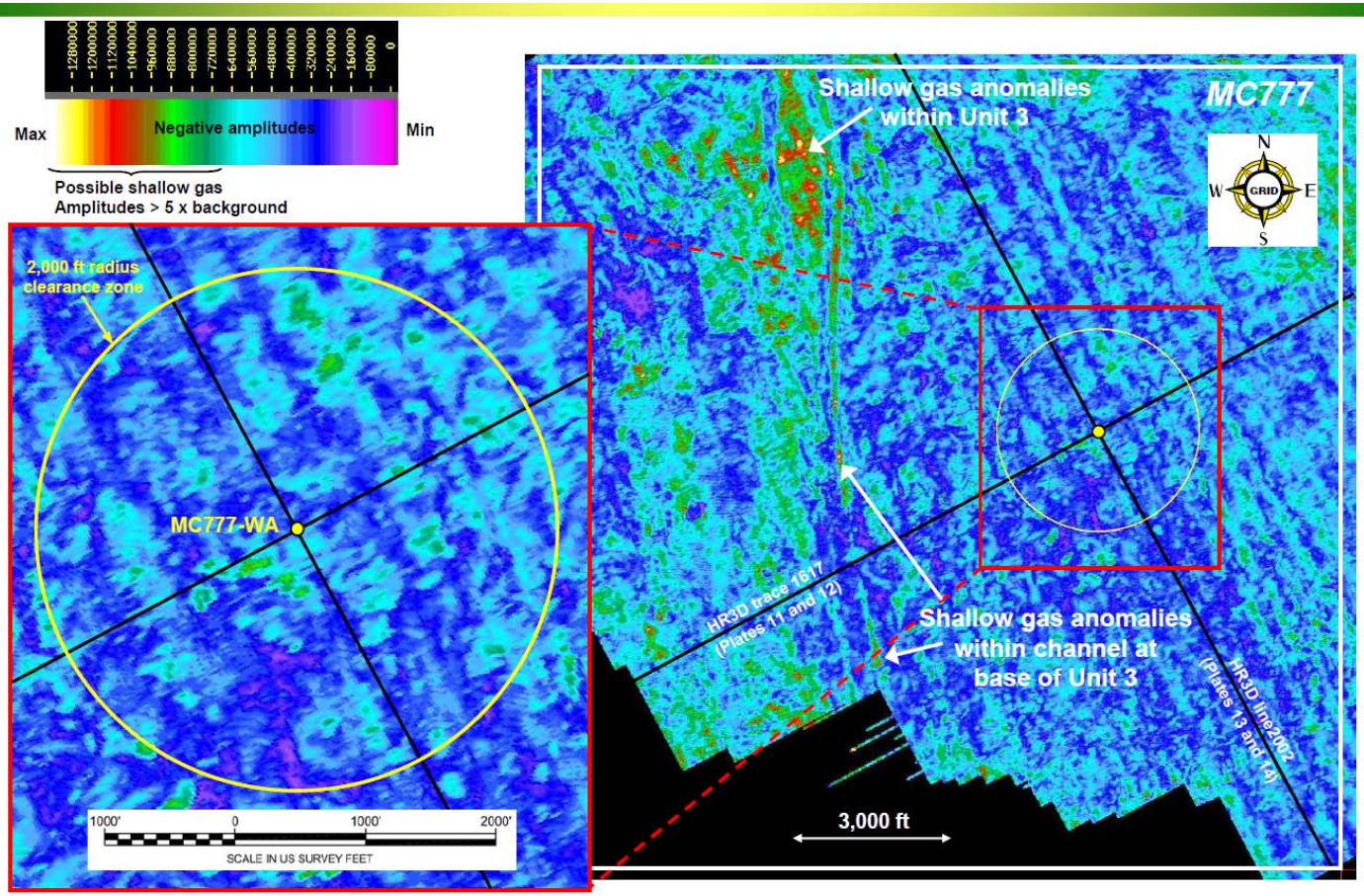


Plate 15

SHALLOW GAS AMPLITUDE EXTRACTION BETWEEN HORIZONS D AND E (Unit 6) PROPOSED MC777-WA WELL

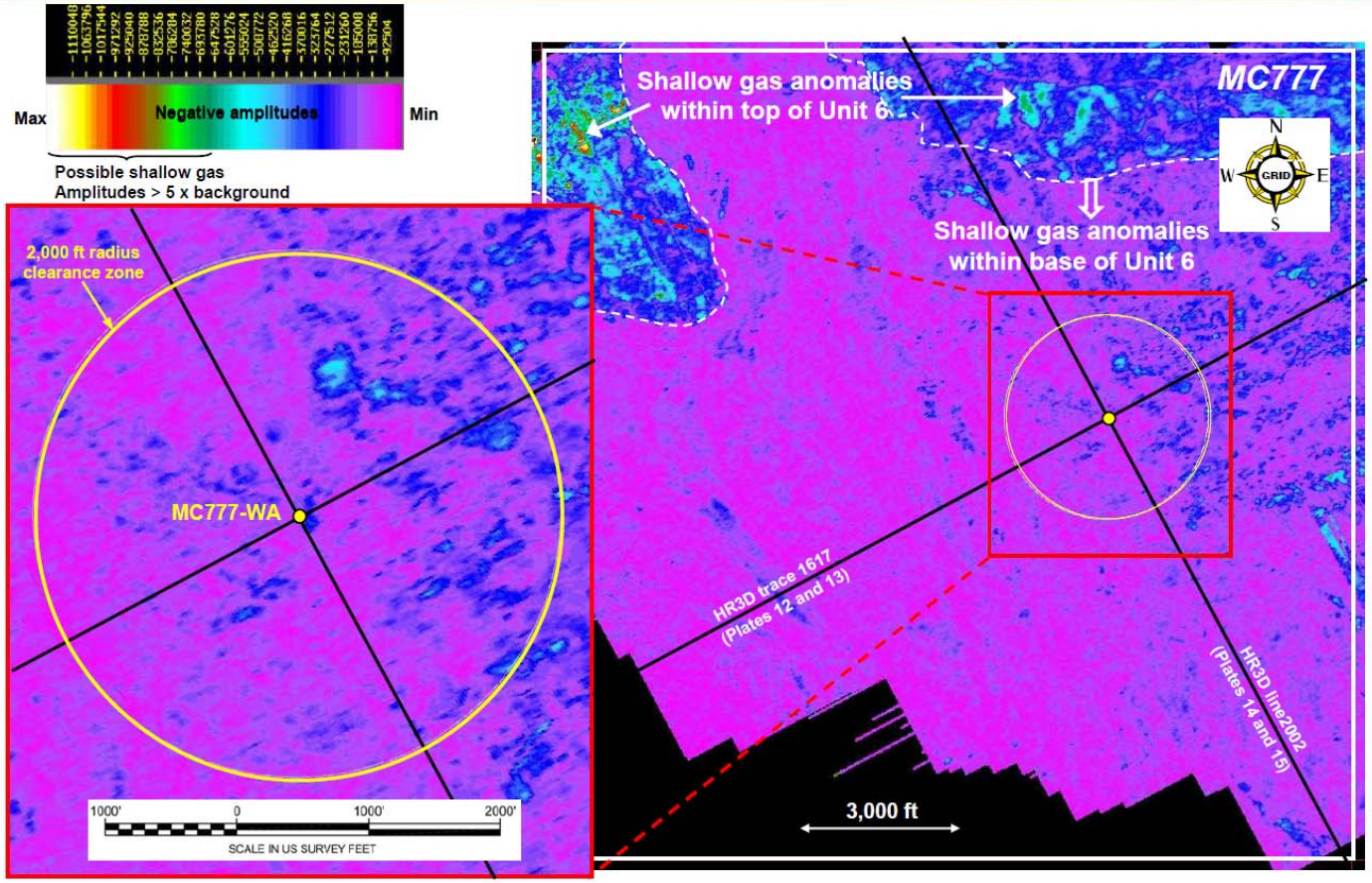


Plate 16

SHALLOW GAS AMPLITUDE EXTRACTION BETWEEN HORIZONS E AND H (Units 7, 8, and 9) PROPOSED MC777-WA WELL

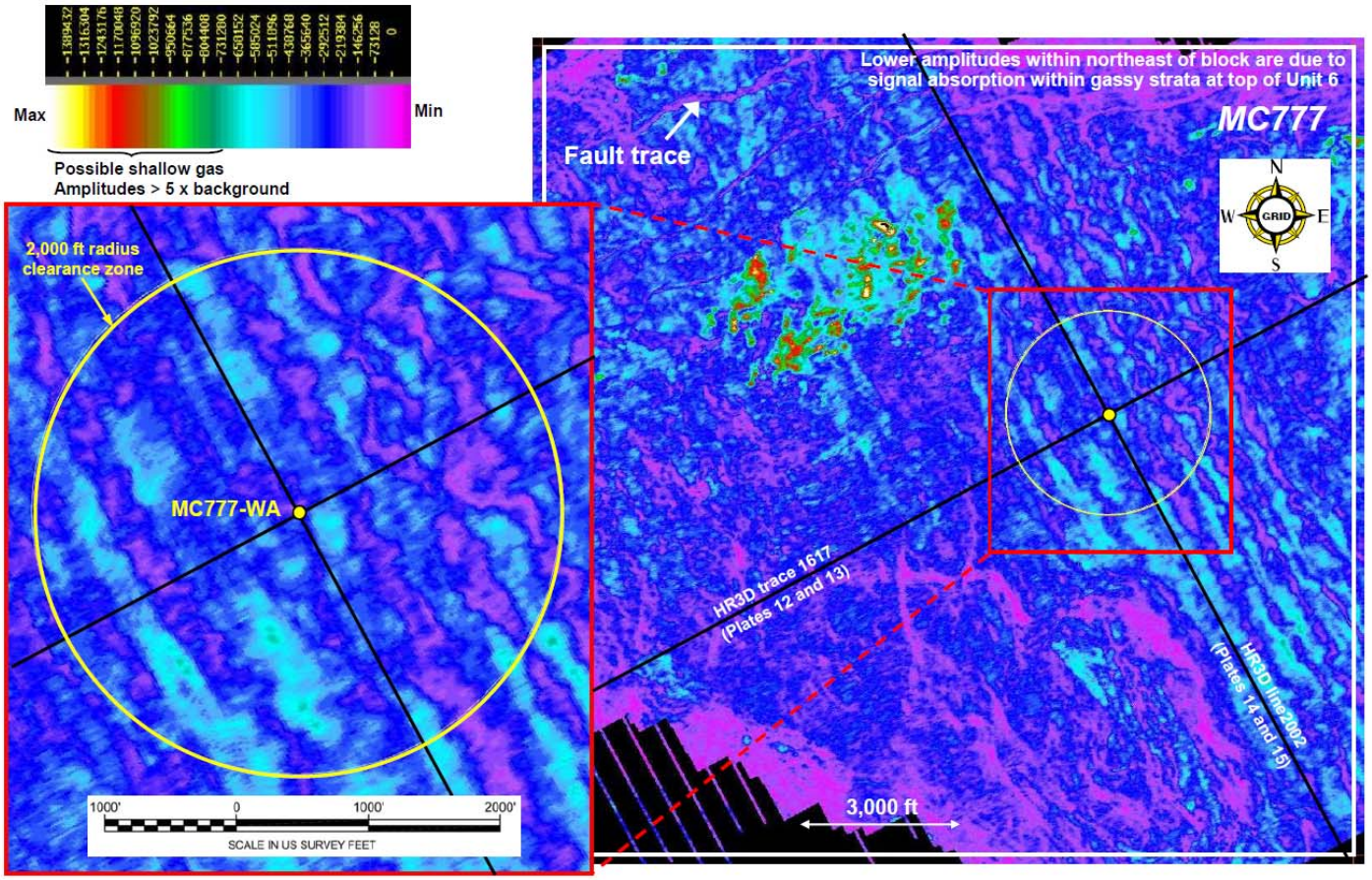


Plate 17

SHALLOW GAS AMPLITUDE EXTRACTION BETWEEN HORIZONS H AND TOP SALT (Units 10 thru 13) PROPOSED MC777-WA WELL

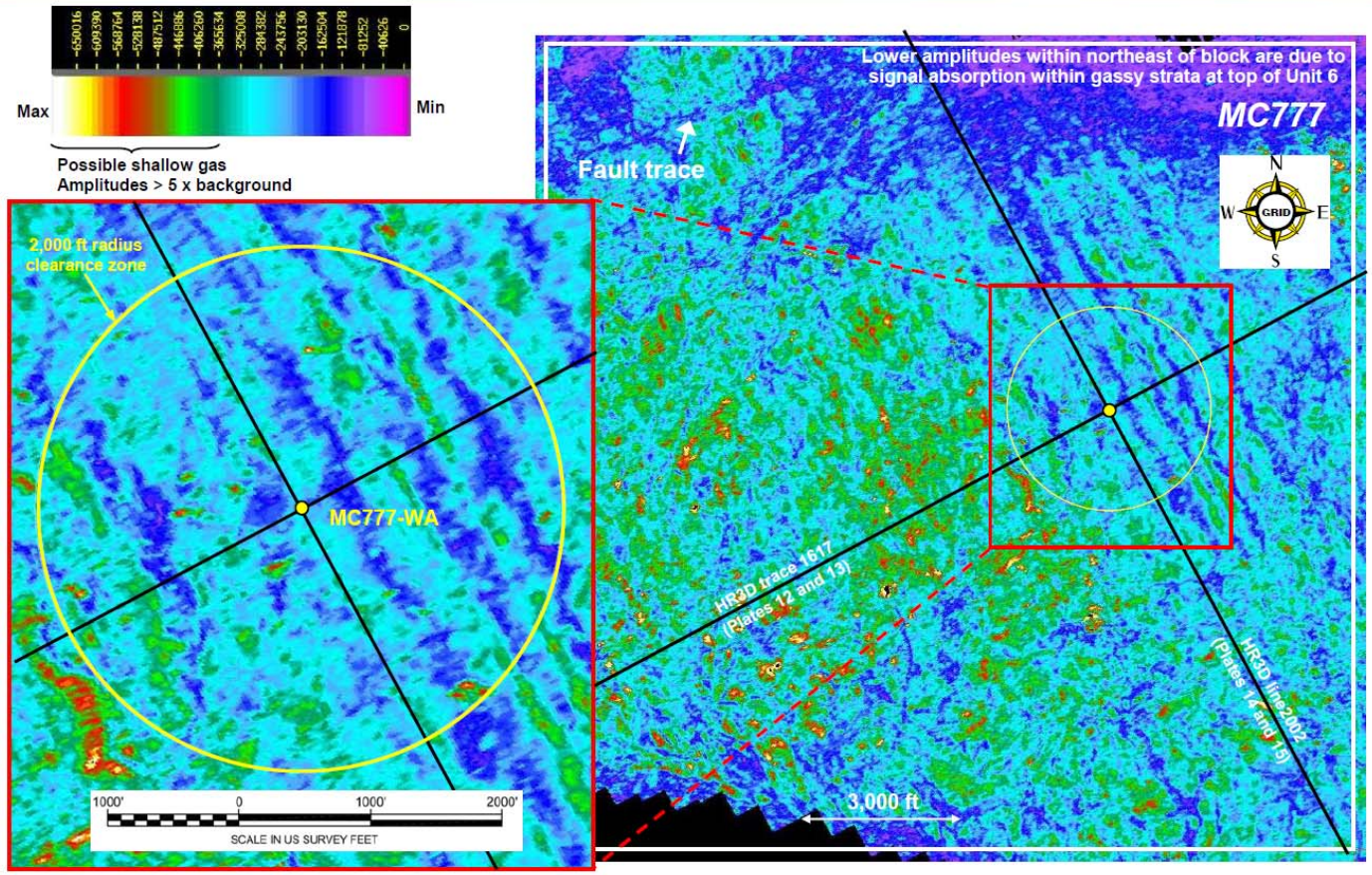
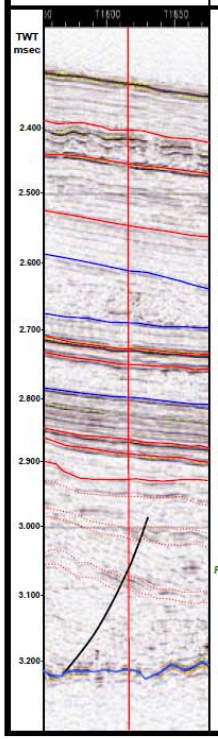


Plate 18

TOPHOLE FORMATION AND GEOHAZARDS SUMMARY SHEET
PROPOSED MC777-WA WELL



MC777-WA Mississippi Canyon 777 (OCS-G-09867)	Interpretation: Stratigraphy	Interpretation: Lithology	Depth BML (ft)	Depth BSL (ft)	TWT BSL (sec)	Interval Thickness (ft)	Comments	Hazards Risk: Hydrates	Hazards Risk: Shallow Gas	Hazards Risk: Shallow Water Flow
			Depth uncertainty ranges from ±29 ft at Seafloor to ±112 ft at Top-of-Salt							
	Seafloor		0	5,722	2.337		Relatively smooth, hummocky seafloor, slopes ~1.7° down to the south			
	Unit 1	Hemipelagic clays with slumps/debris flows at base				209	Approx 160-ft thick debris flow at base of Unit A in vicinity of proposed location resulting in hummocky topography at seafloor			
	Horizon A		209	5,931	2.406					
	Unit 2	Slumped hemipelagic clays				155	N-S trending erosional channel in Horizon B containing sands with shallow gas is ~5,200 ft to W			
	Horizon B		364	6,086	2.457					
	Unit 4	Clay/silt/sand turbidites				282	Unit 3 is absent at proposed location, but is present ~5,200 ft to the W and contains sands with shallow gas			
	Horizon C		646	6,368	2.550					
	Unit 5	Clay/silt turbidites with channeling				216	Horizon D corresponds to a prominent BSR in the N of MC777 and MC778			
	Horizon D		862	6,584	2.621					
	Unit 6	Clay/silt/sand turbidites with basal slumps				215	Continuous sands with shallow gas and SWF risk at top of Unit 6 in the N of MC777 terminate ~4,700 ft to N of wellbore. Scattered minor sands/gas anomalies are 1,000 ft to N and 1,500 ft to NE			
	Horizon E		1,077	6,799	2.692					
	Unit 7	Interbedded clay-prone turbidites and debris flows				128				
	Horizon F		1,205	6,927	2.734					
	Unit 8	Clay/silt turbidites				73	Shallow gas and slight to low instances of SWF recorded from sandy intervals within Units 8 and 9 at offset wells MC776#1 and #2			
	Horizon G		1,278	7,000	2.758					
	Unit 9	Clay/silt turbidites with some channeling				151				
	Horizon H		1,429	7,151	2.808					
	Unit 10	Clay/silt turbidites				189	Scattered shallow gas anomalies within Unit 10 ~500 ft to W and S, ~1,200 ft to N and ~1,900 ft to SE			
	Horizon I		1,618	7,340	2.870					
	Unit 11	Sand-prone turbidites				63				
	Horizon III		1,681	7,403	2.891					
	Unit 12	Clay/silt/sand turbidites with some channeling				110	Shallow gas in MC775#1			
	Horizon J		1,791	7,513	2.927					
		Sand-prone turbidites	1,842	7,564	2.944		Shallow gas and severe to moderate SWF experienced in Unit 13 at MC775#1			
		Sand-prone turbidites	2,040	7,762	3.009					
			2,070	7,792	3.019		Slight SWF experienced in Unit 13 at MC777#4			
	Unit 13	Clay, silt/sand turbidites w/ rotated slump blocks				877				
	Fault		2,185	7,907	3.057					
		Sand-prone turbidites	2,240	7,962	3.075		Three sands identified within this interval in MC777#5 with slight SWF			
			2,294	8,016	3.093					
							Slight instances of SWF recorded from sandy intervals overlying Top-of-Salt within this sequence at offset wells MC778#1 and #13			
	Top-of-Salt	Top-of-Salt	2,668	8,390	3.216					
		Salt								

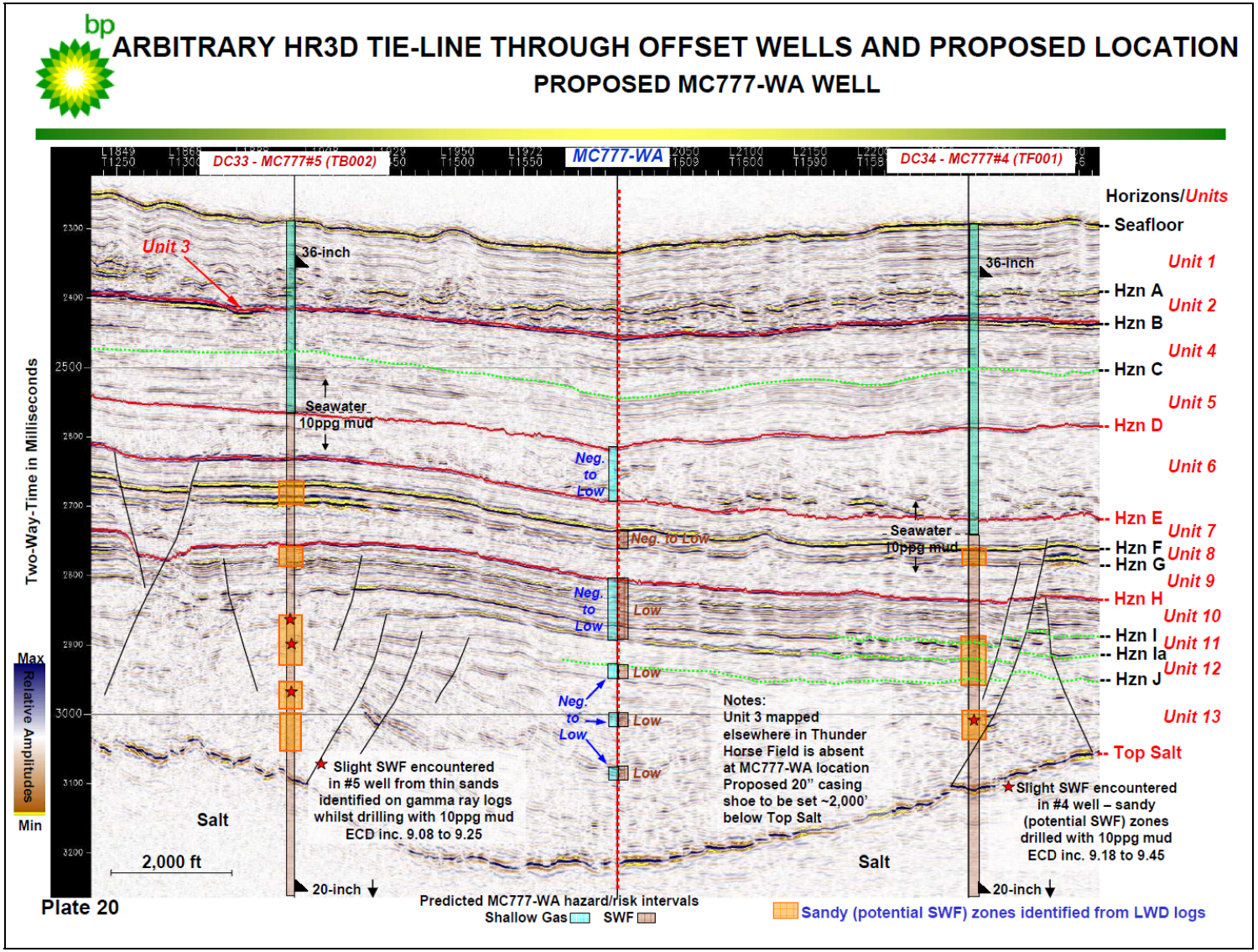
Risk level: Negligible | Low | Moderate | High

Red horizons are interpolated from offset well interpretations.
Blue horizons are mapped within proposed well area and used for interval amplitude analysis

Time-Depth conversions based on an overburden velocity of 6,070 ft/sec derived from SF and TOS picks at MC777#5

Note: Unit 3 mapped elsewhere in Thunder Horse Field is absent at MC777-WA location
Proposed 20-inch casing shoe to be set ~2,000 ft below Top-of-Salt

Plate 19



Title of Document:	Supplemental Development Operations Coordination Document - Thunder Horse	**Document Number:**	1410-10-RG-PN-0001
Authority:	James Grant	**Revision:**	0
Custodian/Owner:	Bekki Winfree	**Issue Date:**	October 26, 2011
Retention Code:		**Next Review Date (if applicable):**	
Security Classification:	Public Information Copy	**Page:**	120 of 250
Warning: Check DW Docs revision to ensure you are using the correct revision.			

Appendix C: Air Quality Report

Thunder Horse Plan AQR

COMPANY	BP Exploration & Production Inc
AREA	Mississippi Canyon
BLOCK	Plan Emissions- MC778, Agreement #98003
LEASE	09866-09867, 14657, 14658, and 19997
PLATFORM	Thunderhorse PDQ; MODU Enterprise
WELL	8 Waterflood Injection Wells at MC777 & MC776
COMPANY CONTACT	Jim Pfeiffer (Air Quality); Bekki Winfree (Plans)
TELEPHONE NO.	281-366-1542 (Jim); 281-366-8372 (Bekki)
REMARKS	Supplemental DOCD - Thunderhorse Project

LEASE TERM PIPELINE CONSTRUCTION INFORMATION:		
YEAR	**NUMBER OF PIPELINES**	**TOTAL NUMBER OF CONSTRUCTION DAYS**
2011	0	
2012	0	
2013	2	56 Days- DC32Wi &DC 33 Wi P/L & accessories
2014	0	
2015	1	28 Days- DC32Wi Phase 2 P/L & accessories
2016	0	
2017	0	
2018	0	
2019	0	
2020	0	

Air Emissions Computation Factors

Fuel Usage Conversion Factors	Natural Gas Turbines		Natural Gas Engines		Diesel Recip. Engine		REF.	DATE
	SCF/hp-hr	9.524	SCF/hp-hr	7.143	GAL/hp-hr	0.0483	AP42 3.2-1	4/76 & 8/84
	Diesel Turbine GE LM2500							
		gal/min	28.6					

Equipment/Emission Factors	units	PM	SOx	NOx	VOC	CO	REF.	DATE
NG Turbines	gms/hp-hr		0.00247	1.3	0.01	0.83	AP42 3.2-1& 3.1-1	10/96
NG Turbines	#/mmbtu	0.0066		0.32	0.0021	0.082	AP42 3.1-1&3.1-2a	Apr-00
NG Turbines	gms/hp-hr	0.029	0.00247	**2.6**	0.0093	0.36	1-1&3.1-2a; NOx per	Apr-00
NG 2-cycle lean	gms/hp-hr		0.00185	10.9	0.43	1.5	AP42 3.2-1	10/96
NG 4-cycle lean	gms/hp-hr		0.00185	11.8	0.72	1.6	AP42 3.2-1	10/96
NG 4-cycle rich	gms/hp-hr		0.00185	10	0.14	8.6	AP42 3.2-1	10/96
Diesel Turbine	lb/MMBtu	0.012	0.404		4.10E-04	0.0033	AP-42 3.1-1&3.1-2a	4/00
Diesel Turbine	lbs/gal	0.002	0.056		5.70E-05	4.59E-04	calculated based on above	
Diesel Turbine GE LM2500	gms/hp-hr			**4.0**			manufacturer data	
Diesel Recip. < 600 hp.	gms/hp-hr	1	1.468	14	1.12	3.03	AP42 3.3-1	10/96
Diesel Recip. > 600 hp.	gms/hp-hr	0.32	1.468	11	0.33	2.4	AP42 3.4-1	10/96
Diesel Boiler	lbs/bbl	0.084	2.42	0.84	0.008	0.21	AP42 1.3-12,14	9/98
NG Heaters/Boilers/Burners	lbs/mmscf	7.6	0.593	100	5.5	84	P42 1.4-1, 14-2, & 14	7/98
NG Flares	lbs/mmscf		0.593	71.4	60.3	388.5	AP42 11.5-1	9/91
Liquid Flaring	lbs/bbl	0.42	6.83	2	0.01	0.21	AP42 1.3-1 & 1.3-3	9/98
Tank Vapors	lbs/bbl				0.03		E&P Forum	1/93
Fugitives	lbs/hr/comp.				0.0005		API Study	12/93
Glycol Dehydrator Vent	lbs/mmscf				6.6		La. DEQ	1991
Gas Venting	lbs/scf				0.0034			

Sulphur Content Source	Value	Units
Fuel Gas	3.33	ppm
Diesel Fuel	0.4	% weight
Produced Gas(Flares)	3.33	ppm
Produced Oil (Liquid Flaring)	1	% weight

Emissions #1

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT	PHONE	REMARKS
BP Exploration & Production Inc	Mississippi Canyon	ts- MC778, Agre	09866-09867, 14	rse PDQ; MODU	8 Water Injection Wells at MC777 & MC776		Jim Pfeiffer (Air Quality); Bekki W	281-366-1542 (J	Supplemental DOCD - Thunderhorse Project

OPERATIONS	EQUIPMENT	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS				
	Diesel Engines	HP	GAL/HR	GAL/D												
	Nat. Gas Engines	HP	SCF/HR	SCF/D												
	Burners	MMBTU/HR	SCF/HR	SCF/D	HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
DRILLING: MODU Enterprise																
Mains- 6 x Wartsilla 18V32 LNE (9772 hp ea)	PRIME MOVER>600hp diesel	0	0	12779	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mains- 2X Wartsilla 12V32 LNE (6515 hp ea)	PRIME MOVER>600hp diesel	0	0	2840	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E-gen-Wartsilla 6R32 LNE (3257 hp)	AUXILIARY EQUIP>600hp diesel	0	0	702	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	0	0	544	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel #2	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel #3	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPELINE INSTALLATION:																
Deep Blue	VESSELS>600hp diesel (offshore c	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Skandi Neptune	VESSELS>600hp diesel (multi-serv	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BOA Sub C	VESSELS>600hp diesel (offshore s	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FACILITY INSTALLATION	DERRICK BARGE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	MATERIAL TUG diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(supply)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PRODUCTION:																
5 x GE LM2500 turbine (dual fuel)	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LM2500s on diesel fuel (emergency only)	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2X7188 hp Aux Gen (Wartsila 18V26)	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2816 hp E Gen (Wartsila 12V200)	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
382 hp Hurricane Gen (Cat 3306TA)	RECIP.<600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2x750 hp Forward Cranes (Cat 3412)	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2x525 hp Aft Cranes (Cat 3408)	RECIP.<600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2X1368 hp Fire Water pump (Wartsila	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROV Vessel	VESSELS>600hp diesel (multi-serv	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	MISC.	BPD	SCF/HR	COUNT												
	FLARE-		0		0	0		0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
	FLARE-		0		0	0		0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
	FUGITIVES-			0		0				0.00					0.00	
	GLYCOL STILL VENT- VRU controlled		0		0	0				0.00					0.00	
	GLYCOL STILL VENT- Uncontrolled		0		0	0				0.00					0.00	
2011 YEAR TOTAL							0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES											2131.20	2131.20	2131.20	2131.20	54400.00
	64.0															

Emissions #2

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT	PHONE	REMARKS
BP Exploration & Production Inc	Mississippi Canyon	s- MC778, Agre	09866-09867,	Hrse PDQ; MODU	8 Water Injection Wells at MC777 & MC776		Jim Pfeiffer (Air Quality); Bekki W	281-366-1542 (J	Supplemental DOCD - Thunderhorse Project

OPERATIONS	EQUIPMENT	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS				
	Diesel Engines	HP	GAL/HR	GAL/D												
	Nat. Gas Engines	HP	SCF/HR	SCF/D												
	Burners	MMBTU/HR	SCF/HR	SCF/D	HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
DRILLING: MODU Enterprise																
Mains- 6 x Wartsilla 18V32 LNE (9772 hp ea)	PRIME MOVER>600hp diesel	58632	2832	12779	24	180	41.33	189.59	1420.60	42.62	309.95	16.78	77.00	576.95	17.31	125.88
Mains- 2X Wartsilla 12V32 LNE (6515 hp ea)	PRIME MOVER>600hp diesel	13030	629	2840	24	180	9.18	42.13	315.70	9.47	68.88	3.73	17.11	128.23	3.85	27.98
E-gen-Wartsilla 6R32 LNE (3257 hp)	AUXILIARY EQUIP>600hp diesel	3257	157	702	2	180	2.30	10.53	78.91	2.37	17.22	0.08	0.35	2.64	0.08	0.58
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	2500	121	544	24	45	5.51	8.08	77.09	6.17	16.69	0.56	0.82	7.81	0.63	1.69
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	7200	348	6272	6	60	5.07	23.28	174.45	5.23	38.06	0.69	3.15	23.60	0.71	5.15
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
Offshore Supply Vessel #2	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
Offshore Supply Vessel #3	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
PIPELINE INSTALLATION:																
Deep Blue	VESSELS>600hp diesel (offshore c	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Skandi Neptune	VESSELS>600hp diesel (multi-serv	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BOA Sub C	VESSELS>600hp diesel (offshore s	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FACILITY	DERRICK BARGE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTALLATION	MATERIAL TUG diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(supply)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PRODUCTION:																
5 x GE LM2500 turbine	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(dual fuel)	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LM2500s on diesel fuel	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(emergency only)	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2X7188 hp Aux Gen (Wartsila 18V26)	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2816 hp E Gen (Wartsila 12V200)	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
382 hp Hurricane Gen (Cat 3306TA)	RECIP.<600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2x750 hp Forward Cranes (Cat 3412)	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2x525 hp Aft Cranes (Cat 3408)	RECIP.<600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2X1368 hp Fire Water pump (Wartsila	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROV Vessel	VESSELS>600hp diesel (multi-serv	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	MISC.	BPD	SCF/HR	COUNT												
	FLARE-		0		0	0		0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
	FLARE-		0		0	0		0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
	FUGITIVES-			0		0				0.00					0.00	
	GLYCOL STILL VENT- VRU controlled		0		0	0				0.00					0.00	
	GLYCOL STILL VENT- Uncontrolled		0		0	0				0.00					0.00	
2012	YEAR TOTAL						78.61	343.46	2590.11	81.56	564.98	28.47	128.89	967.45	29.41	211.07
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES											2131.20	2131.20	2131.20	2131.20	54400.00
	64.0															

Emissions #3

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT	PHONE	REMARKS
BP Exploration & Production Inc	Mississippi Canyon	ns- MC778, Agre	09866-09867, 1	rse PDQ; MODU	8 Water Injection Wells at MC777 & MC776		Jim Pfeiffer (Air Quality); Bekki W	281-366-1542 (J	Supplemental DOCD - Thunderhorse Project

OPERATIONS	EQUIPMENT	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS				
	Diesel Engines	HP	GAL/HR	GAL/D												
	Nat. Gas Engines	HP	SCF/HR	SCF/D												
	Burners	MMBTU/HR	SCF/HR	SCF/D	HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
DRILLING: MODU Enterprise																
Mains- 6 x Wartsilla 18V32 LNE (9772 hp ea)	PRIME MOVER>600hp diesel	58632	2832	12779	24	180	41.33	189.59	1420.60	42.62	309.95	16.78	77.00	576.95	17.31	125.88
Mains- 2X Wartsilla 12V32 LNE (6515 hp ea)	PRIME MOVER>600hp diesel	13030	629	2840	24	180	9.18	42.13	315.70	9.47	68.88	3.73	17.11	128.23	3.85	27.98
E-gen-Wartsilla 6R32 LNE (3257 hp)	AUXILIARY EQUIP>600hp diesel	3257	157	702	2	180	2.30	10.53	78.91	2.37	17.22	0.08	0.35	2.64	0.08	0.58
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	2500	121	544	24	45	5.51	8.08	77.09	6.17	16.69	0.56	0.82	7.81	0.63	1.69
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	7200	348	6272	6	60	5.07	23.28	174.45	5.23	38.06	0.69	3.15	23.60	0.71	5.15
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
Offshore Supply Vessel #2	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
Offshore Supply Vessel #3	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
PIPELINE INSTALLATION:																
Deep Blue	VESSELS>600hp diesel (offshore c	46341	2238	53718	24	42	32.66	149.84	1122.80	33.68	244.97	16.46	75.52	565.89	16.98	123.47
Skandi Neptune	VESSELS>600hp diesel (multi-serv	13685	661	15864	24	56	9.65	44.25	331.57	9.95	72.34	6.48	29.74	222.82	6.68	48.61
BOA Sub C	VESSELS>600hp diesel (offshore s	32124	1552	37238	24	12	22.64	103.87	778.33	23.35	169.82	3.26	14.96	112.08	3.36	24.45
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	7200	348	8346	24	63	5.07	23.28	174.45	5.23	38.06	3.84	17.60	131.88	3.96	28.77
FACILITY	DERRICK BARGE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTALLATION	MATERIAL TUG diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(supply)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PRODUCTION:																
5 x GE LM2500 turbine	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(dual fuel)	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LM2500s on diesel fuel	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(emergency only)	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2X7188 hp Aux Gen (Wartsila 18V26)	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2816 hp E Gen (Wartsila 12V200)	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
382 hp Hurricane Gen (Cat 3306TA)	RECIP.<600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2x750 hp Forward Cranes (Cat 3412)	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2x525 hp Aft Cranes (Cat 3408)	RECIP.<600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2X1368 hp Fire Water pump (Wartsila	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROV Vessel	VESSELS>600hp diesel (multi-serv	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	MISC.	BPD	SCF/HR	COUNT												
	FLARE-		0		0	0		0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
	FLARE-		0		0	0		0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
	FUGITIVES-			0		0				0.00					0.00	
	GLYCOL STILL VENT- VRU controlled		0		0	0				0.00					0.00	
	GLYCOL STILL VENT- Uncontrolled		0		0	0				0.00					0.00	
2013 YEAR TOTAL							148.64	664.70	4997.27	153.77	1090.18	58.52	266.70	2000.12	60.39	436.38
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES											2131.20	2131.20	2131.20	2131.20	54400.00
	64.0															

Emissions #4

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT	PHONE	REMARKS
BP Exploration & Production Inc	Mississippi Canyon	s- MC778, Agre	09866-09867, 1	se PDQ; MODU	8 Water Injection Wells at MC777 & MC776		Jim Pfeiffer (Air Quality); Bekki W	281-366-1542 (a	Supplemental DOCD - Thunderhorse Project

OPERATIONS	EQUIPMENT	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS				
	Diesel Engines	HP	GAL/HR	GAL/D												
	Nat. Gas Engines	HP	SCF/HR	SCF/D												
	Burners	MMBTU/HR	SCF/HR	SCF/D	HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
DRILLING: MODU Enterprise																
Mains- 6 x Wartsilla 18V32 LNE (9772 hp ea)	PRIME MOVER>600hp diesel	0	0	12779	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mains- 2X Wartsilla 12V32 LNE (6515 hp ea)	PRIME MOVER>600hp diesel	0	0	2840	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E-gen-Wartsilla 6R32 LNE (3257 hp)	AUXILIARY EQUIP>600hp diesel	0	0	702	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	0	0	544	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel #2	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel #3	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPELINE INSTALLATION:																
Deep Blue	VESSELS>600hp diesel (offshore c	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Skandi Neptune	VESSELS>600hp diesel (multi-serv	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BOA Sub C	VESSELS>600hp diesel (offshore s	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FACILITY	DERRICK BARGE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTALLATION	MATERIAL TUG diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(supply)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PRODUCTION:																
5 x GE LM2500 turbine	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(dual fuel)	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LM2500s on diesel fuel	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(emergency only)	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2X7188 hp Aux Gen (Wartsila 18V26)	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2816 hp E Gen (Wartsila 12V200)	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
382 hp Hurricane Gen (Cat 3306TA)	RECIP.<600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2x750 hp Forward Cranes (Cat 3412)	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2x525 hp Aft Cranes (Cat 3408)	RECIP.<600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2X1368 hp Fire Water pump (Wartsila	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROV Vessel	VESSELS>600hp diesel (multi-serv	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	MISC.	BPD	SCF/HR	COUNT												
	FLARE-		0		0	0		0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
	FLARE-		0		0	0		0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
	FUGITIVES-			0		0				0.00					0.00	
	GLYCOL STILL VENT- VRU controlled		0		0	0				0.00					0.00	
	GLYCOL STILL VENT- Uncontrolled		0		0	0				0.00					0.00	
2014 YEAR TOTAL							0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES											2131.20	2131.20	2131.20	2131.20	54400.00
	64.0															

Emissions #5

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT	PHONE	REMARKS
BP Exploration & Production Inc	Mississippi Canyon	s- MC778, Agre	09866-09867, 1	se PDQ; MODU	8 Water Injection Wells at MC777 & MC776		Jim Pfeiffer (Air Quality); Bekki W	281-366-1542 (J	Supplemental DOCD - Thunderhorse Project

OPERATIONS	EQUIPMENT	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS				
	Diesel Engines	HP	GAL/HR	GAL/D												
	Nat. Gas Engines	HP	SCF/HR	SCF/D												
	Burners	MMBTU/HR	SCF/HR	SCF/D	HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
DRILLING: MODU Enterprise																
Mains- 6 x Wartsilla 18V32 LNE (9772 hp ea)	PRIME MOVER>600hp diesel	58632	2832	12779	24	180	41.33	189.59	1420.60	42.62	309.95	16.78	77.00	576.95	17.31	125.88
Mains- 2X Wartsilla 12V32 LNE (6515 hp ea)	PRIME MOVER>600hp diesel	13030	629	2840	24	180	9.18	42.13	315.70	9.47	68.88	3.73	17.11	128.23	3.85	27.98
E-gen-Wartsilla 6R32 LNE (3257 hp)	AUXILIARY EQUIP>600hp diesel	3257	157	702	2	180	2.30	10.53	78.91	2.37	17.22	0.08	0.35	2.64	0.08	0.58
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	2500	121	544	24	45	5.51	8.08	77.09	6.17	16.69	0.56	0.82	7.81	0.63	1.69
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	7200	348	6272	6	60	5.07	23.28	174.45	5.23	38.06	0.69	3.15	23.60	0.71	5.15
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
Offshore Supply Vessel #2	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
Offshore Supply Vessel #3	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
PIPELINE INSTALLATION:																
Deep Blue	VESSELS>600hp diesel (offshore c	46341	2238	53718	24	14	32.66	149.84	1122.80	33.68	244.97	5.49	25.17	188.63	5.66	41.16
Skandi Neptune	VESSELS>600hp diesel (multi-serv	13685	661	15864	24	28	9.65	44.25	331.57	9.95	72.34	3.24	14.87	111.41	3.34	24.31
BOA Sub C	VESSELS>600hp diesel (offshore s	32124	1552	37238	24	6	22.64	103.87	778.33	23.35	169.82	1.63	7.48	56.04	1.68	12.23
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	7200	348	8346	24	14	5.07	23.28	174.45	5.23	38.06	0.85	3.91	29.31	0.88	6.39
FACILITY	DERRICK BARGE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTALLATION	MATERIAL TUG diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(supply)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PRODUCTION:																
5 x GE LM2500 turbine	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(dual fuel)	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LM2500s on diesel fuel	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(emergency only)	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2X7188 hp Aux Gen (Wartsila 18V26)	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2816 hp E Gen (Wartsila 12V200)	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
382 hp Hurricane Gen (Cat 3306TA)	RECIP.<600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2x750 hp Forward Cranes (Cat 3412)	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2x525 hp Aft Cranes (Cat 3408)	RECIP.<600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2X1368 hp Fire Water pump (Wartsila	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROV Vessel	VESSELS>600hp diesel (multi-serv	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	MISC.	BPD	SCF/HR	COUNT												
	FLARE-		0		0	0		0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
	FLARE-		0		0	0		0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
	FUGITIVES-			0		0				0.00					0.00	
	GLYCOL STILL VENT- VRU controlled		0		0	0				0.00					0.00	
	GLYCOL STILL VENT- Uncontrolled		0		0	0				0.00					0.00	
2015 YEAR TOTAL							148.64	664.70	4997.27	153.77	1090.18	39.69	180.32	1352.84	40.98	295.15
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES											2131.20	2131.20	2131.20	2131.20	54400.00
	64.0															

Emissions #6

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT			PHONE	REMARKS
BP Exploration & Production Inc	Mississippi Canyon	s- MC778, Agre	09866-09867, 1	se PDQ; MODU	8 Water Injection Wells at MC777 & MC776		Jim Pfeiffer (Air Quality); Bekki W			281-366-1542 (J	Supplemental DOCD - Thunderhorse Project

OPERATIONS	EQUIPMENT	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS				
	Diesel Engines	HP	GAL/HR	GAL/D												
	Nat. Gas Engines	HP	SCF/HR	SCF/D												
	Burners	MMBTU/HR	SCF/HR	SCF/D	HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
DRILLING: MODU Enterprise																
Mains- 6 x Wartsilla 18V32 LNE (9772 hp ea)	PRIME MOVER>600hp diesel	58632	2832	12779	24	365	41.33	189.59	1420.60	42.62	309.95	34.03	156.13	1169.93	35.10	255.26
Mains- 2X Wartsilla 12V32 LNE (6515 hp ea)	PRIME MOVER>600hp diesel	13030	629	2840	24	365	9.18	42.13	315.70	9.47	68.88	7.56	34.70	260.02	7.80	56.73
E-gen-Wartsilla 6R32 LNE (3257 hp)	AUXILIARY EQUIP>600hp diesel	3257	157	702	2	365	2.30	10.53	78.91	2.37	17.22	0.16	0.71	5.36	0.16	1.17
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	2500	121	544	24	91	5.51	8.08	77.09	6.17	16.69	1.13	1.66	15.85	1.27	3.43
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	7200	348	6272	6	122	5.07	23.28	174.45	5.23	38.06	1.39	6.39	47.85	1.44	10.44
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	7200	348	3370	24	183	5.07	23.28	174.45	5.23	38.06	4.49	20.59	154.26	4.63	33.66
Offshore Supply Vessel #2	VESSELS>600hp diesel(support)	7200	348	3370	24	183	5.07	23.28	174.45	5.23	38.06	4.49	20.59	154.26	4.63	33.66
Offshore Supply Vessel #3	VESSELS>600hp diesel(support)	7200	348	3370	24	183	5.07	23.28	174.45	5.23	38.06	4.49	20.59	154.26	4.63	33.66
PIPELINE INSTALLATION:																
Deep Blue	VESSELS>600hp diesel (offshore c	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Skandi Neptune	VESSELS>600hp diesel (multi-serv	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BOA Sub C	VESSELS>600hp diesel (offshore s	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FACILITY	DERRICK BARGE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTALLATION	MATERIAL TUG diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(supply)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PRODUCTION:																
5 x GE LM2500 turbine	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(dual fuel)	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LM2500s on diesel fuel	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(emergency only)	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2X7188 hp Aux Gen (Wartsila 18V26)	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2816 hp E Gen (Wartsila 12V200)	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
382 hp Hurricane Gen (Cat 3306TA)	RECIP.<600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2x750 hp Forward Cranes (Cat 3412)	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2x525 hp Aft Cranes (Cat 3408)	RECIP.<600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2X1368 hp Fire Water pump (Wartsila	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROV Vessel	VESSELS>600hp diesel (multi-serv	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	MISC.	BPD	SCF/HR	COUNT												
	FLARE-		0		0	0		0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
	FLARE-		0		0	0		0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
	FUGITIVES-			0		0				0.00					0.00	
	GLYCOL STILL VENT- VRU controlled		0		0	0				0.00					0.00	
	GLYCOL STILL VENT- Uncontrolled		0		0	0				0.00					0.00	
2016 YEAR TOTAL							78.61	343.46	2590.11	81.56	564.98	57.74	261.35	1961.78	59.65	428.00
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES											2131.20	2131.20	2131.20	2131.20	54400.00
	64.0															

Emissions #7

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT	PHONE	REMARKS
BP Exploration & Production Inc	Mississippi Canyon	s- MC778, Agree	09866-09867, use PDQ; MODU		8 Water injection Wells at MC777 & MC776		Jim Pfeiffer (Air Quality); Bekki W	281-366-1542 (a	Supplemental DOCD - Thunderhorse Project

OPERATIONS	EQUIPMENT	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS				
	Diesel Engines	HP	GAL/HR	GAL/D												
	Nat. Gas Engines	HP	SCF/HR	SCF/D												
	Burners	MMBTU/HR	SCF/HR	SCF/D	HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
DRILLING: MODU Enterprise																
Mains- 6 x Wartsilla 18V32 LNE (9772 hp ea)	PRIME MOVER>600hp diesel	58632	2832	12779	24	180	41.33	189.59	1420.60	42.62	309.95	16.78	77.00	576.95	17.31	125.88
Mains- 2X Wartsilla 12V32 LNE (6515 hp ea)	PRIME MOVER>600hp diesel	13030	629	2840	24	180	9.18	42.13	315.70	9.47	68.88	3.73	17.11	128.23	3.85	27.98
E-gen-Wartsilla 6R32 LNE (3257 hp)	AUXILIARY EQUIP>600hp diesel	3257	157	702	2	180	2.30	10.53	78.91	2.37	17.22	0.08	0.35	2.64	0.08	0.58
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	2500	121	544	24	45	5.51	8.08	77.09	6.17	16.69	0.56	0.82	7.81	0.63	1.69
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	7200	348	6272	6	60	5.07	23.28	174.45	5.23	38.06	0.69	3.15	23.60	0.71	5.15
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
Offshore Supply Vessel #2	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
Offshore Supply Vessel #3	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
PIPELINE INSTALLATION:																
Deep Blue	VESSELS>600hp diesel (offshore c	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Skandi Neptune	VESSELS>600hp diesel (multi-serv	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BOA Sub C	VESSELS>600hp diesel (offshore s	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FACILITY	DERRICK BARGE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTALLATION	MATERIAL TUG diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(supply)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PRODUCTION:																
5 x GE LM2500 turbine	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(dual fuel)	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LM2500s on diesel fuel	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(emergency only)	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2X7188 hp Aux Gen (Wartsila 18V26)	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2816 hp E Gen (Wartsila 12V200)	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
382 hp Hurricane Gen (Cat 3306TA)	RECIP.<600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2x750 hp Forward Cranes (Cat 3412)	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2x525 hp Aft Cranes (Cat 3408)	RECIP.<600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2X1368 hp Fire Water pump (Wartsila	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROV Vessel	VESSELS>600hp diesel (multi-serv	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	MISC.	BPD	SCF/HR	COUNT												
	FLARE-		0		0	0		0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
	FLARE-		0		0	0		0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
	FUGITIVES-			0		0				0.00					0.00	
	GLYCOL STILL VENT- VRU controlled		0		0	0				0.00					0.00	
	GLYCOL STILL VENT- Uncontrolled		0		0	0				0.00					0.00	
2017 YEAR TOTAL							78.61	343.46	2590.11	81.56	564.98	28.47	128.89	967.45	29.41	211.07
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES											2131.20	2131.20	2131.20	2131.20	54400.00
	64.0															

Emissions #8

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT	PHONE	REMARKS
BP Exploration & Production Inc	Mississippi Canyon	s- MC778, Agre	09866-09867, 1	se PDQ; MODU	8 Water Injection Wells at MC777 & MC776		Jim Pfeiffer (Air Quality); Bekki W	281-366-1542 (a	Supplemental DOCD - Thunderhorse Project

OPERATIONS	EQUIPMENT	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS				
	Diesel Engines	HP	GAL/HR	GAL/D												
	Nat. Gas Engines	HP	SCF/HR	SCF/D												
	Burners	MMBTU/HR	SCF/HR	SCF/D	HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
DRILLING: MODU Enterprise																
Mains- 6 x Wartsilla 18V32 LNE (9772 hp ea)	PRIME MOVER>600hp diesel	58632	2832	12779	24	180	41.33	189.59	1420.60	42.62	309.95	16.78	77.00	576.95	17.31	125.88
Mains- 2X Wartsilla 12V32 LNE (6515 hp ea)	PRIME MOVER>600hp diesel	13030	629	2840	24	180	9.18	42.13	315.70	9.47	68.88	3.73	17.11	128.23	3.85	27.98
E-gen-Wartsilla 6R32 LNE (3257 hp)	AUXILIARY EQUIP>600hp diesel	3257	157	702	2	180	2.30	10.53	78.91	2.37	17.22	0.08	0.35	2.64	0.08	0.58
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	2500	121	544	24	45	5.51	8.08	77.09	6.17	16.69	0.56	0.82	7.81	0.63	1.69
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	7200	348	8346	6	60	5.07	23.28	174.45	5.23	38.06	0.91	4.19	31.40	0.94	6.85
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	7200	348	8346	24	90	5.07	23.28	174.45	5.23	38.06	5.48	25.14	188.41	5.65	41.11
Offshore Supply Vessel #2	VESSELS>600hp diesel(support)	7200	348	8346	24	90	5.07	23.28	174.45	5.23	38.06	5.48	25.14	188.41	5.65	41.11
Offshore Supply Vessel #3	VESSELS>600hp diesel(support)	7200	348	8346	24	90	5.07	23.28	174.45	5.23	38.06	5.48	25.14	188.41	5.65	41.11
PIPELINE INSTALLATION:																
Deep Blue	VESSELS>600hp diesel (offshore c	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Skandi Neptune	VESSELS>600hp diesel (multi-serv	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BOA Sub C	VESSELS>600hp diesel (offshore s	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FACILITY	DERRICK BARGE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTALLATION	MATERIAL TUG diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(supply)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PRODUCTION:																
5 x GE LM2500 turbine	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(dual fuel)	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LM2500s on diesel fuel	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(emergency only)	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2X7188 hp Aux Gen (Wartsila 18V26)	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2816 hp E Gen (Wartsila 12V200)	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
382 hp Hurricane Gen (Cat 3306TA)	RECIP.<600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2x750 hp Forward Cranes (Cat 3412)	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2x525 hp Aft Cranes (Cat 3408)	RECIP.<600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2X1368 hp Fire Water pump (Wartsila	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROV Vessel	VESSELS>600hp diesel (multi-serv	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	MISC.	BPD	SCF/HR	COUNT												
	FLARE-		0		0	0		0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
	FLARE-		0		0	0		0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
	FUGITIVES-			0		0				0.00					0.00	
	GLYCOL STILL VENT- VRU controlled		0		0	0				0.00					0.00	
	GLYCOL STILL VENT- Uncontrolled		0		0	0				0.00					0.00	
2018 YEAR TOTAL							78.61	343.46	2590.11	81.56	564.98	38.51	174.90	1312.25	39.76	286.30
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES											2131.20	2131.20	2131.20	2131.20	54400.00
	64.0															

Emissions #9

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT	PHONE	REMARKS
BP Exploration & Production Inc	Mississippi Canyon	s- MC778, Agre	09866-09867, 1	se PDQ; MODU	8 Water Injection Wells at MC777 & MC776		Jim Pfeiffer (Air Quality); Bekki W	281-366-1542 (J	Supplemental DOCD - Thunderhorse Project

OPERATIONS	EQUIPMENT	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS				
	Diesel Engines	HP	GAL/HR	GAL/D												
	Nat. Gas Engines	HP	SCF/HR	SCF/D												
	Burners	MMBTU/HR	SCF/HR	SCF/D	HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
DRILLING: MODU Enterprise																
Mains- 6 x Wartsilla 18V32 LNE (9772 hp ea)	PRIME MOVER>600hp diesel	0	0	12779	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mains- 2X Wartsilla 12V32 LNE (6515 hp ea)	PRIME MOVER>600hp diesel	0	0	2840	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E-gen-Wartsilla 6R32 LNE (3257 hp)	AUXILIARY EQUIP>600hp diesel	0	0	702	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	0	0	544	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel #2	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel #3	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPELINE INSTALLATION:																
Deep Blue	VESSELS>600hp diesel (offshore c	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Skandi Neptune	VESSELS>600hp diesel (multi-serv	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BOA Sub C	VESSELS>600hp diesel (offshore s	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FACILITY	DERRICK BARGE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTALLATION	MATERIAL TUG diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(supply)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PRODUCTION:																
5 x GE LM2500 turbine	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(dual fuel)	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LM2500s on diesel fuel	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(emergency only)	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2X7188 hp Aux Gen (Wartsila 18V26)	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2816 hp E Gen (Wartsila 12V200)	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
382 hp Hurricane Gen (Cat 3306TA)	RECIP.<600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2x750 hp Forward Cranes (Cat 3412)	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2x525 hp Aft Cranes (Cat 3408)	RECIP.<600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2X1368 hp Fire Water pump (Wartsila	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROV Vessel	VESSELS>600hp diesel (multi-serv	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	MISC.	BPD	SCF/HR	COUNT												
	FLARE-		0		0	0		0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
	FLARE-		0		0	0		0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
	FUGITIVES-			0		0				0.00					0.00	
	GLYCOL STILL VENT- VRU controlled		0		0	0				0.00					0.00	
	GLYCOL STILL VENT- Uncontrolled		0		0	0				0.00					0.00	
2019 YEAR TOTAL							0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES											2131.20	2131.20	2131.20	2131.20	54400.00
	64.0															

Emissions #10

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT			PHONE	REMARKS					
BP Exploration & Production Inc	Mississippi Canyon	s- MC778, Agre	09866-09867, 1se PDQ; MODU		8 Water Injection Wells at MC777 & MC776		Jim Pfeiffer (Air Quality); Bekki W			281-366-1542 (a	Supplemental DOCD - Thunderhorse Project					
OPERATIONS	EQUIPMENT	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS				
	Diesel Engines	HP	GAL/HR	GAL/D												
	Nat. Gas Engines	HP	SCF/HR	SCF/D												
	Burners	MMBTU/HR	SCF/HR	SCF/D	HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
DRILLING: MODU Enterprise																
Mains- 6 x Wartsilla 18V32 LNE (9772 hp ea)	PRIME MOVER>600hp diesel	58632	2832	12779	24	180	41.33	189.59	1420.60	42.62	309.95	16.78	77.00	576.95	17.31	125.88
Mains- 2X Wartsilla 12V32 LNE (6515 hp ea)	PRIME MOVER>600hp diesel	13030	629	2840	24	180	9.18	42.13	315.70	9.47	68.88	3.73	17.11	128.23	3.85	27.98
E-gen-Wartsilla 6R32 LNE (3257 hp)	AUXILIARY EQUIP>600hp diesel	3257	157	702	2	180	2.30	10.53	78.91	2.37	17.22	0.08	0.35	2.64	0.08	0.58
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	2500	121	544	24	45	5.51	8.08	77.09	6.17	16.69	0.56	0.82	7.81	0.63	1.69
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	7200	348	6272	6	60	5.07	23.28	174.45	5.23	38.06	0.69	3.15	23.60	0.71	5.15
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
Offshore Supply Vessel #2	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
Offshore Supply Vessel #3	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
PIPELINE INSTALLATION:																
Deep Blue	VESSELS>600hp diesel (offshore c	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Skandi Neptune	VESSELS>600hp diesel (multi-serv	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BOA Sub C	VESSELS>600hp diesel (offshore s	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FACILITY	DERRICK BARGE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTALLATION	MATERIAL TUG diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(supply)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PRODUCTION:																
5 x GE LM2500 turbine	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(dual fuel)	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LM2500s on diesel fuel	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(emergency only)	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TURBINE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2X7188 hp Aux Gen (Wartsila 18V26)	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2816 hp E Gen (Wartsila 12V200)	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
382 hp Hurricane Gen (Cat 3306TA)	RECIP.<600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2x750 hp Forward Cranes (Cat 3412)	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2x525 hp Aft Cranes (Cat 3408)	RECIP.<600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2X1368 hp Fire Water pump (Wartsila	RECIP.>600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROV Vessel	VESSELS>600hp diesel (multi-serv	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	MISC.	BPD	SCF/HR	COUNT												
	FLARE-		0		0	0		0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
	FLARE-		0		0	0		0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
	FUGITIVES-			0		0				0.00					0.00	
	GLYCOL STILL VENT- VRU controlled		0		0	0				0.00					0.00	
	GLYCOL STILL VENT- Uncontrolled		0		0	0				0.00					0.00	
2020 YEAR TOTAL							78.61	343.46	2590.11	81.56	564.98	28.47	128.89	967.45	29.41	211.07
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES											2131.20	2131.20	2131.20	2131.20	54400.00
	64.0															

Summary

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL
BP Exploration & Production Inc	Mississippi Canyon	Plan Emissions-MC778, Agreement #98003	09866-09867, 14657, 14658, and 19997	Thunderhorse PDQ; MODU Enterprise	8 Waterflood Injection Wells at MC777 & MC776

Year	Emitted Substance				
	PM	SOx	NOx	VOC	CO
2011	0.00	0.00	0.00	0.00	0.00
2012	28.47	128.89	967.45	29.41	211.07
2013	58.52	266.70	2,000.12	60.39	436.38
2014	58.52	266.70	2,000.12	60.39	436.38
2015	39.69	180.32	1,352.84	40.98	295.15
2016	57.74	261.35	1961.78	59.65	428.00
2017	28.47	128.89	967.45	29.41	211.07
2018	38.51	174.90	1,312.25	39.76	286.30
2019	38.51	174.90	1,312.25	39.76	286.30
2020	28.47	128.89	967.45	29.41	211.07
Allowable	2,131.20	2,131.20	2,131.20	2,131.20	54,400.00

Thunder Horse Complex PQR

DOCD Air Quality Screening Checklist

COMPANY	BP Exploration & Production Inc
AREA	Mississippi Canyon
BLOCK	Complex Total Emissions- MC778, Agreement #98003
LEASE	09866-09867, 14657, 14658, and 19997
PLATFORM	Thunderhorse PDQ; MODU Enterprise
WELL	8 Waterflood Injection Wells at MC777 & MC776
COMPANY CONTACT	Jim Pfeiffer (Air Quality); Bekki Winfree (Plans)
TELEPHONE NO.	281-366-1542 (Jim); 281-366-8372 (Bekki)
REMARKS	Supplemental DOCD - Thunderhorse Project

LEASE TERM PIPELINE CONSTRUCTION INFORMATION:		
YEAR	NUMBER OF PIPELINES	TOTAL NUMBER OF CONSTRUCTION DAYS
2011	0	
2012	0	
2013	2	56 Days- DC32Wi &DC 33 Wi P/L & accessories
2014	0	
2015	1	28 Days- DC32Wi Phase 2 P/L & accessories
2016	0	
2017	0	
2018	0	
2019	0	
2020	0	

Air Emissions Computation Factors

Fuel Usage Conversion Factors	Natural Gas Turbines		Natural Gas Engines		Diesel Recip. Engine		REF.	DATE
	SCF/hp-hr	9.524	SCF/hp-hr	7.143	GAL/hp-hr	0.0483	AP42 3.2-1	4/76 & 8/84
	Diesel Turbine GE LM2500							
	gal/min		28.6					

Equipment/Emission Factors	units	PM	SOx	NOx	VOC	CO	REF.	DATE
NG Turbines	gms/hp-hr		0.00247	1.3	0.01	0.83	AP42 3.2-1& 3.1-1	10/96
NG Turbines	#/mmbtu	0.0066		0.32	0.0021	0.082	AP42 3.1-1&3.1-2a	Apr-00
NG Turbines	gms/hp-hr	0.029	0.00247	**2.6**	0.0093	0.36	1-1&3.1-2a; NOx per	Apr-00
NG 2-cycle lean	gms/hp-hr		0.00185	10.9	0.43	1.5	AP42 3.2-1	10/96
NG 4-cycle lean	gms/hp-hr		0.00185	11.8	0.72	1.6	AP42 3.2-1	10/96
NG 4-cycle rich	gms/hp-hr		0.00185	10	0.14	8.6	AP42 3.2-1	10/96
Diesel Turbine	lb/MMBtu	0.012	0.404		4.10E-04	0.0033	AP-42 3.1-1&3.1-2a	4/00
Diesel Turbine	lbs/gal	0.002	0.056		5.70E-05	4.59E-04	calculated based on above	
Diesel Turbine GE LM2500	gms/hp-hr			**4.0**			manufacturer data	
Diesel Recip. < 600 hp.	gms/hp-hr	1	1.468	14	1.12	3.03	AP42 3.3-1	10/96
Diesel Recip. > 600 hp.	gms/hp-hr	0.32	1.468	11	0.33	2.4	AP42 3.4-1	10/96
Diesel Boiler	lbs/bbl	0.084	2.42	0.84	0.008	0.21	AP42 1.3-12,14	9/98
NG Heaters/Boilers/Burners	lbs/mmscf	7.6	0.593	100	5.5	84	P42 1.4-1, 14-2, & 14	7/98
NG Flares	lbs/mmscf		0.593	71.4	60.3	388.5	AP42 11.5-1	9/91
Liquid Flaring	lbs/bbl	0.42	6.83	2	0.01	0.21	AP42 1.3-1 & 1.3-3	9/98
Tank Vapors	lbs/bbl				0.03		E&P Forum	1/93
Fugitives	lbs/hr/comp.				0.0005		API Study	12/93
Glycol Dehydrator Vent	lbs/mmscf				6.6		La. DEQ	1991
Gas Venting	lbs/scf				0.0034			

Sulphur Content Source	Value	Units
Fuel Gas	3.33	ppm
Diesel Fuel	0.4	% weight
Produced Gas(Flares)	3.33	ppm
Produced Oil (Liquid Flaring)	1	% weight

Emissions #1

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT	PHONE	REMARKS
BP Exploration & Production Inc	Mississippi Canyon	issions- MC778,	09866-09867, 1	rse PDQ; MODU	8 Water Injection Wells at MC777 & MC776		Jim Pfeiffer (Air Quality); Bekki W	281-366-1542 (a	Supplemental DOCD - Thunderhorse Project

OPERATIONS	EQUIPMENT	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS				
	Diesel Engines	HP	GAL/HR	GAL/D												
	Nat. Gas Engines	HP	SCF/HR	SCF/D												
	Burners	MMBTU/HR	SCF/HR	SCF/D	HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
DRILLING: MODU Enterprise																
Mains- 6 x Wartsilla 18V32 LNE (9772 hp ea)	PRIME MOVER>600hp diesel	0	0	12779	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mains- 2X Wartsilla 12V32 LNE (6515 hp ea)	PRIME MOVER>600hp diesel	0	0	2840	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E-gen-Wartsilla 6R32 LNE (3257 hp)	AUXILIARY EQUIP>600hp diesel	0	0	702	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	0	0	544	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	0	0	6272	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	0	0	3370	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel #2	VESSELS>600hp diesel(support)	0	0	3370	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel #3	VESSELS>600hp diesel(support)	0	0	3370	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPELINE INSTALLATION:																
Deep Blue	VESSELS>600hp diesel (offshore c	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Skandi Neptune	VESSELS>600hp diesel (multi-serv	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BOA Sub C	VESSELS>600hp diesel (offshore s	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FACILITY INSTALLATION	DERRICK BARGE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	MATERIAL TUG diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(supply)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PRODUCTION:																
5 x GE LM2500 turbine (dual fuel)	TURBINE nat gas	29745	283291	6798993	24	160	1.91	0.16	170.35	0.61	23.69	3.66	0.31	327.06	1.17	45.49
	TURBINE nat gas	29745	283291	6798993	24	160	1.91	0.16	170.35	0.61	23.69	3.66	0.31	327.06	1.17	45.49
	TURBINE nat gas	29745	283291	6798993	24	160	1.91	0.16	170.35	0.61	23.69	3.66	0.31	327.06	1.17	45.49
	TURBINE nat gas	29745	283291	6798993	24	160	1.91	0.16	170.35	0.61	23.69	3.66	0.31	327.06	1.17	45.49
	TURBINE nat gas	29745	283291	6798993	24	160	1.91	0.16	170.35	0.61	23.69	3.66	0.31	327.06	1.17	45.49
LM2500s on diesel fuel (emergency only)	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
2X7188 hp Aux Gen (Wartsila 18V26)	RECIP.>600hp diesel	14376	694	16665	24	125	10.13	46.48	348.32	10.45	76.00	15.20	69.73	522.48	15.67	113.99
2816 hp E Gen (Wartsila 12V200)	RECIP.>600hp diesel	2816	136	3264	24	8	1.98	9.11	68.23	2.05	14.89	0.19	0.87	6.55	0.20	1.43
382 hp Hurricane Gen (Cat 3306TA)	RECIP.<600hp diesel	382	18	443	24	10	0.84	1.24	11.78	0.94	2.55	0.10	0.15	1.41	0.11	0.31
2x750 hp Forward Cranes (Cat 3412)	RECIP.>600hp diesel	1500	72	1739	12	365	1.06	4.85	36.34	1.09	7.93	2.32	10.62	79.59	2.39	17.37
2x525 hp Aft Cranes (Cat 3408)	RECIP.<600hp diesel	1050	51	1217	8	365	2.31	3.40	32.38	2.59	7.01	3.38	4.96	47.27	3.78	10.23
2X1368 hp Fire Water pump (Wartsila	RECIP.>600hp diesel	2736	132	3172	2	12	1.93	8.85	66.29	1.99	14.46	0.02	0.11	0.80	0.02	0.17
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	2500	121	2898	24	90	5.51	8.08	77.09	6.17	16.69	5.95	8.73	83.26	6.66	18.02
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	7200	348	6272	12	13	5.07	23.28	174.45	5.23	38.06	0.30	1.36	10.23	0.31	2.23
Offshore Supply Vessel	VESSELS>600hp diesel(support)	7200	348	3370	24	52	5.07	23.28	174.45	5.23	38.06	1.28	5.87	43.95	1.32	9.59
ROV Vessel	VESSELS>600hp diesel (multi-serv	12000	580	2334	24	52	8.46	38.80	290.75	8.72	63.44	0.89	4.06	30.44	0.91	6.64
	MISC.	BPD	SCF/HR	COUNT												
	FLARE-		560		24	365		0.00	0.04	0.03	0.22		0.00	0.18	0.15	0.95
	FLARE-		2083333		24	30		1.24	148.75	125.62	809.37		0.44	53.55	45.22	291.37
	FUGITIVES-			25000		365				12.50					54.75	
	GLYCOL STILL VENT- VRU controlled		8333333		24	347				0.00					0.00	
	GLYCOL STILL VENT- Uncontrolled		8333333		24	347				55.00					229.02	
2011 YEAR TOTAL							**66.22**	**651.23**	**3590.95**	**241.15**	**1211.08**	**51.36**	**224.09**	**2829.51**	**366.46**	**700.72**
EXEMPTION CALCULATION	**DISTANCE FROM LAND IN MILES**											**2131.20**	**2131.20**	**2131.20**	**2131.20**	**54400.00**
	64.0															

Emissions #2

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT	PHONE	REMARKS
BP Exploration & Production Inc	Mississippi Canyon	issions- MC778,	09866-09867,	1erse PDQ, MODU	8 Water Injection Wells at MC777 & MC776		Jim Pfeiffer (Air Quality); Bekki W	281-366-1542 (J	Supplemental DOCD - Thunderhorse Project

OPERATIONS	EQUIPMENT	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS				
	Diesel Engines	HP	GAL/HR	GAL/D												
	Nat. Gas Engines	HP	SCF/HR	SCF/D												
	Burners	MMBTU/HR	SCF/HR	SCF/D	HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
DRILLING: MODU Enterprise																
Mains- 6 x Wartsilla 18V32 LNE (9772 hp ea)	PRIME MOVER>600hp diesel	58632	2832	12779	24	180	41.33	189.59	1420.60	42.62	309.95	16.78	77.00	576.95	17.31	125.88
Mains- 2X Wartsilla 12V32 LNE (6515 hp ea)	PRIME MOVER>600hp diesel	13030	629	2840	24	180	9.18	42.13	315.70	9.47	68.88	3.73	17.11	128.23	3.85	27.98
E-gen-Wartsilla 6R32 LNE (3257 hp)	AUXILIARY EQUIP>600hp diesel	3257	157	702	2	180	2.30	10.53	78.91	2.37	17.22	0.08	0.35	2.64	0.08	0.58
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	2500	121	544	24	45	5.51	8.08	77.09	6.17	16.69	0.56	0.82	7.81	0.63	1.69
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	7200	348	6272	6	60	5.07	23.28	174.45	5.23	38.06	0.69	3.15	23.60	0.71	5.15
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
Offshore Supply Vessel #2	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
Offshore Supply Vessel #3	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
PIPELINE INSTALLATION:																
Deep Blue	VESSELS>600hp diesel (offshore c	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Skandi Neptune	VESSELS>600hp diesel (multi-serv	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BOA Sub C	VESSELS>600hp diesel (offshore s	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FACILITY	DERRICK BARGE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTALLATION	MATERIAL TUG diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(supply)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PRODUCTION:																
5 x GE LM2500 turbine	TURBINE nat gas	29745	283291	6798993	24	160	1.91	0.16	170.35	0.61	23.69	3.66	0.31	327.06	1.17	45.49
(dual fuel)	TURBINE nat gas	29745	283291	6798993	24	160	1.91	0.16	170.35	0.61	23.69	3.66	0.31	327.06	1.17	45.49
	TURBINE nat gas	29745	283291	6798993	24	160	1.91	0.16	170.35	0.61	23.69	3.66	0.31	327.06	1.17	45.49
	TURBINE nat gas	29745	283291	6798993	24	160	1.91	0.16	170.35	0.61	23.69	3.66	0.31	327.06	1.17	45.49
	TURBINE nat gas	29745	283291	6798993	24	160	1.91	0.16	170.35	0.61	23.69	3.66	0.31	327.06	1.17	45.49
LM2500s on diesel fuel	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
(emergency only)	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
2X7188 hp Aux Gen (Wartsila 18V26)	RECIP.>600hp diesel	14376	694	16665	24	125	10.13	46.48	348.32	10.45	76.00	15.20	69.73	522.48	15.67	113.99
2816 hp E Gen (Wartsila 12V200)	RECIP.>600hp diesel	2816	136	3264	24	8	1.98	9.11	68.23	2.05	14.89	0.19	0.87	6.55	0.20	1.43
382 hp Hurricane Gen (Cat 3306TA)	RECIP.<600hp diesel	382	18	443	24	10	0.84	1.24	11.78	0.94	2.55	0.10	0.15	1.41	0.11	0.31
2x750 hp Forward Cranes (Cat 3412)	RECIP.>600hp diesel	1500	72	1739	12	365	1.06	4.85	36.34	1.09	7.93	2.32	10.62	79.59	2.39	17.37
2x525 hp Aft Cranes (Cat 3408)	RECIP.<600hp diesel	1050	51	1217	8	365	2.31	3.40	32.38	2.59	7.01	3.38	4.96	47.27	3.78	10.23
2X1368 hp Fire Water pump (Wartsila	RECIP.>600hp diesel	2736	132	3172	2	12	1.93	8.85	66.29	1.99	14.46	0.02	0.11	0.80	0.02	0.17
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	2500	121	2898	24	90	5.51	8.08	77.09	6.17	16.69	5.95	8.73	83.26	6.66	18.02
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	7200	348	6272	12	13	5.07	23.28	174.45	5.23	38.06	0.30	1.36	10.23	0.31	2.23
Offshore Supply Vessel	VESSELS>600hp diesel(support)	7200	348	3370	24	52	5.07	23.28	174.45	5.23	38.06	1.28	5.87	43.95	1.32	9.59
ROV Vessel	VESSELS>600hp diesel (multi-serv	12000	580	2334	24	52	8.46	38.80	290.75	8.72	63.44	0.89	4.06	30.44	0.91	6.64
	MISC.	**BPD**	**SCF/HR**	**COUNT**												
	FLARE-		560		24	365		0.00	0.04	0.03	0.22		0.00	0.18	0.15	0.95
	FLARE-		2083333		24	30		1.24	148.75	125.62	809.37		0.44	53.55	45.22	291.37
	FUGITIVES-			25000		365				12.50					54.75	
	GLYCOL STILL VENT- VRU controlled		8333333		24	347				0.00					0.00	
	GLYCOL STILL VENT- Uncontrolled		8333333		24	347				55.00					229.02	
2012 YEAR TOTAL							**144.83**	**994.69**	**6181.06**	**322.70**	**1776.06**	**79.83**	**352.98**	**3796.96**	**395.88**	**911.79**
EXEMPTION CALCULATION	**DISTANCE FROM LAND IN MILES**											**2131.20**	**2131.20**	**2131.20**	**2131.20**	**54400.00**
	64.0															

Emissions #3

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT			PHONE	REMARKS					
BP Exploration & Production Inc	Mississippi Canyon	issions- MC778,	09866-09867, 14rze PDQ; MODU		8 Water Injection Wells at MC777 & MC776		Jim Pfeiffer (Air Quality); Bekki W			281-366-1542 (a	Supplemental DOCD - Thunderhorse Project					
OPERATIONS	EQUIPMENT	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS				
	Diesel Engines	HP	GAL/HR	GAL/D												
	Nat. Gas Engines	HP	SCF/HR	SCF/D												
	Burners	MMBTU/HR	SCF/HR	SCF/D	HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
DRILLING: MODU Enterprise																
Mains- 6 x Wartsilla 18V32 LNE (9772 hp ea)	PRIME MOVER>600hp diesel	58632	2832	12779	24	180	41.33	189.59	1420.60	42.62	309.95	16.78	77.00	576.95	17.31	125.88
Mains- 2X Wartsilla 12V32 LNE (6515 hp ea)	PRIME MOVER>600hp diesel	13030	629	2840	24	180	9.18	42.13	315.70	9.47	68.88	3.73	17.11	128.23	3.85	27.98
E-gen-Wartsilla 6R32 LNE (3257 hp)	AUXILIARY EQUIP>600hp diesel	3257	157	702	2	180	2.30	10.53	78.91	2.37	17.22	0.08	0.35	2.64	0.08	0.58
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	2500	121	544	24	45	5.51	8.08	77.09	6.17	16.69	0.56	0.82	7.81	0.63	1.69
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	7200	348	6272	6	60	5.07	23.28	174.45	5.23	38.06	0.69	3.15	23.60	0.71	5.15
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
Offshore Supply Vessel #2	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
Offshore Supply Vessel #3	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
PIPELINE INSTALLATION:																
Deep Blue	VESSELS>600hp diesel (offshore c	46341	2238	53718	24	42	32.66	149.84	1122.80	33.68	244.97	16.46	75.52	565.89	16.98	123.47
Skandi Neptune	VESSELS>600hp diesel (multi-serv	13685	661	15864	24	56	9.65	44.25	331.57	9.95	72.34	6.48	29.74	222.82	6.68	48.61
BOA Sub C	VESSELS>600hp diesel (offshore s	32124	1552	37238	24	12	22.64	103.87	778.33	23.35	169.82	3.26	14.96	112.08	3.36	24.45
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	7200	348	8346	24	63	5.07	23.28	174.45	5.23	38.06	3.84	17.60	131.88	3.96	28.77
FACILITY	DERRICK BARGE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTALLATION	MATERIAL TUG diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(supply)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PRODUCTION:																
5 x GE LM2500 turbine	TURBINE nat gas	29745	283291	6798993	24	200	1.91	0.16	170.35	0.61	23.69	4.58	0.39	408.83	1.46	56.87
(dual fuel)	TURBINE nat gas	29745	283291	6798993	24	200	1.91	0.16	170.35	0.61	23.69	4.58	0.39	408.83	1.46	56.87
	TURBINE nat gas	29745	283291	6798993	24	200	1.91	0.16	170.35	0.61	23.69	4.58	0.39	408.83	1.46	56.87
	TURBINE nat gas	29745	283291	6798993	24	200	1.91	0.16	170.35	0.61	23.69	4.58	0.39	408.83	1.46	56.87
	TURBINE nat gas	29745	283291	6798993	24	200	1.91	0.16	170.35	0.61	23.69	4.58	0.39	408.83	1.46	56.87
LM2500s on diesel fuel	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
(emergency only)	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
2X7188 hp Aux Gen (Wartsila 18V26)	RECIP.>600hp diesel	14376	694	16665	24	125	10.13	46.48	348.32	10.45	76.00	15.20	69.73	522.48	15.67	113.99
2816 hp E Gen (Wartsila 12V200)	RECIP.>600hp diesel	2816	136	3264	24	8	1.98	9.11	68.23	2.05	14.89	0.19	0.87	6.55	0.20	1.43
382 hp Hurricane Gen (Cat 3306TA)	RECIP.<600hp diesel	382	18	443	24	10	0.84	1.24	11.78	0.94	2.55	0.10	0.15	1.41	0.11	0.31
2x750 hp Forward Cranes (Cat 3412)	RECIP.>600hp diesel	1500	72	1739	12	365	1.06	4.85	36.34	1.09	7.93	2.32	10.62	79.59	2.39	17.37
2x525 hp Aft Cranes (Cat 3408)	RECIP.<600hp diesel	1050	51	1217	8	365	2.31	3.40	32.38	2.59	7.01	3.38	4.96	47.27	3.78	10.23
2X1368 hp Fire Water pump (Wartsila	RECIP.>600hp diesel	2736	132	3172	2	12	1.93	8.85	66.29	1.99	14.46	0.02	0.11	0.80	0.02	0.17
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	2500	121	2898	24	90	5.51	8.08	77.09	6.17	16.69	5.95	8.73	83.26	6.66	18.02
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	7200	348	6272	12	13	5.07	23.28	174.45	5.23	38.06	0.30	1.36	10.23	0.31	2.23
Offshore Supply Vessel	VESSELS>600hp diesel(support)	7200	348	3370	24	52	5.07	23.28	174.45	5.23	38.06	1.28	5.87	43.95	1.32	9.59
ROV Vessel	VESSELS>600hp diesel (multi-serv	12000	580	2334	24	52	8.46	38.80	290.75	8.72	63.44	0.89	4.06	30.44	0.91	6.64
	MISC.	BPD	SCF/HR	COUNT												
	FLARE-		560		24	365		0.00	0.04	0.03	0.22		0.00	0.18	0.15	0.95
	FLARE-		2083333		24	30		1.24	148.75	125.62	809.37		0.44	53.55	45.22	291.37
	FUGITIVES-			25000		365				12.50					54.75	
	GLYCOL STILL VENT- VRU controlled		8333333		24	347				0.00					0.00	
	GLYCOL STILL VENT- Uncontrolled		8333333		24	347				55.00					229.02	
2013 YEAR TOTAL							214.86	1315.93	8588.22	394.92	2301.26	114.45	491.19	5238.46	428.31	1193.97
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES											2131.20	2131.20	2131.20	2131.20	54400.00
	64.0															

Emissions # 4

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT	PHONE	REMARKS
BP Exploration & Production Inc	Mississippi Canyon	ssions- MC778,	09866-09867,	1-se PD/Q; MODU	8 Water Injection Wells at MC777 & MC776		Jim Pfeiffer (Air Quality); Bekki W	281-366-1542 (J	Supplemental DOCD - Thunderhorse Project

OPERATIONS	EQUIPMENT	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS				
	Diesel Engines	HP	GAL/HR	GAL/D												
	Nat. Gas Engines	HP	SCF/HR	SCF/D												
	Burners	MMBTU/HR	SCF/HR	SCF/D	HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
DRILLING: MODU Enterprise																
Mains- 6 x Wartsilla 18V32 LNE (9772 hp ea)	PRIME MOVER>600hp diesel	0	0	12779	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mains- 2X Wartsilla 12V32 LNE (6515 hp ea)	PRIME MOVER>600hp diesel	0	0	2840	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E-gen-Wartsilla 6R32 LNE (3257 hp)	AUXILIARY EQUIP>600hp diesel	0	0	702	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	0	0	544	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	0	0	6272	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	0	0	3370	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel #2	VESSELS>600hp diesel(support)	0	0	3370	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel #3	VESSELS>600hp diesel(support)	0	0	3370	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPELINE INSTALLATION:																
Deep Blue	VESSELS>600hp diesel (offshore c	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Skandi Neptune	VESSELS>600hp diesel (multi-serv	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BOA Sub C	VESSELS>600hp diesel (offshore s	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FACILITY	DERRICK BARGE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTALLATION	MATERIAL TUG diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(supply)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PRODUCTION:																
5 x GE LM2500 turbine	TURBINE nat gas	29745	283291	6798993	24	200	1.91	0.16	170.35	0.61	23.69	4.58	0.39	408.83	1.46	56.87
(dual fuel)	TURBINE nat gas	29745	283291	6798993	24	200	1.91	0.16	170.35	0.61	23.69	4.58	0.39	408.83	1.46	56.87
	TURBINE nat gas	29745	283291	6798993	24	200	1.91	0.16	170.35	0.61	23.69	4.58	0.39	408.83	1.46	56.87
	TURBINE nat gas	29745	283291	6798993	24	200	1.91	0.16	170.35	0.61	23.69	4.58	0.39	408.83	1.46	56.87
	TURBINE nat gas	29745	283291	6798993	24	200	1.91	0.16	170.35	0.61	23.69	4.58	0.39	408.83	1.46	56.87
LM2500s on diesel fuel	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
(emergency only)	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
2X7188 hp Aux Gen (Wartsila 18V26)	RECIP.>600hp diesel	14376	694	16665	24	125	10.13	46.48	348.32	10.45	76.00	15.20	69.73	522.48	15.67	113.99
2816 hp E Gen (Wartsila 12V200)	RECIP.>600hp diesel	2816	136	3264	24	8	1.98	9.11	68.23	2.05	14.89	0.19	0.87	6.55	0.20	1.43
382 hp Hurricane Gen (Cat 3306TA)	RECIP.<600hp diesel	382	18	443	24	10	0.84	1.24	11.78	0.94	2.55	0.10	0.15	1.41	0.11	0.31
2x750 hp Forward Cranes (Cat 3412)	RECIP.>600hp diesel	1500	72	1739	12	365	1.06	4.85	36.34	1.09	7.93	2.32	10.62	79.59	2.39	17.37
2x525 hp Aft Cranes (Cat 3408)	RECIP.<600hp diesel	1050	51	1217	8	365	2.31	3.40	32.38	2.59	7.01	3.38	4.96	47.27	3.78	10.23
2X1368 hp Fire Water pump (Wartsila	RECIP.>600hp diesel	2736	132	3172	2	12	1.93	8.85	66.29	1.99	14.46	0.02	0.11	0.80	0.02	0.17
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	2500	121	2898	24	90	5.51	8.08	77.09	6.17	16.69	5.95	8.73	83.26	6.66	18.02
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	7200	348	6272	12	13	5.07	23.28	174.45	5.23	38.06	0.30	1.36	10.23	0.31	2.23
Offshore Supply Vessel	VESSELS>600hp diesel(support)	7200	348	3370	24	52	5.07	23.28	174.45	5.23	38.06	1.28	5.87	43.95	1.32	9.59
ROV Vessel	VESSELS>600hp diesel (multi-serv	12000	580	2334	24	52	8.46	38.80	290.75	8.72	63.44	0.89	4.06	30.44	0.91	6.64
	MISC.	BPD	SCF/HR	COUNT												
	FLARE-		560		24	365		0.00	0.04	0.03	0.22		0.00	0.18	0.15	0.95
	FLARE-		2083333		24	30		1.24	148.75	125.62	809.37		0.44	53.55	45.22	291.37
	FUGITIVES-			25000		365				12.50					54.75	
	GLYCOL STILL VENT- VRU controlled		8333333		24	347				0.00					0.00	
	GLYCOL STILL VENT- Uncontrolled		8333333		24	347				55.00					229.02	
2014 YEAR TOTAL							**66.22**	**651.23**	**3590.95**	**241.15**	**1211.08**	**55.93**	**224.48**	**3238.34**	**367.92**	**757.59**
EXEMPTION CALCULATION	**DISTANCE FROM LAND IN MILES**											**2131.20**	**2131.20**	**2131.20**	**2131.20**	**54400.00**
	64.0															

Emissions #5

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT	PHONE	REMARKS
BP Exploration & Production Inc	Mississippi Canyon	ssions- MC778,	09866-09867,	se PDQ; MODU	8 Water Injection Wells at MC777 & MC776		Jim Pfeiffer (Air Quality); Bekki W	281-366-1542 (J	Supplemental DOCD - Thunderhorse Project

OPERATIONS	EQUIPMENT	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS				
	Diesel Engines	HP	GAL/HR	GAL/D												
	Nat. Gas Engines	HP	SCF/HR	SCF/D												
	Burners	MMBTU/HR	SCF/HR	SCF/D	HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
DRILLING: MODU Enterprise																
Mains- 6 x Wartsilla 18V32 LNE (9772 hp ea)	PRIME MOVER>600hp diesel	58632	2832	12779	24	180	41.33	189.59	1420.60	42.62	309.95	16.78	77.00	576.95	17.31	125.88
Mains- 2X Wartsilla 12V32 LNE (6515 hp ea)	PRIME MOVER>600hp diesel	13030	629	2840	24	180	9.18	42.13	315.70	9.47	68.88	3.73	17.11	128.23	3.85	27.98
E-gen-Wartsilla 6R32 LNE (3257 hp)	AUXILIARY EQUIP>600hp diesel	3257	157	702	2	180	2.30	10.53	78.91	2.37	17.22	0.08	0.35	2.64	0.08	0.58
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	2500	121	544	24	45	5.51	8.08	77.09	6.17	16.69	0.56	0.82	7.81	0.63	1.69
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	7200	348	6272	6	60	5.07	23.28	174.45	5.23	38.06	0.69	3.15	23.60	0.71	5.15
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
Offshore Supply Vessel #2	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
Offshore Supply Vessel #3	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
PIPELINE INSTALLATION:																
Deep Blue	VESSELS>600hp diesel (offshore c	46341	2238	53718	24	14	32.66	149.84	1122.80	33.68	244.97	5.49	25.17	188.63	5.66	41.16
Skandi Neptune	VESSELS>600hp diesel (multi-serv	13685	661	15864	24	28	9.65	44.25	331.57	9.95	72.34	3.24	14.87	111.41	3.34	24.31
BOA Sub C	VESSELS>600hp diesel (offshore s	32124	1552	37238	24	6	22.64	103.87	778.33	23.35	169.82	1.63	7.48	56.04	1.68	12.23
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	7200	348	8346	24	14	5.07	23.28	174.45	5.23	38.06	0.85	3.91	29.31	0.88	6.39
FACILITY	DERRICK BARGE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTALLATION	MATERIAL TUG diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(supply)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PRODUCTION:																
5 x GE LM2500 turbine	TURBINE nat gas	29745	283291	6798993	24	280	1.91	0.16	170.35	0.61	23.69	6.41	0.54	572.36	2.04	79.61
(dual fuel)	TURBINE nat gas	29745	283291	6798993	24	280	1.91	0.16	170.35	0.61	23.69	6.41	0.54	572.36	2.04	79.61
	TURBINE nat gas	29745	283291	6798993	24	280	1.91	0.16	170.35	0.61	23.69	6.41	0.54	572.36	2.04	79.61
	TURBINE nat gas	29745	283291	6798993	24	280	1.91	0.16	170.35	0.61	23.69	6.41	0.54	572.36	2.04	79.61
	TURBINE nat gas	29745	283291	6798993	24	280	1.91	0.16	170.35	0.61	23.69	6.41	0.54	572.36	2.04	79.61
LM2500s on diesel fuel	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
(emergency only)	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
2X7188 hp Aux Gen (Wartsila 18V26)	RECIP.>600hp diesel	14376	694	16665	24	125	10.13	46.48	348.32	10.45	76.00	15.20	69.73	522.48	15.67	113.99
2816 hp E Gen (Wartsila 12V200)	RECIP.>600hp diesel	2816	136	3264	24	8	1.98	9.11	68.23	2.05	14.89	0.19	0.87	6.55	0.20	1.43
382 hp Hurricane Gen (Cat 3306TA)	RECIP.<600hp diesel	382	18	443	24	10	0.84	1.24	11.78	0.94	2.55	0.10	0.15	1.41	0.11	0.31
2x750 hp Forward Cranes (Cat 3412)	RECIP.>600hp diesel	1500	72	1739	12	365	1.06	4.85	36.34	1.09	7.93	2.32	10.62	79.59	2.39	17.37
2x525 hp Aft Cranes (Cat 3408)	RECIP.<600hp diesel	1050	51	1217	8	365	2.31	3.40	32.38	2.59	7.01	3.38	4.96	47.27	3.78	10.23
2X1368 hp Fire Water pump (Wartsila	RECIP.>600hp diesel	2736	132	3172	2	12	1.93	8.85	66.29	1.99	14.46	0.02	0.11	0.80	0.02	0.17
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	2500	121	2898	24	90	5.51	8.08	77.09	6.17	16.69	5.95	8.73	83.26	6.66	18.02
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	7200	348	6272	12	13	5.07	23.28	174.45	5.23	38.06	0.30	1.36	10.23	0.31	2.23
Offshore Supply Vessel	VESSELS>600hp diesel(support)	7200	348	3370	24	52	5.07	23.28	174.45	5.23	38.06	1.28	5.87	43.95	1.32	9.59
ROV Vessel	VESSELS>600hp diesel (multi-serv	12000	580	2334	24	52	8.46	38.80	290.75	8.72	63.44	0.89	4.06	30.44	0.91	6.64
	MISC.	BPD	SCF/HR	COUNT												
	FLARE-		560		24	365		0.00	0.04	0.03	0.22		0.00	0.18	0.15	0.95
	FLARE-		2083333		24	30		1.24	148.75	125.62	809.37		0.44	53.55	45.22	291.37
	FUGITIVES-			25000		365				12.50					54.75	
	GLYCOL STILL VENT- VRU controlled		8333333		24	347				0.00					0.00	
	GLYCOL STILL VENT- Uncontrolled		8333333		24	347				55.00					229.02	
2015 YEAR TOTAL							214.86	1315.93	8588.22	394.92	2301.26	104.78	405.58	5408.84	411.81	1166.47
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES											2131.20	2131.20	2131.20	2131.20	54400.00
	64.0															

Emissions #6

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT	PHONE	REMARKS
BP Exploration & Production Inc	Mississippi Canyon	ssions- MC778,	09866-09867,	se PDQ; MODU	8 Water Injection Wells at MC777 & MC776		Jim Pfeiffer (Air Quality); Bekki W	281-366-1542 (J	Supplemental DOCD - Thunderhorse Project

OPERATIONS	EQUIPMENT	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS				
	Diesel Engines	HP	GAL/HR	GAL/D												
	Nat. Gas Engines	HP	SCF/HR	SCF/D												
	Burners	MMBTU/HR	SCF/HR	SCF/D	HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
DRILLING: MODU Enterprise																
Mains- 6 x Wartsilla 18V32 LNE (9772 hp ea)	PRIME MOVER>600hp diesel	58632	2832	12779	24	365	41.33	189.59	1420.60	42.62	309.95	34.03	156.13	1169.93	35.10	255.26
Mains- 2X Wartsilla 12V32 LNE (6515 hp ea)	PRIME MOVER>600hp diesel	13030	629	2840	24	365	9.18	42.13	315.70	9.47	68.88	7.56	34.70	260.02	7.80	56.73
E-gen-Wartsilla 6R32 LNE (3257 hp)	AUXILIARY EQUIP>600hp diesel	3257	157	702	2	365	2.30	10.53	78.91	2.37	17.22	0.16	0.71	5.36	0.16	1.17
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	2500	121	544	24	91	5.51	8.08	77.09	6.17	16.69	1.13	1.66	15.85	1.27	3.43
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	7200	348	6272	6	122	5.07	23.28	174.45	5.23	38.06	1.39	6.39	47.85	1.44	10.44
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	7200	348	3370	24	183	5.07	23.28	174.45	5.23	38.06	4.49	20.59	154.26	4.63	33.66
Offshore Supply Vessel #2	VESSELS>600hp diesel(support)	7200	348	3370	24	183	5.07	23.28	174.45	5.23	38.06	4.49	20.59	154.26	4.63	33.66
Offshore Supply Vessel #3	VESSELS>600hp diesel(support)	7200	348	3370	24	183	5.07	23.28	174.45	5.23	38.06	4.49	20.59	154.26	4.63	33.66
PIPELINE INSTALLATION:																
Deep Blue	VESSELS>600hp diesel (offshore c	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Skandi Neptune	VESSELS>600hp diesel (multi-serv	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BOA Sub C	VESSELS>600hp diesel (offshore s	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FACILITY	DERRICK BARGE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTALLATION	MATERIAL TUG diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(supply)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PRODUCTION:																
5 x GE LM2500 turbine	TURBINE nat gas	29745	283291	6798993	24	280	1.91	0.16	170.35	0.61	23.69	6.41	0.54	572.36	2.04	79.61
(dual fuel)	TURBINE nat gas	29745	283291	6798993	24	280	1.91	0.16	170.35	0.61	23.69	6.41	0.54	572.36	2.04	79.61
	TURBINE nat gas	29745	283291	6798993	24	280	1.91	0.16	170.35	0.61	23.69	6.41	0.54	572.36	2.04	79.61
	TURBINE nat gas	29745	283291	6798993	24	280	1.91	0.16	170.35	0.61	23.69	6.41	0.54	572.36	2.04	79.61
	TURBINE nat gas	29745	283291	6798993	24	280	1.91	0.16	170.35	0.61	23.69	6.41	0.54	572.36	2.04	79.61
LM2500s on diesel fuel	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
(emergency only)	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
2X7188 hp Aux Gen (Wartsila 18V26)	RECIP.>600hp diesel	14376	694	16665	24	125	10.13	46.48	348.32	10.45	76.00	15.20	69.73	522.48	15.67	113.99
2816 hp E Gen (Wartsila 12V200)	RECIP.>600hp diesel	2816	136	3264	24	8	1.98	9.11	68.23	2.05	14.89	0.19	0.87	6.55	0.20	1.43
382 hp Hurricane Gen (Cat 3306TA)	RECIP.<600hp diesel	382	18	443	24	10	0.84	1.24	11.78	0.94	2.55	0.10	0.15	1.41	0.11	0.31
2x750 hp Forward Cranes (Cat 3412)	RECIP.>600hp diesel	1500	72	1739	12	365	1.06	4.85	36.34	1.09	7.93	2.32	10.62	79.59	2.39	17.37
2x525 hp Aft Cranes (Cat 3408)	RECIP.<600hp diesel	1050	51	1217	8	365	2.31	3.40	32.38	2.59	7.01	3.38	4.96	47.27	3.78	10.23
2X1368 hp Fire Water pump (Wartsila	RECIP.>600hp diesel	2736	132	3172	2	12	1.93	8.85	66.29	1.99	14.46	0.02	0.11	0.80	0.02	0.17
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	2500	121	2898	24	90	5.51	8.08	77.09	6.17	16.69	5.95	8.73	83.26	6.66	18.02
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	7200	348	6272	12	13	5.07	23.28	174.45	5.23	38.06	0.30	1.36	10.23	0.31	2.23
Offshore Supply Vessel	VESSELS>600hp diesel(support)	7200	348	3370	24	52	5.07	23.28	174.45	5.23	38.06	1.28	5.87	43.95	1.32	9.59
ROV Vessel	VESSELS>600hp diesel (multi-serv	12000	580	2334	24	52	8.46	38.80	290.75	8.72	63.44	0.89	4.06	30.44	0.91	6.64
	MISC.	BPD	SCF/HR	COUNT												
	FLARE-		560		24	365		0.00	0.04	0.03	0.22		0.00	0.18	0.15	0.95
	FLARE-		2083333		24	30		1.24	148.75	125.62	809.37		0.44	53.55	45.22	291.37
	FUGITIVES-			25000		365				12.50					54.75	
	GLYCOL STILL VENT- VRU controlled		8333333		24	347				0.00					0.00	
	GLYCOL STILL VENT- Uncontrolled		8333333		24	347				55.00					229.02	
2016 YEAR TOTAL							**144.83**	**994.69**	**6181.06**	**322.70**	**1776.06**	**122.83**	**486.61**	**6017.78**	**430.48**	**1299.32**
EXEMPTION CALCULATION	**DISTANCE FROM LAND IN MILES**											**2131.20**	**2131.20**	**2131.20**	**2131.20**	**54400.00**
	64.0															

Emissions #7

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT	PHONE	REMARKS
BP Exploration & Production Inc	Mississippi Canyon	ssions- MC778,	09866-09867, 1	se PDQ; MODU	8 Water Injection Wells at MC777 & MC776		Jim Pfeiffer (Air Quality); Bekki W	281-366-1542 (a	Supplemental DOCD - Thunderhorse Project

OPERATIONS	EQUIPMENT	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS				
	Diesel Engines	HP	GAL/HR	GAL/D												
	Nat. Gas Engines	HP	SCF/HR	SCF/D												
	Burners	MMBTU/HR	SCF/HR	SCF/D	HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
DRILLING: MODU Enterprise																
Mains- 6 x Wartsilla 18V32 LNE (9772 hp ea)	PRIME MOVER>600hp diesel	58632	2832	12779	24	180	41.33	189.59	1420.60	42.62	309.95	16.78	77.00	576.95	17.31	125.88
Mains- 2X Wartsilla 12V32 LNE (6515 hp ea)	PRIME MOVER>600hp diesel	13030	629	2840	24	180	9.18	42.13	315.70	9.47	68.88	3.73	17.11	128.23	3.85	27.98
E-gen-Wartsilla 6R32 LNE (3257 hp)	AUXILIARY EQUIP>600hp diesel	3257	157	702	2	180	2.30	10.53	78.91	2.37	17.22	0.08	0.35	2.64	0.08	0.58
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	2500	121	544	24	45	5.51	8.08	77.09	6.17	16.69	0.56	0.82	7.81	0.63	1.69
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	7200	348	6272	6	60	5.07	23.28	174.45	5.23	38.06	0.69	3.15	23.60	0.71	5.15
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
Offshore Supply Vessel #2	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
Offshore Supply Vessel #3	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
PIPELINE INSTALLATION:																
Deep Blue	VESSELS>600hp diesel (offshore c	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Skandi Neptune	VESSELS>600hp diesel (multi-serv	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BOA Sub C	VESSELS>600hp diesel (offshore s	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FACILITY	DERRICK BARGE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTALLATION	MATERIAL TUG diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(supply)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PRODUCTION:																
5 x GE LM2500 turbine	TURBINE nat gas	29745	283291	6798993	24	280	1.91	0.16	170.35	0.61	23.69	6.41	0.54	572.36	2.04	79.61
(dual fuel)	TURBINE nat gas	29745	283291	6798993	24	280	1.91	0.16	170.35	0.61	23.69	6.41	0.54	572.36	2.04	79.61
	TURBINE nat gas	29745	283291	6798993	24	280	1.91	0.16	170.35	0.61	23.69	6.41	0.54	572.36	2.04	79.61
	TURBINE nat gas	29745	283291	6798993	24	280	1.91	0.16	170.35	0.61	23.69	6.41	0.54	572.36	2.04	79.61
	TURBINE nat gas	29745	283291	6798993	24	280	1.91	0.16	170.35	0.61	23.69	6.41	0.54	572.36	2.04	79.61
LM2500s on diesel fuel	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
(emergency only)	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
2X7188 hp Aux Gen (Wartsila 18V26)	RECIP.>600hp diesel	14376	694	16665	24	125	10.13	46.48	348.32	10.45	76.00	15.20	69.73	522.48	15.67	113.99
2816 hp E Gen (Wartsila 12V200)	RECIP.>600hp diesel	2816	136	3264	24	8	1.98	9.11	68.23	2.05	14.89	0.19	0.87	6.55	0.20	1.43
382 hp Hurricane Gen (Cat 3306TA)	RECIP.<600hp diesel	382	18	443	24	10	0.84	1.24	11.78	0.94	2.55	0.10	0.15	1.41	0.11	0.31
2x750 hp Forward Cranes (Cat 3412)	RECIP.>600hp diesel	1500	72	1739	12	365	1.06	4.85	36.34	1.09	7.93	2.32	10.62	79.59	2.39	17.37
2x525 hp Aft Cranes (Cat 3408)	RECIP.<600hp diesel	1050	51	1217	8	365	2.31	3.40	32.38	2.59	7.01	3.38	4.96	47.27	3.78	10.23
2X1368 hp Fire Water pump (Wartsila	RECIP.>600hp diesel	2736	132	3172	2	12	1.93	8.85	66.29	1.99	14.46	0.02	0.11	0.80	0.02	0.17
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	2500	121	2898	24	90	5.51	8.08	77.09	6.17	16.69	5.95	8.73	83.26	6.66	18.02
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	7200	348	6272	12	13	5.07	23.28	174.45	5.23	38.06	0.30	1.36	10.23	0.31	2.23
Offshore Supply Vessel	VESSELS>600hp diesel(support)	7200	348	3370	24	52	5.07	23.28	174.45	5.23	38.06	1.28	5.87	43.95	1.32	9.59
ROV Vessel	VESSELS>600hp diesel (multi-serv	12000	580	2334	24	52	8.46	38.80	290.75	8.72	63.44	0.89	4.06	30.44	0.91	6.64
	MISC.	BPD	SCF/HR	COUNT												
	FLARE-		560		24	365		0.00	0.04	0.03	0.22		0.00	0.18	0.15	0.95
	FLARE-		2083333		24	30		1.24	148.75	125.62	809.37		0.44	53.55	45.22	291.37
	FUGITIVES-			25000		365				12.50					54.75	
	GLYCOL STILL VENT- VRU controlled		8333333		24	347				0.00					0.00	
	GLYCOL STILL VENT- Uncontrolled		8333333		24	347				55.00					229.02	
2017 YEAR TOTAL							144.83	994.69	6181.06	322.70	1776.06	93.56	354.15	5023.45	400.25	1082.39
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES											2131.20	2131.20	2131.20	2131.20	54400.00
	64.0															

Emissions #8

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT	PHONE	REMARKS
BP Exploration & Product	Mississippi Canyon	ssions- MC778,	09866-09867,	rse PDQ; MODU	8 Water Injection Wells at MC777 & MC776		Jim Pfeiffer (Air Quality); Bekki W	281-366-1542 (J	Supplemental DOCD - Thunderhorse Project

OPERATIONS	EQUIPMENT	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS				
	Diesel Engines	HP	GAL/HR	GAL/D												
	Nat. Gas Engines	HP	SCF/HR	SCF/D												
	Burners	MMBTU/HR	SCF/HR	SCF/D	HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
DRILLING: MODU																
Enterprise Mains- 6 x Wartsilla 18V32 LNE (9772 hp ea)	PRIME MOVER>600hp diesel	58632	2832	12779	24	180	41.33	189.59	1420.60	42.62	309.95	16.78	77.00	576.95	17.31	125.88
Mains- 2X Wartsilla 12V32 LNE (6515 hp ea)	PRIME MOVER>600hp diesel	13030	629	2840	24	180	9.18	42.13	315.70	9.47	68.88	3.73	17.11	128.23	3.85	27.98
E-gen-Wartsilla 6R3	AUXILIARY EQUIP>600hp diesel	3257	157	702	2	180	2.30	10.53	78.91	2.37	17.22	0.08	0.35	2.64	0.08	0.58
Small and Large Aux	AUXILIARY EQUIP<600hp diesel	2500	121	544	24	45	5.51	8.08	77.09	6.17	16.69	0.56	0.82	7.81	0.63	1.69
Fast Supply Vessel/	VESSELS>600hp diesel(crew)	7200	348	6272	6	60	5.07	23.28	174.45	5.23	38.06	0.69	3.15	23.60	0.71	5.15
Offshore Supply Ves	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
Offshore Supply Ves	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
Offshore Supply Ves	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
PIPELINE INSTALLATION:																
Deep Blue	VESSELS>600hp diesel (offshore o	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Skandi Neptune	VESSELS>600hp diesel (multi-servi	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BOA Sub C	VESSELS>600hp diesel (offshore s	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Ves	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FACILITY INSTALLATION	DERRICK BARGE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	MATERIAL TUG diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(supply)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PRODUCTION:																
5 x GE LM2500 turbi	TURBINE nat gas	29745	283291	6798993	24	280	1.91	0.16	170.35	0.61	23.69	6.41	0.54	572.36	2.04	79.61
(dual fuel)	TURBINE nat gas	29745	283291	6798993	24	280	1.91	0.16	170.35	0.61	23.69	6.41	0.54	572.36	2.04	79.61
	TURBINE nat gas	29745	283291	6798993	24	280	1.91	0.16	170.35	0.61	23.69	6.41	0.54	572.36	2.04	79.61
	TURBINE nat gas	29745	283291	6798993	24	280	1.91	0.16	170.35	0.61	23.69	6.41	0.54	572.36	2.04	79.61
	TURBINE nat gas	29745	283291	6798993	24	280	1.91	0.16	170.35	0.61	23.69	6.41	0.54	572.36	2.04	79.61
LM2500s on diesel f	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
(emergency only)	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
2X7188 hp Aux Gen	RECIP.>600hp diesel	14376	694	16665	24	125	10.13	46.48	348.32	10.45	76.00	15.20	69.73	522.48	15.67	113.99
2816 hp E Gen (War	RECIP.>600hp diesel	2816	136	3264	24	8	1.98	9.11	68.23	2.05	14.89	0.19	0.87	6.55	0.20	1.43
382 hp Hurricane Ge	RECIP.<600hp diesel	382	18	443	24	10	0.84	1.24	11.78	0.94	2.55	0.10	0.15	1.41	0.11	0.31
2x750 hp Forward C	RECIP.>600hp diesel	1500	72	1739	12	365	1.06	4.85	36.34	1.09	7.93	2.32	10.62	79.59	2.39	17.37
2x525 hp Aft Cranes	RECIP.<600hp diesel	1050	51	1217	8	365	2.31	3.40	32.38	2.59	7.01	3.38	4.96	47.27	3.78	10.23
2X1368 hp Fire Wate	RECIP.>600hp diesel	2736	132	3172	2	12	1.93	8.85	66.29	1.99	14.46	0.02	0.11	0.80	0.02	0.17
Small and Large Aux	AUXILIARY EQUIP<600hp diesel	2500	121	2898	24	90	5.51	8.08	77.09	6.17	16.69	5.95	8.73	83.26	6.66	18.02
Fast Supply Vessel/	VESSELS>600hp diesel(crew)	7200	348	6272	12	13	5.07	23.28	174.45	5.23	38.06	0.30	1.36	10.23	0.31	2.23
Offshore Supply Ves	VESSELS>600hp diesel(support)	7200	348	3370	24	52	5.07	23.28	174.45	5.23	38.06	1.28	5.87	43.95	1.32	9.59
ROV Vessel	VESSELS>600hp diesel (multi-servi	12000	580	2334	24	52	8.46	38.80	290.75	8.72	63.44	0.89	4.06	30.44	0.91	6.64
	MISC.	BPD	SCF/HR	COUNT												
	FLARE-		560		24	365		0.00	0.04	0.03	0.22		0.00	0.18	0.15	0.95
	FLARE-		2083333		24	30		1.24	148.75	125.62	809.37		0.44	53.55	45.22	291.37
	FUGITIVES-			25000		365				12.50					54.75	
	GLYCOL STILL VENT- VRU controlled		8333333		24	347				0.00					0.00	
	GLYCOL STILL VENT- Uncontrolled		8333333		24	347				55.00					229.02	
2018 YEAR TOTAL							144.83	994.69	6181.06	322.70	1776.06	93.56	354.15	5023.45	400.25	1082.39
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES											2131.20	2131.20	2131.20	2131.20	54400.00
	64.0															

Emissions #9

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT	PHONE	REMARKS
BP Exploration & Production Inc	Mississippi Canyon	ssions- MC778,	09866-09867,	se PDQ; MODU	8 Water Injection Wells at MC777 & MC776		Jim Pfeiffer (Air Quality); Bekki W	281-366-1542 (J	Supplemental DOCD - Thunderhorse Project

OPERATIONS	EQUIPMENT	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS				
	Diesel Engines	HP	GAL/HR	GAL/D												
	Nat. Gas Engines	HP	SCF/HR	SCF/D												
	Burners	MMBTU/HR	SCF/HR	SCF/D	HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
DRILLING: MODU Enterprise																
Mains- 6 x Wartsilla 18V32 LNE (9772 hp ea)	PRIME MOVER>600hp diesel	0	0	12779	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mains- 2X Wartsilla 12V32 LNE (6515 hp ea)	PRIME MOVER>600hp diesel	0	0	2840	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E-gen-Wartsilla 6R32 LNE (3257 hp)	AUXILIARY EQUIP>600hp diesel	0	0	702	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	0	0	544	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	0	0	6272	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	0	0	3370	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel #2	VESSELS>600hp diesel(support)	0	0	3370	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel #3	VESSELS>600hp diesel(support)	0	0	3370	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPELINE INSTALLATION:																
Deep Blue	VESSELS>600hp diesel (offshore c	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Skandi Neptune	VESSELS>600hp diesel (multi-serv	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BOA Sub C	VESSELS>600hp diesel (offshore s	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FACILITY	DERRICK BARGE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTALLATION	MATERIAL TUG diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(supply)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PRODUCTION:																
5 x GE LM2500 turbine	TURBINE nat gas	29745	283291	6798993	24	280	1.91	0.16	170.35	0.61	23.69	6.41	0.54	572.36	2.04	79.61
(dual fuel)	TURBINE nat gas	29745	283291	6798993	24	280	1.91	0.16	170.35	0.61	23.69	6.41	0.54	572.36	2.04	79.61
	TURBINE nat gas	29745	283291	6798993	24	280	1.91	0.16	170.35	0.61	23.69	6.41	0.54	572.36	2.04	79.61
	TURBINE nat gas	29745	283291	6798993	24	280	1.91	0.16	170.35	0.61	23.69	6.41	0.54	572.36	2.04	79.61
	TURBINE nat gas	29745	283291	6798993	24	280	1.91	0.16	170.35	0.61	23.69	6.41	0.54	572.36	2.04	79.61
LM2500s on diesel fuel	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
(emergency only)	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
2X7188 hp Aux Gen (Wartsila 18V26)	RECIP.>600hp diesel	14376	694	16665	24	125	10.13	46.48	348.32	10.45	76.00	15.20	69.73	522.48	15.67	113.99
2816 hp E Gen (Wartsila 12V200)	RECIP.>600hp diesel	2816	136	3264	24	8	1.98	9.11	68.23	2.05	14.89	0.19	0.87	6.55	0.20	1.43
382 hp Hurricane Gen (Cat 3306TA)	RECIP.<600hp diesel	382	18	443	24	10	0.84	1.24	11.78	0.94	2.55	0.10	0.15	1.41	0.11	0.31
2x750 hp Forward Cranes (Cat 3412)	RECIP.>600hp diesel	1500	72	1739	12	365	1.06	4.85	36.34	1.09	7.93	2.32	10.62	79.59	2.39	17.37
2x525 hp Aft Cranes (Cat 3408)	RECIP.<600hp diesel	1050	51	1217	8	365	2.31	3.40	32.38	2.59	7.01	3.38	4.96	47.27	3.78	10.23
2X1368 hp Fire Water pump (Wartsila	RECIP.>600hp diesel	2736	132	3172	2	12	1.93	8.85	66.29	1.99	14.46	0.02	0.11	0.80	0.02	0.17
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	2500	121	2898	24	90	5.51	8.08	77.09	6.17	16.69	5.95	8.73	83.26	6.66	18.02
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	7200	348	6272	12	13	5.07	23.28	174.45	5.23	38.06	0.30	1.36	10.23	0.31	2.23
Offshore Supply Vessel	VESSELS>600hp diesel(support)	7200	348	3370	24	52	5.07	23.28	174.45	5.23	38.06	1.28	5.87	43.95	1.32	9.59
ROV Vessel	VESSELS>600hp diesel (multi-serv	12000	580	2334	24	52	8.46	38.80	290.75	8.72	63.44	0.89	4.06	30.44	0.91	6.64
	MISC.	BPD	SCF/HR	COUNT												
	FLARE-		560		24	365		0.00	0.04	0.03	0.22		0.00	0.18	0.15	0.95
	FLARE-		2083333		24	30		1.24	148.75	125.62	809.37		0.44	53.55	45.22	291.37
	FUGITIVES-			25000		365				12.50					54.75	
	GLYCOL STILL VENT- VRU controlled		8333333		24	347				0.00					0.00	
	GLYCOL STILL VENT- Uncontrolled		8333333		24	347				55.00					229.02	
2019 YEAR TOTAL							**66.22**	**651.23**	**3590.95**	**241.15**	**1211.08**	**65.09**	**225.26**	**4056.00**	**370.83**	**871.32**
EXEMPTION CALCULATION	**DISTANCE FROM LAND IN MILES**											**2131.20**	**2131.20**	**2131.20**	**2131.20**	**54400.00**
	64.0															

Emissions #10

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT	PHONE	REMARKS
BP Exploration & Production Inc	Mississippi Canyon	ssions- MC778,	09866-09867,	use PDQ; MODU	8 Water Injection Wells at MC777 & MC776		Jim Pfeiffer (Air Quality); Bekki W	281-366-1542 (J	Supplemental DOCD - Thunderhorse Project

OPERATIONS	EQUIPMENT	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS				
	Diesel Engines	HP	GAL/HR	GAL/D												
	Nat. Gas Engines	HP	SCF/HR	SCF/D												
	Burners	MMBTU/HR	SCF/HR	SCF/D	HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
DRILLING: MODU Enterprise																
Mains- 6 x Wartsilla 18V32 LNE (9772 hp ea)	PRIME MOVER>600hp diesel	58632	2832	12779	24	180	41.33	189.59	1420.60	42.62	309.95	16.78	77.00	576.95	17.31	125.88
Mains- 2X Wartsilla 12V32 LNE (6515 hp ea)	PRIME MOVER>600hp diesel	13030	629	2840	24	180	9.18	42.13	315.70	9.47	68.88	3.73	17.11	128.23	3.85	27.98
E-gen-Wartsilla 6R32 LNE (3257 hp)	AUXILIARY EQUIP>600hp diesel	3257	157	702	2	180	2.30	10.53	78.91	2.37	17.22	0.08	0.35	2.64	0.08	0.58
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	2500	121	544	24	45	5.51	8.08	77.09	6.17	16.69	0.56	0.82	7.81	0.63	1.69
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	7200	348	6272	6	60	5.07	23.28	174.45	5.23	38.06	0.69	3.15	23.60	0.71	5.15
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
Offshore Supply Vessel #2	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
Offshore Supply Vessel #3	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
PIPELINE INSTALLATION:																
Deep Blue	VESSELS>600hp diesel (offshore c	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Skandi Neptune	VESSELS>600hp diesel (multi-serv	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BOA Sub C	VESSELS>600hp diesel (offshore s	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FACILITY	DERRICK BARGE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTALLATION	MATERIAL TUG diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(supply)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PRODUCTION:																
5 x GE LM2500 turbine	TURBINE nat gas	29745	283291	6798993	24	280	1.91	0.16	170.35	0.61	23.69	6.41	0.54	572.36	2.04	79.61
(dual fuel)	TURBINE nat gas	29745	283291	6798993	24	280	1.91	0.16	170.35	0.61	23.69	6.41	0.54	572.36	2.04	79.61
	TURBINE nat gas	29745	283291	6798993	24	280	1.91	0.16	170.35	0.61	23.69	6.41	0.54	572.36	2.04	79.61
	TURBINE nat gas	29745	283291	6798993	24	280	1.91	0.16	170.35	0.61	23.69	6.41	0.54	572.36	2.04	79.61
	TURBINE nat gas	29745	283291	6798993	24	280	1.91	0.16	170.35	0.61	23.69	6.41	0.54	572.36	2.04	79.61
LM2500s on diesel fuel	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
(emergency only)	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
2X7188 hp Aux Gen (Wartsila 18V26)	RECIP.>600hp diesel	14376	694	16665	24	125	10.13	46.48	348.32	10.45	76.00	15.20	69.73	522.48	15.67	113.99
2816 hp E Gen (Wartsila 12V200)	RECIP.>600hp diesel	2816	136	3264	24	8	1.98	9.11	68.23	2.05	14.89	0.19	0.87	6.55	0.20	1.43
382 hp Hurricane Gen (Cat 3306TA)	RECIP.<600hp diesel	382	18	443	24	10	0.84	1.24	11.78	0.94	2.55	0.10	0.15	1.41	0.11	0.31
2x750 hp Forward Cranes (Cat 3412)	RECIP.>600hp diesel	1500	72	1739	12	365	1.06	4.85	36.34	1.09	7.93	2.32	10.62	79.59	2.39	17.37
2x525 hp Aft Cranes (Cat 3408)	RECIP.<600hp diesel	1050	51	1217	8	365	2.31	3.40	32.38	2.59	7.01	3.38	4.96	47.27	3.78	10.23
2X1368 hp Fire Water pump (Wartsila	RECIP.>600hp diesel	2736	132	3172	2	12	1.93	8.85	66.29	1.99	14.46	0.02	0.11	0.80	0.02	0.17
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	2500	121	2898	24	90	5.51	8.08	77.09	6.17	16.69	5.95	8.73	83.26	6.66	18.02
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	7200	348	6272	12	13	5.07	23.28	174.45	5.23	38.06	0.30	1.36	10.23	0.31	2.23
Offshore Supply Vessel	VESSELS>600hp diesel(support)	7200	348	3370	24	52	5.07	23.28	174.45	5.23	38.06	1.28	5.87	43.95	1.32	9.59
ROV Vessel	VESSELS>600hp diesel (multi-serv	12000	580	2334	24	52	8.46	38.80	290.75	8.72	63.44	0.89	4.06	30.44	0.91	6.64
	MISC.	BPD	SCF/HR	COUNT												
	FLARE-		560		24	365		0.00	0.04	0.03	0.22		0.00	0.18	0.15	0.95
	FLARE-		2083333		24	30		1.24	148.75	125.62	809.37		0.44	53.55	45.22	291.37
	FUGITIVES-			25000		365				12.50					54.75	
	GLYCOL STILL VENT- VRU controlled		8333333		24	347				0.00					0.00	
	GLYCOL STILL VENT- Uncontrolled		8333333		24	347				55.00					229.02	
2020 YEAR TOTAL							144.83	994.69	6181.06	322.70	1776.06	93.56	354.15	5023.45	400.25	1082.39
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES											2131.20	2131.20	2131.20	2131.20	54400.00
	64.0															

Summary

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL
BP Exploration & Production Inc	Mississippi Canyon	Complex Total Emissions- MC778, Agreement #98003	09866-09867, 14657, 14658, and 19997	Thunderhorse PDQ; MODU Enterprise	8 Waterflood Injection Wells at MC777 & MC776

Year	Emitted Substance				
	PM	SOx	NOx	VOC	CO
2011	51.36	224.09	2829.51	366.46	700.72
2012	79.83	352.98	3796.96	395.88	911.79
2013	114.45	491.19	5238.46	428.31	1193.97
2014	55.93	224.48	3238.34	367.92	757.59
2015	104.78	405.58	5408.84	411.81	1166.47
2016	122.83	486.61	6017.78	430.48	1299.32
2017	93.56	354.15	5023.45	400.25	1082.39
2018	93.56	354.15	5023.45	400.25	1082.39
2019	65.09	225.26	4056.00	370.83	871.32
2020	93.56	354.15	5023.45	400.25	1082.39
Allowable	2131.20	2131.20	2131.20	2131.20	54400.00

BP EXPLORATION & PRODUCTION Inc.
SUPPLEMENTAL DOCD
THUNDER HORSE PROJECT

OFFSHORE AND COASTAL AIR QUALITY MODELING REPORT

Prepared for

BP EXPLORATION & PRODUCTION Inc.

Prepared by

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Telephone (860) 298-9692

TRC Project No. 185188

SEPTEMBER 2011

EXECUTIVE SUMMARY

Air quality dispersion modeling was performed for Nitrogen Dioxide (NO_2) impacts of Thunder Horse' emissions at the shoreline (receptors spread along the continental shore) and at receptors at the Breton National Wildlife Refuge (specified by the Federal Land Manager). The distance to the closest shore point is 64 miles (102 kilometers) and the distance to the closest point at Breton is 95.7 miles (154 kilometers). Maximum hourly emissions of 7588 pounds per hour were used which did not include flare emissions and also used diesel for the turbines on the production platform instead of natural gas. Annual average emissions were scaled at 1196 pounds per hour (15.8% of maximum hourly emissions).

The OCD Model as preferred by the Guideline on Air Quality was run as a screening tool. Five years (2000-2004) of meteorological data supplied by BOEMRE were run in the model. The results of this screening analysis were a maximum 1-hour average concentration of 277.7 µg/m3 and annual concentrations above the Significant Impact Level. This result is, as expected, extremely conservative because it assumes that the emissions travel in a straight line for the 102 kilometers.

The CALPUFF model was used for a more refined analysis, using in part the 5 years of meteorological data (again 2000-2004, the 2003 data were incomplete) supplied by BOEMRE. In addition to the actual meteorology, the chemistry package in CALPUFF was run to determine how much of the emitted nitrogen oxides would be converted to nitrates over the long path of the plume. For hourly impacts, 100% of the predicted NO_x concentration was assumed to be NO_2. For annual impacts, 75% of the predicted NO_x concentration was assumed to be NO_2 (Ambient Ratio Method). The CALPUFF model results are summarized in the following table:

Concentrations µg/m^3	2000		2001		2002		2004	
Nitrogen Dioxide	1-Hour	Annual	1-Hour	Annual	1-Hour	Annual	1-Hour	Annual
Shoreline	34.09	0.082	42.79	0.081	41.26	0.111	41.87	0.098
Breton NWR	28.87	0.048	28.19	0.062	35.34	0.081	28.22	0.053
Significant Impact Level								
Class II		1.0		1.0		1.0		1.0
Class I		0.1		0.1		0.1		0.1

To determine the total potential 1-hour impact, a background concentration is needed. Kenner, Louisiana is the nearest monitor. The NO_2 3 year average (2007, 2009-2010) of the 98th percentile of measured one hour concentration data is 94.07 µg/m^3. When added to the maximum modeled concentrations, the results are 137 µg/m^3 at the shore and 129 µg/m^3 at Breton, both below the NAAQS of 188 µg/m^3. As shown on the table, the annual average impact of the project at both the shore and Breton are below the annual average Significant Impact Level (SIL) and require no further analysis. The Thunder Horse project meets the BOEMRE air quality analysis requirements.

TABLE OF CONTENTS

PAGE

1.0 INTRODUCTION 1-1

2.0 PROJECT DESCRIPTION 2-1

2.1 Project Location 2-1
2.2 Project Emissions 2-1
2.3 Modeling Scenarios 2-4

3.0 MODEL SELECTION AND INPUTS 3-1

3.1 Offshore and Coastal Dispersion Model (OCD) Inputs 3-2

4.0 MODEL OUTPUT ANALYSIS 4-1

5.0 REFERENCES 5-1

A. APPENDIX A – EMISSIONS DATA A-1

Factors A-2
Emissions 1 - 2011 ..... A-3
Emissions 2 – 2012 ..... A-4
Emissions 3 – 2013 ..... A-5
Emissions 4 – 2014 ..... A-6
Emissions 5 – 2015 ..... A-7
Emissions 6 – 2016 ..... A-8
Emissions 7 – 2017 ..... A-9
Emissions 8 – 2018 ..... A-10
Emissions 9 – 2019 ..... A-11
Emissions 10 – 2020 ..... A-12

LIST OF FIGURES

Figure 1-1: Relative Locations Of Well And Production Quarters 1-2

Figure 2-1: Project Location 2-2

Figure 3-1: Thunder Horse Receptor Locations 3-8

LIST OF TABLES

Table 2-1: Summary of Emissions (in tons) by Year 2-3

Table 2-2: NOx Emission Sources and Rates included in the Modeling Analysis. 2-5

Table 4-1: OCD Model Results for Thunder Horse: NO_2 Concentrations ($\mu g/m^3$) 4-1

Table 4-2: CALPUFF Model results for Thunder Horse: NO_2 Concentrations ($\mu g/m^3$) 4-2

Table 4-3: NO_2 Monitored Data at Kenner 4-3

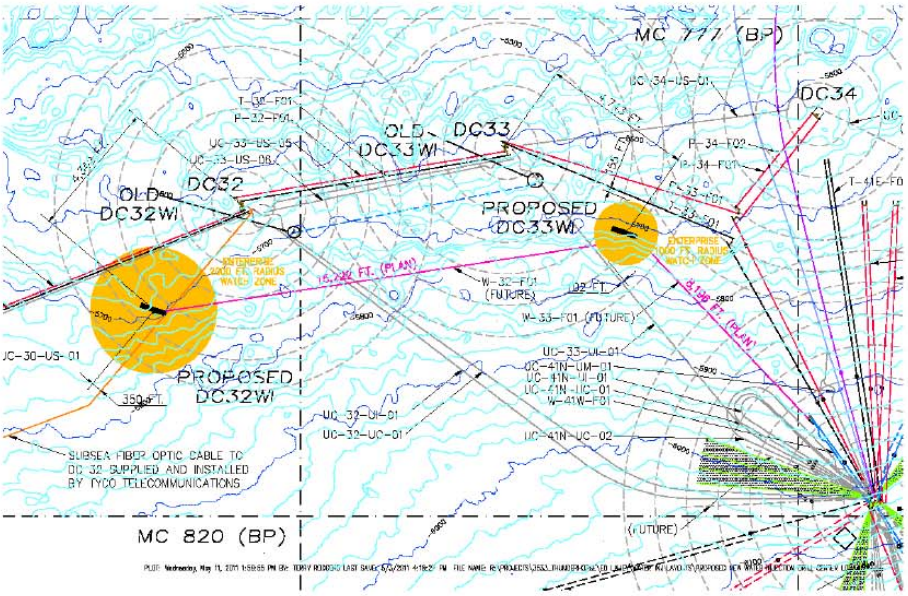
1.0 INTRODUCTION

BP Exploration & Production Inc. (BP) is planning to submit a Supplemental Development Operations Coordination Document (SDOCD) for the Thunder Horse Project to include the Mobile Offshore Drilling Unit (MODU) Enterprise. The scope includes new wells for water injection, the building of pipelines and continued production. The Enterprise will be located at Drill Centers (DC) DC32W and DC33W. The relative locations of the wells and the Thunder Horse Production Drilling Quarters (PDQ) are illustrated in Figure 1-1. The Thunder Horse PDQ is located approximately 103 kilometers (64 miles) south of South Pass, LA (the closest land) in the Mississippi Canyon area, Block MC778. DC32W and DC33W are located in the adjacent Blocks of the Thunder Horse PDQ in MC777 and MC776. BP has asked TRC Environmental Corp. (TRC) to provide assistance with air quality modeling analyses that the supplemental DOCD may require to demonstrate compliance with applicable air quality standards.

Exploration activities on the Outer Continental Shelf (OCS) are regulated by the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) under the authority of the Secretary of the Interior. The regulations that govern the activities on the OCS and that prescribe the requirements for potential sources of air emissions associated with exploration and drilling activities and that may impact receptors on the coast or on nearby protected areas, such as designated Federal Class I areas, are codified in the code of Federal Regulations at 30 CFR 250. These regulations require the submission of projected air emissions for criteria pollutants including sulfur dioxide (SO_2), particulate matter less than 10 micrometers in diameter (PM_{10}) and particulate matter less than 2.5 micrometers in diameter ($PM_{2.5}$) when applicable, nitrogen oxides (NO_x), carbon monoxide (CO), and volatile organic compounds (VOC) that will be generated by activities associated with the project. Considering the distance of the facility or

activity from shore, the size of the facility, the number of sources planned for the facility and their operational status, and the air quality status of the onshore area, the Regional Supervisor may review any Exploration Plan or Development and Production Plan to determine whether any facility described in the plan should be subject to review under Section 250.303 of the regulation. Review under this section provides for a screening level exemption from further air quality impact analyses based on distance to shore and projected emissions (30 CFR 250.303 (d)) and establishes the criterion for determining if the expected emissions may result in significant air quality impacts (30 CFR 250.303 (e)).

Figure 1-1: Relative Locations of Drill Centers and Production Quarters



The purpose of this document is to report the model results in support of the Thunder Horse project including the modeling methods and procedures, the data that was used to demonstrate compliance with all applicable ambient air quality standards. The following sections provide a brief summary of the sources that were included in the modeling analyses and also the model and modeling

methodologies that were used to make the appropriate demonstrations of compliance.

2.0 PROJECT DESCRIPTION

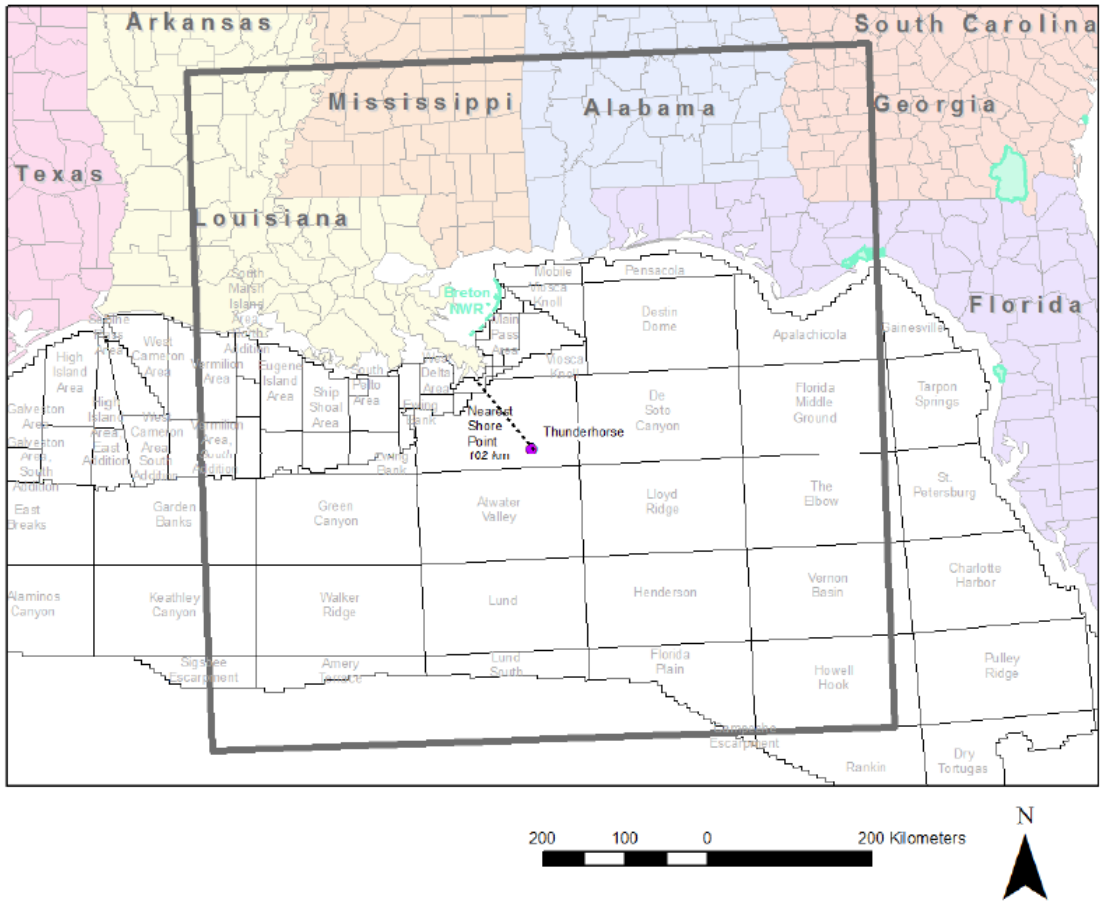
2.1 Project Location

The Thunder Horse Project position is approximately 64 miles south of Louisiana in the Mississippi Canyon area. Figure 1-1 illustrates the location of the Enterprise and the PDQ. These are located approximately 64 miles (102 kilometers) from land and more than 97.5 miles (154 kilometers) from the closest receptors at the Breton National Wildlife Refuge Class I area (BNWR). Figure 2-1 illustrates the relative location of the project sources, coastal area and BNWR.

2.2 Project Emissions

The BOEMRE has developed an Excel spreadsheet document (DOCD_AQ.XLS) which is intended to standardize the way potential air emissions for DOCDs are calculated and approved by the BOEMRE. The relevant MMS Form-139 forms for the Enterprise and PDQ and associated emission sources containing specific information regarding the proposed project emissions are provided in Appendix A. These tables list the equipment associated with each operation, the fuel feed rate and the calculated short term hourly and annual mass emission rates. The final page of each spreadsheet includes a calculation of the modeling exemption thresholds based on specific information for each facility. A summary of the AQR annual emissions for each year and pollutant are provided below as Table 2-1.

Figure 2-1: Project Location



Title of Document:	Supplemental Development Operations Coordination Document - Thunder Horse	**Document Number:**	1410-10-RG-PN-0001
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Retention Code:		**Next Review Date (if applicable):**	
Security Classification:	BP Confidential	**Page:**	157 of 250
Warning: Check DW Docs revision to ensure you are using the correct revision.			

Table 2-1: Summary of Emissions (in tons) by Year

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL
BP Exploration & Production Inc	Mississippi Canyon	Complex Total Emissions- MC778, Agreement #754398003	09866-09867, 14657, 14658, and 19997	Thunderhorse PDQ; MODU Enterprise	8 Water Injection Wells at MC777 & MC776

Year	Emitted Substance				
	PM	SOx	NOx	VOC	CO
2011	51.36	224.09	2829.51	366.46	700.72
2012	79.83	352.98	3796.96	395.88	911.79
2013	114.45	491.19	5238.46	428.31	1193.97
2014	55.93	224.48	3238.34	367.92	757.59
2015	104.78	405.58	5408.84	411.81	1166.47
2016	122.83	486.61	6017.78	430.48	1299.32
2017	93.56	354.15	5023.45	400.25	1082.39
2018	93.56	354.15	5023.45	400.25	1082.39
2019	65.09	225.26	4056.00	370.83	871.32
2020	93.56	354.15	5023.45	400.25	1082.39
Allowable	2131.20	2131.20	2131.20	2131.20	54400.00

Review of the Summary Table 2-1 indicates that the calculated emissions for the project are below the exemption thresholds for all pollutants of interest, except NO_x. The calculated NO_x emissions for the years 2011 through 2020 are projected to be above the exemption formula threshold (shown as "Allowable" row in the table), thus further analyses of the potential impact of these emissions are necessary.

2.3 Modeling Scenarios

Based on the threshold analyses shown above the only substance that is subject to modeling analysis is NO_x. The maximum annual emissions are calculated for the 2016 operational period, while the maximum hourly emission rate is calculated to occur during the years 2013 and 2015. The modeling analysis scenario modeled is based on the maximum hourly emission rate for the period of 2013 and includes the emission sources listed in Table 2-2. The short term hourly maximum emission rates were used to model potential hourly and annual impacts. It was assumed that the flare is not a continuously emitting source and therefore does not need to be included in the modeling for annual concentrations or the three year period covered by the 1-hour NAAQS. It will be conservatively assumed that the turbines on the PDQ production platform will be running on diesel fuel rather than natural gas. Considering these assumptions the total NO_x emissions modeled are 7588 pounds as shown in Table 2-2.

Table 2-2: NOx Emission Sources and Rates included in the Modeling Analysis.

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT			PHONE	REMARKS					
BP Exploration & Production Inc	Mississippi Canyon	sions- MC778,	09866-09867,	hse PDQ, MODU	8 Water Injection Wells at MC777 & MC776		Jim Pfeiffer (Air Quality), Bekki			281-366-1542	Supplemental DOCD - Thunderhorse Project					
OPERATIONS	EQUIPMENT	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS				
	Diesel Engines	HP	GAL/HR	GAL/D												
	Nat. Gas Engines	HP	SCF/HR	SCF/D												
	Burners	MMBTU/HR	SCF/HR	SCF/D	HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
DRILLING: MODU Enterprise																
Mains- 6 x Wartsilla 18V32 LNE (9772 hp ea)	PRIME MOVER>600hp diesel	58632	2832	12779	24	180	41.33	189.59	1420.60	42.62	309.95	16.78	77.00	576.95	17.31	125.88
Mains- 2X Wartsilla 12V32 LNE (6515 hp ea)	PRIME MOVER>600hp diesel	13030	629	2840	24	180	9.18	42.13	315.70	9.47	68.88	3.73	17.11	128.23	3.85	27.98
E-gen-Wartsilla 6R32 LNE (3257 hp)	AUXILIARY EQUIP>600hp diesel	3257	157	702	2	180	2.30	10.53	78.91	2.37	17.22	0.08	0.35	2.64	0.08	0.58
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	2500	121	544	24	45	5.51	8.08	77.09	6.17	16.69	0.56	0.82	7.81	0.63	1.69
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	7200	348	6272	6	60	5.07	23.28	174.45	5.23	38.06	0.69	3.15	23.60	0.71	5.15
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
Offshore Supply Vessel #2	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
Offshore Supply Vessel #3	VESSELS>600hp diesel(support)	7200	348	3370	24	90	5.07	23.28	174.45	5.23	38.06	2.21	10.15	76.07	2.28	16.60
PIPELINE INSTALLATION:																
Deep Blue	VESSELS>600hp diesel (offshore	46341	2238	53718	24	42	32.66	149.84	1122.80	33.68	244.97	16.46	75.52	565.89	16.98	123.47
Skandi Neptune	VESSELS>600hp diesel (multi-se	13685	661	15864	24	56	9.65	44.25	331.57	9.95	72.34	6.48	29.74	222.82	6.68	48.61
BOA Sub C	VESSELS>600hp diesel (offshore	32124	1552	37238	24	12	22.64	103.87	778.33	23.35	169.82	3.26	14.96	112.08	3.36	24.45
Offshore Supply Vessel #1	VESSELS>600hp diesel(support)	7200	348	8346	24	63	5.07	23.28	174.45	5.23	38.06	3.84	17.60	131.88	3.96	28.77
FACILITY	DERRICK BARGE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTALLATION	MATERIAL TUG diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(supply)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PRODUCTION:																
5 x GE LM2500 turbine	TURBINE nat gas	29745	283291	6798993	24	200	1.91	0.16	170.35	0.61	23.69	4.58	0.39	408.83	1.46	56.87
(dual fuel)	TURBINE nat gas	29745	283291	6798993	24	200	1.91	0.16	170.35	0.61	23.69	4.58	0.39	408.83	1.46	56.87
	TURBINE nat gas	29745	283291	6798993	24	200	1.91	0.16	170.35	0.61	23.69	4.58	0.39	408.83	1.46	56.87
	TURBINE nat gas	29745	283291	6798993	24	200	1.91	0.16	170.35	0.61	23.69	4.58	0.39	408.83	1.46	56.87
	TURBINE nat gas	29745	283291	6798993	24	200	1.91	0.16	170.35	0.61	23.69	4.58	0.39	408.83	1.46	56.87
LM2500s on diesel fuel	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
(emergency only)	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
	TURBINE diesel	29745	1716	41184	24	20	2.86	96.36	262.07	0.10	0.79	0.69	23.13	62.90	0.02	0.19
2X7188 hp Aux Gen (Wartsilla 18V26	RECIP.>600hp diesel	14376	694	16665	24	125	10.13	46.48	348.32	10.45	76.00	15.20	69.73	522.48	15.67	113.99
2816 hp E Gen (Wartsilla 12V200)	RECIP.>600hp diesel	2816	136	3264	24	8	1.98	9.11	68.23	2.05	14.89	0.19	0.87	6.55	0.20	1.43
382 hp Hurricane Gen (Cat 3306TA)	RECIP.<600hp diesel	382	18	443	24	10	0.84	1.24	11.78	0.94	2.55	0.10	0.15	1.41	0.11	0.31
2x750 hp Forward Cranes (Cat 3412	RECIP.>600hp diesel	1500	72	1739	12	365	1.06	4.85	36.34	1.09	7.93	2.32	10.62	79.59	2.39	17.37
2x525 hp Aft Cranes (Cat 3408)	RECIP.<600hp diesel	1050	51	1217	8	365	2.31	3.40	32.38	2.59	7.01	3.38	4.96	47.27	3.78	10.23
2X1368 hp Fire Water pump (Wartsil	RECIP.>600hp diesel	2736	132	3172	2	12	1.93	8.85	66.29	1.99	14.46	0.02	0.11	0.80	0.02	0.17
Small and Large Aux Engines	AUXILIARY EQUIP<600hp diesel	2500	121	2898	24	90	5.51	8.08	77.09	6.17	16.69	5.95	8.73	83.26	6.66	18.02
Fast Supply Vessel/Crew Boat	VESSELS>600hp diesel(crew)	7200	348	6272	12	13	5.07	23.28	174.45	5.23	38.06	0.30	1.36	10.23	0.31	2.23
Offshore Supply Vessel	VESSELS>600hp diesel(support)	7200	348	3370	24	52	5.07	23.28	174.45	5.23	38.06	1.28	5.87	43.95	1.32	9.59
ROV Vessel	VESSELS>600hp diesel (multi-se	12000	580	2334	24	52	8.46	38.80	290.75	8.72	63.44	0.89	4.06	30.44	0.91	6.64
	MISC.	BPD	SCF/HR	COUNT												
	FLARE-		560		24	365		0.00	0.04	0.03	0.22		0.00	0.18	0.15	0.95
	FLARE-		2083333		24	30		1.24	148.75	125.62	809.37		0.44	53.55	45.22	291.37
	FUGITIVES-			25000		365				12.50					54.75	
	GLYCOL STILL VENT- VRU controlled		8333333		24	347				0.00					0.00	
	GLYCOL STILL VENT- Uncontrolled		8333333		24	347				55.00					229.02	
2013	YEAR TOTAL						214.86	1315.93	8588.22	394.92	2301.26	114.45	491.19	5238.46	428.31	1193.97
	MODELED TOTAL*								7587.70							
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES											2131.20	2131.20	2131.20	2131.20	54400.00
	64.0															

* NOx modeling did not include the flares, nor the natural gas mode of the 5 LM2500 turbines.

3.0 MODEL SELECTION AND INPUTS

For all project air pollutant emissions exceeding the allowable exemption formulas air quality dispersion modeling must be conducted following the U.S. EPA Guideline on Air Quality Models (Revised) (the Guideline) (Appendix W to 40 CFR 51, U.S. EPA, 2005). For the proposed project, only NO_x exceeds the exemption formula calculations and is subject to further air quality dispersion modeling. The Guideline recommends the Offshore and Coastal Dispersion Model (OCD), Version 5 (http://www.epa.gov/ttn/scram/dispersion_prefrec.htm#ocd) for application to offshore emission sources. The Guideline states:

"(1) OCD is a straight-line Gaussian model developed to determine the impact of offshore emissions from point, area or line sources on the air quality of coastal regions. OCD incorporates overwater plume transport and dispersion as well as changes that occur as the plume crosses the shoreline. Hourly meteorological data are needed from both offshore and onshore locations. These include water surface temperature, overwater air temperature, mixing height, and relative humidity.

(2) Some of the key features include platform building downwash, partial plume penetration into elevated inversions, direct use of turbulence intensities for plume dispersion, interaction with the overland internal boundary layer, and continuous shoreline fumigation."

The Guideline recommends limiting the application of straight-line Gaussian models to source-receptor distances less than 50 km. As noted in the prior sections the distance of the Thunder Horse PDQ and associated emission sources are located well beyond 50 km from shore at approximately 196 km. However, the OCD model authors (DiChristofaro, D. and Hanna, S., OCD: The Offshore and Coastal Dispersion (OCD) Model, VOLUME I: USER'S GUIDE, Report No, AO85-1, November, 1989) note, "For very long plume travel distances (such as 50 km and beyond) or very low wind speeds, the assumption of steady-state conditions is likely to lead to conservative (high) concentration estimates." Thus OCD provides a conservative screening tool to predict onshore concentration impacts.

If a more refined (less conservative) impact analysis is warranted, a long range transport (LRT) model would be required. The only LRT model currently approved by EPA and included in the Guideline as a recommended model and also approved by the Federal Land Managers (FLMs) for Class I impact assessments (FLAG, 2010) is the CALPUFF modeling system. The currently approved version of this model, however, may not be optimized for over water transport, although a version of the CALPUFF modeling system has been developed under the auspices of the BOEMRE, formerly the Minerals Management Service (MMS), and is available for use on a case-by-case basis. The version of CALPUFF proposed to be used in this study includes enhancements funded by the MMS for overwater transport and dispersion (Earth Tech, 2006). The MMS-sponsored study was geared for applications in the Gulf of Mexico and included five model evaluation studies involving overwater transport and coastal dispersion, including a field experiment conducted along the Louisiana coastline.

To obtain further guidance and concurrence on the appropriate model to use for these analyses, TRC contacted the BOEMRE modeling staff and discussed the potential options for the modeling protocol (private communication with Mr. Dirk Herkhof, July 6, 2011). Based on this communication and our concurrence it was suggested that, due to its conservative nature, OCD may be used as a screening tool to determine coastal concentrations for comparison to the air pollution modeling Significance Levels found in 30 CFR 250.303. If OCD predicts concentrations at coastal receptors or at the Breton National Wildlife Refuge Class I area that exceeds the Significance Levels, then more refined modeling will be considered.

3.1 Offshore and Coastal Dispersion Model (OCD) Inputs

A series of modeling runs were conducted using OCD to determine compliance with modeling significance levels for nitrogen oxides/nitrogen dioxide (NO_x/NO_2). These runs applied increasing levels of modeling

sophistication until compliance with the significance level is attained, or alternatively until it becomes necessary to run CALPUFF to demonstrate compliance.

Level 1 Screening

As suggested by DiChristafaro and Hanna, the first OCD screening modeling run is typically "...conducted with one row of model receptors covering a direction in which high concentrations are expected. Such a direction would probably involve the shortest distance between the source and the shoreline, and would be covered by closely-spaced receptors." However, considering the NO_x emission rates of this project and the proximity to the nearest land receptors it was expected that the predicted impacts with this extremely conservative screening approach would not demonstrate compliance, therefore a more refined analysis was undertaken.

Level 2 Screening

Modeling Domain:

The modeling domain along the coast ranges from longitude 88°30' W to 92°00' W. This range of the coastline was input into MAKEGEO in 30' longitude increments with 120 by 120 grid cells (IXG and IYG). This corresponds to DiChristafaro and Hanna's recommendation for spacing to define the coastline. The domain includes both over-water and over-land areas, for which OCD treats plume dispersion differently.

Meteorological Input Data:

Meteorological input data were compiled as reported in Five-Year Meteorological Datasets for CALMET/CALPUFF and OCD5 Modeling of the Gulf of Mexico Region (Douglas, SG and Hudischewskyj, AB, OCS Study MMS 2008-029) and provided electronically by Ms. Holli Ensz of the

BOEMRE, Gulf of Mexico Office. The input meteorological data sets were prepared following the guidelines presented in the OCD user's guide. The onshore meteorological file (lmet) and the offshore meteorological file (wmet) were selected from the groupings provided in the Meteorological Datasets document. OCD Group 4b, consisting of buoy, onshore surface and onshore upper air meteorological data, for the region covering the years 2000 through 2004 was selected as climatologically representative of the modeling domain. These data are from Buoy Number 42007, the Mobile National Weather Service station and the Slidell, LA upper air station.

Receptor Array:

OCD model receptor locations were selected within the modeling domain, along the shoreline and in the Breton NWR. The Breton NWR receptor locations were taken from the FLMs' recommended receptor locations. The shoreline and Breton NWR receptors were input as discrete receptor locations.

Structure Induced Downwash:

The OCD model contains algorithms to treat aerodynamic downwash induced by structures typical of offshore production facilities. Downwash causes increased turbulence and dispersion of the plume in the lee of the structure and also reduces plume rise. The OCD model's downwash algorithm was developed specifically to treat structures above a water surface. The algorithm requires input of the building or obstacle height above the surface and width. The facility's height and maximum projected width were used for the stationary sources on the PDQ and Enterprise, however, downwash parameters were not used for the support ships.

Control File Inputs:

Specific OCD control file parameters were set as follows:

- IOPT(2) = 0 (use stack tip downwash)
- IOPT(3) = 1 (do not use gradual plume rise, as recommended by DiChristafaro and Hanna)
- IOPT(4) = 1 (use buoyancy induced dispersion)
- IOPT(25) = 0 (no pollutant decay rate)

NOx/NO_2 Chemistry:

Following EPA's guidance (Fox, T., "Memorandum: Additional Clarification Regarding Application of Appendix W Modeling Guidance for 1-hour NO_2 National Ambient Air Quality Standard, March 1, 2011), OCD was run first at the Tier 1 level, assuming full conversion of NOx to NO_2, and, subsequently at the Tier 2 level, assuming 75 percent conversion on an annual basis and 80 percent conversion on a one-hour basis.

Level 3 Refined Modeling

The refined air quality modeling analysis focuses on the long range transport of emissions from these sources at the Breton Wilderness Class I area and at land receptors located onshore in Louisiana, Mississippi, Alabama and Florida. The CALPUFF modeling system (Scire et al., 2000a, b) was used in the refined dispersion modeling analysis. CALPUFF is a Guideline Model recommended by the US Environmental Protection Agency (Federal Register, April 15, 2003) and the Federal Land Managers (FLMs) for LRT and Class I impact assessments (FLAG, 2010). The version of CALPUFF used in this study includes enhancements funded by the BOEMRE, formerly the Minerals Management Service (MMS), for overwater transport and dispersion (Earth Tech, 2006). The MMS-sponsored study was geared for applications in the Gulf of Mexico and included five model evaluation studies involving overwater transport and coastal dispersion, including a field experiment conducted along the Louisiana coastline.

In CALMET, the initial estimate field is created using the hourly analysis fields from the Rapid Update Cycle (RUC) model. This involves a horizontal interpolation of the RUC data from its 20-km grid cells to the 12-km CALMET grid and a vertical mapping of the variable RUC layers to the fixed terrain-following CALMET layers. The observational data are blended with the gridded RUC data in a second stage of the CALMET model to produce winds consistent with the observations at the locations of the meteorological stations. The meteorological data for 2000-2004, supplied by BOEMRE was used. All surface data were used; however, the RUC data was not used due to data problems. TRC tested the model using TRC RUC data and found very little difference in the results.

CALPUFF model options include chemical conversion of SO_2 to sulfate and NO_x to nitric acid and nitrate using the MESOPUFF II chemistry algorithms, wet and dry deposition, and turbulence-based dispersion with a probability density function (PDF) for convective conditions. The partial penetration algorithm for buoyant plumes interacting with elevated inversions is used in the modeling. Turbulence profiles over water are based on the COARE overwater boundary layer formulation as recommended in the MMS study for the Gulf of Mexico.

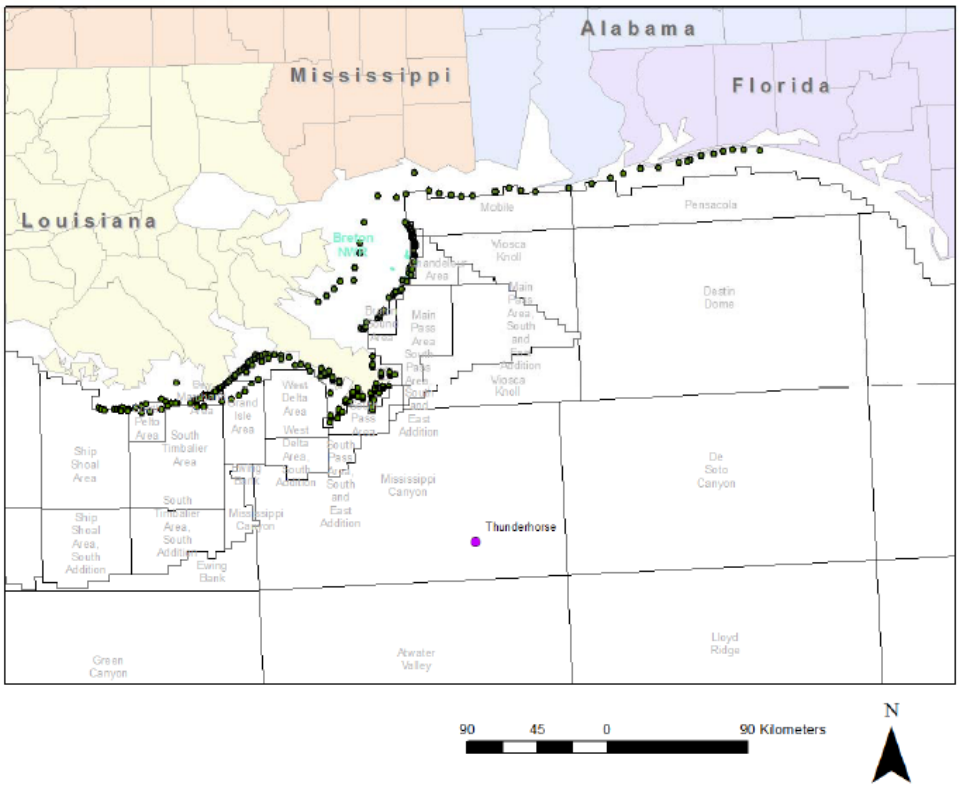
Relatively large values of background ammonia are used in the modeling (10 ppb) to account for possible high sodium levels resulting from an abundance of sea salt.

Ozone observational data are used in the CALPUFF chemical conversion mechanism. Because ozone observations were not available over water for this historical time period, land-based, monthly average ozone concentrations from the southeastern United States were used to create monthly average ozone data for the general region. The average monthly ozone values used are based on data derived from a study sponsored by

the Visibility Improvement State and Tribal Association of the Southeast (VISTAS) for evaluation of long range transport impacts of Best Available Retrofit Technology (BART) in the area. In the VISTAS study, observed ozone data for a three year period (2001-2003) from CASTNet and AIRS stations were compiled and monthly average ozone background values were computed at non-urban ozone stations for daytime hours between 6 am to 6 pm. Daytime ozone monitoring data are input into the model because the chemical mechanism in CALPUFF uses ozone concentrations as an indicator of OH radical concentrations during the day. The VISTAS modeling domain includes the coastal states of Louisiana, Mississippi, Alabama and Florida, which are included in the current modeling domain. The monthly ozone averages calculated in VISTAS and used in this study are 24.05 ppb (January), 27.89 ppb (February), 33.24 ppb (March), 40.02 ppb (April), 40.30 ppb (May), 37.25 ppb (June), 36.86 ppb (July), 36.60 ppb (August), 36.14 ppb (September), 30.52 ppb (October), 28.27 ppb (November), and 24.03 ppb (December).

The same receptor set used in the OCD modeling was used in the CALPUFF analyses. Receptors in the Breton Wilderness area are based on the recommendations of the National Park Service as implemented in the CALPOST post-processing program. Fifty six (56) Class I receptors as shown in Figure 3-1are placed in the Breton NWR Class I area. In addition, 537 receptors were placed along the coast.

Figure 3-1: Thunder Horse Receptor Locations



4.0 MODEL OUTPUT ANALYSIS

OCD provides hourly and annual predictions of NOx concentrations. Following the EPA Guideline, both Tier 1 and Tier 2 analyses were conducted to predict the maximum hourly and annual NO_2 concentrations at shoreline and BNWR receptors. These predicted concentrations are compared to the NO_2 EPA Significant Impact Levels. The OCD model Tier 2 results are presented in Table 4-1.

Table 4-1: OCD Model Results for Thunder Horse: NO_2 Concentrations ($\mu g/m^3$)

Concentrations $\mu g/m^3$		2000		2001		2002		2003		2004	
Nitrogen Dioxide		1-Hour	Annual	1-Hour	Annual	1-Hour	Annual	1-Hour	Annual	1-Hour	Annual
Shoreline		241.3	0.2	277.7	0.2	255.2	0.2	175.2	0.1	207.9	0.2
Breton NWR		159.7	0.1	169.9	0.1	185.8	0.1	136.5	0.1	167.1	0.1
Significant Impact Level											
	Class II		1.00		1.00		1.00		1.00		1.00
	Class I		0.10		0.10		0.10		0.10		0.10

These results are a large over prediction of the concentrations that one would expect to occur at distances of 100-150 kilometers. Additionally they predict that the Thunder Horse project would be over the SIL at the Breton National Wildlife Refuge, prompting a more refined analysis. This occurs despite the application of the Tier 1 factor of 0.8 to the NO_x emissions to account for the NO_2/NO_x split in emissions.

Since the predicted impact exceeds the significance level, a refined CALPUFF modeling analysis was prepared.

CALPUFF was run with the emissions and meteorology described above. The results are shown in Table 4-2. Maximum hourly emissions of 7588 pounds per hour were used which did not include flare emissions and also used diesel for the

turbines on the production platform instead of natural gas. Annual average emissions were scaled at 1196 pounds per hour (15.8% of maximum hourly emissions). For hourly impacts, 100% of the predicted NO_x concentration was assumed to be NO_2. For annual impacts, 75% of the predicted NO_x concentration was assumed to be NO_2 (Ambient Ratio Method).

Table 4-2: CALPUFF Model results for Thunder Horse: NO_2 Concentrations ($\mu g/m^3$)

Concentrations $\mu g/m^3$		2000		2001		2002		2004	
Nitrogen Dioxide		**1-Hour**	**Annual**	**1-Hour**	**Annual**	**1-Hour**	**Annual**	**1-Hour**	**Annual**
Shoreline		34.09	0.082	42.79	0.081	41.26	0.111	41.87	0.098
Breton NWR		28.87	0.048	28.19	0.062	35.34	0.081	28.22	0.053
Significant Impact Level									
	Class II		1.0		1.0		1.0		1.0
	Class I		0.1		0.1		0.1		0.1

The model results for the maximum 1-hour value from the project contributions range from 34.09 $\mu g/m^3$ to 42.79 $\mu g/m^3$ over the four years. In order to assess the impact of the project on the 1-hour NAAQS, it is necessary to add the background concentration to the model results. The nearest and only NO_2 monitor along the Gulf coast is at Kenner, Louisiana. Kenner is an urban/suburban area west of New Orleans and is the site of the airport. The concentrations at Kenner are likely to be substantially higher than at more rural location along the shore and in the Breton islands. Nevertheless, the Guidance suggests that the 98th percentile of this measured data be added to the project impact to test for compliance with the NAAQS. The EPA AQS website was used to download hourly data from the Kenner monitor for the years 2001 to 2010. The 98th percentile for each year was evaluated and is shown on Table 4-3:

Table 4-3: NO_2 Monitored Data at Kenner

YEAR	98th Percentile Daily Max (ppb)	98th Percentile Daily Max (ug/m3)	Days Missing	4 Quarters Available?
2001	53	99.71	5	YES
2002	46	86.54	4	YES
2003	47	88.42	1	YES
2004	46	86.54	10	YES
2005	50	94.07	22	YES
2006	53	99.71	13	YES
2007	55	103.47	7	YES
2008	49	92.19	63	NO
2009	48	90.30	14	YES
2010	47	88.42	8	YES

The most recent three years of data with all four quarters available (2007, 2009, and 2010) were used to calculate a three-year average background concentration of 94.07 $\mu g/m^3$. This value was adopted as the background concentration despite its probable over prediction of the true ambient concentration. When combined with the maximum modeled concentration in the 4 years the maximum is 137 $\mu g/m^3$ which is well below the NAAQS. At Breton the maximum modeled plus the Kenner 98th percentile concentration is 129 $\mu g/m^3$ again well below the NAAQS. The project will not interfere with attainment of the NAAQS. Additionally, the CALPUFF modeling shows that the project will not exceed the SIL for the annual average at either the shore or at Breton. Digital copies of the CALPUFF model input and output files in support of this demonstration are provided in a separate Compact Disk.

Summary:

The refined modeling analyses with CALPUFF demonstrates that the Thunder Horse project will not exceed the NAAQS at the shore or at Breton Wilderness Area and will not exceed the annual SIL at either location.

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Appendix D: Waste Tables

TABLE 1. WASTES YOU WILL GENERATE, TREAT AND DOWNHOLE DISPOSE OR DISCHARGE TO THE GOM

please specify if the amount reported is a total or per well amount

Thunder Horse Projected generated waste			Projected ocean discharges		Projected Downhole Disposal
Type of Waste	**Composition**	**Projected Amount**	**Discharge rate**	**Discharge Method**	**Answer yes or no**
Will drilling occur ? If yes, you should list muds and cuttings					
EXAMPLE: Cuttings wetted with synthetic based fluid	*Cuttings generated while using synthetic based drilling fluid.*	*X bbl/well*	*X bbl/hr/well*	*discharge overboard*	*No*
Water-based drilling fluid	Spent drilling fluid drilling riserless hole plus pad mud to fill the hole	76,988 bbl/well	42.21 bbl/hr/well	Ocean seafloor discharge	No
Cuttings wetted with water-based fluid	Water base interval	8,132 bbl/well	4.46 bbl/hr/well	Ocean seafloor discharge	No
Excess Cement Slurry	Excess mixed cement after a cement operation	12 bbl/well	0.006 bbl/hr/well	Ocean discharge	No
Cuttings wetted with synthetic-based fluid	Drill cuttings, cement cuttings, and Synthetic base mud retained on cuttings	4,910 bbl/well	2.69 bbl/hr/well	Ocean discharge	No
Wash water from cementing equipment	Equipment cleaning	160 bbl/well	0.08 bbl/hr/well	Ocean discharge	No
Small Volume Drilling Fluid Discharges	Pit cleanout solids, accumulated solids in sand traps, displacement interfaces	85 bbl/well	0.05 bbl/hr/well	Ocean discharge	No
Cement transfer losses	Bulk transfer from boat to rig	146 bbl/well	0.08 bbl/hr/well	Ocean discharge	No
Barite transfer losses	Bulk transfer from boat to rig	82 bbl/well	0.05 bbl/hr/well	Ocean discharge	No
Will humans be there? If yes, expect conventional waste					
EXAMPLE: Sanitary waste water	*Sanitary waste from living quarters*	*X bbl/well*	*X bbl/hr/well*	*chlorinate and discharge overboard*	*No*
Domestic waste	Food waste	168.9 bbl/well	0.09 bbl/hr/well	Ocean discharge	No
Sanitary waste	Treated human body waste discharged from toilets & urinals	4,705 bbl/well	2.58 bbl/hr/well	Ocean discharge	No
Gray water	Drainage from dishwasher, shower, laundry, bath, & washbasin drains	27,142 bbl/well	14.88 bbl/hr/well	Ocean discharge	No
Is there a deck? If yes, there will be Deck Drainage					
Deck Drainage	Deck washdown & rain water	32,865 bbl/well	18.02 bbl/hr/well	Ocean discharge	No
Will you conduct well treatment, completion, or workover?					
Well treatment fluids	Stimulation fluids include acids, solvents & propping agents	3,200 bbl/well	1.8 bbl/hr/well	Ocean discharge	No
Well completion fluids	Salt solutions or weighted brines	2,200 bbl/well	1.2 bbl/hr/well	Ocean discharge	No
Workover fluids	Salt solutions or weighted brines	400 bbl/well	0.2 bbl/hr/well	Ocean discharge	No
Miscellaneous discharges. If yes, only fill in those associated with your activity.					
Desalinization unit discharge	Creating freshwater from seawater	2,133,429 bbl/well	1,170 bbl/hr/well	Ocean discharge	No
Blowout preventer fluid	Fluid used to actuate the hydraulic equipment on the BOP	181 bbl/well	0.1 bbl/hr/well	Ocean discharge	No
Ballast water	Uncontaminated seawater added or removed to maintain proper draft	64,628 bbl/well	35.43 bbl/hr/well	Ocean discharge	No
Bilge water	Uncontaminated seawater added or removed to maintain proper draft	1,547 bbl/well	0.85 bbl/well	Ocean discharge	No
Excess cement at seafloor	Excess cement and additives	594 bbl/well	0.33 bbl/well	Ocean seafloor discharge	No
Fire water	Uncontaminated seawater used for fire control	5,188 bbl/well	2.84 bbl/hr/well	Ocean discharge	No
Cooling water	Uncontaminated seawater	14,914,392 bbl/well	8,177 bbl/hr/well	Ocean discharge	No
Will you produce hydrocarbons? If yes fill in for produced water.					
Produced water	No value was on the last table	N/A			No
Treatment Chemicals	Corrosion, inhibitors, biocides	N/A			No
Will you be covered by an individual or general NPDES permit ?		General NPDES Permit			

NOTE: If you will not have a type of waste, enter NA in the row.

TABLE 2. WASTES YOU WILL TRANSPORT AND /OR DISPOSE OF ONSHORE

please specify whether the amount reported is a total or per well

	Projected generated waste		Solid and Liquid Wastes transportation	Waste Disposal		
	Type of Waste	**Composition**	**Transport Method**	**Name/Location of Facility**	**Amount**	**Disposal Method**
Will drilling occur ? If yes, fill in the muds and cuttings.						
	EXAMPLE: Synthetic-based drilling fluid or mud	*internal olefin, ester*	*Below deck storage tanks on offshore support vessels*	*Newport Environmental Services Inc., Ingleside, TX*	*X bbl/well*	*Recycled*
	Synthetic-based drilling fluid	Synthetic-based drilling fluid	Liquid mud storage on workboat	Baroid / MI Swaco Fouchon LA	6,571 bbls/well	For reuse
	Contaminated Synthetic base mud	Contaminated Synthetic base mud	Barged in (15 or 25 barrel cutting boxes)	Newpark Environmental Services, Fourchon LA	300 bbls/well	Deepwell injection on land
	Drilling mud contaminated absorbents	Absorbent pads contaminated with drilling muds	Barged in (Omega 2 yard boxes)	Omega Waste Management, Patterson, LA	1 tons/well	Recycled
	Excess barite	Excess barite from vessel tank cleaning	Transported by vehicle (supersacks)	Francis Drilling Mud or River Birch landfill	5 tons/well	Reuse/Disposal
	Excess cement	Excess cement from vessel tank cleaning	Transported by vehicle (supersacks)	Grand Isle Port Commission or River	5 tons/well	Reuse/Disposal
	Washwater	Washwater from boat tank cleaning	Transported in (15 barrel cuttings boxes)	Newpark Environmental Services, Fourchon LA	200 tons/well	Deepwell injection on land
	Well Related Hazardous Waste	Rig lab titrations containing isopropanol alcohol, silver	Barged in (5 gallon DOT containers)	Chemical Waste Management, Sulphur,	5 gallons/well	Disposal
	Rig Maintenance Wastes (painting, blasting)	Paint thinner, paint chips, blast media, aerosol cans	Barged in (drums or totes)	L&L Oil and Gas Services Fourchon, LA	1,520 lbs/well	Disposal
	Rig Maintenance Wastes (non hazardous)	Oily rags, pads, oil filters etc.	Barged in (totes)	L&L Oil and Gas Services Fourchon, LA	76 ft3/well	Recycle or Disposal
	Rig Used oil	Lube oil, hydraulic oil, glycol	Barged in (drums)	L&L Oil and Gas Services Fourchon, LA	122 m3/well	Recycled
	Domestic waste	Municipal trash	Barged in (supersacks)	River Birch Landfill, Avondale, LA	30 tons/well	Disposal
	Scrap Metal	scrap piping, grating and other metals	Barged in (scrap baskets)	Southern Scrap. LA	11 tons/well	Recycled
	Universal Waste	Batteries	Barged in (DOT drums)	L&L Oil and Gas Services Fourchon, LA	61 lbs/well	Recycled
	Universal Waste	Fluorescent light bulbs	Barged in (DOT drums)	L&L Oil and Gas Services Fourchon, LA	182 bulbs/well	Recycled
	Misc. unused chemical	Pills, spacers, additives etc.	Barged in (totes)	River Birch Landfill, Avondale, LA	10 bbls/well	Disposal
	Rig Drilling washwater	Cleaning out of mud tanks	Barged in (15 or 25 barrel cutting boxes)	Newpark Environmental Services, Fourchon LA	200 bbls/well	Deepwell injection on land
	Completion Fluids	Used completion fluids	Barged in (15 or 25 barrel cutting boxes)	Newpark Environmental Services, Fourchon LA	650 bbls/well	Deepwell injection on land
Will you produce hydrocarbons? If yes fill in for produced sand.						
Will you have additional wastes that are not permitted for discharge? If yes, fill in the appropriate rows.						
	EXAMPLE: trash and debris (recylables)	*Plastic, paper, aluminum*	*barged in a storage bin*	*ARC, New Iberia, LA*	*X lb/well*	*Recycled*
	NOTE: If you will not have a type of waste, enter NA in the row.					

Appendix E: Environmental Impact Analysis (EIA)

Environmental Impact Analysis

SUPPLEMENTAL DEVELOPMENT OPERATIONS COORDINATION DOCUMENT
Thunder Horse (Unit Agreement 754398003)
Mississippi Canyon Block 776 (OCS –G-0986)
Mississippi Canyon Block 777 (OCS-G-09866)
Offshore Louisiana

25 July 2011

Prepared for:

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Contents

Page

Introduction 182

A. Impact-Producing Factors 188

A.1 Drilling Rig Presence (including noise and lights) 188
A.2 Physical Disturbance to the Seafloor 192
A.3 Air Pollutant Emissions 192
A.4 Effluent Discharges 192
A.5 Water Intake 193
A.6 Onshore Waste Disposal 193
A.7 Marine Debris 194
A.8 Support Vessel and Helicopter Traffic 194
A.9 Accidents 194
A.9.1 Types of Accidents Evaluated 194
A.9.2 Diesel Fuel Spills 195
A.9.3 Other Accidents Not Analyzed in Detail 196

B. Affected Environment 198

C. Impact Analysis 201

C.1 Physical/Chemical Environment 201
C.1.1 Air Quality 201
C.1.2 Water Quality 202
C.2 Seafloor Habitats and Biota 204
C.2.1 Soft Bottom Benthic Communities 205
C.2.2 High-Density Deepwater Benthic Communities 206
C.2.3 Designated Topographic Features 207
C.2.4 Pinnacle Trend Area Live Bottoms 207
C.2.5 Live Bottom/Low-Relief 207
C.3 Threatened, Endangered, and Protected Species and Critical Habitat 207
C.3.1 Sperm Whale (Endangered) 209
C.3.2 West Indian Manatee (Endangered) 212
C.3.3 Endangered Mysticete Whales 213
C.3.4 Non-Endangered Marine Mammals (Protected) 213
C.3.5 Sea Turtles (Endangered/Threatened) 216
C.3.6 Piping Plover (Threatened) 218
C.3.7 Whooping Crane (Endangered) 220
C.3.8 Gulf Sturgeon (Threatened) 220
C.3.9 Smalltooth Sawfish (Endangered) 221
C.3.10 Beach Mice (Endangered) 221

C.3.11 Elkhorn Coral (Endangered) ... 221
C.4 Coastal and Marine Birds ... 222
C.4.1 Marine and Pelagic Birds ... 222
C.4.2 Shore Birds and Coastal Nesting Birds ... 224
C.5 Fisheries Resources ... 225
C.5.1 Pelagic Communities and Ichthyoplankton ... 225
C.5.2 Essential Fish Habitat ... 227
C.6 Archaeological Resources ... 230
C.6.1 Shipwreck Sites ... 230
C.6.2 Prehistoric Archaeological Sites ... 230
C.7 Coastal Habitats and Protected Areas ... 231
C.8 Socioeconomic and Other Resources ... 231
C.8.1 Recreational and Commercial Fishing ... 231
C.8.2 Public Health and Safety ... 233
C.8.3 Employment and Infrastructure ... 233
C.8.4 Recreation and Tourism ... 233
C.8.5 Land Use ... 233
C.8.6 Other Marine Uses ... 234
D. Environmental Hazards ... 234
D.1 Geologic Hazards ... 234
D.2 Severe Weather ... 234
D.3 Currents and Waves ... 234
E. Alternatives ... 235
F. Mitigation Measures ... 235
G. Consultation ... 236
H. Preparers ... 236
Danielle Johnson (Technical Editor) ... 236
I. References ... 237

List of Tables

Table		Page
1	Notices to Lessees and Operators (NTLs) that are referenced in this Environmental Impact Analysis (EIA)	186
2	Matrix of impact-producing factors and affected environmental resources	189
3	Benthic community data from stations near the lease area and in similar water depths sampled during the Northern Gulf of Mexico Continental Slope Habitats and Benthic Ecology Study (From: Wei, 2006; Rowe and Kennicutt, 2009)	205
4	Federally-listed endangered and threatened species potentially present in the lease area and along the northern Gulf Coast	208

List of Figures

Figure		Page
1	Location of Thunder Horse Unit, Mississippi Canyon Block 776	184
2	Location of Thunder Horse Unit, Mississippi Canyon Block 777	185
3	Bathymetric map showing the drill centers (DCs); production, drilling and quarters (PDQ) location; and seafloor locations for the eight water injection wells to be drilled during this Supplemental Development Operations Coordination Document (SDOCD)	199
4	Location of selected environmental features in relation to the lease area	219

Acronyms and Abbreviations

ADIOS	Automated Data Inquiry for Oil Spills
BOEMRE	Bureau of Ocean Energy Management, Regulation and Enforcement
BOP	blowout preventer
BOPD	barrels of oil per day
BP	BP Exploration & Production Inc.
B.P.	before present
BPD	barrels per day
BWPD	barrels of water per day
C&C	C&C Technologies Survey Services
CEI	Coastal Environments, Inc.
CO	carbon monoxide
CWIS	Cooling Water Intake Structures
DC	Drilling Center
DOCD	Development Operations Coordination Document
DP	dynamically positioned
EA	Environmental Assessment
EFH	Essential Fish Habitat
EIA	Environmental Impact Analysis
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FAD	fish-attracting device
GC	Green Canyon
GMFMC	Gulf of Mexico Fishery Management Council
GoM	Gulf of Mexico
H_2S	hydrogen sulfide
HAPC	Habitat Area of Particular Concern
IPF	impact-producing factor
MARPOL	International Convention for the Prevention of Pollution from Ships
MC	Mississippi Canyon
MGD	million gallons per day
MMC	Marine Mammal Commission
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
MMSCFD	million standard cubic feet per day
NAAQS	National Ambient Air Quality Standards
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NO_2	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRC	National Research Council
NRDA	National Resource Damage Assessment
NTL	Notice to Lessees and Operators
NWR	National Wildlife Refuge
OBM	oil-based mud
OCS	Outer Continental Shelf
OSAT	Operational Science Advisory Team
OSRA	Oil Spill Risk Analysis
OSRP	Oil Spill Response Plan
PAH	polycyclic aromatic hydrocarbon
PDQ	Production, Drilling and Quarters
PM	particulate matter
PSD	Prevention of Significant Deterioration
ROV	remotely operated vehicle
SBM	synthetic-based mud
SDOCD	Supplemental Development Operations Coordination Document
SHL	surface hole location
SO_x	sulfur oxides
THN	Thunder Horse North
THS	Thunder Horse South
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compound
WCD	worst case discharge

Introduction

This Environmental Impact Analysis (EIA) was prepared on behalf of BP Exploration & Production Inc. (BP) for submittal to the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE, formerly Minerals Management Service [MMS]). The EIA evaluates the impacts of BP's Supplemental Development Operations Coordination Document (SDOCD) for the Thunder Horse Field Mississippi Canyon (MC) Unit Agreement 754398003.

The Thunder Horse Field includes MC Blocks 775, 776, 777, 778, 821, and 822 (OCS-G 19997, 9866, 9867, 9868, 14657, and 14658, respectively). BP holds a 75% working interest in the unit and ExxonMobil owns the remaining 25% interest. BP is the designated operator.

The Thunder Horse Project consists of two separate but related accumulations referred to as Thunder Horse North (THN) and Thunder Horse South (THS). THS is comprised of MC 777, 778, 821, and 822. THN comprises MC Blocks 775, 776, and portions of 777 and 778.

A Programmatic Environmental Assessment for Grid 16 – Site-Specific Evaluation of BP's DOCD (N-7469) Thunder Horse Project was issued in December 2002 (MMS, 2002).

The Thunder Horse Semi-Submersible Production, Drilling and Quarters (PDQ) platform was installed on 11 May 2005 near the southern boundary of MC 778. Production commenced 14 June 2008.

The original Development Operations Coordination Document (DOCD) (N-7469) included a water injection system for THN, which consisted of a single pipeline supplying water to two water injection wells in the vicinity of Drilling Center (DC) 33, and two water injection wells in the vicinity of DC 31.

This SDOCD proposes revising the locations of the four original THN water injection wells and drilling an additional four water injection wells. The revised THN Water Injection System will consist of eight water injection wells from two proposed DCs in THN and the installation of two 4-slot single-header manifolds, two 10-in pipelines and one 12-in pipeline along with the associated plets, sleds, jumpers, and infield umbilical's.

The two DCs are designated as DC 33WI in MC 777 and DC 32WI in MC 776. The proposed drill centers will be tied into the MC 778 "A" Platform (Thunder Horse PDQ) via the proposed pipelines.

The PDQ is an existing floating production system (semi-submersible) with a maximum capacity of 250,000 barrels of oil per day (BOPD) and 200 million standard cubic feet per day (MMSCFD) and a maximum water injection capacity of 300,000 barrels of water per day (BWPD). The proposed wells will be drilled with Transocean's dynamically positioned (DP) *Discoverer Enterprise* rig. Each well is anticipated to take 90 days to drill and 90 days to complete.

This SDOCD also includes revisions to comply with the requirements of NTL 2010-N06, but does not include a blowout scenario and worst case discharge (WCD) scenario. The requirements of NTL 2008-G04 for this information are not applicable to an SDOCD for the activities related to waterflood injection wells, as proposed. See BOEMRE guidance document entitled "Approval Requirements for Activities That Involve the Use of a Subsea Blowout Preventer (BOP) or a Surface BOP on a Floating Facility" specifically provides that "clarifying guidance in Appendix A regarding the submission of information to be used in connection with an EIA does not apply to EPs and DOCDs that propose to conduct the following activities … b. drilling a waterflood, gas injection, or a disposal well …" as is the case with this SDOCD.

The lease area is located in the deepwater Gulf of Mexico, approximately 64 miles (103 km) from the nearest shoreline (Louisiana), 117 miles (188 km) from the primary onshore support base at Port Fourchon, Louisiana and 162 miles (262 km) from the helicopter support base in Houma, Louisiana. The construction vessels may also be based in Theodore, Alabama (**Figures 1** and **2**). No new or expanded facilities will be required for this project.

Water depths in the Thunder Horse Field range from 1,609 to 2,012 m (5,280 to 6,600 ft), with depths at the proposed water injection wellsites ranging from 1,744 to 1,748 m (5,722 to 5,739 ft).

This EIA is a project- and site-specific analysis of BP's planned activities prepared in accordance with BOEMRE regulations, including 30 CFR 250.242(s) and 250.261, as well as Notice to Lessees and Operators (NTL) 2008-G04. An EIA is a project-specific analysis that focuses on the impacts of a specific plan to the extent feasible. Potential impacts have been analyzed at a broader level in the Programmatic Environmental Impact Statement (EIS) for the Outer Continental Shelf (OCS) Oil and Gas Leasing Program (MMS, 2007a) and in recent multi-lease-sale EISs for the Western and Central Gulf of Mexico Planning Areas (MMS, 2007b, 2008), as well as the Environmental Assessment (EA) for Gulf of Mexico deepwater operations and activities (MMS, 2000). In addition, the Draft Supplemental EISs for the Central and Western Planning Area lease sales (BOEMRE, 2011a,b) update environmental baseline information in light of the Macondo (*Deepwater Horizon*) incident. Analysis from these documents is incorporated here by reference.

Oil spill response-related activities for facilities included in this SDOCD are governed by the BP Regional Oil Spill Response Plan (OSRP). This OSRP meets the requirements contained in 30 CFR 254.

Sections A through I of this EIA provide the information required by NTL 2008-G04. The main impact related discussions are in **Section A** (Impact Producing Factors) and **Section C** (Impact Analysis). **Table 1** summarizes the NTLs that are referenced in this EIA.

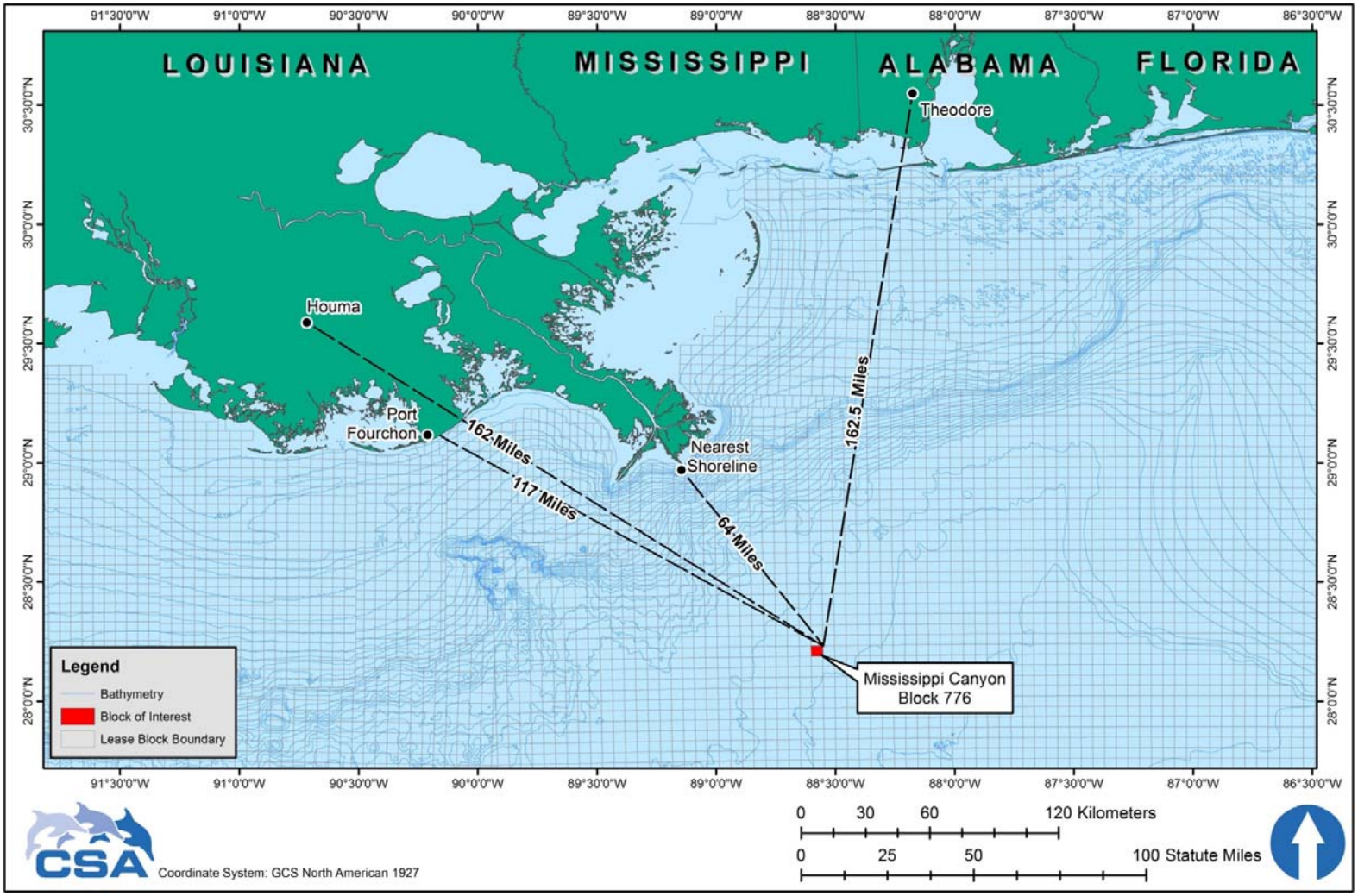

Figure 1. Location of Thunder Horse Unit, Mississippi Canyon Block 776.

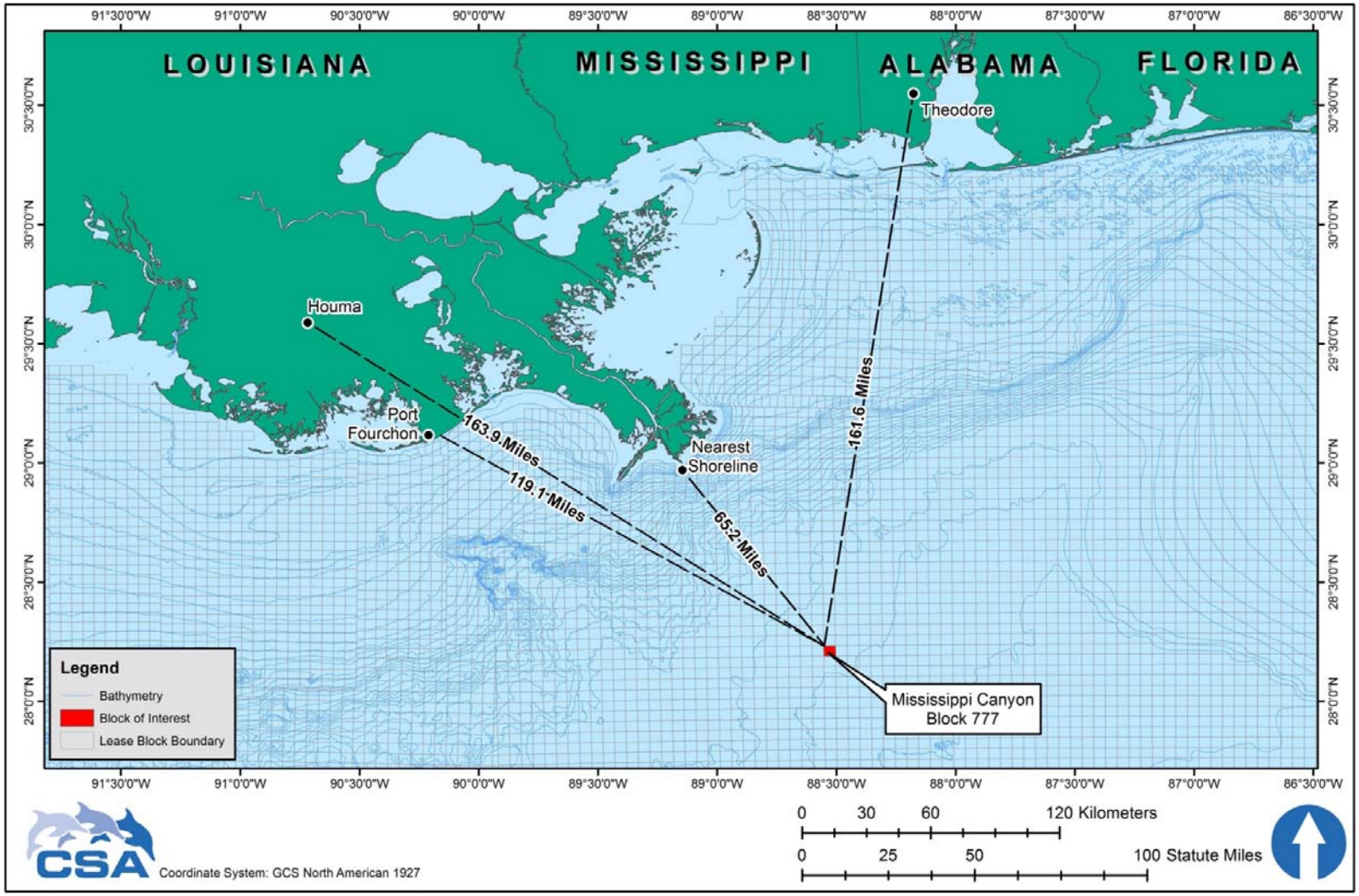

Figure 2. Location of Thunder Horse Unit, Mississippi Canyon Block 777.

Table 1. Notices to Lessees and Operators (NTLs) that are referenced in this Environmental Impact Analysis (EIA).

NTL	Title	Summary
2010-N10	Statement of Compliance with Applicable Regulations and Evaluation of Information Demonstrating Adequate Spill Response and Well Containment Resources	Informs operators using subsea blowout preventers (BOPs) or surface BOPs on floating facilities that applications for well permits must include a statement signed by an authorized company official stating that the operator will conduct all activities in compliance with all applicable regulations, including the increased safety measures regulations (75 FR 63346). Informs operators that BOEMRE will evaluate whether each operator has submitted adequate information demonstrating that it has access to and can deploy containment resources to promptly respond to a blowout or other loss of well control.
2010 N06*	Information Requirements for Exploration Plans, Development and Production Plans, and Development Operations Coordination Documents on the OCS	Rescinds the limitations set forth in NTL 2008-G04 regarding a blowout scenario and worst case discharge scenario, and provides guidance regarding the information required in blowout scenario and worst case discharge scenario descriptions.
2009 G40	Deepwater Benthic Communities	Guidance for avoiding and protecting high-density deepwater benthic communities (including chemosynthetic and deepwater coral communities) from damage caused by Outer Continental Shelf (OCS) oil and gas activities in water depths greater than 300 m (984 ft). Prescribes separation distances of 610 m (2,000 ft) from each mud and cuttings discharge location and 76 m (250 ft) from all other seafloor disturbances.
2009 G39	Biologically-Sensitive Underwater Features and Areas	Guidance for avoiding and protecting biologically sensitive features and areas (i.e., topographic features, pinnacles, low-relief live bottom areas, and other potentially sensitive biological features) when conducting OCS operations in water depths less than 300 m (984 ft) in the Gulf of Mexico.
2009-G06	Military Warning and Water Test Areas	Provides contact links to individual command headquarters for the military warning and water test areas in the Gulf of Mexico. Lease stipulations require lessees or designated operators to enter into an agreement with the appropriate individual military command headquarters concerning the control of electromagnetic emissions and use of boats and aircraft in the applicable warning area or water test area before commencing such traffic.
2008 G04	Information Requirements for Exploration Plans and Development Operations Coordination Documents	Guidance on the information requirements for OCS plans, including EIA requirements and information regarding compliance with the provisions of the Endangered Species Act and Marine Mammal Protection Act.
2007-G04	Vessel Strike Avoidance and Injured/Dead Protected Species Reporting	Recommends protected species identification training, recommends that vessel operators and crews maintain a vigilant watch for marine mammals and slow down or stop their vessel to avoid striking protected species, and requires operators to report sightings of any injured or dead

NTL	Title	Summary
		protected species.
2007 G03	Marine Trash and Debris Awareness and Elimination	Instructs operators to exercise caution in the handling and disposal of small items and packaging materials, requires the posting of placards at prominent locations on offshore vessels and structures, and mandates a yearly marine trash and debris awareness training and certification process.
2005-G07	Archaeological Resource Surveys and Reports	Provides guidance on regulations regarding archaeological discoveries, specifies requirements for archaeological resource surveys and reports, and outlines options for protecting archaeological resources.

* Not applicable. This information is not required. The requirements of NTL 2008-G04 for this information are not applicable to an SDOCD for the activities related to waterflood injection wells, as proposed in this SDOCD. Also, the BOEMRE guidance document entitled "Approval Requirements for Activities That Involve the Use of a Subsea Blowout Preventer (BOP) or a Surface BOP on a Floating Facility" specifically provides that "clarifying guidance in Appendix A regarding the submission of information to be used in connection with an EIA does not apply to EPs and DOCDs that propose to conduct the following activities … b. drilling a waterflood, gas injection, or a disposal well …" As this SDOCD relates to the drilling of waterflood injection wells, the requirements of that guidance do not apply.

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A. Impact-Producing Factors

Table 2 is a matrix of impact producing factors (IPFs) and potentially affected environmental resources. An "X" indicates that an IPF could reasonably be expected to affect a certain resource, and a dash ( ) indicates no impact or negligible impact. Where there may be an effect, an analysis is provided in **Section C**. Potential IPFs for the proposed activity are listed below and briefly discussed in the following subsections:

- Drilling rig presence (including noise and lights);
- Physical disturbance to the seafloor;
- Air pollutant emissions;
- Effluent discharges;
- Water intake;
- Onshore waste disposal;
- Marine debris;
- Support vessel and helicopter traffic; and
- Accidents.

A.1 Drilling Rig Presence (including noise and lights)

The Transocean *Discoverer Enterprise* has six 7,000-horsepower thrusters controlled by a triple redundant, dynamic positioning system to ensure stability offshore, even during a hurricane. The vessel is 255 m (835 ft) long and over 127 m (418 ft) high and displaces over 220 million pounds (103,000 metric tons). It has living accommodations for up to 200 people.

Discoverer Enterprise, Transocean's dynamically positioned drilling rig.

The *Discoverer Enterprise* will be present on site for the duration of the drilling efforts. Construction vessels will be on site during pipeline installations.

The physical presence of a floating structure in the ocean can attract pelagic fishes and other marine life, as discussed in **Section C.5.1**. Sound and vibration from generators and machinery aboard a floating dynamically positioned (DP) facility are also transmitted into the water. Richardson et al. (1995) noted that underwater noise levels from semisubmersibles are relatively low. Drilling operations produce noise that is not particularly intense and is strongest at low frequencies, averaging 10 to 500 Hz (Richardson et al., 1995; MMS, 2000). All DP vessels, such as the *Discoverer Enterprise,* maintain exterior lighting for navigational and aviation safety in accordance with Federal regulations.

Table 2. Matrix of impact-producing factors and affected environmental resources. X = potential impact; ( ) = no impact or negligible impact relative to the identified footnote (Adapted from: Minerals Management Service Form MMS-142).

Environmental Resources	Impact-producing Factors								
	Drilling and Construction Vessel Presence (including noise and lights)	Physical Disturbance to Seafloor	Air Pollutant Emissions	Effluent Discharges	Water Intake	Onshore Waste Disposal	Marine Debris	Support Vessel/Helicopter Traffic	Accidents: Diesel Fuel Spill
Physical/Chemical Environment									
Air quality			X						X(6)
Water quality				X					X(6)
Seafloor Habitats and Biota									
Soft bottom benthic communities		X		X					
High-density deepwater benthic communities		(4)		(4)					
Designated topographic features		(1)		(1)					
Pinnacle trend area live bottoms		(2)		(2)					
Live bottom / low relief		(3)		(3)					
Threatened, Endangered, and Protected Species and Critical Habitat									
Sperm whale (endangered)	X(8)						X	X(8)	X(6,8)
West Indian manatee (endangered)							X	X(8)	
Endangered mysticete whales									
Non-endangered marine mammals (protected)	X						X	X	X(6)
Sea turtles (endangered/threatened)	X(8)						X	X(8)	X(6,8)
Piping Plover (threatened)									
Whooping Crane (endangered)									
Gulf sturgeon (threatened)							X		
Smalltooth sawfish (endangered)							X		
Beach mice (endangered)									
Elkhorn coral (endangered)									
Coastal and Marine Birds									
Marine and pelagic birds	X							X	X(6)
Shore birds and coastal nesting birds								X	
Fisheries Resources									
Pelagic communities and ichthyoplankton	X			X	X				X(6)
Essential Fish Habitat	X	X		X	X				X(6)
Archaeological Resources									
Shipwreck sites		(7)							
Prehistoric archaeological sites		(7)							
Coastal Habitats and Protected Areas									
Beaches									
Wetlands and seagrass beds								X	
Coastal wildlife refuges and wilderness areas									

Socioeconomic and Other Resources									
Recreational and commercial fishing	X								X(6)
Public health and safety									
Employment and infrastructure									
Recreation and tourism									
Land use						X			
Other marine uses									

Table 2 Footnotes and Applicability:

(1) *Activities that may affect a marine sanctuary or topographic feature. Specifically, if the well, platform site, or any anchors will be on the seafloor within the following:*
   (a) *4-mi zone of the Flower Garden Banks, or the 3-mi zone of Stetson Bank;*
   (b) *1,000-m, 1-mi, or 3-mi zone of any topographic feature (submarine bank) protected by the Topographic Features Stipulation attached to an Outer Continental Shelf (OCS) lease;*
   (c) *Essential Fish Habitat (EFH) criteria of 500 ft from any no-activity zone; or*
   (d) *Proximity of any submarine bank (500-ft buffer zone) with relief greater than 2 m that is not protected by the Topographic Features Stipulation attached to an OCS lease.*
   - Not applicable. The lease is not within or near any marine sanctuary, topographic feature, or no activity zone. There are no submarine banks in the blocks.

(2) *Activities with any bottom disturbance within an OCS lease block protected through the Live Bottom (Pinnacle Trend) Stipulation attached to an OCS lease.*
   - The Live Bottom (Pinnacle Trend) Stipulation is not applicable to the lease area.

(3) *Activities within any Eastern Gulf OCS block where seafloor habitats are protected by the Live Bottom (Low-Relief) Stipulation attached to an OCS lease.*
   - The Live Bottom (Low-Relief) Stipulation is not applicable to the lease area.

(4) *Activities on blocks designated by the BOEMRE as being in water depths 300 m or greater.*
   - No impacts on high-density deepwater benthic communities are anticipated. Because dynamically positioned vessels will be used for the activities in this plan, there will be no seafloor disturbances from the use of anchors. The pipeline and umbilical route and the proposed mooring locations for the water injection wells avoid any potential indicators of chemosynthetic or high-density deepwater benthic communities.

(5) *Exploration or production activities where H_2S concentrations greater than 500 ppm might be encountered.*
   - Not applicable. The BOEMRE Regional Supervisor has classified the area as "H_2S absent."

(6) *All activities that could result in an accidental spill of produced liquid hydrocarbons or diesel fuel that you determine would impact these environmental resources. If the proposed action is located a sufficient distance from a resource that no impact would occur, the EIA can note that in a sentence or two.*
   - Accidental diesel fuel spills might affect the resources marked (X) in the matrix, and impacts are analyzed in **Section C**.

(7) *All activities that involve seafloor disturbances, including anchor emplacements, in any OCS block designated by the BOEMRE as having high-probability for the occurrence of shipwrecks or prehistoric sites, including such blocks that will be affected that are adjacent to the lease block in which your planned activity will occur. If the proposed activities are located a sufficient distance from a shipwreck or prehistoric site that no impact would occur, the EIA can note that in a sentence or two.*
   - No impacts on archaeological resources are expected. The lease area is not on the list of high-probability blocks for shipwrecks and is well beyond the 60-m depth contour used by the BOEMRE as the seaward extent for prehistoric archaeological site potential in the Gulf of Mexico. Because dynamically positioned vessels will be used for the activities in this plan, there will be no seafloor disturbances from the use of anchors for facility installation. The pipeline and umbilical route and proposed mooring locations for the floating production unit avoid any potential indicators of chemosynthetic or high-density deepwater benthic communities.

(8) *All activities that you determine might have an adverse effect on endangered or threatened marine mammals or sea turtles or their critical habitats.*
   - IPFs that may affect marine mammals, sea turtles, or their critical habitats include drilling vessel presence including noise and lights, support vessel and helicopter traffic, and accidents. See **Section C**.

A.2 Physical Disturbance to the Seafloor

Sources of seafloor disturbance include drilling water injection wells at the seafloor and installing subsea facilities including the pipelines, umbilicals, jumpers, and manifolds. All facility installation will be done by DP vessels.

In water depths of 600 m (1,969 ft) or greater, DP drillships and DP semisubmersibles disturb only a very small area of the seafloor around the wellbore surface hole location (SHL) where the bottom template and BOP are located. Depending on the specific well configuration, this area is generally about 0.25 hectares (ha) (0.62 acres [ac]) per well.

Pipelines and umbilicals will be installed by DP pipelaying barges. Since there will be no anchoring, the disturbance will be limited to the immediate vicinity where the pipelines and umbilicals are laid. Pipeline installation in deepwater areas is estimated to disturb 0.32 ha (0.79 ac) per km (MMS, 2001, 2007b). The total length of the two 10-in and one 12-in diameter pipelines running from the PDQ platform in MC 778 will be 13.22 km, therefore an estimated 4.2 ha (10.44 ac) of seafloor will be disturbed. Umbilical installation is assumed to result in negligible additional seafloor disturbance. The seafloor is soft bottom at both drill centers and along the pipeline and umbilical route (C&C Technologies Survey Services [C&C], 2001).

A.3 Air Pollutant Emissions

Air pollutant emissions are estimated in **SDOCD Appendix D**. Sources include construction vessels involved in facility installation, drilling operations onboard the drilling vessel, and the engines of service vessels. These emissions occur mainly from combustion of diesel fuel. The combustion of fuels occurs on diesel powered generators, pumps, or motors and from lighter fuel motors. Primary air pollutants typically associated with OCS activities are suspended particulate matter (PM), sulfur oxides (SO_x), nitrogen oxides (NO_2), volatile organic compounds (VOCs), and carbon monoxide (CO).

Mississippi Canyon Blocks 776 and 777 are approximately 154 km (96 miles) from the nearest island of Breton National Wildlife Refuge (NWR). Dispersion modeling has been conducted to evaluate the significance level at the shoreline and at Breton NWR Class 1 area. A modeling protocol has been developed using BOEMRE/40 CFR 51 Appendix W approved methods for evaluating offshore drilling and production operations and their impact on coastal air quality. The model results have demonstrated that maximum 1-hour average NO_2 concentrations at the nearest shoreline and the Breton NWR are below the NAAQS of 188 ug/m^3 and will comply with Class 1 significant impact level at Breton NWR. The complete model report can be found in Appendix D of the SDOCD.

A.4 Effluent Discharges

Effluent discharges are summarized in **SDOCD Section 7.2, Projected Ocean Discharges**. All offshore discharges will be in accordance with the National Pollutant Discharge Elimination System (NPDES) General Permit No. GMG290000 issued by the U.S. Environmental Protection Agency (USEPA). Discharges will be in compliance with and monitored as required by the permit.

Water-based drilling muds and cuttings will be released at the seafloor during the initial well intervals before the marine riser, which allows returns to the surface, is set. Excess cement slurry also will be released at the seafloor during casing installation for the riserless portion of the drilling operations. All muds associated with synthetic-based drilling muds (SBMs) will be collected on the rig and either reused by the vendor, or transported to Port Fourchon, Louisiana for recycling and/or disposal in an approved facility. Well bore cuttings with residual SBMs will be treated to levels at or below NPDES requirements and discharged to the seafloor in accordance with the NPDES permit.

Other effluent discharges in accordance with the NPDES permit may include excess cement slurries, non-contact cooling water, treated sanitary and domestic wastes, deck drainage, desalination unit brine, BOP control fluids, uncontaminated fresh water and seawater, ballast water, and miscellaneous discharges identified in the NPDES permit.

A.5 Water Intake

Seawater will be drawn from the ocean for once through, non-contact cooling of machinery on the drilling rig. The estimated intake and discharge of cooling water is approximately 467,657 barrels per day (BPD) (19.6 million gallons per day [MGD]).

Cooling Water Intake Structures (CWIS) on new offshore facilities are regulated by Section 316(b) of the Clean Water Act. The *Discoverer Enterprise* is not considered a new facility and therefore NPDES permit (GMG290000) design requirements for CWIS are not applicable. Regardless, no significant entrainment or impingement impact on key species is expected based on the findings of the 2009 desktop CWIS Source Water Biological Baseline Characterization Study, as required in the NPDES permit, Part I.B.12.a.

A.6 Onshore Waste Disposal

A list of the solid and liquid wastes generated during this type of the project to be disposed of onshore are tabulated in **SDOCD Appendix E, Project Generated Waste**. Typical waste streams requiring onshore disposal from a project of this nature include:

- Drilling Muds/cuttings
- Completion fluids
- Domestic wastes
- Recyclables (glass, plastic, cardboard, paper and aluminum) - Non hazardous
- Waste chemicals

All other wastes generated in the Enterprise rig are considered contractor waste and are identified in the waste table in **Appendix E** of the **SDOCD**. These wastes will be managed accordingly to contractor's waste procedures.

These waste streams will be separated at the rig and transported to shore for disposal in an appropriately permitted facility.

A.7 Marine Debris

Trash and debris released into the marine environment can harm marine mammals, turtles, and birds through entanglement and ingestion. BP will adhere to the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) Annex V requirements, USEPA, U.S. Coast Guard (USCG), and BOEMRE regulations, and NTLs regarding solid wastes. BOEMRE regulations at 30 CFR 250.300(a) and (b)(6) prohibit operators from deliberately discharging containers and other similar materials (i.e., trash and debris) into the marine environment, and 30 CFR 250.300(c) requires durable identification markings on equipment, tools and containers (especially drums), and other material. USCG and USEPA regulations require operators to become proactive in avoiding accidental loss of solid waste items by developing waste management plans, posting informational placards, manifesting trash sent to shore, and using special precautions such as covering outside trash bins to prevent accidental loss of solid waste. BP complies with NTL 2007-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, requires the posting of placards at prominent locations on offshore vessels and structures, and mandates a yearly marine trash and debris awareness training and certification process. BP's compliance with all applicable laws, regulations, and NTL 2007-G03 should avoid significant impacts on the environment.

A.8 Support Vessel and Helicopter Traffic

BP will use existing shorebase facilities at Port Fourchon and Houma, Louisiana, and Theodore, Alabama, for onshore support for water and air transportation. No terminal expansion or construction is planned.

Installation of the water injection pipelines will require numerous construction vessels including heavy lift installation vessels, tugs, umbilical and pipelaying vessels, remotely operated vehicle (ROV) support vessels, and supply vessels. Construction vessels based out of Port Fourchon, Louisiana, and Theodore, Alabama will be on site during pipeline installation and tieback. Typically, all vessels involved in this project will move to the project area via the most direct route from their respective shorebase. During routine drilling operations, supply vessels and crewboats will make two round-trips weekly.

A helicopter such as the Sikorsky S92 or similar, will be used for crew changes. The helicopter will be used to transport personnel and small supplies and normally will take the most direct route of travel between the shorebase and the lease area when air traffic and weather conditions permit. Helicopters typically maintain a minimum altitude of 213 m (700 ft) while in transit offshore, 305 m (1,000 ft) over unpopulated areas or across coastlines, and 610 m (2,000 ft) over populated areas and sensitive habitats such as wildlife refuges and park properties.

A.9 Accidents

A.9.1 Types of Accidents Evaluated

The analysis in this EIA discussed the most significant potential accident associated with the drilling of water injection wells, a diesel fuel spill occurring at the surface during operations.

As noted above in the introduction, a WCD calculation is not required for water injection wells. Since BP will be targeting only water injection wells in the aquifer no pressurized oil reservoirs are expected to be encountered.

The following sections summarize assumptions about the sizes and fate of a diesel fuel spill as well as BP's spill response plans. Potential impacts are analyzed in **Section C**.

Recent lease sale EISs (MMS, 2007b; BOEMRE 2011a,b) analyze three other types of accidents which could occur in a project of this type: releases of SBMs resulting from accidental riser disconnect incidences, chemical spills, and vessel collisions. These accidents are discussed briefly in **Section A.9.3**.

A.9.2 Diesel Fuel Spills

Spill Size. According to the analysis in MMS (2007b), the most likely type of diesel fuel spill is generally less than 1,000 bbl. Historically, most diesel spills have been ≤1 bbl, and this size is predicted to be the most common in ongoing and future OCS activities in the Western and Central Gulf of Mexico Planning Areas (MMS, 2007b). The average size for spills ≤1 bbl is 0.07 bbl, and the median size for spills of 1 to 10 bbl is 3 bbl (MMS, 2007b). Operational experience suggests that the most likely cause of a diesel fuel spill would be a hose rupture resulting in the loss of the contents of a diesel fuel transfer hose.

Spill Fate. The fate of a diesel fuel spill in the lease area would depend on meteorological and oceanographic conditions at the time, as well as the effectiveness of spill response activities. However, given the open ocean location of the lease area, and the duration of a diesel fuel spill of 1,000 bbl or less, the opportunity for impacts to occur would be very brief. Slicks from spills <1,000 bbl may persist from a few minutes (<1 bbl), to a few days (10-1,000 bbl) on the open ocean. Spilled diesel fuel would rapidly spread out, evaporate, and weather, quickly becoming dispersed into the water column. Most spills <1,000 bbl are expected to be diesel, which dissipates very rapidly. Diesel is a distillate of crude oil and does not contain the heavier components that contribute to crude oil's longer persistence in the environment (MMS 2007b).

The water-soluble fractions of diesel are dominated by two- and three-ringed polycyclic aromatic hydrocarbons (PAHs), which are moderately volatile (National Research Council [NRC], 2003). The constituents of these oils are light-to-intermediate in molecular weight and can be readily degraded by aerobic microbial oxidation. Diesel is so light that it will not sink to the seafloor. Diesel dispersed in the water column can adhere to suspended sediments, but this generally occurs only in coastal areas with high suspended solids loads (NRC, 2003) and would not be expected to occur to any appreciable degree in offshore waters of the Gulf of Mexico. Diesel oil is readily and completely degraded by naturally occurring microbes (National Oceanic and Atmospheric Administration [NOAA], 2006).

The fate of a diesel fuel spill was estimated using NOAA's ADIOS2 (Automated Data Inquiry for Oil Spills) model. This model uses the physical properties of oils in its database to predict the rate of evaporation and dispersion over time, as well as changes in the density, viscosity, and water content of the product spilled. It is estimated that over 90% of a diesel fuel spill would be evaporated or dispersed within 24 hours. The area of the sea surface with diesel fuel on it

would range from 0.5 to 5 ha (1.2 to 12 ac) depending on sea state and weather conditions (NOAA, 2006).

The ADIOS2 results indicate that a diesel fuel spill in the 1,000 bbl or less range would not have any impacts on coastal or shoreline resources. The lease blocks are approximately 64 miles (105 km) from the nearest shoreline (Louisiana). MMS (2007b) similarly concluded that diesel fuel spills <1,000 bbl are not expected to persist as a slick on the surface of the water beyond a few days and are unlikely to make landfall or reach coastal waters prior to breaking up. MMS (2007b) noted that this conclusion is supported by a previous analysis of 3-day trajectory model runs, previous weathering analyses, and historical records of spill incidents.

Spill Response. In the event the shipboard prevention procedures fail to prevent a diesel fuel spill, response equipment and trained personnel would be activated so that any spill effects would be localized and would result only in short-term environmental consequences. **Section 9**, **"Oil Spill Information"** of this SDOCD provides a discussion of BP's spill response procedures.

Weathering. Following a diesel fuel spill, several physical, chemical, and biological processes, collectively called weathering, interact to change the physical and chemical properties of the diesel, and thereby influence its harmful effects on marine organisms and ecosystems. The most important weathering processes include spreading, evaporation, dissolution, dispersion into the water column, formation of water-in-oil emulsions, photochemical oxidation, microbial degradation, adsorption to suspended particulate matter, and stranding on shore or sedimentation to the seafloor (NRC, 2003).

Weathering decreases the concentration of diesel fuel and produces changes in its chemical composition, physical properties, and toxicity. The more toxic, light aromatic and aliphatic hydrocarbons are lost rapidly by evaporation and dissolution from the slick on the water surface. Evaporated hydrocarbons are degraded rapidly by sunlight. Biodegradation of diesel fuel on the water surface and in the water column by marine bacteria removes first the n-alkanes and then the light aromatics. Other petroleum components are biodegraded more slowly. Photooxidation attacks mainly the medium and high molecular weight PAHs in the oil on the water surface.

Diesel fuel spill response-related activities for facilities included in this SDOCD are governed by BP's Regional OSRP. The OSRP meets all requirements contained in 30 CFR 250. BP has the capability to respond, to the maximum extent practicable, to any substantial threat of a diesel fuel spill or discharge for all BP facilities.

A.9.3 Other Accidents Not Analyzed in Detail

BOEMRE EIAs (MMS, 2007b; BOEMRE 2011a,b) discusses three other types of accidents which have the potential to occur in this type of a development project: SBM releases resulting from accidental riser disconnects, chemical spills, and vessel collisions. These accidents are discussed briefly here; there are no other site-specific issues for this SDOCD. The analysis in the lease sale EISs for these topics is incorporated by reference.

Riser Disconnect SBM Spills. In deepwater drilling, SBMs are preferred over petroleum oil-based muds (OBMs) due to the superior environmental properties of SBMs. The synthetic base fluid used in SBM's are less toxic to the marine environment and have the potential to biodegrade. SBMs have been used in the Gulf of Mexico since the mid 1990's and between 5 and 20 SBM releases are anticipated each year as a result of offshore drilling programs. The majority of these releases are <50 bbls in size, but accidental riser disconnects may result in the release of medium (238 to 2,380 bbls) to large (>2,381 bbls) quantities of drilling fluids (BOEMRE, 2011c).

The frequency of SBM spills in the Gulf of Mexico has been decreasing. An SBM spill of 1,061 bbl which occurred in October 2007 in GC Block 726 was to be studied as a "spill of opportunity" using funds set aside from a previous MMS research program. However, this study, titled *Synthetic-based Fluid Spill of Opportunity Environmental Impact and Recovery*, suffered a major equipment malfunction and because SBM releases were declining additional funding was not provided to continue this study (BOEMRE, 2011c).

Chemical Spill. Chemicals used in drilling operations are required to overcome technical issues in the drilling process, improve the efficiency and safety of operations, and protect associated equipment. To perform these tasks, a variety of chemicals may be mixed together to develop the site-specific properties required. Examples of chemicals used to achieve these properties include surfactants, bentonite clays, olefins, inorganic salts, nut shells, glycols, polymers, barite, and calcium carbonate. Supplies are renewed on a regular basis by transfer in containers on supply boats (Boehm et al., 2001). Other than chemicals used in drilling fluids, examples of chemicals that may be found on or transported to offshore facilities include ethylene glycol (blowout prevention control fluid, used in closed cooling loops for crane and main engines, and brake coolers), cement (used to cement casing in place), solvents (used in painting operations), hydraulic fluids (used in cranes and other hydraulic rig equipment), lubricating oil and grease (used in reciprocating and electrical equipment), and sodium hypochlorite (dilute, used as laundry bleach and disinfectant).

A study of environmental risks of chemical products used in OCS activities determined that only two chemicals could potentially affect the marine environment: zinc bromide and ammonium chloride (Boehm et al., 2001). In this project only zinc bromide will be present and the risk of a spill for this chemical is very low. Most other chemicals are either nontoxic or used in small quantities. No significant impacts are expected from chemical spills.

Vessel Collisions. As summarized in MMS (2007b), vessel collisions occasionally occur during routine operations. Most collision mishaps are the result of service vessels colliding with platforms or vessel collisions with pipeline risers. Some of these collisions have caused spills of diesel fuel or chemicals. BP will comply with USCG and BOEMRE-mandated safety requirements to minimize the potential for vessel collisions.

B. Affected Environment

The lease area is in the north central Gulf of Mexico. **Figures 1** and **2** show vicinity maps for MC Blocks 776 and 777, respectively. Overall, the lease area is located 64 miles (103 km) from the nearest shoreline (Louisiana) and 117 miles (188 km) from the onshore support base at Port Fourchon, Louisiana. **Figure 3** shows the location and bathymetry of the proposed project area.

Water depths in the Thunder Horse Field range from 1,609 to 2,012 m (5,280 to 6,600 ft). The seafloor is divided into four general topographic zones, with a major series of faults showing scarps of up to 7 m (23 ft) in height across the northern margin of the lease. Rock outcrops with possible chemosynthetic communities are noted in the northwest area (C&C, 2001).

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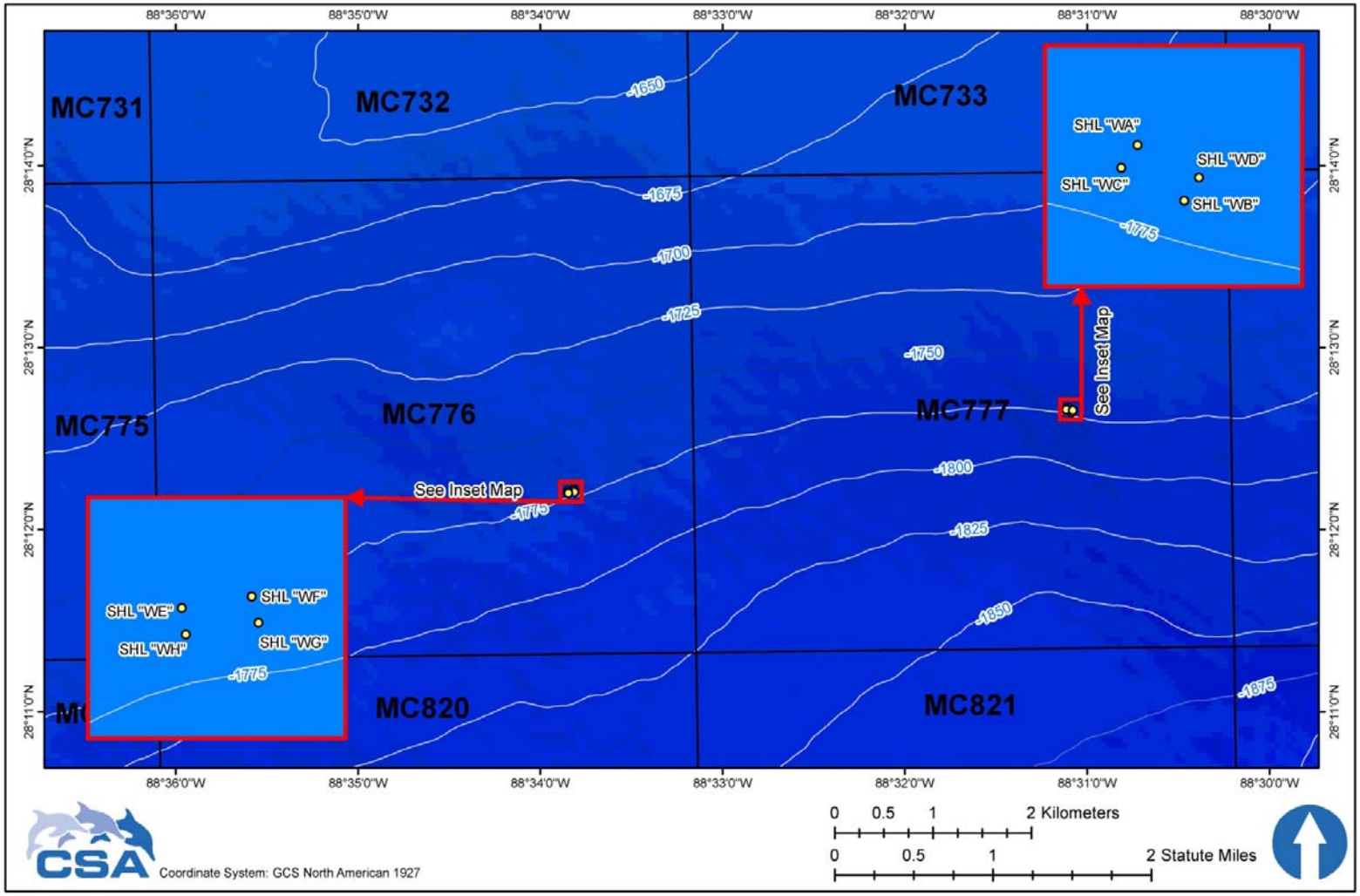

Figure 3. Bathymetric map showing the drill centers (DCs); production, drilling and quarters (PDQ) location; and seafloor locations for the eight water injection wells that are described in this Supplemental Development Operations Coordination Document (SDOCD).

Based on the geohazards assessments by C&C (2001) as summarized in **SDOCD Section 3**, **Geological and Geophysical Information**, there are no indications of seafloor features that could support high-density deepwater benthic communities at the drill centers in MC 776 and 777, along the proposed water injection pipeline routes, or at the SHLs for the eight proposed water injection wells.

A detailed description of the regional affected environment is provided in recent EISs (MMS, 2007b, 2008; BOEMRE, 2011a), including meteorology, oceanography, geology, air and water quality, benthic communities, threatened and endangered species, biologically sensitive resources, archaeological resources, socioeconomic conditions, and other marine uses. These regional descriptions are based on extensive literature reviews and are incorporated by reference. General information is presented below, and brief descriptions of each potentially affected resource are presented in **Section C**, including site-specific and/or new information if available.

Following the 2010 Macondo incident, there is a large amount of ongoing research and studies being conducted on the impacts to water quality from an oil spill and potential deepwater "clouds" of dispersed oil. For example, Terry Hazen with the Lawrence Berkeley National Laboratory (Berkeley Lab), operated by the University of California, is studying the impacts and fate of deepwater oil clouds. Initial study results suggest that the potential exists for rapid intrinsic bioremediation (bacterial degradation) of sub-sea dispersed oil in the water column by deep-sea indigenous microbial activity without significant oxygen depletion (Hazen et al., 2010). Additional studies lead by David Valentine (University of California, Santa Barbara) and John Kessler (Texas A&M University) are researching the effects of deepwater dissolved hydrocarbon gases (e.g., methane, propane, and ethane) and the microbial response to a deepwater oil spill. Initial study results suggest deepwater dissolved hydrocarbon gases may promote rapid hydrocarbon respiration by low-diversity bacterial blooms, and thus priming indigenous bacterial populations for rapid hydrocarbon degradation of sub-sea oil clouds (Kessler et al., 2011; Valentine et al., 2010). These and other studies are ongoing and more data will be generated, analyzed, and final conclusions made. As more information from these studies is made publicly available the impacts to water quality from oil spills and potential deepwater clouds will be addressed and analyzed accordingly by the scientific community. Results to date suggest that sub-surface concentrations of hydrocarbons may be more rapidly degraded by biological means than was previously anticipated.

The lease area is located approximately 37 miles (60 km) south-southwest of the Macondo spill site. Based on an analysis of satellite imagery (ESRI, 2010), the surface slick extended over the lease area, and therefore existing water quality in the lease was potentially affected during that event. Water and sediment monitoring data reported by the Operational Science Advisory Team (OSAT, 2010) show that after August 2010, waters and sediments in the deepwater Gulf of Mexico beyond 1.8 miles (3 km) from the Macondo site, including those in the lease area, were below USEPA acute and chronic benchmarks for PAHs and were not hypoxic. These observations indicate that baseline environmental conditions in the lease area are unlikely to have been significantly altered by the spill.

C. Impact Analysis

This section analyses the potential direct and indirect impacts of routine activities and accidents. Impacts have been analyzed extensively in recent multi-lease-sale EISs for the Western and Central Gulf of Mexico Planning Areas (MMS, 2007b, 2008) as well as the EA for Gulf of Mexico deepwater operations and activities (MMS, 2000) and the Supplemental EIS for Lease Sale 218 (BOEMRE, 2011a). Site-specific issues are addressed in this section as appropriate.

C.1 Physical/Chemical Environment

C.1.1 Air Quality

There are no site-specific air quality data for the project area. Due to the distance from shore-based pollution sources, offshore air quality is expected to be good. The attainment status of Federal OCS waters is unclassified because there is no provision in the Clean Air Act for classification of areas outside State waters (MMS, 2007b).

As of May 2011, all Louisiana, Mississippi, Alabama, and Florida coastal counties and parishes are in attainment of the National Ambient Air Quality Standards (NAAQS) for all criteria pollutants (USEPA, 2010). Two metropolitan areas in Texas are nonattainment areas for 8-h ozone (Dallas-Fort Worth and Houston-Brazoria), and El Paso County is a nonattainment area for PM_{10} (USEPA, 2010).

Winds in the region are driven by the clockwise circulation around the Bermuda High (MMS, 2007b). The Gulf of Mexico is located to the southwest of this center of circulation, resulting in a prevailing southeasterly to southerly flow, which is conducive to transporting emissions toward shore. However, circulation also is affected by tropical cyclones (hurricanes) during summer and fall, and by extratropical cyclones (cold fronts) during winter.

The IPF potentially affecting air quality during this project are air pollutant emissions from normal operations and from a diesel fuel spill.

Impacts of Air Pollutant Emissions

Air pollutant emissions are the only routine IPF likely to affect air quality. Sources include drilling operations aboard the *Discoverer Enterprise*, the construction and pipe laying vessels involved in the water well system installation, operations onboard the PDQ, and the engines of service vessels and helicopters. These emissions occur mainly from combustion or burning of diesel fuel. The combustion of fuels occurs primarily on diesel-powered generators, pumps, or motors and from lighter fuel motors. Primary air pollutants typically associated with OCS activities are suspended PM, SO_x, NO_2, VOCs, and CO.

Due to the distance from shore, routine operations in the project area are not expected to have any impact on air quality conditions along the coast, including nonattainment areas. As noted in the recent lease sale EISs (MMS, 2007b; BOEMRE 2011a,b), emissions of air pollutants from routine activities in the Central Gulf of Mexico Planning Area are projected to have minimal

impacts to onshore air quality because of the prevailing atmospheric conditions, emission heights, emission rates, and the distance of these emissions from the coast.

The Breton Wilderness Area, which is part of the Breton NWR, is designated under the Clean Air Act as a Prevention of Significant Deterioration (PSD) Class I air quality area. BOEMRE is required to notify the National Park Service (NPS) and U.S. Fish and Wildlife Service (USFWS) if emissions from proposed projects may affect the Breton Class I area. Additional review and mitigation measures may be required for sources within 300 km (186 miles) of the Breton Class I area that exceed emission limits agreed upon by the administering agencies (NPS, 2010). The lease area is approximately 96 miles (154 km) from the Breton Wilderness Area and dispersion modeling has been conducted to evaluate the significance of air pollutant levels at the shoreline and at Breton NWR Class 1 area. A modeling protocol has been developed using BOEMRE/40 CFR 51 Appendix W approved methods for evaluating offshore drilling and production operations and their impact of coastal air quality. The model results have demonstrated that 1-hour maximum NO_2 concentrations are below the 188 $\mu g/m^3$ NAAQS level and will be less than the Class 1 PSD significant impact level. The complete model report can be found in Appendix D of this SDOCD.

Impacts of a Diesel Fuel Spill

Potential impacts of a diesel fuel spill on air quality are expected to be consistent with those analyzed and discussed in recent EISs (MMS, 2007b, 2008). The probability of a fuel spill would be minimized by BP's preventative measures during routine operations, including fuel transfer. In the unlikely event of a spill, implementation of BP's OSRP will be an available option to reduce impacts. Given the open ocean location of the lease area, the extent and duration of air quality impacts from a fuel spill are not expected to be significant.

A fuel spill would affect air quality near the spill site by introducing VOCs through evaporation. The ADIOS2 model (**Section A.9.2**) indicates that over 90% of a diesel fuel spill would be evaporated or dispersed within 24 hours. The area of the sea surface with diesel fuel on it would range from 0.5 to 5 ha (1.2 to 12 ac) depending on sea state and weather conditions. Assuming the evaporated volume is 100% VOCs and assuming a diesel fuel density of 7.08 lb/gal, the estimated VOC emissions would be 803 lb. This small volume of VOC emissions would have no impact on coastal air quality.

A diesel fuel spill would not affect coastal air quality because the spill would not be expected to make landfall or reach coastal waters prior to breaking up (**Section A.9.2**).

C.1.2 Water Quality

There are no site-specific water quality data for the lease area. Due to the lease location in deep offshore waters, water quality is expected to be good, with low levels of contaminants. As noted in the lease sale EIS (MMS, 2007b), deepwater areas in the northern Gulf of Mexico are relatively homogeneous with respect to temperature, salinity, and oxygen. Kennicutt (2000) noted that the deepwater region has little evidence of contaminants in the dissolved or particulate phases of the water column. However, there are localized occurrences of natural seepage of oil, gas, and brines in near-surface sediments and up through the water column.

The lease area is located approximately 37 miles (60 km) from the Macondo spill site. Based on satellite imagery (ESRI, 2010), the surface slick extended over the lease area, and therefore existing water quality in the lease area may have been affected in the short-term. The Operational Science Advisory Team (OSAT, 2010) data show that after August 2010, waters and sediments in the deepwater Gulf of Mexico beyond 1.8 miles (3 km) from the Macondo wellsite, including those in the lease area, were below USEPA acute and chronic benchmarks for PAHs and were not hypoxic. No lingering impacts to water quality in the project area are expected.

IPFs potentially affecting water quality are effluent discharges and a diesel fuel spill.

Impacts of Effluent Discharges

Effluent discharges include muds and cuttings from the drilling of the water injection wells, sanitary and domestic wastes, deck drainage, and various discharges of uncontaminated seawater such as cooling water, firewater, ballast and bilge water, and desalination brine. Water quality impacts of effluent discharges are discussed in Section 4.2.1.1.2.2 of the lease sale EIS (MMS, 2007b) and Section 4.1.1.2 of the Supplemental EIS (BOEMRE, 2011a). NPDES permit limitations are expected to be in compliance.

Water-based drilling muds and cuttings will be released at the seafloor during the initial well intervals before the marine riser, which allows returns to the surface, is set. Excess cement slurry also will be released at the seafloor during casing installation for the riserless portion of the drilling operations. Muds associated with SBMs will be collected on the rig and either reused by the vendor, or transported to Port Fourchon, Louisiana for recycling and/or disposal in an approved facility. Wellbore cuttings wetted with SBMs will be treated to SBM levels at or below NPDES requirements and discharged to the seafloor in accordance with the NPDES permit.

Treated sanitary and domestic wastes will have little or no impact on water quality in the immediate vicinity of these discharges. These wastes may have elevated levels of nutrients, organic matter, and chlorine, but should be diluted rapidly to undetectable levels within tens to hundreds of meters from the source. Little or no impact on water quality is anticipated.

Deck drainage includes all effluents resulting from rain, deck washings, and runoff from curbs, gutters, and drains, including drip pans in work areas. Rainwater that falls on uncontaminated areas of the drillship will flow overboard without treatment. However, rainwater that falls on the drilling vessel deck and other areas such as chemical storage areas and places where equipment is exposed will be collected and oil and water separated to meet NPDES permit requirements. Little or no impact on water quality is anticipated.

Other discharges in accordance with the NPDES permit, such as desalination unit brine, BOP hydraulic fluids, and uncontaminated cooling water, firewater, ballast water, and bilge water, are expected to be diluted rapidly and have little or no impact on water quality.

Support vessels will discharge treated sanitary and domestic wastes. These will have little or no impact on water quality in the immediate vicinity of the discharges. All support vessel discharges will be in accordance with USCG and MARPOL regulations and, as applicable, the

NPDES Vessel General Permit, and therefore are not expected to cause significant impacts on water quality.

Impacts of a Diesel Fuel Spill

Potential impacts of a diesel fuel spill on water quality are expected to be consistent with those analyzed and discussed in recent EISs (MMS, 2007b, 2008; BOEMRE 2011a,b). The probability of a diesel fuel spill would be minimized by BP's preventative measures during routine operations, including fuel transfer. In the unlikely event of a spill, implementation of BP's OSRP will be an available option to reduce the impacts. Given the open ocean location of the lease area, the extent and duration of water quality impacts from a diesel fuel spill are not be expected to be significant.

A diesel fuel spill in offshore waters would produce a slick on the water surface and increase the concentrations of petroleum hydrocarbons and their degradation products. The extent and persistence of impacts would depend on the meteorological and oceanographic conditions at the time and the effectiveness of spill response measures. However, it is estimated that over 90% of a diesel fuel spill would be evaporated or dispersed within 24 hours (see **Section A.9.2**). The area of the sea surface with diesel fuel on it would range from 0.5 to 5 ha (1.2 to 12 ac) depending on sea state and weather conditions.

The water-soluble fractions of diesel are dominated by two- and three-ringed PAHs, which are moderately volatile (NRC, 2003). The constituents of these oils are light to intermediate in molecular weight and can be readily degraded by aerobic microbial oxidation. Diesel is so light that it is not possible for the oil to sink and pool on the seafloor. Diesel dispersed in the water column can adhere to suspended sediments, but this generally occurs only in coastal areas with high suspended solid loads (NRC, 2003) and would not be expected to occur to any appreciable degree in offshore waters of the Gulf of Mexico. Diesel oil is readily and completely degraded by naturally occurring microbes (NOAA, 2006).

A diesel fuel spill would not affect coastal water quality because the spill would not be expected to make landfall or reach coastal waters prior to breaking up (see **Section A.9.2**).

C.2 Seafloor Habitats and Biota

Water depths in the Thunder Horse Field range from 1,609 to 2,012 m (5,280 to 6,600 ft). The seafloor in the lease area is expected to consist mainly of soft bottom communities. Based on the geohazards assessments by C&C (2001) and BP GoM Resources (2011) as summarized in **SDOCD Section 3**, **Geological and Geophysical Information**, there are no indications of seafloor features that could support high density deepwater benthic communities at the drill centers in MC 776 and MC 777, or along the pipeline routes leading to the water injection wells.

The BOEMRE uses a biologically based grid system to ensure broad and systematic analysis of the deepwater Gulf of Mexico, including ROV coverage. The BOEMRE website indicates that ROV survey coverage for Grid 16, where the lease area is located, is adequate to characterize the area (BOEMRE, 2011d).

C.2.1 Soft Bottom Benthic Communities

There are no site-specific benthic community data from the lease area. However, data from the recent Northern Gulf of Mexico Continental Slope Habitats and Benthic Ecology Study (Wei, 2006; Rowe and Kennicutt, 2009) can be used to describe typical benthic communities in the area. **Table 3** summarizes data from two nearby stations in similar water depths. Sediments at the MT4 station were predominantly clay (45.5%) and silt (45.5%). In contrast the MT5 sediments were 64.3% sand, 15.3% silt, and 20.4% clay.

Table 3. Benthic community data from stations near the lease area and in similar water depths sampled during the Northern Gulf of Mexico Continental Slope Habitats and Benthic Ecology Study (From: Wei, 2006; Rowe and Kennicutt, 2009).

Station	Location Relative to Lease Area	Water Depth (m)	Abundance		
			Meiofauna (individuals/m^2)	Macroinfauna (individuals/m^2)	Megafauna (individuals/ha)
MT4	45.7 mi SW	1,403	246,058	3,262	1,548
MT5	60.7 mi S	2,294	128,964	1,763	1,111

Meiofaunal and megafaunal abundance from Rowe and Kennicutt (2009); macroinfaunal abundance from Wei, 2006.

Meiofauna (animals passing through a 0.3-mm sieve but retained on a 0.062-mm sieve) densities in water depths representative of the lease area typically range from about 148,000 to 800,000 individuals/m^2 (Rowe and Kennicutt, 2009). Nematodes, nauplii, and harpacticoid copepods were the three dominant groups in the meiofauna, accounting for about 90% of total abundance.

The benthic macroinfauna (animals retained on a 0.3-mm sieve) is characterized by small mean individual sizes and low densities, both of which are a reflection of the meager primary production in Gulf of Mexico surface waters (Wei, 2006). Densities decrease exponentially with water depth. Based on an equation presented by Wei (2006), macroinfaunal densities in the water depths of the lease area are expected to be about 1,500 to 2,000 individuals/m^2.

Polychaetes are typically the most abundant macroinfaunal group on the northern Gulf of Mexico continental slope, followed by amphipods, tanaids, bivalves, and isopods. Wei (2006) recognized four depth dependent faunal zones (1 through 4), two of which are divided horizontally. The lease area is in Zone 2E, which consists of stations on the mid Texas-Louisiana Slope ranging in depth from 625 to 1,828 m (2,050 to 5,997 ft). The five most abundant species in Zone 2E were the polychaetes *Litocorsa antennata*, *Aricidea suecica*, *Tharyx marioni*, *Paralacydonia paradoxa,* and the bivalve *Heterodonta* sp.

Megafaunal densities from nearby stations ranged from 1,111 to 1,548 individuals/ha (**Table 3**). Common megafauna included motile groups such as decapods, ophiuroids, holothurians, and demersal fishes, as well as sessile groups such as sponges and anemones.

Bacteria are also an important component in terms of biomass and cycling of organic carbon (Cruz-Kaegi, 1998). Bacterial biomass at the depth range of the lease area typically is about 1 to 2 g C/m^2 in the top 15 cm of sediments (Rowe and Kennicutt, 2009).

IPFs potentially affecting benthic communities are physical disturbance to the seafloor during drilling and pipeline installation and the discharge of muds and cuttings during drilling of the water wells. There will be no potential for impacts resulting from anchoring at the seafloor and because DP construction vessels will be used. A diesel fuel spill would not affect benthic communities because the diesel fuel would float and dissipate on the sea surface.

Impacts of Physical Disturbance to the Seafloor

Sources of seafloor disturbance include the drilling of eight water injection wells from DC 32 in MC 776 and DC 33 in MC 777, and installation of subsea facilities including the pipelines, umbilicals, jumpers, and manifolds. All facility installation will be done by DP vessels.

Water-based drilling muds and cuttings will be released at the seafloor during the initial well intervals before the marine riser is set that allows returns to the surface at each of the water injection well SHLs. Excess cement slurry also will be released at the seafloor during casing installation for the riserless portion of the drilling operations. Muds associated with SBMs will be collected on the rig and either reused by the vendor, or transported to Port Fourchon, Louisiana for recycling and/or disposal in an approved facility. Wellbore cuttings wetted with SBMs will be discharged to the seafloor in accordance with the NPDES permit.

Pipelines and umbilicals will be installed by a DP pipelaying barge. Since there will be no anchoring, the disturbance will be limited to the immediate vicinity where the pipelines and umbilicals are laid. Pipeline installation in deepwater areas is estimated to disturb 0.32 ha (0.79 ac) per km (MMS, 2001, 2007b). The total length of the three pipelines to be installed is approximately 43,387 ft (13.22 km), therefore, the total seafloor disturbance is approximately 4.2 ha (10.44 ac). Umbilical installation is assumed to result in negligible additional seafloor disturbance.

The benthic impacts of physical disturbance to the seafloor will be minor. Soft bottom communities are ubiquitous along the northern Gulf of Mexico continental slope (Gallaway, 1988; Gallaway et al., 2003; Rowe and Kennicutt, 2009). Impacts from physical disturbance in the lease area during this project are not expected to be significant in the context of similar soft bottom benthic communities in the region.

C.2.2 High-Density Deepwater Benthic Communities

As defined by NTL 2009-G40, high-density deepwater benthic communities are features or areas that could support high-density chemosynthetic communities, or features or areas that could support high-density deepwater corals and other associated high-density hard bottom communities. Chemosynthetic communities were discovered in the central Gulf of Mexico in 1984 and have been studied extensively (MacDonald, 2002). Deepwater coral communities are also known from numerous locations in the Gulf of Mexico (Brooke and Schroeder, 2007; CSA International, Inc., 2007). These communities occur almost exclusively on authigenic carbonates created by chemosynthetic communities. Based on a list of sites compiled by the BOEMRE (2011e) and maps presented by the U.S. Geological Survey (2011), the nearest known chemosynthetic community site is in Viosca Knoll Block 826, located approximately 74 miles (119 km) north-northeast from the lease area (Brooks et al., 2009).

Based on the geohazards assessments by C&C (2001) and the assessment made by BP's Senior Geohazard Specialist (BP GoM Resources, 2011) presented in **SDOCD Appendix C**, there are no indications of seafloor features that could support high-density deepwater benthic communities at the drill center in MC 776 and 777, or along the pipeline routes to the proposed water injection wells.

A diesel fuel spill would not affect benthic communities because the diesel fuel would float and dissipate on the sea surface. Because DP vessels will be used for facility installation, there will be no physical disturbance to the seafloor due to anchoring during the activities analyzed in this EIA.

C.2.3 Designated Topographic Features

The lease area is not within or near a designated topographic feature or a no-activity zone as identified in NTL 2009-G39. The nearest designated topographic feature is Sackett Bank, located approximately 62 miles (100 km) north of the lease area in West Delta Block 147.

There are no IPFs associated with either routine operations or accidents that could cause impacts to designated topographic features due to the distance from the lease area. A diesel fuel spill would float and dissipate on the surface and would not reach these seafloor features.

C.2.4 Pinnacle Trend Area Live Bottoms

The lease area is not covered by the Live Bottom (Pinnacle Trend) Stipulation. The nearest pinnacle trend blocks, as defined by NTL 2009-G39, are about 70 miles (113 km) from the lease area, along the shelf edge south of Alabama in Main Pass Block 290.

There are no IPFs associated with either routine operations or accidents that could cause impacts to pinnacle trend area live bottoms due to the distance from the lease area. A diesel fuel spill would float on the surface and would not reach these seafloor features.

C.2.5 Live Bottom/Low-Relief

The lease area is not covered by the Live Bottom (Low-Relief) Stipulation, which applies to Eastern Gulf of Mexico Planning Area leases in water depths of 100 m (328 ft) or less. The nearest blocks covered by the live bottom stipulation, as defined by NTL 2009-G39, are about 92 miles (149 km) east-northeast of the project area.

There are no IPFs associated with either routine operations or accidents that could cause impacts to eastern Gulf live bottom areas due to the distance from the lease area. A fuel diesel spill would float and dissipate on the surface and would not reach these seafloor features.

C.3 Threatened, Endangered, and Protected Species and Critical Habitat

This section discusses species listed as endangered or threatened under the Endangered Species Act (ESA). In addition, it includes all marine mammal species in the region, which are protected under the Marine Mammal Protection Act (MMPA).

Endangered or threatened species that may occur in the project area and/or along the northern Gulf Coast are listed in **Table 4**. The table also indicates the location of critical habitat (if designated in the Gulf of Mexico). Critical habitat is defined as (1) specific areas within the geographical area occupied by the species at the time of listing, if they contain physical or biological features essential to conservation, and those features may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by the species if the agency determines that the area itself is essential for conservation. The National Marine Fisheries Service (NMFS) has jurisdiction over ESA-listed cetaceans, sea turtles, and fishes in the Gulf of Mexico. The USFWS has jurisdiction over ESA-listed birds and the West Indian manatee.

The sperm whale and five species of sea turtles are the only endangered or threatened species likely to occur at or near the lease area. No critical habitat has been designated for these species in the Gulf of Mexico.

Table 4. Federally-listed endangered and threatened species potentially present in the lease area and along the northern Gulf Coast.

Species	Scientific Name	Status	Potential Presence		Critical Habitat Designated in Gulf of Mexico
			Lease Area	Coastal	
Marine Mammals					
Sperm whale	*Physeter macrocephalus*	E	X	--	None
West Indian manatee	*Trichechus manatus latirostris*	E	--	X	Florida
(Peninsular)					
Blue whale	*Balaenoptera musculus*	E	X[a]	--	None
Fin whale	*Balaenoptera physalus*	E	X[a]	--	None
Humpback whale	*Megaptera novaeangliae*	E	X[a]	--	None
North Atlantic right whale	*Eubalaena glacialis*	E	X[a]	--	None
Sei whale	*Balaenoptera borealis*	E	X[a]	--	None
Sea Turtles					
Loggerhead turtle	*Caretta caretta*	T	X	X	None
Green turtle	*Chelonia mydas*	T, E[b]	X	X	None
Leatherback turtle	*Dermochelys coriacea*	E	X	X	None
Hawksbill turtle	*Eretmochelys imbricata*	E	X	X	None
Kemp's ridley turtle	*Lepidochelys kempii*	E	X	X	None
Birds					
Piping Plover	*Charadrius melodus*	T	--	X	Coastal Texas, Louisiana, Mississippi, Alabama, and Florida (Panhandle)
Whooping Crane	*Grus americana*	E	--	X	Coastal Texas (Aransas National Wildlife Refuge)
Fishes					
Gulf sturgeon	*Acipenser oxyrinchus desotoi*	T	--	X	Coastal Louisiana, Mississippi, Alabama, and Florida (Panhandle)
Smalltooth sawfish	*Pristis pectinata*	E	--	X	Southwest Florida and the Florida Keys
Invertebrates					
Elkhorn coral	*Acropora palmata*	E	--	X	Flower Garden Banks
Terrestrial Mammals					

Beach mice (Alabama, Choctawhatchee, Perdido Key, St. Andrew)	*Peromyscus polionotus*	E	--	X	Alabama and Florida (Panhandle) beaches

Abbreviations: E = Endangered; T = Threatened.

[a] The blue, fin, humpback, North Atlantic right, and sei whales are rare or extralimital in the Gulf of Mexico and are unlikely to be present in the lease area.

[b] The green sea turtle is threatened, except for the Florida breeding population, which is listed as endangered.

As mandated by the ESA, BOEMRE consulted NMFS and USFWS on possible and potential impacts from the proposed leasing in the Western Gulf of Mexico Planning Area on endangered/threatened species and their designated critical habitat (MMS, 2007a,b). A biological assessment was prepared for each consultation. The formal ESA consultation with NMFS was concluded with receipt of the Biological Opinion on 3 July 2007 (NMFS, 2007). The Biological Opinion concludes that the proposed lease sales and associated activities in the Five-Year Leasing Plan for Western and Central Planning Areas 2007-2012 are not likely to jeopardize the continued existence of threatened and endangered species under NMFS jurisdiction or destroy or adversely modify designated critical habitat. The informal ESA consultation with USFWS was concluded with a letter dated 14 September 2007. The USFWS concurred with BOEMRE's determination that proposed actions of the current Five-Year Leasing Plan were not likely to adversely affect the threatened/endangered species or designated critical habitat under USFWS jurisdiction. Following the Macondo oil spill, BOEMRE requested to reinitiate an ESA consultation with both the NMFS and USFWS on 30 July 2010. The NMFS responded with a letter to BOEMRE on 24 September 2010. The USFWS responded with a letter to BOEMRE on 27 September 2010. At this time the re-initiated consultation has not been completed and the existing consultation remains in effect. The existing consultation recognizes that BOEMRE-required mitigations and other reasonable and prudent measures should reduce the likelihood of impacts from BOEMRE-authorized activities.

Five endangered mysticete whales (blue whale, fin whale, humpback whale, North Atlantic right whale, and sei whale) also have been reported from the Gulf of Mexico but are considered rare or extralimital there (Würsig et al., 2000). No critical habitat has been designated for these species in the Gulf of Mexico.

Coastal endangered or threatened species include the West Indian manatee, Piping Plover, Whooping Crane, Gulf sturgeon, and four subspecies of beach mice. Critical habitat has been designated for all of these species as indicated in **Table 4** and discussed in individual sections.

Two other coastal species (Bald Eagle and Brown Pelican) discussed by MMS (2007b) are no longer listed as endangered or threatened; these are discussed in **Section C.4.2**.

There are no other endangered animals or plants in the Gulf of Mexico that are reasonably likely to be affected by either routine or accidental events.

C.3.1 Sperm Whale (Endangered)

The only endangered marine mammal likely to be present at or near the project area is the sperm whale (*Physeter macrocephalus*). Resident populations of sperm whales occur within the

Gulf of Mexico. A species description is presented in a recent lease sale EIS (MMS, 2007b). Gulf of Mexico sperm whales are classified as an endangered species and a "strategic stock" (defined as a stock that may have unsustainable human-caused impacts) by NOAA Fisheries (Waring et al., 2009). No critical habitat for sperm whale has been designated in the Gulf of Mexico.

The distribution of sperm whales in the Gulf of Mexico is correlated with mesoscale physical features such as eddies associated with the Gulf of Mexico Loop Current (Jochens et al., 2008). Sperm whale populations are present in the north-central Gulf of Mexico throughout the year (Davis et al., 2000). Results of a multi-year tracking study show female sperm whales typically concentrated along the upper continental slope between the 200- and 1,000-m (656- and 3,280-ft) depth contours (Jochens et al., 2008). Male sperm whales were more variable in their movements and were documented in water depths greater than 3,000 m (9,843 ft). Generally, groups of sperm whales sighted in the Gulf of Mexico during the MMS funded Sperm Whale Seismic Study consisted of mixed-sex groups comprising adult females and immatures, and groups of bachelor males. Typical group size for mixed groups was 10 individuals (Jochens et al., 2008). Study results showed that sperm whales transit through the vicinity of the lease area. Movements of satellite-tracked individuals suggest that this area of the Gulf continental slope is within the home range of the Gulf of Mexico population (within the 95% utilization distribution) (Jochens et al., 2008).

IPFs potentially affecting sperm whales include drilling vessel presence, noise, and lights; support vessel and helicopter traffic; and accidents such as a diesel fuel spill. Effluent discharges are likely to have negligible impacts on sperm whales due to rapid dispersion, the small area of ocean affected, the intermittent nature of the discharges, and the mobility of these marine mammals. Compliance with NTL 2007-G03 should minimize the potential for marine debris related impacts on sperm whales.

Impacts of Drilling Vessel Presence, Noise, and Lights

Noise from routine drilling and pipeline installation activities has the potential to disturb sperm whales. Sperm whales appear to have good midrange frequency hearing (Southall et al., 2007), but the available data do not indicate a consistent response to anthropogenic noise (Jochens et al., 2008). Noise associated with offshore oil and gas production is relatively weak in intensity, and an individual animal's noise exposure would be transient. There are other OCS facilities and activities near the lease area, and the region as a whole has a large number of similar noise sources. This project would represent a small contribution to the overall noise regime.

The NMFS (2007) analyzed the potential for impacts of OCS-related noise on sperm whales in its Biological Opinion for the Five-Year Oil and Gas Leasing Program in the Central and Western Planning Areas of the Gulf of Mexico. The analysis noted that OCS drilling and production activities produce low sound source levels and concluded that noise from these sources is not expected to produce amplitudes sufficient to cause hearing or behavioral effects in sperm whales; therefore, these effects are insignificant (NMFS, 2007).

Current threats to sperm whale populations worldwide are discussed in a final recovery plan for the sperm whale recently published by NOAA (NMFS, 2010a). Threats are defined as "any factor

that could represent an impediment to recovery" and these include fisheries interactions, anthropogenic noise, vessel interactions, contaminants and pollutants, disease, injury from marine debris, research, predation and natural mortality, direct harvest, competition for resources, loss of prey base due to climate change and ecosystem change, and cable laying. In the Gulf of Mexico, the impacts from many of these threats are identified as either low or unknown (BOEMRE, 2011a).

Impacts of Support Vessel and Helicopter Traffic

Support vessel traffic has the potential to disturb sperm whales, and there is also a risk of vessel strikes, which are identified as a threat in the recovery plan for this species (NMFS, 2010a). Data concerning the frequency of vessel strikes are presented in the lease sale EIS (MMS, 2007b). To reduce the potential for vessel strikes, BOEMRE has issued NTL 2007-G04, which recommends protected species identification training and that vessel operators and crews maintain a vigilant watch for marine mammals and slow down or stop their vessel to avoid striking protected species, and requires operators to report sightings of any injured or dead protected species. When whales are sighted, vessel operators and crews are required to attempt to maintain a distance of 91 m (300 ft) or greater whenever possible. When safety permits, vessel operators are required to reduce vessel speed to 10 knots or less when mother/calf pairs, pods, or large assemblages of cetaceans are observed near an underway vessel. Compliance with this NTL will minimize the likelihood of vessel strikes as well as reduce the chance for disturbing sperm whales.

The NMFS (2010a) analyzed the potential for vessel strikes and harassment of sperm whales in its Biological Opinion for the Five-Year Oil and Gas Leasing Program in the Central and Western Planning Areas of the Gulf of Mexico. With implementation of the mitigation measures in NTL 2007-G04, the NMFS concluded that the likelihood of collisions between vessels and sperm whales would be reduced to insignificant levels. The NMFS concluded that the observed avoidance of passing vessels by sperm whales is an advantageous response to avoid a potential threat and is not expected to result in any significant effect on migration, breathing, nursing, breeding, feeding, or sheltering to individuals, or have any consequences at the level of the population. With implementation of the vessel strike avoidance measures requirement to maintain a distance of 90 m (295 ft) from sperm whales, the NMFS concluded that the potential for harassment of sperm whales would be reduced to discountable levels.

Helicopter traffic also has the potential to disturb sperm whales. Smultea et al. (2008) documented responses of sperm whales offshore Hawaii to fixed wing aircraft flying at an altitude of 245 m (800 ft). A reaction to the initial pass of the aircraft was observed during three (12%) of 24 sightings. All three reactions consisted of a hasty dive and occurred at less than 360 m (1,180 ft) lateral distance from the aircraft. Additional reactions were seen when aircraft circled certain whales to make further observations. Based on other studies of cetacean responses to sound, the authors concluded that the observed reactions to brief overflights by the aircraft were short-term and probably of no long-term biological significance.

While flying offshore in the Gulf of Mexico, helicopters maintain altitudes above 213 m (700 ft) during transit to and from the working area. In the event that a whale is seen during transit, the helicopter will not approach or circle the animals. Although responses are possible, based on

the Smultea et al. (2008) study, the NMFS (2007) concluded that this altitude would minimize the potential for disturbing sperm whales. Therefore, no significant impacts are expected.

Impacts of a Diesel Fuel Spill

Potential diesel fuel spill impacts on marine mammals including sperm whales are discussed in recent EISs (MMS, 2007b, 2008) and by the NMFS (2007) in its Biological Opinion for the Five-Year Oil and Gas Leasing Program in the Central and Western Planning Areas of the Gulf of Mexico. For the SDOCD, there are no unique site-specific issues with respect to diesel fuel spill impacts on these animals.

The probability of a diesel fuel spill will be minimized by BP's preventative measures during routine operations including fuel transfer. In the unlikely event of a spill, implementation of BP's OSRP will be an available option to reduce impacts. Given the open ocean location of the lease area, the duration of a diesel fuel spill and opportunity for impacts to occur would be very brief.

A diesel fuel spill in offshore waters would produce a slick on the water surface and increase the concentrations of petroleum hydrocarbons and their degradation products. The extent and persistence of impacts would depend on the meteorological and oceanographic conditions at the time and the effectiveness of spill response measures. **Section A.9.2** discusses the likely fate of a diesel fuel spill and indicates that over 90% would be evaporated or dispersed naturally within 24 hours. The area of the sea surface with diesel fuel on it would range from 0.5 to 5 ha (1.2 to 12 ac), depending on sea state and weather conditions.

Direct physical and physiological effects of exposure to diesel fuel could include skin irritation, inflammation, or necrosis; chemical burns of skin, eyes, and mucous membranes; inhalation of toxic fumes; ingestion of oil directly or via contaminated prey; and stress from the activities and noise of response vessels and aircraft (Marine Mammal Commission [MMC], 2010). However, due to the limited areal extent and short duration of water quality impacts from a diesel fuel spill, as well as the mobility of sperm whales, no significant impacts would be expected.

C.3.2 West Indian Manatee (Endangered)

Most of the manatee population is located in peninsular Florida (USFWS, 2001), but manatee sightings in Louisiana have been increasing as manatees extend their presence further west of Florida in the warmer months (Wilson, 2003). A species description is presented in a recent lease sale EIS (MMS, 2007b) and in the recovery plan for this species (USFWS, 2001).

IPFs potentially affecting manatees include support vessel and helicopter traffic. A diesel fuel spill in the lease area would be unlikely to affect manatees, as the lease area is approximately 64 miles (103 km) from the nearest shoreline (Louisiana). As explained in **Section A.9.2**, a diesel fuel spill would not be expected to make landfall or reach coastal waters prior to breaking up. Compliance with NTL 2007-G03 will minimize the potential for marine debris-related impacts on manatees.

Impacts of Support Vessel and Helicopter Traffic

Support vessel traffic has the potential to disturb manatees, and there is also a risk of vessel strikes, which are identified as a threat in the recovery plan for this species (USFWS, 2001). To reduce the potential for vessel strikes, the BOEMRE has issued NTL 2007-G04, which recommends protected species identification training and that vessel operators and crews maintain a vigilant watch for marine mammals and slow down or stop their vessel to avoid striking protected species, and requires operators to report sightings of any injured or dead protected species. Compliance with this NTL will minimize the likelihood of vessel strikes, and no significant impacts on manatees are expected.

Helicopter traffic also has the potential to disturb manatees. Rathbun (1988) reported that manatees were disturbed more by helicopters than by fixed-wing aircraft; however, the helicopter was flown at a relatively low altitude of 20 to 160 m (66 to 525 ft). Helicopters used in support operations maintain a minimum altitude of 213 m (700 ft) while in transit offshore, 305 m (1,000 ft) over unpopulated areas or across coastlines, and 610 m (2,000 ft) over populated areas and sensitive habitats such as wildlife refuges and park properties. This mitigation measure will minimize the potential for disturbing manatees, and no significant impacts are expected.

C.3.3 Endangered Mysticete Whales

Five endangered mysticete whales (blue whale, fin whale, humpback whale, North Atlantic right whale, and sei whale) have been reported from the Gulf of Mexico but are considered rare or extralimital there (Würsig et al., 2000). No critical habitat has been designated for these species in the Gulf of Mexico.

Due to the rare occurrence of these whales in the Gulf of Mexico and the limited scope and duration of the project, it is highly unlikely that any endangered mysticete would come into contact with any project activities, either routine operations or accidents. The NMFS (2007) did not include any of these mysticete whales as affected species in its Biological Opinion for the Five-Year Oil and Gas Leasing Program in the Central and Western Planning Areas of the Gulf of Mexico. Potential impacts are analyzed in recent lease sale EISs (MMS, 2007b, 2008; BOEMRE 2011a,b), and those analyses are incorporated by reference. If any of these whales were present in the area, potential impacts would be the same as those discussed below in **Section C.3.4**.

C.3.4 Non-Endangered Marine Mammals (Protected)

Excluding the seven endangered species that have been cited previously, there are 22 additional species of marine mammals that may be found in the Gulf of Mexico. All marine mammals are protected species under the MMPA. This includes two mysticete whales, the dwarf and pygmy sperm whales, 4 species of beaked whales, and 14 species of delphinids. The most common non-endangered cetaceans in the deepwater environment are odontocetes such as the pantropical spotted dolphin, spinner dolphin, and clymene dolphin. A brief summary is presented below, and additional information on these groups is presented in a recent lease sale EIS (MMS, 2007b).

Mysticete Whales. Two non-endangered mysticete whales are known from the Gulf of Mexico: the Bryde's whale (*Balaenoptera edeni*) and minke whale (*Balaenoptera acutorostrata*). The Bryde's whale has been sighted most frequently along the 100-m (328-ft) isobath (Davis and Fargion, 1996; Davis et al., 2000). Most sightings have been made in the DeSoto Canyon region and off western Florida, although there have been some in the west-central portion of the northeastern Gulf. The minke whale is considered rare in the Gulf of Mexico, with the only confirmed records coming from strandings (Würsig et al., 2000). Based on the available data, it is possible that Bryde's whales could occur in the lease area.

Dwarf and pygmy sperm whales. At sea, it is difficult to differentiate dwarf sperm whales (*Kogia sima*) from pygmy sperm whales (*Kogia breviceps*), and sightings are often grouped together as "*Kogia* spp." Both species have a worldwide distribution in temperate to tropical waters. In the Gulf of Mexico, both species occur primarily along the continental shelf edge and in deeper waters off the continental shelf (Mullin et al., 1991). Either species could occur in the lease area.

Beaked whales. Four species of beaked whales are known from the Gulf of Mexico. They are Blainville's beaked whale (*Mesoplodon densirostris*), Cuvier's beaked whale (*Ziphius cavirostris*), Sowerby's beaked whale (*Mesoplodon bidens*), and Gervais' beaked whale (*Mesoplodon europaeus*). Stranding records in the Gulf of Mexico suggest that Gervais' beaked whale is the most common and Sowerby's is extralimital. Due to the difficulties of at-sea identification, beaked whales in the Gulf of Mexico are identified either as Cuvier's beaked whales or are grouped into an undifferentiated complex (*Mesoplodon* spp. and *Ziphius* spp.). In the northern Gulf of Mexico, they are broadly distributed in waters greater than 1,000 m (3,281 ft) over lower slope and abyssal landscapes (Davis et al., 2000). Any of these species could occur in the lease area.

Delphinids. Fourteen species of delphinids are known from the Gulf of Mexico: Atlantic spotted dolphin (*Stenella frontalis*), bottlenose dolphin (*Tursiops truncatus*), clymene dolphin (*Stenella clymene*), false killer whale (*Pseudorca crassidens*), Fraser's dolphin (*Lagenodelphis hosei*), killer whale (*Orcinus orca*), melon-headed whale (*Peponocephala electra*), pantropical spotted dolphin (*Stenella attenuata*), pygmy killer whale (*Feresa attenuata*), short-finned pilot whale (*Globicephala macrorhynchus*), Risso's dolphin (*Grampus griseus*), rough-toothed dolphin (*Steno bredanensis*), spinner dolphin (*Stenella longirostris*), and striped dolphin (*Stenella coeruleoalba*). The most common non-endangered cetaceans in the deepwater environment are the pantropical spotted dolphin, spinner dolphin, and clymene dolphin. However, any of these species could occur in the lease area.

IPFs potentially affecting non-endangered marine mammals include drilling vessel presence, noise, and lights; support vessel and helicopter traffic; and a diesel fuel spill. Effluent discharges are likely to have negligible impacts on marine mammals due to rapid dispersion, the small area of ocean affected, the intermittent nature of the discharges, and the mobility of marine mammals. Compliance with NTL 2007-G03 will minimize the potential for marine debris related impacts on marine mammals.

Impacts of Drilling Vessel Presence, Noise, and Lights

Noise from routine oil and gas production activities has the potential to disturb marine mammals. Most odontocetes (toothed whales and dolphins) use sounds in a higher frequency range than the low frequency sounds produced by OCS activities (Richardson et al., 1995). Noise associated with OCS drilling activities is relatively weak in intensity, and an individual animal's noise exposure would be transient. There are other OCS facilities and activities near the lease area, and the region as a whole has a large number of similar sources. This project would represent a small contribution to the overall noise regime, and any short-term impacts are not expected to be biologically significant to marine mammal populations.

Platform lighting and presence are not identified as IPFs for marine mammals in recent lease sale EISs (MMS, 2007b, 2008; BOEMRE, 2011a,b).

Impacts of Support Vessel and Helicopter Traffic

Support vessel traffic has the potential to disturb marine mammals, and there is also a risk of vessel strikes. Data concerning the frequency of vessel strikes are presented in the lease sale EIS (MMS, 2007b). To reduce the potential for vessel strikes, BOEMRE has issued NTL 2007-G04, which recommends protected species identification training and that vessel operators and crews maintain a vigilant watch for marine mammals and slow down or stop their vessel to avoid striking protected species, and requires operators to report sightings of any injured or dead protected species. Vessel operators and crews are required to attempt to maintain a distance of 91 m (300 ft) or greater when whales are sighted and 45 m (150 ft) when small cetaceans are sighted. When cetaceans are sighted while a vessel is underway, vessels must attempt to remain parallel to the animal's course and avoid excessive speed or abrupt changes in direction until the cetacean has left the area. Vessel operators are required to reduce vessel speed to 10 knots or less when mother/calf pairs, pods, or large assemblages of cetaceans are observed near an underway vessel, when safety permits. Compliance with this NTL will minimize the likelihood of vessel strikes as well as reduce the chance for disturbing marine mammals, and therefore no significant impacts are expected.

Aircraft traffic also has the potential to disturb marine mammals (Würsig et al., 1998). However, while flying offshore, helicopters maintain altitudes above 213 m (700 ft) during transit to and from the working area. This altitude will minimize the potential for disturbing marine mammals, and no significant impacts are expected (MMS, 2007b).

Impacts of a Diesel Fuel Spill

Potential diesel fuel spill impacts on marine mammals are discussed in recent EISs (MMS, 2007b, 2008), and oil impacts on marine mammals in general are discussed by Geraci and St. Aubin (1990). For this SDOCD, there are no unique site-specific issues with respect to diesel fuel spill impacts on these animals.

The probability of a diesel fuel spill will be minimized by BP's preventative measures during fuel transfer. In the unlikely event of a spill, implementation of BP's OSRP will be an available option to reduce impacts. Given the open ocean location of the lease area, the duration of a spill and opportunity for impacts to occur would be very brief.

A diesel fuel spill in offshore waters would produce a slick on the water surface and increase the concentrations of petroleum hydrocarbons and their degradation products. The extent and persistence of impacts would depend on the meteorological and oceanographic conditions at the time and the effectiveness of spill response measures. **Section A.9.2** discusses the likely fate of a diesel fuel spill and indicates that over 90% would be evaporated or dispersed naturally within 24 hours. The area of the sea surface with diesel fuel on it would range from 0.5 to 5 ha (1.2 to 12 ac), depending on sea state and weather conditions.

Direct physical and physiological effects of exposure to diesel fuel could include skin irritation, inflammation, or necrosis; chemical burns of skin, eyes, and mucous membranes; inhalation of toxic fumes; ingestion of oil directly or via contaminated prey; and stress from the activities and noise of response vessels and aircraft (MMC, 2010). However, due to the limited areal extent and short duration of water quality impacts from a diesel fuel spill, as well as the mobility of marine mammals, no significant impacts would be expected.

C.3.5 Sea Turtles (Endangered/Threatened)

Five species of endangered or threatened sea turtles may be found near the lease area. Endangered species are the leatherback (*Dermochelys coriacea*), Kemp's ridley (*Lepidochelys kempii*), and hawksbill (*Eretmochelys imbricata*) turtles. The loggerhead turtle (Caretta caretta) is a threatened species. The green turtle (*Chelonia mydas*) is listed as threatened, except for the Florida breeding population, which is listed as endangered. Species descriptions are presented in a recent lease sale EIS (MMS, 2007b).

Leatherbacks and loggerheads are the most likely species to be present near the lease area as adults. Green, hawksbill, and Kemp's ridley turtles are typically inner shelf and nearshore species, unlikely to occur near the lease area as adults. Hatchlings or juveniles of any of the sea turtles may be present in deepwater areas, including the lease area, where they may be associated with *Sargassum* and other flotsam.

Sea turtle nesting in the northern Gulf of Mexico can be summarized by species as follows:

- Loggerhead turtles – Loggerheads nest in significant numbers along the Florida Panhandle and, to a lesser extent, from Texas through Alabama (MMS, 2007b). The nearest significant nesting area of loggerhead turtles is found in Louisiana, on beaches within the Breton NWR;
- Green and leatherback turtles – Green and leatherback turtles infrequently nest on Florida Panhandle beaches (Florida Fish and Wildlife Conservation Commission, 2010);
- Kemp's ridley turtles – The main Kemp's ridley nesting site is Rancho Nuevo beach, Tamaulipas, Mexico (NMFS et al., 2010). Kemp's ridley turtles typically do not nest anywhere near the project area, although there have been occasional reports of Kemp's ridleys nesting in Alabama (Share the Beach, 2010); and
- Hawksbill turtles – Hawksbills typically do not nest anywhere near the project area.

IPFs potentially affecting sea turtles include drilling and construction vessel presence, noise, and lights; support vessel and helicopter traffic; and a diesel fuel spill. Effluent discharges are likely to have negligible impacts on sea turtles due to rapid dispersion, the small area of ocean

affected, and the intermittent nature of the discharges. Compliance with NTL 2007-G03 should minimize the potential for marine debris related impacts on sea turtles.

Impacts of Drilling and Construction Presence, Noise, and Lights

Offshore oil and gas related activities produce a broad array of sounds at frequencies and intensities that may be detected by sea turtles (Geraci and St. Aubin, 1987). Potential impacts may include behavioral disruption and temporary or permanent displacement from the area near the sound source. Certain sea turtles, especially loggerheads, may be attracted to offshore structures (Lohoefener et al., 1990) and, thus, may be more susceptible to impacts from sounds produced during routine operations. Helicopters and service vessels may also affect sea turtles due to machinery noise and/or visual disturbances. The most likely impacts would be short-term behavioral changes such as diving and evasive swimming, disruption of activities, or departure from the area. These short-term impacts are not expected to be biologically significant to sea turtle populations.

Artificial lighting can disrupt the nocturnal orientation of sea turtle hatchlings (Witherington, 1997; Tuxbury and Salmon, 2005). However, hatchlings may rely less on light cues when they are offshore than when they are emerging on the beach (Salmon and Wyneken, 1990). The NMFS (2007) concluded that the effects of lighting from offshore structures on sea turtles are insignificant.

Support Vessel and Helicopter Traffic

Support vessel traffic has the potential to disturb sea turtles, and there is also a risk of vessel strikes. Data show that vessel traffic is one cause of sea turtle mortality in the Gulf of Mexico (Lutcavage et al., 1997). While adult sea turtles are visible at the surface during the day and in clear weather, they can be difficult to spot from a moving vessel when resting below the water surface, during nighttime, or during periods of inclement weather. To reduce the potential for vessel strikes, BOEMRE has issued NTL 2007-G04, which recommends protected species identification training and that vessel operators and crews maintain a vigilant watch for sea turtles and slow down or stop their vessel to avoid striking protected species, and requires operators to report sightings of any injured or dead protected species. When sea turtles are sighted, vessel operators and crews are required to attempt to maintain a distance of 45 m (150 ft) or greater whenever possible. Compliance with this NTL will minimize the likelihood of vessel strikes as well as reduce the chance for disturbing sea turtles (NMFS, 2007).

Helicopter traffic also has the potential to disturb sea turtles. However, while flying offshore, helicopters maintain altitudes above 213 m (700 ft) during transit to and from the working area. This altitude will minimize the potential for disturbing sea turtles, and no significant impacts are expected.

Impacts of a Diesel Fuel Spill

Potential diesel fuel spill impacts on sea turtles are discussed in recent EISs (MMS, 2007b, 2008) and by the NMFS (2007) in its Biological Opinion for the Five-Year Oil and Gas Leasing Program in the Central and Western Planning Areas of the Gulf of Mexico. For the SDOCD, there are no unique site-specific issues with respect to diesel fuel spill impacts on these animals.

The probability of a diesel fuel spill will be minimized by BP's preventative measures during fuel transfer. In the unlikely event of a spill, implementation of BP's OSRP is available as an option to reduce potential for impacts. Given the open ocean location of the lease area, the duration of a diesel fuel spill and opportunity for impacts to occur would be very brief.

A diesel fuel spill in offshore waters would produce a slick on the water surface and increase the concentrations of petroleum hydrocarbons and their degradation products. The extent and persistence of impacts would depend on the meteorological and oceanographic conditions at the time and the effectiveness of spill response measures. **Section A.9.2** discusses the likely fate of a diesel fuel spill and indicates that over 90% would be evaporated or dispersed naturally within 24 hours. The area of the sea surface with diesel fuel on it would range from 0.5 to 5 ha (1.2 to 12 ac), depending on sea state and weather conditions.

Direct physical and physiological effects of exposure to diesel fuel could include skin irritation, inflammation, or necrosis; chemical burns of skin, eyes, and mucous membranes; inhalation of toxic fumes; ingestion of oil directly or via contaminated prey; and stress from the activities and noise of response vessels and aircraft (MMC, 2010). However, due to the limited areal extent and short duration of water quality impacts from a fuel spill, no significant impacts would be expected.

A diesel fuel spill in the lease area would be unlikely to affect sea turtle nesting beaches, as the lease area is 64 miles (103 km) from the nearest shoreline (Louisiana). As explained in **Section A.9.2**, a diesel fuel spill would not be expected to make landfall or reach coastal waters prior to breaking up.

C.3.6 Piping Plover (Threatened)

The Piping Plover (*Charadrius melodus*) is a migratory shore bird that overwinters along the southeastern U.S. and Gulf of Mexico coasts. This threatened species is in decline as a result of hunting, habitat loss and modification, predation, and disease (USFWS, 2003). Critical overwintering habitat has been designated, including beaches in Texas, Louisiana, Mississippi, Alabama, and Florida (**Figure 4**). Piping Plovers inhabit coastal sandy beaches and mudflats, feeding by probing for invertebrates at or just below the surface. They use beaches adjacent to foraging areas for roosting and preening (USFWS, 2010a). A species description is presented in a recent lease sale EIS (MMS, 2007b).

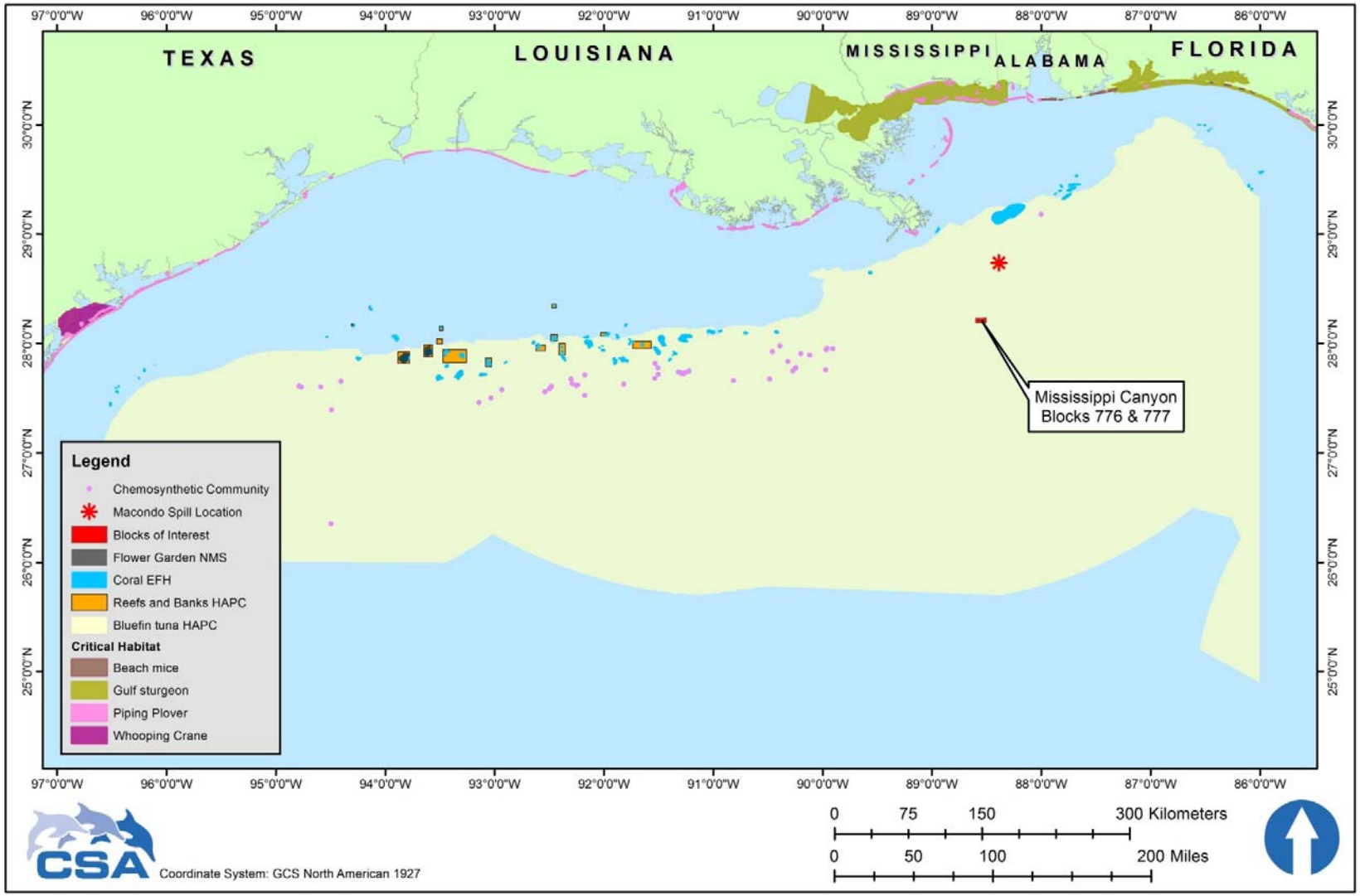

Figure 4. Location of selected environmental features in relation to the lease area.

There are no IPFs associated with routine project activities that could affect these birds. A diesel fuel spill in the lease area would be unlikely to affect Piping Plovers because a diesel fuel spill would not be expected to make landfall or reach coastal waters prior to breaking up (see explanation in **Section A.9.2**).

C.3.7 Whooping Crane (Endangered)

The Whooping Crane (*Grus americana*) is an omnivorous wading bird and an endangered species. There are three wild populations in North America (Whooping Crane Eastern Partnership, 2010). One population winters along the Texas coast at Aransas NWR and summers at Wood Buffalo National Park in Canada. This population represents the majority of the world's population of free-ranging Whooping Cranes and reached a record population of 270 at Aransas NWR in December 2008 (Whooping Crane Eastern Partnership, 2010). A non-migrating population has been reintroduced in central Florida, and another reintroduced population summers in Wisconsin and migrates to the southeastern U.S. for the winter. Whooping Cranes breed, migrate, winter, and forage in a variety of habitats, including coastal marshes and estuaries, inland marshes, lakes, ponds, wet meadows and rivers, and agricultural fields (USFWS, 2007). About 9,000 ha (22,240 ac) of salt flats on Aransas NWR and adjacent islands comprise the principal wintering grounds of the Whooping Crane. Aransas NWR is designated as critical habitat for the species (**Figure 4**). A species description is presented in a recent lease sale EIS (MMS, 2007b).

A diesel fuel spill in the lease area would also be unlikely to affect Whooping Cranes, due to the distance from Aransas NWR. As explained in **Section A.9.2**, a diesel fuel spill would not be expected to make landfall or reach coastal waters prior to breaking up.

C.3.8 Gulf Sturgeon (Threatened)

The Gulf sturgeon (*Acipenser oxyrinchus desotoi*) is a threatened fish species that inhabits major rivers and inner shelf waters from the Mississippi River to the Suwannee River, Florida (Barkuloo, 1988; Wakeford, 2001). An anadromous fish that migrates from the sea upstream into coastal rivers to spawn in freshwater, it historically ranged from the Mississippi River to Charlotte Harbor, Florida (Wakeford, 2001). Populations have been depleted or even extirpated throughout the species' historical range by fishing, shoreline development, dam construction, water quality changes, and other factors (Barkuloo, 1988; Wakeford, 2001). These declines prompted the listing of the Gulf sturgeon as a threatened species in 1991. The best known populations occur in the Apalachicola and Suwannee Rivers in Florida (Carr, 1996; Sulak and Clugston, 1998), the Choctawhatchee River in Alabama (Fox et al., 2000), and the Pearl River in Mississippi/Louisiana (Morrow et al., 1998). Critical habitat in the Gulf extends from Lake Borgne, Louisiana (St. Bernard Parish) to Suwannee Sound, Florida (Levy County) (NMFS, 2010b) (**Figure 4**). A species description is presented in a recent lease sale EIS (MMS, 2007b) and in the recovery plan for this species (USFWS and Gulf States Marine Fisheries Commission, 1995).

There are no IPFs associated with routine project activities that could affect these fishes. A diesel fuel spill in the lease area would be unlikely to affect Gulf sturgeon because a diesel fuel spill would not be expected to make landfall or reach coastal waters prior to breaking up (see explanation in **Section A.9.2**).

C.3.9 Smalltooth Sawfish (Endangered)

Smalltooth sawfish (*Pristis pectinata*) are found in the tropical and subtropical Atlantic Ocean. In the western Atlantic they have historically ranged from New York to Brazil, including the Gulf of Mexico and Caribbean Sea. This sawfish primarily occurs in estuarine and coastal habitats such as bays, lagoons, and rivers. The smalltooth sawfish was listed as endangered on 1 April 2003, under the ESA. The critical habitat consists of two units: the Charlotte Harbor Estuary Unit, which comprises approximately 89,621 ha (221,459 ac) of coastal habitat, and the Ten Thousand Islands/Everglades Unit, which comprises approximately 250,506 ha (619,013 ac) of coastal habitat. The two units are located along the southwestern coast of Florida between Charlotte Harbor and Florida Bay.

There are no IPFs associated with routine project activities that could affect these fish. A diesel fuel spill in the lease area would be unlikely to affect smalltooth sawfish because a diesel fuel spill would not be expected to make landfall or reach coastal waters prior to breaking up (see explanation in **Section A.9.2**).

C.3.10 Beach Mice (Endangered)

Four subspecies of endangered beach mice (*Peromyscus polionotus*) occur on the barrier islands of Alabama and the Florida Panhandle: the Alabama, Choctawatchee, Perdido Key, and St. Andrew beach mice. Critical habitat has been designated for all four subspecies; **Figure 4** shows their combined critical habitat. Species descriptions are provided in a recent lease sale EIS (MMS, 2007b).

There are no IPFs associated with routine project activities that could affect these animals due to the distance from shore and the lack of any onshore support activities near their habitat. A diesel fuel spill in the lease area would not affect beach mice because a diesel fuel spill would not be expected to make landfall or reach coastal waters prior to breaking up (see explanation in **Section A.9.2**).

C.3.11 Elkhorn Coral (Endangered)

Elkhorn coral (*Acropora palmata*) is found primarily in shallow waters with temperatures ranging between 26 °C and 30 °C (79 and 86 °F) and significant water movement. Elkhorn coral was once one of the most abundant species in waters ranging from 1 to 5 m (3.3 to 16 ft) deep in tropical and subtropical waters. In the northern Gulf, elkhorn coral has been found within the coral cap region of the Flower Garden Banks National Marine Sanctuary (Flower Garden Banks National Marine Sanctuary, 2011).

There are no IPFs associated with routine project activities that could affect this species in the northern Gulf. A diesel fuel spill would not affect elkhorn coral colonies because the fuel would float and dissipate on the sea surface.

C.4 Coastal and Marine Birds

C.4.1 Marine and Pelagic Birds

A variety of seabirds may occur in the pelagic environment of the project areas (Clapp et al., 1982a,b, 1983; Peake, 1996; Hess and Ribic, 2000). Seabirds spend much of their lives offshore over the open ocean, except during breeding season when they nest along the coast. In addition, other birds such as waterfowl, marsh birds, and shore birds may occasionally be present over open ocean areas. No endangered or threatened bird species are likely to occur at the project area due to the distance from shore. For a discussion of shore birds and coastal nesting birds, see **Section C.4.2**.

Seabirds of the northern Gulf of Mexico were surveyed from ships during the GulfCet II program. Hess and Ribic (2000) reported that terns, storm-petrels, shearwaters, and jaegers were the most frequently sighted seabirds in the deepwater area. From these surveys, four ecological categories of seabirds were documented in the deepwater areas of the Gulf: summer migrants (e.g., shearwaters, storm petrels, and boobies); summer residents that breed in the Gulf (e.g., Sooty Tern, Least Tern, Sandwich Tern, and Magnificent Frigatebird); winter residents (e.g., gannets, gulls, and jaegers); and permanent resident species (e.g., Laughing Gulls, Royal Terns, and Bridled Terns) (Hess and Ribic, 2000).

Common seabird species include Wilson's Storm-Petrel (*Oceanites oceanicus*), Magnificent Frigatebird (*Fregata magnificens*), Northern Gannet (*Morus bassanus*), Masked Booby (*Sula dactylatra*), Brown Booby (*Sula leucogaster*), Cory's Shearwater (*Calonectris diomedea*), Greater Shearwater (*Puffinus gravis*), and Audubon's Shearwater (*Puffinus lherminieri*). Seabirds are distributed Gulf-wide and are not specifically associated with the lease area.

Relationships with hydrographic features were found for several seabird species, possibly due to effects of hydrography on nutrient levels and productivity of surface waters where birds forage. GulfCet II did not estimate bird densities; however, Powers (1987) indicates that seabird densities over the open ocean typically are <10 birds/km^2.

Trans-Gulf migrant birds including shorebirds, wading birds, and terrestrial birds may also be present in the lease area. Migrant birds may use offshore structures and platforms for resting, feeding, or as temporary shelter from inclement weather (Russell, 2005). Some birds may be attracted to offshore structures because of the lights and the fish populations that aggregate around these structures.

IPFs potentially affecting marine and pelagic birds include drilling and construction vessel presence, noise, and lights; support vessel and helicopter traffic; and a diesel fuel spill. Effluent discharges are likely to have negligible impacts on the birds due to rapid dispersion, the small area of ocean affected, the intermittent nature of the discharges, and the mobility of these animals. Compliance with NTL 2007-G03 should minimize the potential for marine debris related impacts on birds.

Impacts of Drilling and Construction Vessel Presence, Noise, and Lights

Birds that frequent platforms may be exposed to contaminants including air pollutants and routine discharges, but significant impacts are unlikely due to rapid dispersion. Birds migrating over water have been known to strike offshore structures, resulting in death or injury (Wiese et al., 2001; Russell, 2005). Mortality of migrant birds at tall towers and other land-based structures has been reviewed extensively, and the mechanisms involved in platform collisions appear to be similar. In some cases, migrants simply do not see a part of the platform until it is too late. In other cases, navigation may be disrupted by noise (Russell, 2005). On the other hand, offshore structures are suitable stopover habitats for most trans-Gulf migrant species, and most of the migrants that stop over on platforms probably benefit from their stay, particularly in spring (Russell, 2005). Any impacts on populations of either seabirds or trans-Gulf migrant birds are not expected to be significant.

A recent study in the North Sea indicated that platform lighting causes circling behavior in various birds, especially on cloudy nights; apparently the birds' geomagnetic compass is upset by the red part of the spectrum from the lights currently in use (Nederlandse Aardolie Maatschappij, 2007). The numbers varied greatly, from none at all to some tens of thousands of birds per night per platform, with an apparent effect radius of up to 3 miles (5 km). A study in the Gulf of Mexico also noted the phenomenon, but did not recommend mitigation (Russell, 2005). Factors to consider in evaluating this impact in the Gulf of Mexico would include the lower incidence of cloudy and foggy days in the Gulf of Mexico versus the North Sea. Lighting impacts, collisions, or other adverse effects from a single floating structure are unlikely, and no significant impacts are expected.

Impacts of Support Vessel and Helicopter Traffic

Support vessels and helicopters are unlikely to significantly disturb pelagic birds in open, offshore waters. It is likely that individual birds would experience, at most, only short-term behavioral disruption, and the impact would not be significant.

Impacts of a Diesel Fuel Spill

Potential diesel fuel spill impacts on marine birds are discussed in recent EISs (MMS, 2007b, 2008). For this SDOCD, there are no unique site-specific issues with respect to diesel fuel spill impacts on these animals.

The probability of a diesel fuel spill will be minimized by BP's preventative measures during routine operations including fuel transfer. In the unlikely event of a diesel fuel spill, implementation of BP's OSRP will be an available option to mitigate and reduce the potential for impacts on marine and pelagic birds. Given the open ocean location of the lease area, the duration of a diesel fuel spill and opportunity for impacts to occur would be very brief.

A diesel fuel spill in offshore waters would produce a slick on the water surface and increase the concentrations of petroleum hydrocarbons and their degradation products. The extent and persistence of impacts would depend on the meteorological and oceanographic conditions at the time and the effectiveness of spill response measures. **Section A.9.2** discusses the likely fate of a diesel fuel spill and indicates that over 90% would be evaporated or dispersed naturally

within 24 hours. The area of the sea surface with diesel fuel on it would range from 0.5 to 5 ha (1.2 to 12 ac), depending on sea state and weather conditions.

Birds exposed to oil on the sea surface could experience direct physical and physiological effects including skin irritation; chemical burns of skin, eyes, and mucous membranes; and inhalation of toxic fumes. Due to the limited areal extent and short duration of water quality impacts from a diesel fuel spill, secondary impacts due to ingestion of diesel fuel via contaminated prey or reductions in prey abundance are unlikely. Due to the low densities of birds in open ocean areas, the small area affected, and the brief duration of the surface slick, no significant impacts on pelagic birds would be expected.

C.4.2 Shore Birds and Coastal Nesting Birds

Threatened and endangered bird species (Piping Plover and Whooping Crane) have been discussed previously in **Section C.3**. Various species of non-endangered birds are also found along the northern Gulf Coast, including diving birds, shore birds, marsh birds, wading birds, and waterfowl. Gulf Coast marshes and beaches also provide important feeding grounds and nesting habitats. Species that breed on beaches, flats, dunes, bars, barrier islands, and similar habitats include the Sandwich Tern, Wilson's Plover, Black Skimmer, Forster's Tern, Gull-Billed Tern, Laughing Gull, Least Tern, and Royal Tern (USFWS, 2010b). Additional information is presented in recent lease sale EISs (MMS, 2007b, 2008).

The Eastern Brown Pelican (*Pelecanus occidentalis*) has been delisted from its endangered status under ESA (USFWS, 2010c). However, this species is listed as a species of greatest conservation need by the State of Mississippi (Mississippi Department of Wildlife, Fisheries and Parks, 2011) and as a species of special concern by the State of Florida (Florida Fish and Wildlife Conservation Commission, 2010). Brown Pelicans inhabit coastal habitats and forage within both coastal waters and waters of the inner continental shelf. Aerial and shipboard surveys, including GulfCet and GulfCet II, indicate that Brown Pelicans do not occur in deep offshore waters (Fritts and Reynolds, 1981; Peake, 1996; Hess and Ribic, 2000). Nearly half the southeastern population of Brown Pelicans live in the northern Gulf Coast, generally nesting on protected islands (USFWS, 2010b).

The Southern Bald Eagle (*Haliaeetus leucocephalus*) was delisted from its threatened status in the lower 48 states on 28 June 2007. The Bald Eagle is a terrestrial raptor widely distributed across the southern U.S., including coastal habitats along the Gulf of Mexico. The Gulf Coast is inhabited by both wintering migrant and resident Bald Eagles (Johnsgard, 1990; Ehrlich et al., 1992).

IPFs potentially affecting shore birds and coastal nesting birds include support vessel and helicopter traffic. A diesel fuel spill in the lease area would be unlikely to affect shore birds or coastal nesting birds, as the lease area is 64 miles (103 km) from the nearest shoreline. As explained in **Section A.9.2**, a diesel fuel spill would not be expected to make landfall or reach coastal waters prior to breaking up. Compliance with NTL 2007-G03 should minimize the potential for marine debris-related impacts on shore birds.

Impacts of Support Vessel and Helicopter Traffic

Support vessels and helicopters will transit coastal areas near Port Fourchon and Houma, Louisiana where shore birds and coastal nesting birds may be found. These activities could periodically disturb individuals or groups of birds within sensitive coastal habitats (e.g., wetlands that may support feeding, resting, or breeding birds).

Vessel traffic may disturb some foraging and resting birds. The disturbances will be limited to flushing birds away from vessel pathways. Flushing distances vary among species and individuals; known distances are from 20 to 49 m (65 to 160 ft) for personal watercraft and 23 to 58 m (75 to 190 ft) for an outboard-powered boat (Rodgers and Schwikert, 2002). Flushing distances may be similar or less for the support vessels to be used for BP's project, and some species such as gulls are attracted to boats. Support vessels will not approach nesting or breeding areas on the shoreline, so disturbances to nesting birds, eggs, and chicks is not expected. Vessel operators will use designated navigation channels and comply with posted speed and wake restrictions while transiting sensitive inland waterways. Any short-term impacts are not expected to be biologically significant to coastal bird populations.

Aircraft traffic can cause some disturbance to birds onshore and offshore. Responses are highly dependent on the type of aircraft, the bird species, the activities that animals were previously engaged in, and previous exposures to overflights (Efroymson et al., 2000). Helicopters seem to cause the most intense responses compared to other human disturbances for some species (Bélanger and Bédard, 1989). However, Federal Aviation Administration Advisory Circular No. 91-36D recommends that pilots maintain a minimum altitude of 610 m (2,000 ft) when flying over noise sensitive areas such as wildlife refuges, parks, and areas with wilderness characteristics. This is greater than the distance (slant range) at which aircraft overflights have been reported to cause behavioral effects on most species of birds studied (Efroymson et al., 2000). With these guidelines in effect, it is likely that individual birds would experience, at most, only short-term behavioral disruption.

C.5 Fisheries Resources

C.5.1 Pelagic Communities and Ichthyoplankton

Biggs and Ressler (2000) reviewed the biology of pelagic communities in the deepwater environment of the northern Gulf of Mexico. The biological oceanography of the region is dominated by the influence of the Loop Current, whose surface waters are among the most oligotrophic in the world's oceans. Superimposed on this low-productivity condition are productive "hot spots" associated with entrainment of nutrient-rich Mississippi River water and mesoscale oceanographic features. Anticyclonic and cyclonic hydrographic features play an important role in determining biogeographic patterns and controlling primary productivity in the northern Gulf of Mexico (Biggs and Ressler, 2000).

Most fishes inhabiting shelf or oceanic waters of the Gulf of Mexico have planktonic eggs and larvae (Ditty, 1986; Ditty et al., 1988; Richards et al., 1989, 1993). Pelagic eggs and larvae become part of the planktonic community for various lengths of time (10 to 100 days, depending on the species) (MMS, 2007b).

IPFs potentially affecting pelagic communities and ichthyoplankton include drilling and construction vessel presence, noise, and lights; effluent discharges; water intakes; and a diesel fuel spill.

Impacts of Drilling Vessel Presence, Noise, and Lights

The drilling vessel, as a floating structure that remains stationary in the deepwater environment for some period of time, will act as a fish-attracting device (FAD). Construction vessels are assumed to be moving more often than drilling vessels and will therefore not demonstrate the FAD effect. In oceanic waters, the FAD effect would be most pronounced for epipelagic fishes such as tunas, dolphin, billfishes, and jacks, which are commonly attracted to fixed and drifting surface structures (Holland et al., 1990; Higashi, 1994; Relini et al., 1994). This FAD effect could possibly enhance the feeding of epipelagic predators by attracting and concentrating smaller fish species. Because the drilling vessel is a single structure, impacts on fish populations, whether beneficial or adverse, are considered minor.

Impacts of Effluent Discharges

Treated sanitary and domestic wastes will have little or no impact on the pelagic environment in the immediate vicinity of these discharges. These wastes may have elevated levels of nutrients, organic matter, and chlorine, but should be diluted rapidly to undetectable levels within tens to hundreds of meters from the source. Little or no impact on water quality, plankton, and nekton is anticipated.

Deck drainage will have little or no impact on the pelagic environment in the immediate vicinity of these discharges. Deck drainage from contaminated areas will be passed through an oil-and-water separator prior to release, and discharges will be monitored for visible sheen. The discharges may have slightly elevated levels of hydrocarbons but should be diluted rapidly to undetectable levels within tens to hundreds of meters from the source. Little or no impact on water quality, plankton, and nekton is anticipated.

Other discharges in accordance with the NPDES permit, such as desalination unit brine and uncontaminated cooling water, firewater, ballast water, and bilge water are expected to be diluted rapidly and have little or no impact on water column biota.

Impacts of Water Intakes

Seawater will be drawn from the ocean for once-through, non-contact cooling of machinery on the drilling vessel. The estimated intake and discharge of cooling water is approximately 467,657 BPD (19.6 MGD).

The intake of seawater for cooling water will entrain plankton. The low intake velocity should allow most strong-swimming juvenile fishes and smaller adults to escape entrainment or impingement. However, drifting plankton would not be able to escape entrainment with the exception of a few fast-swimming larvae of certain taxonomic groups. Those organisms entrained may be stressed or killed, primarily through changes in water temperature during the route from cooling intake structure to discharge structure, and mechanical damage (turbulence

in pumps and condensers). Any short-term impacts of entrainment are not expected to be biologically significant to plankton or ichthyoplankton populations.

Impacts of a Diesel Fuel Spill

Potential diesel fuel spill impacts on fisheries resources are discussed in recent EISs (MMS, 2007b, 2008). For the SDOCD, there are no unique site-specific issues with respect to diesel fuel spill impacts.

The probability of a diesel fuel spill will be minimized by BP's preventative measures during routine operations including fuel transfer. In the unlikely event of a spill, implementation of BP's OSRP will be an available option to help reduce the potential for impacts on pelagic communities, including ichthyoplankton. Given the open ocean location of the lease area, the duration of a diesel fuel spill and opportunity for impacts to occur would be very brief.

A diesel fuel spill in offshore waters would produce a slick on the water surface and increase the concentrations of petroleum hydrocarbons and their degradation products. The extent and persistence of impacts would depend on the meteorological and oceanographic conditions at the time and the effectiveness of spill response measures. **Section A.9.2** discusses the likely fate of a diesel fuel spill and indicates that over 90% would be evaporated or dispersed naturally within 24 hours. The area of the sea surface with diesel fuel on it would range from 0.5 to 5 ha (1.2 to 12 ac), depending on sea state and weather conditions.

A diesel fuel spill could have localized impacts on phytoplankton, zooplankton, and nekton. Due to the limited areal extent and short duration of water quality impacts, a diesel fuel spill would be unlikely to produce detectable impacts on pelagic communities.

C.5.2 Essential Fish Habitat

Essential Fish Habitat (EFH) is defined as those waters and substrate necessary to fish for spawning, breeding, feeding, and growth to maturity. Under the Magnuson-Stevens Fishery Conservation and Management Act, as amended, Federal agencies are required to consult on activities that may adversely affect EFH designated in Fishery Management Plans developed by the regional Fishery Management Councils.

The Gulf of Mexico Fishery Management Council (GMFMC) has prepared Fishery Management Plans for corals and coral reefs, shrimps, stone crab, spiny lobster, reef fishes, coastal migratory pelagic fishes, and red drum. In 2005, the EFH for these managed species was redefined in Generic Amendment No. 3 to the various Fishery Management Plans (GMFMC, 2005). The EFH for most of these GMFMC-managed species is on the continental shelf in waters shallower than 183 m (600 ft). The shelf edge is the outer boundary for coastal migratory pelagic fishes, reef fishes, and shrimps. EFH for corals and coral reefs includes some shelf-edge topographic features on the Texas-Louisiana OCS, the nearest of which is Sackett Bank, located approximately 62 miles (100 km) from the lease area.

Highly migratory pelagic fishes, which occur as transients in the lease area, are the only remaining group for which EFH has been identified in the deepwater Gulf of Mexico. Species in

this group, including tunas, swordfishes, billfishes, and sharks, are managed by NMFS. Highly migratory species with EFH at or near the lease area include the following (NMFS, 2009):

- Blue marlin (juveniles, adults)
- White marlin (juveniles, adults)
- Swordfish (larvae, juveniles, adults)
- Longbill spearfish (juveniles, adults)
- Albacore tuna (adults)
- Atlantic bluefin tuna (spawn, eggs, larvae, adults)
- Bigeye tuna (adults)
- Skipjack tuna (spawn, adults)
- Yellowfin tuna (spawn, juveniles, adults)
- Bigeye thresher shark (all)
- Common thresher shark (all)
- Longfin mako shark (all)
- Oceanic whitetip shark (all)
- Silky shark (all)

On 27 May 2011, after an extensive scientific review, NOAA announced that Atlantic bluefin tuna currently do not warrant species protection under the ESA. NOAA said the species would be classified as a species of concern, however, effectively placing bluefin on a watch list as the agency awaits new data on the impact of a stricter international management regimen. The central and western Gulf of Mexico may be important spawning habitat for Atlantic bluefin tuna, and NMFS (2009) has designated a Habitat Area of Particular Concern (HAPC) for this species. The HAPC covers much of the deepwater Gulf of Mexico, including the lease area (**Figure 4**). The areal extent of the HAPC is approximately 300,000 km^2 (15,000 mi^2). The prevailing assumption is that Atlantic bluefin tuna follow an annual cycle of foraging in June through March off the eastern United States and Canadian coasts, followed by migration to the Gulf of Mexico to spawn in April, May, and June (NMFS, 2009).

Other HAPCs have been identified in the Gulf of Mexico by the GMFMC (2005). These include the Florida Middle Grounds, Madison-Swanson Marine Reserve, Tortugas North and South Ecological Reserves, Pulley Ridge, and several individual reefs and banks of the northwestern Gulf of Mexico (**Figure 4**). The nearest of these is Jakkula Bank, located approximately 182 miles (294 km) from the lease area.

Routine IPFs potentially affecting EFH include drilling and construction vessel presence, noise, and lights; physical disturbance to the seafloor; effluent discharges; water intakes; and a diesel fuel spill.

Impacts of Drilling Vessel Presence, Noise, and Lights

The drilling vessel presence, as a stationary floating structure in the deepwater environment, will act as an FAD. In oceanic waters, the FAD effect would be most pronounced for epipelagic fishes such as tunas, dolphin, billfishes, and jacks, which are commonly attracted to fixed and drifting surface structures (Holland et al., 1990; Higashi, 1994; Relini et al., 1994). This FAD effect would possibly enhance feeding of epipelagic predators by attracting and concentrating smaller fish species. Because the drilling vessel is a single structure, any impacts on EFH for highly migratory pelagic fishes are considered minor.

Impacts of Physical Disturbance to the Seafloor

Sources of seafloor disturbance include the drilling of the eight water injection wells and installation of subsea facilities including the pipelines, umbilicals, jumpers, and manifolds. All

facility installation will be done by DP vessels. Calculations of the seafloor area potentially impacted have been summarized in **Section A.2**. The total seafloor disturbance area is estimated to be approximately 4.2 ha (10.44 ac). Soft bottom substrates are ubiquitous along the northern Gulf of Mexico continental slope (Gallaway, 1988; Gallaway et al., 2003; Rowe and Kennicutt, 2009). Impacts on soft bottom EFH from physical disturbance to the seafloor during this project are not expected to be significant in the context of similar EFH distributed throughout the region.

Impacts of Effluent Discharges

Effluent discharges potentially affecting EFH by diminishing ambient water quality include produced water, treated sanitary and domestic wastes, deck drainage, and miscellaneous discharges such as desalination unit brine and uncontaminated cooling water, firewater, ballast water, and bilge water. Impacts on water quality have been discussed previously. NPDES permit limitations and requirements are expected to be in compliance, and little or no impact on water quality is anticipated. No significant impacts on EFH for highly migratory pelagic fishes are expected from these discharges.

Impacts of Water Intakes

As noted previously, cooling water intake will cause entrainment and impingement of plankton, including fish eggs and larvae (ichthyoplankton). Any short-term impacts on EFH for highly migratory pelagic fishes are not expected to be biologically significant.

Impacts of a Diesel Fuel Spill

The probability of a diesel fuel spill will be minimized by BP's preventative measures during routine operations including fuel transfer. In the unlikely event of a diesel fuel spill, implementation of BP's OSRP will be an available option to reduce the potential for impacts on EFH. Given the open ocean location of the lease area, the duration of a diesel spill and opportunity for impacts to occur would be very brief.

Potential diesel fuel spill impacts on EFH are discussed in recent EISs (MMS, 2007b, 2008). For the SDOCD, there are no unique site-specific issues with respect to diesel fuel spill impacts.

A diesel fuel spill in offshore waters would produce a slick on the water surface and increase the concentrations of petroleum hydrocarbons and their degradation products. The extent and persistence of impacts would depend on the meteorological and oceanographic conditions at the time and the effectiveness of spill response measures. **Section A.9.2** discusses the likely fate of a diesel fuel spill and indicates that over 90% would be evaporated or dispersed naturally within 24 hours. The area of the sea surface with diesel fuel on it would range from 0.5 to 5 ha (1.2 to 12 ac), depending on sea state and weather conditions.

A diesel fuel spill could have localized impacts on EFH for highly migratory pelagic fishes, including tunas, swordfishes, billfishes, and sharks. These species occur as transients in the lease area. A spill would also produce short-term impact on water quality in the HAPC for spawning Atlantic bluefin tuna, which covers much of the deepwater Gulf of Mexico. The areal extent of the affected area would represent a negligible portion of the HAPC.

A diesel fuel spill would not affect EFH for corals and coral reefs, the nearest of these EFH areas being Sackett Bank, located approximately 62 miles (100 km) from the lease area. A diesel fuel spill would float and dissipate on the sea surface and would not contact these features.

C.6 Archaeological Resources

C.6.1 Shipwreck Sites

Substantial new information that alters the impact conclusion for archaeological resources presented in MMS 2007b and 2008 has come to light as a result of BOEMRE-sponsored studies and industry surveys (BOEMRE, 2011a,b). Specifically, evidence of damage to significant cultural resources (i.e., historic shipwrecks) has been shown to have occurred because of an incomplete knowledge of seafloor conditions in lease areas >200 m (656 ft) deep that have been exempted from high-resolution surveys. Since significant historic shipwrecks have been discovered recently outside the previously designated high-probability areas (some of which show evidence of impacts from permitted activities prior to their discovery), a survey will now be required prior to construction beginning in 2011 in the area of potential effect for all OCS operations as a requirement of the plan permit issued by BOEMRE.

MC 775, 776, 777, 778, 821, and 822, are not on the list of lease blocks with a high potential for historic shipwrecks and there were no indications of wrecks or other archaeological resources detected during the site clearance survey (C&C, 2001, 2006). BP will abide by the applicable requirements of NTL 2005-G07, which stipulate that work be stopped at the project site should any previously undetected archaeological resource be discovered after work has begun until appropriate surveys and evaluations have been completed.

There are no IPFs that are likely to affect shipwrecks.

C.6.2 Prehistoric Archaeological Sites

Available evidence suggests that sea level in the northern Gulf of Mexico was at least 90 m (295 ft), and possibly as much as 130 m (427 ft), lower than present sea level during the period 20,000-17,000 years Before Present (B.P.) (Nelson and Bray, 1970). Sea level in the northern Gulf reached its present stand around 3,500 years B.P. (Pearson et al., 1986).

During periods that the continental shelf was exposed above sea level, the area was open to habitation by prehistoric peoples. The advent of early man into the Gulf of Mexico region is currently accepted to be around 12,000 years B.P. (Aten, 1983). The sea-level curve for the northern Gulf of Mexico proposed by Coastal Environments, Inc. (CEI) suggests that sea level at 12,000 years B.P. would have been approximately 45 to 60 m (148 to 197 ft) below the present day sea level (CEI, 1977, 1982). On this basis, the continental shelf shoreward of the 45- to 60-m (148- to 197-ft) bathymetric contours has potential for prehistoric sites dating after 12,000 years B.P. Because of inherent uncertainties in both the depth of sea level and the entry date of prehistoric man into North America, the MMS adopted the 60-m (197-ft) water depth as the seaward extent for archaeological site potential in Gulf of Mexico region.

With water depths ranging from 1,609 to 2,012 m (5,280 to 6,600 ft), the lease area is well beyond the 60-m (197-ft) depth contour used by BOEMRE as the seaward extent for prehistoric archaeological site potential in the Gulf of Mexico. A diesel fuel spill would not affect prehistoric archaeological resources because the fuel would float and dissipate on the sea surface.

C.7 Coastal Habitats and Protected Areas

Coastal habitats in the northeastern Gulf of Mexico that may be affected by oil and gas activities are described in recent EISs (MMS, 2007b, 2008) and in a literature review by Collard and Way (1997). Sensitive coastal habitats are also tabulated in the OSRP. Coastal habitats inshore of the project area include barrier beaches and dunes, wetlands, and submerged seagrass beds. Generally, most of the northeastern Gulf is fringed by barrier beaches, with wetlands and/or submerged seagrass beds occurring in sheltered areas behind the barrier islands and in estuaries.

Due to the distance from shore, there are no IPFs associated with routine offshore activities at the project site that are likely to affect beaches and dunes, wetlands, seagrass beds, coastal wildlife refuges, wilderness areas, or any other managed or protected coastal area. The support base at Port Fourchon, Louisiana and the construction vessel base in Theodore, Alabama are not in wildlife refuges or other designated wilderness area. Potential impacts of support vessel traffic are briefly addressed below.

A diesel fuel spill in the lease area would be unlikely to affect coastal habitats, as the lease area is 64 miles (103 km) from the nearest shoreline. As explained in **Section A.9.2**, a diesel fuel spill would not be expected to make landfall or reach coastal waters prior to breaking up.

Impacts of Support Vessel Traffic

For OCS activities in general, support operations, including crew boats and supply boats, may have a minor incremental impact on wetlands and seagrass beds. Over time, with a large number of vessel trips, vessel wakes can erode shorelines along inlets, channels, and harbors. Support operations, including crew boats and supply boats, may have a minor incremental impact on wetlands and seagrass beds. Impacts should be minimized by following the speed and wake restrictions in harbors and channels.

C.8 Socioeconomic and Other Resources

C.8.1 Recreational and Commercial Fishing

The main commercial fishing activity in deep waters of the northern Gulf of Mexico is pelagic longlining for tunas, swordfishes, and other billfishes (Continental Shelf Associates, Inc., 2002). Pelagic longlining has occurred historically in the project area, primarily during spring and summer. In August 2000, the Federal government closed two areas in the northeastern Gulf of Mexico to longline fishing (65 Federal Register 47214, 1 August 2000). The lease is outside of the closure areas.

Longline gear consists of monofilament line deployed from a moving vessel and generally allowed to drift for 4 to 5 hours (Continental Shelf Associates, Inc., 2002). As the mainline is put

out, baited leaders and buoys are clipped in place at regular intervals. It takes 8 to 10 hours to deploy a longline and about the same time to retrieve it. Longlines are often set near oceanographic features such as fronts or downwellings, with the aid of sophisticated on-board temperature sensors, depth finders, and positioning equipment. Vessels are 10 to 30 m long, and their trips last from about 1 to 3 weeks. The main homeports for Gulf longlining vessels are in Louisiana (Dulac and Venice) and Florida (Destin, Madeira Beach, and Panama City).

It is unlikely that any commercial fishing activity other than longlining occurs at or near the project area. Benthic species targeted by commercial fishers occur on the upper continental slope, well inshore of the project area. Royal red shrimp are caught by trawlers in water depths of about 250 to 550 m (820 to 1,804 ft). Tilefish are caught by bottom longlining in water depths from about 165 to 450 m (540 to 1,476 ft) (Continental Shelf Associates, Inc., 2002).

Most recreational fishing activity in the region occurs in water depths less than 200 m (656 ft) (Continental Shelf Associates, Inc., 1997, 2002). In deeper water, the main attraction to recreational fishers would be petroleum platforms offshore Texas and Louisiana. Due to the distance from shore, it is unlikely that recreational fishing activity is occurring in the lease area.

The only routine IPF potentially affecting fisheries are the drilling and construction vessel presence (including noise and lights) and a diesel fuel spill.

Impacts of Drilling and Construction Vessel Presence, Noise, and Lights

There is a slight possibility of pelagic longlines becoming entangled in drilling or construction vessels. For example, in January 1999, a portion of a pelagic longline snagged on the acoustic Doppler current profiler of a drillship working in the Gulf of Mexico (Continental Shelf Associates, Inc., 2002). The line was removed without incident. Generally, longline fishers use radar and are aware of offshore structures and ships when placing their sets. Therefore, little or no impact on pelagic longlining is expected.

Because it is unlikely that any recreational fishing activity is occurring in the project area, no adverse impacts are anticipated. Other factors such as effluent discharges are likely to have negligible impacts on commercial or recreational fisheries due to rapid dispersion, the small area of ocean affected, and the intermittent nature of the discharges.

Impacts of a Diesel Fuel Spill

The probability of a diesel fuel spill should be minimized by BP's preventative measures during routine operations including fuel transfer. Given the open ocean location of the lease area, the duration of a diesel fuel spill and opportunity for impacts to occur would be very brief.

Pelagic longlining activities in the lease area, if any, could be interrupted in the event of a diesel fuel spill. The area of the sea surface with diesel fuel on it would range from 0.5 to 5 ha (1.2 to 12 ac), depending on sea state and weather conditions. Fishing activities could be interrupted due to the activities of response vessels operating in the lease area. A diesel fuel spill would not affect coastal water quality because the spill would not be expected to make landfall or reach coastal waters prior to breaking up (see **Section A.9.2**).

C.8.2 Public Health and Safety

There are no IPFs associated with routine operations that are expected to affect public health and safety. A diesel fuel spill would not have any impacts on public health and safety because it would affect only a small area of the open ocean 64 miles (103 km) from the nearest shoreline, and nearly all of the diesel fuel would evaporate or disperse naturally within 24 hours. Response crews would be equipped with appropriate safety equipment to avoid injury and health effects. A diesel fuel spill would not be expected to make landfall or reach coastal waters prior to breaking up (see **Section A.9.2**).

C.8.3 Employment and Infrastructure

There are no IPFs associated with routine operations that are expected to affect employment and infrastructure. The project would be supported from existing shorebase facilities in Louisiana and Alabama. No new or expanded facilities will be constructed, and no new employees are expected to move permanently into the area. The project will have a negligible impact on socioeconomic conditions such as local employment, existing offshore and coastal infrastructure (including major sources of supplies, services, energy, and water), and minority and lower income groups.

C.8.4 Recreation and Tourism

There are no known recreational uses of the lease area. Recreational resources and tourism in coastal areas would not be affected by any routine activities due to the distance from shore. Compliance with NTL 2007-G03 should minimize the chance of trash or debris being lost overboard from the drilling or construction vessels and subsequently washing up on beaches. A diesel fuel spill in the lease area would be unlikely to affect recreation and tourism because, as explained in **Section A.9.2**, it would not be expected to make landfall or reach coastal waters prior to breaking up.

C.8.5 Land Use

Land use along the northern Gulf Coast is discussed in recent lease sale EISs (MMS, 2007b, 2008). The project will use existing onshore support facilities in Louisiana and Alabama. The land use at the existing shorebases is industrial. The project will not involve any new construction or changes to existing land use. Levels of boat and helicopter traffic will not have any effect on existing land uses, and the additional demands for goods and services resulting from this project will not require any expansion of the existing shore base facilities. IPFs from onshore waste disposal include loss, escape, or mismanagement of waste at the shore base facility and potential ground water impacts from onshore waste management/disposal facilities.

BP will operate in accordance with regulations to avoid accidental loss of solid waste items by maintaining waste management plans, records of all trash transferred to shore in accordance with NTL 2007-G03.

Facilities that accept OCS-generated waste such as municipal waste landfills and hazardous waste treatment, storage and disposal facilities, are diverse and manage waste for the broad range of industry and governmental facilities. **Section 6** of the SDOCD provides a list of BP

approved vendor sites. BP conducts routine independent audits of their approved commercial waste disposal facilities to review their waste management practices, permitting, and compliance history.

The activities proposed in this project will not generate a large waste stream into these facilities and are not expected to affect the overall capacity of these facilities. The capacity of the existing industrial waste management facilities is abundant, and there are no commonly accepted or recognized problems in terms of limited capacity, high-capacity utilizations, or significant constraints in storing waste from oil and gas facilities, now or in the foreseeable future (MMS, 2007). Additional research conducted by BOEMRE (2011a) further supports past conclusions that existing onshore waste disposal infrastructure is adequate to support both existing and projected offshore oil and gas drilling and production needs (Dismukes et al., 2007).

C.8.6 Other Marine Uses

The lease area is not located within any USCG-designated fairway or shipping lane. The lease area is not within a Military Warning Area. There are no other known marine uses of the lease area.

There are no IPFs from routine project activities that are likely to affect other marine uses. A diesel fuel spill would not have any impacts on other marine uses, as spill response activities would be mainly within the lease area and the duration would be brief.

D. Environmental Hazards

D.1 Geologic Hazards

Based on the geohazards assessments by C&C (2001) and site clearance letters by BP GoM Resources (2011) as summarized in **SDOCD Section 3**, the lease area is free of any significant geological hazards and is suitable for the proposed activities.

D.2 Severe Weather

Under most circumstances, weather is not expected to have any effect on the proposed activities. Extreme weather, including high winds, strong currents, and large waves, was considered in the design criteria for the drilling vessel. High winds and limited visibility during a severe storm could disrupt support activities (vessel and helicopter traffic) and make it necessary to suspend some activities on the drilling vessel for safety reasons until the storm or weather event passes. In the event of a hurricane, procedures as outlined in the Hurricane Evacuation Plan would be adhered to.

D.3 Currents and Waves

Metocean conditions such as sea states, wind speed, ocean currents, etc., will be continuously monitored. Under most circumstances, physical oceanographic conditions are not expected to

have any effect on the proposed activities. Strong currents (e.g., caused by Loop Current eddies and intrusions) and large waves were considered in the design criteria for the drilling vessel. High waves during a severe storm could disrupt support activities (i.e., vessel and helicopter traffic) and make it necessary to suspend some activities on the drilling vessel for safety reasons until the storm or weather event passes.

E. Alternatives

The Thunder Horse Field DOCD was originally approved in 2003. At that time a number of different design, installation, and development alternatives were considered. Design safety, which includes environmental risks, was a key factor for evaluating options and determining the optimal design. The activities addressed within this SDOCD are based on the original design philosophy that was previously established and approved by BOEMRE. This supplement includes only minor changes and additions to locations and equipment within the existing field. The changes and additions are described in **Section 1.2**, **Description of Activities**, of the SDOCD. No significant different development alternatives were considered for this SDOCD.

F. Mitigation Measures

The SDOCD contains numerous mitigation measures required by laws and regulations, lease stipulations and NTL's. Additional mitigation measures have been included for this project in the following areas:

Energy Efficiency

A power management plan to control engine loads and minimize energy usage has been developed and will be in place.

Air Emissions and Land Disposal Minimization

- Low sulfur fuel will be used;
- A recycling program including participation in "Recycle the Gulf;"
- A rig green team that meets regularly to identify environmental issues and implement environmental performance plans; and
- A waste management plan has been developed that addresses minimization options to recycle and source reduce waste.

Water Quality Optimization

- Water treatment equipment will be carefully operated and maintained to all pollutant discharges in accordance with NPDES requirements;
- An EMS system meeting the requirements that all deck drainage and runoff will be confined on board until it is verified on pollutants are present;
- BMP plans for painting and rig maintenance to the best extent practicable release of maintenance waste;
- Use of environmentally-friendly "Green" products whenever feasible;
- Secondary containment in place for all liquid bulk storage; and
- An on board drilling fluid management system with valves clearly identified double isolation of all overboard discharge lines.

G. Consultation

No persons or agencies were consulted during the preparation of this EIA.

H. Preparers

The EIA was prepared by CSA International, Inc. Contributors included

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Appendix F: Alabama CZM

COASTAL ZONE MANAGEMENT

CONSISTENCY CERTIFICATION

Supplemental Development Operations Coordination Document

Type of OCS Plan

Mississippi Canyon 776, Mississippi Canyon 777 Mississippi Canyon 777 Unit

Area and Block

OCS-G 09866, OCS-G 09867

Lease Number

The proposed activities described in detail in this OCS Plan comply with Alabama's approved Coastal Management Program(s) and will be conducted in a manner consistent with such Program(s).

BP Exploration and Production Inc.

Lessee or Operator

Bekki Winfree

Certifying Official

10/12/11

Date

Alabama Coastal and Natural Resources Review

The OCS related oil and gas development activities having potential impact on the Alabama Coastal Zone are based on the location of the proposed facilities, access to those sites, best practical techniques for operations and production equipment, guidelines for the prevention of adverse environmental effects, effective environmental protection, emergency plans and contingency plans.

The State of Alabama provides for the management of the natural and cultural resources of Alabama's coastal area through the Alabama Coastal Area Management Program (Management Program). The relevant Management Program policies (January 1999) were referenced in assessing conformance with and potential impacts to Alabama resources described below. No significant impact is expected on any Alabama natural or cultural resources.

Scope of Operations - The Technip Deep Blue Construction /pipelay Vessel (680 ft,) will spend 5 to 7 days dockside at the Technip yard in Theodore Alabama for load out of the Thunder Horse Rigid water injection flowlines that will be installed as part of development activities covered under this submittal.

Topic	Comments
Coastal Resources Uses	
Coastal Development	An existing shore base / port facility will be used for this activity. There will be no new construction, dredging, or filling in state waters. There will be no new commercial development or capital improvements in the coastal zone, nor any employment effects.
Mineral Resource Exploration and Extraction	The oil and gas development operations will occur 265-miles from Mobile Alabama.
Commercial Fishing	No impact is expected to fisheries in the Bay or state coastal waters or wetlands. No coastal discharge, other than vessel deck drainage will occur while dockside or within state waters. The vessel owner's NPDES Vessel General Permit (VGP) will be followed. No dredging will occur as part of this operation. The vessel owner's Shipboard Oil Pollution Emergency Plan (SOPEP) describes response activities in the unlikely event of a spill.
Hazard Management	An existing shore base will be the site of this load out operation. No new coastal or onshore development will occur.
Shoreline Erosion	An existing shore base will be the site of this load out operation. No new coastal or onshore development construction, dredging or filling will occur. Vessels will follow existing channels and sea lanes for ingress and egress.
Recreation	An existing shore base will be the site of this load out operation. Vessels will follow existing channels and sea lanes for ingress and egress and will avoid recreational sites by using these approved commercial routes.
Transportation	An existing shore base and associated local infrastructure will be used for this load out operation.
Natural Resources	
Living Resources (aquatic, avian, terrestrial, vegetative)	This activity is of short duration at an existing shore facility accessed via existing channels and roads. The quality and quantity of living resources are not expected to be affected. See other sections on development, water, air, habitats and protected

	species.
Water Quality	Existing onshore support infrastructure in Theodore, Alabama will be used. No new construction, dredging, filling or pollutant discharge will occur to affect water quality. The vessel owner's NPDES Vessel General Permit (VGP) will be followed. The vessel owner's Shipboard Oil Pollution Emergency Plan (SOPEP) describes response activities in the unlikely event of a spill. No impact on water quality standards is expected.
Water Resources	Existing onshore support infrastructure in Theodore, Alabama will be used. No new construction, dredging, filling or pollutant discharge will occur to affect natural hydrological conditions that could impact water resources. Any freshwater used will be generated onboard or will have been secured from Core Base water system and stored in vessel tanks.
Air Quality	The vessel will be moored while dockside. Only one generator will be operated to provide utility and crane electrical power. Minor short term, localized impact to air quality may occur but is not anticipated to affect ambient air quality standards. The vessel operates in compliance with MARPOL Annex VI Regulation.
Waste Management	Solid waste generation will be minimal. They will be managed and disposed in accordance with state and federal regulations.
Wetlands and Submerged Lands and Grassbeds	An existing shore base will be the site of this load out operation. No new coastal or onshore development construction, dredging or filling will occur. Vessels will follow existing channels and sea lanes for ingress and egress to avoid wetlands and submerged lands and aquatic vegetation in Mobile Bay.
Shoreline - Beach and Dune Protection; Banks and Bluffs	An existing shore base will be the site of this load out operation. No new coastal or onshore development construction, dredging or filling will occur. Vessels will follow existing channels and sea lanes for ingress and egress.
Wildlife Habitat Protection	An existing shore base will be the site of this load out operation and designated shipping lanes and channels will be used. No impact is expected to coastal, estuarine or marine wildlife habitats, refuges or special management areas.
Endangered Species	An existing shore base will be the site of this load out operation and designated shipping lanes and channels will be used. No impact is expected to the bird, mammal, reptile and fish species or any critical habitat within the Mobile Bay ecosystem protected by the Endangered Species Act.
Cultural Resources Protection	An existing shore base will be the site of this load out operation. No impact to cultural resources is expected.

Appendix H: Fee Recovery

Online Payment

Step 3: Confirm Payment 1 | 2 | 3

Thank you.
Your transaction has been successfully completed.

Pay.gov Tracking Information

Application Name: MMS Development/DOCD Plan - BD
Pay.gov Tracking ID: 254CR2UP
Agency Tracking ID: 74235874266
Transaction Date and Time: 09/08/2011 11:32 EDT

Payment Summary

Address Information	Account Information	Payment Information
Account Holder Name: Rebecca L Winfree	**Card Type:** American Express	**Payment Amount:** $31,768.00
Billing Address: 200 WestLake Park Blvd	**Card Number:** **********1009	**Transaction Date and Time:** 09/08/2011 11:32 EDT
Billing Address 2:	**Region:** Gulf of Mexico	
City: Houston	**Contact:** Bekki Winfree 713-470-7765	
State / Province: TX	**Company Name/No:** BP Exploration Produciton Inc., 02481	
Zip / Postal Code: 77079	**Lease Number(s):** 09866, 09867, , ,	
Country: USA	**Area-Block:** Mississippi Canyon MC, 776: Mississippi Canyon MC, 777: , : , : ,	
	Type-Wells: Supplemental Plan, 8	