UNITED STATES GOVERNMENT 07/07/2020
MEMORANDUM

To: Public Information
From: Plan Coordinator, OLP, Plans Section (GM 235D)

Subject: Public Information copy of plan

Control #	-	S-8002
Type	-	Supplemental Exploration Plan
Lease(s)	-	OCS-G 07969 Block - 890 Mississippi Canyon Area OCS-G 07975 Block - 934 Mississippi Canyon Area
Operator	-	SHELL OFFSHORE INC.
Description	-	Subsea Wells AA, AA-Alt, BB, BB-Alt, CC, CC-Alt, and DD
Rig Type	-	Drillship or DP Semisubmersible

Attached is a copy of the subject plan.

It has been deemed submitted and is under review for approval.

Ronald O’Connor
Plan Coordinator

Shell Offshore Inc.
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New Orleans, LA 70161-1933
United States of America
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Public Information Copy

February 18, 2020

Mrs. Michelle Picou, Section Chief
Bureau of Ocean Energy Management
1201 Elmwood Park Blvd.
New Orleans, LA 70123-2394

Attn: Plans Group GM 235D

SUBJECT: Supplemental Exploration Plan
OCS-G 7969, Mississippi Canyon Block 890
OCS-G 7975, Mississippi Canyon Block 934
Offshore Louisiana

Dear Mrs. Picou:

In compliance with 30 CFR 550.211 and NTLs 2008-G04, 2009-G27 and 2015-N01, giving Exploration Plan guidelines, Shell Offshore Inc. (Shell) requests your approval of this Supplemental Exploration Plan (EP) to add seven new subsea wells.

This Plan consists of a series of attachments describing our intended operations. The attachments we desire to be exempted from disclosure under the Freedom of Information Act are marked "Proprietary" and excluded from the Public Information Copies of this submittal. The cost recovery fee receipt is attached to the Proprietary copy of the plan.

Enclosed is the following report:

> Ocean Geo Solutions, "3D Geohazards Assessment, Shell Exploration and Production Company, Blocks MC890&934, Offshore Gulf of Mexico" (Ocean Geo Solutions Project No. 2019-162), September 2019.

Should you require additional information, please contact Tracy Albert at 504.425.4652 or tracy.albert@shell.com or me at 504.425.7215.

Sincerely,

Sylvia A Bellone

Sylvia A. Bellone

Attachments

SHELL OFFSHORE INC.

SUPPLEMENTAL EXPLORATION PLAN

for

Mississippi Canyon Block 890

(OCS-G 7969)

and

Mississippi Canyon Block 934

(OCS-G 7975)

PUBLIC INFORMATION COPY

FEBRUARY 2020

PREPARED BY:

Sylvia A. Bellone
Sr. Regulatory Specialist

504.425.7215

sylvia.bellone@shell.com

REVISIONS TABLE:

Date of Request	Section of Plan	What Changed	Date of Response
3-11-2020	17	Added LA CZM Certification	3-11-2020
4-16-2020	1 – Schedule Update 6 – Threatened/Endangered Species 10- Environmental Monitoring 12- Environmental Mitigation 14 – Support Vessels 18 – Environmental Impact Analysis	Updates as a result of NMFS ESA Section 7 Programmatic Biological Opinion dated 3/13/2020 (BiOp)	6-24-2020

SUPPLEMENTAL EXPLORATION PLAN
OFFSHORE LOUISIANA

TABLE OF CONTENTS

SECTION 1: PLAN CONTENTS

A. DESCRIPTION, OBJECTIVES & SCHEDULE

Shell Offshore Inc. (Shell) is submitting an Exploration Plan (EP/Plan) for Mississippi Canyon (MC) Blocks 890 and 934. This Exploration Plan is for the drilling of seven subsea wells: Wells AA, AA-Alt, BB, BB-Alt, CC, CC-Alt, and D. If the wells are unsuccessful, they will be permanently plugged and abandoned in accordance with the Bureau of Safety and Environmental Enforcement (BSEE) regulations. Shell Offshore Inc. is the designated operator of Blocks 890 and 934 as wells as of the MC 935 Unit which is made up of MC Blocks 890, 934 and 935.

OCS-G 07969 and OCS-G 07975 leases were awarded as part of Lease Sale 98 on May 22, 1985, effective July 1, 1985. On July 10, 1995 they became part of Unit No. 754395016, with Shell as designated operator.

The Initial Exploration Plan for these leases was approved January 14, 1991, Plan Number N-3910.

The proposed rig is either a dynamically positioned (DP) drillship or a DP semi-submersible, and both are self-contained drilling vessels with accommodations for a crew which includes quarters, galley and sanitation facilities. The drilling activities will be supported by the support vessels and aircraft as well as onshore support facilities as listed in Sections 14 and 15 of the EP. Shell has employed or contracted with trained personnel to carry out its exploration activities. Shell is committed to local hire, local contracting and local purchasing to the maximum extent possible. Shell personnel and contractors are experienced at operating in the Gulf of Mexico and are well versed in all Federal and State laws regulating operations. Shell's employees and contractors share Shell's deep commitment to operating in a safe and environmentally responsible manner.

Shell, through its parent and affiliate corporations, has extensive experience safely exploring for oil and gas in the Gulf of Mexico. Shell will draw upon this experience in organizing and carrying out its planned drilling program. Shell believes that the best way to manage blowouts is to prevent them from happening. Significant effort goes into the design and execution of wells and into building and maintaining staff competence. In the unlikely event of a spill, Shell's Regional OSRP is designed to contain and respond to a spill that meets or exceeds the WCD as detailed in Section 9 of this EP. The WCD does not take into account potential flow mitigating factors such as well bridging, obstructions in wellbore, reservoir barriers, or early intervention. We continue to invest in research and development (R&D) to improve safety and reliability of our well systems. All operations will be conducted in accordance with applicable federal and state laws, regulations, and lease and permit requirements. Shell will have trained personnel and monitoring programs in place to ensure such compliance.

B. LOCATION

See attached location plats (Attachments 1A and 1B) and BOEM forms (Attachments 1C through 1J).

C. RIG SAFETY AND POLLUTION FEATURES

The rig to be used for future well work (Atwood Condor or similar DP semi-submersible or Transocean Deepwater Proteus or similar Drill Ship) will comply with the regulations of the American Bureau of Shipping (ABS), International Maritime Organization (IMO) and the United States Coast Guard (USCG). All drilling operations will be conducted under the provisions of 30 CFR, Part 250, Subpart D and other applicable regulations and notices, including those regarding the avoidance of potential drilling hazards and safety and pollution prevention control. Such measures as inflow detection and well control, monitoring for loss of circulation and seepage loss and casing design will be our primary safety measures. Primary pollution prevention measures are contaminated and non-contaminated drain system, mud drain system and oily water processing.

The following drain items are typical for rigs in Shell's fleet.

DRAIN SYSTEM POLLUTION FEATURES

Drains are provided on the rig in all spaces and on all decks where water or oil can accumulate. The drains are divided into two categories, non-contaminated and contaminated. All deck drains are fitted with a removable strainer plate to prevent debris from entering the system.

Deck drainage from rainfall, rig washing, deck washing and runoff from curbs and gutters, including drip pans and work areas, are discharged depending on if it comes in contact with the contaminated or non-contaminated areas of the Rig.

1) Non-contaminated Drains

Non-contaminated drains are designated as drains that under normal circumstances do not contain hydrocarbons and are mostly located around the main deck and outboard in places where it is unlikely that hydrocarbons will be found. Non-Contaminated drains can be directed overboard or to Non-Hazardous storage tanks. Drains are normally directed to storage tanks and only sent overboard if static sheen test is completed.

All drains that have the ability to go overboard are plugged and labeled and are lined up to normally go into Hazardous and Non-Hazardous storage tanks. Any deviation from this requires a Request for Approval Drain Plug Removal Form to be filled out prior to any plug being pulled. The rig's drain plug program consists of a daily check of all deck drains leading to the sea to verify that their status is as designated.

In the event a leak or spill on deck, the event shall be contained as all drains are lined up to the holding tanks. Emergency spill kits are located around the vessel and kit deployment and notifications will be implemented as needed.

Rig personnel shall ensure that the perimeter kick-plates on weather decks are maintained and drain plugs are in place as needed to ensure a proper seal.

2) Contaminated Drains

Contaminated drains are designated as drains that may contain hydrocarbons, drains from likely zones (rig floor, active mud tanks, etc.) cannot be discharged overboard and are directed to hazardous storage tanks. Drains from zones less likely to be contaminated (BOP setback areas, well test deck, etc.) have the option to go overboard or to the hazardous storage tanks, drains are always directed to storage tank for this system. When oil-based mud is used for drilling it will be collected from decks via a mud vac system or pumped from storage tanks to portable tanks and sent to shore for processing.

3) Oily Water Processing

Oily water is collected in an oily water tank. It must be separated and cannot be pumped overboard until oil content is <15 ppm. The separated oil is pumped to a dirty oil tank and has to be sent ashore for disposal. On board the MODU an oil record log is kept according to instructions included in the log. All waste oil that is sent in to be disposed of is recorded in the MODU's oil log book.

All discharges will be in accordance with applicable NPDES permits. See Section 18, EIA.

4) Lower Hull Bilge System

- The main bilge system is designed to have drains directed to bilge pockets in lower machinery rooms or directly to the FWD and Aft bilge storage tanks. They are electrically driven, self-priming centrifugal pumps – forward and aft that automatically pump bilge pockets to storage tanks when high level is sensed.
- Bilge water is stored onboard and pumped overboard via the Oily Water Separator if below 15 PPM.

The Bilge pumps are manual/automatic type pumps. They are equipped with sensors that give a high and a high alarm. They are set to a point at which the water gets to a certain point they will automatically turn on to pump water out in order to keep flooding under control. The pumps are also capable of being put in manual mode in which they can be turned on by hand.

5) Emergency Bilge System

The Vessel has specific procedures for emergency bilge operations. It has emergency bilge pumps forward and aft for secondary response of de-watering vessel areas. For emergency purposes these overboard valves are kept open at all times. The pumps are manually controlled by the engine room operator in the Engine control room and all bilge pockets can be pumped and controlled from this area. In addition to this there is a third means of dewatering the vessel utilizing saltwater pumps and ballast pumps in various aft spaces. These valves must be manually operated in the affected machinery room.

6) Oily Water Drain/Separation System

Oily water/engine room bilge water is collected in an oily water tank. It must be separated and not pumped overboard until oil content is <15 ppm. The separated oil is pumped to a dirty oil tank and will to be sent ashore for disposal. On board all drilling Units, an oil record log is kept according to instructions included in the log.

The rig floor drains go to the hazardous or non-hazardous drain system. From there they are pumped through a 15ppm meter before going overboard or being diverted to a drain holding tank. Once the drain holding thank is full it is processed through a decanting and centrifugal separation system. The heavy solids that cannot pass are pumped to a tote and sent in for processing, the remaining fluid is either sent back to the holding tank or if under 15ppm it is diverted overboard.

7) Drain, Effluent and Waste Systems

- The rig's drainage system is designed in line with our environmental and single point discharge policies. Drains are either hazardous, i.e. from a hazardous area as depicted on the Area Classification drawings, or non-hazardous drains from nonhazardous areas.
- To prevent migration of hazardous materials and flammable gas from hazardous to non-hazardous areas, the drainage systems are segregated.
- The rig drainage systems tie into oily water separators that take out elements in the drainage that could harm the environment.

8) Rig Floor Drainage

The rig floor drains to the hazardous or non-hazardous drain system as described above. A dedicated mud vacuum system is also installed to remove any mud that may go down the drain.

9) Cement unit Drains

The drains in the containment for the mixing skid and chemical tanks are directed to a dedicated overboard line. This line is controlled by two gate valves for double isolation and is kept normally closed with locks.

10) Main Engine Rooms

The engine rooms have their own drainage and handling system. The engine rooms are outfitted with a dirty oil tank and the drainage in the tank is processed through the separator, the waste from the separator goes back to the dirty oil tank and the clean water (<15 ppm) goes overboard.

11) Helideck Drains

The helideck has a dedicated drainage system around its perimeter to drain heli-fuel from a helicopter incident. The fuel can be diverted to the designated heli fuel recovery tank which is located under the Helideck structure.

Operating configurations are as follows:

- The overboard piping valves and hydrocarbons take on valves are closed and locked. To unlock overboard or take on valves a permit or a Bulk Transfer Certificate must be filled out.
- The oily water separator continuously circulates the oily water collection tank. Waste oil is discharged into the waste oil tank and oily water is re-circulated back into the oily water collection tank. Clean water is pumped overboard, which is controlled/monitored by the oil content detector, set at 15 ppm.
- The solids control system is capable of being isolated for cuttings collection.

D. Storage Tanks – Transocean Proteus (or similar) Drillship

Type of Storage Tank	Tank Capacity (bbls)	Number of Tanks	Total Capacity (bbls)	Fluid Gravity (Specific)
Marine Oil	14788	1	14788	Marine oil (0.85 SG)
Marine Oil	14482	2	28964	Marine oil (0.85 SG)
Marine Oil settling tank	2338	2	4676	Marine oil (0.85 SG)
Marine Oil settling tank	1415	2	2830	Marine oil (0.85 SG)
Marine Oil settling tank	1145	2	2290	Marine oil (0.85 SG)
Lube oil	214	1	214	Lube Oil (.9 SG)
Lube oil	381	1	381	Lube Oil (.9 SG)
Lube oil	127	1	127	Lube Oil (.9 SG)
Lube Oil	169	1	169	Lube Oil (.9 SG)

Storage Tanks – Atwood Condor (or similar) DP Semi-Submersible

Type of Storage Tank	Type of Facility	Tank Capacity (Bbls)	Number of Tanks	Total Capacity (Bbls)	Fluid Gravity (Specific)
Diesel Tank in stbd 1 80% fill in all hull tanks	Drilling Rig	3597	1	3597	Marine Diesel (0.91 SG)
Diesel Tank in stbd 2	Drilling Rig	2,713	1	2713	Marine Diesel (0.91 SG)
Diesel Tank in stbd 3	Drilling Rig	3,456	1	3456	Marine Diesel (0.91 SG)
Diesel Tank in stbd 4	Drilling Rig	653	1	653	Marine Diesel (0.91 SG)
Diesel Tank in port 1	Drilling Rig	2,090	1	2090	Marine Diesel (0.91 SG)
Diesel Tank in port 2	Drilling Rig	1,366	1	1366	Marine Diesel (0.91 SG)
Diesel Tank in port 3	Drilling Rig	4,787	1	4787	Marine Diesel (0.91 SG)
Diesel Tank in port 4	Drilling Rig	3,456	1	3456	Marine Diesel (0.91 SG)
Total storage hull tanks	Drilling Rig			22,118	Marine Diesel (0.91 SG)
Diesel Settling Tanks	Drilling Rig	129	3	387	Marine Diesel (0.91 SG)
Diesel Settling Tanks	Drilling Rig	139	1	139	Marine Diesel (0.91 SG)

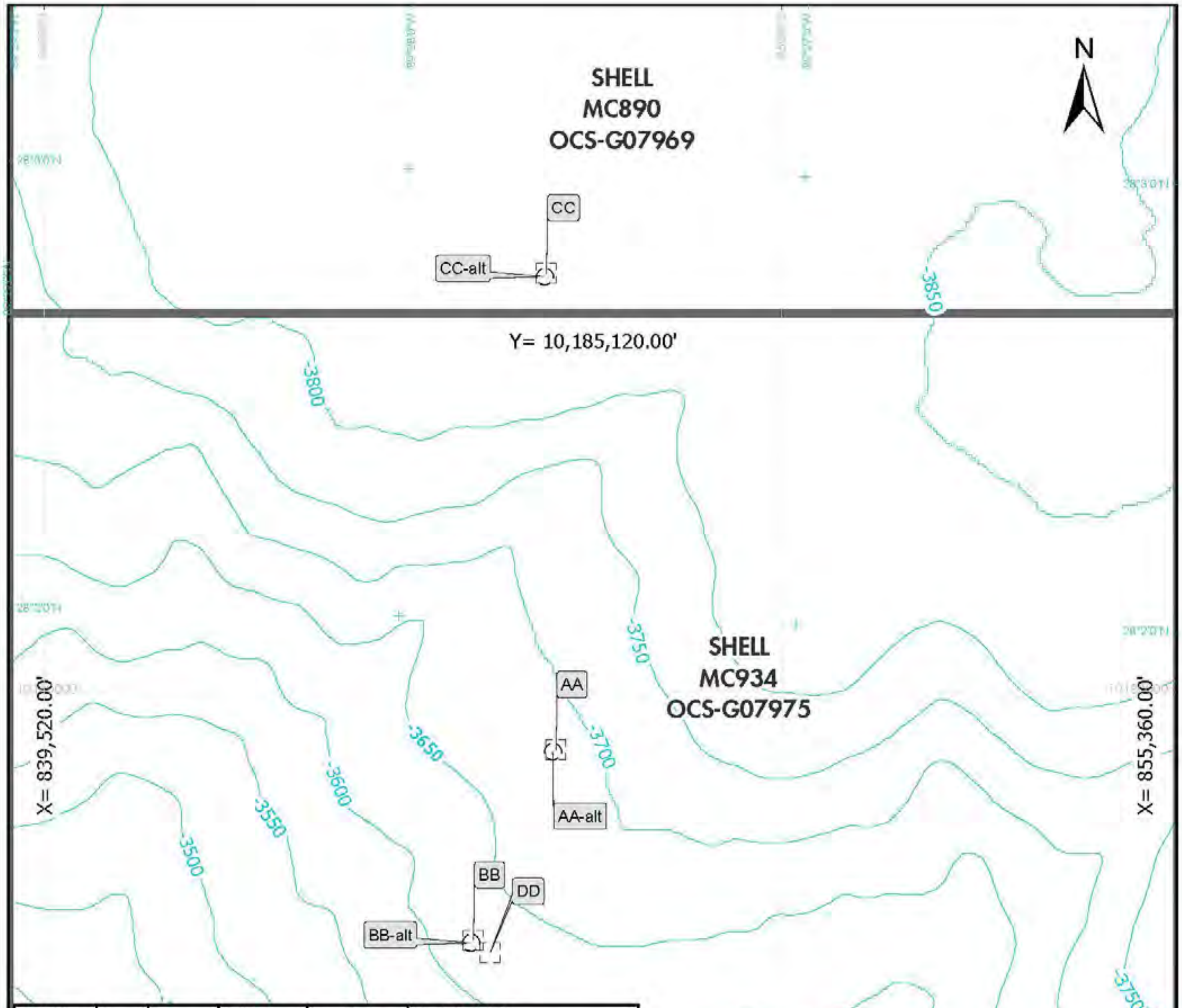
E. Pollution Prevention Measures

Pursuant to NTL 2008-G04 the proposed operations covered by this EP do not require Shell to specifically address the discharges of oil and grease from the rig during rainfall or routine operations. Nevertheless, Shell has provided this information as part of its response to 1(c) above.

F. Additional Measures

- HSE (health safety and environment) are the primary topics in pre-tour and pre-job safety meetings. The discussion around no harm to people or environment is a key mindset. All personnel are reminded daily to inspect work areas for safety issues as well as potential pollution issues.
- All tools that come to and from the rig have their pollution pans inspected, cleaned and confirmation of plugs installed prior to leaving dock and prior to loading on the boat.
- Preventive maintenance of rig equipment includes visual inspection of hydraulic lines and reservoirs on routine scheduled basis.
- All pollution pans on rig are inspected daily.
- Containment dikes are installed around all oil containment, drum storage areas, fuel vents and fuel storage tanks.
- All used oil and fuel is collected and sent in for recycling.
- Every drain on the rig is assigned a number. The number is logged when plug is removed and replaced.
- All trash containers are checked and emptied daily. The trash containers are kept covered. Trash is disposed of in a compactor and shipped in via boat.
- Fuel hoses and SBM are changed on annual basis.
- TODO or (KLAW) spill prevention fittings are installed on all liquid take on hoses.
- Waste paint thinner is collected and sent ashore for disposal.
- Shell has obtained ISO14001 certification.
- Shell uses low sulfur fuel.

Attachment 1A - BATHYMETRY WITH SURFACE LOCATIONS



Well Name	X	Y	Latitude	Longitude	Block Call (ft)
AA	846,938	10,179,193	28° 1' 42.466"	-89° 27' 35.874"	7418' FWL & 5927 ' FNL of BLK MC934
AA-alt	846,892	10,179,170	28° 1' 42.229"	-89° 27' 36.382"	7372' FWL & 5950 ' FNL of BLK MC934
BB	845,818	10,176,618	28° 1' 16.758"	-89° 27' 47.784"	6298' FWL & 7338 ' FSL of BLK MC934
BB-alt	845,785	10,176,579	28° 1' 16.365"	-89° 27' 48.143"	6265' FWL & 7299 ' FSL of BLK MC934
CC	846,808	10,185,656	28° 2' 46.402"	-89° 27' 38.78"	7288' FWL & 536 ' FSL of BLK MC890
CC-alt	846,782	10,185,611	28° 2' 45.951"	-89° 27' 39.059"	7262' FWL & 491 ' FSL of BLK MC890
DD	846,046	10,176,450	28° 1' 15.141"	-89° 27' 45.204"	6526' FWL & 7170 ' FSL of BLK MC934

MAP INFORMATION

Legend

Proposed Well Locations
- Surface Hole Location
- Alt / Respud Location
- Lease Block
- Bathymetry Contour (Ft)

Graticule Grid Tick

Measured Grid Line

MAP SCALE

0 1,000 2,000 4,000
Feet

1:24,000
Print size: 8.5"x11" (ANSI A)

SHELL EXPLORATION & PRODUCTION COMPANY

Supplemental Exploration Plan
Gulf of Mexico
Mississippi Canyon OCS-G-07969 BLK 890 &
OCS-G-07975 934 AA, AA-alt, BB, BB-alt, CC,
CC-alt, DD Proposed Surface Locations

GEODETIC PARAMETERS

Horizontal Coordinate Reference System
CRS name (ESRI): NAD 1927 BLM Zone 16N
CRS name (Shell): NAD27 / UTM zone 16N (ftUS) [1241_32066]
CRS code (EPSG): 32066
Geodetic datum: North American 1927
Projection name: Transverse Mercator
Horizontal units: Foot US

Author: S.W.Bridges
Date: 22 Oct 2019
Reviewed By: G. Cai
EP Catalog No.: EP201909204380

Document Path: C:\Users\steven.bridges\AppData\Local\Temp\ArcGISPro3592\b3d63586-bf38-4527-b335-0194001c439e\Untitled.aprx

Attachment 1B - BOTTOM HOLE LOCATIONS

Proprietary Data

U.S. Department of the Interior
Bureau of Ocean Energy Management

Attachment 1C

OMB Control Number: 1010-0151

OCS PLAN INFORMATION FORM

General Information

Type of OCS Plan:	X	Exploration Plan (EP)	Development Operations Coordination Document (DOCD)	

Company Name: Shell Offshore Inc.	BOEM Operator Number: 0689
Address: 701 Poydras St.	Contact Person: Tracy Albert
New Orleans, LA 70131	Phone Number: 504.425.4652
	Email Address tracy.albert@shell.com

If a service fee is required under 30 CFR 550.125(a) provide:	Amount Paid: $14,692	Receipt No. 26NH2390

Project and Worst-Case Discharge (WCD) Information

Lease(s): (OCS-G 7969 and 7975)	Area: MC	Block(s): 934	Project Name: Europa

Objectives(s):	X	Oil		Gas		Sulphur		Salt	Onshore Support Base(s) Fourchon & Houma (or Boothville)

Platform/Well Name: DD	Total Volume of WCD: 27.2 MM BO	API Gravity: 27°

Distance to Closest Land (Miles): 53	Volume from uncontrolled blowout: 364,696 BO

Have you previously provided information to verify the calculations and assumptions of your WCD?		Yes	X	No
If so, provide the Control Number of the EP or DOCD with which this information was provided				
Do you propose to use new or unusual technology to conduct your activities?		Yes	X	No
Do you propose to use a vessel with anchors to install or modify a structure?		Yes	X	No
Do you propose any facility that will serve as a host facility for deepwater subsea development?		Yes	X	No

Description of Proposed Activities and Tentative Schedule (Mark all that apply)

Proposed Activity	Start Date	End Date	No. of Days
Exploratory drilling	See attached		
Development drilling			
Well completion	See attached		
Well test flaring (for more than 48 hours)			
Installation or modification of structure			
Installation of production facilities			
Installation of subsea wellheads and/or dry hole tree	See attached		
Installation of lease term pipelines			
Commence production			
Other (Specify and attach description)			

Description of Drilling Rig				Description of Structure			
	Jackup	x	Drillship		Caisson		Tension Leg Platform
	Gorilla Jackup		Platform rig		Fixed Platform		Compliant Tower
	Semisubmersible		Submersible		Spar Other		Guyed tower
x	DP Submersible		Other (attached description)		Floating production system		Other (attached description)

Drilling Rig Name (If known) DW Proteus or similar DS, Atwood Condor or Similar DP-Semi

Description of Lease Term Pipelines

From (Facility/Area/Block)	To (Facility/Area/Block)	Diameter (Inches)	Length (Feet)
NA			

Attachment 1C.1 Schedule to Drill/Complete and Install Tree

Well	Days	Start	End
AA	125	8/1/20	12/4/20
AA-Alt	250	4/23/21	12/31/21
BB	250	4/23/22	12/31/22
BB-Alt	250	4/23/23	12/31/23
CC	250	4/23/24	12/31/24
CC-Alt	250	4/23/25	12/31/25
DD	250	4/23/26	12/31/26

Attachment 1D

Proposed Well/Structure Location

Well or Structure Name/Number (if renaming well or structure, reference previous name): AA	Previously reviewed under an approved EP or DOCD?		Yes	X	No

Is this an existing well or structure?		Yes	X	No	If this is an existing well or structure, list the Complex ID or API Number:	NA

Do you plan to use a subsea BOP or a surface BOP on a floating facility to conduct your proposed activities?	X	Yes		No

WCD Info	For wells, volume of uncontrolled Blowouts (bbls/day): 364,696	For structures, volume of all storage and pipelines (bbls): NA	API Gravity of fluid	27°

	Surface Location	Bottom Hole Location (for Wells)	Completion (for multiple enter separate lines)
Lease Number	OCS-G 07975	OCS-G 07975	OCS
Area Name	MC	MC	
Block No.	934	934	
Blockline Departure (in feet)	N/S Departure: 5,927′ FNL		N/S Departure:
	E/W Departure 7,418′ FWL		E/W Departure:
Lambert X-Y Coord.	X: 846,938		X:
	Y: 10,179,193		Y:
Lat/Long	Latitude: 28° 1′ 42.466″		Latitude
	Longitude: -89° 27′ 35.874″		Longitude

Water Depth (Feet): 3,688′			MD (Feet)	TVD (Feet)

Anchor Radius (if applicable) in feet: NA

Anchor locations for drilling rig or construction barge (if anchor radius is supplied above, not necessary)

Anchor Name or No.	Area	Block	X Coordinate	Y Coordinate	Length of Anchor Chain on Seafloor
			X=	Y=	
			X=	Y=	
			X=	Y=	
			X=	Y=	
			X=	Y=	
			X=	Y=	
			X=	Y=	

Attachment 1E

Proposed Well/Structure Location

Well or Structure Name/Number (if renaming well or structure, reference previous name): AA-Alt	Previously reviewed under an approved EP or DOCD?		Yes	X	No

Is this an existing well or structure?		Yes	X	No	If this is an existing well or structure, list the Complex ID or API Number:	NA

Do you plan to use a subsea BOP or a surface BOP on a floating facility to conduct your proposed activities?	X	Yes		No

WCD Info	For wells, volume of uncontrolled Blowouts (bbls/day): 364,696	For structures, volume of all storage and pipelines (bbls): NA	API Gravity of fluid	27°

	Surface Location	Bottom Hole Location (for Wells)	Completion (for multiple enter separate lines)
Lease Number	OCS-G 07975	OCS-G 07975	OCS OCS
Area Name	MC	MC	
Block No.	934	934	
Blockline Departure (in feet)	N/S Departure: 5,950′ FNL		N/S Departure: N/S Departure:
	E/W Departure 7,372′ FWL		E/W Departure: E/W Departure:
Lambert X-Y Coord.	X: 846,892		X:
	Y: 10,179,170		Y:
Lat/Long	Latitude: 28° 1′ 42.229″		Latitude
	Longitude: -89° 27′ 36.382″		Longitude

Water Depth (Feet): 3,688′			MD (Feet)	TVD (Feet)

Anchor locations for drilling rig or construction barge (if anchor radius is supplied above, not necessary)

Anchor Name or No.	Area	Block	X Coordinate	Y Coordinate	Length of Anchor Chain on Seafloor
			X=	Y=	
			X=	Y=	
			X=	Y=	
			X=	Y=	
			X=	Y=	
			X=	Y=	
			X=	Y=	

Attachment 1F

Proposed Well/Structure Location

Well or Structure Name/Number (if renaming well or structure, reference previous name): BB	Previously reviewed under an approved EP or DOCD?		Yes	X	No

Is this an existing well or structure?		Yes	X	No	If this is an existing well or structure, list the Complex ID or API Number:	NA

Do you plan to use a subsea BOP or a surface BOP on a floating facility to conduct your proposed activities?	X	Yes		No

WCD Info	For wells, volume of uncontrolled Blowouts (bbls/day): 364,696	For structures, volume of all storage and pipelines (bbls): NA	API Gravity of fluid	27°

	Surface Location	Bottom Hole Location (for Wells)	Completion (for multiple enter separate lines)
Lease Number	OCS-G 07975	OCS-G 07975	OCS OCS
Area Name	MC	MC	
Block No.	934	934	
Blockline Departure (in feet)	N/S Departure: 7,338′ FSL		N/S Departure: N/S Departure:
	E/W Departure 6,298′ FWL		E/W Departure: E/W Departure:
Lambert X-Y Coord.	X: 845,818		X:
	Y: 10,176,618		Y:
Lat/Long	Latitude: 28° 1′ 16.758″		Latitude
	Longitude: -89° 27′ 47.784″		Longitude

Water Depth (Feet): 3,622′			MD (Feet)	TVD (Feet)

Anchor Radius (if applicable) in feet: NA

Anchor locations for drilling rig or construction barge (if anchor radius is supplied above, not necessary)

Anchor Name or No.	Area	Block	X Coordinate	Y Coordinate	Length of Anchor Chain on Seafloor
			X=	Y=	
			X=	Y=	
			X=	Y=	
			X=	Y=	
			X=	Y=	
			X=	Y=	
			X=	Y=	

Attachment 1G

Proposed Well/Structure Location

Well or Structure Name/Number (if renaming well or structure, reference previous name): BB-Alt	Previously reviewed under an approved EP or DOCD?		Yes	X	No

Is this an existing well or structure?		Yes	X	No	If this is an existing well or structure, list the Complex ID or API Number:	NA

Do you plan to use a subsea BOP or a surface BOP on a floating facility to conduct your proposed activities?	X	Yes		No

WCD Info	For wells, volume of uncontrolled Blowouts (bbls/day): 364,696	For structures, volume of all storage and pipelines (bbls): NA	API Gravity of fluid	27°

	Surface Location	Bottom Hole Location (for Wells)	Completion (for multiple enter separate lines)
Lease Number	OCS-G 07975	OCS-G 07975	OCS OCS
Area Name	MC	MC	
Block No.	934	934	
Blockline Departure (in feet)	N/S Departure: 7,299′ FSL		N/S Departure: N/S Departure:
	E/W Departure 6,265′ FWL		E/W Departure: E/W Departure:
Lambert X-Y Coord.	X: 845,785		X:
	Y: 10,176,579		Y:
Lat/Long	Latitude: 28° 1′ 16.365″		Latitude
	Longitude: -89° 27′ 48.143″		Longitude

Water Depth (Feet): 3,622′			MD (Feet)	TVD (Feet)

Anchor Radius (if applicable) in feet: NA

Anchor locations for drilling rig or construction barge (if anchor radius is supplied above, not necessary)

Anchor Name or No.	Area	Block	X Coordinate	Y Coordinate	Length of Anchor Chain on Seafloor
			X=	Y=	
			X=	Y=	
			X=	Y=	
			X=	Y=	
			X=	Y=	
			X=	Y=	
			X=	Y=	

Attachment 1H

Proposed Well/Structure Location

Well or Structure Name/Number (if renaming well or structure, reference previous name): CC	Previously reviewed under an approved EP or DOCD?		Yes	X	No

Is this an existing well or structure?		Yes	X	No	If this is an existing well or structure, list the Complex ID or API Number:	NA

Do you plan to use a subsea BOP or a surface BOP on a floating facility to conduct your proposed activities?	X	Yes		No

WCD Info	For wells, volume of uncontrolled Blowouts (bbls/day): 364,696	For structures, volume of all storage and pipelines (bbls): NA	API Gravity of fluid	27°

	Surface Location	Bottom Hole Location (for Wells)	Completion (for multiple enter separate lines)
Lease Number	OCS-G 07969	OCS-G 07969	OCS OCS
Area Name	MC	MC	
Block No.	890	890	
Blockline Departure (in feet)	N/S Departure: 536′ FSL		N/S Departure: N/S Departure:
	E/W Departure 7,288′ FWL		E/W Departure: E/W Departure:
Lambert X-Y Coord.	X: 846,808		X:
	Y: 10,185,656		Y:
Lat/Long	Latitude: 28° 2′ 46.402″		Latitude
	Longitude: -89° 27′ 38.78″		Longitude

Water Depth (Feet): 3,833′			MD (Feet)	TVD (Feet)

Anchor Radius (if applicable) in feet: NA

Anchor locations for drilling rig or construction barge (if anchor radius is supplied above, not necessary)

Anchor Name or No.	Area	Block	X Coordinate	Y Coordinate	Length of Anchor Chain on Seafloor
			X=	Y=	
			X=	Y=	
			X=	Y=	
			X=	Y=	
			X=	Y=	
			X=	Y=	
			X=	Y=	

Attachment 1I

Proposed Well/Structure Location

Well or Structure Name/Number (if renaming well or structure, reference previous name): CC-Alt	Previously reviewed under an approved EP or DOCD?		Yes	X	No

Is this an existing well or structure?		Yes	X	No	If this is an existing well or structure, list the Complex ID or API Number:	NA

Do you plan to use a subsea BOP or a surface BOP on a floating facility to conduct your proposed activities?	X	Yes		No

WCD Info	For wells, volume of uncontrolled Blowouts (bbls/day): 364,696	For structures, volume of all storage and pipelines (bbls): NA	API Gravity of fluid	27°

	Surface Location	Bottom Hole Location (for Wells)	Completion (for multiple enter separate lines)
Lease Number	OCS-G 07969	OCS-G 07969	OCS OCS
Area Name	MC	MC	
Block No.	890	890	
Blockline Departure (in feet)	N/S Departure: 491′ FSL		N/S Departure: N/S Departure:
	E/W Departure 7,262′ FWL		E/W Departure: E/W Departure:
Lambert X-Y Coord.	X: 846,782		X:
	Y: 10,185,611		Y:
Lat/Long	Latitude: 28° 2′ 45.951″		Latitude
	Longitude: -89° 27′ 39.059″		Longitude

Water Depth (Feet): 3,833′			MD (Feet)	TVD (Feet)

Anchor Radius (if applicable) in feet: NA

Anchor locations for drilling rig or construction barge (if anchor radius is supplied above, not necessary)

Anchor Name or No.	Area	Block	X Coordinate	Y Coordinate	Length of Anchor Chain on Seafloor
			X=	Y=	
			X=	Y=	
			X=	Y=	
			X=	Y=	
			X=	Y=	
			X=	Y=	
			X=	Y=	

Attachment 1J

Proposed Well/Structure Location

Well or Structure Name/Number (if renaming well or structure, reference previous name): DD	Previously reviewed under an approved EP or DOCD?		Yes	X	No

Is this an existing well or structure?		Yes	X	No	If this is an existing well or structure, list the Complex ID or API Number:	NA

Do you plan to use a subsea BOP or a surface BOP on a floating facility to conduct your proposed activities?	X	Yes		No

WCD Info	For wells, volume of uncontrolled Blowouts (bbls/day): 364,696	For structures, volume of all storage and pipelines (bbls): NA	API Gravity of fluid	27°

	Surface Location	Bottom Hole Location (for Wells)	Completion (for multiple enter separate lines)
Lease Number	OCS-G 07975	OCS-G 07975	OCS OCS
Area Name	MC	MC	
Block No.	934	934	
Blockline Departure (in feet)	N/S Departure: 7,170′ FSL		N/S Departure: N/S Departure:
	E/W Departure 6,526′ FWL		E/W Departure: E/W Departure:
Lambert X-Y Coord.	X: 846,046		X:
	Y: 10,176,450		Y:
Lat/Long	Latitude: 28° 1′ 15.141″		Latitude
	Longitude: -89° 27′ 45.204″		Longitude

Water Depth (Feet): 3,623′			MD (Feet)	TVD (Feet)

Anchor Radius (if applicable) in feet: NA

Anchor locations for drilling rig or construction barge (if anchor radius is supplied above, not necessary)

Anchor Name or No.	Area	Block	X Coordinate	Y Coordinate	Length of Anchor Chain on Seafloor
			X=	Y=	
			X=	Y=	
			X=	Y=	
			X=	Y=	
			X=	Y=	
			X=	Y=	
			X=	Y=	

SECTION 2: GENERAL INFORMATION

A. Application and Permits

There are no individual or site-specific permits other than general NPDES Permit and rig move notifications that need to be obtained. An Application for Permit to Drill (APD) will be submitted and approved by BSEE before drilling operations commence.

B. Drilling Fluids

See Section 7, Table 7A and 7B for a list of drilling fluids to be used and disposal of same.

C. Production

Information regarding production is not included in this EP as such information is only necessary in the case of DOCDs.

D. Oil Characteristics

Information regarding oil characteristics is not included in this EP as such information is only necessary in the case of DOCDs.

E. New or Unusual Technology

Shell is not proposing to use new or unusual technology as defined in 30 CFR 250.200 to carry out the proposed activities in this EP.

F. Bonding

The bond requirement for the activities proposed in this EP are satisfied by an area-wide bond furnished and maintained according to 30 CFR Part 556.901 Bonding; NTL No. 2015-N04, "General Financial Assurance" and additional security under National NTL No. 2016-BOEM-N01.

G. Oil Spill Financial Responsibility (OSFR)

Shell Offshore Inc. (Shell), BOEM Operator Number 0689, has demonstrated oil spill financial responsibility for the wells proposed in the EP according to 30 CFR Parts 250 and 253, and NTL No. 2008-N05, "Guidelines for Oil Spill Financial Responsibility for Covered Facilities."

H. Deepwater well control statement

Shell Offshore Inc. (Shell), BOEM Operator Number 0689, has the financial capability to drill a relief well and conduct other emergency well control operations.

I. Suspension of Production

Information regarding Suspension of Production is not included in this EP as such information is only necessary in the case of DOCDs.

2J Blowout Scenario

This Section 2J was prepared by Shell Offshore Inc. (Shell) pursuant to the guidance provided in the Bureau of Ocean Energy Management (BOEM) Notice to Lessees (NTL) No. 2015-N01 with respect to blowout and worst-case discharge scenario descriptions. Shell intends to comply with all applicable laws, regulations, rules and Notices to Lessees.

Shell focuses on an integrated, three-pronged approach to a blowout, including prevention, intervention/containment, and recovery.

1. Shell believes that the best way to manage blowouts is to prevent them from happening. Significant effort goes into design and execution of wells and into building and maintaining staff competence. Shell continues to invest independently in Research and Development (R&D) to improve safety and reliability of our well systems.
2. Shell is a founding member of the Marine Well Containment Company (MWCC), which provides robust well containment (shut-in and controlled flow) capabilities. Additionally, Shell is investing in R&D to improve containment systems.
3. As outlined in Shell's Oil Spill Response Plan (OSRP), and detailed in EP Section 9, Shell has contracts with Oil Spill Removal Organizations (OSROs) to provide the resources necessary to respond to this Worst Case Discharge (WCD) scenario. The capabilities for on-water recovery, aerial and subsea dispersant application, in-situ burning, and nighttime monitoring and tracking have been significantly increased.

The WCD blowout scenario is calculated for the exploration well "DD" of the target sands and based on the guidelines outlined in NTL No. 2015-N01 and subsequent Frequently Asked Questions (FAQ). The WCD for this well falls below the WCD exploratory scenario included in Shell's regional OSRP. Shell's Regional OSRP has response capabilities based on the first 30-day average daily rate; thus in the unlikely event of a spill, Shell's Regional OSRP is designed to contain and respond to a spill that meets or exceeds this WCD.

The WCD scenario, in terms of both initial and the sustained rates, has a low probability of being realized. Some of the factors that are likely to reduce rates and volumes, and are not included in the WCD calculation, include but are not limited to, obstructions or equipment in the wellbore, well bridging, and early intervention, such as containment capabilities.

Uncontrolled blowout (volume first day)	364,696bbl oil
Uncontrolled blowout rate (first 30 days average daily rate)	335,767BOPD
Duration of flow (days) based on relief well	90 Days
Total volume of spill (bbls) until relief well drilled	27.20 mmbbl oil

Table 1: Worst Case Discharge Summary

O West Project Overview

The O-West prospect sits on a salt ridge between two salt mini basins 20 miles to the SW of Mars in the Mississippi Canyon. O-West is directly West and across a structural graben from the Europa field. The Europa field is a subsea development in the deepwater Gulf of Mexico tied back to the Mars A TLP It is located on a three-block MMS unit (MC890, MC934, MC935) 18 miles southwest of the Mars platform. The subsea system is located in 3,875 feet of water. First production in the Europa Field began in early 2000. In Europa and O-West Shell is the operator with 33.67% WI, BP holds 33.33%, ENI holds 32% and Conoco holds the remaining 1%. O West is located in block MC934 of the US GoM held by Europa production. Well 'DD' is considered the base plan, while the other plans proposed here (AA, BB, CC) could be used as possible appraisal well locations or as re-spud locations in case of operational or mechanical need.

1) Purpose

Pursuant with 30 CFR 250.213(g), 250.219, 250.250, and NTL No. 2015-N01, this document provides a blowout scenario description, further information regarding any potential oil spill, the assumptions and calculations used to determine the WCD and the measures taken to 1) enhance the ability to prevent a blowout and 2) respond and manage a blowout scenario if it were to occur. These calculations are based on best technical estimates of subsurface parameters that are derived from the offset wells, and from seismic. These parameters are better than or consistent with the estimates used by Shell to justify the investment. Therefore, these assumed parameters were used to calculate the WCD. They do not reflect probabilistic estimates.

2) Background

This attachment has been developed to document the additional information requirements for Exploration Plans as requested by NTL No. 2015-N01 in response to the explosion and sinking of the Mobile Offshore Drilling Unit (MODU) Deepwater Horizon and the resulting subsea well blowout and recovery operations of the exploration well at the MC-252 Macondo location.

3) Information Requirements

a) Blowout scenario

All seven well locations addressed in this EP were assessed for Worst Case Discharge using the expected well path, the expected reservoir thickness, structural elevation, and rock/fluid properties for each. The O West "DD" well with a bottom hole location represents the highest 30-day average well flow potential. The O West "DD" well will be drilled through the reservoirs as outlined in the Geological and Geophysical Information Section of the O West EP, and described above, utilizing a typical subsea wellhead system, conductor, surface and intermediate casing program, and using a Dynamically Positioned Drill ship rig with a marine riser and subsea Blowout Preventer. A hydrocarbon influx and a well control event are modeled to occur from the reservoir. The simulated blowout model results in unrestricted flow from the well at the seafloor. This represents the worst case discharge, with no restrictions in the wellbore, plus failure/loss of the subsea BOP, and a blowout to the seabed.

b) Estimated flow rate of the potential blowout

Category	EP
Type of Activity	Drilling
Facility Location (area/block)	MC 934
Facility Designation	DP
Distance to Nearest Shoreline (miles)	63 statute miles
Uncontrolled blowout volume (first day)	364,696bbl oil
Uncontrolled blowout volume (first 30 day average daily rate)	335,767BOPD

Table 2: Estimated Flow Rates of a Potential Blowout

c) Total volume and maximum duration of the potential blowout

Duration of flow (days)	90
Total volume of spill (bbls)	27.20 mmbbl oil

Table 3: Estimated Duration and Volume of a Potential Blowout

There is usually a decline in the discharge rate as time proceeds, which is illustrated by the difference between the first 24-hour volume and 30-day average rate. The total volume calculated until a well is killed in a potential blowout further demonstrates this decline. At very short times, e.g. during the first 24 hours, the pressure profile in the reservoir changes from the moment when a well first starts flowing to a pseudo-steady state pressure profile with time, and as a result the rate declines. At somewhat longer time scales, effects such as reservoir voidage and the impact of boundaries can cause the rate to drop continuously with production. Simulation and material balance models can include these effects and form the basis of the NTL No. 2015-N01 estimates for 24-hour and 30-day rates as well as maximum duration volumes.

d) Assumptions and calculations used in determining the worst-case discharge for **O West Well "DD" MC934**

(Proprietary data)

e) Potential for the well to bridge over

Mechanical failure/collapse of the borehole in a blowout scenario is influenced by several factors including in-situ stress, rock strength and fluid velocities at the sand face. Based on the nodal analysis and reservoir simulation models outlined above, a surface blowout would create a high drawdown at the sand face. Given the substantial fluid velocities inherent in the worst case discharge, and the scenario as defined where the formation is not supported by a cased and cemented wellbore, it is possible that the borehole may fail/collapse/bridge over within the span of a few days, significantly reducing outflow rates. However, this WCD scenario does not include any bridging or consideration of solids production with the oil and gas.

f) Likelihood for intervention to stop the blowout.

Safety of operations is our top priority. Maintaining well control at all times to prevent a blowout is the key focus of our operations. Our safe drilling record is based on our robust standards, conservative well design, prudent operations practices, competency of personnel, and strong HSE focus. Collectively, these constitute a robust system making blowouts extremely rare events.

Intervention Devices: Notwithstanding these facts, the main scenario for recovery from a blowout event is via intervention with the BOP attached to the well. There are built in redundancies in the BOP system to allow activation of selected components with the intent to seal off the well bore. As a minimum, the Shell contracted rig fleet in the GOM will have redundancies meeting the Final Drilling Safety Rule with respect to Remotely Operated Vehicle (ROV) hot stab capabilities, a deadman system, and an autoshear system.

Containment: The experience of gaining control over the Macondo well has resulted in a better understanding of the necessary equipment and systems for well containment. As a result, industry and government are better equipped and prepared today to contain an oil well blowout in. Shell is further analyzing these advances and incorporating them into its comprehensive approach to help prevent and, if needed, control another deepwater control incident.

Shell is a founding member of the Marine Well Containment Company (MWCC), which provides robust well containment (shut-in and controlled flow) capabilities. Pursuant to NTL No. 2010-N10, Shell will provide additional information regarding our containment capabilities in a subsequent filing.

g) Availability of a rig to drill a relief well and rig package constraints

There are no platforms in the vicinity of this location to drill a relief well from. Blowout intervention can be conducted from an ROV equipped vessel, the existing drilling rig or from another drilling rig. The dynamically positioned rigs under contract below will be preferred rigs for blowout intervention work. However, moored rigs can also be used in some scenarios. Additionally, in the event of a blowout, there are other non-contracted rigs in the GOM which could be utilized for increased expediency or better suitability. All efforts will be made at the time to secure the appropriate rig. Shell's current contracted rigs capable of operating at Whale water depths and reservoir depths without technical constraints are shown in the table below.

Rig Name	Rig Type
Noble Don Taylor	Dynamically Positioned Drill ship
Noble Globetrotter 1	Dynamically Positioned Drill ship
TO Deepwater Thalassa	Dynamically Positioned Drill ship
TO Deepwater Pontus	Dynamically Positioned Drill ship
TO Deepwater Posiden	Dynamically Positioned Drill ship
TO Deepwater Proteus	Dynamically Positioned Drill ship

Table 4: Available Rigs in Shell's fleet

Future modifications may change the rig's capability. Rig capabilities need to be assessed on a work scope basis.

h) Time taken to contract a rig, mobilize, and drill a relief well

Relief well operations will immediately take priority and displace any activity from Shell's contracted rig fleet. The list of Shell contracted rigs capable of operating at this location is shown in Table 4 above. It is expected to take an average of 2 days to safely secure (kill) the well that the rig is working on; up to the point the rig departs location, and a further 10 days transit to mobilize/demobilize to the relief well site depending on distance to travel. The relief well will take approximately 30 days to drill down to the last casing string above the blowout zone plus approximately 30 days for precision ranging activity to intersect the blowout well bore. Total time to mobilize and drill a relief well would be approximately 72 days for this well.

If a moored rig is chosen to conduct the relief well operations, anchor handlers would be prioritized to prepare mooring on the relief well site while the rig is being mobilized. This activity is not expected to delay initiation of relief well drilling operations. Shell has deep water anchor handlers on long term contract to support its moored rigs.

i) Measures proposed to enhance ability to prevent blowout and to reduce likelihood of a blowout

Shell believes that the best way to manage blowouts is to prevent them from happening. Detailed below are the measures employed by Shell with the goal of no harm to people or the environment. The Macondo incident has highlighted the importance of these practices. The lessons learned from the investigation are, and will continue to be, incorporated into our operations.

Standards: Shell's well design and operations adhere to internal corporate standards, the Code of Federal Regulations, and industry standards. A robust management of change process is in place to handle un-defined or exception situations. Ingrained in the Shell standards for well control is the philosophy of multiple barriers in the well design and operations on the well.

Risk Management: Shell believes that prevention of major incidents is best managed through the systematic identification and mitigation process (Safety Case). All Shell contracted rigs in the GOM have been operating with a Safety Case and will continue to do so. A Safety Case requires both the owner and contractors to systematically identify the risks in drilling operations and align plans to mitigate those risks; an alignment which is critical before drilling begins.

Well Design Workflow: The Well Delivery Process (WDP) is a rigorous internal assurance process with defined decision gates. The WDP leverages functional experts (internal and external) to examine the well design at the conceptual and detailed design stages for robustness before making a recommendation to the management review board. Shell's involvement in global deepwater drilling, starting in the GOM in the mid-1980's, provides a significant depth and breadth of internal drilling and operational expertise. Third party vendors and rig contractors are involved in all stages of the planning, providing their specific expertise. A Drill the Well on Paper (DWOP) exercise is conducted with rig personnel and vendors involved in execution of the well. This forum communicates the well plan and solicits input as to the safety of the plan and procedures proposed.

Well and rig equipment qualification, certification, and quality assurance: All rigs will meet all applicable rules, regulations, and Notice to Lessees. Shell works closely with rig contractors to ensure proper upkeep of all rig equipment, which meets or exceeds the strictest of Shell, industry, or regulatory requirements. Well tangibles are governed by our internal quality assurance/control standards and industry standards.

MWD/LWD/PWD Tools: Shell intends to use these tools at O West. The MWD/LWD/PWD tools are run on the drill string so that data on subsurface zones can be collected as the well advances in real time instead of waiting until the drill string is pulled to run wireline logs. Data from the tools are monitored and interpreted real time against prognosis to provide early warning of abnormal pressures to allow measures to be taken to progress the well safely.

Mud Logger: Mud logging personnel continually monitor returning drilling fluids for indications of hydrocarbons, utilizing both a hot wire and a gas chromatograph. An abrupt increase in gas or oil carried in the returning fluid can be an indication of an impending kick. The mud logger also monitors drill cuttings returned to the surface in the drilling fluid for changes in lithology that can be an indicator that the well has penetrated or is about to penetrate a hydrocarbon-bearing interval. Mud logging instruments also monitor penetration rate to provide an early indication of drilling breaks that show the bit penetrating a zone that could contain hydrocarbons. The mud logging personnel are in close communication with both the offshore drilling foremen and onshore Shell representative(s) to report any observed anomalies so appropriate action can be taken.

Remote Monitoring: The Real Time Operating Center has been used by Shell to complement and support traditional rig-site monitoring since 2003. Well site operations are lived virtually by onshore teams consisting of geoscientists, petrophysicists, well engineers, and 24/7 monitoring specialists. The same real time well control indicators monitored by the rig personnel are watched by the monitoring specialist for an added layer of redundancy.

Competency and Behavior: A structured training program for Well Engineers and Foreman is practiced, which includes internal professional examinations to verify competency. Other industry training in well control, such as by International Association of Drilling Contractors (IADC) and International Well Control Forum (IWCF) are also mandated. Progressions have elements of competency and Shell continues to have comprehensive internal training programs. The best systems and processes can be defeated by lack of knowledge and/or improper values. We believe that a combination of HSE tools (e.g. stop work, pre-job analysis, behavior-based safety, DWOPs, audits), management HSE involvement and enforcement (e.g. compliance to life saving rules) have created a strong safety culture in our operations.

j) Measures to conduct effective and early intervention in the event of a blowout

The response to a blowout is contained in our Well Control Contingency Plan (WCCP) which is a specific requirement of our internal well control standards. The WCCP in turn is part of the wider emergency response framework within Shell that addresses the overall organization response to an emergency situation. Resources are dedicated to these systems and drills are run frequently to test preparedness (security, medical, oil spill, and hurricane). This same framework is activated and tested during hurricane evacuations, thereby maintaining a fresh and responsive team.

The WCCP specifically addresses implementing actions at the emergency site that will ensure personnel safety, organizing personnel and their roles in the response, defining information requirements, establishing protocols to mobilize specialists and pre-selecting sources, and developing mobilization plans for personnel, material and services for well control procedures. The plan references individual activity checklists, a roster of equipment and services, initial information gathering forms, a generic description of relief well drilling, strategy and guidelines, intervention techniques and equipment, site safety management, exclusion zones, and re-boarding.

As set forth in 3f of this document, Shell is currently analyzing recent advances in containment technology and equipment and will incorporate them as they become available.

k) Arrangements for drilling a relief well

The size of the Shell contracted rig fleet in the GOM from 2018-2024 ensures that there is adequate well equipment (e.g. casing and wellhead) available for relief wells. Rigs and personnel will also be readily available within Shell, diverted from their active roles elsewhere. Resources from other operators can also be leveraged should the need arise. Generally, relief well plans will mirror the blowout well, incorporating any learning on well design based on root cause analysis of the blowout. A generic relief well description is outlined in the WCCP.

l) Assumptions and calculations used in approved or proposed OSRP

Shell has designed a response program (Regional OSRP) based upon a regional capability of responding to a range of spill volumes, from small operational spills up to and including the WCD from an exploration or development well blowout. Shell's program is developed to fully satisfy federal oil spill planning regulations. The Regional OSRP presents specific information on the response program that includes a description of personnel and equipment mobilization, the incident management team organization, and the strategies and tactics used to implement effective and sustained spill containment and recovery operations.

J. Chemical Products

Information regarding chemical products is not included in this plan as such information is not required by BOEM GOMR.

SECTION 3: GEOLOGICAL AND GEOPHYSICAL

Proprietary Data

A. Geological description

B. Structure Contour Map(s)

C. Interpreted 2D and/or 3D Seismic line(s)

D. Geological Structure Cross-section(s)

E. Shallow Hazards Report

Ocean Geo Solutions, "3D Geohazards Assessment, Shell Exploration and Production Company, Blocks MC 890 & 934, Offshore Gulf of Mexico" (Ocean Geo Solutions Project No. 2019-162), September 2019.

Archaeological and Hazard Report Blocks 890-979, Mississippi Canyon Area, US. Gulf of Mexico, &C Technologies Project No. 10023, October 2010.

F. Shallow Hazards Assessment – See Section 6 for assessment, top-hole prognosis and power spectrums.

G. High-Resolution Seismic Lines
ESR Map can be found in Section 6.

H & I. Stratigraphic Column with Time vs depth table

J. Geochemical Information
This information is not required for Plans submitted in the GOM Region.

K. Future G&G Activities
This information is not required for Plans submitted in the GOM Region.

SECTION 4: HYDROGEN SULFIDE

A. Concentration

0 ppm

B. Classification

Based on 30 CFR 550.215 and 250.490, Shell requests that the Regional Supervisor, Field Operations, classify the area in the proposed drilling operations as H2S absent.

C. H2S Contingency Plan

Shell will provide an H_2S Contingency Plan with the Application for Permit to Drill before conducting the proposed exploration activities.

D. Modeling Report

We do not anticipate encountering or handling H_2S at concentrations greater than 500 parts per million (ppm) and therefore have not included modeling for H_2S.

SECTION 5: MINERAL RESOURCE CONSERVATION

Information regarding Mineral Resource Conservation is not included in this EP as such information is only necessary in the case of DOCDs.

SECTION 6: BIOLOGICAL, PHYSICAL, AND SOCIOECONOMIC INFORMATION

A. Well Discussion

This report addresses seafloor and subsurface conditions specific to the following proposed well locations, and complies with BOEM NTL 2008-G05 (Shallow Hazards Program), NTL 2008-G04 (Information Requirements for EPs and DOCDs), NTL 2009-G40 (Deepwater Benthic Communities), and NTL 2005-G07 and Joint 2011-G01 (Archaeological Resource Surveys and Reports).

Geohazards and Archaeological Assessment. The following summary of the geohazards and archaeological assessment is based on the findings provided within the following detailed reports, which was submitted concurrently with this exploration plan:

- Ocean Geo Solutions, "3D Geohazards Assessment, Shell Exploration and Production Company, Blocks MC890&934, Offshore Gulf of Mexico" (Ocean Geo Solutions Project No. 2019-162), September 2019.
- Archaeological and Hazard Report Blocks 890-979, Mississippi Canyon Area, US. Gulf of Mexico, &C Technologies Project No. 10023, October 2010.

These assessments address the seafloor and subsurface conditions within a 2,000-ft radius around the proposed wellsite locations, to the depth of Horizon H11.

Available Data. Assessments are based on the supplied mapping from an AUV (Autonomous Underwater Vehicle) geophysical survey data (multi-beam echo-sounder), and 3D seismic data volumes. All data were provided by Shell. Power spectrums of the 3D seismic data is presented in Figures 6E-H.

Existing Infrastructure and Shipping Activity. Several existing wells and several pipelines occur within the study area. The nearest exiting well is located 5,880ft to the northeast of the proposed MC934-AA. No shipping lanes occurs within the study area (Blocks MC 890 & 934).

Proposed Wellsite MC 934-AA & MC934 AA-ALT, Mississippi Canyon Block 934 (OCS-G-07975)

The surface location of the proposed wellsite is located in the central region of block MC934. The alternate location is 50ft to the southwest of the main location. Due to the close proximity of the proposed MC934-AA location and MC934-AA Alt location the two locations remain together in this document.

Table A-1. Proposed Well Location Coordinates

Proposed Well MC934-AA			
Spheroid & Datum: Clarke 1866 NAD27 Projection: UTM Zone 16 North		Line Reference	Block Calls (MC934)
X: 846,938 ft	Latitude: 28.02846267° N	Inline 4448	7,418 ft FWL
Y: 10,179,193 ft	Longitude: -89.45996492° W	Crossline 8964	5,927 ft FNL

Proposed Well MC934-AA ALT			
Spheroid & Datum: Clarke 1866 NAD27 Projection: UTM Zone 16 North		Line Reference	Block Calls (MC934)
X: 846,892 ft	Latitude: 28.02839689° N	Inline 4447	7,372 ft FWL
Y: 10,179,170 ft	Longitude: -89.46010599° W	Crossline 8966	5,950 ft FNL

Water Depth and Seafloor Conditions. Based on the AUV multibeam echo-sounder data, the water depth at the proposed well location is -3,688 ft, and the seafloor slopes at 1.6° down to the northeast.

The wellsite is in an area of relatively smooth seafloor approximately 904 ft to the southwest of a cuspate seafloor scar marking the headwall failure of an interpreted relict slump that moved to the northeast. This feature does not impact the proposed well location. Several drag scar features from previous drilling operations are present around the proposed location and within a 2,000ft radius.

AUV backscatter amplitudes are uniform within the 2,000ft radius (Figure 6A) suggestive of probable clays and silts. No problems while jetting the conductor at the seafloor are expected.

Deepwater Benthic Communities. There is no potential for high-density benthic communities within 2,000 ft of the proposed location (Figure 6A). The seafloor amplitudes from 3D seismic data and the multibeam backscatter data, all show ambient amplitudes or backscatter at the seafloor with no indications of hardgrounds or fluid expulsion features or the potential for benthic communities. The nearest area exhibiting such indicators is located 13,854ft to the northeast of the proposed well location. Areas of possible seep anomalies such as mud volcanoes identified by BOEM in the regional seismic water bottom anomalies mapping project do not occur within the study area. The nearest areas are located 14,830ft to the northeast of the proposed well location. These anomalies are corroborated by this study.

Stratigraphy. Stratigraphic conditions from the seafloor to Horizon H11 are shown on the Top-Hole Prognosis Chart (Figure 6I). Subsurface depths to Horizons were converted by Shell. Intra depths between horizons are determined using a polynomial time-to-depth conversion function derived from these depth converted horizons.

Unit 1 (Seafloor to Horizon 01). Unit 1 is 272-ft thick at the proposed wellbore. These upper sediments immediately below the seafloor are interpreted to consist of clays and silts.

Unit 2 (Horizon 01 to Horizon H02). Unit 2, between 272 ft and 515 ft BML (243-ft thick) presents as low and occasional moderate-amplitude, slightly chaotic reflectors interpreted as channelized deposits of clays and silts with possibility of several <10ft thick sands. A Moderately Low Shallow Water Flow Probability and minor wellbore stability and drilling fluid circulation problems are assigned to this interval.

The lower part of Unit 2 between 515 ft and 629 ft BML (114-ft thick) is characterized by well-layered, low-amplitude reflectors interpreted as clays and silts.

Unit 3 (Horizon H02 to Horizon H03). Unit 3, between 629 ft and 890 ft BML (261-ft thick), presents as well-layered, low-amplitude reflectors expected to comprise clays and silts, with occasional possible thin sands.

Unit 4 (Horizon H03 to Horizon H04). Unit 4, between 890 ft and 1,076 ft BML (186-ft thick), represents a mass-transport complex characterized by discontinuous low-amplitude reflectors interpreted as clays, silts, and occasional sands. The base gas hydrate stability zone occurs in this unit at 905ft BML.

Unit 5 (Horizon H04 to Horizon H05). Unit 5, between 1,076 ft and 1,385 ft BML (309-ft thick), is characterized by slightly variable amplitude semi-continuous reflectors interpreted as slightly chaotic clays, silts, and several sands. Minor wellbore stability and drilling fluid circulation problems may occur in this interval.

Between 1,385 ft and 1,645 ft BML (260-ft thick) presents as chaotic, low and moderate-amplitudes interpreted as clays, silts, and several sands. A Moderately Low Shallow Water Flow Probability and minor wellbore stability and drilling fluid circulation problems are assigned to this interval.

The lower interval between 1,645 ft and 1,823 ft BML (178-ft thick) is characterized by well-layered, low-amplitude reflectors interpreted as clays, silts, and occasional sands.

Unit 6 (Horizon H05 to Horizon H06). Unit 6, between 1,823 ft and 2,032 ft BML (209-ft thick), presents seismically as low and slightly moderate-amplitude reflectors interpreted as well-layered clays, silts, and several <10ft thick sands. The sand interbeds may cause minor wellbore stability and drilling fluid circulation problems.

Unit 7 (Horizon H06 to Horizon H07). Unit 7, between 2,032 ft and 2,147 ft BML (115-ft thick), is characterized by well-layered low and moderate-amplitude reflectors interpreted as clays and silts with occasional sands.

The lower interval in Unit 7 from 2,147 ft and 2,2,690 ft BML (543-ft thick), is interpreted as a mass-transport complex characterized by complex low and moderate amplitude discontinuous reflectors interpreted to comprise clays, silts, and several sands. A Moderately Low Shallow Water Flow Probability and minor wellbore stability and drilling fluid circulation problems are assigned to this interval. A better defined <40ft thick sand interbed at 2,382 ft BML exhibits a moderate to high-amplitude response and a Moderate Shallow Water Flow Probability is assigned at the level of this interbed.

Unit 8 (Horizon H07 to Horizon H08). The upper part of Unit 8, between 2,690 ft and 2,834 ft BML (144-ft thick), appears as well-layered and low-amplitude reflectors interpreted to represent possible clays, silts, and occasional sands.

The lower interval from 2,834 ft to 3,048 ft BML (214-ft thick) is interpreted as slightly chaotic reflectors, interpreted as mass-transport deposits of clays and silts.

Unit 9 (Horizon H08 to Horizon H09). The upper part of Unit 9, between about 3,048 ft and 3,696 ft BML (648-ft thick), appears seismically as a chaotic discontinuous, low and slightly moderate-amplitude reflectors interpreted as clays, silts, and several possible sand interbeds. A Moderately Low Shallow Water Flow Probability and minor wellbore stability and drilling fluid circulation problems are assigned to this interval.

The lower interval from 3,696 ft to 3,909 ft BML (213-ft thick) appears seismically as well layered reflectors interpreted as clays, silts, and occasional sands.

Unit 10 (Horizon H09 to Horizon H10). The upper part of Unit 10, between 3,909 ft and 4,061 ft BML (152-ft thick), is characterized by slightly chaotic, low-amplitude reflectors interpreted as clays and silts.

From 4,061 ft to 4,276 ft BML (215-ft thick) the interval presents as semi continuous low to moderate amplitude reflectors interpreted as well-layered clays, silts, and occasional sands.

The lower interval from 4,276 ft to 4,784 ft BML (508-ft thick) displays well-layered, low and moderate to high amplitude reflectors interpreted as clays, silts, and several pronounced sheet sands. A Moderately Low Shallow Water Flow Probability and minor wellbore stability and drilling fluid circulation problems are assigned to this interval.

Unit 11 (Horizon H10 to Horizon H11). The upper part of Unit 11, between 4,784 ft and 5,126 ft BML (342-ft thick), displays slightly chaotic, low-amplitude reflectors interpreted as a mass-transport complex interval comprising clays, silts, and occasional sand interbeds.

From 5,126 ft to 5,603 ft BML (477-ft thick) the interval displays well-layered, low-amplitude reflectors interpreted as clays and silts with occasional sands.

Between 5,603 ft to 6,027 ft BML (424-ft thick) well-layered and slightly chaotic, low and moderate-amplitude reflectors are observed interpreted as clays, silts, and several pronounced sheet sands. The interval is interpreted as a Moderately Low Shallow Water Flow Probability increasing to a Moderate Shallow Water Flow Probability at the level of a better defined <40ft thick sand interbed occurring at 5,762ft BML. Minor wellbore stability and drilling fluid circulation problems are assigned to this interval.

The lower interval from 6,027 ft to 6,611 ft BML (584-ft thick) is of similar character and expected to comprise clays, silts and several sands. The interval has a Moderately Low Shallow Water Flow Probability increasing to a Moderate Shallow Water Flow Probability at the level of a better defined <40ft thick sand interbed at 6,186ft BML. Minor wellbore stability and drilling fluid circulation problems are possible within this lower interval.

Faults. There are no mapped faults along the proposed well path to base of evaluation at 6,611 ft BML (Horizon H11).

Gas Hydrates. The upper interval of the shallow section at the proposed wellsite falls within the gas hydrate stability zone. However, no geophysical indications of gas hydrates or the Base of Gas Hydrate Stability (BGHS) were identified at the proposed well or within 2,000 ft. Therefore, there is a negligible potential for massive or significant gas hydrates to be present at the seafloor or within subsurface sediments at or near the proposed well. The potential for significant gas hydrate accumulations is assessed to be low.

Shallow Gas. There are some areas of significant accumulation of shallow hydrocarbons in MC 934 (Ocean Geo Solutions, 2019). None of these identified risk of gas areas occurs within 250 ft of the proposed well. There are no high-amplitude anomalies indicative of shallow gas in the predominantly clay and silt rich sediments at the proposed wellsite. The potential for encountering significant shallow gas is assessed to be low.

Shallow Water Flow. The proposed well is in a region with relatively high sedimentation rates and shallow water flow potential is generally high in the Mississippi Canyon Area. This is evident in the BOEM shallow water flow database and also from information provided by Shell, in which there are several shallow water flow events reported from wells drilled in the study area. Interpretation of the 3D seismic data indicates there are some sandier deposits that were deposited at a slightly higher energy and may still contain trapped fluid.

A Moderately Low Shallow Water Flow Probability is assigned to some sandier interval within Units 2, 5, 7, 9, 10, and 11.

A Moderate Shallow Water Flow Probability is assigned to <40ft thick semi-continuous sand interbeds within Units 7 and 11.

The potential for shallow water flow at this well is assessed to be Low, Moderately Low, and Moderate.

Archaeological Review. P&C Scientific, LLC conducted an archaeological assessment review for Shell's proposed 934-AA and 934-AA-ALT wellsites in Block 934, Mississippi Canyon Area, Gulf of Mexico. P&C's review is based on a 2003 assessment of AUV survey data entitled "Archaeological and Hazard Report Blocks 890-979, Mississippi Canyon Area, Gulf of Mexico" written by C & C Technologies, Inc. The archaeological assessment reviewed all sonar contacts within a 2,000-foot radius of the proposed wellsites.

The review found 16 sonar contacts within the archaeological assessment area for the proposed 934-AA and 934-AA-ALT wellsites. Of these, 14 are interpreted as potential modern barrels or other containers related to industrial waste disposal activities in the area. A 32.8-foot radius BOEM avoidance zone is in place around each of these contacts. The remaining 2 sonar contacts are considered non-container modern debris related to shipping and development activities. A standard 100-foot radius BOEM avoidance zone is in place around each of these contacts. The closest sonar contact to the proposed 934-AA wellsite is a potential barrel (Contact No. 533) approximately 694 feet to the north. None of the 16 sonar contacts within proposed 934-AA and 934-AA-ALT wellsite assessment areas have acoustic signatures indicative of archaeological resources. Based on the review of available AUV data, the Area of Potential Effect around the proposed 934-AA and 934-AA-ALT wellsites appears clear of archaeological resources.

Proposed Wellsite MC 934-AA & MC934-AA-ALT, Concluding Remarks. Seafloor conditions appear favorable in the vicinity of the proposed surface location, with no problems interpreted while jetting in the conductor. There are no potential sites for deepwater benthic communities within 2,000 ft, and no sonar targets of archaeological significance were identified. At the proposed location, there is low potential for shallow gas. A moderate low and moderate potential for shallow water flow (overpressured sands) within Units 2, 5, 7, 9, 10, and 11. The depth limit of investigation (6,611 ft BML).

There is the potential for minor wellbore stability and drilling fluid circulation problems within several sand prone intervals.

Proposed Wellsite MC 934-BB and MC93-BB-ALT, Mississippi Canyon Block 934 (OCS-G-07975)

The surface location of the proposed wellsite is located in the central region of block MC934. Alternate location is 50ft to the southwest of the main location. Due to the close proximity the proposed MC934-BB location and the MC934-BB Alt the two locations remain together in this document.

Table A-1. Proposed Well Location Coordinates

Proposed Well MC934-BB			
Spheroid & Datum: Clarke 1866 NAD27 Projection: UTM Zone 16 North		Line Reference	Block Calls (MC934)
X: 845,818 ft	Latitude: 28.02132162° N	Inline 4408	6,298 ft FWL
Y: 10,176,618 ft	Longitude: -89.46327332° W	Crossline 8940	7,338 ft FSL

Proposed Well MC934-BB ALT			
Spheroid & Datum: Clarke 1866 NAD27 Projection: UTM Zone 16 North		Line Reference	Block Calls (MC934)
X: 845,785 ft	Latitude: 28.02121257° N	Inline 4407	6,265 ft FWL
Y: 10,176,579 ft	Longitude: -89.46337310° W	Crossline 8940	7,299 ft FSL

Water Depth and Seafloor Conditions. Based on the AUV multibeam echo-sounder data, the water depth at the proposed well location is -3,622 ft, and the seafloor slopes at 1.8° down to the northeast.

The wellsite is in an area of relatively smooth seafloor.

Backscatter amplitude are uniform within the 2,000 ft radius (Figure 6B) suggestive of probably clays and silts at the seabed. No problems while jetting the conductor at the seafloor are expected.

Deepwater Benthic Communities. There is no potential for high-density benthic communities within 2,000 ft of the proposed location (Figure 6B). The seafloor amplitudes from 3D seismic data and the multibeam backscatter data, all show ambient amplitudes or backscatter at the seafloor with no indications of hardgrounds or fluid expulsion features and the potential for benthic communities within the study area. The nearest area exhibiting such indicators is located 16,583ft to the northeast of the proposed well location. No areas of possible seep anomalies such as mud volcanoes identified by BOEM in the regional seismic water bottom anomalies mapping project also occur within the study area. The nearest areas are located 17,814ft to the northeast of the proposed well location. These anomalies are corroborated by this study.

Stratigraphy. Stratigraphic conditions from the seafloor to Horizon H11 are shown on the Top-Hole Prognosis Chart (Figure 6J). Subsurface depths to Horizons were converted by Shell. Intra depths between horizons are determined using a polynomial time-to-depth conversion function derived from these depth converted horizons.

Unit 1 (Seafloor to Horizon 01). Unit 1 is 212-ft thick at the proposed wellbore. These upper sediments immediately below the seafloor are interpreted to consist of clays and silts.

Unit 2 (Horizon 01 to Horizon H02). Unit 2, between 212 ft and 375 ft BML (243-ft thick) presents as low and occasional moderate-amplitude, slightly-chaotic reflectors interpreted as channelized deposits with silts and clays, and several <10ft thick sands. A Moderately Low Shallow Water Flow Probability and minor wellbore stability and drilling fluid circulation problems are assigned to this interval.

The lower part of this unit between 375 ft and 525 ft BML (150-ft thick) is characterized by well-layered, low-amplitude reflectors interpreted as clays and silts.

Unit 3 (Horizon H02 to Horizon H03). Unit 3, between 525 ft and 802 ft BML (277-ft thick), is interpreted as a mass-transport complex characterized by slightly chaotic, low and slightly-moderate-amplitude reflectors interpreted as clays and silts, with occasional possible sands. A Moderately Low Shallow Water Flow Probability and minor wellbore stability and drilling fluid circulation problems are assigned to this interval.

The lower interval from 802 ft and 1,033 ft BML (231-ft thick), presents as well-layered low amplitude continuous reflectors interpreted as clays, silts, and occasional possible thin sands. The base gas hydrate stability zone occurs in this interval at 911ft BML.

Unit 4 (Horizon H03 to Horizon H04). Unit 4, between 1,033 ft and 1,378 ft BML (345-ft thick), represents a mass-transport complex exhibiting low and occasional moderate--amplitude reflectors at and immediately east of the proposed wellbore interpreted as chaotic poorly consolidated clays, silts, and occasional sands. A Moderately Low Shallow Water Flow Probability and minor wellbore stability and drilling fluid circulation problems are assigned to this interval.

Unit 5 (Horizon H04 to Horizon H05). Unit 5, between about 1,378 ft and 1,712 ft BML (334-ft thick), is interpreted as a mass-transport complex characterized by slightly chaotic, low and occasional moderate-amplitude reflectors interpreted as clays, silts, and several sands. A better defined <40ft thick sand interbed occurs at the top of the interval at 1,378ft BML. A Moderately Low Shallow Water Flow Probability and minor wellbore stability and drilling fluid circulation problems are assigned at the level of the interbed.

The lower interval between 1,712 ft and 1,913 ft BML (201-ft thick) presents as well-layered, low-amplitude reflectors interpreted as clays, silts, and occasional sands.

Unit 6 (Horizon H05 to Horizon H06). Unit 6, between 1,913 ft and 2,112 ft BML (199-ft thick), presents seismically as low and slightly moderate-amplitude reflectors interpreted as well-layered clays, silts, and several <10ft thick sands. The sand interbeds may cause minor wellbore stability and drilling fluid circulation problems.

Unit 7 (Horizon H06 to Horizon H07). Unit 7, between 2,112 ft and 2,328 ft BML (216-ft thick), is characterized by well-layered and slightly chaotic, low and slightly-moderate-amplitude reflectors interpreted as clays and silts with several sands. A Moderately Low Shallow Water Flow Probability and minor wellbore stability and drilling fluid circulation problems are assigned to this interval.

The lower interval from 2,328 ft and 2,769 ft BML (441-ft thick) is interpreted as a higher energy mass-transport complex with chaotic, low and moderate-amplitude reflectors interpreted as clays, silts, and several sands. A Moderate Shallow Water Flow Probability and minor wellbore stability and drilling fluid circulation problems are assigned to this lower interval.

Unit 8 (Horizon H07 to Horizon H08). Unit 8, between 2,769 ft and 3,126 ft BML (357-ft thick), appears as well-layered and low-amplitude reflectors interpreted to represent possible clays, silts, and occasional sands.

Unit 9 (Horizon H08 to Horizon H09). The upper part of Unit 9, between about 3,126 ft and 3,414 ft BML (288-ft thick), appears seismically as a chaotic, low and slightly moderate-amplitude reflectors interpreted as clays, silts, and occasional possible sand interbeds.

The lower interval from 3,414 ft to 4,003 ft BML (589-ft thick) the interval appears seismically as chaotic reflectors interpreted as clays, silts, and several sands. A Moderately Low Shallow Water Flow Probability and minor wellbore stability and drilling fluid circulation problems are assigned to this interval.

Unit 10 (Horizon H09 to Horizon H10). The upper part of Unit 10, between about 4,003 ft and 4,132 ft BML (129-ft thick), presents as slightly chaotic, low-amplitude reflectors interpreted as clays and silts.

The lower interval from 4,132 ft to 4,794 ft BML (662-ft thick) is characterized by well-layered low and moderate to high amplitude continuous reflectors interpreted clays, silts, and several pronounced sheet sand interbeds. A Moderate Shallow Water Flow Probability and minor wellbore stability and drilling fluid circulation problems are assigned to this interval.

Unit 11 (Horizon H10 to Horizon H11). The upper part of Unit 11, between about 4,794 ft and 4,970 ft BML (176-ft thick), displays slightly chaotic, low-amplitude reflectors interpreted as a mass-transport complex interval comprising clays, silts, and occasional sand interbeds.

From 4,970 ft to 5,512 ft BML (542-ft thick) well-layered, low-amplitude reflectors are observed interpreted as clays and silts with occasional sands.

The lower interval from 5,512 ft to 6,529 ft BML (335-ft thick) is characterized by well-layered and slightly chaotic moderate to high amplitude reflectors interpreted as clays and silts with several pronounced sheet sands. The interval is assigned a Moderately Low Shallow Water Flow Probability increasing to a Moderate Shallow Water Flow Probability at the level of a better defined <40ft thick sand interbed at 5,847ft BML. Minor wellbore stability and drilling fluid circulation problems are possible within this lower interval.

Faults. There are no mapped faults along the proposed well path to base of evaluation at 6,611 ft BML (Horizon H11).

Gas Hydrates. The upper interval of the shallow section at the proposed wellsite falls within the gas hydrate stability zone. However, no geophysical indications of gas hydrates or the Base of Gas Hydrate Stability (BGHS) were identified at the proposed well or within 2,000 ft. Therefore, there is a negligible potential for massive or significant gas hydrates to be present at the seafloor or within subsurface sediments at or near the proposed well. The potential for significant gas hydrate accumulations is assessed to be low.

Shallow Gas. There are some areas of significant accumulation of shallow hydrocarbons in MC934 (Ocean Geo Solutions, 2019). None of the identified risk of gas areas occur within 250ft of the proposed well. There are no high-amplitude anomalies indicative of shallow gas in the predominantly clay and silt rich sediments at the proposed wellsite. The potential for encountering significant shallow gas is assessed to be low.

Shallow Water Flow. The proposed well is in a region with relatively high sedimentation rates and shallow water flow potential is generally high in the Mississippi Canyon Area. This is evident in the BOEM shallow water flow database and information provided by Shell, in which there are several shallow water flow events reported in the study area. Interpretation of the 3D seismic data indicates there are some sandier deposits that were deposited at a slightly higher energy and may still contain trapped fluid.

A Moderately Low Shallow Water Flow Probability is assigned to some sandier interval within Units 2 through 5 and 7, 9, and 11.

A Moderate Shallow Water Flow Probability is assigned to sand interbeds within Units 7, 10, and 11.

The potential for shallow water flow at this well is assessed to be Low, Moderately Low, and Moderate.

Archaeological Review. P&C Scientific, LLC conducted an archaeological assessment review for Shell's proposed 934-BB and 934-BB-ALT wellsites in Block 934, Mississippi Canyon Area, Gulf of Mexico. P&C's review is based on a 2003 assessment of AUV survey data entitled "Archaeological and Hazard Report Blocks 890-979, Mississippi Canyon Area, Gulf of Mexico" written by C & C Technologies, Inc. The archaeological assessment reviewed all sonar contacts within a 2,000-foot radius of the proposed wellsites.

The review found 44 sonar contacts within the archaeological assessment area for the proposed 934-BB and 934-BB-ALT wellsites. Of these, 40 are interpreted as potential modern barrels or other containers related to industrial waste disposal activities in the area. A 32.8-foot radius BOEM avoidance zone is in place around each of these contacts. The remaining 4 sonar contacts are considered non-container modern debris related to shipping and development activities. A standard 100-foot radius BOEM avoidance zone is in place around each of these contacts. The closest sonar contact to the proposed 934-BB wellsite is a potential barrel (Contact No. 481) approximately 585 feet to the southeast.

None of the 44 sonar contacts within proposed 934-BB and 934-BB-ALT wellsite assessment areas have acoustic signatures indicative of archaeological resources. Based on the review of available AUV data, the Area of Potential Effect around the proposed 934-BB and 934-BB-ALT wellsites appears clear of archaeological resources.

Proposed Wellsite MC934-BB and MC934-BB-ALT, Concluding Remarks. Seafloor conditions appear favorable in the vicinity of the proposed surface location, with no problems interpreted while jetting in the conductor. There are no potential sites for deepwater benthic communities within 2,000 ft, and no sonar targets of archaeological significance were identified. At the proposed location, there is low potential for shallow gas. A moderately low and moderate potential for shallow water flow (overpressured sands) within Units 2 through 5 and 7, 9, 10, and 11. The depth limit of investigation (6,529 ft BML).

There is the potential for minor wellbore stability and drilling fluid circulation problems within several sand prone intervals.

Proposed Wellsite MC 890-CC and MC934-CC-ALT, Mississippi Canyon Block 890 (OCS-G-07969)

The surface location of the proposed wellsite is located in the south-central region of block MC890. Alternate location is 50ft to the southwest of the main location. Due to the close proximity the proposed MC890-CC location and MC890-CC Alt the two locations remain together in this document.

Table A-1. Proposed Well Location Coordinates

Proposed Well MC890-CC			
Spheroid & Datum: Clarke 1866 NAD27 Projection: UTM Zone 16 North		Line Reference	Block Calls (MC890)
X: 846,808ft	Latitude: 28.04622271° N	Inline 4516	7,288 ft FWL
Y: 10,185,656ft	Longitude: -89.46077209° W	Crossline 9078	536 ft FSL

Proposed Well MC890-CC ALT			
Spheroid & Datum: Clarke 1866 NAD27 Projection: UTM Zone 16 North		Line Reference	Block Calls (MC890)
X: 846,782ft	Latitude: 28.04609755° N	Inline 4515	7,262 ft FWL
Y: 10,185,611ft	Longitude: -89.46084983° W	Crossline 9078	491 ft FSL

Water Depth and Seafloor Conditions. Based on the AUV multibeam echo-sounder data, the water depth at the proposed well location is -3,833 ft, and the seafloor slopes at 1.0° down to the northeast. The wellsite is located in an area of relatively smooth seafloor approximately 2,355 ft to the northwest of an axis of an elongated ridge.

Backscatter amplitudes are uniform within a 2,000ft radius (Figure 6C) suggestive of clays and silts at the seafloor. No problems while jetting the conductor at the seafloor are expected.

Deepwater Benthic Communities. There is no potential for high-density benthic communities within 2,000 ft of the proposed location (Figure 6C). The seafloor amplitudes from 3D seismic data and the multibeam backscatter data, all show ambient amplitudes or backscatter at the seafloor with no indications of hardgrounds or fluid expulsion features and the potential for benthic communities within the study area. The nearest area exhibiting such indicators is located 7,976ft to the NNE of the proposed well location. No areas of possible seep anomalies such as mud volcanoes identified by BOEMRE in the regional seismic water bottom anomalies mapping project also occur within the study area. The nearest areas are located 9,052ft to the northeast of the proposed well location. These anomalies are corroborated by this study.

Stratigraphy. Stratigraphic conditions from the seafloor to Horizon H11 are shown on the Top-Hole Prognosis Chart (Figure 6K). Subsurface depths to Horizons were converted by Shell. Intra depths between horizons are determined using a polynomial time-to-depth conversion function derived from these depth converted horizons.

Unit 1 (Seafloor to Horizon 01). The upper part of Unit 1 between seafloor and 294 ft BML (294-ft thick) is interpreted to consist of clays and silts overlying a clay and silt interval with occasional sands. The lower part of Unit 1 between about 294 ft and 477 ft BML (294-ft thick) is composed of well-layered and slightly-chaotic low and moderate-amplitude reflectors with clays and silts and several sands. Minor wellbore stability and drilling fluid circulation problem may occur in the lower interval.

Unit 2 (Horizon 01 to Horizon H02). Unit 2, between 477 ft and 691 ft BML (477-ft thick) presents as low and occasional moderate-amplitude, slightly-chaotic reflectors interpreted as channelized deposits with silts and clays, and several <10ft thick sands. A Moderately Low Shallow Water Flow Probability and minor wellbore stability and drilling fluid circulation problems are assigned to this interval.

Unit 3 (Horizon H02 to Horizon H03). Unit 3 will not be traversed by the well-path.

Unit 4 (Horizon H02 to Horizon H04). Unit 4, between about 691 ft and 1,038 ft BML (691-ft thick), is interpreted as a mass-transport complex exhibiting low and occasional moderate--amplitude reflectors interpreted as chaotic poorly consolidated clays, silts, and occasional sands. The base gas hydrate stability zone occurs in this interval at 875ft BML.

Unit 5 (Horizon H04 to Horizon H05). Unit 5, between about 1,038 ft and 1,334 ft BML (296-ft thick), is interpreted as a mass-transport complex characterized by slightly chaotic, low and occasional moderate-amplitude reflectors interpreted as clays, silts, and several sands. A Moderately Low Shallow Water Flow Probability and minor wellbore stability and drilling fluid circulation problems are assigned to this interval.

The lower interval Between 1,334 ft and 1,542 ft BML (208-ft thick) presents as well-layered, low-amplitude reflectors interpreted as clays, silts, and several sands. Minor wellbore stability and drilling fluid circulation problems are considered possible.

<u>Unit 6 (Horizon H05 to Horizon H06).</u> Unit 6, between 1,542 ft and 1,810 ft BML (268-ft thick), presents seismically as low and moderate-amplitude reflectors interpreted as well-layered clays, silts, and several <10ft thick sands. The sand interbeds may cause minor wellbore stability and drilling fluid circulation problems. A better defined <40ft thick sand is interpreted at 1,716 ft BML and a Moderate Shallow Water Flow Probability is assigned at the level of this interbed.

<u>Unit 7 (Horizon H06 to Horizon H07).</u> Unit 7, between 1,810 ft and 1,987 ft BML (177-ft thick), is characterized by well-layered and slightly chaotic, low and slightly-moderate-amplitude reflectors interpreted as clays and silts with several sands. A Moderately Low Shallow Water Flow Probability and possible minor wellbore stability and drilling fluid circulation problems are assigned to this interval.

The lower interval from 1,987 ft and 2,431 ft BML (444-ft thick) is interpreted as a higher energy mass-transport complex characterized by low and moderate-amplitude reflectors interpreted as clays, silts, and several sands. A Moderately Low Shallow Water Flow Probability is assigned to the lower interval.

<u>Unit 8 (Horizon H07 to Horizon H08).</u> Unit 8, between 2,431 ft and 3,126 ft BML (304-ft thick), presents as well-layered and low-amplitude reflectors interpreted to represent possible clays, silts, and occasional sands.

<u>Unit 9 (Horizon H08 to Horizon H09).</u> The upper part of Unit 9, between about 2,735 ft and 3,037 ft BML (302-ft thick), appears seismically as a chaotic, low and slightly moderate-amplitude reflectors interpreted as clays, silts, and several possible sand interbeds. A Moderately Low Shallow Water Flow Probability and minor wellbore stability and drilling fluid circulation problems are assigned to this upper interval.

The lower interval from 3,037 ft to 3,604 ft BML (567-ft thick) the interval appears seismically as chaotic variable discontinuous reflectors interpreted as clays, silts, and several sands. A Moderate Shallow Water Flow Probability and minor wellbore stability and drilling fluid circulation problems are assigned to this interval.

<u>Unit 10 (Horizon H09 to Horizon H10).</u> The upper part of Unit 10, between about 3,604 ft and 3,727 ft BML (123-ft thick), presents as slightly chaotic, low-amplitude reflectors interpreted as clays and silts.

The lower interval from 3,727 ft to 4,318 ft BML (591-ft thick) displays well-layered, low and moderate-amplitude reflectors interpreted as clays, silts, and several sand interbeds. A Moderately Low Shallow Water Flow Probability and minor wellbore stability and drilling fluid circulation problems are assigned to this interval.

<u>Unit 11 (Horizon H10 to Horizon H11).</u> The upper part of Unit 11, between about 4,318 ft and 5,183 ft BML (865-ft thick), displays slightly chaotic, low-amplitude reflectors interpreted as a mass-transport complex interval comprising clays, silts, and occasional sand interbeds.

From 5,183 ft to 5,849 ft BML (666-ft thick) the interval displays well-layered and slightly chaotic, low and moderate-amplitude reflectors interpreted as clays and silts with several pronounced sheet sands. A Moderate Shallow Water Flow Probability and minor wellbore stability and drilling fluid circulation problems is assigned to this interval.

The lower interval from 5,849 ft to 6,275 ft BML (426-ft thick) is characterized by well-layered and slightly chaotic reflectors interpreted as clays and silts and possible minor sands. Minor wellbore stability and drilling fluid circulation problems are possible within this lower interval.

Faults. There are no mapped faults along the proposed well path to base of evaluation at 6,275 ft BML (Horizon H11).

Gas Hydrates. The upper interval of the shallow section at the proposed wellsite falls within the gas hydrate stability zone. However, no geophysical indications of gas hydrates or the Base of Gas Hydrate Stability (BGHS) were identified at the proposed well or within 2,000 ft. Therefore, there is a negligible potential for massive or significant gas hydrates to be present at the seafloor or within subsurface sediments at or near the proposed well. The potential for significant gas hydrate accumulations is assessed to be low.

Shallow Gas. There are some areas of significant accumulation of shallow hydrocarbons in MC890 (Ocean Geo Solutions, 2019). None of the identified risk of gas areas occur within 250ft of the proposed well. There are no high-amplitude anomalies indicative of shallow gas in the predominantly clay and silt rich sediments at the proposed wellsite. The potential for encountering significant shallow gas is assessed to be low.

Shallow Water Flow. The proposed well is in a region with relatively high sedimentation rates and shallow water flow potential is generally high in the Mississippi Canyon Area. This is evident in the BOEM shallow water flow database and information provided by Shell, in which there are several shallow water flow events reported in the study area. Interpretation of the 3D seismic data indicates there are some sandier deposits that were deposited at a slightly higher energy and may still contain fluid.

A Moderately Low Shallow Water Flow Probability is assigned to some sandier interval within Units 2, 5, 7, 9, and 10.

A Moderate Shallow Water Flow Probability is assigned to sand interbeds within Units 6, 9, and 11.
The potential for shallow water flow at this well is assessed to be Moderately Low and Moderate.

Archaeological Review. P&C Scientific, LLC conducted an archaeological assessment review for Shell's proposed 890-CC and 890-CC-ALT wellsites in Block 890, Mississippi Canyon Area, Gulf of Mexico. P&C's review is based on a 2003 assessment of AUV survey data entitled "Archaeological and Hazard Report Blocks 890-979, Mississippi Canyon Area, Gulf of Mexico" written by C & C Technologies, Inc. The archaeological assessment reviewed all sonar contacts within a 2,000-foot radius of the proposed wellsites.

The review found 43 sonar contacts within the archaeological assessment area for the proposed 890-CC and 890-CC-ALT wellsites. Of these, 35 are interpreted as potential modern barrels or other containers related to industrial waste disposal activities in the area. A 32.8-foot radius BOEM avoidance zone is in place around each of these contacts. The remaining 8 sonar contacts are considered non-container modern debris related to shipping and development activities. A standard 100-foot radius BOEM avoidance zone is in place around each of these contacts. The closest sonar contact to the proposed 890-CC wellsite is a potential barrel (Contact No. 547) approximately 336 feet to the southeast. None of the 43 sonar contacts within proposed 890-CC and 890-CC-ALT wellsite assessment areas have acoustic signatures indicative of archaeological resources. Based on the review of available AUV data, the Area of Potential Effect around the proposed 890-CC and 890-CC-ALT wellsites appears clear of archaeological resources.

Proposed Wellsite MC890-CC and MC934-CC-ALT, Concluding Remarks. Seafloor conditions appear favorable in the vicinity of the proposed surface location, with no problems while jetting the conductor. There are no potential sites for deepwater benthic communities within 2,000 ft, and no sonar targets of archaeological significance were identified. At the proposed location, there is low potential for shallow gas. A moderately low and moderate potential for shallow water flow (overpressured sands) within Units 2, 5, 6, 7, 9, 10, and 11. The depth limit of investigation (6,275 ft BML).

There is the potential for minor wellbore stability and drilling fluid circulation problems within several sand prone intervals.

Proposed Wellsite MC 934-DD, Mississippi Canyon Block 934 (OCS-G-07975)

The surface location of the proposed wellsite is located in the central region of block MC934.

Table A-1. Proposed Well Location Coordinates

Proposed Well MC934-DD			
Spheroid & Datum: Clarke 1866 NAD27 Projection: UTM Zone 16 North		Line Reference	Block Calls (MC934)
X: 846,046ft	Latitude: 28.02087243° N	Inline 4409	6,526 ft FWL
Y: 10,176,450ft	Longitude: -89.46255715° W	Crossline 8932	7,170 ft FSL

Water Depth and Seafloor Conditions. Based on the AUV multibeam echo-sounder data, the water depth at the proposed well location is -3,623 ft, and the seafloor slopes at 1.7° down to the northeast.

The wellsite is in an area of relatively smooth seafloor.

Backscatter amplitude are uniform within the 2,000 ft radius (Figure 6D) suggestive of clays and silts at the seabed. No problems while jetting the conductor at the seafloor are expected.

Deepwater Benthic Communities. There is no potential for high-density benthic communities within 2,000 ft of the proposed location (Figure 6D). The seafloor amplitudes from 3D seismic data and the multibeam backscatter data, all show ambient amplitudes or backscatter at the seafloor with no indications of hardgrounds or fluid expulsion features and the potential for benthic communities within the study area. The nearest area exhibiting such indicators is located 16,631ft to the northeast of the proposed well location. No areas of possible seep anomalies such as mud volcanoes identified by BOEM in the regional seismic water bottom anomalies mapping project also occur within the study area. The nearest areas are located 17,710ft to the northeast of the proposed well location. These anomalies are corroborated by this study.

Stratigraphy. Stratigraphic conditions from the seafloor to Horizon H11 are shown on the Top-Hole Prognosis Chart (Figure 6L). Subsurface depths to Horizons were converted by Shell. Intra depths between horizons are determined using a polynomial time-to-depth conversion function derived from these depth converted horizons.

Unit 1 (Seafloor to Horizon 01). Unit 1 is 216-ft thick at the proposed wellbore. These upper sediments immediately below the seafloor are interpreted to consist of clays and silts and occasional sands.

Unit 2 (Horizon 01 to Horizon H02). Unit 2, between 216 ft and 380 ft BML (164-ft thick) presents as low and occasional moderate-amplitude, slightly-chaotic reflectors interpreted as channelized deposits with silts and clays, and several <10ft thick sands. A Moderately Low Shallow Water Flow

Probability and minor wellbore stability and drilling fluid circulation problems are assigned to this interval.

The lower part of this unit between 380 ft and 533 ft BML (153-ft thick) is characterized by well-layered, low-amplitude reflectors interpreted as clays and silts.

Unit 3 (Horizon H02 to Horizon H03). Unit 3, between 533 ft and 807 ft BML (274-ft thick), is interpreted as a mass-transport complex characterized by slightly chaotic, low and slightly-moderate-amplitude reflectors interpreted as clays and silts, with occasional possible sands. A Moderately Low Shallow Water Flow Probability and minor wellbore stability and drilling fluid circulation problems are assigned to this interval.

The lower interval from 807 ft and 1,035 ft BML (228-ft thick), presents as well-layered low amplitude continuous reflectors interpreted as clays, silts, and occasional possible thin sands. The base gas hydrate stability zone occurs in this interval at 911ft BML.

Unit 4 (Horizon H03 to Horizon H04). Unit 4, between 1,035 ft and 1,384 ft BML (349-ft thick), represents a mass-transport complex exhibiting low and occasional moderate--amplitude reflectors at and immediately east of the proposed wellbore interpreted as chaotic poorly consolidated clays, silts, and occasional sands. A Moderately Low Shallow Water Flow Probability and minor wellbore stability and drilling fluid circulation problems are assigned to this interval.

Unit 5 (Horizon H04 to Horizon H05). Unit 5, between about 1,384 ft and 1,821 ft BML (437-ft thick), is interpreted as a mass-transport complex characterized by slightly chaotic, low and occasional moderate-amplitude reflectors interpreted as clays, silts, and several sands. A better defined <40ft thick sand interbed occurs at the top of the interval at 1,384ft BML. A Moderately Low Shallow Water Flow Probability and minor wellbore stability and drilling fluid circulation problems are assigned at the level of the interbed.

The lower interval between 1,821 ft and 1,912 ft BML (91-ft thick) presents as well-layered, low-amplitude reflectors interpreted as clays, silts, and occasional sands.

Unit 6 (Horizon H05 to Horizon H06). Unit 6, between 1,912 ft and 2,112 ft BML (200-ft thick), presents seismically as low and slightly moderate-amplitude reflectors interpreted as well-layered clays, silts, and several <10ft thick sands. The sand interbeds may cause minor wellbore stability and drilling fluid circulation problems.

Unit 7 (Horizon H06 to Horizon H07). Unit 7, between 2,112 ft and 2,215 ft BML (103-ft thick), is characterized by well-layered and slightly chaotic, low and slightly-moderate-amplitude reflectors interpreted as clays and silts with several sands. A Moderately Low Shallow Water Flow Probability and minor wellbore stability and drilling fluid circulation problems are assigned to this interval.

The lower interval from 2,215 ft and 2,768 ft BML (553-ft thick) is interpreted as a higher energy mass-transport complex with chaotic, low and moderate-amplitude reflectors interpreted as clays, silts, and several sands. A Moderate Shallow Water Flow Probability and minor wellbore stability and drilling fluid circulation problems are assigned to this lower interval.

Unit 8 (Horizon H07 to Horizon H08). Unit 8, between 2,768 ft and 3,131 ft BML (363-ft thick), appears as well-layered and low-amplitude reflectors interpreted to represent possible clays, silts, and occasional sands.

Unit 9 (Horizon H08 to Horizon H09). The upper part of Unit 9, between about 3,131 ft and 3,360 ft BML (229-ft thick), appears seismically as a chaotic, low and slightly moderate-amplitude reflectors interpreted as clays, silts, and occasional possible sand interbeds.

The lower interval from 3,360 ft to 3,999 ft BML (639-ft thick) the interval appears seismically as chaotic reflectors interpreted as clays, silts, and several sands. A Moderately Low Shallow Water Flow Probability and minor wellbore stability and drilling fluid circulation problems are assigned to this interval.

Unit 10 (Horizon H09 to Horizon H10). The upper part of Unit 10, between about 3,999 ft and 4,147 ft BML (148-ft thick), presents as slightly chaotic, low-amplitude reflectors interpreted as clays and silts.

The lower interval from 4,147 ft to 4,788 ft BML (641-ft thick) is characterized by well-layered low and moderate to high amplitude continuous reflectors interpreted clays, silts, and several pronounced sheet sand interbeds. A Moderate Shallow Water Flow Probability and minor wellbore stability and drilling fluid circulation problems are assigned to this interval.

Unit 11 (Horizon H10 to Horizon H11). The upper part of Unit 11, between about 4,788 ft and 4,984 ft BML (196-ft thick), displays slightly chaotic, low-amplitude reflectors interpreted as a mass-transport complex interval comprising clays, silts, and occasional sand interbeds.

From 4,984 ft to 5,524 ft BML (540-ft thick) well-layered, low-amplitude reflectors are observed interpreted as clays and silts with occasional sands.

The lower interval from 5,524 ft to 6,491 ft BML (971-ft thick) is characterized by well-layered and slightly chaotic moderate to high amplitude reflectors interpreted as clays and silts with several pronounced sheet sands. The interval is assigned a Moderately Low Shallow Water Flow Probability increasing to a Moderate Shallow Water Flow Probability at the level of a better defined <40ft thick sand interbed at 5,821ft BML. Minor wellbore stability and drilling fluid circulation problems are possible within this lower interval.

Faults. There are no mapped faults along the proposed well path to base of evaluation at 6,495 ft BML (Horizon H11).

Gas Hydrates. The upper interval of the shallow section at the proposed wellsite falls within the gas hydrate stability zone. However, no geophysical indications of gas hydrates or the Base of Gas Hydrate Stability (BGHS) were identified at the proposed well or within 2,000 ft. Therefore, there is a negligible potential for massive or significant gas hydrates to be present at the seafloor or within subsurface sediments at or near the proposed well. The potential for significant gas hydrate accumulations is assessed to be low.

Shallow Gas. There are some areas of significant accumulation of shallow hydrocarbons in MC934 (Ocean Geo Solutions, 2019). None of the identified risk of gas areas occur within 250ft of the proposed well. There are no high-amplitude anomalies indicative of shallow gas in the predominantly clay and silt rich sediments at the proposed wellsite. The potential for encountering significant shallow gas is assessed to be low.

Shallow Water Flow. The proposed well is in a region with relatively high sedimentation rates and shallow water flow potential is generally high in the Mississippi Canyon Area. This is evident in the BOEM shallow water flow database and information provided by Shell, in which there are several shallow water flow events reported in the study area. Interpretation of the 3D seismic data indicates there are some sandier deposits that were deposited at a slightly higher energy and may still contain trapped fluid.

A Moderately Low Shallow Water Flow Probability is assigned to some sandier interval within Units 2 through 5 and 7, 9, and 11.

A Moderate Shallow Water Flow Probability is assigned to sand interbeds within Units 7, 10, and 11.

The potential for shallow water flow at this well is assessed to be Low, Moderately Low, and Moderate.

Archaeological Review. P&C Scientific, LLC conducted an archaeological assessment review for Shell's proposed 934-DD wellsite in Block 934, Mississippi Canyon Area, Gulf of Mexico. P&C's review is based on a 2003 assessment of AUV survey data entitled "Archaeological and Hazard Report Blocks 890-979, Mississippi Canyon Area, Gulf of Mexico" written by C & C Technologies, Inc. The archaeological assessment reviewed all sonar contacts within a 2,000-foot radius of the proposed wellsite.

P&C's review found 41 sonar contacts within the archaeological assessment area for the proposed 934-DD wellsite. Of these, 37 are interpreted as potential modern barrels or other containers related to industrial waste disposal activities in the area. A 32.8-foot radius BOEM avoidance zone is in place around each of these contacts. The remaining 4 sonar contacts are considered non-container modern debris related to shipping and development activities. A standard 100-foot radius BOEM avoidance zone is in place around each of these contacts. The closest sonar contact to the proposed 934-DD wellsite is a potential barrel (Contact No. 481) approximately 384 feet to the south and slightly west. None of the 41 sonar contacts within proposed 934-DD wellsite assessment area have acoustic signatures indicative of archaeological resources. Based on the review of *available* AUV data, the Area of Potential Effect around the proposed 934-DD wellsite appears clear of archaeological resources.

Proposed Wellsite MC934-DD, Concluding Remarks. Seafloor conditions appear favorable in the vicinity of the proposed surface location, with no problems interpreted while jetting in the conductor. There are no potential sites for deepwater benthic communities within 2,000 ft, and no sonar targets of archaeological significance were identified. At the proposed location, there is low potential for shallow gas. A moderately low and moderate potential for shallow water flow (overpressured sands) within Units 2 through 5 and 7, 9, 10, and 11. The depth limit of investigation (6,495 ft BML).

There is the potential for minor wellbore stability and drilling fluid circulation problems within several sand prone intervals.

See Attached Waste Barrel Avoidance and Release Response Plan for Mississippi Canyon Area.

Shell Exploration & Production

Waste Barrel Avoidance and Release Response in the Mississippi Canyon Area

Document Title	Waste Barrel Avoidance and Release Response in the Mississippi Canyon Area
Document Number	MRB-100-HX-0505-0000002-000
Document Revision	REV 5
Version Code	Not Applicable
Document Status	Issued for Review
EIS Discipline / Document Type	Hazard Analysis Report
Originator / Author	Joshua O'Brien
Classification	Restricted
ECCN	EAR 99
Issue Date	4/01/19

Revision History is shown on next page

Contents

Purpose

This document provides expectations and guidance for avoiding, and responding to a release of the contents of, a seafloor waste barrel. The procedures below describe Shell's expectations for routine barrel avoidance, data management, and response to inadvertent release of barrel contents.

Applicability

This document applies to all ROV, anchor and other operations which could cause a seafloor barrel rupture.

Changes to this procedure must be approved by BOEM.[1]

Revision History

Date	Person	Revision
12/16/08	RBKuehn	Incorporated comments from MMS[1] and issued as final.
8/16/10	RBKuehn	Incorporated comment from BOEMRE[2] to include New Orleans District manager in the notification of Step 2 of the section *Barrel Impact Reporting.* Also revised all relevant references to MMS as BOEMRE
10/20/10	RBKuehn	➢ In Background, added in summary of suspected materials disposed at the site, based on research of the site in public records. ➢ In section on Equipment Decontamination- Decon Procedure: o clarified what types of detergents are preferred/allowed, using the NPDES Vessel General Permit as a guide. o Expanded on appropriate PPE and other personnel precautions o Noted a need for secondary containment as appropriate Significant changes to the text are shown in yellow shade. ➢ Added page numbers and cleaned up format. ➢ Issued as REV 2
05/19/17	BMontchanin	➢ Deleted Mars B reference to generalize procedure to all projects in the MC area ➢ Changed BOEMRE to BOEM ➢ Changed name of duty phone ➢ Changed Shell contact focal point to Joshua O'Brien

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[1] Per MMS approval of West Boreas Supplemental Exploration Plan, MS 5231 December 16, 2008
Control No. S-07273, Lease(s) OCS-G07957, Block 762, Mississippi Canyon Area OCS-G07962, Block 806, Mississippi Canyon Area

[2] Per BOEM approval of the Supplement to the Conceptual DWOP for Mars B project, 8/12/10, MS 5220

10/01/18	Andy Englande	➢ Revised "Barrel Impact Reporting Section" in the event Shell disrupted a barrel causing a release.
4/01/19	Andy Englande	➢ Changed originator/author from Bertrand Montchanin to Joshua O'Brien.

Background

Various projects will be carried out in an area of the Mississippi Canyon known to contain barrels of chemical waste.

- The barrels were discharged in this area in the 1970's under government approved permits.

- The content, and its toxicity, of each individual barrel is not known. However, there are records of a wide range of industrial waste materials that were disposed in the barrels including chlorinated hydrocarbons and liquid metal salts. Below is a summary of the barrel contents based on available records.

    1. Metallic sodium and calcium; calcium oxide, sodium oxide, and inert salts.[3]

    2. 80-90% dichlorobutene, 20% organic high-boilers, and 1% quaternary ammonium salts. "Other wastes produced from the manufacture of fungicides and herbicides".[4]

- Within the area there are/could be many hundreds of waste barrels. Many of the barrels may have released their contents over time. However, an unknown number of barrels still look intact, and they may or may not still contain their original content. Also, as some of the barrels contained metal based solid waste, some of the barrels that no longer look intact may still contain some waste.

- Extensive sonar surveys of the area exist and are available for planning purposes.

Potential Hazards

Although there are no records of any issues regarding the barrels during the many years of Oil and Gas operations in the Mississippi Canyon area, the following potential hazards exist:

- Personnel exposure or equipment damage due to adherence of waste chemicals to recovered subsea equipment
- Equipment damage from sodium exposure to water (very vigorous reaction).

Normal Operations

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[3] EPA Permit Application No. 730D009E from Ethyl Corp, March 1, 1977, Public Notice April 20, 1977,

[4] Chapter 5 "Ocean Discharge" in the book Assessing Potential Ocean Pollutants, A Report of the Study Panel on Assessing Potential Ocean Pollutants. National Academy of Sciences, Washington DC, 438 pp. This document details DuPont's application to dispose of the following at the ocean disposal site

For normal operations, all contractors and Shell employees must meet the following expectations:

1. Shell's over-arching policy is to avoid barrel contact.

2. Press releases making any reference to the chemical waste or barrels, or any incidents involving any chemical waste or barrels, will require the express written permission from Shell.

3. All recorded video material is confidential and the property of Shell (standard contract provision).

   If during normal ROV operations there is a discovery of any potential archaeological resource (i.e., cannot be definitively identified as waste barrel/barrel remnant, modern debris, or refuse), any seafloor-disturbing activities in its proximity, must be stopped, the discovery must be reported to Dr. Chris Horrell at 504-736-2796, and further instructions must be obtained before proceeding.

4. <u>Equipment Placement/Stand-off Distance</u>
   4.1. A safe stand-off distance from the waste barrels is considered 10m (33ft). Care must be taken that flexible components (e.g. ROV tether, anchor lines, seismic cables) are controlled as well (e.g. don't drag through a barrel field).
   4.2. If a seafloor action will generate cuttings or debris, increase the stand-off distance as needed to avoid debris contact with nearby barrels.
   4.3. Do not investigate any barrels or remainders of barrels. Remain the minimum stand-off of 10m (33ft) at all times.
   4.4. Survey the anchor/pile/export locations with an ROV to ensure barrel avoidance.
   4.5. Record the (approximate) location of any chemical waste barrel seen, if feasible, without getting closer than the 10m (33ft) stand-off distance.

5. Contact the Shell GOM Environmental Duty Phone for any questions or concerns. 1-504-390-1330.

6. Decontamination of Equipment: In the event of contact with a barrel contents decontaminate equipment per Decontamination of Equipment below.

7. Make reports of barrel contact/rupture per Barrel Release Reporting below.

Decontamination of Equipment

1. General
   In the unlikely case that contact is suspected or has been made with any wastes from a barrel, appropriate action needs to be taken to guarantee the topside safety of personnel handling the equipment (e.g. ROV, anchor lines, etc).
   It is left solely to the judgment of the Person-in-Charge of the equipment/vessel to determine if it is necessary to abandon all or part of the equipment on the sea floor.

2. Decon Procedure

Based on various factors[5], Shell recommends the following:

2.1. Use the ocean to "wash" the equipment (e.g. fly an ROV for at least an hour at depth high enough above sea floor to prevent umbilical dragging or other disturbance of the sea floor). For other equipment, provide any movement through the water column that's possible, again avoiding seafloor dragging.

2.2. Retrieve the equipment to the surface, but do not bring onboard if feasible.

2.3. Hose the equipment off before retrieving onto the vessel. Use as high a water flow as is available/safe. CAUTION- detergent/soap may be used BUT in as low a quantity as practicable to minimize foam. Only non-toxic and phosphate free cleaners and detergents may be used. Furthermore, cleaners and detergents should not be caustic or only minimally caustic and should be biodegradable[6].

2.4. Avoid physical contact with the equipment and keep the equipment off the vessel at this point.

2.5. Dunk the equipment back in the sea and "wash" the equipment for approximately 15 minutes.

2.6. Retrieve the equipment to the surface. Before recovering, visually inspect the equipment, umbilical, cable surfaces with binoculars for signs of corrosion, discoloration, air reaction such as fuming/smoking, or any other signs of chemical contact. Rewash and dunk the equipment as needed.

2.7. Retrieve the equipment onto the back deck. Monitor the equipment and surrounding storage area for indications of chemical contamination (corrosion, discoloration, air reaction such as fuming/smoking, etc.). Establish secondary containment as necessary to collect any potentially contaminated drips.

2.8. Only essential personnel should be allowed near the equipment, once retrieved on the back deck.

2.9. While performing cleaning operations on the equipment, involving contact with potentially contaminated surfaces, personal protective equipment must be worn including, but not limited to: safety eye goggles, safety clothing such as coverall and aprons, Nitrile type chemical resistant industrial-safety gloves, and PVC boots.

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[5] Shell assumes, for purposes of this decontamination guidance, that:

- The most toxic material identified in the disposal area's permits and other available documents is involved. However, Shell cannot guarantee there are not other toxic materials present than those identified in the permits and other documents.
- It is assumed that the materials do not chemically interact with the materials of the ROV, its tools and equipment.

[6] The NPDES General Permit for Discharges Incidental to the Normal Operation of a Vessel provides insight into managing any washing. Also, EPA provides the following definitions:
"Non-toxic" soaps, cleaners, and detergents mean these materials which do not exhibit potentially harmful characteristics as defined by the Consumer Product Safety Commission regulations found at 16 CFR Chapter II, Subchapter C, Part 1500.
"Phosphate Free" soaps, cleaners, and detergents means these materials which contain, by weight, 0.5% or less of phosphates or derivatives of phosphates.

2.10. Wash hands thoroughly and take a shower after performing cleaning operations on the equipment.

2.11. Avoid drinking liquids or eating food in the work area.

2.12. If contamination is still suspected, consult with the Shell representatives/management for further actions including additional washing, abandonment on the seafloor, segregated storage on the boat, wrapping the equipment partially or fully in plastic sheeting, etc.

2.13. Document all actions and results in a log.

Barrel Impact Reporting

1. <u>Initial reporting:</u>

    1.1. Equipment opera tor is to inform the Shell onsite representative and the Shell operations supervisor on duty.

    1.2 The Shell onsite representative or the Shell operations supervisor will call the Environmental Duty Phone 504-390-1330 with an estimate of chemical and volume released.

    1.3 The Shell onsite representative or the Shell operations supervisor should contact Regulatory Affairs (Sylvia Bellone or Tracy Albert) via email or phone listed in GAL.

2. The SEPCo Regulatory Affairs person will contact

    2.1 BSEE’s Environmental Enforcement Branch Chief, T. J. Broussard at 504-736-3245

    2.2 BSEE New Orleans District Manager

    to report the event. The call should include the lat/long, estimate of release if any (chemical or liquid hydrocarbon) and any circumstances of note.

3. <u>Follow-up Reporting</u>

    SEPCo Regulatory Affairs will follow up with an email to the Environment Enforcement Branch Chief T. J. Broussard with the details of the ruptured barrel.

    BSEE have requested submission of a copy of whatever relevant video is available for the event period. *No dedicated* video survey is required for a barrel rupture (i.e. just be prepared to submit whatever video was obtained as normal part of the activities). BOEM has agreed we can submit any video after the project is completed.

B - F

Pursuant to NTL No. 2008-G04 the proposed operations covered by this EP do not involve operations impacting the following: Topographic features map, Topographic features statement (shunting), Live bottoms, (Pinnacle Trend) map, Live bottoms (low relief) map, or potentially sensitive biological features map.

G. Remotely Operated Vehicle (ROV) Monitoring Plan

This information is no longer required by BOEM.

H. Threatened and Endangered Species Information

Under Section 7 of the Endangered Species Act (ESA) all federal agencies must ensure that any actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of a listed species, or destroy or adversely modify its designated critical habitat.

In accordance with the 30 CFR 250, Subpart B, effective May 14, 2007 and further outlined in Notice to Lessees (NTL) 2008-G04, lessees/operators are required to address site-specific information on the presence of federally listed threatened or endangered species and critical habitat designated under the ESA and marine mammals protected under the Marine Mammal Protection Act (MMPA) in the area of proposes activities under this plan.

Currently there are no designated critical habitats for the listed species in the Gulf of Mexico Outer Continental Shelf; however, it is possible that one or more of these species could be seen in the area of our operations.

The following table reflects the Federally-listed endangered and threatened species in the lease area and along the northern Gulf coast:

Common Name	Scientific Name	T/E Status
Hawksbill Turtle	*Eretmochelys imbricata*	E
Green Turtle	*Chelonia mydas*	T/E
Kemp's Ridley Turtle	*Lepidochelys kempii*	E
Leatherback Turtle	*Dermochelys coriacea*	E
Loggerhead Turtle	*Caretta caretta*	T

Table 6.1 – Threatened and Endangered Sea Turtles

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

There are 29 species of marine mammals that may be found in the Gulf of Mexico (see Table 6.7 below). Of the species listed as Endangered, only the Sperm whale is commonly found in the project area. No critical habitat for these species has been designated in the Gulf of Mexico.

Common Name	Scientific Name	T/E Status
Atlantic Spotted Dolphin	*Stenella frontalis*	
Blainville's Beaked Whale	*Mesoplodon densirostris*	
Blue Whale	*Balaenoptera musculus*	E
Bottlenose Dolphin	*Tursiops truncatus*	
Bryde's Whale	*Balaenoptera edeni*	E
Clymene Dolphin	*Stenella clymene*	
Cuvier's Beaked Whale	*Ziphius cavirostris*	
Dwarf Sperm Whale	*Kogia simus*	
False Killer Whale	*Pseudorca crassidens*	
Fin Whale	*Balaenoptera physalus*	E
Fraser's Dolphin	*Lagenodelphis hosei*	
Gervais' Beaked Whale	*Mesoplodon europaeus*	
Humpback Whale	*Megaptera novaeangliae*	E
Killer Whale	*Orcinus orca*	
Melon-headed Whale	*Peponocephala electra*	
Minke Whale	*Balaenoptera acutorostrata*	
North Atlantic Right Whale	*Eubalaena glacialis*	E
Pantropical Spotted Dolphin	*Stenella attenuata*	
Pygmy Killer Whale	*Feresa attenuata*	
Pygmy Sperm Whale	*Kogia breviceps*	
Risso's Dolphin	*Grampus griseus*	
Rough-toothed Dolphin	*Steno bredanensis*	
Sei Whale	*Balaenoptera borealis*	E
Short-finned Pilot Whale	*Globicephala macrorhynchus*	
Sowerby's Beaked Whale	*Mesoplodon bidens*	
Sperm Whale	*Physeter macrocephalus*	E
Spinner Dolphin (Long-snouted)	*Stenella longirostris*	
Striped Dolphin	*Stenella coeruleoalba*	
Florida manatee	*Trichechus manatus*	E

Table 6.2 Threatened and Endangered Marine Mammals

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. The Environmental Impact Analysis found in Section 18 discusses potential impacts and mitigation measures related to threatened and endangered species.

There are also listed species of birds, fishes, invertebrates and terrestrial mammals in the Gulf of Mexico waters and coastal environments. Of these, it is possible that Giant manta ray may be present in the lease area, but it is highly unlikely that any other birds, fish species and terrestrial mammals, given their coastal ranges, will be present in the lease area. The presence of invertebrates is identified through different lease operations, as biologically sensitive habitat features that must be avoided per BOEM NTL 2009-G40.

Birds		
Piping Plover	*Charadrius melodus*	T
Whooping Crane	*Grus americana*	E
Fishes		
Oceanic whitetip shark	*Carcharhinus longimanus*	T
Giant manta ray	*Mobula birostris*	T
Gulf sturgeon	*Acipenser oxyrinchus desotoi*	T
Nassau grouper	*Epinephelus striatus*	T
Smalltooth sawfish	*Pristis pectinata*	E
Invertebrates		
Elkhorn coral	*Acropora palmata*	T
Staghorn coral	*Acropora cervicornis*	T
Pillar coral	*Dendrogyra cylindrus*	T
Rough cactus coral	*Mycetophyllia ferox*	T
Lobed star coral	*Orbicella annularis*	T
Mountainous star coral	*Orbicella faveolata*	T
Boulder star coral	*Orbicella franksi*	T
Terrestrial Mammals		
Beach mice (Alabama, Choctawhatchee, Perdido Key, St. Andrew)	*Peromyscus polionotus*	E
Florida salt marsh vole	*Microtus pennsylvanicus dukecampbelli*	E

Table 6.3– Birds, fishes, invertebrates and terrestrial mammals

I. Archaeological Report

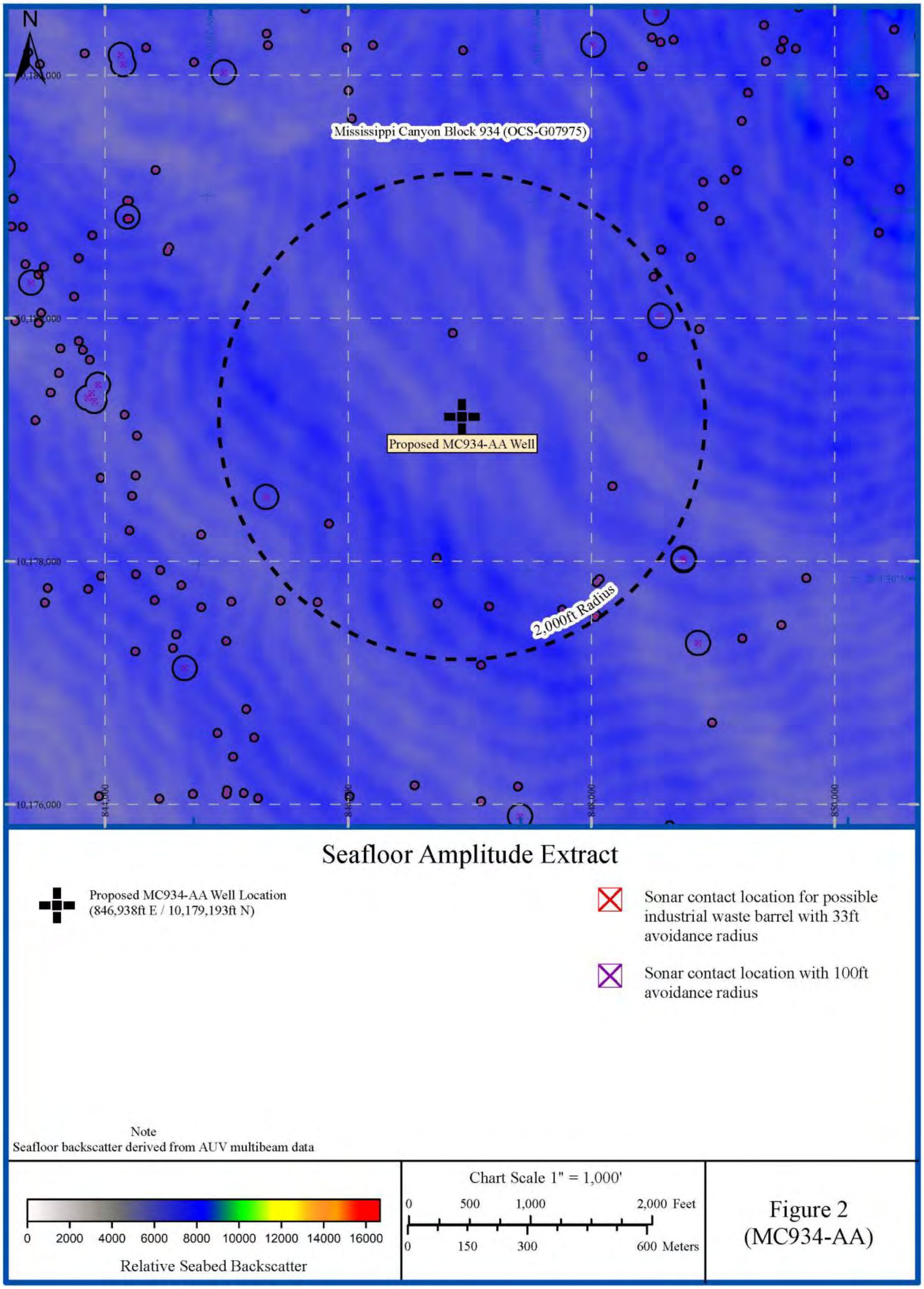
See previous section A for archaeological assessments by well.

J. Air and Water Quality Information

Pursuant to NTL 2008-G04 the proposed operations covered by this EP do not require Shell to provide additional information relating to air and water quality information. For specific information relating to air and water quality information please refer to Section 18.

K. Socioeconomic Information

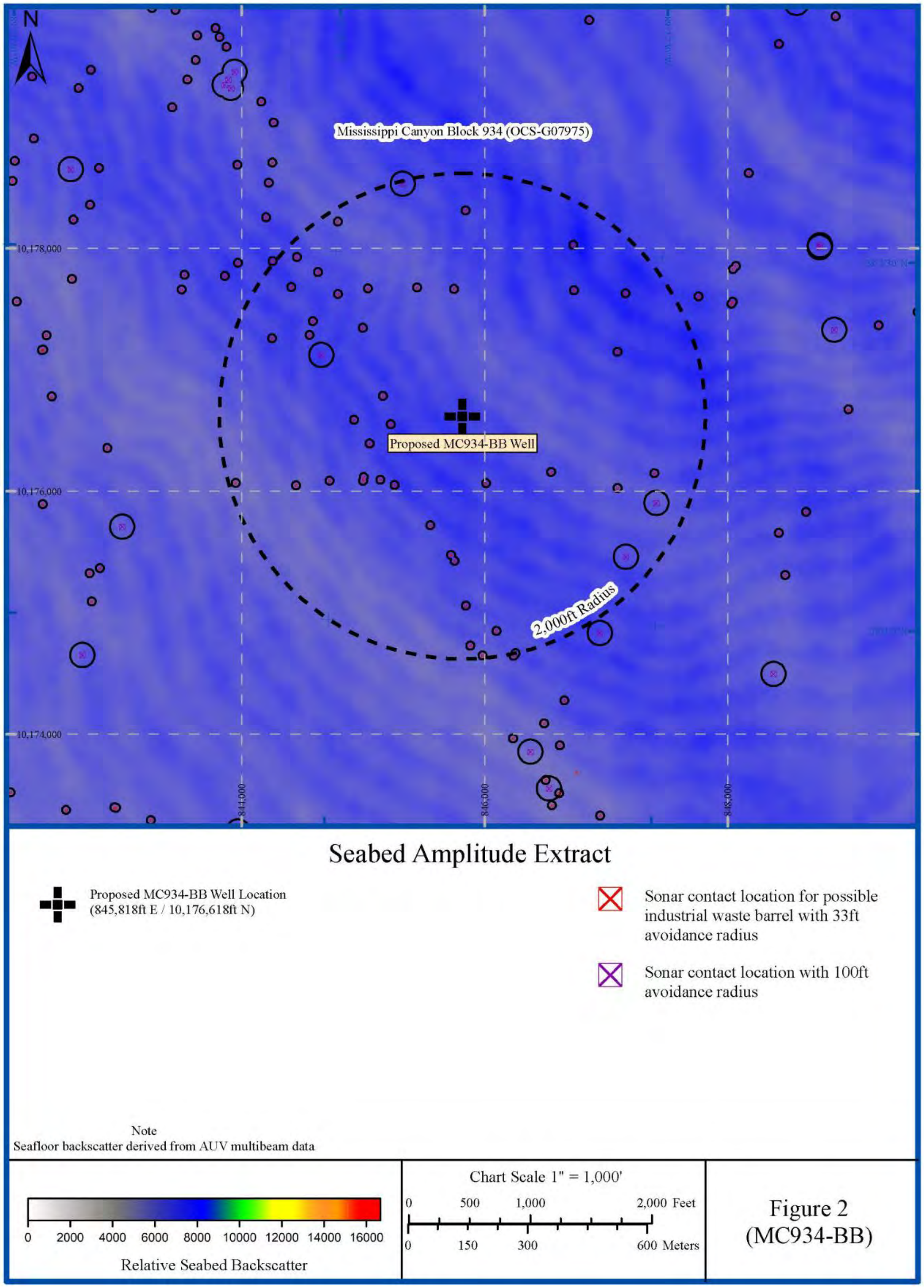
Pursuant to NTL 2008-G04 the proposed operations covered by this EP do not require Shell to provide additional information relating to air and water quality information. For specific information relating to socioeconomic information please refer to Section 18.

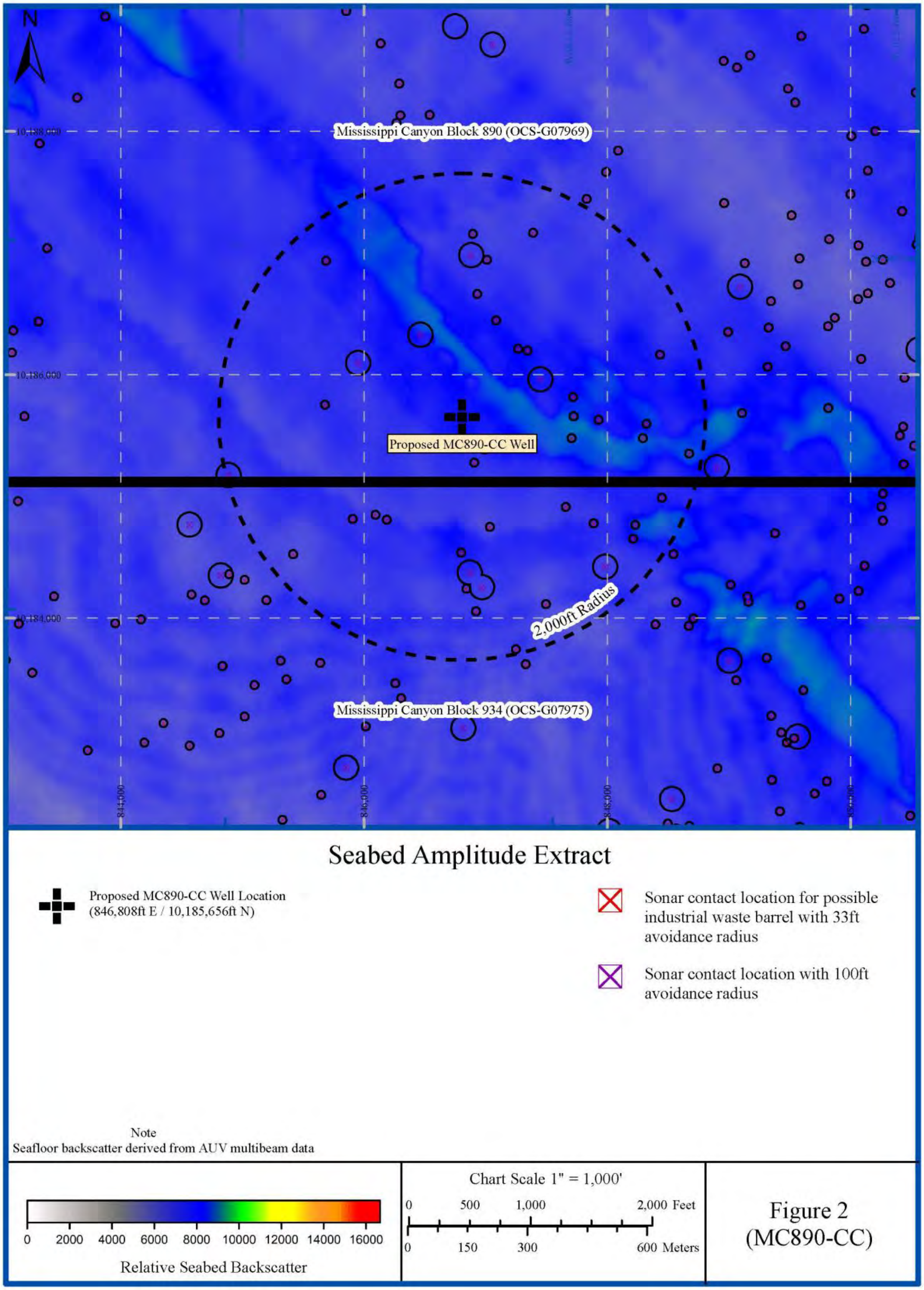


Seafloor Amplitude Extract

Note
Seafloor backscatter derived from AUV multibeam data

Figure 2
(MC934-AA)


N
Mississippi Canyon Block 934 (OCS-G07975)
10,178,000
10,176,000
10,174,000
844,000
846,000
848,000
Proposed MC934-BB Well
2,000ft Radius
Seabed Amplitude Extract
Proposed MC934-BB Well Location
(845,818ft E / 10,176,618ft N)
Sonar contact location for possible industrial waste barrel with 33ft avoidance radius
Sonar contact location with 100ft avoidance radius
Note
Seafloor backscatter derived from AUV multibeam data
0
2000
4000
6000
8000
10000
12000
14000
16000
Relative Seabed Backscatter
Chart Scale 1" = 1,000'
0
500
1,000
2,000 Feet
0
150
300
600 Meters
Figure 2
(MC934-BB)



Seabed Amplitude Extract

Proposed MC890-CC Well Location (846,808ft E / 10,185,656ft N)

☒ Sonar contact location for possible industrial waste barrel with 33ft avoidance radius

☒ Sonar contact location with 100ft avoidance radius

Note
Seafloor backscatter derived from AUV multibeam data

Figure 2
(MC890-CC)

Attachment 6D – ESR Well DD

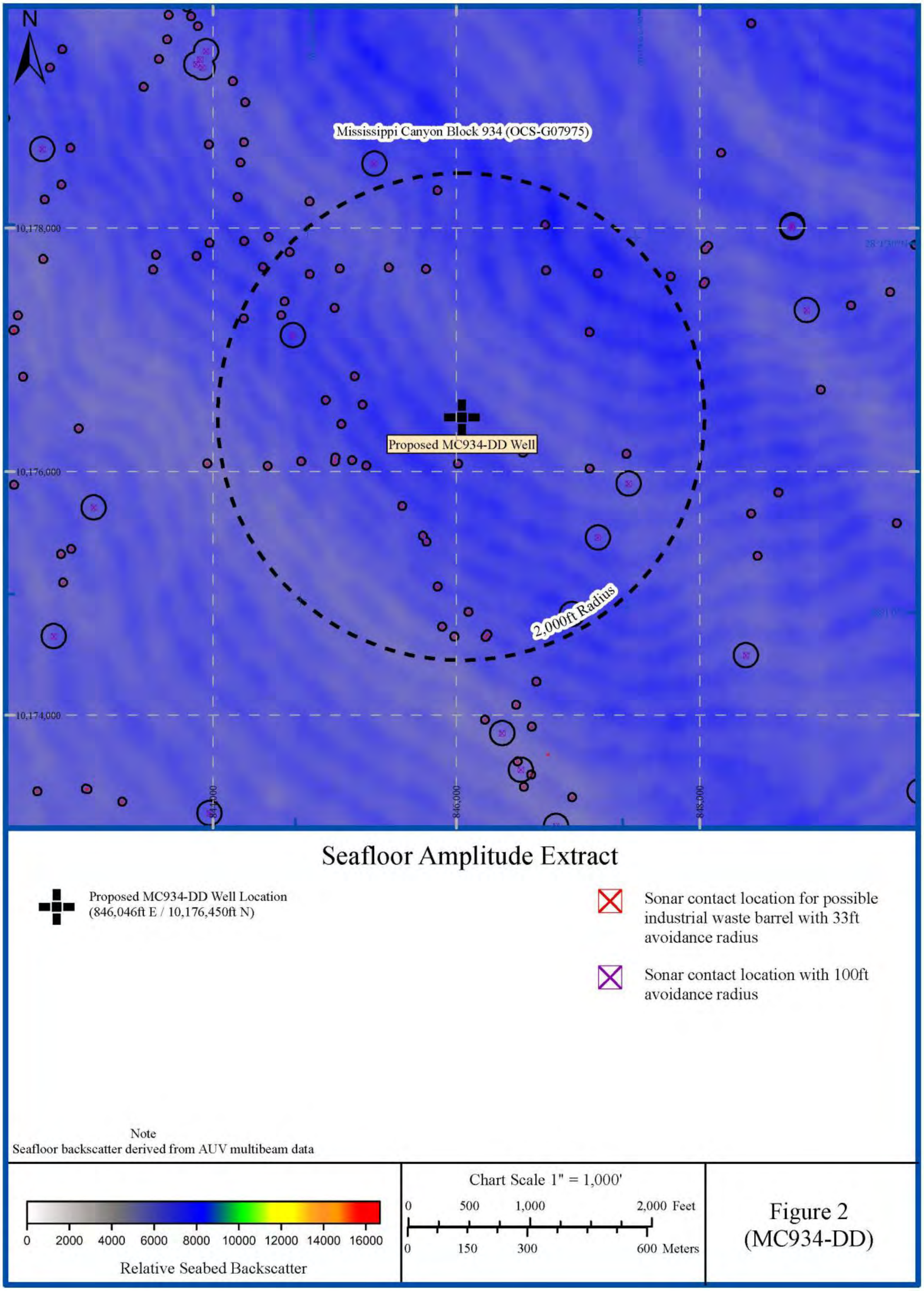
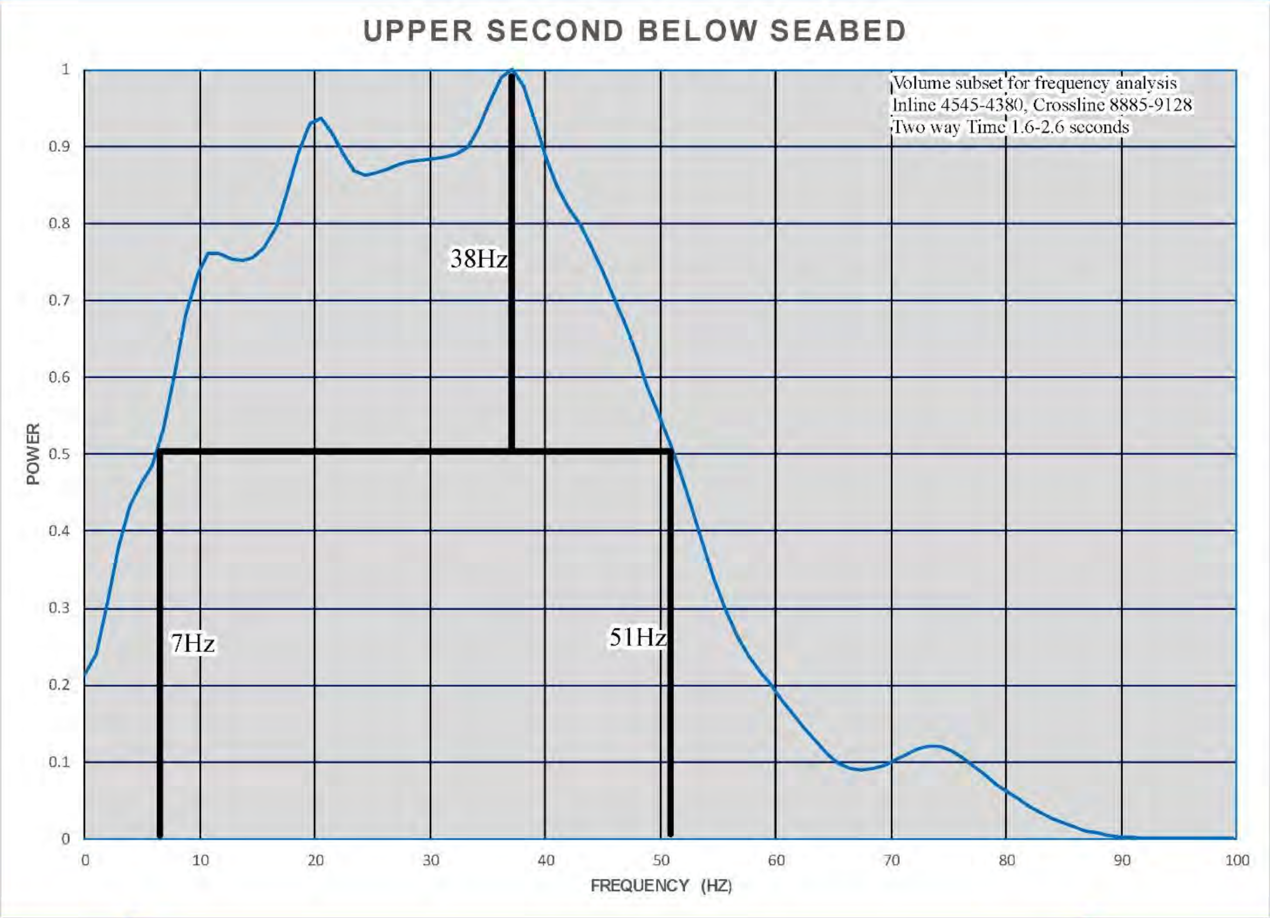


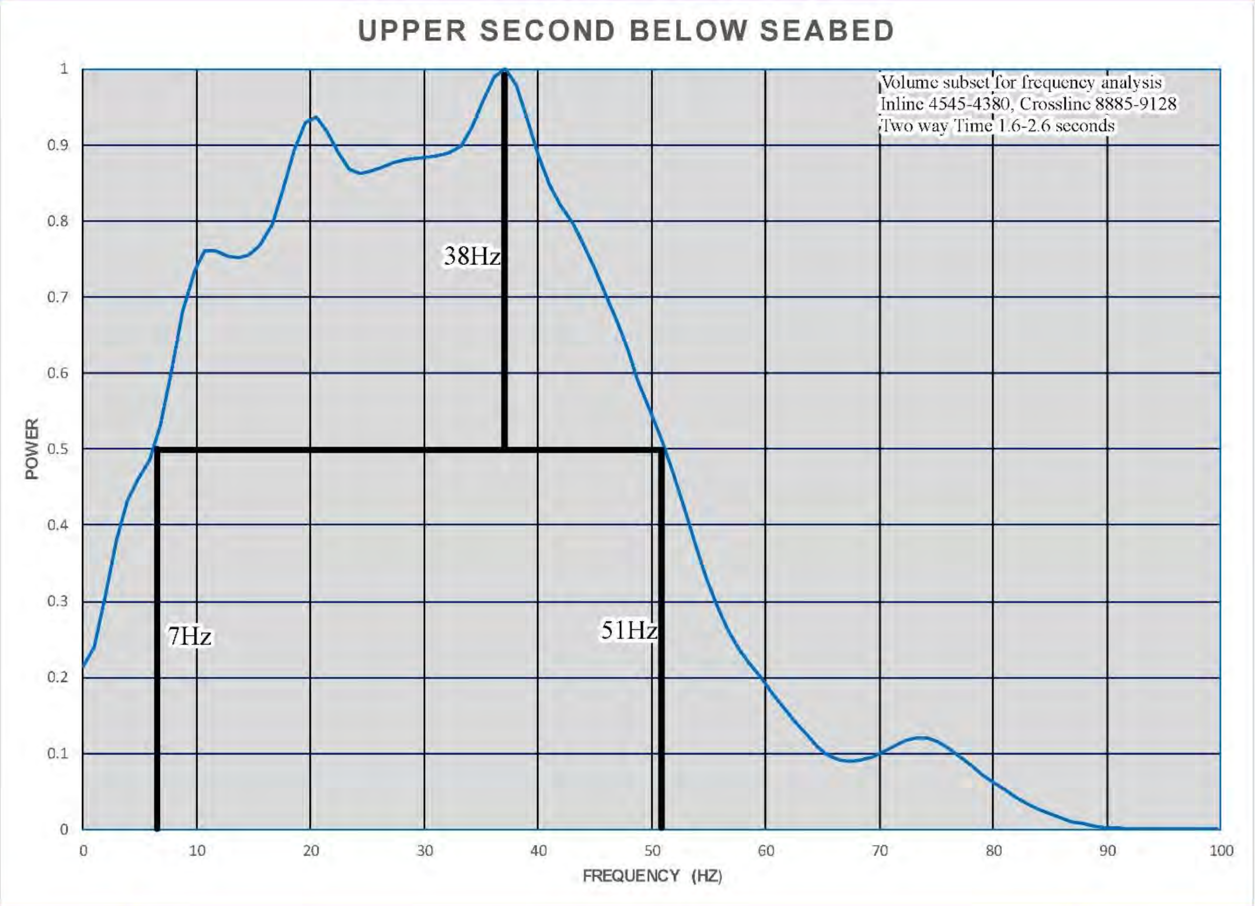
Figure 2 (MC934-DD)

Attachment 6E – Power Spectrim Wells AA and AA-Alt



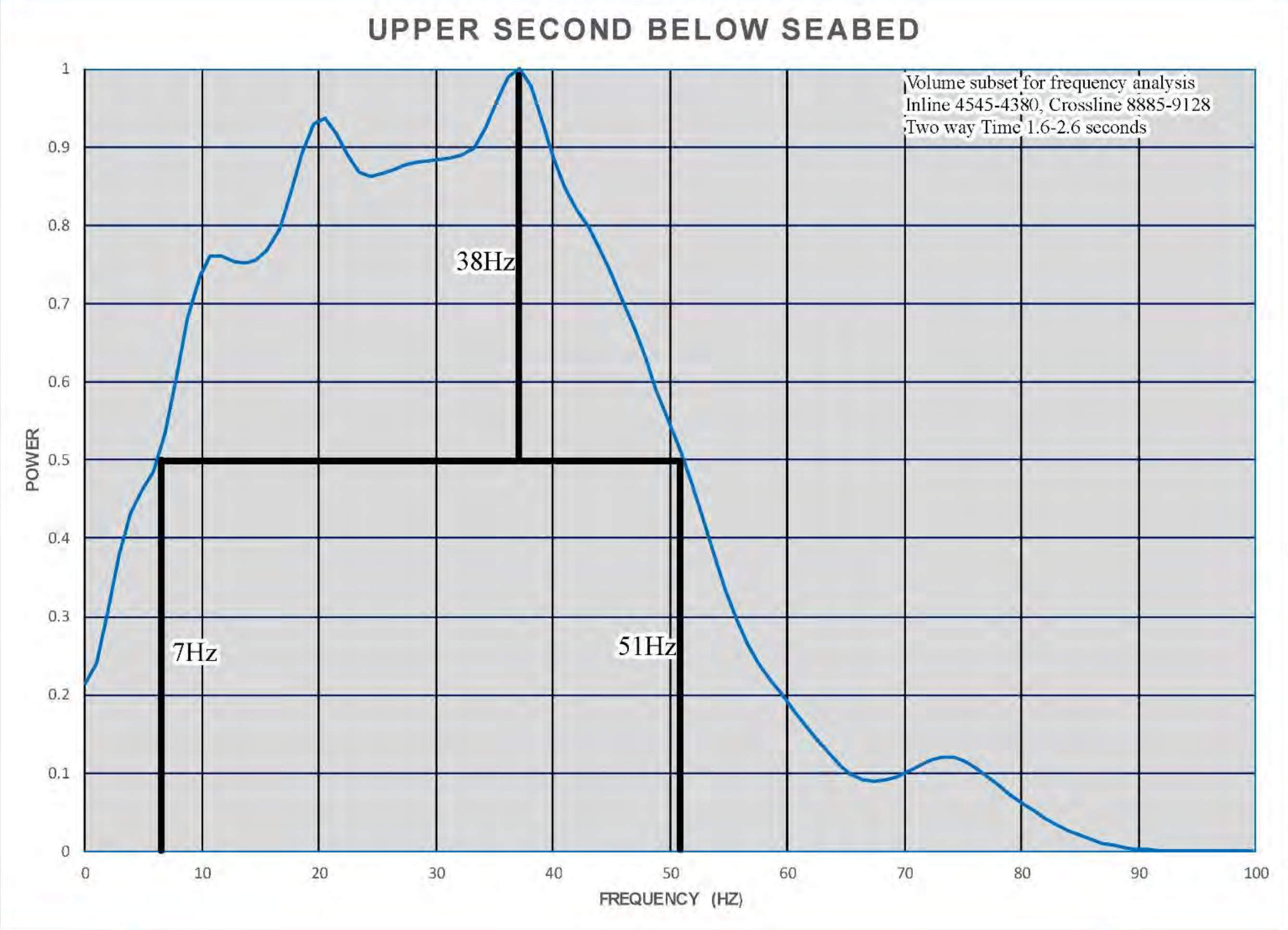
MC934-AA	Power Spectrum	Figure 1

Attachment 6F – Power Spectrim Wells BB and BB-Alt



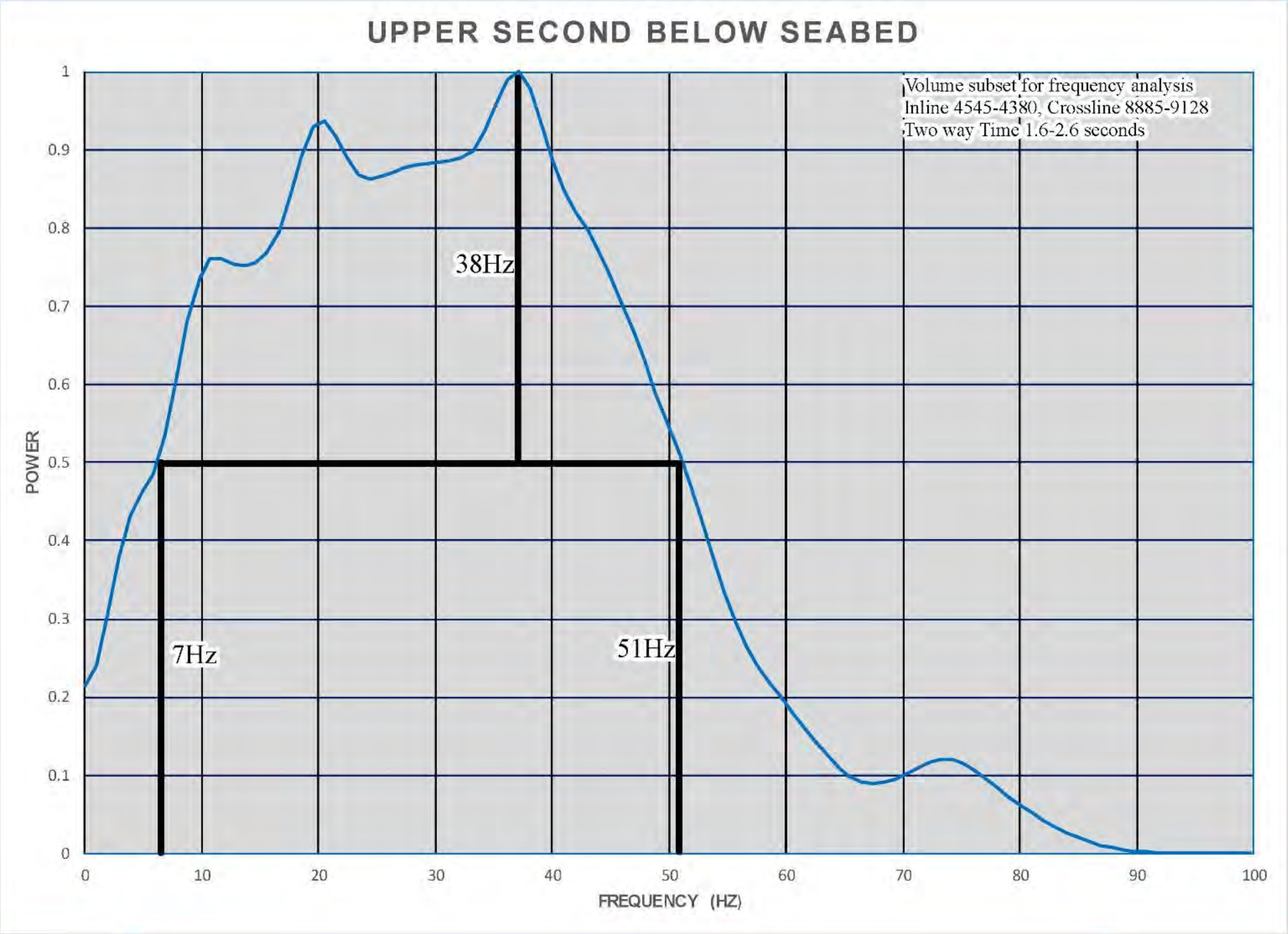
MC934-BB	Power Spectrum	Figure 1

Attachment 6G - Power Spectrim Well CC and CCAlt



MC890-CC	Power Spectrum	Figure 1

Attachment 6H – Power Spectrim Well DD



Volume subset for frequency analysis
Inline 4545-4380, Crossline 8885-9128
Two way Time 1.6-2.6 seconds

MC934-DD	Power Spectrum	Figure 1

Attachment 6I – Tophole Prog Wells AA and AA-Alt

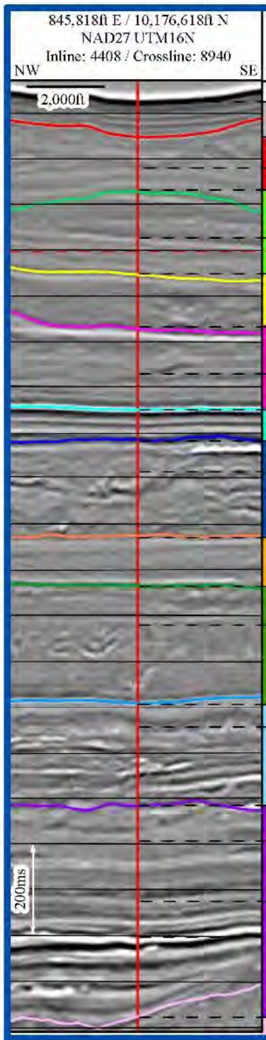
Horizon	Subsea Depth (Feet)	TVD Below Seabed (Feet)	Horizon TWT (sec)	Thickness (Feet)	Unit Name
Seabed	-3,688	0	1.505		
Horizon H01	-3,960	272	1.602	272	1
Interface	-4,203	515	1.695	243	2
Horizon H02	-4,317	629	1.736	114	2
Horizon H03	-4,578	890	1.829	261	3
	-4,593	905	1.835		
Horizon H04	-4,764	1,076	1.895	186	4
Interface	-5,073	1,385	2.000	309	5
Interface	-5,333	1,645	2.088	260	5
Horizon H05	-5,511	1,823	2.149	178	5
Horizon H06	-5,720	2,032	2.219	209	6
Interface	-5,835	2,147	2.254	115	7
Sand Interbed	-6,070	2,382	2.330	235	7
Horizon H07	-6,378	2,690	2.430	308	7
Interface	-6,522	2,834	2.473	144	8
Horizon H08	-6,736	3,048	2.542	214	8
Interface	-7,384	3,696	2.735	648	9
Horizon H09	-7,597	3,909	2.796	213	9
Interface	-7,749	4,061	2.842	152	10
Interface	-7,964	4,276	2.904	215	10
Horizon H10	-8,472	4,784	3.041	508	10
Interface	-8,814	5,126	3.141	342	11
Interface	-9,291	5,603	3.269	477	11
Sand Interbed	-9,450	5,762	3.311	159	11
Interface	-9,715	6,027	3.380	265	11
Sand Interbed	-9,874	6,186	3.421	159	11
Horizon H11	-10,299	6,611	3.531	425	11

Unit Name	Lithology, Structure & Stratigraphy	Potential Drilling Hazards & Constraints	Prob. of Gas	SWF Prob.
			🟩 Low 🟦 Moderately Low 🟨 Moderate 🟧 Moderately High 🟥 High	🟩 Low 🟦 Moderately Low 🟨 Moderate 🟧 Moderately High 🟥 High
1	Seabed is smooth sloping to the northeast at 1.6°. Surficial sediments comprise of clays and silts	None predicted	🟩	🟩
2	Clays and silts with several sand interbeds	Moderately Low Shallow Water Flow Probabilty and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟦
2	Clays and silts	None predicted	🟩	🟩
3	Clays and silts with occasional minor sand interbeds	None predicted	🟩	🟩
4	Clays and silts and occasional sand interbeds	None predicted Base GHSZ	🟩	🟩
5	Clays and silts with several sand interbeds	Minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟩
5	Clays and silts with several sand interbeds	Moderately Low Shallow Water Flow Probabilty and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟦
5	Clays and silts with occasional sand interbeds	Minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟩
6	Clays and silts with several sand interbeds	Minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟩
7	Clays and silts with occasional sand interbeds	None predicted	🟩	🟩
7	Clays and silts with several sand interbeds <40ft thick sand interbed	Moderately Low Shallow Water Flow Probabilty and minor drilling fluid circulation and minor wellbore stability problems possible Moderate Shallow Water Flow Probability at sand interbed and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟦 🟨 🟩
8	Clays and silts with occasional sand interbeds	None predicted	🟩	🟩
8	Clays and silts	None predicted	🟩	🟩
9	Clays and silts with several possible sand interbeds	Moderately Low Shallow Water Flow Probabilty and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟦
9	Clays and silts with occasional sand interbeds	None predicted	🟩	🟩
10	Clays and silts	None predicted	🟩	🟩
10	Clays and silts with occasional sand interbeds	None predicted	🟩	🟩
10	Clays and silts with several sand interbeds	Moderately Low Shallow Water Flow Probabilty and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟦
11	Clays and silts with occasional sand interbeds	None predicted	🟩	🟩
11	Clays and silts with occasional sand interbeds	None predicted	🟩	🟩
11	Clays and silts with several sand interbeds <40ft thick sand interbed	Moderately Low Shallow Water Flow Probabilty and minor drilling fluid circulation and minor wellbore stability problems possible Moderate Shallow Water Flow Probability at sand interbed and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟦 🟨 🟩
11	Clays and silts <40ft thick sand interbed	Moderately Low Shallow Water Flow Probabilty and minor drilling fluid circulation and minor wellbore stability problems possible Moderate Shallow Water Flow Probability at sand interbed and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟦 🟨 🟩
	Base of interpretation			

Top Hole Prognosis for Proposed MC934-AA Well Location

Figure 3

Attachment 6J – Tophole Prog Wells BB and BB-Alt

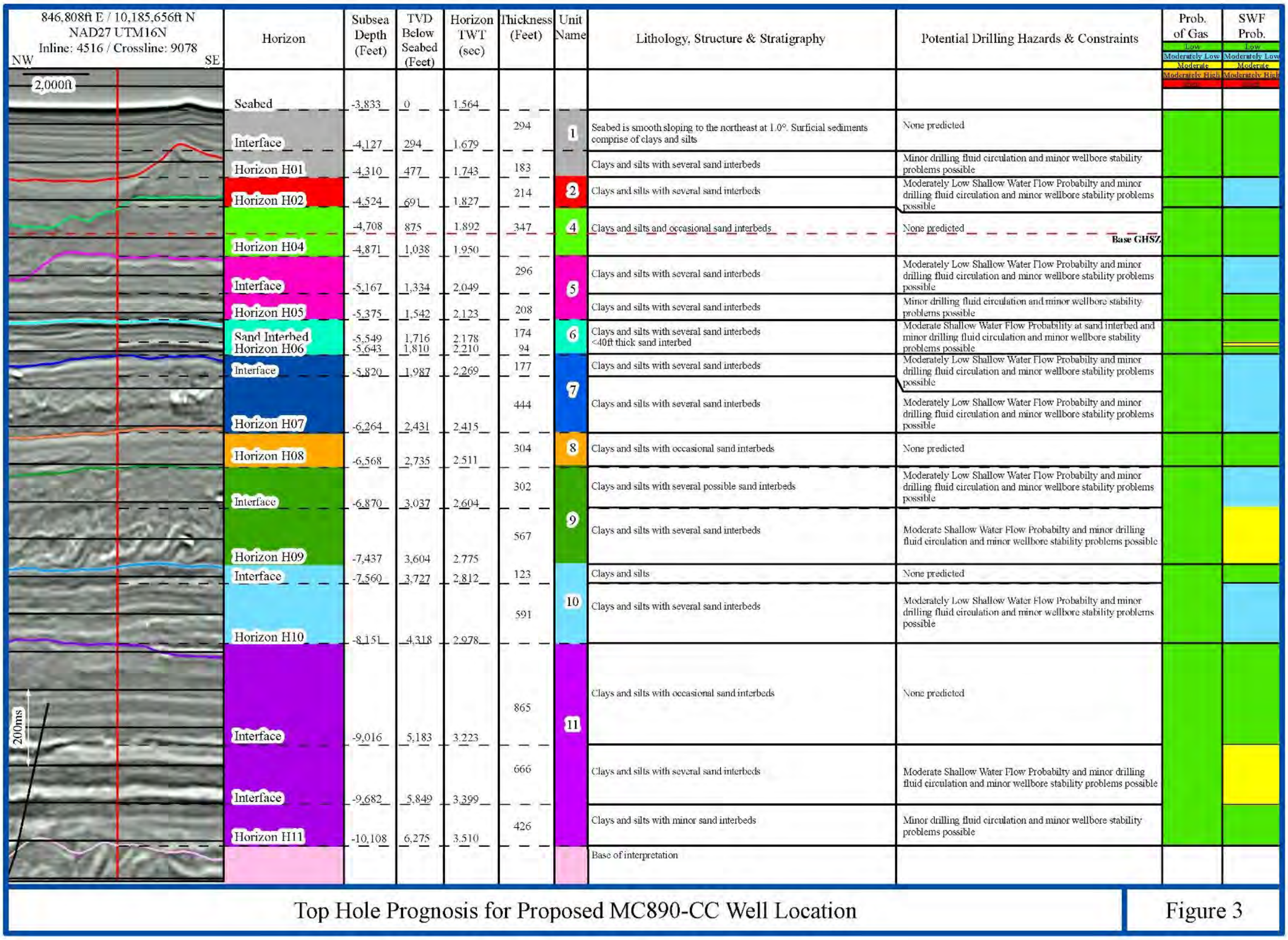


Horizon	Subsea Depth (Feet)	TVD Below Seabed (Feet)	Horizon TWT (sec)	Thickness (Feet)	Unit Name	Lithology, Structure & Stratigraphy	Potential Drilling Hazards & Constraints	Prob. of Gas 🟩 Low 🟦 Moderately Low 🟨 Moderate 🟧 Moderately High 🟥 High	SWF Prob. 🟩 Low 🟦 Moderately Low 🟨 Moderate 🟧 Moderately High 🟥 High
Seabed	-3,622	0	1,477						
				212	1	Seabed is smooth sloping to the northeast at 1.8°. Surficial sediments comprise of clays and silts	None predicted	🟩	🟩
Horizon H01	-3,834	212	1,553						
				243	2	Clays and silts with several sand interbeds	Moderately Low Shallow Water Flow Probabilty and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟦
Interface	-3,997	375	1,616						
				150		Clays and silts	None predicted	🟩	🟩
Horizon H02	-4,147	525	1,672						
				277	3	Clays and silts with several minor sand interbeds	Moderately Low Shallow Water Flow Probabilty and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟦
Interface	-4,424	802	1,769						
	-4,533	911	1,810						
				231		Clays and silts with occasional sand interbeds	None predicted **Base GHSZ**	🟩	🟩
Horizon H03	-4,655	1,033	1,853						
				345	4	Clays and silts with occasional sand interbeds	Moderately Low Shallow Water Flow Probabilty and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟦
Horizon H04/ Sand Interbed	-5,000	1,378	1,970						
				334	5	Clays and silts with several sand interbeds. <40ft thick sand interbed	Moderately Low Shallow Water Flow Probabilty and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟦
Interface	-5,334	1,712	2,081						
				201		Clays and silts with occasional sand interbeds	None predicted	🟩	🟩
Horizon H05	-5,535	1,913	2,150						
				199	6	Clays and silts with several sand interbeds	Minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟩
Horizon H06	-5,734	2,112	2,215						
				216	7	Clays and silts with several sand interbeds	Moderately Low Shallow Water Flow Probabilty and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟦
Interface	-5,950	2,328	2,283						
				441		Clays and silts with several sand interbeds	Moderate Shallow Water Flow Risk and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟨
Horizon H07	-6,391	2,769	2,425						
				357	8	Clays and silts with occasional sand interbeds	None predicted	🟩	🟩
Horizon H08	-6,748	3,126	2,534						
				278	9	Clays and silts with occasional sand interbeds	None predicted	🟩	🟩
Interface	-7,036	3,414	2,620						
				589		Clays and silts with several sand interbeds	Moderately Low Shallow Water Flow Probabilty and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟦
Horizon H09	-7,625	4,003	2,791						
				129	10	Clays and silts	None predicted	🟩	🟩
Interface	-7,754	4,132	2,831						
				662		Clays and silts with several sand interbeds	Moderate Shallow Water Flow Probabilty and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟨
Horizon H10	-8,416	4,794	3,013						
				176	11	Clays and silts with occasional sand interbeds	None predicted	🟩	🟩
Interface	-8,592	4,970	3,066						
				542		Clays and silts with occasional sand interbeds	None predicted	🟩	🟩
Interface	-9,134	5,512	3,212						
				335		Clays and silts with several sand interbeds <40ft thick sand interbed	Moderately Low Shallow Water Flow Probabilty and minor drilling fluid circulation and minor wellbore stability problems possible Moderate Shallow Water Flow Probability at sand interbed and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟦 🟨
Sand Interbed	-9,469	5,847	3.300						
				682				🟩	🟩
Horizon H11	-10,151	6,529	3,475						
						Base of interpretation			

Top Hole Prognosis for Proposed MC934-BB Well Location

Figure 3

Attachment 6K – Tophole Prog Well CC and CC Alt



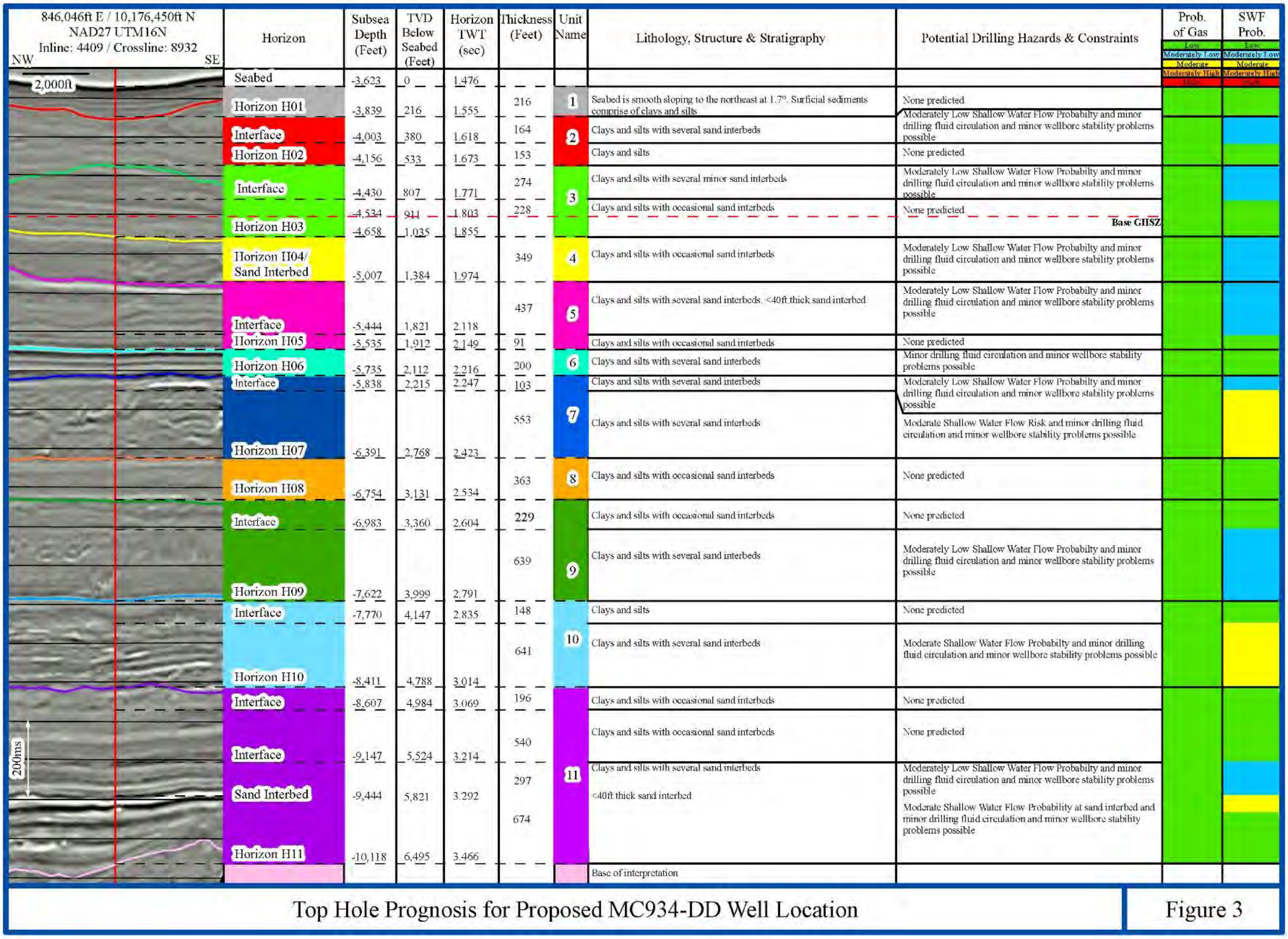
Prob. of Gas / SWF Prob.: 🟩 Low · 🟦 Moderately Low · 🟨 Moderate · 🟧 Moderately High · 🟥

Horizon	Subsea Depth (Feet)	TVD Below Seabed (Feet)	Horizon TWT (sec)	Thickness (Feet)	Unit Name	Lithology, Structure & Stratigraphy	Potential Drilling Hazards & Constraints	Prob. of Gas	SWF Prob.
Seabed	-3,833	0	1,564						
				294	1	Seabed is smooth sloping to the northeast at 1.0°. Surficial sediments comprise of clays and silts	None predicted	🟩	🟩
Interface	-4,127	294	1,679						
				183		Clays and silts with several sand interbeds	Minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟩
Horizon H01	-4,310	477	1,743						
				214	2	Clays and silts with several sand interbeds	Moderately Low Shallow Water Flow Probabilty and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟦
Horizon H02	-4,524	691	1,827						
				347	4	Clays and silts and occasional sand interbeds	None predicted	🟩	🟩
	-4,708	875	1,892				Base GHSZ		
Horizon H04	-4,871	1,038	1,950						
				296	5	Clays and silts with several sand interbeds	Moderately Low Shallow Water Flow Probabilty and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟦
Interface	-5,167	1,334	2,049						
				208		Clays and silts with several sand interbeds	Minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟩
Horizon H05	-5,375	1,542	2,123						
				174	6	Clays and silts with several sand interbeds <40ft thick sand interbed	Moderate Shallow Water Flow Probability at sand interbed and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟩
Sand Interbed	-5,549	1,716	2,178						
				94				🟩	🟨
Horizon H06	-5,643	1,810	2,210						
				177	7	Clays and silts with several sand interbeds	Moderately Low Shallow Water Flow Probabilty and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟦
Interface	-5,820	1,987	2,269						
				444		Clays and silts with several sand interbeds	Moderately Low Shallow Water Flow Probabilty and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟦
Horizon H07	-6,264	2,431	2,415						
				304	8	Clays and silts with occasional sand interbeds	None predicted	🟩	🟩
Horizon H08	-6,568	2,735	2,511						
				302	9	Clays and silts with several possible sand interbeds	Moderately Low Shallow Water Flow Probabilty and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟦
Interface	-6,870	3,037	2,604						
				567		Clays and silts with several sand interbeds	Moderate Shallow Water Flow Probabilty and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟨
Horizon H09	-7,437	3,604	2,775						
				123	10	Clays and silts	None predicted	🟩	🟩
Interface	-7,560	3,727	2,812						
				591		Clays and silts with several sand interbeds	Moderately Low Shallow Water Flow Probabilty and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟦
Horizon H10	-8,151	4,318	2,978						
				865	11	Clays and silts with occasional sand interbeds	None predicted	🟩	🟩
Interface	-9,016	5,183	3,223						
				666		Clays and silts with several sand interbeds	Moderate Shallow Water Flow Probabilty and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟨
Interface	-9,682	5,849	3,399						
				426		Clays and silts with minor sand interbeds	Minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟩
Horizon H11	-10,108	6,275	3,510						
						Base of interpretation			

Top Hole Prognosis for Proposed MC890-CC Well Location

Figure 3

Attachment 6L - Tophole Prog Well DD



Horizon	Subsea Depth (Feet)	TVD Below Seabed (Feet)	Horizon TWT (sec)	Thickness (Feet)	Unit Name	Lithology, Structure & Stratigraphy	Potential Drilling Hazards & Constraints	Prob. of Gas Low Moderately Low Moderate Moderately High High	SWF Prob. Low Moderately Low Moderate Moderately High High
Seabed	-3,623	0	1.476						
				216	1	Seabed is smooth sloping to the northeast at 1.7°. Surficial sediments comprise of clays and silts	None predicted	🟩	🟩
Horizon H01	-3,839	216	1.555						
				164	2	Clays and silts with several sand interbeds	Moderately Low Shallow Water Flow Probabilty and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟦
Interface	-4,003	380	1.618						
				153		Clays and silts	None predicted	🟩	🟩
Horizon H02	-4,156	533	1.673						
				274	3	Clays and silts with several minor sand interbeds	Moderately Low Shallow Water Flow Probabilty and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟦
Interface	-4,430	807	1.771						
				228		Clays and silts with occasional sand interbeds	None predicted	🟩	🟩
	-4,534	911	1.803				Base GHSZ		
Horizon H03	-4,658	1,035	1.855						
				349	4	Clays and silts with occasional sand interbeds	Moderately Low Shallow Water Flow Probabilty and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟦
Horizon H04/ Sand Interbed	-5,007	1,384	1.974						
				437	5	Clays and silts with several sand interbeds. <40ft thick sand interbed	Moderately Low Shallow Water Flow Probabilty and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟦
Interface	-5,444	1,821	2.118						
				91		Clays and silts with occasional sand interbeds	None predicted	🟩	🟩
Horizon H05	-5,535	1,912	2.149						
				200	6	Clays and silts with several sand interbeds	Minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟩
Horizon H06	-5,735	2,112	2.216						
				103	7	Clays and silts with several sand interbeds	Moderately Low Shallow Water Flow Probabilty and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟦
Interface	-5,838	2,215	2.247						
				553		Clays and silts with several sand interbeds	Moderate Shallow Water Flow Risk and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟨
Horizon H07	-6,391	2,768	2.423						
				363	8	Clays and silts with occasional sand interbeds	None predicted	🟩	🟩
Horizon H08	-6,754	3,131	2.534						
				229	9	Clays and silts with occasional sand interbeds	None predicted	🟩	🟩
Interface	-6,983	3,360	2.604						
				639		Clays and silts with several sand interbeds	Moderately Low Shallow Water Flow Probabilty and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟦
Horizon H09	-7,622	3,999	2.791						
				148	10	Clays and silts	None predicted	🟩	🟩
Interface	-7,770	4,147	2.835						
				641		Clays and silts with several sand interbeds	Moderate Shallow Water Flow Probabilty and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟨
Horizon H10	-8,411	4,788	3.014						
				196	11	Clays and silts with occasional sand interbeds	None predicted	🟩	🟩
Interface	-8,607	4,984	3.069						
				540		Clays and silts with occasional sand interbeds	None predicted	🟩	🟩
Interface	-9,147	5,524	3.214						
				297		Clays and silts with several sand interbeds	Moderately Low Shallow Water Flow Probabilty and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟦
Sand Interbed	-9,444	5,821	3.292			<40ft thick sand interbed	Moderate Shallow Water Flow Probability at sand interbed and minor drilling fluid circulation and minor wellbore stability problems possible	🟩	🟨
				674				🟩	🟩
Horizon H11	-10,118	6,495	3.466						
						Base of interpretation			

Top Hole Prognosis for Proposed MC934-DD Well Location

Figure 3

TABLE 7A: WASTES YOU WILL GENERATE, TREAT AND DOWNHOLE DISPOSE OR DISCHARGE TO THE GOM

Note: Please specify if the amount reported is a total or per well amount

Projected generated waste			Projected ocean discharges		Projected Downhole Disposal
Type of Waste and Composition	**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 ynthetic based fluid	*Cuttings generated while using synthetic based drilling fluid.*	*X bbl/well*	*X bbl/day/well*	*discharge pipe*	*No*
Water-based drilling fluid	barite, additives, mud	85000 bbls/well	17000 bbls/day	Overboard and seafloor discharge prior to marine riser installation	No
Cuttings wetted with water-based fluid	Cuttings coated with water based drilling mud	11520 bbls/well	768 bbls/day	Seafloor prior to marine riser installation	No
Cuttings wetted with synthetic-based fluid	Cuttings generated while using synthetic based drilling fluid.	8180 bbls/well	409 bbls/day	Overboard discharge line below the water line	No
Synthetic based drilling fluid adhering to washed drill cuttings	Synthetic based drilling fluid adhering to washed drill cuttings	600 bbls/well	30 bbls/day	Overboard discharge line below the water line	No
Spent drilling fluids - synthetic	Synthetic-based drilling mud	0 bbls / well	0 bbls/well	Overboard discharge line below the water line	No
Spent drilling fluids - water based	Synthetic-based drilling mud	0 bbls / well	0 bbls/well	Overboard discharge line below the water line	No
Chemical product waste	Chemical product waste	0 bbls / well	0 bbls/day	Treated to meet NPDES limits and discharged overboard	No
Brine	brine	N/A	N/A	N/A	No
Will humans be there? If yes, expect conventional waste					
EXAMPLE: Sanitary waste water		*X liter/person/day*	*NA*	*chlorinate and discharge*	*No*
Domestic waste (kitchen water, shower water)	grey water	50000 bbls/well	200 bbls/day/well	Ground to less than 25 mm mesh size and discharge overboard	No
Sanitary waste (toilet water)	treated sanitary waste	37500 bbls/well	150 bbls/day/well	Treated in the MSD** prior to discharge to meet NPDES limits	No
Is there a deck? If yes, there will be Deck Drainage					
Deck Drainage	Wash and rainwater	5000 bbls/well	20 bbls/day	Drained overboard through deck scuppers	No
Will you conduct well treatment, completion, or workover?					
well treatment fluids	Linear Frac Gel Flush Fluids, Crosslinked Frac Fluids carrying ceramic proppant and acidic breaker fluid	1000 bbls/well	10 bbls/day	Overboard discharge line below the water level if oil and greese free and meets LC50 requirements.	No
well completion fluids	Completion brine contaminated with WBDM and displacement spacers	1500 bbls/well	15 bbls/day	Overboard discharge line below the water level if oil and greese free and meets LC50 requirements.	No
workover fluids	NA	NA	NA	NA	No
Miscellaneous discharges. If yes, only fill in those associated with your activity.					
Desalinization unit discharge	Rejected water from watermaker unit	100000 bbls/well	400 bbls/day/well	RO Desalinization Unit Discharge Line below waterline	No
Blowout preventer fluid	Water based	50 bbls/well	0 bbls/day	Discharge Line @ Subsea BOP @ seafloor	No
Ballast water	Uncontaminated seawater	819000 bbls/well	3276 bbls/day	Discharge line overboard just above water line	No
Bilge water	Bilge and drainage water will be treated to MARPOL standards (< 15ppm oil in water).	385750 bbls/well	1543 bbls/day	Bilge and drainage water will be treated to MARPOL standards (< 15ppm oil in water).	No
Excess cement at seafloor	Cement slurry	30000 bbls/well (assume planned 100% excess is discharged)	200 bbls/day	Discharged at seafloor.	No
Fire water	Treated seawater	16666 bbls/well	2000 bbls/month	Discharged below waterline	No
Cooling water	Treated seawater	114085750 bbls/well	456343 bbls/day/well	Discharged below waterline	No
Hydrate Inhibitor	Hydrate Inhibitor	15 bbls/well methanol	15 bbls/well	Used as needed. Discharged at seafloor.	No
Will you produce hydrocarbons? If yes fill in for produced water.					
Produced water	NA	NA	NA	NA	
Will you be covered by an individual or general NPDES permit ?			GENERAL PERMIT	GMG290103	
NOTE: If you will not have a type of waste, enter NA in the row.					

B. Wastes to transport and/or dispose of onshore

TABLE 7B. WASTES YOU WILL TRANSPORT AND/OR DISPOSE OF ONSHORE					
Note: 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: Oil-based drilling fluid or mud	*NA*	*NA*	*NA*	*NA*	*NA*
Oil-based drilling fluid or mud	NA	NA	NA	NA	NA
Synthetic-based drilling fluid or mud	used SBF and additives	Drums/tanks on supply boat/barges	Halliburton Drilling Fluids, MiSwaco, Newpark Drilling Fluids - Fourchon, LA; Ecoserv (Fourchon, La.), or R360 Environmental Solutions (Fourchon, La.),	6,500 bbls/well	Recycled/Reconditioned; Deep Well Injection
Cuttings wetted with Water-based fluid	NA	NA	NA	NA	NA
Cuttings wetted with Synthetic-based fluid	Drill cuttings from synthetic based interval.	storage tank on supply boat.	Ecoserv (Fourchon, La.), or R360 Environmental Solutions (Fourchon, La.),	300 bbls / well	Deep Well Injection or landfarm
Cuttings wetted with oil-based fluids	NA	NA	NA	NA	NA
Completion Fluids	Used brine, acid	Storage tank on supply boat	Halliburton, Baker Hughes, Superior, or Tetra - Fourchon, LA; Ecoserv (Fourchon, La.), or R360 Environmental Solutions (Fourchon, La.),	4000 bbls/well	Recycled/Reconditioned Deep Well Injection
Salvage Hydrocarbons	Well completion fluids, formation water, formation solids, and hydrocarbon	Barge or vessel tank	PSC Industrial Outsourcing, Inc. (Jeaneareette, LA)	<8000 bbl./well	Recycled or Injection
Will you produce hydrocarbons? If yes fill in for produced sand.					
Produced sand	NA	NA	NA	NA	NA
Will you have additional wastes that are not permitted for discharge? If yes, fill in the appropriate rows.					
EXAMPLE: trash and debris	*cardboard, aluminum,*	*barged in a storage bin*	*shorebase*	*z tons total*	*recycle*
Trash and debris - recyclables	trash and debris	various storage containers on supply boat	Omega Waste Managment, W. Patterson, LA; Lamp Environmental, Hammond, LA	200 lbs/month	Recycle
Trash and debris - non-recyclables	trash and debris	various storage containers on supply boat	Republic/BFI landfill, Sorrento, LA or the parish landfill, Avondale, LA	400 lbs/month	Landfill
E&P Wastes	Completion and treatment wastes	various storage containers on supply boat	Ecoserv (Fourchon, La.), or R360 Environmental Solutions (Fourchon, La.),	<60,000 bbl.	Deep Well Injection, or landfarm
Used oil and glycol	used oil, oily rags and pads, empty drums and cooking oil	various storage containers on supply boat	Omega Waste Managment, West Patterson, LA	20 bbls/month	Recycle
Non-Hazardous Waste	paints, solvents, chemicals, completion and treatment fluids	various storage containers on supply boat	Republic/BFI landfill, Sorrento, LA Lamp Environmental, Hammond, LA	60 bbls/mo	Incineration or RCRA Subtitle C landfill
Non-Hazardous Oilfield Waste	Chemicals, completion and treatment fluids	various storage containers on supply boat	Ecoserv (Port Arthur, TX)	60 bbls/mo	Deep Well Injection
Hazardous Waste	paints, solvents and unused chemicals	various storage containers on supply boat	Omega Waste Managment, West Patterson, LA or Lamp Environmental, Hammond, LA	60 bbls/mo	Recycle, treatment, incineration, or landfill
Universal Waste Items	Batteries, lamps, glass and mercury-contaminated waste	various storage containers on supply boat	Lamp Environmental, Hammond, LA	50 bbls/mo	Recycle, treatment, incineration, or landfill
NOTE: If you will not have a type of waste, enter NA in the row.					

C. Modeling Report

Shell did not model the trajectory for discharges - not required in the GoM.

SECTION 8: AIR EMISSIONS

A. Emissions Worksheet and Screening Questions

Screening Questions for EP's	Yes	No
Is any calculated Complex Total (CT) Emission amount (tons) associated with your proposed exploration activities more than 90% of the amounts calculated using the following formulas: CT = $3400D_{2/3}$ 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	
Are your proposed exploration activities located east of 87.5_o W longitude?		X
Do you expect to encounter H_2S at concentrations greater than 20 parts per million (ppm)?		X
Do you propose to flare or vent natural gas for more than 48 continuous hours from any proposed well?		X
Do you propose to burn produced hydrocarbon liquids?		X

*Note: The following AQR is using fuel limitations and Shell will perform fuel monitoring for this project.

B. If you answer *no* to all of the above screening questions from the appropriate table, provide:

(1) Contact: Casey Clark, (504) 425-6885 Casey.Clark@shell.com

C. Worksheets

See attached. The schedule in Form BOEM-0137 will not match the days presented in the AQR, as the AQR contains extra days for contingency delays.

D. Emissions Reduction Measures

Emission Source	Reduction Control Method	Amount of Reduction	Monitoring System
Prime mover	*Actual fuel consumption*	*3090 tons NO_x/year*	*Fuel log*
Supply Vessel	*Actual fuel consumption*	*587 tons NO_x/year*	*Fuel log*
Crew Vessel	*Actual fuel consumption*	*197 tons NO_x/year*	*Fuel log*

COMPANY	Shell Offshore Inc
AREA	Mississippi Canyon
BLOCK	MC 890 & MC 934
LEASE	OCS-G-07969 & OCS-G-07975
PLATFORM	MODU (Semi-sub or Drillship)
WELL	AA, AA-Alt, BB, BB-Alt, CC, CC-Alt and DD
DISTANCE TO LAND	53
COMPANY CONTACT	Casey Clark
TELEPHONE NO.	504-425-6885
REMARKS	Supplemental EP

AQR Fuel Gas Limits

Shell has reviewed engine information for its GOM fleet of Drillship and DP semi-sub MODUs. Of the proposed MODUs, the highest fuel consumption is Shell's contracted Transocean Deepwater MODUs, which has six, main engines of 9,387 hp/engine. (Shell's contracted Noble MODUs have lower total horsepower and fuel consumption.) The projected fuel usages presented below would therefore be conservative across the fleet of Drillships and DP Semi-subs.

Step 1 - Determine Typical Operating Loads

Description	Value	Notes
Actual average daily fuel use (gal/day)	13,006	Based on daily fuel records for the Deepwater Thalassa from January 1, 2016 to December 31, 2016.
Contingency factor	1.55	The contingency factor is used to allow for more usage if need be.
Proposed MODU Campaign Average Daily Fuel Use (gal/day)	20,000	Calculated Value - PTE fuel use * Proposed Operating Load and rounded up to nearest thousand (for additional conservatism). This represents total fuel use on the MODU and is allocated equally amongst the six prime movers.
2020-2027 Annual Fuel Limits,	5,400,000	Calculated Value - Campaign Average Daily Fuel Use * Campaign Days

Step 2 - Support Vessel Fuel Loads

Description	Value	Notes
Proposed Operating Loads	50%	Shell policy restricts D/P to < 50% near rig. When in standby away from rig but within 25 miles load will be < 50% (conserve fuel). When transiting through field (25 nm), traveling at economical speeds.
OSV - PTE Fuel Use (gal/day)	11,708	Offshore Support Vessels are rated at 10,098hp (rounded to 10,100 hp). The PTE fuel use is then estimated using the AQR conversion factor of 0.0483 gal/hp-
Campaign Average Daily Fuel Use (gal/day)	5,854	Calculated Value - PTE fuel use * Proposed Operating Load.
Crew Vessel - PTE Fuel Use (gal/day)	9,274	Crew Vessels are rated at 7,944 hp (rounded to 8,000 hp). The PTE fuel use is then estimated using the AQR conversion factor of 0.0483 gal/hp-hr.
Crew Vessel - Campaign Average Daily Fuel Use (gal/day)	1,391	Calculated Value - PTE fuel use * Proposed Operating Load. Note that Crew Vessels are only in field 30% of campaign and daily average value has been
Proposed Vessel Campaign Average Daily Fuel Use (gal/day)	7,245	Calculated Value - Average fuel use * Contigency Factor and rounded up to nearest thousand (for additional conservatism). This represents total fuel use on the Support and Crew vessels.
Total Vessel Activity		
2020-2027 Annual Fuel Limits,	2,679,143	Sum of (vessel daily fuel use * corresponding campaign days)

Additional Notes

1 - Operating loads are campaign specific and may change in future AQRs depending on the future fuel usage tracking. Fuel levels depicted in this AQR does not restrict Shell from using a different value in future AQRs.

2 - If tracked fuel usage associated with this activity indicates emissions may exceed the approved emissions, Shell will submit revised AQR calculations.

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

Equipment/Emission Factors	units	PM	SOx	NOx	VOC	CO	REF.	DATE	Notes
NG Turbines	gms/hp-hr		0.00247	1.3	0.01	0.83	AP42 3.2-1& 3.1-1	10/96	Factors not used in this spreadsheet
NG 2-cycle lean	gms/hp-hr		0.00185	10.9	0.43	1.5	AP42 3.2-1	10/96	Factors not used in this spreadsheet
NG 4-cycle lean	gms/hp-hr		0.00185	11.8	0.72	1.6	AP42 3.2-1	10/96	Factors not used in this spreadsheet
NG 4-cycle rich	gms/hp-hr		0.00185	10	0.14	8.6	AP42 3.2-1	10/96	Factors not used in this spreadsheet
Diesel Recip. < 600 hp.	gms/hp-hr	1	0.367	14	1.12	3.03	AP42 3.3-1	10/96	Typical BOEM Factors
Diesel Recip. > 600 hp.	gms/hp-hr	0.32	0.367	11	0.33	2.4	AP42 3.4-1	10/96	Typical BOEM Factors
Diesel Boiler	lbs/bbl	0.084	0.605	0.84	0.008	0.21	AP42 1.3-12,14	9/98	Factors not used in this spreadsheet
NG Heaters/Boilers/Burners	lbs/mmscf	7.6	0.593	100	5.5	84	P42 1.4-1, 14-2, & 14	7/98	Factors not used in this spreadsheet
NG Flares	lbs/mmscf		0.593	71.4	60.3	388.5	AP42 11.5-1	9/91	Factors not used in this spreadsheet
Liquid Flaring	lbs/bbl	0.42	6.83	2	0.01	0.21	AP42 1.3-1 & 1.3-3	9/98	Factors not used in this spreadsheet
Tank Vapors	lbs/bbl				0.03		E&P Forum	1/93	Factors not used in this spreadsheet
Fugitives	lbs/hr/comp.				0.0005		API Study	12/93	Factors not used in this spreadsheet
Glycol Dehydrator Vent	lbs/mmscf				6.6		La. DEQ	1991	Factors not used in this spreadsheet
Gas Venting	lbs/scf				0.0034				Factors not used in this spreadsheet

Sulphur Content Source	**Value**	**Units**
Fuel Gas	3.33	ppm
Diesel Fuel (7)	0.1	% weight
Produced Gas(Flares)	3.33	ppm
Produced Oil (Liquid Flaring)	1	% weight

Miscellaneous Constants and Conversions

365	days/yr - Follows FLAG 2010 Guidance
2000	lb/ton conversion factor
454	g/lb conversion factor
1000	SCF/MSCF conversion factor
1.341	hp/kW conversion factor

Notes

1. Reserved
2. Reserved
3. Reserved
4. Reserved
5. Reserved
6. Reserved
7. Per 40 CFR Part 80 Subpart I, as of June 1, 2014, ECA marine fuel is subject to a maximum per-gallon sulfur content of 1,000 ppm. BOEM has indicated that use of low sulfur fuel content on the AQRs will not result in mitigations in Plan approval documents.

	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**
MODU - DRILLING	PRIME MOVER>600hp diesel	9387	453	2667	24	250	6.62	7.59	227.44	6.82	49.62	4.86	5.58	167.21	5.02	36.48
	PRIME MOVER>600hp diesel	9387	453	2667	24	250	6.62	7.59	227.44	6.82	49.62	4.86	5.58	167.21	5.02	36.48
	PRIME MOVER>600hp diesel	9387	453	2667	24	250	6.62	7.59	227.44	6.82	49.62	4.86	5.58	167.21	5.02	36.48
	PRIME MOVER>600hp diesel	9387	453	2667	24	250	6.62	7.59	227.44	6.82	49.62	4.86	5.58	167.21	5.02	36.48
	PRIME MOVER>600hp diesel	9387	453	2667	24	250	6.62	7.59	227.44	6.82	49.62	4.86	5.58	167.21	5.02	36.48
	PRIME MOVER>600hp diesel	9387	453	2667	24	250	6.62	7.59	227.44	6.82	49.62	4.86	5.58	167.21	5.02	36.48
	Energency Generator>600hp diese	2547	123	2952	1	250	1.80	2.06	61.71	1.85	13.46	0.22	0.26	7.71	0.23	1.68
	Emergency Air Compressor< 600h	26	1	30	1	250	0.06	0.02	0.80	0.06	0.17	0.01	0.00	0.10	0.01	0.02
	All other rig-equipment is electric (e.g cranes) or negligible in emissions potential (e.g. life boats, welding equipment, etc.)															
	Supply Vessel>600hp diesel (gene	10100	488	5854	24	250	7.12	8.16	244.71	7.34	53.39	10.68	12.25	367.07	11.01	80.09
	Supply Vessel>600hp diesel (gene	10100	488	5854	24	75	7.12	8.16	244.71	7.34	53.39	3.20	3.67	110.12	3.30	24.03
	Supply Vessel>600hp diesel (gene	10100	488	5854	24	75	7.12	8.16	244.71	7.34	53.39	3.20	3.67	110.12	3.30	24.03
	Crew Vessel>600hp diesel	8000	386	1391	24	100	5.64	6.47	193.83	5.81	42.29	1.01	1.16	34.89	1.05	7.61
	SERVICE/SUPPORT Vessel Diesel - General	37500	1811	43470	24	6	26.43	30.31	908.59	27.26	198.24	1.90	2.18	65.42	1.96	14.27
2020-2027	**ANNUAL TOTAL**						**94.98**	**108.88**	**3263.71**	**97.95**	**712.08**	**49.42**	**56.67**	**1698.71**	**50.97**	**370.63**
EXEMPTION CALCULATION	**DISTANCE FROM LAND IN MILES**											**1764.90**	**1764.90**	**1764.90**	**1764.90**	**47972.92**
	53.0															

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL
Shell Offshore Inc	Mississippi Canyon	MC 890 & MC 934	OCS-G-07969 & OCS-G-07975	MODU (Semi-sub or Drillship)	AA, AA-Alt, BB, BB-Alt, CC, CC-Alt and DD

Year	**Emitted**		**Substance**		
	PM	**SOx**	**NOx**	**VOC**	**CO**
			AQR Emissions if DP MODU (Semi-sub or Drillship) is Utilized		
2020-2027 Annual Total	**49.42**	**56.67**	**1698.71**	**50.97**	**370.63**
Allowable	**1764.90**	**1764.90**	**1764.90**	**1764.90**	**47972.92**

SECTION 9: OIL SPILL INFORMATION

A. Oil Spill Response Planning

All the proposed activities and facilities in this plan will be covered by the Regional OSRP filed by Shell Offshore Inc. (0689) in accordance with 30 CFR 550 and 30 CFR 254 and NTL 2013-N02. Shell's regional OSRP was approved by BSEE in June 2017, and the bi-annual review was found to be in compliance November 22, 2019.

Spill Response Sites:

Primary Response Equipment Locations	Preplanned Staging Location(s)
Ingleside, TX; Galveston, TX; Venice, LA; Ft Jackson, LA; Harvey, LA; Stennis, MS; Pascagoula, MS; Theodore, AL; Tampa, FL	Galveston, TX; Port Fourchon; Venice, LA; Pascagoula, MS ; Mobile, AL; Tampa, FL

OSRO Information: The names of the oil spill removal organizations (OSRO's) under contract include Clean Gulf Associates (CGA), Marine Spill Response Company (MSRC) and Oil Spill Response Limited (OSRL). These OSRO's provide equipment and will in some cases provide trained personnel to operate their response equipment (OSRVs, etc.). Shell has the option to pull from their trained personnel as needed for assistance/expertise in the Command Post and in the field.

Worst Case Scenario Determination:

Category	Regional OSRP	EP
Type of Activity	Subsea Drilling	Drilling Rig
Facility Location (area/block)	MC 812	MC 934
Facility Designation	Subsea well B◇	Subsea Well DD
Distance to Nearest Shoreline (miles)	59	53
Volume		
Storage tanks (total)	N/A	N/A
Flowlines (on facility)	N/A	N/A
Pipelines	N/A	N/A
Uncontrolled blowout (volume per day)	468,000* BOPD	364,696** BOPD
Total Volume	468,000 Bbls	364,696 Bbls
Type of Oil(s) - (crude oil, condensate, diesel)	Crude oil	Crude oil
API Gravity(s)	31°	27°

*24 hour rate (432,000 BOPD 30 day average)
**24 hour rate (335,767 BOPD 30 day average)

◇This well was reviewed and accepted by BOEM on in plan N-9840.

Certification: Shell has the capability to response to the appropriate worst-case spill scenario included in its Regional OSRP, approved June 2017, and the bi-annual review that was found to be in compliance on November 22, 2019. Since the number proposed in this EP does not exceed the number approved in our OSRP, I hereby certify that Shell 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 EP.

Modeling:

Based on the requirement per BSEE NTL 2008-G04 and the outcome of the OSRAM Model, Shell Offshore Inc. determined no additional modeling was needed for potential oil or hazardous substance spill for operations proposed in this exploration plan, as the current, approved OSRP adequately meets the necessary response capabilities.

B. Oil Spill Response Discussion

1. Volume of the Worst-Case Discharge

Please refer to Section 2j and 9(iv) of this EP.

2. Trajectory Analysis

Trajectories of a spill and the probability of it impacting a land segment have been projected utilizing information in the BSEE Oil Spill Risk Analysis Model (OSRAM) for the Central and Western Gulf of Mexico available on the BSEE website using 30-day impact. Offshore areas along the trajectory between the source and land segment contact could be impacted. The land segment contact probabilities are shown in Table 9.C.1.

Area/Block	OCS-G	Launch Area	Land Segment Contact	%
Exploratory MC 934		58	Galveston, TX	1
			Jefferson, TX	1
			Cameron, LA	3
			Vermillion, LA	2
			Iberia, LA	1
			Terrebonne, LA	3
			LaFourche, LA	3
			Jefferson, LA	1
			Plaquemines, LA	8
			St. Bernard, LA	1
			Okaloosa, FL	1

Table 9.C.1 Probability of Land Segment Impact

C. Resource Identification

The locations identified in Table 9.C.1 are the highest probable land segments to be impacted using the BSEE Oil Spill Risk Analysis Model (OSRAM). The environmental sensitivities are identified using the appropriate National Oceanic and Atmospheric Administration (NOAA) Environmental Sensitivity Index (ESI) maps for the given land segment. ESI maps provide a concise summary of coastal resources that are at risk if an oil spill occurs nearby. Examples of at-risk resources include biological resources (such as birds and shellfish beds), sensitive shorelines (such as marshes and tidal flats), and human-use resources (such as public beaches and parks).

In the event an oil spill occurs, ESI maps can help responders meet one of the main response objectives: reducing the environmental consequences of the spill and the cleanup efforts. Additionally, ESI maps can be used by planners to identify vulnerable locations, establish protection priorities, and identify cleanup strategies.

The following is a list of resources of special economic or environmental importance that potentially could be impacted by the Mississippi Canyon 934 WCD scenario.

Onshore/Nearshore: Plaquemines Parish has been identified as the most probable impacted Parish within the Gulf of Mexico for the Greater than 10 Mile Worst Case Discharge and the Exploratory Worst Case Discharge. Plaquemines Parish has a total area of 2,429 square miles of which, 845 square miles of it is land and 1,584 square miles is water. Plaquemines Parish includes two National Wildlife Refuges: Breton National Wildlife Refuge and Delta National Wildlife Refuge. This area is also a nesting ground for the brown pelican, an endangered species. Examples of Environmental Sensitivity maps for Plaquemines Parish are detailed in the following pages. Key ESI maps for Plaquemines Parish and the legend are shown in Figures 9.C.1 through 9.C.5.

Offshore: An offshore spill may require an Essential Fishing Habitat (EFH) Assessment. This assessment would include a description of the spill, analysis of the potential adverse effects on EFH and the managed species; conclusions regarding the effects on the EFH; and proposed mitigation, if applicable.

Significant pre-planning of joint response efforts was undertaken in response to provisions of the National Contingency Plan (NCP). Area Contingency Plans (ACPs) were developed to provide a well coordinated response to oil discharges and other hazardous releases. The One Gulf Plan is specific to the Gulf of Mexico to advance the unity of policy and effort in each of the Gulf Coast ACPs. Strategies used for the response to an oil spill regarding protection of identified resources are detailed in the One Gulf Plan and relevant Gulf Coast ACP.

D. Worst Case Discharge Response

Shell will make every effort to respond to the MC 934 Worst Case Discharge as effectively as possible. Below is a table outlining the applicable evaporation and surface dispersion quantity:

Mississippi Canyon Block 934		Calculations (BBLS)
i.	TOTAL WCD (based on 30-day average (per day))	~335,767
ii.	Approximate loss of volume of oil to natural surface dispersion and evaporation base (approximate bbls per day) (10% Natural surface evaporation and dispersion in 24 hrs)	-33,576
	APPROXIMATE TOTAL REMAINING	~302,191

Table 9.D.1 Oil Remaining After Surface Dispersion

Shell has contracted OSROs to provide equipment, personnel, materials and support vessels as well as temporary storage equipment to be considered in order to cope with a WCD spill. Under adverse weather conditions, major response vessels and Transrec skimmers are still effective and safe in sea states of 6-8 ft. If sea conditions prohibit safe mechanical recovery efforts, then natural dispersion and airborne chemical dispersant application (visibility & wind conditions permitting) may be the only safe and viable recovery option.

MSRC OSRV	8 foot seas
VOSS System	4 foot seas
Expandi Boom	6 foot seas, 20 knot winds
Dispersants	Winds more than 25 knots, Visibility less than 3 nautical miles, or Ceiling less than 1,000 feet.

Table 9.D.2 Operational Limitations of Response Equipment

Upon notification of the spill, Shell would request a partial or full mobilization of contracted resources, including, but not limited to, skimming vessels, oil storage vessels, dispersant aircraft, subsea dispersant, shoreline protection, wildlife protection, and containment equipment. Following is a list of the contracted resources including de-rated recovery capacity, personnel, and estimated response times (procurement, load out, travel time to the site, and deployment). The Incident Commander or designee may contact other service companies if the Unified Command deems such services necessary to the response efforts.

Based on the anticipated worst case discharge scenario, Shell can be onsite with dedicated, contracted on water oil spill recovery equipment with adequate response capacity to contain and recover surface oil, and prevent land impact, within approximately 44 hours (based on the equipment's Estimated Daily Response Capacity (EDRC) and storage capacity). Shell will continue to ramp up additional on-water mechanical recovery resources as well as apply dispersants and in-situ burning as needed and as approved under the supervision of the USCG Captain of the Port (COTP) and the Regional Response Team (RRT).

Subsea Control and Containment: Shell, as a founding member of the MWCC, will have access to the IRCS that can be rapidly deployed through the MWCC. The IRCS is designed to contain oil flow in the unlikely event of an underwater well blowout, and is designed, constructed, tested, and available for rapid response. Shell's specific containment response for MC 934 will be addressed in Shell's NTL 2010-N10 submission at the time the APD is submitted.

Table 9.D.9 Control, Containment, and Subsea Dispersant Package Activation List

Mechanical Recovery (skimming): Response strategies include skimming utilizing available OSROs Oil Spill Response Vessels (OSRVs), Oil Spill Response Barges (OSRBs), ID Boats, and Quick Strike OSRVs. There is a combined de-rated recovery rate capability of approximately 702,000 barrels/day. Temporary storage associated with the identified skimming and temporary storage equipment equals approximately 443,000 barrels.

	De-rated Recovery Rate (bopd)	Storage (bbls)
Offshore Recovery and Storage	381,296	426,534
Nearshore Recovery and Storage	321,042	16,979
Total	702,338	443,513

Table 9.D.3 Mechanical Recovery Combined De-Rated Capability

Table 9.D.4 Offshore On-Water Recovery and Storage Activation List
Table 9.D.5 Nearshore On-Water Recovery and Storage 5ctivation List

Oil Storage: The strategy for transferring, storing and disposing of oil collected in these recovery zones is to utilize two 150,000-160,000 ton (dead weight) tankers mobilized by Shell (or any other tanker immediately available). The recovered oil would be transferred to Motiva's Norco, LA storage and refining facility, or would be stored at Delta Commodities, Inc. Harvey, LA facility.

Aerial Surveillance: Aircraft can be mobilized to detect, monitor, and target response to oil spills. Aircraft and spotters can be mobilized within hours of an event.

Table 9.D.6 Aerial Surveillance Activation List

Aerial Dispersant: Depending on proximity to shore and water depth, dispersants may be a viable response option. If appropriate and approved, 4 to 5 sorties from three DC-3's can be made within the first 12 hour operating day of the response. These aerial systems could disperse approximately 7,704 to 9,630 barrels of oil per day. Additionally, 3 to 4 sorties from the BE90 King Air and 3 to 4 sorties from the Hercules C-130A within the first 12 hour operating day of the response could disperse 4,600 to 6,100 barrels of oil per day. For continuing dispersant operations, the CCA's Aerial Dispersant Delivery System (ADDS) would be mobilized. The ADDS has a dispersant spray capability of 5,000 gallons per sortie.

Table 9.D.7 Offshore Aerial Dispersant Activation List

Vessel Dispersant: Vessel dispersant application is another available response option. If appropriate, vessel spray systems can be installed on offshore vessels of opportunity using inductor nozzles (installed on fire-water monitors), skid mounted systems, or purpose-built boom arm spray systems. Vessels can apply dispersant within the first 12-24 hours of the response and continually as directed.

Table 9.D.8 Offshore Boat Spray Dispersant Activation List

Subsea Dispersant: Shell has contracted with Wild Well Control for a subsea dispersant package. Subsea dispersant application has been found to be highly effective at reducing the amount of oil reaching the surface. Additional data collection, laboratory tests and field tests will help in facilitating the optimal application rate and effectiveness numbers. For planning purposes, the system has the potential to disperse approximately 24,500 to 34,000 barrels of oil per day.

Table 9.D.9 Control, Containment, and Subsea Dispersant Package Activation List

In-Situ Burning: Open-water in-situ burning (ISB) also may be used as a response strategy, depending on the circumstances of the release. ISB services may be provided by the primary OSRO contractors. If appropriate conditions exist and approvals are granted, one or multiple ISB task forces could be deployed offshore. Task forces typically consist of two to four fire teams, each with two vessels capable of towing fire boom, guide boom or tow line with either a handheld or aerially-deployed oil ignition system. At least one support/safety boat would be present during active burning operations to provide logistics, safety and monitoring support. Depending upon a number of factors, up to 4 burns per 12-hour day could be completed per ISB fire team. Most fire boom systems can be used for approximately 8-12 burns before being replaced. Fire intensity and weather will be the main determining factors for actual burns per system. Although the actual amount of oil that will be removed per burn is dependent on many factors, recent data suggests that a typical burn might eliminate approximately 750 barrels. For planning purposes and based on the above assumptions, a single task force of four fire teams with the appropriate weather and safety conditions could complete four burns per day and remove up to ~12,000 bbls/day. In-situ burning nearshore and along shorelines may be a possible option based on several conditions and with appropriate approvals, as outlined in Section 19, In-situ Burn Plan (OSRP). In-situ burning along certain types of shorelines may be used to minimize physical damage where access is limited or if it is determined that mechanical/manual removal may cause a substantial negative impact on the environment. All safety considerations will be evaluated. In addition, Shell will assess the situation and can make notification within 48 hours of the initial spill to begin ramping up fire boom production through contracted OSRO(s). There are potential limitations that need to be assessed prior to ISB operations. Some limitations include atmospheric and sea conditions; oil weathering; air quality impacts; safety of response workers; and risk of secondary fires.

Table 9.D.10 In-Situ Burn Equipment Activation List

Shoreline Protection: If the spill went unabated, shoreline impact in Plaquemines Parish, LA would depend upon existing environmental conditions. Nearshore response may include the deployment of shoreline boom on beach areas, or protection and sorbent boom on vegetated areas. Strategies would be based upon surveillance and real time trajectories provided by The Response Group that depict areas of potential impact given actual sea and weather conditions. Strategies from the New Orleans, Louisiana Area Contingency Plan, Unified Command would be consulted to ensure that environmental and special economic resources would be correctly identified and prioritized to ensure optimal protection. Shell has access to shoreline response guides that depict the protection response modes applicable for oil spill clean-up operations. Each response mode is schematically represented to show optimum deployment and operation of the equipment in areas of environmental concern. Supervisory personnel have the option to modify the deployment and operation of equipment allowing a more effective response to site-specific circumstances.

Table 9.D.11 Shoreline Protection and Wildlife Support List

Wildlife Protection: If wildlife is threatened due to a spill, the contracted OSRO's have resources available to Shell, which can be utilized to protect and/or rehabilitate wildlife. The resources under contract for the protection and rehabilitation of affected wildlife are in Table 9.D.11.

New or unusual technology in regards to spill, prevention, control and clean-up:
Shell will use our normal well design and construction processes with multiple barrier approach as well as new stipulations mandated by NTL 2008-N05. Response techniques will utilize new learnings from Macondo response to include in-situ burning and subsea dispersant application. Mechanical recovery advancements are continuing to be made to incorporate utilization of Koseq arms outfitted on barges, conversion of Platform Support Vessels for Oil Spill Response, and inclusion of nighttime spill detection radar to improve tracking capabilities (X-Band radar, Infrared sensing, etc.). In addition, new response technologies/techniques are continuing to be considered by Shell and the appropriate government organizations for incorporation into our planned response. Any additional response technologies/techniques presented at the time of response will be used at the discretion of the Unified Command and USCG.

LOUISIANA

SHORELINE HABITATS (ESI)

2001 ESI Shoreline Classification

🟪	1B)	EXPOSED, SOLID MAN-MADE STRUCTURES
🟪	2A) 2B)	EXPOSED WAVE-CUT PLATFORMS IN CLAY EXPOSED SCARPS AND STEEP SLOPES IN CLAY
🟦	3A) 3B)	FINE- TO MEDIUM-GRAINED SAND BEACHES SCARPS AND STEEP SLOPES IN SAND
🟦	4)	COARSE-GRAINED SAND BEACHES
🟦	5)	MIXED SAND AND GRAVEL BEACHES
🟩	6A)	GRAVEL BEACHES
🟩	6B)	RIPRAP
🟨	7)	EXPOSED TIDAL FLATS
🟨	8A)	SHELTERED ROCKY SHORES AND SHELTERED SCARPS IN MUD OR CLAY
🟥	8B)	SHELTERED MAN-MADE STRUCTURES
🟨	8C)	SHELTERED RIPRAP
🟧	9A) 9B)	SHELTERED TIDAL FLATS SHELTERED, VEGETATED LOW BANKS
🟥	10A)	SALT- AND BRACKISH-WATER MARSHES
🟥	10B)	FRESHWATER MARSHES
🟥	10C)	FRESHWATER SWAMPS
🟫	10D)	SCRUB-SHRUB WETLANDS

COASTAL HABITATS

From 1988 Digital Shoreline

▨	10A)	SALT MARSH
▨	10A)	BRACKISH MARSH
▨	10A)	INTERMEDIATE MARSH
▨	10B)	FRESHWATER MARSH
▨	10C)	FORESTED WETLAND
▨	10D)	SCRUB-SHRUB WETLAND
▨		SEAGRASS

SENSITIVE BIOLOGICAL RESOURCES

▨ BIRD

- ● DIVING BIRD
- ● GULL / TERN
- ● PASSERINE
- ● RAPTOR
- ● SHOREBIRD
- ● WADING BIRD
- ● WATERFOWL
- • NESTING SITE

▨ FISH

- ● FISH

▥ TERRESTRIAL MAMMAL

- ● BAT
- ● BEAR
- ● SMALL MAMMAL

▨ INVERTEBRATE

- ● BIVALVE
- ● CEPHALOPOD
- ● CRAB
- ● CRAYFISH
- ● INSECT
- ● SHRIMP

▨ REPTILE / AMPHIBIAN

- ● ALLIGATOR
- ● TURTLE
- ● OTHER REPTILE / AMPHIBIAN

▤ HABITAT

- ● PLANT
- ● ▦ SEAGRASS

▨ MUTIPLE ELEMENTS

- ☐ THREATENED / ENDANGERED
- ▭ RAR NUMBER

HUMAN-USE FEATURES

- ○ AIRPORT / HELIPORT
- ○ BOAT RAMP
- ○ INDIAN RESERVATION
- ○ MARINA
- ○ NATIONAL PARK / NATURE CONSERVANCY
- ○ SENIC RIVER
- ○ STATE PARK
- ○ WILDLIFE REFUGE
- ▭ HUMAN-USE NUMBER
- - - - PARISH BOUNDARY
- —·— MANAGEMENT BOUNDARY
- ═ MAJOR ROAD
- — MINOR ROAD
- — SHORELINE FROM 2001 PHOTO INTERPRETATION
- — SHORELINE FROM 1988 DIGITAL DATA

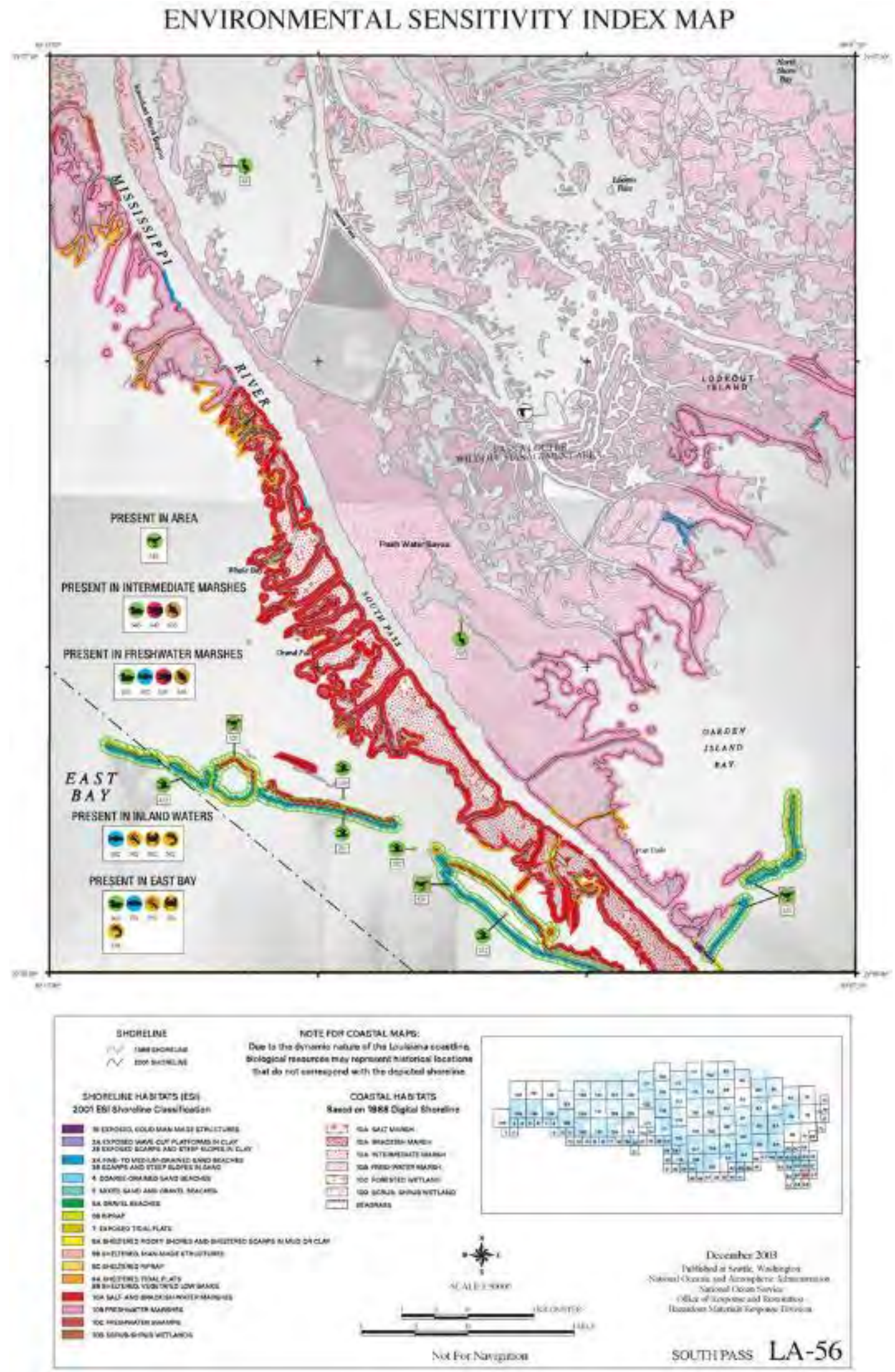


Figure 9.C.2 South Pass ESI Map

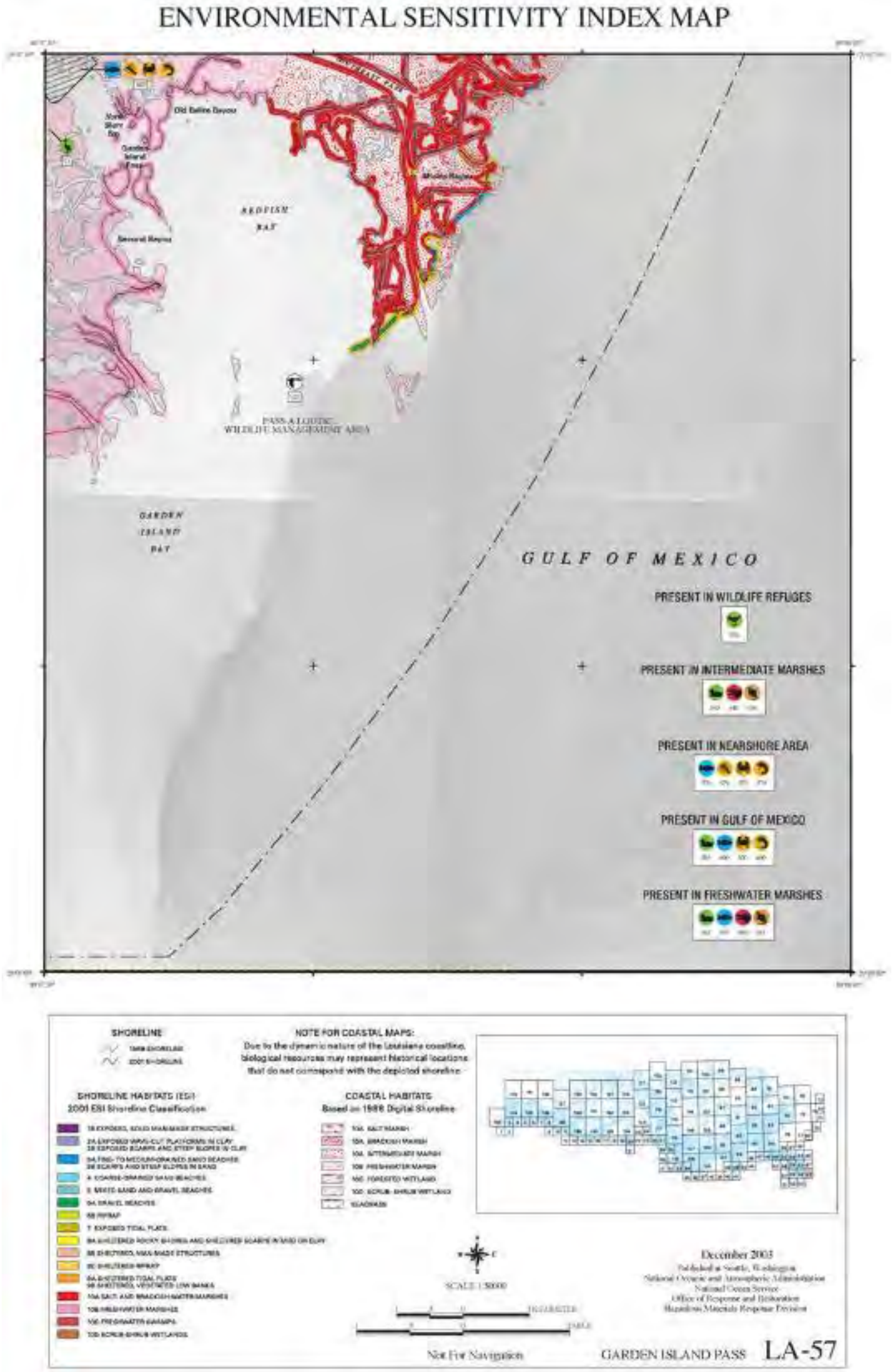


Figure 9.C.3 Garden Island Pass ESI Map

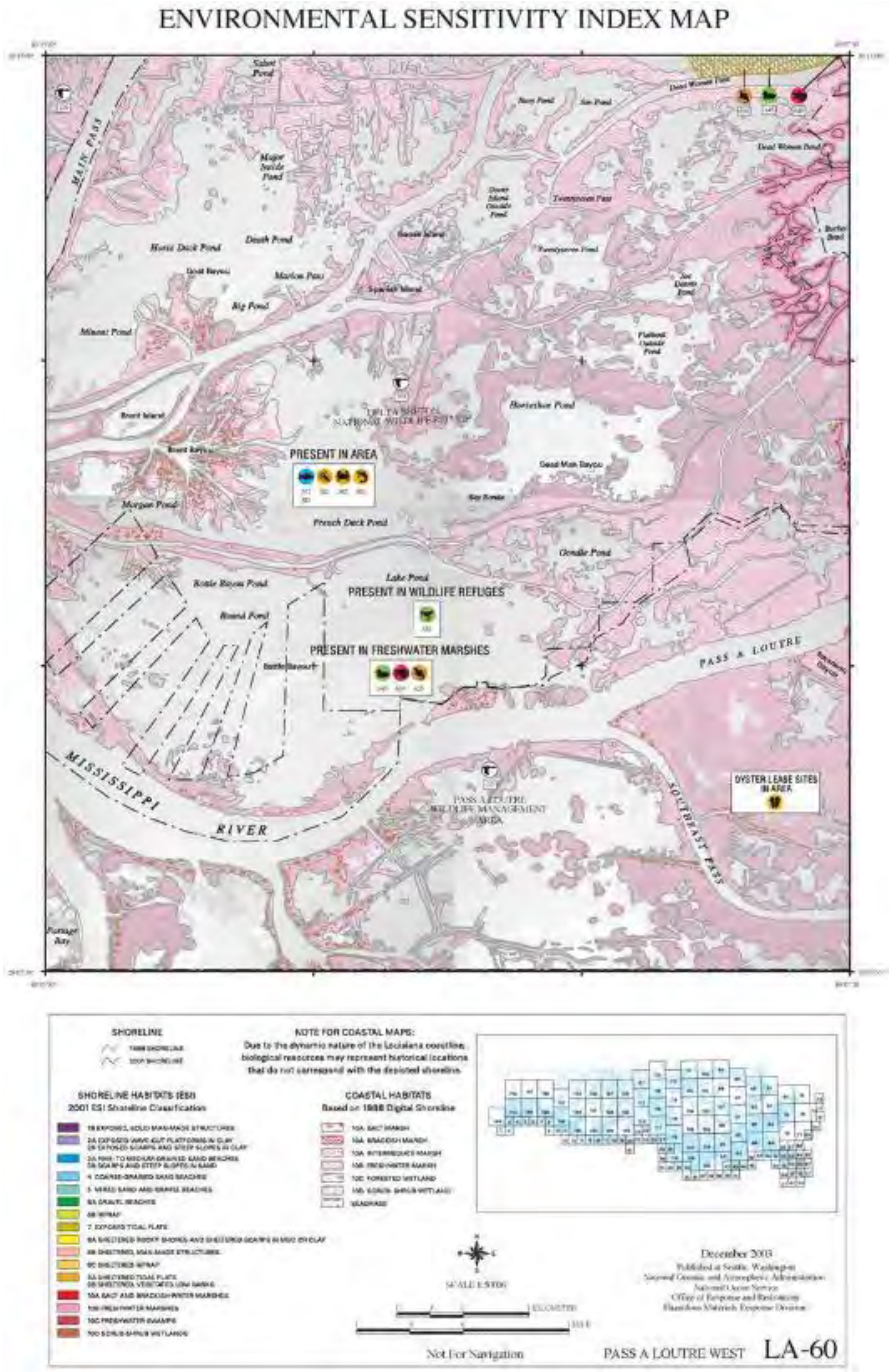


Figure 9.C.4 Pass a Loutre West ESI Map

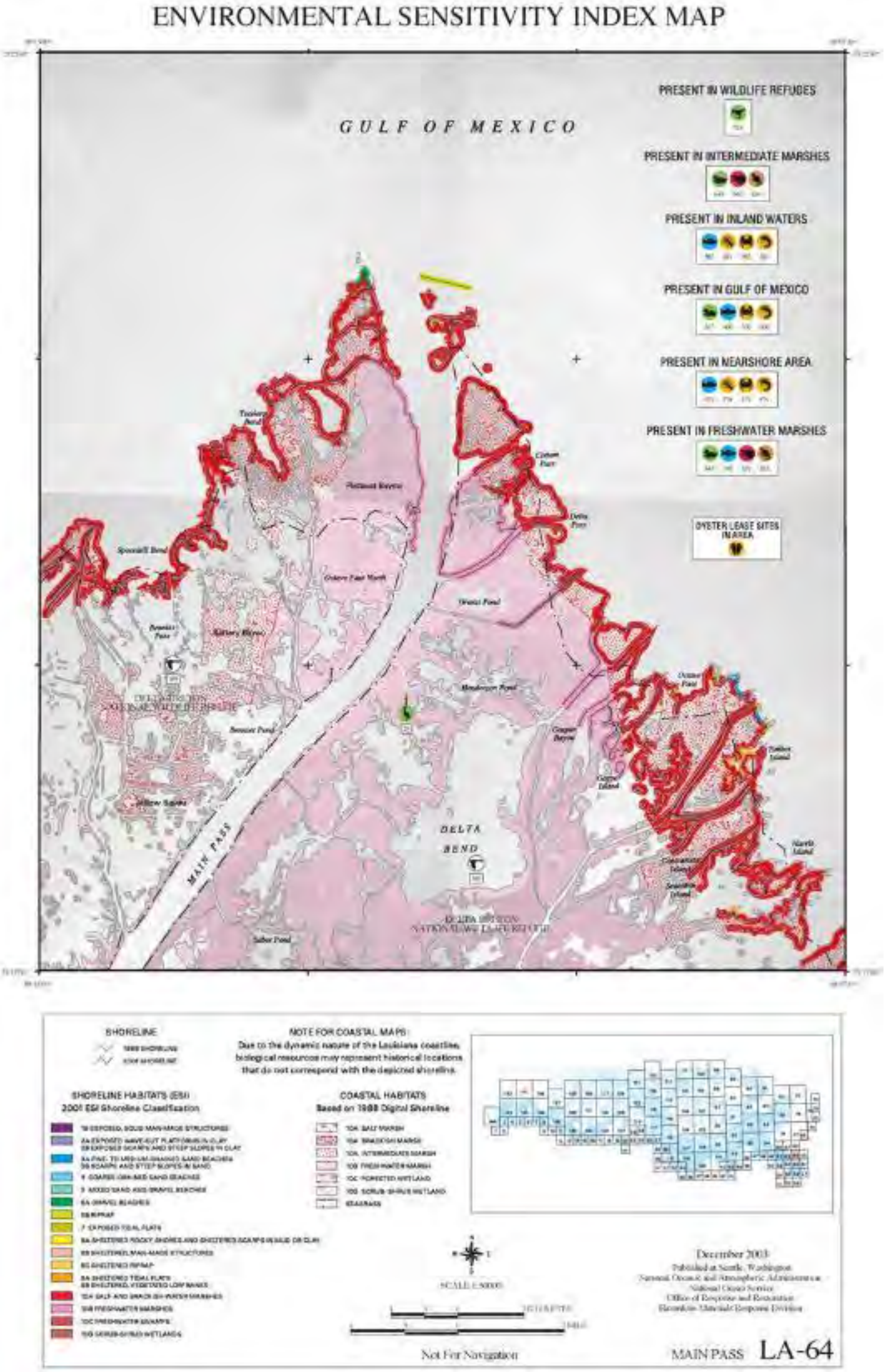


Figure 9.C.5 Main Pass ESI Map

Mississippi Canyon 890
Sample Offshore On-Water Recovery & Storage Activation List

Note: *Total ETA might be effected by weather, sea state, lock closure, 3rd party vessel availability.*

** - These components are additional operational requirements that must be procured in addition to the system identified.*

*** - These components are additional operational requirements for the packages to be used in an enhanced skimming deployment.*

**** - Specific barge names may vary.*

Skimming System	Supplier & Phone	Warehouse	Skimming Package	Quantity	Effective Daily Recovery Capacity (EDRC in Bbls/Day)	Storage (Barrels)	Staging Area	Distance to Site from Staging (Miles)	Response Times (Hours)				
									Staging ETA	Loadout Time	ETA to Site	Deployment Time	Total ETA
FRV Breton Island	CGA (888) 242-2007	Venice, LA	Lamor Brush Skimmer	2	22,885	249	Venice, LA	88	2	0	5	1	**8**
			36" Boom	64									
			95' Vessel	1									
			X Band Radar	1									
			Personnel	6									
FRV JL O'Brien	CGA (888) 242-2007	Leeville, LA	Lamor Brush Skimmer	2	22,885	249	Leeville, LA	88	2	0	5	1	**8**
			36" Boom	64									
			95' Vessel	1									
			X Band Radar	1									
			Personnel	6									
Louisiana Responder Transec 350	MSRC (800) OIL-SPIL	Fort Jackson, LA	Transrec Skimmer	1	10,567	4,000	Fort Jackson, LA	99	2	1	8	1	**12**
			Back - Stress 1 Skimmer	1									
			67" Pressure Inflatable Boom	2310'									
			210' Vessel	1									
			Personnel	10									
			32' Support Boat	1									
			X Band Radar	1									
			Infrared Camera	1									
			FAES #4 "Buster"	1									
S.T. Benz Responder LFF 100 Brush	MSRC (800) OIL-SPIL	Grand Isle, LA	LFF 100 Brush Skimmer	1	18,086	4,000	Grand Isle, LA	91	3	1	7.5	1	**13**
			Backup - Stress 1 Skimmer	1									
			67" Pressure Inflatable Boom	2310'									
			210' Vessel	1									
			Personnel	10									
			32' Support Boat	1									
			X Band Radar	1									
			Infrared Camera	1									
			FAES #4 "Buster"	1									
Stress 1	MSRC (800) OIL-SPIL	Grand Isle, LA	Offshore Skimmer "S.T. Benz Responder"	1	15,840	0	Port Fourchon, LA	88	4	1	7.5	1	**14**
			67" Pressure Inflatable Boom "S.T. Benz Responder"	330'									
			Personnel	5									
			*Appropriate Vessel	2									
			*Temporary Storage	1		500							
Stress 1	MSRC (800) OIL-SPIL	Fort Jackson, LA	Offshore Skimmer "Louisiana Responder"	1	15,840	0	Port Fourchon, LA	88	5.5	1	7.5	1	**15**
			67" Pressure Inflatable Boom "Louisiana Responder"	330'									
			Personnel	5									
			*Appropriate Vessel	2									
			*Temporary Storage	1		500							
FRV H.I. Rich	CGA (888) 242-2007	Vermilion, LA	Lamor Brush Skimmer	2	22,885	249	Vermillion, LA	88	2	0	13	1	**16**
			36" Boom	64									
			95' Vessel	1									
			X Band Radar	1									
			Personnel	6									
Stress 1	MSRC (800) OIL-SPIL	Pascagoula, MS	Offshore Skimmer "Mississippi Responder"	1	15,840	0	Port Fourchon, LA	88	5.75	1	7.5	1	**16**
			67" Pressure Inflatable Boom	330'									
			Personnel	5									
			*Appropriate Vessel	2									
			*Temporary Storage	1		500							
Mississippi Responder Transrec-350	MSRC (800) OIL-SPIL	Pascagoula, MS	Transrec Skimmer	1	10,567	4,000	Pascagoula, MS	180	2	1	15	1	**19**
			Backup - Stress 1 Skimmer	1									
			67" Pressure Inflatable Boom	2640'									
			210' Vessel	1									
			Personnel	10									
			32' Support Boat	1									
			X Band Radar	1									
			Infrared Camera	1									
			FAES #4 "Buster"	1									

Table 9.D.4 Offshore On-Water Recovery Storage Activation List

Mississippi Canyon 890
Sample Offshore On-Water Recovery & Storage Activation List

Skimming System	Supplier & Phone	Warehouse	Skimming Package	Quantity	Effective Daily Recovery Capacity (EDRC in Bbls/Day)	Storage (Barrels)	Staging Area	Distance to Site from Staging (Miles)	Response Times (Hours)				
									Staging ETA	Loadout Time	ETA to Site	Deployment Time	Total ETA
Note: Total ETA might be effected by weather, sea state, lock closure, 3rd party vessel availability. * - These components are additional operational requirements that must be procured in addition to the system identified. ** - These components are additional operational requirements for the packages to be used in an enhanced skimming deployment. *** - Specific barge names may vary.													
MSRC-452 Offshore Barge	MSRC (800) OIL-SPIL	Fort Jackson, LA	Offshore Barge	1	11,122	45,000	Fort Jackson, LA	99	4	1	12.5	1	19
			67" Pressure Inflatable Boom	2640'									
			Crucial Disc Skimmer 88/30	1									
			Backup - Desmi Ocean	1									
			*Appropriate Vessel	1									
			Personnel	9									
			* Offshore Tug	2									
			X Band Radar	1									
			Infrared Camera	1									
PT 150 Aquaguard Skimmer (2)	CGA (888) 242-2007	Harvey, LA	Brush skimmer	1	22,323	0	Port Fourchon, LA	88	4	6	9	1	20
			Personnel	4									
			* Offshore Utility Boat	1									
			* Add'l Storage	2		1,000							
Fast Response Unit "FRU" 1.0	CGA (888) 242-2007	Leeville, LA	Foilex 250 Skimmer	1	4,251	100	Port Fourchon, LA	88	4	6	9	1	20
			Personnel	4									
			Utility Boat	1									
			53" Skimming Boom	75'									
			** 67" Sea Sentry	440'									
			** Crew Boat	1									
			** Add'l Storage	1		100							
Fast Response Unit "FRU" 1.0	CGA (888) 242-2007	Leeville, LA	Foilex 250 Skimmer	1	4,251	100	Port Fourchon, LA	88	4	6	9	1	20
			Personnel	4									
			Utility Boat	1									
			53" Skimming Boom	75'									
			** 67" Sea Sentry	440'									
			** Crew Boat	1									
			** Add'l Storage	1		100							
Fast Response Unit "FRU" 1.0	CGA (888) 242-2007	Vermillion, LA	Foilex 250 Skimmer	1	4,251	100	Port Fourchon, LA	88	5.25	6	9	1	22
			Personnel	4									
			Utility Boat	1									
			53" Skimming Boom	75'									
			** 67" Sea Sentry	440'									
			** Crew Boat	1									
Fast Response Unit "FRU" 1.0	CGA (888) 242-2007	Venice, LA	Foilex 250 Skimmer	1	4,251	100	Port Fourchon, LA	88	5.75	6	9	1	22
			Personnel	4									
			Utility Boat	1									
			53" Skimming Boom	75'									
			** 67" Sea Sentry	440'									
			** Crew Boat	1									
			** Add'l Storage	1		100							
Fast Response Unit "FRU" 1.0	CGA (888) 242-2007	Venice, LA	Foilex 250 Skimmer	1	4,251	100	Port Fourchon, LA	88	5.75	6	9	1	22
			Personnel	4									
			Utility Boat	1									
			53" Skimming Boom	75'									
			** 67" Sea Sentry	440'									
			** Crew Boat	1									
			** Add'l Storage	1		100							
FRV Galveston Island	CGA (888) 242-2007	Galveston, TX	Lamor Brush Skimmer	2	22,885	249	Galveston, TX	338	2	0	22	1	25
			36" Boom	64									
			95' Vessel	1									
			X Band Radar	1									
			Personnel	6									
MSRC-402 Offshore Barge	MSRC (800) OIL-SPIL	Pascagoula, MS	Offshore Barge	1	11,122	40,300	Pascagoula, MS	180	4	1	22.5	1	29
			67" Pressure Inflatable Boom	2640'									
			Crucial Disc Skimmer 88/30	1									
			Backup - Crucial Disc Skimmer 88/30	1									
			*Appropriate Vessel	1									
			Personnel	9									
			* Offshore Tug	2									
			X Band Radar	1									
			Infrared Camera	1									

Table 9.D.4 Offshore On-Water Recovery Storage Activation List (continued)

Mississippi Canyon 890
Sample Offshore On-Water Recovery & Storage Activation List

Note: Total ETA might be effected by weather, sea state, lock closure, 3rd party vessel availability.
** - These components are additional operational requirements that must be procured in addition to the system identified.*
*** - These components are additional operational requirements for the packages to be used in an enhanced skimming deployment.*
**** - Specific barge names may vary.*

Skimming System	Supplier & Phone	Warehouse	Skimming Package	Quantity	Effective Daily Recovery Capacity (EDRC in Bbls/Day)	Storage (Barrels)	Staging Area	Distance to Site from Staging (Miles)	Response Times (Hours)				
									Staging ETA	Loadout Time	ETA to Site	Deployment Time	Total ETA
CGA-200 HOSS Barge (OSRB)	CGA (888) 242-2007	Harvey, LA	Marco Skimmer 67" Sea Sentry Personnel * Tug - 1,200 HP X Band Radar * Tug - 1,800 HP	4 2640' 12 2 1 1	76,285	4,000	Harvey, LA	152	6	0	22	2	30
Gulf Coast Responder Transrec-350	MSRC (800) OIL-SPIL	Lake Charles, LA	Transrec Skimmer Backup - Stress 1 Skimmer 67" Pressure Inflatable Boom 210' Vessel Personnel 32' Support Boat X Band Radar Infrared Camera FAES #4 "Buster"	1 1 2640' 1 10 1 1 1 1	10,567	4,000	Lake Charles, LA	288	2	1	24	1	28
PSV-VOO Skimming System (Brush)	MSRC (800) OIL-SPIL	Lake Charles, LA	Lamor Brush Skimmer 67" Pressure Inflatable Boom * PSV-VOO Personnel Thermal Infrared Camera *Appropriate Vessel * Marine Portable Tank	1 1320' 1 9 1 1 2	18,086	0 1,000	Port Fourchon, LA	88	24	1	7.5	1	34
Texas Responder Transrec-350	MSRC (800) OIL-SPIL	Galveston, TX	Transrec Skimmer Backup - Stress 1 Skimmer 67" Pressure Inflatable Boom 210' Vessel Personnel 32' Support Boat X Band Radar Infrared Camera FAES #4 "Buster"	1 1 2640' 1 10 1 1 1 1	10,567	4,000	Galveston, TX	420	2	1	35	1	39
Southern Responder Transrec-350	MSRC (800) OIL-SPIL	Ingleside, TX	Transrec Skimmer Backup - Stress 1 Skimmer 67" Pressure Inflatable Boom 210' Vessel Personnel 32' Support Boat X Band Radar Infrared Camera FAES #4 "Buster"	1 1 2640' 1 10 1 1 1 1	10,567	4,000	Ingleside, TX	479	2	1	40	1	44
MSRC-570 Offshore Barge	MSRC (800) OIL-SPIL	Galveston, TX	Offshore Barge 67" Pressure Inflatable Boom Crucial Disc Skimmer 88/30 Backup - Crucial Disc Skimmer 88/30 *Appropriate Vessel Personnel * Offshore Tug X Band Radar Infrared Camera	1 2640' 1 1 1 9 2 1 1	11,122	56,900	Galveston, TX	420	4	1	52.5	1	59
***K-Sea DBL 105 Offshore Barge	CGA (888) 242-2007	Belle Chasse, LA	Offshore Barge Personnel * Offshore Tug	1 10 1	N/A	115,183	Houma, LA	138	24-72	0	17.5	1	43 to 91
***K-Sea DBL 134 Offshore Barge	CGA (888) 242-2007	Belle Chasse, LA	Offshore Barge Personnel * Offshore Tug	1 10 1	N/A	135,755	Houma, LA	138	24-72	0	17.5	1	43 to 91

DERATED RECOVERY RATE (BBLS/DAY)	381,296
STORAGE CAPACITY INCLUDING SKIMMING VESSELS (BARRELS)	426,534

Table 9.D.4 Offshore On-Water Recovery Storage Activation List (continued)

Mississippi Canyon 890
Sample Nearshore On-Water Recovery Activation List

Skimming System	Supplier & Phone	Warehouse	Skimming Package	Quantity	Effective Daily Recovery Capacity (EDRC in Bbls/Day)	Storage (Barrels)	Staging Area	Distance to Nearshore Environment (Miles)	Response Times (Hours)				
									Staging ETA	Loadout Time	ETA to Nearshore Environment	Deployment Time	Total ETA
* - These components are additional operational requirements that must be procured in addition to the system identified. NOTE: Total ETA might be effected by weather, sea state, lock closure, 3rd party vessel availability.													
SWS CGA-77 FRV	CGA (888) 242-2007	Venice, LA	Lori Brush Skimmer	2	22,885	249	Venice, LA	46	2	0	2.5	1	6
			36" Boom	150									
			60' Vessel	1									
			X Band Radar	1									
			Personnel	4									
SWS CGA-76 FRV	CGA (888) 242-2007	Leeville, LA	Lori Brush Skimmer	2	22,885	249	Leeville, LA	70	2	0	4	1	7
			36" Boom	150									
			60' Vessel	1									
			X Band Radar	1									
			Personnel	4									
FRV M/V Grand Bay	CGA (888) 242-2007	Venice, LA	Lori Brush Skimmer	2	15,257	65	Venice, LA	46	2	0	4.5	1	8
			36" Boom	46'									
			46' Vessel	1									
			Personnel	4									
SWS CGA-53 MARCO Shallow Water Skimmer	CGA (888) 242-2007	Leeville, LA	Marco Belt Skimmer	1	3,588	34	Port Fourchon, LA	60	4	2	3.5	1	11
			* 18" Boom (contractor)	100'									
			Personnel	3									
			38' Skimming Vessel	1									
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Belle Chasse, LA	Skimmer	1	905	400	Port Fourchon, LA	60	4.25	1	5	1	12
			18" Boom	50'									
			Personnel	4									
			Non-self-propelled barge	1									
			Push Boat	1									
MSRC "Kvichak"	MSRC (800) OIL-SPIL	Belle Chasse, LA	Marco I Skimmer	1	3,588	24	Port Fourchon, LA	60	4.25	1	5	1	12
			Personnel	2									
			30' Shallow Water Vessel	1									
SWS CGA-52 MARCO Shallow Water Skimmer	CGA (888) 242-2007	Venice, LA	Marco Belt Skimmer	1	3,588	34	Port Fourchon, LA	60	6	2	3.5	1	13
			* 18" Boom (contractor)	100'									
			Personnel	3									
			36' Skimming Vessel	1									
			Shallow Water Barge	1		249							
SWS CGA-51 MARCO Shallow Water Skimmer	CGA (888) 242-2007	Lake Charles, LA	Marco Belt Skimmer	1	3,588	20	Port Fourchon, LA	60	6	2	3.5	1	13
			* 18" Boom (contractor)	100'									
			Personnel	3									
			34' Skimming Vessel	1									
			Shallow Water Barge	1		249							
MSRC "Kvichak"	MSRC (800) OIL-SPIL	Pascagoula, MS	Marco I Skimmer	1	3,588	24	Port Fourchon, LA	60	5.75	1	5	1	13
			Personnel	2									
			30' Shallow Water Vessel	1									
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Pascagoula, MS	Skimmer	1	905	400	Port Fourchon, LA	60	5.75	1	5	1	13
			18" Boom	50'									
			Personnel	4									
			Non-self-propelled barge	1									
			Push Boat	1									
SBS w/ GT-185 w/adapter	MSRC (800) OIL-SPIL	Pascagoula, MS	Skimmer	1	1,371	400	Port Fourchon, LA	60	5.75	1	5	1	13
			18" Boom	50'									
			Personnel	4									
			Self-propelled barge	1									
WP-1	MSRC (800) OIL-SPIL	Pascagoula, MS	Skimmer	1	3,017		Port Fourchon, LA	60	6	1	5	1	13
			18" Boom	50'									
			Personnel	5									
			*Appropriate Vessel	2									
			*Temporary Storage	1		500							

Table 9.D.5 Nearshore On-Water Recovery Activation List

Mississippi Canyon 890
Sample Nearshore On-Water Recovery Activation List

Skimming System	Supplier & Phone	Warehouse	Skimming Package	Quantity	Effective Daily Recovery Capacity (EDRC in Bbls/Day)	Storage (Barrels)	Staging Area	Distance to Nearshore Environment (Miles)	Response Times (Hours)				
									Staging ETA	Loadout Time	ETA to Nearshore Environment	Deployment Time	Total ETA
* - These components are additional operational requirements that must be procured in addition to the system identified. NOTE: Total ETA might be effected by weather, sea state, lock closure, 3rd party vessel availability.													
AARDVAC	MSRC (800) OIL-SPIL	Pascagoula, MS	Skimmer 18" Boom Personnel * Appropriate Vessel * Temporary Storage	1 50' 5 2 1	3,840	500	Port Fourchon, LA	60	6	1	5	1	13
FRV M/V RW Armstrong	CGA (888) 242-2007	Leeville, LA	Lori Brush Skimmer 36" Boom 46' Vessel Personnel	2 46' 1 4	15,257	65	Leeville, LA	70	2	0	11	1	14
SW CGA-72 FRV	CGA (888) 242-2007	Leeville, LA	Marco Belt Skimmer 36" Auto Boom Personnel 56' SWS Vessel * 14'-16' Alum. Flatboat	2 150' 4 1 2	21,500	249	Leeville, LA	70	2	0	11	1	14
SBS w/ GT-185 w/adapter	MSRC (800) OIL-SPIL	Lake Charles, LA	Skimmer 18" Boom Personnel Non-self-propelled barge Push Boat	1 50' 4 1 1	1,371	400	Port Fourchon, LA	60	6.25	1	5	1	14
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Lake Charles, LA	Skimmer 18" Boom Personnel Non-self-propelled barge Push Boat	1 50' 4 1 1	905	400	Port Fourchon, LA	60	6.25	1	5	1	14
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Lake Charles, LA	Skimmer 18" Boom Personnel Non-self-propelled barge Push Boat	1 50' 4 1 1	905	400	Port Fourchon, LA	60	6.25	1	5	1	14
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Lake Charles, LA	Skimmer 18" Boom Personnel Non-self-propelled barge Push Boat	1 50' 4 1 1	905	400	Port Fourchon, LA	60	6.25	1	5	1	14
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Lake Charles, LA	Skimmer 18" Boom Personnel Self-propelled barge	1 50' 4 1	905	400	Port Fourchon, LA	60	6.25	1	5	1	14
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Lake Charles, LA	Skimmer 18" Boom Personnel Non-self-propelled barge *Appropriate Vessel	1 50' 5 1 1	905	400	Port Fourchon, LA	60	6.25	1	5	1	14
SWS CGA-55 Egmopol Shallow Water Skimmer	CGA (888) 242-2007	Leeville, LA	Marco Skimmer * 18" Boom (contractor) Personnel 38' Skimming Vessel Shallow Water Barge	1 100' 3 1 1	1,810	100 249	Port Fourchon, LA	60	4	2	8.5	1	16
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Galveston, TX	Skimmer 18" Boom Personnel Non-self-propelled barge Push Boat	1 50' 4 1 1	905	400	Port Fourchon, LA	60	8.75	1	5	1	16

Table 9.D.5 Nearshore On-Water Recovery Activation List (continued)

Mississippi Canyon 890
Sample Nearshore On-Water Recovery Activation List

* - These components are additional operational requirements that must be procured in addition to the system identified.
NOTE: Total ETA might be effected by weather, sea state, lock closure, 3rd party vessel availability.

Skimming System	Supplier & Phone	Warehouse	Skimming Package	Quantity	Effective Daily Recovery Capacity (EDRC in Bbls/Day)	Storage (Barrels)	Staging Area	Distance to Nearshore Environment (Miles)	Response Times (Hours)				
									Staging ETA	Loadout Time	ETA to Nearshore Environment	Deployment Time	Total ETA
SBS w/ GT-185 w/adapter	MSRC (800) OIL-SPIL	Galveston, TX	Skimmer	1	1,371	400	Port Fourchon, LA	60	8.75	1	5	1	**16**
			18" Boom	50'									
			Personnel	4									
			Non-self-propelled barge	1									
			Push Boat	1									
MSRC "Kvichak"	MSRC (800) OIL-SPIL	Galveston, TX	Marco I Skimmer	1	3,588	24	Port Fourchon, LA	60	8.75	1	5	1	**16**
			Personnel	2									
			30' Shallow Water Vessel	1									
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Memphis, TN	Skimmer	1	905	400	Port Fourchon, LA	60	9.25	1	5	1	**17**
			18" Boom	60'									
			Personnel	4									
			Non-self-propelled barge	1									
			Push Boat	1									
SW CGA-74 FRV	CGA (888) 242-2007	Vermilion, LA	Marco Belt Skimmer	2	21,500	249	Vermilion, LA	245	2	0	14.5	1	**18**
			36" Auto Boom	150'									
			Personnel	4									
			56' SW Vessel	1									
			* 14'-16' Alum. Flatboat	2									
MSRC "Kvichak"	MSRC (800) OIL-SPIL	Ingleside, TX	Marco I Skimmer	1	3,588	24	Port Fourchon, LA	60	11.5	1	5	1	**19**
			Personnel	2									
			30' Shallow Water Vessel	1									
SBS w/ GT-185 w/adapter	MSRC (800) OIL-SPIL	Ingleside, TX	Skimmer	1	1,371	400	Port Fourchon, LA	60	11.5	1	5	1	**19**
			18" Boom	50'									
			Personnel	4									
			Self-propelled barge	1									
SBS w/ GT-185 w/adapter	MSRC (800) OIL-SPIL	Jacksonville, FL	Skimmer	1	1,371	400	Port Fourchon, LA	60	12	1	5	1	**19**
			18" Boom	60'									
			Personnel	5									
			Non-self-propelled barge	1									
			*Appropriate Vessel	1									
CGA-54 Egmopol Shallow Water Skimmer	CGA (888) 242-2007	Galveston, TX	Marco Belt Skimmer	1	1,810	100	Port Fourchon, LA	60	9	2	8.5	1	**21**
			* 18" Boom (contractor)	100'									
			Personnel	3									
			34' Skimming Vessel	1									
			Shallow Water Barge	1		249							
SBS w/ GT-185 w/adapter	MSRC (800) OIL-SPIL	Savannah, GA	Skimmer	1	1,371	400	Port Fourchon, LA	60	13.75	1	5	1	**21**
			18" Boom	50'									
			Personnel	4									
			Non-self-propelled barge	1									
			Push Boat	1									
SBS w/ GT-185 w/adapter	MSRC (800) OIL-SPIL	Tampa, FL	Skimmer	1	1,371	400	Port Fourchon, LA	60	13	1	5	1	**21**
			18" Boom	50'									
			Personnel	5									
			Non-self-propelled barge	1									
			Push Boat	1									
WP-1	MSRC (800) OIL-SPIL	Tampa, FL	Skimmer	1	3,017		Port Fourchon, LA	60	13	1	5	1	**21**
			18" Boom	50'									
			Personnel	5									
			*Appropriate Vessel	2									
			*Temporary Storage	1		500							
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Roxana, IL	Skimmer	1	905	400	Port Fourchon, LA	60	14	1	5	1	**21**
			18" Boom	50'									
			Personnel	4									
			Non-self-propelled barge	1									
			Push Boat	1									

Table 9.D.5 Nearshore On-Water Recovery Activation List (continued)

Mississippi Canyon 890
Sample Nearshore On-Water Recovery Activation List

** - These components are additional operational requirements that must be procured in addition to the system identified.*
NOTE: Total ETA might be effected by weather, sea state, lock closure, 3rd party vessel availability.

Skimming System	Supplier & Phone	Warehouse	Skimming Package	Quantity	Effective Daily Recovery Capacity (EDRC in Bbls/Day)	Storage (Barrels)	Staging Area	Distance to Nearshore Environment (Miles)	Response Times (Hours)				
									Staging ETA	Loadout Time	ETA to Nearshore Environment	Deployment Time	Total ETA
FRV M/V Bastian Bay	CGA (888) 242-2007	Lake Charles, LA	Lori Brush Skimmer	2	15,257	65	Lake Charles, LA	294	2	0	19.5	1	**23**
			36" Boom	46'									
			46' Vessel	1									
			Personnel	4									
SW CGA-73 FRV	CGA (888) 242-2007	Lake Charles, LA	Marco Belt Skimmer	2	21,500	249	Lake Charles, LA	294	2	0	21	1	**24**
			36" Auto Boom	150'									
			Personnel	5									
			56' SWS Vessel	1									
			* 14'-16' Alum. Flatboat	2									
WP-1	MSRC (800) OIL-SPIL	Miami, FL	Skimmer	1	3,017		Port Fourchon, LA	60	16	1	5	1	**24**
			18" Boom	50'									
			Personnel	5									
			*Appropriate Vessel	2									
			*Temporary Storage	1		500							
AARDVAC	MSRC (800) OIL-SPIL	Miami, FL	Skimmer	1	3,840		Port Fourchon, LA	60	16	1	5	1	**24**
			18" Boom	50'									
			Personnel	5									
			* Appropriate Vessel	2									
			* Temporary Storage	1		500							
AARDVAC	MSRC (800) OIL-SPIL	Miami, FL	Skimmer	1	3,840		Port Fourchon, LA	60	16	1	5	1	**24**
			18" Boom	50'									
			Personnel	5									
			* Appropriate Vessel	2									
			* Temporary Storage	1		500							
MSRC "Kvichak"	MSRC (800) OIL-SPIL	Miami, FL	Marco I Skimmer	1	3,588	24	Port Fourchon, LA	60	16.25	1	5	1	**24**
			Personnel	2									
			30' Shallow Water Vessel	1									
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Whiting, IN	Skimmer	1	905	400	Port Fourchon, LA	60	17.25	1	5	1	**25**
			18" Boom	60'									
			Personnel	4									
			Non-self-propelled barge	1									
			Push Boat	1									
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Toledo, OH	Skimmer	1	905	400	Port Fourchon, LA	60	18.75	1	5	1	**26**
			18" Boom	50'									
			Personnel	4									
			Non-self-propelled barge	1									
			Push Boat	1									
SBS w/ GT-185 w/adapter	MSRC (800) OIL-SPIL	Chesapeake, VA	Skimmer	1	1,371	400	Port Fourchon, LA	60	19.5	1	5	1	**27**
			18" Boom	50'									
			Personnel	4									
			Self-propelled barge	1									
MSRC "Kvichak"	MSRC (800) OIL-SPIL	Chesapeake, VA	Marco I Skimmer	1	3,588	24	Port Fourchon, LA	60	19.5	1	5	1	**27**
			Personnel	2									
			30' Shallow Water Vessel	1									
MSRC "Quick Strike"	MSRC (800) OIL-SPIL	Lake Charles, LA	LORI Brush Skimmer	2	5,000	50	Lake Charles, LA	294	2	1	24.5	1	**29**
			Personnel	3									
			47' Fast Response Boat	1									
SBS w/ GT-185 w/adapter	MSRC (800) OIL-SPIL	Chesapeake City, MD	Skimmer	1	1,371	400	Port Fourchon, LA	60	21.5	1	5	1	**29**
			18" Boom	50'									
			Personnel	4									
			Non-self-propelled barge	1									
			Push Boat	1									

Table 9.D.5 Nearshore On-Water Recovery Activation List (continued)

Mississippi Canyon 890
Sample Nearshore On-Water Recovery Activation List

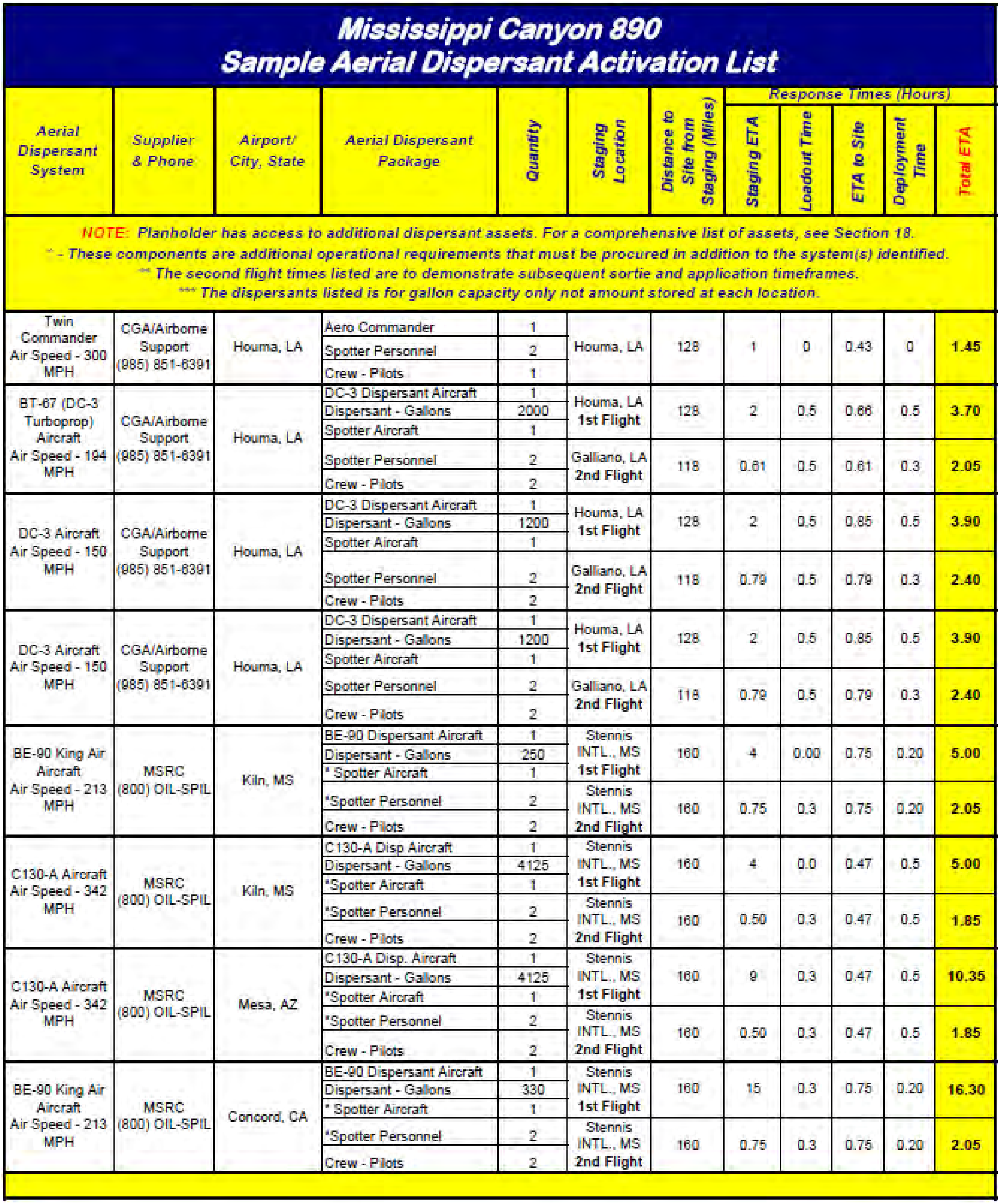
Skimming System	Supplier & Phone	Warehouse	Skimming Package	Quantity	Effective Daily Recovery Capacity (EDRC in Bbls/Day)	Storage (Barrels)	Staging Area	Distance to Nearshore Environment (Miles)	Response Times (Hours)				
									Staging ETA	Loadout Time	ETA to Nearshore Environment	Deployment Time	Total ETA
* - These components are additional operational requirements that must be procured in addition to the system identified. NOTE: Total ETA might be effected by weather, sea state, lock closure, 3rd party vessel availability.													
SBS w/ GT-185 w/adapter	MSRC (800) OIL-SPIL	Edison/Perth Amboy, NJ	Skimmer 18" Boom Personnel Self-propelled barge	1 50' 4 1	1,371	400	Port Fourchon, LA	60	23	1	5	1	**30**
MSRC "Kvichak"	MSRC (800) OIL-SPIL	Edison/Perth Amboy, NJ	Marco I Skimmer Personnel 30' Shallow Water Vessel	1 2 1	3,588	24	Port Fourchon, LA	60	23	1	5	1	**30**
SBS w/ GT-185 w/adapter	MSRC (800) OIL-SPIL	Bayonne, NJ	Skimmer 18" Curtain Internal Foam Personnel Non-self-propelled barge *Appropriate Vessel	1 50' 4 1 1	1,371	400	Port Fourchon, LA	60	23	1	5	1	**30**
SWS CGA-75 FRV	CGA (888) 242-2007	Galveston, TX	Lori Brush Skimmer 36" Boom 60' Vessel X Band Radar Personnel	2 150 1 1 4	22,885	249	Galveston, TX	344	2	0	30	1	**33**
FRV CGA 58 Timbalier Bay	CGA (888) 242-2007	Aransas Pass, TX	Lori Brush Skimmer 36" Boom 46' Vessel Personnel	2 46' 1 4	15,257	65	Aransas Pass, TX	514	2	0	30	1	**33**
SBS w/ GT-185 w/adapter	MSRC (800) OIL-SPIL	Providence, RI	Skimmer 18" Curtain Internal Foam Personnel Non-self-propelled barge Push Boat	1 60' 4 1 1	1,371	400	Port Fourchon, LA	60	26	1	5	1	**33**
SBS w/ GT-185	MSRC (800) OIL-SPIL	Everett, MA	Skimmer 18" Boom Personnel Non-self-propelled barge Push Boat	1 60' 4 1 1	1,371	400	Port Fourchon, LA	60	26	1	5	1	**33**
MSRC "Kvichak"	MSRC (800) OIL-SPIL	Portland, ME	Marco I Skimmer Personnel 30' Shallow Water Vessel	1 2 1	3,588	24	Port Fourchon, LA	60	28	1	5	1	**35**
SBS w/ WP-1	MSRC (800) OIL-SPIL	Portland, ME	Skimmer 18" Boom Personnel Self-propelled barge	1 50' 4 1	3,017	400	Port Fourchon, LA	60	28	1	5	1	**35**
SW CGA-71 FRV	CGA (888) 242-2007	Aransas Pass, TX	Marco Belt Skimmer 36" Auto Boom Personnel 56' SWS Vessel * 14'-16' Alum. Flatboat	2 150' 5 1 2	21,500	249	Aransas Pass, TX	514	2	0	40	1	**43**
MSRC "Lightning"	MSRC (800) OIL-SPIL	Tampa, FL	LORI Brush Skimmer Personnel 47' Fast Response Boat	2 3 1	5,000	50	Tampa, FL	592	2	1	49.5	1	**54**
DERATED RECOVERY RATE (BBLS/DAY)											321,042		
SKIMMING VESSEL STORAGE CAPACITY (BARRELS)											16,979		

Table 9.D.5 Nearshore On-Water Recovery Activation List (continued)

Mississippi Canyon 890
Sample Aerial Surveillance Activation List

Aerial Surveillance System	Supplier & Phone	Airport/City, State	Aerial Surveillance Package	Quantity	Staging Location	Distance to Site from Staging (nautical miles)	Response Times (Hours)			
							Staging ETA	Loadout Time	ETA to Site	Total ETA
* - These components are additional operational requirements that must be procured in addition to the system identified.										
Twin Commander Air Speed - 260 Knots	Airborne Support (985) 851-6391	Houma, LA	Surveillance Aircraft	1	Houma, LA	128	1	0.25	0.43	**1.70**
			Spotter Personnel	2						
			Crew - Pilots	1						
Aztec Piper Air Speed - 150 Knots	Airborne Support (985) 851-6391	Houma, LA	Surveillance Aircraft	1	Houma, LA	128	1	0.25	0.74	**2.00**
			Spotter Personnel	2						
			Crew - Pilots	1						
Eurocopter EC-135 Helicopter Air Speed - 141 knots	PHI (800) 235-2452	Houma, LA	Surveillance Aircraft	1	Houma, LA	128	1	0.25	0.79	**2.05**
			Spotter Personnel	2						
			Crew - Pilots	1						
Sikorsky S-76 Helicopter Air Speed - 141 knots	PHI (800) 235-2452	Houma, LA	Surveillance Aircraft	1	Houma, LA	128	1	0.25	0.79	**2.05**
			Spotter Personnel	2						
			Crew - Pilots	1						

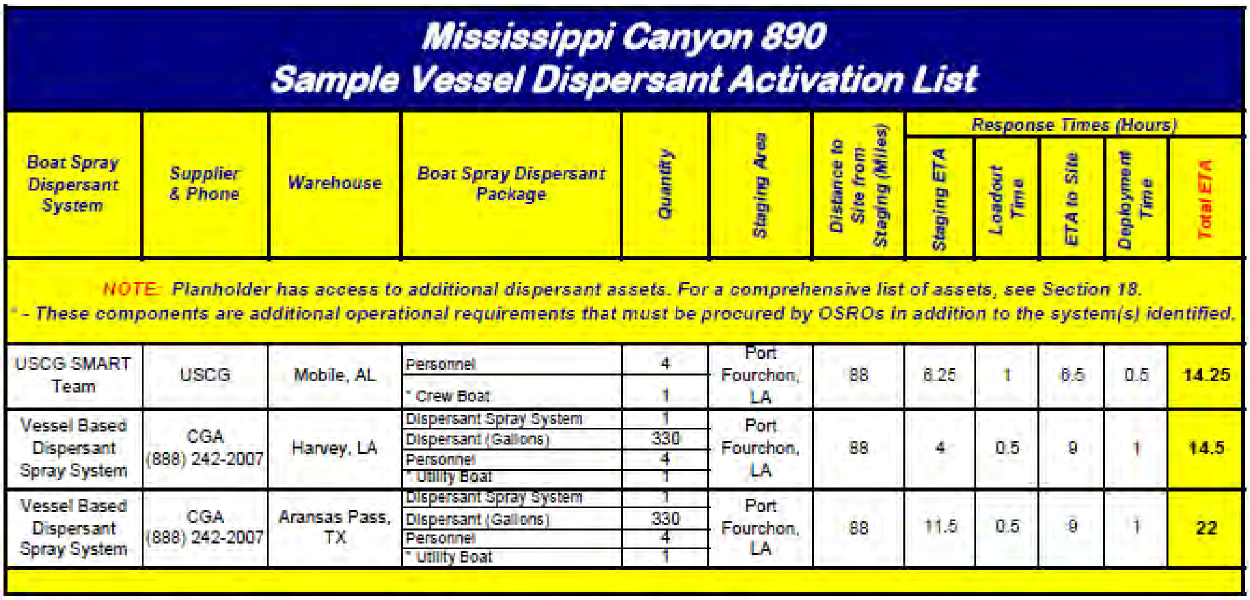
Table 9.D.6 Aerial Surveillance Activation List



Mississippi Canyon 890
Sample Aerial Dispersant Activation List

Aerial Dispersant System	Supplier & Phone	Airport/ City, State	Aerial Dispersant Package	Quantity	Staging Location	Distance to Site from Staging (Miles)	Response Times (Hours)				
							Staging ETA	Loadout Time	ETA to Site	Deployment Time	Total ETA
NOTE: Planholder has access to additional dispersant assets. For a comprehensive list of assets, see Section 18. * - These components are additional operational requirements that must be procured in addition to the system(s) identified. ** The second flight times listed are to demonstrate subsequent sortie and application timeframes. *** The dispersants listed is for gallon capacity only not amount stored at each location.											
Twin Commander Air Speed - 300 MPH	CGA/Airborne Support (985) 851-6391	Houma, LA	Aero Commander	1	Houma, LA	128	1	0	0.43	0	**1.45**
			Spotter Personnel	2							
			Crew - Pilots	1							
BT-67 (DC-3 Turboprop) Aircraft Air Speed - 194 MPH	CGA/Airborne Support (985) 851-6391	Houma, LA	DC-3 Dispersant Aircraft	1	Houma, LA **1st Flight**	128	2	0.5	0.66	0.5	**3.70**
			Dispersant - Gallons	2000							
			Spotter Aircraft	1							
			Spotter Personnel	2	Galliano, LA **2nd Flight**	118	0.61	0.5	0.61	0.3	**2.05**
			Crew - Pilots	2							
DC-3 Aircraft Air Speed - 150 MPH	CGA/Airborne Support (985) 851-6391	Houma, LA	DC-3 Dispersant Aircraft	1	Houma, LA **1st Flight**	128	2	0.5	0.85	0.5	**3.90**
			Dispersant - Gallons	1200							
			Spotter Aircraft	1							
			Spotter Personnel	2	Galliano, LA **2nd Flight**	118	0.79	0.5	0.79	0.3	**2.40**
			Crew - Pilots	2							
DC-3 Aircraft Air Speed - 150 MPH	CGA/Airborne Support (985) 851-6391	Houma, LA	DC-3 Dispersant Aircraft	1	Houma, LA **1st Flight**	128	2	0.5	0.85	0.5	**3.90**
			Dispersant - Gallons	1200							
			Spotter Aircraft	1							
			Spotter Personnel	2	Galliano, LA **2nd Flight**	118	0.79	0.5	0.79	0.3	**2.40**
			Crew - Pilots	2							
BE-90 King Air Aircraft Air Speed - 213 MPH	MSRC (800) OIL-SPIL	Kiln, MS	BE-90 Dispersant Aircraft	1	Stennis INTL., MS **1st Flight**	160	4	0.00	0.75	0.20	**5.00**
			Dispersant - Gallons	250							
			* Spotter Aircraft	1							
			*Spotter Personnel	2	Stennis INTL., MS **2nd Flight**	160	0.75	0.3	0.75	0.20	**2.05**
			Crew - Pilots	2							
C130-A Aircraft Air Speed - 342 MPH	MSRC (800) OIL-SPIL	Kiln, MS	C130-A Disp Aircraft	1	Stennis INTL., MS **1st Flight**	160	4	0.0	0.47	0.5	**5.00**
			Dispersant - Gallons	4125							
			*Spotter Aircraft	1							
			*Spotter Personnel	2	Stennis INTL., MS **2nd Flight**	160	0.50	0.3	0.47	0.5	**1.85**
			Crew - Pilots	2							
C130-A Aircraft Air Speed - 342 MPH	MSRC (800) OIL-SPIL	Mesa, AZ	C130-A Disp. Aircraft	1	Stennis INTL., MS **1st Flight**	160	9	0.3	0.47	0.5	**10.35**
			Dispersant - Gallons	4125							
			*Spotter Aircraft	1							
			*Spotter Personnel	2	Stennis INTL., MS **2nd Flight**	160	0.50	0.3	0.47	0.5	**1.85**
			Crew - Pilots	2							
BE-90 King Air Aircraft Air Speed - 213 MPH	MSRC (800) OIL-SPIL	Concord, CA	BE-90 Dispersant Aircraft	1	Stennis INTL., MS **1st Flight**	160	15	0.3	0.75	0.20	**16.30**
			Dispersant - Gallons	330							
			* Spotter Aircraft	1							
			*Spotter Personnel	2	Stennis INTL., MS **2nd Flight**	160	0.75	0.3	0.75	0.20	**2.05**
			Crew - Pilots	2							

Table 9.D.7 Offshore Aerial Dispersant Activation List

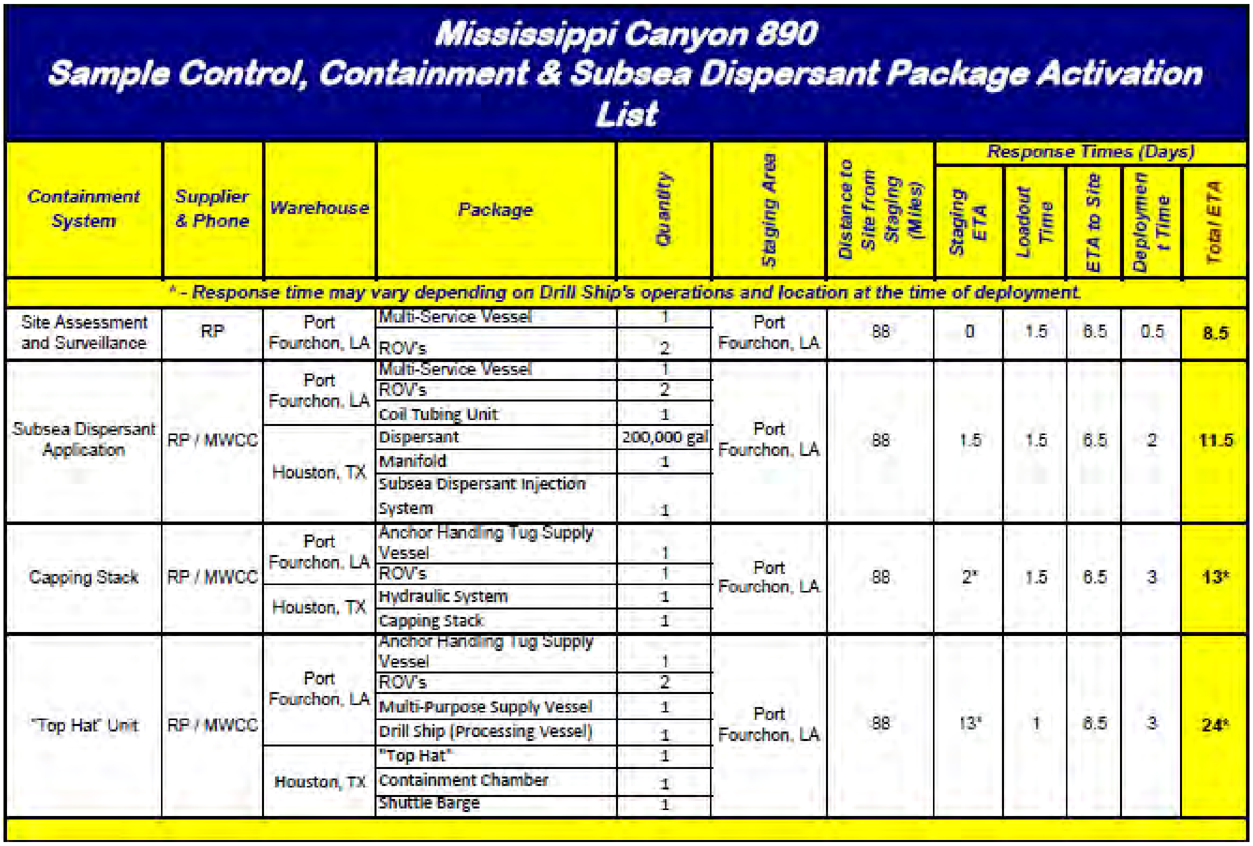


Mississippi Canyon 890
Sample Vessel Dispersant Activation List

NOTE: Planholder has access to additional dispersant assets. For a comprehensive list of assets, see Section 18.
* - These components are additional operational requirements that must be procured by OSROs in addition to the system(s) identified.

Boat Spray Dispersant System	Supplier & Phone	Warehouse	Boat Spray Dispersant Package	Quantity	Staging Area	Distance to Site from Staging (Miles)	Response Times (Hours)				
							Staging ETA	Loadout Time	ETA to Site	Deployment Time	Total ETA
USCG SMART Team	USCG	Mobile, AL	Personnel	4	Port Fourchon, LA	88	6.25	1	6.5	0.5	14.25
			* Crew Boat	1							
Vessel Based Dispersant Spray System	CGA (888) 242-2007	Harvey, LA	Dispersant Spray System	1	Port Fourchon, LA	88	4	0.5	9	1	14.5
			Dispersant (Gallons)	330							
			Personnel	4							
			* Utility Boat	1							
Vessel Based Dispersant Spray System	CGA (888) 242-2007	Aransas Pass, TX	Dispersant Spray System	1	Port Fourchon, LA	88	11.5	0.5	9	1	22
			Dispersant (Gallons)	330							
			Personnel	4							
			* Utility Boat	1							

Table 9.D.8 Offshore Boat Spray Dispersant Activation List

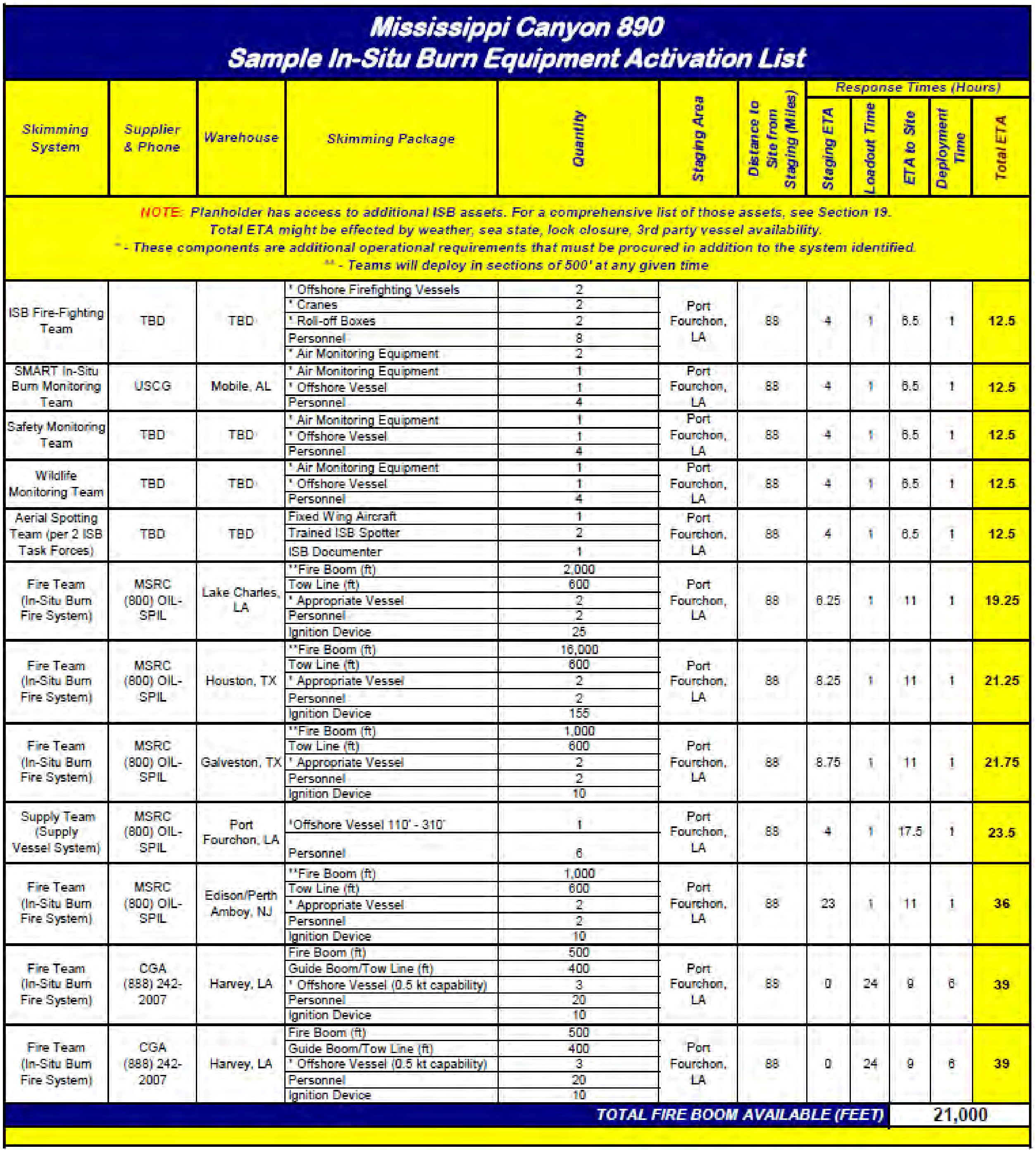


Mississippi Canyon 890
Sample Control, Containment & Subsea Dispersant Package Activation List

* - Response time may vary depending on Drill Ship's operations and location at the time of deployment.

Containment System	Supplier & Phone	Warehouse	Package	Quantity	Staging Area	Distance to Site from Staging (Miles)	Response Times (Days)				
							Staging ETA	Loadout Time	ETA to Site	Deployment Time	Total ETA
Site Assessment and Surveillance	RP	Port Fourchon, LA	Multi-Service Vessel	1	Port Fourchon, LA	88	0	1.5	6.5	0.5	8.5
			ROV's	2							
Subsea Dispersant Application	RP / MWCC	Port Fourchon, LA	Multi-Service Vessel	1	Port Fourchon, LA	88	1.5	1.5	6.5	2	11.5
			ROV's	2							
			Coil Tubing Unit	1							
		Houston, TX	Dispersant	200,000 gal							
			Manifold	1							
			Subsea Dispersant Injection System	1							
Capping Stack	RP / MWCC	Port Fourchon, LA	Anchor Handling Tug Supply Vessel	1	Port Fourchon, LA	88	2*	1.5	6.5	3	13*
			ROV's	1							
		Houston, TX	Hydraulic System	1							
			Capping Stack	1							
"Top Hat" Unit	RP / MWCC	Port Fourchon, LA	Anchor Handling Tug Supply Vessel	1	Port Fourchon, LA	88	13*	1	6.5	3	24*
			ROV's	2							
			Multi-Purpose Supply Vessel	1							
			Drill Ship (Processing Vessel)	1							
		Houston, TX	"Top Hat"	1							
			Containment Chamber	1							
			Shuttle Barge	1							

Table 9.D.9 Subsea Control, Containment, and Subsea Dispersant Package Activation List

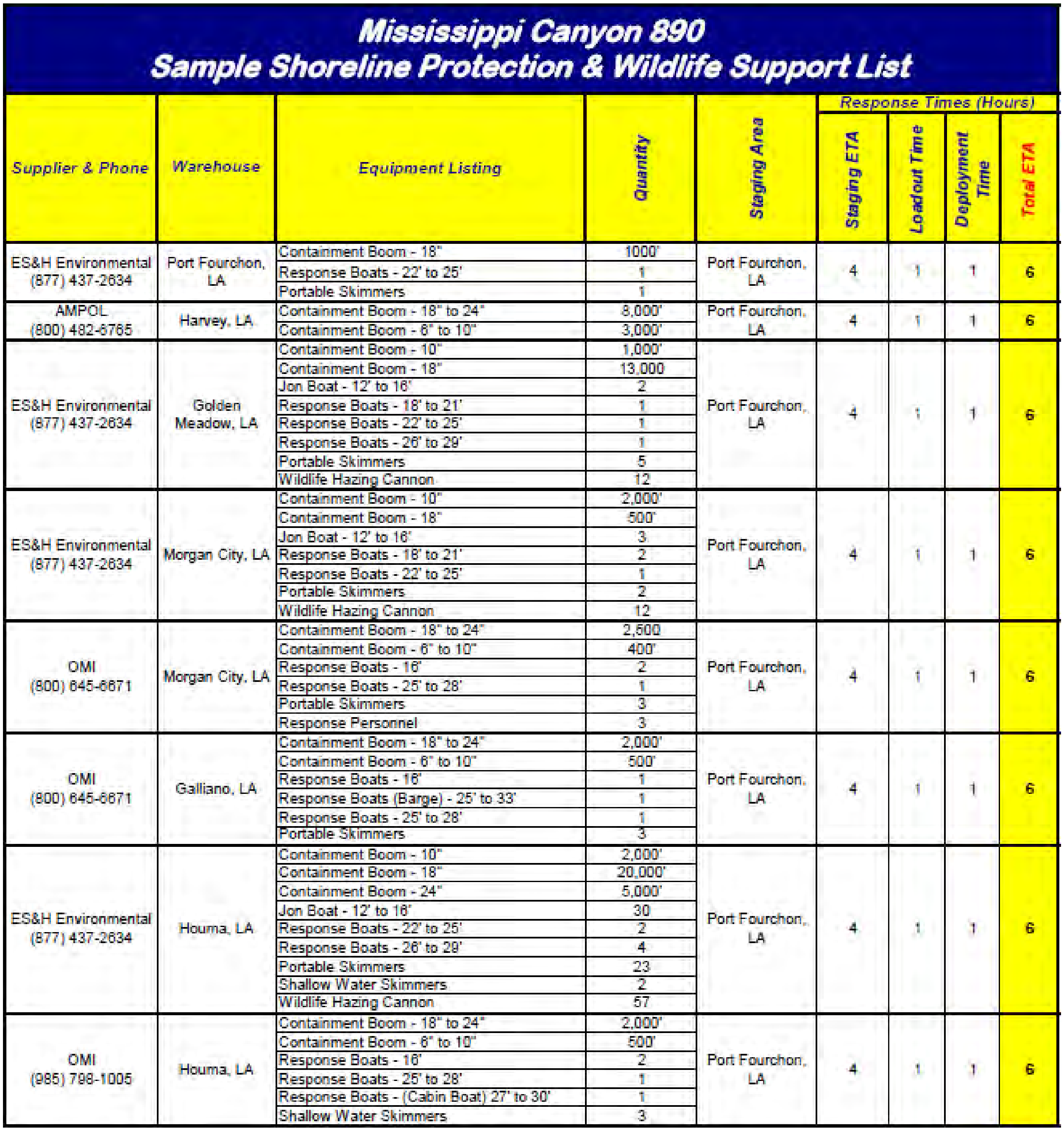


Mississippi Canyon 890
Sample In-Situ Burn Equipment Activation List

Skimming System	Supplier & Phone	Warehouse	Skimming Package	Quantity	Staging Area	Distance to Site from Staging (Miles)	Response Times (Hours)				
							Staging ETA	Loadout Time	ETA to Site	Deployment Time	Total ETA
ISB Fire-Fighting Team	TBD	TBD	* Offshore Firefighting Vessels	2	Port Fourchon, LA	88	4	1	6.5	1	12.5
			* Cranes	2							
			* Roll-off Boxes	2							
			Personnel	8							
			* Air Monitoring Equipment	2							
SMART In-Situ Burn Monitoring Team	USCG	Mobile, AL	* Air Monitoring Equipment	1	Port Fourchon, LA	88	4	1	6.5	1	12.5
			* Offshore Vessel	1							
			Personnel	4							
Safety Monitoring Team	TBD	TBD	* Air Monitoring Equipment	1	Port Fourchon, LA	88	4	1	6.5	1	12.5
			* Offshore Vessel	1							
			Personnel	4							
Wildlife Monitoring Team	TBD	TBD	* Air Monitoring Equipment	1	Port Fourchon, LA	88	4	1	6.5	1	12.5
			* Offshore Vessel	1							
			Personnel	4							
Aerial Spotting Team (per 2 ISB Task Forces)	TBD	TBD	Fixed Wing Aircraft	1	Port Fourchon, LA	88	4	1	6.5	1	12.5
			Trained ISB Spotter	2							
			ISB Documenter	1							
Fire Team (In-Situ Burn Fire System)	MSRC (800) OIL-SPIL	Lake Charles, LA	**Fire Boom (ft)	2,000	Port Fourchon, LA	88	6.25	1	11	1	19.25
			Tow Line (ft)	600							
			* Appropriate Vessel	2							
			Personnel	2							
			Ignition Device	25							
Fire Team (In-Situ Burn Fire System)	MSRC (800) OIL-SPIL	Houston, TX	**Fire Boom (ft)	16,000	Port Fourchon, LA	88	8.25	1	11	1	21.25
			Tow Line (ft)	600							
			* Appropriate Vessel	2							
			Personnel	2							
			Ignition Device	155							
Fire Team (In-Situ Burn Fire System)	MSRC (800) OIL-SPIL	Galveston, TX	**Fire Boom (ft)	1,000	Port Fourchon, LA	88	8.75	1	11	1	21.75
			Tow Line (ft)	600							
			* Appropriate Vessel	2							
			Personnel	2							
			Ignition Device	10							
Supply Team (Supply Vessel System)	MSRC (800) OIL-SPIL	Port Fourchon, LA	*Offshore Vessel 110' - 310'	1	Port Fourchon, LA	88	4	1	17.5	1	23.5
			Personnel	6							
Fire Team (In-Situ Burn Fire System)	MSRC (800) OIL-SPIL	Edison/Perth Amboy, NJ	**Fire Boom (ft)	1,000	Port Fourchon, LA	88	23	1	11	1	36
			Tow Line (ft)	600							
			* Appropriate Vessel	2							
			Personnel	2							
			Ignition Device	10							
Fire Team (In-Situ Burn Fire System)	CGA (888) 242-2007	Harvey, LA	Fire Boom (ft)	500	Port Fourchon, LA	88	0	24	9	6	39
			Guide Boom/Tow Line (ft)	400							
			* Offshore Vessel (0.5 kt capability)	3							
			Personnel	20							
			Ignition Device	10							
Fire Team (In-Situ Burn Fire System)	CGA (888) 242-2007	Harvey, LA	Fire Boom (ft)	500	Port Fourchon, LA	88	0	24	9	6	39
			Guide Boom/Tow Line (ft)	400							
			* Offshore Vessel (0.5 kt capability)	3							
			Personnel	20							
			Ignition Device	10							
TOTAL FIRE BOOM AVAILABLE (FEET)								21,000			

NOTE: Planholder has access to additional ISB assets. For a comprehensive list of those assets, see Section 19.
Total ETA might be effected by weather, sea state, lock closure, 3rd party vessel availability.
* - These components are additional operational requirements that must be procured in addition to the system identified.
** - Teams will deploy in sections of 500' at any given time

Table 9.D.10 In-Situ Burn Equipment Activation List



Mississippi Canyon 890
Sample Shoreline Protection & Wildlife Support List

Supplier & Phone	Warehouse	Equipment Listing	Quantity	Staging Area	Response Times (Hours)			
					Staging ETA	Loadout Time	Deployment Time	Total ETA
ES&H Environmental (877) 437-2634	Port Fourchon, LA	Containment Boom - 18"	1000'	Port Fourchon, LA	4	1	1	6
		Response Boats - 22' to 25'	1					
		Portable Skimmers	1					
AMPOL (800) 482-6765	Harvey, LA	Containment Boom - 18" to 24"	8,000'	Port Fourchon, LA	4	1	1	6
		Containment Boom - 6" to 10"	3,000'					
ES&H Environmental (877) 437-2634	Golden Meadow, LA	Containment Boom - 10"	1,000'	Port Fourchon, LA	4	1	1	6
		Containment Boom - 18"	13,000					
		Jon Boat - 12' to 16'	2					
		Response Boats - 18' to 21'	1					
		Response Boats - 22' to 25'	1					
		Response Boats - 26' to 29'	1					
		Portable Skimmers	5					
		Wildlife Hazing Cannon	12					
ES&H Environmental (877) 437-2634	Morgan City, LA	Containment Boom - 10"	2,000'	Port Fourchon, LA	4	1	1	6
		Containment Boom - 18"	500'					
		Jon Boat - 12' to 16'	3					
		Response Boats - 18' to 21'	2					
		Response Boats - 22' to 25'	1					
		Portable Skimmers	2					
		Wildlife Hazing Cannon	12					
OMI (800) 645-6671	Morgan City, LA	Containment Boom - 18" to 24"	2,500	Port Fourchon, LA	4	1	1	6
		Containment Boom - 6" to 10"	400'					
		Response Boats - 16'	2					
		Response Boats - 25' to 28'	1					
		Portable Skimmers	3					
		Response Personnel	3					
OMI (800) 645-6671	Galliano, LA	Containment Boom - 18" to 24"	2,000'	Port Fourchon, LA	4	1	1	6
		Containment Boom - 6" to 10"	500'					
		Response Boats - 16'	1					
		Response Boats (Barge) - 25' to 33'	1					
		Response Boats - 25' to 28'	1					
		Portable Skimmers	3					
ES&H Environmental (877) 437-2634	Houma, LA	Containment Boom - 10"	2,000'	Port Fourchon, LA	4	1	1	6
		Containment Boom - 18"	20,000'					
		Containment Boom - 24"	5,000'					
		Jon Boat - 12' to 16'	30					
		Response Boats - 22' to 25'	2					
		Response Boats - 26' to 29'	4					
		Portable Skimmers	23					
		Shallow Water Skimmers	2					
		Wildlife Hazing Cannon	57					
OMI (985) 798-1005	Houma, LA	Containment Boom - 18" to 24"	2,000'	Port Fourchon, LA	4	1	1	6
		Containment Boom - 6" to 10"	500'					
		Response Boats - 16'	2					
		Response Boats - 25' to 28'	1					
		Response Boats - (Cabin Boat) 27' to 30'	1					
		Shallow Water Skimmers	3					

Table 9.D.11 Shoreline Protection and Wildlife Support List

Mississippi Canyon 890
Sample Shoreline Protection & Wildlife Support List

Supplier & Phone	Warehouse	Equipment Listing	Quantity	Staging Area	Response Times (Hours)			
					Staging ETA	Loadout Time	Deployment Time	Total ETA
Lawson Environmental Service (985) 876-0420	Houma, LA	Containment Boom - 18"	30,000'	Port Fourchon, LA	4	1	1	6
		Containment Boom - 12"	2,000'					
		Containment Boom - 10"	9,500'					
		Response Boats - 14'	10					
		Response Boats - 16'	6					
		Response Boats - 20'	5					
		Response Boats - 24'	8					
		Response Boats - 26'	4					
		Response Boats - 28'	7					
		Response Boats - 32'	4					
		Portable Skimmers	6					
USES Environmental (888) 279-9930	Hahnville, LA	Containment Boom - 18"	500'	Port Fourchon, LA	4	1	1	6
USES Environmental (888) 279-9930	Amelia, LA	Containment Boom - 18"	500'	Port Fourchon, LA	4	1	1	6
USES Environmental (888) 279-9930	Marrero, LA	Containment Boom - 18"	600'	Port Fourchon, LA	4	1	1	6
CGA (888) 242-2007	Harvey, LA	Wildlife Rehab Trailer	1	Port Fourchon, LA	4	1	1	6
		Wildlife Husbandry Trailer	1					
		Support Trailer	3					
		Bird Scare Cannons	120					
		Contract Truck (Third Party)	3					
		Personnel (Responder/Mechanic)	4					
ES&H Environmental (877) 437-2634	Lafayette, LA	Containment Boom - 10"	500'	Port Fourchon, LA	4.25	1	1	7
		Containment Boom - 18"	13,000'					
		Jon Boat - 12' to 16'	3					
		Response Boats - 18' to 21'	1					
		Response Boats - 22' to 25'	1					
		Response Boats - 26' to 29'	1					
		Portable Skimmers	4					
		Wildlife Hazing Cannon	12					
ES&H Environmental (877) 437-2634	Belle Chasse, LA	Containment Boom - 10"	1,500'	Port Fourchon, LA	4.25	1	1	7
		Containment Boom - 18"	15,500'					
		Containment Boom - 24"	5,000'					
		Jon Boat - 12' to 16'	4					
		Response Boats - 18' to 21'	1					
		Response Boats - 22' to 25'	1					
		Response Boats - 26' to 29'	3					
		Portable Skimmers	10					
		Wildlife Hazing Cannon	50					
OMI (800) 645-6671	Belle Chasse, LA	Containment Boom - 18" to 24"	4,500'	Port Fourchon, LA	4.25	1	1	7
		Containment Boom - 6" to 10"	500'					
		Response Boats - 20'	1					
		Response Boats - 25' to 28'	2					
		Portable Skimmers	12					
		Shallow Water Skimmers	1					
		Bird Scare Cannons	12					
		Response Personnel	24					

Table 9.D.11 Shoreline Protection and Wildlife Support List (cont.)

Mississippi Canyon 890
Sample Shoreline Protection & Wildlife Support List

					Response Times (Hours)			
Supplier & Phone	Warehouse	Equipment Listing	Quantity	Staging Area	Staging ETA	Loadout Time	Deployment Time	Total ETA
USES Environmental (888) 279-9930	Meraux, LA	Containment Boom - 18"	6,000'	Port Fourchon, LA	4.25	1	1	7
		Containment Boom - 10"	1,000'					
		Response Boats - 16'	23					
		Response Boats - 18'	1					
		Response Boats - 24'	1					
		Response Boats - 26'	2					
		Response Boats - 28'	1					
		Portable Skimmers	2					
USES Environmental (888) 279-9930	Lafitte, LA	Containment Boom - 18"	1,000'	Port Fourchon, LA	4.5	1	1	7
		Response Boats - 18'	2					
USES Environmental (888) 534-2744	Geismar, LA	Containment Boom - 18"	1,000'	Port Fourchon, LA	4.5	1	1	7
		Response Boats - 16'	2					
		Portable Skimmers	1					
OMI (800) 645-6671	Port Allen, LA	Containment Boom - 18" to 24"	2500'	Port Fourchon, LA	4.75	1	1	7
		Containment Boom - 6" to 10"	500'					
		Response Boats - 16'	2					
		Response Boats - 25 to 33'	1					
		Shallow Water Skimmers	1					
		Response Personnel	6					
OMI (800) 645-6671	New Iberia, LA	Containment Boom - 18" to 24"	12,000'	Port Fourchon, LA	4.75	1	1	7
		Containment Boom - 6" to 10"	300'					
		Response Boats - 16'	3					
		Response Boats (Barge) - 25' to 33'	1					
		Response Boats - 25' to 28'	1					
		Portable Skimmers	8					
		Response Personnel	8					
AMPOL (800) 482-6765	New Iberia, LA	Containment Boom - 6" to 10"	4,150'	Port Fourchon, LA	4.75	1	1	7
		Containment Boom - 18" to 24"	34,050'					
		Response Boats - 14' to 20'	3					
		Response Boats - 21' to 36'	3					
		Portable Skimmers	27					
Clean Harbors (800) 645-8265	New Iberia, LA	Containment Boom - 18" to 24"	33,800'	Port Fourchon, LA	4.75	1	1	7
		Containment Boom - 6" to 10"	500'					
		Response Boats - 21' to 36'	4					
Wildlife Ctr. of Texas (713) 861-9453	Baton Rouge, LA	Wildlife Specialist - Personnel	6 to 20	Port Fourchon, LA	5	1	1	7
Clean Harbors (800) 645-8265	Baton Rouge, LA	Containment Boom - 18" to 24"	14,000'	Port Fourchon, LA	5	1	1	7
		Response Boats - 14' to 20'	1					
		Portable Skimmers	3					
		Response Personnel	13					
USES Environmental (888) 279-9930	Biloxi, MS	Containment Boom - 18"	2,000'	Port Fourchon, LA	5.25	1	1	8
		Response Boats - 16'	1					

Table 9.D.11 Shoreline Protection and Wildlife Support List (cont.)

Mississippi Canyon 890
Sample Shoreline Protection & Wildlife Support List

Supplier & Phone	Warehouse	Equipment Listing	Quantity	Staging Area	Response Times (Hours)			
					Staging ETA	Loadout Time	Deployment Time	Total ETA
USES Environmental (888) 279-9930	Jackson, MS	Containment Boom - 10"	400'	Port Fourchon, LA	5.5	1	1	8
		Containment Boom - 18"	2,000'					
		Response Boats - 12'	3					
		Response Boats - 14'	1					
		Response Boats - 16'	1					
		Response Boats - 18'	1					
		Response Boats - 20'	1					
		Portable Skimmers	2					
USES Environmental (888) 279-9930	Venice, LA	Containment Boom - 18"	10,000'	Port Fourchon, LA	5.75	1	1	8
		Response Boats - 16'	15					
		Response Boats - 26'	2					
		Response Boats - 30'	1					
		Portable Skimmers	2					
		Shallow Water Skimmers	1					
AMPOL (800) 482-6765	Venice, LA	Containment Boom - 18" to 24"	2,250'	Port Fourchon, LA	5.75	1	1	8
		Response Boats - 14' to 20'	2					
		Response Boats - 21' to 36'	1					
		Portable Skimmers	2					
ES&H Environmental (877) 437-2634	Venice, LA	Containment Boom - 10"	2,000'	Port Fourchon, LA	5.75	1	1	8
		Containment Boom - 18"	13,000'					
		Containment Boom - 24"	10,000					
		Jon Boat - 12' to 16'	4					
		Response Boats - 22' to 25'	1					
		Response Boats - 26' to 29'	2					
		Portable Skimmers	5					
		Wildlife Hazing Cannon	25					
OMI (800) 645-6671	Venice, LA	Containment Boom - 18" to 24"	1,500'	Port Fourchon, LA	5.75	1	1	8
		Response Boats - 16'	4					
		Response Boats (Barge) - 25' to 33'	1					
		Response Boats - 25' to 28'	2					
		Response Boats - (Cabin Boat) 27' to 30'	1					
		Shallow Water Skimmers	3					
		Portable Skimmers	2					
USES Environmental (888) 279-9930	Mobile, AL	Containment Boom - 10"	800'	Port Fourchon, LA	6.25	1	1	9
		Containment Boom - 18"	5,000'					
		Response Boats - 16'	1					
		Response Boats - 18'	1					
		Response Boats - 20'	1					
		Response Boats - 26'	1					
		Portable Skimmers	2					
ES&H Environmental (877) 437-2634	Lake Charles, LA	Containment Boom - 10"	500'	Port Fourchon, LA	6.25	1	1	9
		Containment Boom - 18"	15,000'					
		Containment Boom - 24"	5,000'					
		Jon Boat - 12' to 16'	3					
		Response Boats - 18' to 21'	2					
		Response Boats - 26' to 29'	2					
		Portable Skimmers	13					
		Wildlife Hazing Cannon	40					

Table 9.D.11 Shoreline Protection and Wildlife Support List (cont.)

Mississippi Canyon 890
Sample Shoreline Protection & Wildlife Support List

Supplier & Phone	Warehouse	Equipment Listing	Quantity	Staging Area	Response Times (Hours)			
					Staging ETA	Loadout Time	Deployment Time	Total ETA
Miller Env. Services (800) 929-7227	Sulphur, LA	Containment Boom - 10"	600'	Port Fourchon, LA	8.25	1	1	9
		Containment Boom - 18"	14,000'					
		Jon Boats - 14' to 16'	2					
		Jon Boats - 16' w/25hp HP Outboard Motor	2					
		Air Boat - 18'	1					
		Work Boat - 18'	2					
		Response Boats - 24' - 28'	4					
		Portable Skimmers	5					
		Shallow Water Skimmers	1					
		Response Personnel	49					
USES Environmental (888) 279-9930	Lake Charles, LA	Containment Boom - 10"	100'	Port Fourchon, LA	8.25	1	1	9
		Containment Boom - 18"	7,700'					
		Response Boats - 16'	3					
		Response Boats - 27'	1					
		Response Boats - 37'	1					
MSRC (800) OIL-SPIL	Lake Charles, LA	Wildlife Trailer	1	Port Fourchon, LA	8.25	1	1	9
		Contract Truck (Third Party)	1					
		Personnel (Responder/Mechanic)	1					
USES Environmental (888) 279-9930	Shreveport, LA	Containment Boom - 6"	500'	Port Fourchon, LA	7	1	1	9
		Containment Boom - 18"	2,000'					
		Response Boats - 16'	1					
		Response Boats - 24'	1					
		Shallow Water Skimmers	1					
Miller Env. Services (800) 929-7227	Beaumont, TX	Containment Boom - 18"	14,000'	Port Fourchon, LA	7	1	1	9
		Response Boats - 18'	2					
		Response Boats - 24'	2					
		Shallow Water Skimmers	1					
		Response Personnel	47					
AMPOL (800) 482-6765	Port Arthur, TX	Containment Boom - 18" to 24"	16,000'	Port Fourchon, LA	7.25	1	1	10
		Response Boats - 14' to 20'	2					
		Response Boats - 21' to 36'	1					
		Portable Skimmers	3					
Clean Harbors (800) 645-8265	Port Arthur, TX	Containment Boom - 18" to 24"	3,000'	Port Fourchon, LA	7.25	1	1	10
		Response Boats - 21' to 36'	2					
		Portable Skimmers	2					
		Response Personnel	54					

Table 9.D.11 Shoreline Protection and Wildlife Support List (cont.)

Mississippi Canyon 890
Sample Shoreline Protection & Wildlife Support List

Supplier & Phone	Warehouse	Equipment Listing	Quantity	Staging Area	Response Times (Hours)			
					Staging ETA	Loadout Time	Deployment Time	Total ETA
Gamer Environmental (800) 424-1716	Port Arthur, TX	Containment Boom - 6"	22,000'	Port Fourchon, LA	7.25	1	1	10
		Response Boats - 14' to 20'	8					
		Response Boats - 21' to 36'	1					
		Portable Skimmers	3					
OMI (800) 645-6671	Port Arthur, TX	Containment Boom - 18" to 24"	4000'	Port Fourchon, LA	7.25	1	1	10
		Response Boats - 14' to 20'	6					
		Response Boats - 21' to 36'	2					
		Shallow Water Skimmers	1					
Phoenix Pollution Control & Environmental Services (281) 838-3400	Baytown, TX	Containment Boom - 18"	13,000'	Port Fourchon, LA	8	1	1	10
		Containment Boom - 10"	1,150'					
		Response Boats - 16'	6					
		Response Boats - 20'	3					
		Response Boats - 24'	1					
		Response Boats - 35'	2					
		Portable Skimmers	24					
OMI (800) 645-6671	Houston, TX	Containment Boom - 18" to 24"	4000'	Port Fourchon, LA	8.25	1	1	11
		Response Boats - 16'	3					
		Response Boats - 25' to 28'	1					
		Portable Skimmers	1					
Clean Harbors (800) 645-8265	Houston, TX	Containment Boom - 18" to 24"	4,500'	Port Fourchon, LA	8.25	1	1	11
		Response Boats - 14' to 20'	2					
		Response Boats - 21' to 36'	3					
		Portable Skimmers	1					
		Response Personnel	14					
ES&H Environmental (877) 437-2634	Houston, TX	Containment Boom - 10"	500'	Port Fourchon, LA	8.25	1	1	11
		Containment Boom - 18"	13,000'					
		Containment Boom - 24"	5,000'					
		Jon Boat - 12' to 16'	2					
		Response Boats - 26' to 29'	2					
		Portable Skimmers	2					
		Wildlife Hazing Cannon	12					
Miller Env. Services (800) 929-7227	Houston, TX	Containment Boom - 18"	12,000'	Port Fourchon, LA	8.25	1	1	11
		Shallow Water Skimmers	1					
		Response Boats - 28'	1					
		Responder Personnel	38					
USES Environmental (888) 279-9930	Houston, TX	Containment - 18"	10,000'	Port Fourchon, LA	8.25	1	1	11
		Response Boats - 16'	4					
		Response Boats - 26'	1					
		Portable Skimmers	1					
Wildlife Ctr. of Texas (713) 861-9453	Houston, TX	Wildlife Specialist - Personnel	6 to 20	Port Fourchon, LA	8.25	1	1	11

Table 9.D.11 Shoreline Protection and Wildlife Support List (cont.)

Mississippi Canyon 890
Sample Shoreline Protection & Wildlife Support List

Supplier & Phone	Warehouse	Equipment Listing	Quantity	Staging Area	Response Times (Hours)			
					Staging ETA	Loadout Time	Deployment Time	Total ETA
Gamer Environmental (800) 424-1716	Deer Park, TX	Containment Boom - 18"	16,000'	Port Fourchon, LA	8.25	1	1	**11**
		Response Boats - 12'	2					
		Response Boats - 16' to 20'	5					
		Respons Boats - 30'	2					
		Portable Skimmers	13					
Gamer Environmental (800) 424-1716	La Marque, TX	Containment Boom - 6"	9,500'	Port Fourchon, LA	8.75	1	1	**11**
		Response Boats - 16'	5					
		Response Boats - 24'	1					
		Portable Skimmers	7					
USES Environmental (888) 279-9930	Memphis, TN	Containment Boom - 6"	850'	Port Fourchon, LA	9.25	1	1	**12**
		Containment Boom - 12"	300'					
		Containment Boom - 18"	5,000'					
		Response Boats - 12'	3					
		Response Boats - 14'	5					
		Response Boats - 16'	2					
		Response Boats - 24'	1					
		Response Boats - 28'	1					
		Portable Skimmers	2					
Miller Env. Services (800) 929-7227	Corpus Christi, TX	Containment Boom - 10"	2,000'	Port Fourchon, LA	11.5	1	1	**14**
		Containment Boom - 18"	30,000'					
		Jon Boats - 14' to 16' w/25hp motor	4					
		Jon Boats - 16' to 18' w/Outboard motor	4					
		Air Boat - 14'	1					
		Response Boats - 24' to 26'	4					
		Portable Skimmers	6					
		Shallow Water Skimmers	2					
		Response Personnel	142					
Tri-State Bird Rescue & Research, Inc. (800) 261-0980	Newark, DE	Wildlife Specialist - Personnel	6 to 12	Port Fourchon, LA	21.5	1	1	**24**

Table 9.D.11 Shoreline Protection and Wildlife Support List (cont.)

SECTION 10: ENVIRONMENTAL MONITORING

A. Monitoring Systems

A rig based Acoustic Doppler Current Profiler (ADCP) is used to continuously monitor the current beneath the rig. Metocean conditions such as sea states, wind speed, ocean currents, etc. will also be continuously monitored. Shell will comply with NTL 2015-G04.

B. Incidental Takes

No incidental takes are anticipated. Although marine mammals may be seen in the area, Shell does not believe that its operations proposed under this EP will result Shell implements the mitigation measures and monitors for incidental takes of protected species according to the following notices to lessees and operators from the BOEM/BSEE:

NTL 2015-BSEE-G03	"Marine Trash and Debris Awareness and Elimination"
NTL 2016-BOEM-G01	"Vessel Strike Avoidance and Injured/Dead Protected Species Reporting"
NTL 2016-BOEM-G02	"Implementation of Seismic Survey Mitigation Measures & Protected Species Observer Program"

Additionally, the NMFS 2020 Endangered Species Act, Section 7 Consultation – Biological Opinion discusses the potential for entrapment or entanglement of listed marine species from proposed operations, and specifically references the use of areas commonly called "moon pools." Shell provides the following information regarding the use of moon pools on vessels supporting the proposed operations:

- The area that may be referred to as a "moon pool" on a DP semi-submersible rig is an open area under the rig and is not enclosed and poses no risk to marine life.

- The typical drillship MODUs that may be used to conduct the operations stated in this plan will be selected from our common fleet and the sizes of the moonpools range from approximately 82 x 41 ft to 111 x 36 ft.

- Regardless of which MODU will be used, all moon pool/open areas for these operations will be used for deploying casing and well heads, tools supporting drilling, blow-out preventers, and riser system components. The moon pool will not be used to deploy remote-operated vehicles (ROVs).

- Moon pools on MODUs intended to be used do not have doors. Some MODUs have wave breakers, but these will not be used during drilling operations. All MODUs have flexible lines, which are drape hoses, to support drilling operations, see image below. By definition, drape hoses have a U-shaped bend or 'drape' in the line that allows for relative movement between the inner barrel of the telescopic joint and the outer barrel of the telescopic joint as the MODU moves (ISO 13624-1:2009 Petroleum and Natural Gas Industries). The purpose of the flexible lines is to connect a choke, kill, or auxiliary line (e.g. hydraulic) terminal fitting on the telescopic joint to the appropriate piping on the drilling structure (API Specification 16Q). These drape hoses do not present a potential entanglement or entrapment threat to listed species.

Additionally, the NMFS 2020 Endangered Species Act, Section 7 Consultation – Biological Opinion discusses the potential for entrapment or entanglement of listed marine species from proposed operations, and specifically references the use of areas commonly called "moon pools." Shell provides the following information regarding the use of moon pools on vessels supporting the proposed operations:

- The area that may be referred to as a "moon pool" on a DP semi-submersible rig is an open area under the rig and is not enclosed and poses no risk to marine life.

- The typical drillship MODUs that may be used to conduct the operations stated in this plan will be selected from our common fleet and the sizes of the moonpools range from approximately 82 x 41 ft to 111 x 36 ft.

- Regardless of which MODU will be used, all moon pool/open areas for these operations will be used for deploying casing and well heads, tools supporting drilling, blow-out preventers, and riser system components. The moon pool will not be used to deploy remote-operated vehicles (ROVs).

- Moon pools on MODUs intended to be used do not have doors. Some MODUs have wave breakers, but these will not be used during drilling operations. All MODUs have flexible lines, which are drape hoses, to support drilling operations, see image below. By definition, drape hoses have a U-shaped bend or 'drape' in the line that allows for relative movement between the inner barrel of the telescopic joint and the outer barrel of the telescopic joint as the MODU moves (ISO 13624-1:2009 Petroleum and Natural Gas Industries). The purpose of the flexible lines is to connect a choke, kill, or auxiliary line (e.g. hydraulic) terminal fitting on the telescopic joint to the appropriate piping on the drilling structure (API Specification 16Q). These drape hoses do not present a potential entanglement or entrapment threat to listed species.

Figure 1 Moon Pool on Transocean MODU

Specific to monitoring of the moon pool during operations, there is a minimum of one camera monitoring each moon pool 24/7. During operations there are generally two or more personnel monitoring the drilling unit and overseeing the moon pool.

At the time of this submission, the MODU contractor is not selected. Once this is determined, the following mitigations will be adhered to. Shell is committed to protecting marine life and will mitigate the potential for entrapment of endangered marine species in a moon pool area specific to these activities as follows:

1. The presence of Endangered Species Act listed marine species (listed species) in moon pools will be documented in MODU daily reports and logs. If a listed species is observed, rig/vessel personnel will follow actions listed in Bullet 3.

2. MODU personnel will take steps to avoid the presence or use of multiple flexible lines or ropes and/or nettings in the moon pool in a way that potentially may result in the entrapment or entanglement of a listed species. In the event critical operational and/or safety lines, ropes or nettings will be present, camera monitoring of the moon pool area as specified below will be in place. As stated above, drape hoses are not considered a type of flexible line that potentially may result in the entanglement or entrapment of listed species.

3. Cameras will monitor the moon pool area for the presence of listed species. Camera footage will be transmitted to the control room where personnel will monitor for presence of listed species. The occurrence of sea turtles or other listed species in a moon pool will be documented in operations daily report logs and personnel will alert our environmental lead on duty, who will immediately contact NMFS at nmfs.psoreview@noaa.gov and BSEE at 985-722-7902 and protectedspecies@bsee.gov for additional guidance on any operation restrictions, continued monitoring requirements, recovery assistance needs (if required), and incidental report information.

    a. If a listed species is observed in the moon pool prior to the start of operations, appropriate rig/vessel personnel will be notified by the control room before operations will be allowed to begin.

    b. If operations have not commenced and conditions within the moonpool are such that visibility is limited to visually detect a listed species, rig/vessel personnel will monitor the moon pool for 30 minutes prior to start of activities in the moon pool. If operations are ongoing and conditions within the moonpool are such that visibility is limited, rig/vessel personnel will continue to monitor the moon pool and adjust operations (e.g., deploy or retrieve equipment) when it is safe to do so to minimize any potential interaction with an undetected listed species.

    c. If any listed species is detected in the moon pool, personnel will assess whether ongoing operations have the potential to entangle or entrap the listed species:
        - If ongoing operations in the moon pool pose no potential threat of entrapment or entanglement to the listed species (e.g. drill pipe), operations will proceed and monitoring by rig/vessel operations personnel will continue.
        - If personnel determine that a potential threat exists, operations will pause until the threat is eliminated (e.g., the animal exits the moon pool on its own).
        - If pausing operations cannot eliminate the threat (e.g., the animal cannot or will not exit the moon pool within a reasonable time on its own volition) and/or the animal is dead, in distress, or injured, personnel will alert our environmental lead on duty, who will immediately contact NMFS at nmfs.psoreview@noaa.gov and BSEE at 985-722-7902 and protectedspecies@bsee.gov for additional guidance on any operation restrictions, continued monitoring requirements, recovery assistance needs (if required), and incidental report information.

C. Flower Garden Banks National Marine Sanctuary

The operations proposed in this EP will not be conducted within the Protective Zones of the Flower Garden Banks and Stetson Bank.

SECTION 11: LEASE STIPULATIONS

Mississippi Canyon Block 890, OCS-G 07969

This lease was obtained in Lease Sale 98 on May 22, 1985. The lease became part of the MC 935 Unit, No. 754395016 effective April 1, 1995.

Stipulation No. 1 – Cultural Resources

See Section 6 for information regarding this stipulation.

Mississippi Canyon Block 934, OCS-G 07975

This lease was obtained in Lease Sale 98 on May 22, 1985. The lease became part of the MC 935 Unit, No. 754395016 effective April 1, 1995.

Stipulation No. 1 – Cultural Resources

See Section 6 for information regarding this stipulation.

SECTION 12: ENVIRONMENTAL MITIGATION MEASURE INFORMATION

A. Impacts to Marine and coastal environments

The proposed action will implement mitigation measures required by laws and regulations, including all applicable Federal & State requirements concerning air emissions, discharges to water, and solid waste disposal, as well as any additional permit requirements and Shell policies. Project activities will be conducted in accordance with the Regional Oil Spill Response Plan. Section 18 of this plan discusses impacts and mitigation measures.

B. Incidental Takes

We do not anticipate any incidental takes related to the proposed operations. Shell implements the mitigation measures and monitors for incidental takes of protected species according to the following notices to lessees and operators from the BOEM/BSEE:

NTL 2015-BSEE-G03	"Marine Trash and Debris Awareness and Elimination"
NTL 2016-BOEM-G01	"Vessel Strike Avoidance and Injured/Dead Protected Species Reporting"
NTL 2016-BOEM-G02	"Implementation of Seismic Survey Mitigation Measures & Protected Species Observer Program"

NMFS 2020 Endangered Species Act, Section 7 Consultation – Biological Opinion:

- Appendix A: No seismic survey activities will take place in this Plan.

- Appendix B: Shell will comply with GOM Marine and Trash Requirements in Appendix B 2020 NMFS BiOp and BOEM/BSEE Regulations.

- Appendix C: Shell will comply with GOM Vessel Strike Avoidance and Protected Species Reporting Requirements in Appendix C and BOEM/BSEE Regulations.

- Appendix J: There will be no explosive severance operations conducted in this Plan that may result in potential for entanglement or entrapment of endangered marine species. Shell intends to follow the monitoring and reporting procedures outlined in Section 12 and apply the measures in Appendix J, if appropriate, based on consultation with NMFS.

SECTION 13: RELATED FACILITIES AND OPERATIONS INFORMATION

Information regarding Related Facilities and Operations Information, transportation systems, & produced liquid hydrocarbon transportation vessels are not included in this plan as such information is only necessary in the case of DOCDs.

SECTION 14: SUPPORT VESSELS AND AIRCRAFT

A. General

Type	Maximum Fuel Tank Storage Capacity (Gals)	Maximum No. In Area at Any Time	Trip Frequency or Duration
Crew Boats	8,000	2	Twice per week
Offshore Support Vessels	120,000	3	Twice per week
Helicopter	760	1	Once per day

B. 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-foot length	100,000 gals.	1 week	Port Fourchon to MC 890

C. Drilling Fluids Transportation

Type of Material	Quantity Being Transported	Transportation Method
Dry Bulk (Cement, Barite, Gel)	12,000 sx max combined	Below deck dry bulk tanks onboard OSV
Synthetic-base drilling fluids	11,000 bbls max per voyage	Tanks below deck onboard OSV

Vessels associated with this proposed activity will not transit the designated Bryde's whale area in the NMFS 2020 Endangered Species Act, Section 7 Consultation – Biological Opinion.

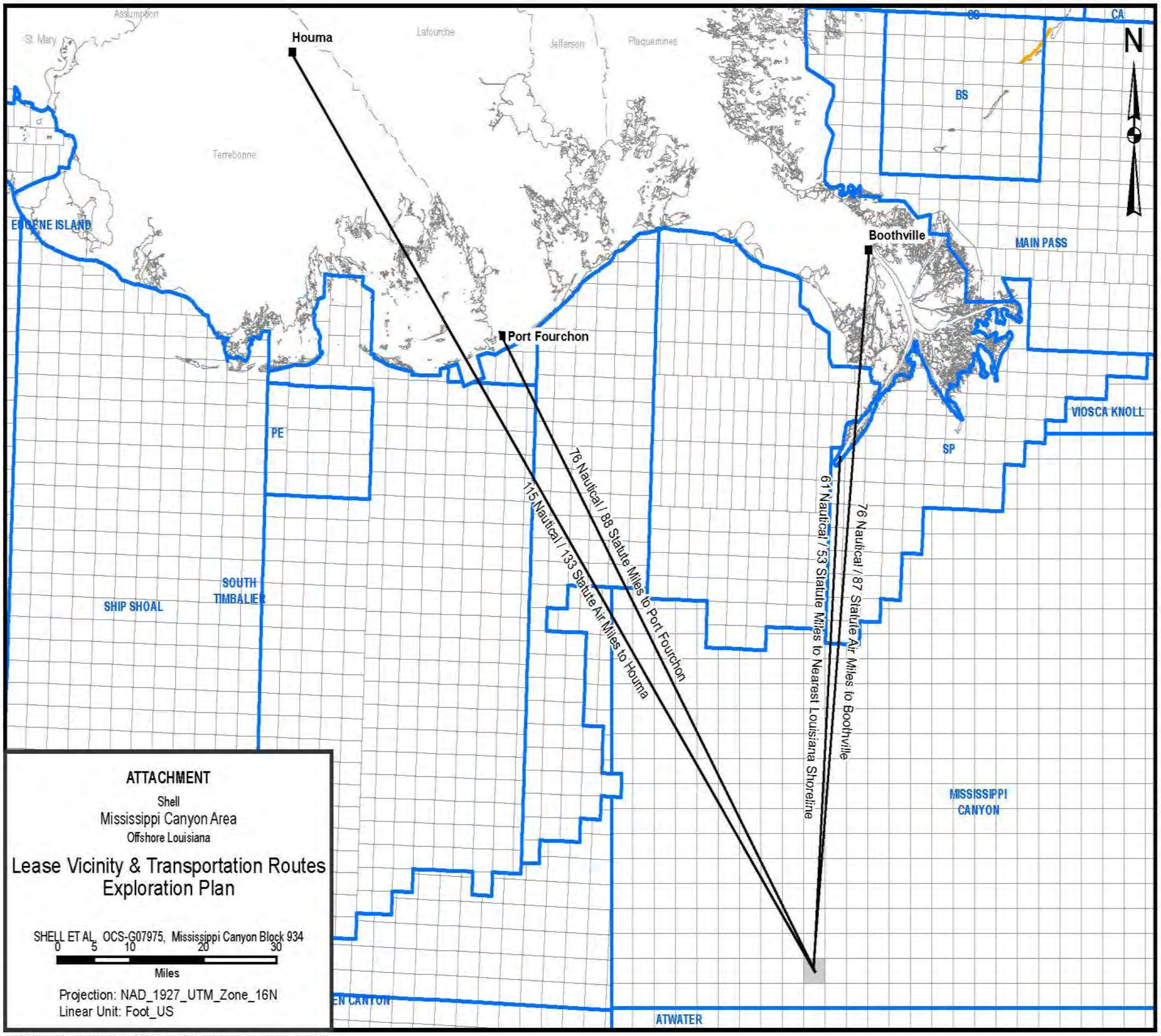
D. Solid and Liquid Wastes Transportation

See Section 7, Table 7B.

E. Vicinity Map

See Attachment 14A.

Attachment 14A - Vicinity Map



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SECTION 15: ONSHORE SUPPORT FACILITIES

A. General

Name	Location	Existing/New/Modified
Fourchon	Port Fourchon, LA	Existing
PHI Heliport	Houma, LA	Existing
PHI Heliport	Boothville, LA	Existing

The onshore support bases for water and air transportation will be the existing terminals in Houma, Boothville and Fourchon, Louisiana. The Fourchon boat facility is operated by Shell and is located on Bayou Lafourche, south of Leeville, LA approximately 3 miles from the Gulf of Mexico. The existing onshore air support base in Houma, LA is located at 3550 Taxi Rd., Houma, LA 70363. The existing onshore air support base in Boothville, LA is located at 38963 LA 23, Buras LA 70041.

B. Support Base Construction or Expansion

This section does not apply to this plan as Shell does not plan to construct a new onshore support base or expand an existing one to accommodate the activities proposed in this EP.

C. Support Base Construction or Expansion Timetable

This section does not apply to this plan as Shell does not plan to construct a new onshore support base or expand an existing one to accommodate the activities proposed in this EP.

D. Waste Disposal

See Section 7, Tables 7A and 7B.

E. Air emissions

Not required by BOEM GOM.

F. Unusual solid and liquid wastes

Not required by BOEM GOM.

SECTION 16: SULPHUR OPERATIONS

Information regarding Sulphur Operations is not included in this EP as we are not proposing to conduct sulphur operations.

SECTION 17: COASTAL ZONE MANAGEMENT ACT (CZMA) INFORMATION

LOUISIANA
COASTAL ZONE MANAGEMENT
CONSISTENCY CERTIFICATION

SUPPLEMENTAL EXPLORATION PLAN
Type of Plan

Mississippi Canyon Blocks 890
Area and Blocks

OCS-G 7969
Lease Numbers

The proposed activities described in detail in this Plan will comply with Louisiana's State and Local Coastal Resources Management Act of 1978, Coastal Resources Program, and Coastal Area Management Enforceable Policies.

We have considered all of Louisiana's Enforceable Policies in making this certification of consistency.

SHELL OFFSHORE INC.
Operator

Sylvia A Bellone

Sylvia Bellone
Certifying Official

03/11/2020
Date

TEXAS
COASTAL ZONE MANAGEMENT
CONSISTENCY CERTIFICATION

EXPLORATION PLAN
Type of Plan

Mississippi Canyon Blocks 890 & 934
Area and Blocks

OCS-G 7969 & OCS-G 7975
Lease Numbers

The proposed activities described in detail in this Plan will comply with the Texas approved Coastal Resources Program and Coastal Area Management Program Policies.

SHELL OFFSHORE INC.
Operator

Sylvia A Bellone

Sylvia A. Bellone
Certifying Official

02/14/2020
Date

Coastal Zone Management Consistency Information
For the State of Texas

In accordance with Subpart E of 15 CFR 903 "Consistency for Outer Continental Shelf (OCS) Exploration, Development and Production Activities" and as required by 15 CFR 930.58, Shell is hereby providing the following information in support of the Environmental Impact Analysis submitted as Section 18 of this plan.

15 CFR 930.58 identifies necessary data and information to be furnished to the State agency. The information is as follows:

CONSISTENCY CERTIFICATION

A Coastal Zone Consistency Certification for activities that affect the State of Texas is provided in Section 17 of the EP.

OTHER INFORMATION

A detailed description of the proposed activities, coastal effects, and comprehensive information sufficient to support this Consistency Certification is presented in Section 17 of the EP. As per NTL 2008-G04, the following items have been identified as being required:

- A discussion of the method of disposal of wastes and discharges is provided in Section 7 of the EP.
- Oil Spill Information is provided in Section 9 of the EP. All operations are covered by Shell's Regional Oil Spill Response Plan. The Plan is available upon request.

Following is an evaluation that includes findings relating the coastal effects of the proposed activities and associated facilities to the relevant enforceable policies of the Texas' Coastal Management Program (TCMP), Title 31, Part 16, Chapter 501, Subchapter B.:

(Category 2)
Construction, Operation & Maintenance of Oil & Gas Exploration & Production Facilities

No operations are proposed in or near any critical areas. The proposed activities are of a development in nature, but no facility construction is proposed. The proposed activities are located >100 miles from the Texas shoreline; therefore, we expect no adverse impacts to CNRAs or beach access and use rights of the public. All activities shall be conducted in a manner that minimizes significant impacts to coastal resources. No adverse effects to Texas' coastal area are expected in association with the proposed activities.

(Category 3)
Discharges of Wastewater and Disposal of Waste from Oil and Gas Exploration and Production Activities

No discharge of wastewater or disposal of waste from the proposed activities will occur in the Texas' coastal zone, therefore no impact to Texas' coastal waters is expected.

(Category 4)
Construction and Operation of Solid Waste Treatment, Storage, and Disposal Facilities

No construction of solid waste facilities or expansion of existing facilities in the coastal zone are proposed in the attached plan, therefore, no adverse effects on any features of Texas' coastal cone are expected.

(Category 5)

Prevention, Response, and Remediation of Oil Spills

The proposed activities will be covered under an approved Regional Oil Spill Response Plan. The plan is in place, practiced, and updated as necessary. The best practical techniques shall be utilized to prevent the release of pollutants or toxic substances into the environment. All involved vessels and facilities are designed to be capable of prompt response and adequate removal of accidental discharges of oil. In addition, the proposed activities are >100 from shore; therefore, no damages to natural resources are expected as the result of an unauthorized discharge of oil into coastal waters.

(Category 6)

Discharge of Municipal and Industrial Waster Water to Coastal Waters

No discharges from the proposed activities will occur in coastal waters. The proposed activities are >100 from shore, therefore there will be no effect on coastal waters.

(Category 8)

Development in Critical Areas

None of the proposed activities will occur in a critical area; therefore, no effects to Texas' coastal zone are expected. The activity will not jeopardize the continued existence of species listed as endangered or threatened, and will not result in likelihood of the destruction or adverse modification of a habitat determined to be a critical habitat under the Endangered Species Act. The activity will not cause or contribute to violation of any applicable surface water quality standards. The activity will not violate any requirement imposed to protect a marine sanctuary.

(Category 9)

Construction of Waterfront Facilities and Other Structures on Submerged lands

No waterfront facilities or other structures are proposed on submerged lands in the Texas coastal zone, therefore the proposed activities are not expected to have any adverse impacts on submerged lands.

(Category 10)

Dredging and Dredged Material Disposal and Placement

No dredging or disposal/placement of dredged material is proposed, therefore no adverse effects to coastal waters, submerged lands, critical areas, coastal shore areas, or Gulf beaches are expected.

(Category 11)

Construction in the Beach / Dune System

The proposed activities do not include any construction projects in critical dune areas or areas adjacent to or on Gulf beaches, therefore, no impact to Texas' beach or dune systems are expected.

(Category 15)

Alteration of Coastal Historic Areas

The proposed activities do not include any alteration or disturbance of a coastal historic area; therefore, no impacts to are expected to adversely affect any historical, architectural, or archaeological site in Texas' coastal zone.

(Category 16)

Transportation

The proposed activities do not include any transportation construction projects within the coastal zone; therefore, no impacts to Texas' coastal zone are expected.

(Category 17)
Emission of Air Pollutants

The proposed activities shall be carried out in conformance with applicable air quality laws, standards, and regulations. Emissions from the proposed activities are not expected to have significant impacts on onshore air quality because of the prevailing atmospheric conditions, emission heights, emission rates, and the distance of these emissions from the coastline. The proposed activities will occur >100 from shore and will be within the exemption limits set by BOEM, therefore, no impacts to Texas' coastal zone is expected.

(Category 18)
Appropriations of Water

The proposed activities do not include the impoundment or diversion of state water, therefore, no impacts to Texas' coastal zone is expected.

(Category 20)
Marine Fishery Management

The proposed activities are located >100 from shore and are not expected to have any effect on marine fishery management or fishery migratory patterns within waters in the coastal zone of Texas.

(Category 22)
Administrative Policies

The necessary information for applicable agencies to make an informed decision on the proposed activities has been provided

In conclusion, all activities shall be consistent with Texas' coastal management program and shall comply with all relevant rules and regulations. No activities are planned within any critical areas. Activities will be carried out avoiding unnecessary conflicts with other uses of the vicinity.

18 ENVIRONMENTAL IMPACT ANALYSIS

Supplemental Exploration Plan

Mississippi Canyon Block 890 (OCS-G 07969)
Mississippi Canyon Block 934 (OCS-G 07975)

Offshore Louisiana
May 2020

Prepared for:
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Prepared by:
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Acronyms and Abbreviations

ac	acre
ADIOS	Automated Data Inquiry for Oil Spills
AQR	Air Quality Emissions Report
AQRV	Air Quality Related Values
bbl	barrel
BOEM	Bureau of Ocean Energy Management
BSEE	Bureau of Safety and Environmental Enforcement
CFR	Code of Federal Regulations
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
dB	decibel
DP	dynamically positioned
DPS	distinct population segment
EEZ	exclusive economic zone
EFH	Essential Fish Habitat
EIA	Environmental Impact Analysis
EIS	Environmental Impact Statement
EP	Exploration Plan
ESA	Endangered Species Act
FAD	fish-aggregating device
FR	Federal Register
GMFMC	Gulf of Mexico Fishery Management Council
H_2S	hydrogen sulfide
ha	hectare
HAPC	Habitat Area of Particular Concern
Hz	hertz
IPF	impact-producing factor
kHz	kilohertz
µPa	micropascal
MARPOL	International Convention for the Prevention of Pollution from Ships
MC	Mississippi Canyon
MMC	Marine Mammal Commission
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
MODU	mobile offshore drilling unit
MWCC	Marine Well Containment Company
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NTL	Notice to Lessees and Operators
NWR	National Wildlife Refuge
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OSRA	Oil Spill Risk Analysis
OSRP	Oil Spill Response Plan
PAH	polycyclic aromatic hydrocarbon
PM	particulate matter
re	referenced to
s	second
SBM	synthetic-based mud
Shell	Shell Offshore Inc.
SO_x	sulfur oxides
USCG	U.S. Coast Guard
USDOI	U.S. Department of the Interior
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compound
WBM	water-based drilling muds
WCD	worst case discharge
WMA	Wildlife Management Area

Introduction

Project Summary

Shell Offshore Inc. (Shell) is submitting a Initial Exploration Plan (EP) for Mississippi Canyon (MC) Blocks 890 (MC 890) for two exploration wells (C and C-Alt) and 934 (MC 934) for five exploration wells (A, A-Alt, B, B-Alt, and DD). The Environmental Impact Analysis (EIA) provides information on potential impacts to environmental resources that could be affected by Shell's proposed activities in the project area under this EP.

The project area is in the Central Planning Area, approximately 53 miles (85 km) from the nearest shoreline (Louisiana), 88 miles (142 km) from the onshore support base at Port Fourchon, Louisiana, and 87 miles (140 km) from the helicopter base in Boothville or alternatively 133 miles (214 km) from the helicopter base in Houma, Louisiana. Estimated water depths at the proposed wellsites range from approximately 3,622 to 3,833 ft (1,104 to 1,168 m). All distances are in statute miles.

Drilling operations are expected to require up to 250 days per year from 2020 to 2027. A mobile offshore drilling unit (MODU), which will be either a dynamically positioned (DP) drillship or a DP semisubmersible rig for this project. The EIA addresses the environmental impacts from the proposed EP activities.

Purpose of the Environmental Impact Analysis

The EIA was prepared pursuant to the requirements of the Outer Continental Shelf Lands Act (OCSLA), 43 United States Code §§ 1331-1356 as well as regulations including 30 Code of Federal Regulations (CFR) 550.212 and 550.227. The EIA is a project- and site-specific analysis of Shell's planned activities under this EP.

The EIA presents data, analyses, and conclusions to support the Bureau of Ocean Energy Management (BOEM) reviews as required by the National Environmental Policy Act (NEPA) and other relevant federal laws, including the Endangered Species Act (ESA) and Marine Mammal Protection Act (MMPA). The EIA addresses impact-producing factors (IPFs), resources, and impacts associated with the proposed project activities. It identifies mitigation measures to be implemented in connection with the planned activities. Potential environmental impacts of a blowout scenario and worst-case discharge (WCD) are also analyzed.

Potential impacts have been analyzed at a broader level in the 2017 to 2022 Programmatic Environmental Impact Statement (EIS) for the Outer Continental Shelf (OCS) Oil and Gas Leasing Program (BOEM, 2016a) and in multisale EISs for the Western and Central Gulf of Mexico Planning Areas (BOEM, 2012a, b, 2013, 2014, 2015, 2016b, 2017a).

The most recent multisale EISs update environmental baseline information in light of the Macondo (*Deepwater Horizon*) incident and address potential impacts of a catastrophic spill (BOEM, 2012a, b, 2013, 2014, 2015, 2016b, 2017a). Numerous technical studies have also been conducted to address the impacts of the incident. The findings of the post-Macondo incident studies have been incorporated into this report and are supplemented by site-specific analyses, where applicable. The EIA relies on the analyses from these documents, technical studies, and post-Macondo incident studies, where applicable, to provide BOEM and other regulatory agencies with the necessary information to evaluate Shell's EP and ensure that oil and gas exploration activities are performed in an environmentally sound manner, with minimal impacts on the environment.

OCS Regulatory Framework

The regulatory framework for OCS activities in the Gulf of Mexico is summarized by BOEM in its Final Programmatic EIS for the OCS Oil and Gas Leasing Program for 2017 to 2022 (BOEM, 2016a). Under the OCSLA, the U.S. Department of the Interior (USDOI) is responsible for the administration of mineral exploration and development of the OCS. Within the USDOI, BOEM and the Bureau of Safety and Environmental Enforcement (BSEE) are responsible for managing and regulating the development of OCS oil and gas resources in accordance with the provisions of the OCSLA. The BSEE offshore regulations are in 30 CFR Chapter II, Subchapter B. BOEM offshore regulations are in 30 CFR Chapter V, Subchapter B.

In implementing its responsibilities under the OCSLA and NEPA, BOEM consults numerous federal departments and agencies that have authority to comment on permitting documents under their jurisdiction and maintain ocean resources pursuant to other federal laws. Among these are the U.S. Coast Guard (USCG), U.S. Environmental Protection Agency (USEPA), U.S. Fish and Wildlife Service (USFWS), and the National Oceanic and Atmospheric Administration (NOAA) through the National Marine Fisheries Service (NMFS). Federal laws (e.g., the ESA, MMPA, Coastal Zone Management Act of 1972, Magnuson-Stevens Fishery Conservation and Management Act) establish the consultation and coordination processes with federal, state, and local agencies.

In addition, Notices to Lessees and Operators (NTLs) are formal documents issued by BOEM and BSEE that provide clarification, description, or interpretation of pertinent regulations or standards. **Table 1** lists and summarizes the NTLs applicable to the EIA.

Table 1. Notices to Lessees and Operators (NTLs) that are applicable to this Environmental Impact Analysis (EIA), ordered from most recent to oldest.

NTL	Title	Summary
BOEM-2016-G01	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 protected species.
BSEE-2015-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.
BOEM-2015-N02	Elimination of Expiration Dates on Certain Notice to Lessees and Operators Pending Review and Reissuance	Eliminates the expiration dates on past or upcoming expiration dates from NTLs currently posted on the Bureau of Ocean Energy Management website.

NTL	Title	Summary
BOEM-2015-N01	Information Requirements for Exploration Plans, Development and Production Plans, and Development Operations Coordination Documents on the Outer Continental Shelf (OCS) for Worst Case Discharge (WCD) Blowout Scenarios	Provides guidance regarding information required in WCD descriptions and blowout scenarios.
BOEM-2014-G04	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.
BSEE-2014-N01	Elimination of Expiration Dates on Certain Notices to Lessees and Operators Pending Review and Reissuance	Eliminates expiration dates (past or upcoming) of all NTLs currently posted on the Bureau of Safety and Environmental Enforcement website.
BSEE-2012-N06	Guidance to Owners and Operators of Offshore Facilities Seaward of the Coast Line Concerning Regional Oil Spill Response Plans	Provides clarification, guidance, and information for preparation of regional Oil Spill Response Plans. Recommends description of response strategy for WCD scenarios to ensure capability to respond to oil discharges is both efficient and effective.
2011-JOINT-G01	Revisions to the List of OCS Blocks Requiring Archaeological Resource Surveys and Reports	Provides new information on which OCS blocks require archaeological surveys and reports and line spacing required in each block. This NTL augments NTL 2005-G07.
2010-N10	Statement of Compliance with Applicable Regulations and Evaluation of Information Demonstrating Adequate Spill Response and Well Containment Resources	Informs operators using subsea or surface blowout preventers 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 *Federal Register* 63346). Informs operators that the Bureau of Ocean Energy Management will be evaluating 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.
2009-G40	Deepwater Benthic Communities	Provides guidance for avoiding and protecting high-density deepwater benthic communities (including chemosynthetic and deepwater coral communities) from damage caused by OCS oil and gas activities in water depths greater than 984 ft (300 m). Prescribes separation distances of 2,000 ft (610 m) from each mud and cuttings discharge location and 250 ft (76 m) from all other seafloor disturbances.

NTL	Title	Summary
2009-G39	Biologically Sensitive Underwater Features and Areas	Provides 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 984 ft (300 m) in the Gulf of Mexico.
2009-N11	Air Quality Jurisdiction on the OCS	Clarifies jurisdiction for regulation of air quality in the Gulf of Mexico OCS.
2008-G04	Information Requirements for Exploration Plans and Development Operations Coordination Documents	Provides guidance on the information requirements for OCS plans, including EIA requirements and information regarding compliance with the provisions of the Endangered Species Act and the Marine Mammal Protection Act.
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.

Oil Spill Prevention and Contingency Planning

Shell has an approved Gulf of Mexico Regional Oil Spill Response Plan (OSRP) as a fundamental component of the planned drilling program that certifies Shell’s capability to respond to the maximum extent practicable to a WCD (30 CFR 254.2) (see EP Section 9). The OSRP demonstrates Shell’s capability to rapidly and effectively manage oil spills that may result from drilling operations. Despite the extremely low likelihood of a large oil spill occurring during the project, Shell has designed its response program based on a regional capability of responding to a range of spill volumes that increase from small operational spills to a WCD from a well blowout. Shell’s program is intended to meet the response planning requirements of the relevant coastal states and federal oil spill planning regulations. The OSRP includes information regarding Shell’s regional oil spill organization, dedicated response assets, potential spill risks, and local environmental sensitivities. The OSRP presents specific information on the response program that includes a description of personnel and equipment mobilization, the incident management team organization, and the strategies and tactics used to implement effective and sustained spill containment and recovery operations.

EIA Organization

The EIA is organized into **Sections A** through **I** corresponding to the requirements of NTL 2008-G04 (as extended by NTL 2015-N02), which provides guidance regarding information required by 30 CFR Part 550 for EIAs. The main impact-related discussions are in **Section A** (Impact-Producing Factors) and **Section C** (Impact Analysis).

A. Impact-Producing Factors

Based on the description of Shell's proposed activities, a series of IPFs have been identified. **Table 2** identifies the environmental resources that may be affected in the left column and identifies sources of impacts associated with the proposed project across the top. **Table 2** was adapted from Form BOEM-0142 and developed *a priori* to focus the impact analysis on those environmental resources that may be impacted as a result of one or more IPFs. The tabular matrix indicates which routine activities and accidental events could affect specific 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 activities are listed below and briefly discussed in the following sections.

- MODU 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.

Table 2. Matrix of impact-producing factors and affected environmental resources. X = potential impact on the resource; dash (--) = no impact or negligible impact on the resource.

Environmental Resources	Impact-producing Factors									
	MODU Presence (incl. noise & lights)	Physical Disturbance to Seafloor	Air Pollutant Emissions	Effluent Discharges	Water Intake	Onshore Waste Disposal	Marine Debris	Support Vessel/Helicopter Traffic	Accidents	
									Small Fuel Spill	Large Oil Spill
Physical/Chemical Environment										
Air quality	--	--	X(5)	--	--	--	--	--	X(6)	X(6)
Water quality	--	--	--	X	--	--	--	--	X(6)	X(6)
Seafloor Habitats and Biota										
Soft bottom benthic communities	--	X	--	X	--	--	--	--	--	X(6)
High-density deepwater benthic communities	--	--(4)	--	--(4)	--	--	--	--	--	X(6)
Designated topographic features	--	--(1)	--	--(1)	--	--	--	--	--	--
Pinnacle trend area live bottoms	--	--(2)	--	--(2)	--	--	--	--	--	--
Eastern Gulf live bottoms	--	--(3)	--	--(3)	--	--	--	--	--	--
Threatened, Endangered, and Protected Species and Critical Habitat										
Sperm whale (Endangered)	X(8)	--	--	--	--	--	--	X(8)	X(6,8)	X(6,8)
Bryde's whale (Endangered)	X(8)	--	--	--	--	--	--	X(8)	X(6,8)	X(6,8)
West Indian manatee (Endangered)	--	--	--	--	--	--	--	X(8)	--	X(6,8)
Non-endangered marine mammals (protected)	X	--	--	--	--	--	--	X	X(6)	X(6)
Sea turtles (Endangered/Threatened)	X(8)	--	--	--	--	--	--	X(8)	X(6,8)	X(6,8)
Piping Plover (Threatened)	--	--	--	--	--	--	--	--	--	X(6)
Whooping Crane (Endangered)	--	--	--	--	--	--	--	--	--	X(6)
Oceanic whitetip shark (Threatened)	X	--	--	--	--	--	--	--	--	X(6)
Giant manta ray (Threatened)	X	--	--	--	--	--	--	--	--	X(6)
Gulf sturgeon (Threatened)	--	--	--	--	--	--	--	--	--	X(6)
Nassau grouper (Threatened)	--	--	--	--	--	--	--	--	--	X(6)
Smalltooth sawfish (Endangered)	--	--	--	--	--	--	--	--	--	X(6)
Beach mice (Endangered)	--	--	--	--	--	--	--	--	--	X(6)
Florida salt marsh vole (Endangered)	--	--	--	--	--	--	--	--	--	X(6)
Threatened coral species	--	--	--	--	--	--	--	--	--	X(6)
Coastal and Marine Birds										
Marine birds	X	--	--	--	--	--	--	X	X(6)	X(6)
Coastal birds	--	--	--	--	--	--	--	X	--	X(6)
Fisheries Resources										
Pelagic communities and ichthyoplankton	X	--	--	X	X	--	--	--	X(6)	X(6)
Essential Fish Habitat	X	--	--	X	X	--	--	--	X(6)	X(6)
Archaeological Resources										
Shipwreck sites	--	--(7)	--	--	--	--	--	--	--	X(6)
Prehistoric archaeological sites	--	--(7)	--	--	--	--	--	--	--	X(6)
Coastal Habitats and Protected Areas										
Coastal habitats and protected areas	--	--	--	--	--	--	--	X	--	X(6)
Socioeconomic and Other Resources										
Recreational and commercial fishing	X	--	--	--	--	--	--	--	X(6)	X(6)
Public health and safety	--	--	--	--	--	--	--	--	--	X(6)
Employment and infrastructure	--	--	--	--	--	--	--	--	--	X(6)
Recreation and tourism	--	--	--	--	--	--	--	--	--	X(6)
Land use	--	--	--	--	--	--	--	--	--	X(6)
Other marine uses	--	--	--	--	--	--	--	--	--	X(6)

Numbers in parentheses refer to table footnotes on the following page. MODU = mobile offshore drilling unit.

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-mile zone surrounding the Flower Garden Banks, or the 3-mile zone of Stetson Bank;*
   - *(b) 1,000-m, 1-mile, or 3-mile 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.*
   - None of these conditions (a through d) are applicable. The project area is not within the given range (buffer zone) of any marine sanctuary, topographic feature, or no-activity zone. There are no submarine banks in the project area.
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 project area.
3. *Activities within any Eastern Gulf OCS block and portions of Pensacola and Destin Dome area blocks in the Central Planning Area 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 project area.
4. *Activities on blocks designated by the Bureau of Ocean Energy Management (BOEM) as being in water depths 300 m or greater.*
   - No impacts on high-density deepwater benthic communities are anticipated. A wellsite assessment found that no features indicative of high-density chemosynthetic communities or coral communities were identified within 2,000 ft (610 m) of the proposed well locations (C&C Technologies, 2010; Ocean Geo Solutions, 2019).
5. *Exploration or production activities where hydrogen sulfide (H_2S) concentrations greater than 500 parts per million might be encountered.*
   - Mississippi Canyon Blocks 890 and 934 are classified 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 Environmental Impact Analysis (EIA) can note that in a sentence or two.*
   - Accidental hydrocarbon spills could 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 BOEM 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 from routine activities. Mississippi Canyon Blocks 890 and 934 are on BOEM's list of archaeology survey blocks (BOEM, 2011), but the locations of the proposed activities are well beyond the 197 ft (60 m) depth contour used by BOEM as the seaward extent for prehistoric archaeological site potential in the Gulf of Mexico. A dynamically positioned mobile offshore drilling unit (MODU) will be used; therefore, seafloor disturbances due to anchoring will not occur.
8. *All activities that might have an adverse effect on endangered or threatened marine mammals or sea turtles or their critical habitats.*
   - IPFs that may affect marine mammals or sea turtles include mobile offshore drilling unit presence and emissions, support vessel and helicopter traffic, and accidents. See **Section C**.
9. *Production activities that involve transportation of produced fluids to shore using shuttle tankers or barges.*
   - Not applicable.

A.1 Mobile Offshore Drilling Unit Presence (including noise and lights)

The MODU to be used for the wells will be either a DP drillship or a DP semisubmersible drilling rig that will be on site for an estimated up to 250 days per year from 2020 to 2027. DP MODUs are self-propelled and maintain position using a global positioning system, specific computer software, and sensors in conjunction with a series of thrusters or azimuth propellers. Potential impacts to marine resources from the MODU include the physical presence of the MODU in the ocean, increased light from working and safety lighting on the vessel, and noise audible above and below the water surface.

The physical presence of a MODU in the ocean can attract pelagic fishes and other marine life. The MODU would be a single structure that may concentrate small epipelagic fish species, resulting in the attraction of epipelagic predators. See **Section C.5.1** for further discussion.

The MODU will maintain exterior lighting for working at night and navigational and aviation safety in accordance with federal navigation and aviation safety regulations (International Regulations for Preventing Collisions at Sea, 1972 [72 COLREGS], Part C). Artificial lighting may attract and directly or indirectly impact natural resources, particularly birds, as discussed in **Section C.4**.

MODUs can be expected to produce noise from station keeping, drilling, and maintenance operations. The noise levels produced by DP vessels largely depend on the level of thruster activity required to keep position and, therefore, vary based on environmental site conditions and operational requirements. Representative source levels for vessels in DP mode range from 184 to 190 decibels referenced to one micropascal meter (dB re 1 µPa m) from the source, with a primary frequency below 600 hertz (Hz) (Blackwell and Greene Jr., 2003, McKenna et al., 2012, Kyhn et al., 2014). Drilling operations produce noise that includes strong tonal components at low frequencies (Minerals Management Service [MMS], 2000). When drilling, the drill string represents a long vertical sound source (McCauley, 1998). Sound source levels associated with drilling activities have a maximum broadband (10 Hz to 10 kilohertz [kHz]) energy of approximately 190 dB re 1 µPa m (Hildebrand, 2005). Based on available data, sound source levels generated from MODUs during drilling and in the absence of thrusters can be expected to range between 154 and 176 dB re 1 µPa m (Nedwell et al., 2001). The use of thrusters, whether drilling or not, can elevate sound source levels from a drillship or semisubmersible to approximately 188 dB re 1 µPa m (Nedwell and Howell, 2004).

The response of marine mammals, sea turtles, and fishes to a perceived marine sound depends on a range of factors, including 1) the sound pressure level, frequency, duration, and novelty of the sound; 2) the physical and behavioral state of the animal at the time of perception; and 3) the ambient acoustic features of the environment (Hildebrand, 2004).

A.2 Physical Disturbance to the Seafloor

The seven proposed wells will be drilled using a DP MODU. Therefore, there will be minimal disturbance to the seafloor and soft bottom communities during positioning of the wellbore and blowout preventers. Physical disturbance of the seafloor will be limited to the proximal area where the wellbore penetrates the substrate and where mud and drill cuttings will be deposited.

A.3 Air Pollutant Emissions

Estimates of air pollutant emissions are provided in EP Section 8. Offshore air pollutant emissions will result from operations of the MODU as well as service vessels and helicopters. These emissions occur mainly from combustion of diesel. Primary air pollutants typically associated with OCS activities are suspended particulate matter (PM), sulfur oxides (SO_x), nitrogen oxides (NO_x), volatile organic compounds (VOCs), and carbon monoxide (CO) (Reşitoğlu et al., 2015).

The project is located westward of 87.5° W longitude; thus, air quality is under BOEM jurisdiction, as explained in NTL 2009-N11. Anticipated emissions from the proposed project activities are calculated in the Air Quality Emissions Report (AQR) (see EP Section 8) prepared in accordance with BOEM requirements provided in 30 CFR 550 Subpart C. The AQR shows that the projected emissions associated with the proposed activities meet BOEM's exemption criteria.

A.4 Effluent Discharges

Effluent discharges from drilling operations are summarized in EP Section 7. Discharges from MODUs are required to comply with the National Pollutant Discharge Elimination System (NPDES) General Permit for Oil and Gas Activities (Permit No. GMG290103). Support vessel discharges are expected to be in accordance with USCG regulations.

Water-based drilling muds (WBM) and cuttings will be released at the seafloor during the initial well intervals before the marine riser is set, which allows their return to the surface vessel. Excess cement slurry and blowout preventer fluid will also be released at the seafloor.

A synthetic-based mud (SBM) system will be used for drilling activities after the marine riser is installed, which allows recirculation of the SBM fluids and cuttings. Unused or residual SBM will be collected and transported to Port Fourchon, Louisiana, for recycling. Drill cuttings wetted with SBM will be discharged overboard via a downpipe below the water surface, after treatment that complies with the NPDES permit limits for synthetic fluid retained on cuttings. The estimated volume of drill cuttings to be discharged is provided in EP Section 7.

Other effluent discharges from the MODU and support vessels are expected to include treated sanitary and domestic wastes, deck drainage, non-contaminated well treatment and completion fluids, desalination unit discharge, blowout preventer fluid, ballast water, bilge water, cement slurry, fire water, hydrate inhibitor, and non-contact cooling water. All discharges shall comply with the NPDES General Permit and/or USCG regulations, as applicable.

A.5 Water Intake

Seawater will be drawn from several meters below the ocean surface for various services, including firewater and once-through, non-contact cooling of machinery on the MODU (EP Table 7a).

Section 316(b) of the Clean Water Act requires NPDES permits to ensure that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available to minimize adverse environmental impacts from impingement and entrainment of aquatic organisms. The NPDES General Permit No. GMG290103 specifies requirements for new facilities for which construction commenced after July 17, 2006, with cooling water intake structures having a design intake capacity of greater than 2 million gallons of water per day, of which at least 25% is used for cooling purposes.

The MODU selected for this project meets the described applicability for new facilities, and the vessel's water intakes are expected to be in compliance with the design, monitoring, and recordkeeping requirements of the NPDES permit.

A.6 Onshore Waste Disposal

Wastes generated during exploration activities are tabulated in EP Section 7. Used SBMs and additives will be transported to shore for recycling, reconditioning, or deep well injection at Halliburton Drilling Fluids, MiSwaco, Newpark Drilling Fluids, Ecoserv, or R360 Environmental Solutions, in Port Fourchon, Louisiana. Exploration and production wastes and cuttings wetted with SBMs will be transported to shore for deep well injection or landfarm at Ecoserv or R360 Environmental Solutions, in Port Fourchon, Louisiana. Completion fluids will be transported to shore for recycling or deep well injection at Haliburton, Baker Hughes, Tetra, Superior, Ecoserv, or R360 Environmental Solutions in Port Fourchon, Louisiana. Salvage hydrocarbons will be transported to shore for recycling or deep well injection at PSC Industrial Outsourcing, Inc. in Jeanerette, Louisiana.

Recyclable trash and debris will be generated during the proposed project and will be recycled at Omega Waste Management in West Patterson, Louisiana, Lamp Environmental in Hammond, Louisiana, or at a similarly permitted facility. Non-recyclable trash and debris will be transported to the Republic/BFI landfill in Sorrento, Louisiana; the parish landfill in Avondale, Louisiana; or to a similarly permitted facility. Used oil and glycol will be transported to Omega Waste Management in West Patterson, Louisiana. Non-hazardous waste will be transported to the Republic/BFI landfill in Sorrento, Louisiana; Lamp Environmental in Hammond, Louisiana; or to a similarly permitted facility. Non-hazardous oilfield waste will be transported to Ecoserv in Port Arthur, Texas. Universal waste items such as batteries, lamps, glass, and mercury contaminated waste will be sent to Lamp Environmental Services in Hammond, Louisiana, for processing. Hazardous waste will be sent to Omega Waste Management in West Patterson, Louisiana; Lamp Environmental in Hammond, Louisiana; or to a similarly permitted facility. Wastes will be recycled or disposed according to applicable regulations at the respective onshore facilities.

A.7 Marine Debris

Trash and debris released into the marine environment can harm marine animals through entanglement and ingestion. Shell will adhere to the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) Annex V requirements, USEPA and USCG regulations, and BSEE regulations and NTLs regarding solid wastes. BSEE regulations at 30 CFR 250.300(a) and (b)(6) prohibit operators from deliberately discharging containers and other materials (e.g., trash and debris) into the marine environment, and BSEE regulation 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, manifesting trash sent to shore, and using special precautions such as covering outside trash bins to prevent accidental loss of solid waste. Additionally, the debris awareness training, instruction, and placards required by the Protected Species Lease Stipulation should minimize the amount of debris that is accidentally lost overboard by offshore personnel (NMFS [2020] Appendix B). Shell will comply with NTL BSEE-2015-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, requires the posting of informational placards at prominent locations on offshore vessels and structures, and mandates a yearly marine trash and debris awareness training and certification process. Compliance with these requirements is expected to result in either no or negligible impacts from this factor.

A.8 Support Vessel and Helicopter Traffic

Shell will use existing shore-based facilities at Port Fourchon, Louisiana, for onshore support of vessels and at Houma or Boothville, Louisiana, for air transportation support. No terminal expansion or construction is planned at either location.

The supply base at Port Fourchon, Louisiana, is operated by Shell and located on Bayou Lafourche, approximately 3 miles (5 km) from the Gulf of Mexico. There will likely be at least one support vessel in the field at all times during drilling activities. NMFS (2020) has found that support vessel traffic has the potential to disturb protected species (e.g., marine mammals, sea turtles, and fishes) and creates a risk of vessel strikes. The probability of a vessel strike depends on the number, size, and speed of vessels as well as the distribution, abundance, and behavior of the species (Conn and Silber, 2013; Hazel et al., 2007; Jensen and Silber, 2004; Laist et al., 2001; Vanderlaan and Taggart, 2007; NMFS, 2020). To reduce the potential for vessel strikes, BOEM issued NTL BOEM-2016-G01, 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. Supply vessels will normally move to the project area via the most direct route from the shorebase.

Helicopters transporting personnel and small supplies will normally take the most direct route of travel between the helicopter base in Houma or Boothville, Louisiana, and the project area when air traffic and weather conditions permit. Helicopters typically maintain a minimum altitude of 700 ft (213 m) while in transit offshore; 1,000 ft (305 m) over unpopulated areas or across coastlines; and 2,000 ft (610 m) over populated areas and sensitive habitats such as wildlife refuges and park properties. Additional guidelines and regulations specify that helicopters maintain an altitude of 1,000 ft (305 m) within 328 ft (100m) of marine mammals (NMFS, 2020).

Vessel noise is one of the main contributors to overall noise in the sea (National Research Council, 2003b, Jasny et al., 2005). Offshore supply and service vessels associated with the proposed project will contribute to the overall acoustic environment by transmitting noise through both air and water. The support vessels will use conventional diesel-powered screw propulsion. Vessel noise is a combination of narrow-band (tonal) and broadband sound (Richardson et al., 1995, Hildebrand, 2009, McKenna et al., 2012). The vessel tonal noise typically dominates frequencies up to approximately 50 Hz, whereas broadband sounds may extend to 100 kHz. The primary sources of vessel noise are propeller cavitation, propeller singing (high-pitched, clear harmonic tone), and propulsion; other sources include auxiliary engine noise, flow noise from water dragging along the hull, and bubbles breaking in the vessel's wake while moving through the water (Richardson et al., 1995). The intensity of noise from service vessels is approximately related to ship size, weight, and speed. Large ships tend to be noisier than small ones, and ships underway with a full load (or towing or pushing a load) produce more noise than unladed vessels. For any given vessel, relative noise tends to increase with increased speed, and propeller cavitation is usually the dominant underwater noise source. Broadband source levels for most small ships (a category that includes support vessels) are anticipated to be in the range of 150 to 180 dB re 1 µPa m (Richardson et al., 1995, Hildebrand, 2009, McKenna et al., 2012).

Helicopters used for offshore oil and gas operational support are potential sources of noise to the marine environment. Helicopter noise is generated from their jet turbine engines, airframe, and rotors. The dominant tones for helicopters are generally below 500 Hz (Richardson et al., 1995). Richardson et al. (1995) reported received sound pressure levels in water of 109 dB re 1 µPa from a Bell 212 helicopter flying at an altitude of 500 ft (152 m). Penetration of aircraft noise below the sea surface is greatest directly below the aircraft; at angles greater than 13 degrees from vertical, much of the sound is reflected from the sea surface and so does not penetrate into the water (Richardson et al., 1995). The duration of underwater sound from passing aircraft is much shorter in water than air. For example, a helicopter passing at an altitude of 500 ft (152 m) that is audible in air for 4 minutes may be detectable under water for only 38 seconds at 10 ft (3 m) depth and for 11 seconds at 59 ft (18 m) depth (Richardson et al., 1995). Additionally, the sound amplitude is greatest as the aircraft approaches or leaves a location.

A.9 Accidents

The analysis in the EIA focuses on two types of potential accidents:

- a small fuel spill (<1,000 barrels [bbl]), which is the most likely type of spill during OCS exploration and development activities; and
- an oil spill resulting from an uncontrolled blowout. A blowout resulting in a large oil spill (>1,000 bbl) is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures detailed in EP Section 2j.

The following subsections summarize assumptions about the sizes and fates of these spills as well as Shell's spill response plans. Impacts are analyzed in **Section C**.

The lease sale EISs (BOEM, 2012a, 2015, 2016b, 2017a) discuss other types of accidents: loss of well control, pipeline failures, vessel collisions, chemical and drilling fluid spills, and H_2S release. These are briefly discussed in this section. No other site-specific issues have been identified for the EIA. The analysis in the lease sale EISs for these topics is incorporated by reference.

Loss of Well Control. A loss of well control is the uncontrolled flow of a reservoir fluid that may result in the release of gas, condensate, oil, drilling fluids, sand, or water. Loss of well control is a broad term that includes very minor up to the most serious well control incidents, while blowouts are considered to be a subset of more serious incidents with greater risk of oil spill or human injury (BOEM, 2016a, 2017a). Loss of well control may result in the release of drilling fluid or loss of oil. Not all loss of well control events result in blowouts (BOEM, 2012a). In addition to the potential release of gas, condensate, oil, sand, or water, the loss of well control can also suspend and disperse bottom sediments (BOEM, 2012a, 2017a). BOEM (2016a) noted that most OCS blowouts have resulted in the release of gas; ABSG Consulting Inc. (2018) reported that most loss of well control event spills were <1,000 bbl.

Shell has a robust system in place to prevent loss of well control. Included in this EP is Shell's response to NTL 2015-N01, which includes descriptions of measures to prevent a blowout, reduce the likelihood of a blowout, and conduct effective and early intervention in the event of a blowout. Shell will comply with NTL 2010-N10, as extended under NTL 2015-N02, as well as the

Final Drilling Safety Rule, which specify additional safety measures for OCS activities. See EP Sections 2j and 9b for further information.

Pipeline Failures. Pipeline failures can result from mass sediment movements and mudslides, impacts from anchor drops, and accidental excavation in the case that the exact location of a pipeline is uncertain (BOEM, 2012a, 2013, 2015). The project area has been evaluated through geologic and geohazard surveys and found to be geologically suitable for the proposed exploration drilling (C&C Technologies, 2010; Ocean Geo Solutions, 2019).

Vessel Collisions. BSEE data show that there were 168 OCS-related collisions between 2007 and 2017 (BSEE, 2017). Most collision mishaps are the result of service vessels colliding with platforms or vessel collisions with pipeline risers. Approximately 10% of vessel collisions with platforms in the OCS resulted in diesel spills, and in several collision incidents, fires resulted from hydrocarbon releases. To date, the largest diesel spill associated with a collision occurred in 1979 when an anchor-handling boat collided with a drilling platform in the Main Pass project area, spilling 1,500 bbl. Diesel fuel is the product most frequently spilled, but oil, natural gas, corrosion inhibitor, hydraulic fluid, and lube oil have also been released as the result of vessel collisions. Human error accounted for approximately half of all reported vessel collisions from 2006 to 2009. As summarized by BOEM (2017c), vessel collisions occasionally occur during routine operations. Some of these collisions have caused spills of diesel fuel or chemicals. Shell intends to comply with all USCG- and BOEM-mandated safety requirements to minimize the potential for vessel collisions.

Chemical Spills. Chemicals are stored and used for pipeline hydrostatic testing, and during drilling and in well completion operations. The relative quantities of their use is reflected in the largest volumes spilled (BOEM, 2017c). Completion, workover, and treatment fluids are the largest quantity used and comprise the largest releases. Between 2007 and 2014, an average of two chemical spills <50 bbl in volume and three chemical spills >50 bbl in volume occurred each year (BOEM, 2017a).

Drilling Fluid Spills. There is the potential for drilling fluids, specifically SBMs to be spilled due to an accidental riser disconnect (BOEM, 2017a). SBMs are relatively nontoxic to the marine environment and have the potential to biodegrade (BOEM, 2014). The majority of SBM releases are <50 bbl in size, but accidental riser disconnects may result in the release of medium (238 to 2,380 bbl) to large (>2,381 bbl) quantities of drilling fluids. In the event of an SBM spill, there could be short-term localized impacts on water quality and the potential for localized benthic impacts due to SBM deposition on the seafloor. Benthic impacts would be similar to those described in **Section C.2.1**. The potential for riser disconnect SBM spills will be minimized by adhering to the requirements of applicable regulations.

H_2S Release. MC 890 and 934 are classified as H_2S absent. See EP Section 4 for more details.

A.9.1 Small Fuel Spill

Spill Size. According to the analysis by BOEM (2017a), the most likely type of small spill (<1,000 bbl) resulting from OCS activities is a failure related to the storage of oil or diesel fuel. Historically, most diesel spills have been ≤1 bbl, and this is predicted to be the most common spill volume in ongoing and future OCS activities in the Western and Central Gulf of Mexico Planning Areas (Anderson et al., 2012). As the spill volume increases, the incident rate declines dramatically (BOEM, 2017a). The median size for spills ≤1 bbl is 0.024 bbl, and the median volume for spills of

1 to 10 bbl is 3 bbl (Anderson et al., 2012). For the EIA, a small diesel fuel spill of 3 bbl is used. Operational experience suggests that the most likely cause of such a spill would be a rupture of the fuel transfer hose resulting in a loss of contents (<3 bbl of fuel) (BOEM, 2012a).

Spill Fate. The fate of a small fuel spill in the project area would depend on meteorological and oceanographic conditions at the time of the spill as well as the effectiveness of spill response activities. However, given the open ocean location of the project area and the short duration of a small spill, it is expected that the opportunity for impacts to occur would be very brief.

The water-soluble fractions of diesel are dominated by two- and three-ringed polycyclic aromatic hydrocarbons (PAHs), which are moderately volatile (National Research Council, 2003a). The constituents of these oils are light to intermediate in molecular weight and can be readily degraded by aerobic microbial oxidation. Diesel density is such that it will not sink to the seafloor unless it is dispersed in the water column and adheres to suspended sediments, but this generally occurs only in coastal areas with high-suspended solids loads (National Research Council, 2003a). Adherence to suspended sediments is not 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, 2019).

The fate of a small diesel fuel spill was estimated using NOAA's Automated Data Inquiry for Oil Spills (ADIOS) 2 model (NOAA, 2016a). 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 more than 90% of a small diesel spill would evaporate or naturally disperse within 24 hours. Based on the results of the ADIOS 2 model, area of diesel fuel on the sea surface would range from 1.2 to 12 acres (ac) (0.5 to 5 hectares [ha]), depending on sea state and weather conditions.

The project area is 53 miles (85 km) from the nearest shoreline (Louisiana). Slicks from fuel spills are expected to persist for relatively short periods of time ranging from minutes (<1 bbl) to hours (<10 bbl) to a few days (10 to 1,000 bbl) and rapidly spread out, evaporate, and disperse into the water column (BOEM, 2012a). Because of the distance from shore of these potential spills and their lack of persistence, it is unlikely that a small diesel spill would make landfall prior to dissipation (BOEM, 2012a).

Spill Response. In the unlikely event of a fuel spill, response equipment and trained personnel would be available to ensure that spill effects are localized and would result only in short-term, localized environmental consequences. EP Section 9b provides a detailed discussion of Shell's oil spill response.

A.9.2 Large Oil Spill

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures detailed in EP Section 2j. Blowouts are rare events, and most well control incidents do not result in oil spills (BOEM, 2016a). According to ABS Consulting Inc. (2016), the spill rate for spills >1,000 bbl is 0.22 spills per billion bbl.

Spill Size. Shell has calculated the WCD for this EP using the requirements prescribed by NTL 2015-N01. The calculated initial release volume is 364,696 bbl of oil during the first day, and the calculated 30-day average WCD rate is 335,767 bbl of oil per day. The total potential spill volume along with a detailed analysis of this calculation can be found in EP Section 2j. The WCD scenario for this EP has a low probability of being realized. Some of the factors that are likely to reduce rates and volumes, which are not incorporated in the WCD calculation, include, but are not limited to, obstructions or equipment in the wellbore, well bridging, and early intervention such as containment.

Shell has a robust system in place to prevent blowouts. Shell's response to NTL 2015-N01, which includes descriptions of measures to prevent a blowout, reduce the likelihood of a blowout, and conduct effective and early intervention in the event of a blowout, can be found in EP Sections 2j and 9b. Shell will also comply with NTL 2010-N10 and applicable drilling regulations in 30 CFR Part 250, Subpart D, which specify additional safety measures for OCS activities.

Spill Trajectory. The fate of a large oil spill in the project area would depend on meteorological and oceanographic conditions at the time. The Oil Spill Risk Analysis (OSRA) model is a computer simulation of oil spill transport that uses realistic data for winds and currents to predict spill fate. The OSRA report by Ji et al. (2004) provides conditional contact probabilities for shoreline segments in the Gulf of Mexico.

The results for Launch Area 58 (the launch area where MC 890 and 934 are located) are presented in **Table 3**. The 30-day OSRA model predicts a 1% to 4% chance of shoreline contact within 10 days of a spill (Terrebonne, Lafourche, and Plaquemines parishes, Louisiana), and a 1% to 8% chance of shoreline contact within 30 days of a spill from Galveston County, Texas to Okaloosa County, Florida. Counties whose conditional probability for shoreline contact is <0.5% for 3, 10, and 30 days are not shown in **Table 3**.

Table 3. Conditional probabilities of a spill in the project area (MC 890 and 934) contacting shoreline segments based on a 30-day Oil Spill Risk Analysis (OSRA) (From: Ji et al., 2004). Values are conditional probabilities that a hypothetical spill in the project area (represented by OSRA Launch Area 58) could contact shoreline segments within 3, 10, or 30 days.

Shoreline Segment	County or Parish, State	Conditional Probability of Contact[1] (%)		
		3 Days	10 Days	30 Days
C10	Galveston County, Texas	--	--	1
C12	Jefferson County, Texas	--	--	1
C13	Cameron Parish, Louisiana	--	--	3
C14	Vermilion Parish, Louisiana	--	--	2
C15	Iberia Parish, Louisiana	--	--	1
C17	Terrebonne Parish, Louisiana	--	1	3
C18	Lafourche Parish, Louisiana	--	2	3
C19	Jefferson Parish, Louisiana	--	--	1
C20	Plaquemines Parish, Louisiana	--	4	8
C21	St. Bernard Parish, Louisiana	--	--	1
C28	Okaloosa County, Florida	--	--	1

[1] Conditional probability refers to the probability of contact within the stated time period, assuming that a spill has occurred. -- indicates <0.5% probability of contact.

The OSRA model presented by Ji et al. (2004) does not evaluate the fate of a spill over time periods longer than 30 days, nor does it predict the fate of a release that continues over a period of weeks or months. Also as noted in Ji et al. (2004), the OSRA model does not take into account the chemical composition or biological weathering of oil spills, the spreading and splitting of oil spills, or spill response activities. The model does not assume a particular spill size; however, the model has generally been used by BOEM to evaluate contact probabilities for spills greater than

1,000 bbl. Thus, OSRA is a preliminary risk assessment model. In the event of an actual oil spill, trajectory modeling would be conducted using the location and estimated amount of spilled oil as well as current and wind data.

Weathering. Following an oil spill, several physical, chemical and biological processes, collectively called weathering, interact to change the properties of the oil, and thereby influence its potential 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 PM, and stranding on shore or sedimentation to the seafloor (National Research Council, 2003a, International Tanker Owners Pollution Federation Limited, 2018).

Weathering decreases the concentration of oil and produces changes in its chemical composition, physical properties, and toxicity (BOEM, 2017a). The more toxic, light aromatic and aliphatic hydrocarbons in the oil are lost rapidly by evaporation and dissolution on the water surface. Evaporated hydrocarbons are degraded rapidly by sunlight. Biodegradation of oil on the water surface and in the water column by marine bacteria removes first the n-alkanes and then the light aromatics from the oil. Other petroleum components are biodegraded more slowly. Photo-oxidation attacks mainly the medium and high molecular weight PAHs in the oil on the water surface.

Spill Response. Shell is a founding member of the Marine Well Containment Company (MWCC) and has access to an integrated subsea well control and containment system that can be rapidly deployed through the MWCC. The MWCC is a non-profit organization that assists with the subsea containment system during a response. The near-term containment response capability will be specifically addressed in Shell's NTL 2010-N10 submission of an Application for Permit to Drill. The application will include equipment and services available to Shell through MWCC's near-term containment capabilities and other industry response sources. Shell is a member of Clean Caribbean & Americas, Marine Preservation Association (which funds Marine Spill Response Corporation), Clean Gulf Associates, and Oil Spill Response Limited: organizations that are committed to providing the resources necessary to respond to a spill as outlined in Shell's OSRP.

MWCC also offers its members access to equipment, instruments, and supplies for marine environmental sampling and monitoring in the event of an oil spill in the Gulf of Mexico. Members have access to a mobile laboratory container, operations container, and a launch and recovery system, which enables water sampling and monitoring to water depths of 3,000 m. The two 8-foot × 20-foot containers have been certified for offshore use by Det Norske Veritas and the American Bureau of Shipping. The launch and recovery system is a combined winch, A-frame, and 3,000-meter long cable customized for instruments in the containers. The containers are designed to enable rapid mobilization of equipment to an incident site. The required equipment includes redundant systems to avoid downtime and supplies for sample handling and storage. Once deployed on a suitable vessel, the mobile containers then act as workspaces for scientists and operations personnel.

Mechanical recovery capabilities are addressed in the OSRP. The mechanical recovery response equipment that could be mobilized to the spill location in normal and adverse weather conditions is included in the Offshore On-Water Recovery Activation List in the OSRP.

Chemical dispersion capabilities are also readily available from resources identified in the OSRP. Available equipment for surface and subsea application of dispersants, response times, and support resources are identified in the OSRP.

Open-water *in situ* burning may also be used as a response strategy, depending on the circumstances of the release. If appropriate conditions exist and approval from the Unified Command is received, one or multiple *in situ* burning task forces could be deployed offshore. See EP Section 9b for a detailed description of spill response measures.

B. Affected Environment

The project area is in the Central Planning Area, approximately 53 miles (85 km) from the nearest shoreline (Louisiana), 88 miles (142 km) from the onshore support base at Port Fourchon, Louisiana, and 87 miles (140 km) from the helicopter base in Boothville or alternatively 133 miles (214 km) from the helicopter base in Houma, Louisiana. Estimated water depths at the proposed wellsites range from approximately 3,622 to 3,833 ft (1,104 to 1,168 m).

The wellsites shallow hazards and archaeological assessments did not identify any seafloor anomalies within 2,000 ft (610 m) of the proposed wellsites that would indicate the potential for chemosynthetic or high-density deepwater benthic communities (C&C Technologies, 2010; Ocean Geo Solutions, 2019). There are no water bottom anomalies within 2,000 ft (610 m) of proposed wellsites. In addition, no archaeologically significant sonar contacts were identified within 2,000 ft (610 m) of the proposed wellsites during the wellsite assessment (C&C Technologies, 2010; Ocean Geo Solutions, 2019).

A detailed description of the regionally affected environment is provided by BOEM (2016b, 2017a), 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 background information is presented in the following sections, and brief descriptions of each potentially affected resource are presented in **Section C**, including site-specific or new information if available.

The local environment in the project area is not known to be unique with respect to the physical/chemical, biological, or socioeconomic conditions found in this region of the Gulf of Mexico. The baseline environmental conditions in the project area are expected to be consistent with the regional description of the locations evaluated by BOEM (2016b, 2017a).

C. Impact Analysis

This section analyzes the potential direct and indirect environmental impacts of routine activities and accidents; cumulative impacts are discussed in **Section C.9**.

Environmental impacts have been analyzed extensively in lease sale EISs for the Central and Western Gulf of Mexico Planning Areas (BOEM, 2012a, 2013, 2014, 2015, 2016b, 2017a). Site-specific issues are addressed in this section as appropriate and are organized by the environmental resources identified in **Table 2** that addresses each potential IPF.

C.1 Physical/Chemical Environment

C.1.1 Air Quality

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 (BOEM, 2012a).

In general, ambient air quality on coastal counties along the Gulf of Mexico is relatively good (BOEM, 2012a). As of April 2020, Mississippi, Alabama, and Florida Panhandle coastal counties are in attainment of the National Ambient Air Quality Standards (NAAQS) for all criteria pollutants (USEPA, 2020). St. Bernard Parish in Louisiana and Hillsborough County in Florida are nonattainment areas for sulfur dioxide based on the 2010 standard. One coastal metropolitan area in Texas (Houston-Galveston-Brazoria) is a nonattainment area for 8-hour ozone (2015 Standard). One coastal metropolitan area in Florida (Tampa) was reclassified in 2018 from a nonattainment area to maintenance status for lead based on the 2008 Standard (USEPA, 2020).

Winds in the region are driven by the clockwise circulation around the Bermuda High (BOEM, 2017a). 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 is also affected by tropical cyclones (hurricanes) during summer and fall and by extratropical cyclones (cold fronts) during winter.

IPFs that could potentially affect air quality are air pollutant emissions associated with both types of accidents: a small fuel spill (<1,000 bbl) and a large oil spill (≥1,000 bbl).

Impacts of Air Pollutant Emissions

Air pollutant emissions are the only routine IPF anticipated to affect air quality. Offshore air pollutant emissions will result from the operation of the MODU and associated equipment as well as helicopters and service vessels as described in **Section A.3**. These emissions occur mainly from combustion or burning of diesel and Jet-A aircraft fuel. Primary air pollutants typically associated with OCS activities are suspended PM, SO_x, NO_x, VOCs, and CO.

Due to the distance from shore, routine operations in the project area are not expected to impact air quality along the coast. As noted by BOEM (BOEM, 2012a, 2013, 2014, 2015, 2016b, 2017b), emissions of air pollutants from routine activities in the project area are projected to have minimal impacts on onshore air quality because of the prevailing atmospheric conditions, emission heights, emission rates, and the distance of these emissions from the coastline.

MC 890 and 934 are located west of 87.5° W longitude; thus, air quality is under BOEM jurisdiction as explained in NTL 2009-N11. The BOEM-implementing regulations are provided in 30 CFR 550 Subpart C. The AQR (see EP Section 8) prepared in accordance with BOEM requirements shows that the projected emissions from sources associated with the proposed activities meet BOEM's exemption criteria. Therefore, this EP is exempt from further air quality review pursuant to 30 CFR 550.303(d).

The Breton Wilderness Area, which is part of the Breton National Wildlife Refuge (NWR), is designated under the Clean Air Act as a Prevention of Significant Deterioration Class I air quality area. The BOEM coordinates with the USFWS if emissions from proposed projects may affect the

Breton Class I area. The project area is approximately 113 miles (182 km) from the Breton Wilderness Area. Shell will comply with emissions requirements as directed by BOEM. No further analysis or control measures are required.

Greenhouse gas emissions contribute to climate change, with impacts on temperature, rainfall, frequency of severe weather, ocean acidification, and sea level rise (Intergovernmental Panel on Climate Change, 2014). Carbon dioxide (CO_2) and methane (CH_4) emissions from the project would constitute a very small incremental contribution to greenhouse gas emissions from all OCS activities. According to Programmatic and OCS lease sale EISs (BOEM, 2017a), estimated CO_2 emissions from OCS oil and gas sources are 0.4% of the U.S. total. Greenhouse gas emissions from the proposed project represent a negligible contribution to the total greenhouse gas emissions from reasonably foreseeable activities in the Gulf of Mexico area and would not significantly alter any of the climate change impacts evaluated in the Programmatic EIS (BOEM, 2016a).

Impacts of a Small Fuel Spill

Potential impacts of a small spill on air quality are expected to be consistent with those analyzed and discussed by BOEM (2012a, 2015, 2016b, 2017a). **Section A.9.1** discusses the size and fate of a potential small diesel fuel spill as a result of Shell's proposed activities. EP Section 9b provides detail on spill response measures. Given the open ocean location of the project area, the extent and duration of air quality impacts at the project area from a small spill would not be significant.

A small fuel spill would likely affect air quality near the spill site by introducing VOCs into the atmosphere through evaporation. The ADIOS 2 model (see **Section A.9.1**) indicates that more than 90% of a small diesel spill would evaporate or disperse within 24 hours. The area of diesel fuel on the sea surface would range from 1.2 to 12 ac (0.5 to 5 ha), depending on sea state and weather conditions. Given the open ocean location of the project area, the extent and duration of air quality impacts at the project area from a small spill would not be significant.

A small fuel spill would not affect coastal air quality because the spill would be expected to dissipate prior to making landfall or reaching coastal waters (see **Section A.9.1**).

Impacts of a Large Oil Spill

Potential impacts of a large oil spill on air quality are expected to be consistent with those analyzed and discussed by BOEM (2012a, 2015, 2016b, 2017a).

A large oil spill would likely affect air quality by introducing VOCs into the atmosphere through evaporation from the oil on the water surface. The extent and persistence of impacts would depend on the meteorological and oceanographic conditions at the time and the effectiveness of spill response measures. Additional air quality impacts could occur if response measures approved by the Unified Command included *in situ* burning of the floating oil. *In situ* burning would generate a plume of black smoke offshore and result in emissions of NO_x, SO_x, CO, and PM as well as greenhouse gases.

Due to the project area location, most air quality impacts would occur in offshore waters. Depending on the spill trajectory and the effectiveness of spill response measures, coastal air quality could also be affected. Based on the 30-day OSRA modeling (**Table 3**), Plaquemines Parish, Louisiana is the coastal area most likely to be affected (4% probability within 10 days, 8% probability within 30 days). Other Louisiana shorelines may be affected within 10 days

(Terrebonne and Lafourche parishes), and shorelines in Texas, Louisiana, and Florida could be affected within 30 days (1% to 8% conditional probability).

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures. No significant spill impacts on air quality are expected.

C.1.2 Water Quality

There are no site-specific baseline water quality data for the project area. Due to the lease location in deep, offshore waters, water quality is expected to be good, with low levels of contaminants. As noted by BOEM (2017a), 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. IPFs that could potentially affect water quality are effluent discharges and two types of accidents (a small fuel spill and a large oil spill).

Impacts of Effluent Discharges

As described in **Section A.4**, NPDES General Permit No. GMG290103 establishes permit limits and monitoring requirements for effluent discharges from the MODU and support vessels.

WBM and cuttings will be released at the seafloor during the initial well intervals before the marine riser is set, which allows their return to the surface vessel. Excess cement slurry and blowout preventer fluid will also be released at the seafloor. The seafloor discharges of WBM and associated drill cuttings will produce turbidity near the seafloor. The turbidity plume will be carried away from the well by near-bottom currents and may be detectable within tens to hundreds of meters of the wellbore. As resuspended sediments settle to the seafloor, the water clarity will return to background conditions within minutes to a few hours after drilling of these well intervals ceases (Neff, 1987). Discharges of WBM and cuttings are likely to have little or no impact on water quality due to the low toxicity and rapid dispersion of these discharges (National Research Council, 1983, Neff, 1987, Hinwood et al., 1994).

Cuttings wetted with SBMs will be discharged overboard in accordance with the NPDES permit. After discharge, SBM retained on cuttings would be expected to adhere to the cuttings particles and, consequently, would not produce much turbidity as the cuttings sink through the water column (Neff et al., 2000). Recent EISs have concluded that the discharge of treated SBM cuttings will not cause persistent impacts on water quality in the project area (BOEM, 2017a). NPDES permit limits and requirements are expected to be met, and little or no impact on water quality is anticipated.

Treated sanitary and domestic wastes will be discharged by the MODU and support vessels and may have a transient effect on water quality in the immediate vicinity of these discharges. NPDES permit limits and USCG requirements are expected to be met, as applicable, and little or no impact on water quality is anticipated.

Deck drainage includes 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 MODU will flow overboard without treatment. However, rainwater that falls on the MODU deck and other areas that may be contaminated with chemicals, such as chemical storage areas or places where equipment is exposed, will be collected and processed to separate oil and water to meet NPDES permit requirements. Negligible impact on water quality is anticipated.

Other effluent discharges from the MODU and support vessels are expected to include non-contaminated well treatment and completion fluids, desalination unit discharge, blowout preventer fluid, ballast water, bilge water, cement slurry, fire water, hydrate inhibitor, and non-contact cooling water. The MODU and support vessel discharges are expected to be in compliance with NPDES permit and USCG regulations, as applicable, and therefore are not expected to cause significant impacts on water quality.

Impacts of a Small Fuel Spill

Potential impacts of a small spill on water quality are expected to be consistent with those analyzed and discussed by BOEM (2012a, 2015, 2016b, 2017a). **Section A.9.1** discusses the size and fate of a potential small diesel fuel spill as a result of Shell's proposed activities. EP Section 9b provides detail on spill response measures. Given the open ocean location of the project area, the extent and duration of water quality impacts from a small spill would not be significant.

The water-soluble fractions of diesel are dominated by two- and three-ringed PAHs, which are moderately volatile (National Research Council, 2003a). The constituents of these oils are light to intermediate in molecular weight and can be readily degraded by aerobic microbial oxidation. Diesel oil is much lighter than water (specific gravity is between 0.83 and 0.88, compared to 1.03 for seawater). When spilled on water, diesel oil spreads very quickly to a thin film of rainbow and silver sheens, except for marine diesel, which may form a thicker film of dull or dark colors. However, because diesel oil has a very low viscosity, it is readily dispersed into the water column when winds reach 5 to 7 knots or with breaking waves (NOAA, 2019). It is possible for diesel oil that is dispersed by wave action to form droplets that are small enough be kept in suspension and moved by the currents.

Diesel dispersed in the water column can adhere to suspended sediments, but this generally occurs only in coastal areas with high suspended solids loads (National Research Council, 2003a) and would not be expected to occur to any appreciable degree in offshore waters of the Gulf of Mexico.

The extent and persistence of water quality impacts from a small diesel fuel spill would depend on the meteorological and oceanographic conditions at the time and the effectiveness of spill response measures. It is estimated that more than 90% of a small diesel spill would evaporate or disperse within 24 hours (see **Section A.9.1**). The sea surface area covered with a very thin layer of diesel fuel would range from 1.2 to 12 ac (0.5 to 5 ha), depending on sea state and weather conditions. In addition to removal by evaporation, constituents of diesel oil are readily and completely degraded by naturally occurring microbes (NOAA, 2019). Given the open ocean location of the project area, the extent and duration of water quality impacts from a small spill would not be significant.

A small fuel spill would not affect coastal water quality because the spill would not be expected to make landfall or reach coastal waters due to response efforts that would be undertaken as well as natural degradation and dilution (**Section A.9.1**).

Impacts of a Large Oil Spill

Potential impacts of a large oil spill on water quality are expected to be consistent with those analyzed and discussed by BOEM (2012a, 2015, 2016b, 2017a). **Section A.9.2** discusses the size and fate of a potential large oil spill as a result of Shell's proposed activities. A large spill would likely affect water quality by producing a slick on the water surface and increasing 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 of the spill as well as the effectiveness of the spill response measures. Most of the spilled oil would be expected to form a slick at the surface, although observations following the *Deepwater Horizon* incident indicate that plumes of submerged oil droplets can be produced when subsea dispersants are applied at the wellhead (Camilli et al., 2010, Hazen et al., 2010, NOAA, 2011a, b, c). Recent analyses of the entire set of samples associated with the *Deepwater Horizon* incident have confirmed that the application of subsurface dispersants resulted in subsurface hydrocarbon plumes (Spier et al., 2013). A report by Kujawinski et al. (2011) indicates that chemical components of subsea dispersants used during the *Deepwater Horizon* incident persisted for up to 2 months and were detectable up to 186 miles (300 km) from the wellsite at water depths of 3,280 to 3,937 ft (1,000 to 1,200 m). Dispersants were detectable in <9% of the samples (i.e., 353 of the 4,114 total water samples), and concentrations in the samples were significantly below the chronic screening level for dispersants (BOEM, 2012b).

Once oil enters the ocean, a variety of physical, chemical, and biological processes take place that degrade and disperse the oil. These processes include spreading, evaporation of the more volatile constituents, dissolution into the water column, emulsification of small droplets, agglomeration sinking, microbial modification, photochemical modification, and biological ingestion and excretion (National Research Council, 2003a). Marine water quality would be temporarily affected by the dissolved components and small oil droplets that do not rise to the surface or are mixed down by surface turbulence. Liu et al. (2017) observed that after the *Deepwater Horizon* incident, the hydrocarbon levels were reduced in the surface waters from May 2010 to August 2010 by either rapid weathering and/or physical dilution. A combination of dispersion by currents that dilutes the constituents and microbial degradation which removes the oil from the water column reduces concentrations to background levels. Most crude oil blends will emulsify quickly when spilled, creating a stable mousse that presents a more persistent cleanup and removal challenge (NOAA, 2017).

A large oil spill could result in a release of gaseous hydrocarbons that could affect water quality. During the *Deepwater Horizon* incident, large volumes of CH_4 were released, causing localized oxygen depletion as methanotrophic bacteria rapidly metabolized the hydrocarbons (Joye et al., 2011, Kessler et al., 2011). However, a broader study of the deepwater Gulf of Mexico found that although some stations showed slight depression of dissolved oxygen concentrations relative to climatological background values, the findings were not indicative of hypoxia (<2.0 mg L^{-1}) (Operational Science Advisory Team, 2010). Stations revisited around the Macondo wellhead in October 2010, approximately 6 months after the beginning of the event showed no measurable oxygen depressions (Operational Science Advisory Team, 2010).

Due to the project area's location, most water quality impacts would occur in offshore waters. Depending on the spill trajectory and the effectiveness of spill response measures, coastal water quality could be affected. Based on the 30-day OSRA modeling (**Table 3**), Plaquemines Parish, Louisiana is the coastal area most likely to be affected (4% probability within 10 days and 8%

probability within 30 days). Other Louisiana shorelines may be affected within 10 days (Terrebonne and Lafourche Parishes), and shorelines in Texas, Louisiana, and Florida could be affected within 30 days (1% to 8% conditional probability).

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures detailed in EP Section 2j. In the event of a large spill, water quality could be temporarily affected, but no long-term significant impacts are expected. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce any resultant impacts. EP Section 9b provides detail on spill response measures.

C.2 Seafloor Habitats and Biota

The water depth at the proposed wellsites ranges from approximately 3,622 to 3,833 ft (1,104 to 1,168 m). See EP Section 6a for further information.

According to BOEM (2016b, 2017a), existing information for the deepwater Gulf of Mexico indicates that the seafloor is composed primarily of soft sediments; exposed hard substrate habitats and associated biological communities are rare. No features or areas that could support significant, high-density benthic communities were found within 2,000 ft (610 m) of the proposed wellsites (C&C Technologies, 2010; Ocean Geo Solutions, 2019). There are no water bottom anomalies within 2,000 ft (610 m) of proposed wellsites (C&C Technologies, 2010; Ocean Geo Solutions, 2019).

C.2.1 Soft Bottom Benthic Communities

There are no site-specific benthic community data from the project area. However, data from various gulf-wide studies have been conducted to regionally characterize the continental slope habitats and benthic ecology (Wei, 2006, Rowe and Kennicutt, 2009, Wei et al., 2010, Carvalho et al., 2013), which can be used to describe typical baseline benthic communities that could be present in vicinity of the proposed wellsites. **Table 4** summarizes data from two stations in the vicinity of the proposed wells. Sediments at these two stations were similar, predominantly clay (53% at Station MT3 and 46% at Station MT4) and silt (42% at Station MT3 and 46% at Station MT4), respectively (Rowe and Kennicutt, 2009).

Table 4. Baseline benthic community data from stations near to the project area in water depths similar to those 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^{-1})
MT3	9 mi (14 km)	988	885,995	4,924	1,034
MT4	20 mi (32 km)	1,401	246,058	3,262	1,548

Densities of meiofauna (animals that pass through a 0.5-millimeter sieve but are retained on a 0.062-millimeter sieve) in sediments collected at water depths representative of the project area were approximately between 246,000 to 886,000 individuals m^{-2} (Rowe and Kennicutt, 2009). Nematodes, nauplii, and harpacticoid copepods were the three dominant groups in the meiofauna, accounting for approximately 90% of total abundance.

The benthic macroinfauna is characterized by small mean individual sizes and low densities, both of which reflect the intrinsically low primary production in surface waters of the Gulf of Mexico continental slope (Wei, 2006). Densities decrease exponentially with water depth (Carvalho et al., 2013). Based on an equation presented by Wei (2006), the macroinfaunal density in the water depths of the proposed wellsites are estimated to range from approximately 2,860 to

2,999 individuals m^{-2}; however, actual densities at the proposed wellsites are unknown and often highly variable.

Polychaetes are typically the most abundant macroinfaunal group on the northern Gulf of Mexico continental slope, followed by amphipods, tanaids, bivalves, and isopods (Rowe and Kennicutt, 2009). Carvalho et al. (2013) found polychaete abundance to be higher in the central region of the northern Gulf of Mexico when compared to the eastern and western regions. Wei (2006) recognized four depth-dependent faunal zones (1 through 4), two of which (Zones 2 and 3) are divided horizontally. The project area is located in Zone 2E, extends from the Texas-Louisiana slope to the west Florida terrace. The most abundant species in this zone were the polychaetes *Aricidea suecica*, *Litocorsa antennata*, *Paralacydonia paradoxa*, and *Tharyx marioni*; and the bivalve *Heterodonta* spp. (Wei, 2006, Wei et al., 2010).

Megafaunal density at stations in the vicinity of the proposed wellsites are approximately 1,034 to 1,548 individuals ha^{-1} (**Table 4**). Common megafauna included motile groups such as decapods, holothurians, and demersal fishes as well as sessile groups such as sponges, gorgonians, and alcyonaria (Rowe and Kennicutt, 2009).

Bacteria are the foundation of deep-sea chemosynthetic communities (Ross et al., 2012) and are an important component in terms of biomass and cycling of organic carbon (Cruz-Kaegi, 1998). In deep-sea sediments, Main et al. (2015) observed that microbial oxygen consumption rates increased and bacterial biomass decreased with hydrocarbon contamination. Bacterial biomass at the depth range of the project area typically is approximately 1 to 2 g C m^{-2} in the top 6 inches (15 cm) of sediments (Rowe and Kennicutt, 2009).

IPFs that could potentially affect benthic communities are physical disturbance, effluent discharges (drilling mud and cuttings), and a large oil spill resulting from a well blowout at the seafloor. A small 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

In water depths such as those that are encountered in the project area, DP MODUs disturb the seafloor only around the wellbore (seafloor surface hole location) where the bottom template and blowout preventer are located. Depending upon the specific well configuration, this area is generally about 0.62 ac (0.25 ha) per well (BOEM, 2012a).

The areal extent of these impacts will be small compared to the project area itself. Soft bottom communities are ubiquitous along the northern Gulf of Mexico continental slope (Gallaway et al., 2003, Rowe and Kennicutt, 2009). Physical disturbance to the seafloor during this project will be localized and are likely to have no significant impact on soft bottom benthic communities on a regional basis.

Impacts of Effluent Discharges

Drilling mud and cuttings are the only effluents likely to affect these soft bottom benthic communities that could be present in vicinity of the wellsites. During initial well interval(s) before the marine riser is set, cuttings and seawater-based “spud mud” will be released at the seafloor. Excess cement slurry will also be released at the seafloor by casing installation during the riserless portion of the drilling operations. Cement slurry components typically include cement mix and some of the same chemicals used in WBM (Boehm et al., 2001). The main impacts will be burial and smothering of benthic organisms within several meters to tens of meters around the wellbore. Small amounts of water-based blowout preventer fluid will be released at the seafloor and are expected to be rapidly diluted and dispersed.

Benthic community effects of drilling discharges have been reviewed extensively by the National Research Council (1983), Neff (1987), Neff et al. (2005), and Hinwood et al. (1994). Due to the low toxicity of WBM and associated drill cuttings, the main mechanism of impact to benthic communities is increased sedimentation, possibly resulting in burial or smothering within several meters to tens of meters around the wellbore. Monitoring programs have shown that benthic impacts of drilling are minor and localized within a few hundred meters of the wellsite (National Research Council, 1983, Neff, 1987, Neff et al., 2005, Continental Shelf Associates, 2006). Soft bottom sediments disturbed by cuttings, drilling mud, cement slurry, and blowout preventer fluid will eventually be recolonized through larval settlement and migration from adjacent areas. Because some deep-sea biota grow and reproduce slowly, recovery may require several years.

Discharges of treated SBM associated cuttings from the MODU may affect benthic communities, primarily within several hundred meters of the wellsites. The fate and effects of SBM cuttings have been reviewed by Neff et al. (2000), and monitoring studies have been conducted in the Gulf of Mexico by Continental Shelf Associates (2004, 2006). In general, cuttings with adhering SBM tend to clump together and form thick cuttings piles close to the drillsites. Areas of SBM cuttings deposition may develop elevated organic carbon concentrations and anoxic conditions (Continental Shelf Associates, 2006). Where SBM cuttings accumulate and concentrations exceed approximately 1,000 mg kg^{-1}, benthic infaunal communities may be adversely affected due to both the toxicity of the base fluid and organic enrichment (with resulting anoxia) (Neff et al., 2000). Infaunal numbers may increase and diversity may decrease as opportunistic species that tolerate low oxygen and high H_2S predominate (Continental Shelf Associates, 2006). As the base synthetic fluid is biodegraded by microbes, the area will gradually recover to pre-drilling conditions. Disturbed sediments will be recolonized through larval settlement and migration from adjacent areas.

The areal extent of impacts from drilling discharges will be small; the typical effect radius is approximately 1,640 ft (500 m) around each wellsite. Soft bottom benthic communities are ubiquitous along the northern Gulf of Mexico continental slope (Gallaway, 1988, Gallaway et al., 2003, Rowe and Kennicutt, 2009); thus impacts from drilling discharges during this project will have no significant impact on soft bottom benthic communities on a regional basis.

Impacts of a Large Oil Spill

Potential impacts of a large oil spill on the benthic community are expected to be consistent with those analyzed and discussed by BOEM (2012a, 2015, 2016b, 2017a). Impacts from a subsea blowout could include smothering and exposure to toxic hydrocarbons from oiled sediment settling to the seafloor. The most likely effects of a subsea blowout on benthic communities would be within a few hundred meters of the wellsites. BOEM (2012a) estimated that a severe subsurface blowout could suspend and disperse sediments within a 984 ft (300 m) radius. Although coarse sediments (sands) would probably settle at a rapid rate within 1,312 ft (400 m) from the blowout site, fine sediments (silts and clays) could be suspended for more than 30 days and dispersed over a much wider area. A previous study characterized surface sediments at the sampling stations in the vicinity of the proposed wellsites. Sediments at these two stations were similar, predominantly clay (53% at Station MT3 and 46% at Station MT4) and silt (42% at Station MT3 and 46% at Station MT4), respectively (Rowe and Kennicutt, 2009).

Previous analyses by (BOEM, 2016b, 2017a) concluded that oil spills would be unlikely to affect benthic communities beyond the immediate vicinity of the wellhead (i.e., due to physical impacts of a blowout) because the oil would rise quickly to the sea surface directly over the spill location. During the *Deepwater Horizon* incident, the use of subsea dispersants at the wellhead caused the formation of subsurface plumes (NOAA, 2011b). While the behavior and impacts of subsurface plumes are not well known, a subsurface plume could contact the seafloor and affect benthic communities beyond the 984 ft (300 m) radius (BOEM, 2012a), depending on its extent, trajectory, and persistence (Spier et al., 2013). This contact could result in smothering and/or toxicity to benthic organisms. The subsurface plumes observed following the *Deepwater Horizon* incident were reported in water depths of approximately 3,600 ft (1,100 m), extending at least 22 miles (35 km) from the wellsite and persisting for more than a month (Camilli et al., 2010). The subsurface plumes apparently resulted from the use of subsea dispersants at the wellhead (NOAA, 2011b, Spier et al., 2013). Montagna et al. (2013) estimated that the most severe impacts to soft bottom benthic communities (e.g., reduction of faunal abundance and diversity) from the *Deepwater Horizon* incident extended 2 miles (3 km) from the wellhead in all directions, covering an area of approximately 9 miles^2 (24 km^2). Moderate impacts were observed up to 11 miles (17 km) to the southwest and 5 miles (8.5 km) to the northeast of the wellhead, covering an area of 57 miles^2 (148 km^2). NOAA (2016b) documented a footprint of over 772 miles^2 (2,000 km^2) of impacts to benthic habitats surrounding the *Deepwater Horizon* incident site. The analysis also identified a larger area of approximately 3,552 miles^2 (9,200 km^2) of potential exposure and uncertain impacts to benthic communities (NOAA, 2016b). Stout and Payne (2017) also noted that SBM released as a result of the blowout covered an area of 2.5 miles^2 (6.5 km^2).

While the behavior and impacts of subsurface oil plumes are not well known, the Macondo findings indicate that benthic impacts likely extend beyond the immediate vicinity of the wellsite, depending on the extent, trajectory, and persistence of the plume. Baguley et al. (2015) noted that while nematode abundance increased with proximity to the Macondo wellhead, copepod abundance, relative species abundance, and diversity decreased in response to the *Deepwater Horizon* incident. Washburn et al. (2017) noted that richness, diversity, and evenness were affected within a radius of 1 km of the wellhead. Reuscher et al. (2017) found that meiofauna and macrofauna community diversity was significantly lower in areas that were impacted by Macondo oil. Demopoulos et al. (2016) reported abnormally high variability in meiofaunal and macrofaunal density in areas near the Macondo wellhead, which supports the Valentine et al. (2014) supposition that hydrocarbon deposition and impacts in the vicinity of the Macondo wellhead were patchy. While there are some indications of partial recovery of benthic fauna, as of 2015, full recovery has not occurred (Montagna et al., 2016, Reuscher et al., 2017, Washburn et al., 2017).

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will minimize potential impacts. EP Section 9b provides detail on spill response measures. No significant spill impacts on soft bottom communities are expected.

C.2.2 High-Density Deepwater Benthic Communities

As defined in NTL 2009-G40, high-density deepwater benthic communities are features or areas that could support high-density chemosynthetic communities, high-density deepwater corals, or 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 (Cordes et al., 2008, Brooks et al., 2012, Demopoulos et al., 2017, Hourigan et al., 2017). These communities occur almost exclusively on exposed authigenic carbonate rock created by a biogeochemical (microbial) process, and on shipwrecks.

Monitoring programs on the Gulf of Mexico continental slope have shown that benthic impacts from drilling discharges typically are concentrated within approximately 1,640 ft (500 m) of the wellsite, although detectable deposits may extend beyond this distance (Continental Shelf Associates, 2004, 2006, Neff et al., 2005). The nearest known high-density deepwater benthic communities are found in MC 969, approximately 26 miles (42 km) from the project area (BOEM, nd).

In water depths such as those encountered in the project area, the DP MODU will disturb the seafloor only in the immediate vicinity of the drill sites (**Section A.2**). Based on the site clearance letters, no features or areas that could support significant, high-density benthic communities were found within 2,000 ft (610 m) of the proposed wellsites (C&C Technologies, 2010; Ocean Geo Solutions, 2019). There are no water bottom anomalies within 2,000 ft (610 m) of proposed wellsites (C&C Technologies, 2010; Ocean Geo Solutions, 2019). As a result, high-density deepwater benthic communities are not expected to be present.

The only IPF identified for this project that could potentially affect high-density deepwater benthic communities is a large oil spill from a well blowout at the seafloor. Physical disturbances and effluent discharges are not likely to affect high-density deepwater benthic communities since these are generally limited to localized impacts. A small fuel spill would not affect benthic communities because the diesel fuel would float and dissipate from the sea surface.

Impacts of a Large Oil Spill

The wellsite assessment did not identify high-density deepwater benthic communities within 2,000 ft (610 m) of the proposed wellsites (C&C Technologies, 2010; Ocean Geo Solutions, 2019).

BOEM (2012a, 2015, 2016c, 2017a) concluded that oil spills would be unlikely to affect benthic communities beyond the immediate vicinity of the wellhead (i.e., due to physical impacts of a blowout) because the oil would rise quickly to the sea surface directly over the spill location. However, subsea oil plumes resulting from a seafloor blowout could affect sensitive deepwater communities (BOEM, 2016b). During the *Deepwater Horizon* incident, subsurface plumes were reported at a water depth of approximately 3,600 ft (1,100 m), extending at least 22 miles (35 km) from the wellsite and persisting for more than a month (Camilli et al., 2010). The subsurface plumes apparently resulted from the use of subsea dispersants at the wellhead (NOAA, 2011c). Chemical components of subsea dispersants used during the *Deepwater Horizon* incident persisted for up to 2 months and were detectable up to 186 miles (300 km) from the wellsite at a water depths of 3,280 to 3,937 ft (1,000 to 1,200 m) (Kujawinski et al., 2011). However, estimated dispersant concentrations in the subsea plume were below levels known to be toxic to marine life. While the behavior and impacts of subsurface plumes are not well known, a subsurface plume could have the potential to contact high-density deepwater benthic communities beyond the 984 ft (300 m) radius estimated by (BOEM, 2016a), depending on its extent, trajectory, and persistence (Spier et al., 2013). Potential impacts on sensitive resources would be an integral part of the decision and approval process for the use of dispersants.

Potential impacts of oil on high-density deepwater benthic communities are discussed by BOEM (2012a, 2015, 2016c, 2017a). Oil plumes that directly contact localized patches of sensitive benthic communities before degrading could potentially impact the resource. However, the potential impacts would be localized due to the directional movement of oil plumes by the water currents and because the sensitive habitats have a scattered, patchy distribution. The more likely result would be exposure to widely dispersed, biodegraded particles that "rain" down from a passing oil plume. While patches of habitat may be affected, the Gulf-wide ecosystem of live bottom communities would be expected to suffer no significant effects (BOEM, 2016b).

Although chemosynthetic communities live among hydrocarbon seeps, natural seepage occurs at a relatively constant low rate compared with the potential rates of oil release from a blowout. In addition, seep organisms require unrestricted access to oxygenated water at the same time as exposure to hydrocarbon energy sources (MacDonald, 2002). Oil droplets or oiled sediment particles could come into contact with chemosynthetic organisms. As discussed by BOEM (2017a), impacts could include loss of habitat and biodiversity; destruction of hard substrate; change in sediment characteristics; and reduction or loss of one or more commercial and recreational fishery habitats.

Sublethal effects are possible for deepwater coral communities that receive a lower level of oil impact. Effects to deepwater coral communities could be temporary (e.g., lack of feeding and loss of tissue mass) or long lasting and affect the resilience of coral colonies to natural disturbances (e.g., elevated water temperature and diseases) (BOEM, 2012a, 2015, 2016b, 2017a). The potential for a spill to affect deepwater corals was observed during an October 2010 survey of deepwater coral habitats in water depths of 4,600 ft (1,400 m) approximately 7 miles (11 km) southwest of the Macondo wellhead. Much of the soft coral observed in a location measuring approximately 50 ft × 130 ft (15 m × 40 m) was covered by a brown flocculent material (Bureau of Ocean Energy Management, Regulation, and Enforcement, 2010) with signs of stress, including varying degrees of tissue loss and excess mucous production (White et al., 2012). Hopanoid petroleum biomarker analysis of the flocculent material indicated that it contained oil from the *Deepwater Horizon* incident. The injured and dead corals were in an area in which a subsea plume of oil had been documented during the spill in June 2010. The deepwater coral at this location showed signs of tissue damage that was not observed elsewhere during these surveys or in previous deepwater coral studies in the Gulf of Mexico. The team of researchers concluded that the observed coral injuries likely resulted from exposure to the subsurface oil plume (White et al., 2012). Apparent recovery of some affected areas by March 2012 correlated negatively with the proportion of the coral covered with floc in late 2010 (Hsing et al., 2013). Fisher et al. (2014b) reported two additional coral areas affected by the *Deepwater Horizon* incident; one 4 miles (6 km) south of the Macondo wellsite, and the other 14 miles (22 km) to the southeast. Prouty et al. (2016) found evidence that corals located northeast of the *Deepwater Horizon* incident were also affected. In addition to direct impacts on corals and other sessile epifauna, the spill also affected macroinfauna associated with these hard bottom communities (Fisher et al., 2014a).

Although no known deepwater coral communities are likely to be impacted by a subsurface plume, previously unidentified communities may be encountered if a large subsurface oil spill occurs. However, because of the scarcity of deepwater hard bottom communities, their comparatively low surface area, and the requirements set by BOEM in NTL 2009-G40, it is unlikely that a sensitive habitat would be located adjacent to a seafloor blowout or that concentrated oil would contact the site (BOEM, 2012a).

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on Shell's spill response measures. Potential impacts on sensitive resources would be an integral part of the decision and approval process for the use of dispersants.

C.2.3 Designated Topographic Features

The project location 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 stipulation block is MC

316, located approximately 36 miles (58 km) from the project area. There are no IPFs associated with either routine operations or accidents that could cause impacts to designated topographic features due to their distance from the project area.

C.2.4 Pinnacle Trend Area Live Bottoms

The project area is not covered by the Live Bottom (Pinnacle Trend) Stipulation. As defined in NTL 2009-G39, the nearest pinnacle trend block is Main Pass Block 290, approximately 97 miles (156 km) from the project area. 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 project area.

C.2.5 Eastern Gulf Live Bottoms

The project area is not covered by the Live Bottom (Low-Relief) Stipulation, which pertains to seagrass communities and low-relief hard bottom reef within the Gulf of Mexico Eastern Planning Area blocks in water depths of 328 ft (100 m) or less and portions of Pensacola and Destin Dome Area Blocks in the Central Planning Area. The nearest block covered by the Live Bottom Stipulation, as defined in NTL 2009-G39, is Destin Dome Block 573, located approximately 134 miles (216 km) northeast from the project area. There are no IPFs associated with either routine operations or accidents that could cause impacts to eastern Gulf of Mexico live bottom areas due to the distance from the project area.

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

This section discusses species listed as endangered or threatened under the ESA. In addition, it includes marine mammal species in the region that are protected under the MMPA.

Endangered, Threatened, or species of concern that may occur in the project area and/or along the northern Gulf Coast are listed in **Table 5**. The table also indicates the location of designated critical habitat 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. NMFS has jurisdiction over ESA-listed marine mammals (cetaceans) and fishes in the Gulf of Mexico, and USFWS has jurisdiction over ESA-listed birds and the West Indian manatee. These two agencies share federal jurisdiction over sea turtles, with NMFS having lead responsibility at sea and USFWS on nesting beaches.

Table 5. Federally listed Endangered and Threatened species potentially present in the project area and along the northern Gulf Coast.

Species	Scientific Name	Status	Potential Presence		Critical Habitat Designated in Gulf of Mexico
			Project Area	Coastal	
Marine Mammals					
Bryde’s whale	*Balaenoptera edeni*	E	X	--	None
Sperm whale	*Physeter macrocephalus*	E	X	--	None
West Indian manatee	*Trichechus manatus*[1]	T	--	X	Florida (Peninsular)
Sea Turtles					
Loggerhead turtle	*Caretta caretta*	T,E[2]	X	X	Nesting beaches and nearshore reproductive habitat in Mississippi, Alabama, and Florida; *Sargassum* habitat including most of the central & western Gulf of Mexico.
Green turtle	*Chelonia mydas*	T	X	X	None
Leatherback turtle	*Dermochelys coriacea*	E	X	X	None

Species	Scientific Name	Status	Potential Presence		Critical Habitat Designated in Gulf of Mexico
			Project Area	Coastal	
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
Whooping Crane	*Grus americana*	E	--	X	Coastal Texas (Aransas National Wildlife Refuge)
Fishes					
Oceanic whitetip shark	*Carcharhinus longimanus*	T	X	--	None
Giant manta ray	*Mobula birostris*	T	X	X	None
Gulf sturgeon	*Acipenser oxyrinchus desotoi*	T	--	X	Coastal Louisiana, Mississippi, Alabama, and Florida
Nassau grouper	*Epinephelus striatus*	T	--	X	None
Smalltooth sawfish	*Pristis pectinata*	E	--	X	Southwest Florida
Invertebrates					
Elkhorn coral	*Acropora palmata*	T	--	X	Florida Keys and the Dry Tortugas
Staghorn coral	*Acropora cervicornis*	T	--	X	Florida Keys and the Dry Tortugas
Pillar coral	*Dendrogyra cylindrus*	T	--	X	None
Rough cactus coral	*Mycetophyllia ferox*	T	--	X	None
Lobed star coral	*Orbicella annularis*	T	--	X	None
Mountainous star coral	*Orbicella faveolata*	T	--	X	None
Boulder star coral	*Orbicella franksi*	T	--	X	None
Terrestrial Mammals					
Beach mice (Alabama, Choctawhatchee, Perdido Key, St. Andrew)	*Peromyscus polionotus*	E	--	X	Alabama and Florida (Panhandle) beaches
Florida salt marsh vole	*Microtus pennsylvanicus dukecampbelli*	E	--	X	None

-- = not present; E = Endangered; T = Threatened; X = potentially present.

[1] There are two subspecies of West Indian manatee: the Florida manatee (*T. m. latirostris*), which ranges from the northern Gulf of Mexico to Virginia, and the Antillean manatee (*T. m. manatus*), which ranges from northern Mexico to eastern Brazil. Only the Florida manatee subspecies is likely to be found in the northern Gulf of Mexico.

[2] The Northwest Atlantic Ocean Distinct Population Segment (DPS) of loggerhead turtles is designated as Threatened (76 *Federal Register* [*FR*] 58868). The National Marine Fisheries Service and the U.S. Fish and Wildlife Service designated critical habitat for this DPS, including beaches and nearshore reproductive habitat in Mississippi, Alabama, and the Florida Panhandle as well as *Sargassum* spp. habitat throughout most of the central and western Gulf of Mexico (79 *FR* 39756 and 79 *FR* 39856).

Coastal Endangered or Threatened species that may occur along the U.S. Gulf Coast include the West Indian manatee (*Trichechus manatus*), Piping Plover (*Charadrius melodus*), Florida salt marsh vole (*Microtus pennsylvanicus dukecampbelli*), Whooping Crane (*Grus americana*), Gulf sturgeon (*Acipenser oxyrinchus desotoi*), smalltooth sawfish (*Pristis pectinate*), and four subspecies of beach mouse. Critical habitat has been designated for all of these species (except the Florida salt marsh vole) as indicated in **Table 5** and discussed in individual sections. Two other coastal bird species (Bald Eagle [*Haliaeetus leucocephalus*] and Brown Pelican [*Pelecanus occidentalis*]) are no longer federally listed as Endangered or Threatened; these are discussed in **Section C.4.2**.

Five sea turtle species, the sperm whale (*Physeter macrocephalus*), and the oceanic whitetip shark (*Carcharhinus longimanus*) are the only Endangered or Threatened species likely to occur within the project area. The listed sea turtles include the leatherback turtle (*Dermochelys coriacea*), Kemp's ridley turtle (*Lepidochelys kempii*), hawksbill turtle (*Eretmochelys imbricata*), loggerhead turtle (*Caretta caretta*), and green turtle (*Chelonia mydas*) (Pritchard, 1997). Effective August 11, 2014, NMFS has designated certain marine areas as critical habitat for the northwest Atlantic distinct population segment (DPS) of the loggerhead sea turtle (**Section C.3.5**). No critical habitat has been designated in the Gulf of Mexico for the leatherback turtle, Kemp's ridley turtle, hawksbill turtle, or the green turtle. Listed marine mammal species include one odontocete (sperm whale) which is known to occur in the Gulf of Mexico (Würsig et al., 2000); no critical habitat has been designated for the sperm whale. The Bryde's whale (*Balaenoptera edeni*) exists in the Gulf of Mexico as a small, resident population. It is the only baleen whale known to be resident to the Gulf. The genetically distinct Northern Gulf of Mexico stock is severely restricted in range, being found only in the northeastern Gulf in the waters of the DeSoto Canyon (Waring et al., 2016) and are therefore not likely to occur within the project area. The giant manta ray (*Mobula birostris*) could occur in the project area but is most commonly observed in the Gulf of Mexico at the Flower Garden Banks. The Nassau grouper (*Epinephelus striatus*) has been observed in the Gulf of Mexico at the Flower Garden Banks but is most commonly observed in shallow tropical reefs of the Caribbean and is not expected to occur in the project area. The smalltooth sawfish is a coastal species limited to shallow areas off the west coast of Florida and is not expected to occur in the project area.

Five Endangered mysticete whales (blue whale [*Balaenoptera musculus*], fin whale [*Balaenoptera physalus*], humpback whale [*Megaptera novaeangliae*], North Atlantic right whale [*Eubalaena glacialis*], and sei whale [*Balaenoptera borealis*]) have been reported from the Gulf of Mexico but are considered rare or extralimital (Würsig et al., 2000). These species are not included in the most recent NMFS stock assessment report (Hayes et al., 2019) nor in the most recent BOEM multisale EIS (BOEM, 2017a) as present in the Gulf of Mexico; therefore, they are not considered further in the EIA.

Seven Threatened coral species are known from the northern Gulf of Mexico: elkhorn coral (*Acropora palmata*), staghorn coral (*Acropora cervicronis*), lobed star coral (*Orbicella annularis*), mountainous star coral (*Orbicella faveolata*), boulder star coral (*Orbicella franksi*), pillar coral (*Dendrogyra cylindrus*), and rough cactus coral (*Mycetophyllia ferox*). None of these species are expected to be present in the project area (see **Section C.3.15**).

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. Resident populations of sperm whales occur within the Gulf of Mexico. Gulf of Mexico sperm whales are classified as an endangered species and a "strategic stock" by NMFS (Waring et al., 2016). A "strategic stock" is defined by the MMPA as a marine mammal stock that meets the following criteria:

- The level of direct human-caused mortality exceeds the potential biological removal level;
- Based on the best available scientific information, is in decline and is likely to be listed as a threatened species under the ESA within the foreseeable future; or
- Is listed as a threatened or endangered species under the ESA or is designated as depleted under the MMPA.

Current threats to sperm whale populations worldwide are discussed in a final recovery plan for the sperm whale published by NMFS (2010a). Threats are defined as "any factor that could represent an impediment to recovery," and 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 (BOEM, 2012a).

The distribution of sperm whales in the Gulf of Mexico is correlated with mesoscale physical features such as eddies associated with the Loop Current (Jochens et al., 2008). Sperm whale populations in the north-central Gulf of Mexico are present there 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 656- and 3,280-foot (200- and 1,000-meter) depth contours (Jochens et al., 2008). Male sperm whales were more variable in their movements and were documented in water depths greater than 9,843 ft (3,000 m). 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 juveniles, and groups of bachelor males. Typical group size for mixed groups was 10 individuals (Jochens et al., 2008). A review of sighting reports from seismic mitigation surveys in the Gulf of Mexico conducted over a 6-year period found a mean group size for sperm whales of 2.5 individuals (Barkaszi et al., 2012).

In these mitigation surveys, sperm whales were the most common cetacean encountered. Results of the Sperm Whale Seismic Study showed that sperm whales transit through the vicinity of the project 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 that could potentially affect sperm whales include MODU presence, noise, and lights; support vessel and helicopter traffic; and both types of spill accidents: a small fuel spill and a large oil 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.

Though NMFS (2020) stated marine debris as an IPF, compliance with BSEE NTL 2015-G03 and NMFS (2020) Appendix B will minimize the potential for marine debris-related impacts on sperm whales. NMFS (2020) estimates that no more than three sperm whales will be nonlethally taken, with one sperm whale lethally taken through the ingestion of marine debris over 50 years of proposed action. Therefore, marine debris is likely to have negligible impacts on sperm whales and is not further discussed (See **Table 2**).

Impacts of Mobile Offshore Drilling Unit Presence, Noise, and Lights

Some sounds produced by the MODU may be emitted at levels that could potentially disturb individual whales or mask the sounds animals would normally produce or hear. Noise associated with drilling is relatively weak in intensity, and an individual animal's noise exposure would be transient. As discussed in **Section A.1**, sounds generated by an actively drilling MODU are maximum broadband (10 Hz to 10 kHz) energy of approximately 190 dB re 1 µPa m (Hildebrand, 2005).

NMFS (2018b) lists sperm whales in the same functional hearing group (i.e., mid frequency cetaceans) as most dolphins and other toothed whales, with an estimated hearing sensitivity from 150 Hz to 160 kHz. Therefore, vessel related noise is likely to be heard by sperm whales. Frequencies <150 Hz produced by the drilling operations are not likely to be perceived with any significance by mid-frequency cetaceans. The sperm whale may possess better low frequency hearing than some of the other odontocetes, although not as low as many baleen whale species that primarily produce sounds between 30 Hz and 5 kHz (Wartzok and Ketten, 1999). Generally, most of the acoustic energy produced by sperm whales is present at frequencies below 10 kHz, although diffuse energy up to and past 20 kHz is common, with source levels up to 236 dB re 1 µPa m (Møhl et al., 2003).

It is expected that, due to the relatively stationary nature of the MODU operations, sperm whales would move away from the proposed operations area, and noise levels that could cause auditory injury would be avoided. Noise associated with proposed vessel operations may cause behavioral (disturbance) effects to sperm whales. Observations of sperm whales near offshore oil and gas operations suggest an inconsistent response to anthropogenic marine sound (Jochens et al., 2008). Most observations of behavioral responses of marine mammals to anthropogenic sounds, in general, have been limited to short-term behavioral responses, which included the cessation of feeding, resting, or social interactions (NMFS, 2009a). Animals can determine the direction from which a sound arrives based on cues, such as differences in arrival times, sound levels, and phases at the two ears. Thus, an animal's directional hearing capabilities have a bearing on its ability to avoid noise sources (National Research Council, 2003b).

NOAA Fisheries West Coast Region (2018) presents criteria that are used in the interim to determine behavioral disturbance thresholds for marine mammals and are applied equally across all functional hearing groups. Received root-mean-square sound pressure levels of 120 dB re 1 μPa from a non-impulsive source are considered high enough to elicit a behavioral reaction in some marine mammal species. The 120-dB isopleth may extend tens to hundreds of kilometers from the source depending on the propagation environment.

For mid frequency cetaceans exposed to a non-impulsive source (such as MODU operations), permanent threshold shifts are estimated to occur when the mammal has received a sound exposure level of 198 dB re 1 μPa^2 s over a 24-hour period (NMFS, 2016a). Similarly, temporary threshold shifts are estimated to occur when the mammal has received a sound exposure level of 178 dB re 1 μPa^2 s over a 24-hour period. Based on transmission loss calculations (Urick, 1983), typical sources with DP thrusters are not expected to produce received root-mean-square sound pressure levels greater than 160 dB re 1 μPa beyond 105 ft (32 m) from the source. Due to the short propagation distance of high sound pressure levels, the transient nature of sperm whales, and the stationary nature of the proposed activites, it is not expected that any sperm whales will receive exposure levels necessary for the onset of auditory threshold shifts.

The MODU will be located within a deepwater, open ocean environment. Sounds generated by drilling operations will be generally non-impulsive, with some variability in sound level. This analysis assumes that the continuous nature of sounds produced by the MODU will provide individual whales with cues relative to the direction and relative distance (sound intensity) of the sound source, and the fixed position of the MODU will allow for active avoidance of potential physical impacts. Drilling-related noise associated with this project will contribute to increases in the ambient noise environment of the Gulf of Mexico, but it is not expected to be in amplitudes sufficient enough to cause hearing effects to sperm whales.

MODU lighting and rig presence are not identified as IPFs for sperm whales 2014a;b;c; 2015, BOEM, 2016b, 2017a).

Impacts of Support Vessel and Helicopter Traffic

NMFS has found that support vessel traffic has the potential to disturb sperm whales and creates a risk of vessel strikes, which are identified as a threat in the recovery plan for this species (NMFS, 2010a). To reduce the potential for vessel strikes, BOEM issued NTL BOEM-2016-G01, 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. In addition, when sperm whales are sighted, vessel operators and crews are required to attempt to maintain a distance of 328 ft (100 m) or greater whenever possible (NTL BOEM 2016-G01 and NMFS, 2020). Vessel operators are required to reduce vessel speed to 10 knots or less, as safety permits, when mother/calf pairs, pods, or large assemblages of cetaceans are observed near an underway vessel (NTL BOEM-2016-G01). When sperm whales are sighted while a vessel is underway, the vessel should take action (e.g., attempt to remain parallel to the whale's course, avoid excessive speed or abrupt changes in direction until the whale has left the area) as necessary to avoid violating the relevant separation distance. However, if the sperm whale is sighted within this distance, the vessel should reduce speed and shift the engine to neutral and not re-engage until the whale is outside of the separation area. This does not apply to any vessel towing gear (NMFS [2020] Appendix C). Compliance with these mitigation measures will minimize the likelihood of vessel strikes as well as reduce the chance for disturbing sperm whales.

NMFS (2020) analyzed the potential for vessel strikes and harassment of sperm whales in its Biological Opinion on the Federally Regulated Oil and Gas Program Activities in the Gulf of Mexico. 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 the implementation of the NMFS vessel strike protocols listed in Appendix C of NMFS (2020) in addition to the NTL BOEM--2016-G01, NMFS concluded that the likelihood of collisions between vessels and sperm whales would be reduced.

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 804 ft (245 m). A reaction to the initial pass of the aircraft was observed during 3 (12%) of 24 sightings. All three reactions consisted of a hasty dive and occurred at less than 1,180 ft (360 m) 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 limited to behavioral disturbances (Smultea et al., 2008).

Helicopters maintain altitudes above 700 ft (213 m) during transit to and from the offshore working area. In the event that a whale is seen during transit, the helicopter will not approach or circle the animal(s). In addition, guidelines and regulations issued by NMFS under the authority of the MMPA specify that helicopters maintain an altitude of 1,000 ft (305 m) within 328 ft (100 m) of marine mammals (BOEM, 2016a, 2017a; NMFS, 2020). Although whales may respond to helicopters (Smultea et al., 2008), NMFS (2020) concluded that this altitude would minimize the potential for disturbing sperm whales. Therefore, no significant impacts are expected.

Impacts of a Small Fuel Spill

Potential spill impacts on marine mammals including sperm whales are discussed by NMFS (2007) and BOEM (2012a, 2015, 2016b, 2017a). Oil impacts on marine mammals are discussed by Geraci and St. Aubin (1990) and by the Marine Mammal Commission (MMC) (2011). For the EIA, there are no unique site-specific issues with respect to spill impacts on sperm whales that were not analyzed in the previous documents.

The probability of a fuel spill will be minimized by Shell’s preventative measures during routine operations, including fuel transfer. In the unlikely event of a spill, implementation of Shell’s OSRP will mitigate and reduce the potential for impacts on sperm whales. EP Section 9b provides detail on spill response measures. Given the open ocean location of the project area and the duration of a small spill, the opportunity for impacts to occur would be very brief.

A small fuel spill in offshore waters would produce a thin slick on the water surface and introduce 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 of the spill as well as the effectiveness of spill response measures. **Section A.9.1** discusses the likely fate of a small fuel spill and indicates that more than 90% would evaporate or disperse naturally within 24 hours. The area of diesel fuel on the sea surface would range from 1.2 to 12 ac (0.5 to 5 ha), 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, 2011). However, due to the limited areal extent and short duration of water quality impacts from a small fuel spill, as well as the mobility of sperm whales, no significant impacts are expected.

Impacts of a Large Oil Spill

Potential spill impacts on marine mammals including sperm whales are discussed by BOEM (2012a, 2015, 2016b, 2017a), and NMFS (2007). Oil impacts on marine mammals are discussed by Geraci and St. Aubin (1990) and by the MMC (2011). For the EIA, there are no unique site-specific issues with respect to spill impacts on sperm whales.

Impacts of oil spills on sperm whales can include direct impacts from oil exposure as well as indirect impacts due to response activities and materials (e.g., vessel traffic, noise, and dispersants) (MMC, 2011). Direct physical and physiological effects can include skin irritation, inflammation, or necrosis; chemical burns of skin, eyes, and mucous membranes; inhalation of toxic fumes; ingestion of oil (and dispersants) directly or via contaminated prey; and stress from the activities and noise of response vessels and aircraft. The level of impact of oil exposure depends on the amount, frequency, and duration of exposure; route of exposure; and type or condition of petroleum compounds or chemical dispersants (Hayes et al., 2019). Complications of the above may lead to dysfunction of immune and reproductive systems, physiological stress, declining physical condition, and death. Behavioral responses can include displacement of animals from prime habitat, disruption of social structure, changing prey availability and foraging distribution and/or patterns, changing reproductive behavior/productivity, and changing movement patterns or migration (MMC, 2011). Ackleh et al. (2012) hypothesized that sperm whales may have temporarily relocated away from the vicinity of the *Deepwater Horizon* incident in 2010. However, based on aerial surveys conducted in the aftermath of the spill, visibly oiled cetaceans (including several sperm whales) were identified within the footprint of the oil slick (Dias et al., 2017).

In the event of a large spill, the level of vessel and aircraft activity associated with spill response could disturb sperm whales and potentially result in vessel strikes, entanglement, or other injury or stress. Response vessels would operate in accordance with NTL BOEM-2016-G01 (see **Table 1**) to reduce the potential for striking or disturbing these animals.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the event of oil from a large spill contacting sperm whales, it is expected that impacts resulting in the injury or death of individual sperm whales would be adverse but not likely significant at the population level. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

C.3.2 Bryde's Whale (Endangered)

The Bryde's whale is the only year-round resident baleen whale in the northern Gulf of Mexico. The Bryde's whale is sighted most frequently in the waters over DeSoto Canyon between the 328 ft (100 m) and 3,280 ft (1,000 m) isobaths (Rosel et al., 2016, Hayes et al., 2019). 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 of Mexico. Based on the available data, it is possible that Bryde's whales could occur in the project area though unlikely.

In 2014, a petition was submitted to designate the northern Gulf of Mexico population as a DPS and list it as endangered under the ESA (Natural Resources Defense Council, 2014). This petition received a 90-day positive finding by NMFS in 2015 and a proposed rule to list was published in 2016 (Hayes et al., 2019). On April 15, 2019, NMFS issued a final rule to list the Gulf of Mexico DPS of Bryde's whale as Endangered under the ESA. The listing was effective on May 15, 2019.

IPFs that could affect the Bryde's whales include MODU presence, noise, and lights; support vessel and helicopter traffic; and both types of spill accidents: a small fuel spill and a large oil spill. Effluent discharges are likely to have negligible impacts on Bryde's whales due to rapid dispersion, the small area of ocean affected, the intermittent nature of the discharges, and the mobility and low abundance of Bryde's whales in the Gulf of Mexico.

Though NMFS (2020) stated marine debris as an IPF, compliance with BSEE NTL 2015-G03 and NMFS (2020) Appendix B will minimize the potential for marine debris-related impacts on Bryde's whales. NMFS (2020) estimated one sublethal take and no lethal takes of Bryde's whales from marine debris over 50 years of proposed action. Therefore, marine debris is likely to have negligible impacts on Bryde's whales and is not further discussed (See **Table 2**).

Impacts of Mobile Offshore Drilling Unit Presence, Noise, and Lights

Some sounds produced by the MODU may be emitted at levels that could potentially disturb individual whales or mask the sounds animals would normally produce or hear. Noise associated with drilling is relatively weak in intensity, and an individual animal's noise exposure would be transient. As discussed in **Section A.1**, frequencies generated by an actively drilling MODU are maximum broadband (10 Hz to 10 kHz) with a root-mean-square source level of approximately 177 to 190 dB re 1 µPa m (Hildebrand, 2005).

NMFS (2018b) lists Bryde's whales in the functional hearing group of low frequency cetaceans (baleen whales), with an estimated hearing sensitivity from 7 Hz to 35 kHz. Therefore, vessel related noise is likely to be heard by Bryde's whales. Frequencies <150 Hz produced by the drilling operations is more likely to be perceived by low-frequency cetaceans.

It is expected that, due to the relatively stationary nature of the MODU operations, Bryde's whales would move away from the proposed operations area, and noise levels that could cause auditory injury would be avoided. Noise associated with proposed vessel operations may cause behavioral (disturbance) effects to individual Bryde's whales. NOAA Fisheries West Coast Region (2018) presents criteria that are used in the interim to determine behavioral disturbance thresholds for marine mammals and are applied equally across all hearing groups. Received root-mean-square sound pressure level of 120 dB re 1 µPa from a non-impulsive source are considered high enough to elicit a behavioral reaction in some marine mammal species. The 120-dB isopleth may extend tens to hundreds of kilometers from the source depending on the propagation environment. However, exposure to a root-mean-square sound pressure level of 120 dB re 1 µPa does not equate to a behavioral response or a biological consequence; rather it represents the level at which onset of a behavioral response may occur.

For low frequency cetaceans, specifically the Bryde's whale, permanent and temporary threshold shift onset from non-impulsive sources is estimated to occur at sound exposure levles of 199 dB re

1 µPa^2 s and 179 re 1 µPa^2 s, repectively. MODU operatorions and DP thrusters are not expected to reach permanent or temporary theshold hold shift values, and based on open water transmission loss calculations (Urick, 1983), noise produced by typical sources with DP thrusters in use during drilling, are not expected to propagate root-mean-square sound pressure levels greater than 120 dB re 1 µPa beyond 700 m (2,290 ft) from the source.

The MODU will be located within a deepwater, open ocean environment. Sounds generated by drilling operations will be generally non-impulsive, with some variability in sound level and frequency. This analysis assumes that the continuous nature of sounds produced by the MODU will provide individual whales with cues relative to the direction and relative distance (sound intensity) of the sound source, and the fixed position of the MODU will allow for active avoidance of potential physical impacts. Drilling-related noise associated with this project will contribute to increases in the ambient noise environment of the Gulf of Mexico, but it is not expected to be in amplitudes sufficient enough to cause hearing effects to Bryde's whales and due to the low density of Bryde's whales in the Gulf of Mexico, no significant impacts are expected.

Impacts of Support Vessel and Helicopter Traffic

Support vessel traffic has the potential to disturb Bryde's whales and creates a risk of vessel strikes. To reduce the potential for vessel strikes, BOEM has issued NTL BOEM-2016-G01, 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 1,640 ft (500 m) or greater whenever possible (NTL BOEM-2016-G01; NMFS, 2020). Vessel operators are required to reduce vessel speed to 10 knots or less, as safety permits, when mother/calf pairs, pods, or large assemblages of cetaceans are observed near an underway vessel (NTL BOEM-2016-G01). When a Bryde's whale is sighted while a vessel is underway, the vessel should take action (e.g., attempt to remain parallel to the whale's course, avoid excessive speed or abrupt changes in direction until the whale has left the area) as necessary to avoid violating the relevant separation distance. However, if the whale is sighted within this distance, the vessel should reduce speed and shift the engine to neutral and not re-engage until the whale is outside of the separation area. This does not apply to any vessel towing gear (NMFS [2020] Appendix C). Compliance with these mitigation measures will minimize the likelihood of vessel strikes as well as reduce the chance for disturbing Bryde's whales.

Helicopter traffic also has the potential to disturb Bryde's whales. Based on studies of cetacean responses to sound, the observed reactions to brief overflights by aircraft were short-term and limited to behavioral disturbances (Smultea et al., 2008). Helicopters maintain altitudes above 700 ft (213 m) during transit to and from the offshore working area. In the event that a whale is seen during transit, the helicopter will not approach or circle the animal(s). In addition, guidelines and regulations issued by NMFS under the authority of the MMPA specify that helicopters maintain an altitude of 1,000 ft (305 m) within 1,640 ft (500 m) of marine mammals (BOEM, 2016a, 2017a; NMFS, 2020). Due to the brief potential for disturbance the low density of Bryde's whales thought to reside in the Gulf of Mexico, no significant impacts are expected.

Impacts of a Small Fuel Spill

Potential spill impacts on marine mammals are discussed by NMFS (2020) and BOEM (2012a, 2015, 2016b, 2017a). Oil impacts on marine mammals are discussed by Geraci and St. Aubin (1990) and by the MMC (2011). The probability of a fuel spill will be minimized by Shell's preventative measures during routine operations, including fuel transfer. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the potential for impacts on Bryde's whales. EP Section 9b provides detail on spill response measures. Given the open ocean location of the project area and the duration of a small spill, the opportunity for impacts to occur would be very brief.

A small fuel spill in offshore waters would produce a thin slick on the water surface and introduce 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 of the spill as well as the effectiveness of spill response measures. **Section A.9.1** discusses the likely fate of a small fuel spill and indicates that more than 90% would evaporate or disperse naturally within 24 hours. The area of diesel fuel on the sea surface would range from 1.2 to 12 ac (0.5 to 5 ha), 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, 2011). However, due to the limited areal extent and short duration of water quality impacts from a small fuel spill, as well as the mobility of Bryde's whales and the unlikelihood of Bryde's whales in the project area, no significant impacts are expected.

Impacts of a Large Oil Spill

Potential spill impacts on marine mammals are discussed by BOEM (2012a, 2015, 2016b, 2017a), and NMFS (2020). Oil impacts on marine mammals are discussed by Geraci and St. Aubin (1990) and by the MMC (2011).

Potential impacts of a large oil spill on Bryde's whales could include direct impacts from oil exposure as well as indirect impacts due to response activities and materials (e.g., vessel traffic, noise, and dispersants) (MMC, 2011). Direct physical and physiological effects could include skin irritation, inflammation, or necrosis; chemical burns of skin, eyes, and mucous membranes; inhalation of toxic fumes; ingestion of oil (and dispersants) directly or via contaminated prey; and stress from the activities and noise of response vessels and aircraft. The level of impact of oil exposure depends on the amount, frequency, and duration of exposure; route of exposure; and type or condition of petroleum compounds or chemical dispersants (Hayes et al., 2019). Complications of the above may lead to dysfunction of immune and reproductive systems, physiological stress, declining physical condition, and death. Behavioral responses can include displacement of animals from prime habitat, disruption of social structure, changing prey availability and foraging distribution and/or patterns, changing reproductive behavior/productivity, and changing movement patterns or migration (MMC, 2011).

In the event of a large spill, the level of vessel and aircraft activity associated with spill response could disturb Bryde's whales and potentially result in vessel strikes, entanglement, or other injury or stress. Response vessels would operate in accordance with NTL BOEM-2016-G01 (see **Table 1**) to reduce the potential for striking or disturbing these animals.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the event of oil from a large spill contacting Bryde's whales, it is expected that impacts resulting in the injury or death of individual Bryde's whales would be adverse but not likely significant at the population level. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

C.3.3 West Indian Manatee (Endangered)

Most of the Gulf of Mexico West Indian manatee population is located in peninsular Florida (USFWS, 2001a). Critical habitat has been designated in southwest Florida in Manatee, Sarasota, Charlotte, Lee, Collier, and Monroe counties. Manatees regularly migrate farther west of Florida in the warmer months (Wilson, 2003) into Alabama and Louisiana coastal habitats, with some individuals traveling as far west as Texas (Fertl et al., 2005). There have been three verified reports of Florida manatee sightings on the OCS during seismic mitigation surveys in mean water depths of over 1,969 ft (600 m) (Barkaszi and Kelly, 2019). One of these sightings resulted in a shutdown of airgun operations. A species description is presented in the recovery plan for this species (USFWS, 2001a).

IPFs that could potentially affect manatees include support vessel and helicopter traffic and a large oil spill. A small fuel spill in the project area would be unlikely to affect manatees because the project area is approximately 53 miles (85 km) from the nearest shoreline (Louisiana). As explained in **Section A.9.1**, a small fuel spill would not be expected to make landfall or reach coastal waters prior to breaking up. Compliance with NTL BSEE 2015-G013 (see **Table 1**) will minimize the potential for marine debris-related impacts on manatees. Consistent with the analysis by BOEM (2016a), impacts of routine project-related activities on the manatee would be negligible.

Impacts of Support Vessel and Helicopter Traffic

Support vessel traffic associated with routine MODU operations 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, 2001a). Manatees are expected to be limited to inner shelf and coastal waters, and impacts are expected to be limited to transits of these vessels and helicopters through these waters. To reduce the potential for vessel strikes, BOEM has issued NTL BOEM-2016-G01, 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 strike avoidance measures described in NMFS (2020) for the marine mammal species managed by that agency may also provide some additional indirect protections to manatees. Compliance with NTL BOEM-2016-G01 will minimize the likelihood of vessel strikes, and no significant impacts on manatees are expected.

Depending on flight altitude, 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 relatively low altitudes of 66 to 525 ft (20 to 160 m). Helicopters used in support operations maintain a minimum altitude of 700 ft (213 m) while in transit offshore, 1,000 ft (305 m) over unpopulated areas or across coastlines, and 2,000 ft (610 m) over populated areas and sensitive habitats such as wildlife refuges and park properties. In addition, guidelines and regulations issued by NMFS under the authority of the MMPA specify that helicopters maintain an altitude of 1,000 ft (305 m) within 328 ft (100 m) of marine mammals

(BOEM, 2012a,b; NMFS, 2020). This mitigation measure will minimize the potential for disturbing manatees, and no significant impacts are expected.

Impacts of a Large Oil Spill

Based on the 30-day OSRA modeling (**Table 3**), Plaquemines Parish, Louisiana is the coastal area most likely to be affected (4% probability within 10 days and 8% probability within 30 days). Other Louisiana shorelines may be affected within 10 days (Terrebonne and Lafourche), and shorelines in Texas, Louisiana, and Florida could be affected within 30 days (1% to 8% conditional probability). There is no manatee critical habitat designated in these areas, and the number of manatees potentially present is a small fraction of the population in peninsular Florida.

In the event that manatees were exposed to oil, effects could include direct impacts from oil exposure, as well as indirect impacts due to response activities and materials (e.g., vessel traffic, noise, and dispersants) (MMC, 2011). Direct physical and physiological effects can include asphyxiation, acute poisoning, lowering of tolerance to other stress, nutritional stress, and inflammation infection (BOEM, 2017a). Indirect impacts include stress from the activities and noise of response vessels and aircraft (BOEM, 2017a). Complications of the above may lead to dysfunction of immune and reproductive systems, physiological stress, declining physical condition, and death. Behavioral responses can include displacement of animals from prime habitat, disruption of social structure, changing prey availability and foraging distribution and/or patterns, changing reproductive behavior/productivity, and changing movement patterns or migration (MMC, 2011).

In the event that a large spill reached coastal waters where manatees were present, the level of vessel and aircraft activity associated with spill response could disturb manatees and potentially result in vessel strikes, entanglement, or other injury or stress. Response vessels would operate in accordance with NTL BOEM-2016-G01 (see **Table 1**) to reduce the potential for striking or disturbing these animals.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the event of oil from a large spill enters areas inhabited by manatees, it is expected that impacts resulting in the injury or death of individual manatees could be significant at the population level. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

C.3.4 Non-Endangered Marine Mammals (Protected)

All marine mammal species are protected under the MMPA. In addition to the three endangered species of marine mammals that were cited in **Sections C.3.1** to **C.3.3**, 20 additional species of marine mammals may be found in the Gulf of Mexico. These include the dwarf and pygmy sperm whales, four species of beaked whales, and 14 species of delphinid whales and dolphins (see EP Section 6h). The minke whale (*Balaenoptera acutorostrata*) is considered rare in the Gulf of Mexico, and is therefore not considered further in the EIA (BOEM, 2012a). The most common non-endangered cetaceans in the deepwater environment are odontocetes (toothed whales and dolphins) such as the pantropical spotted dolphin, spinner dolphin, and Clymene dolphin. A brief summary is presented in this section, and additional information on these groups is presented by BOEM (2017a).

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, Mullin, 2007, Waring et al., 2015). Either species could occur in the project area.

Beaked whales. Four species of beaked whales are known from the Gulf of Mexico. They are Blainville's beaked whale (*Mesoplodon densirostris*), Sowerby's beaked whale (*Mesoplodon bidens*), Gervais' beaked whale (*Mesoplodon europaeus*), and Cuvier's beaked whale (*Ziphius cavirostris*). Stranding records (Würsig et al., 2000), as well as passive acoustic monitoring in the Gulf of Mexico (Hildebrand et al., 2015), suggest that Gervais' beaked whale and Cuvier's beaked whale are the most common species in the region. The Sowerby's beaked whale is considered extralimital, with only one documented stranding in the Gulf of Mexico (Bonde and O'Shea, 1989). Blainville's beaked whales are rare, with only four documented strandings in the northern Gulf of Mexico (Würsig et al., 2000).

Due to the difficulties of at-sea identification, beaked whales in the Gulf of Mexico are identified either as Cuvier's beaked whales (*Ziphius* spp.) or grouped into an undifferentiated species complex (*Mesoplodon* spp.). In the northern Gulf of Mexico, they are broadly distributed in waters greater than 3,281 ft (1,000 m) over lower slope and abyssal landscapes (Davis et al., 2000). Any of these species could occur in the project area (Waring et al., 2015).

Delphinids. Fourteen species of delphinids are known to occur in the Gulf of Mexico: Atlantic spotted dolphin (*Stenella frontalis*), bottlenose dolphin (*Tursiops truncatus*), Clymene dolphin (*Stenella clymene*), killer whale (*Orcinus orca*), false killer whale (*Pseudorca crassidens*), Fraser's dolphin (*Lagenodelphis hosei*), 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 of the northern Gulf of Mexico are the pantropical spotted dolphin, spinner dolphin, and rough-toothed dolphin. However, any of these species could occur in the project area (Waring et al. 2016; Hayes et al., 2019).

The bottlenose dolphin (*Tursiops truncatus*) is a common inhabitant of the northern Gulf of Mexico, particularly within continental shelf waters. There are two ecotypes of bottlenose dolphins, a coastal form and an offshore form, which are genetically isolated from each other (Waring et al. 2016). The offshore form of the bottlenose dolphin inhabits waters seaward from the 200-meter isobath and may occur within the project area. Inshore populations of coastal bottlenose dolphins in the northern Gulf of Mexico are separated by the NMFS into 31 geographically distinct population units, or stocks, for management purposes (Hayes et al., 2019).

Bottlenose dolphins in the Northern Gulf of Mexico are categorized into three stocks by NMFS (2016b): Bay, Sound, and Estuary; Continental Shelf; and Coastal and Oceanic. The Bay, Sound, and Estuary Stocks are considered to be strategic stocks. The strategic stock designation in this case was based primarily on the occurrence of an "unusual mortality event" of unprecedented size and duration (from April 2010 through July 2014) (NOAA, 2016) that affected these stocks.

Carmichael et al. (2012) hypothesized that the unusual number of bottlenose dolphin strandings in the northern Gulf of Mexico during this time may have been associated with environmental perturbations, including sustained cold weather and the *Deepwater Horizon* incident in 2010 as well as large volumes of cold freshwater discharge in the early months of 2011. Carmichael et al. (2012) and Schwacke et al. (2014b) reported that 1 year after the *Deepwater Horizon* incident, many dolphins in Barataria Bay, Louisiana, showed evidence of disease conditions associated with petroleum exposure and toxicity. Venn-Watson et al. (2015) performed histological studies to examine contributing factors and causes of deaths for stranded common bottlenose dolphins from Louisiana, Mississippi, and Alabama and found that the dead dolphins from the "unusual mortality event" were more likely than those from other areas to have primary bacterial pneumonia and thin adrenal cortices. The adrenal gland and lung diseases were consistent with exposure to petroleum compounds, and the exposure to petroleum compounds during and after the *Deepwater Horizon* incident are proposed as a cause.

IPFs that could potentially affect non-endangered marine mammals include MODU presence, noise, and lights; support vessel and helicopter traffic; and two types of accidents (a small fuel spill and a large oil 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 BSEE 2015-G013 (see **Table 1**) will minimize the potential for marine debris-related impacts on marine mammals.

Impacts of Mobile Offshore Drilling Unit Presence, Noise, and Lights

Noise from routine drilling activities has the potential to disturb marine mammals. Most odontocetes use higher frequency sounds than those produced by OCS drilling activities (Richardson et al., 1995). Three functional hearing groups are represented in the 20 non-endangered cetaceans found in the Gulf of Mexico (NMFS, 2018b). Eighteen of the 19 odontocete species are considered to be in the mid-frequency functional hearing group and two species (dwarf and pygmy sperm whales) are in the high frequency functional hearing group (NMFS, 2018b). Thruster and installation noise will affect each group differently depending on the frequency bandwiths produced by operations.

For mid frequency cetaceans exposed to a non-impulsive source (like drilling operations), permanent threshold shifts are estimated to occur when the mammal has received a sound exposure level of 198 dB re 1 μPa^2 s over a 24-hour period. Simlarly, temporary threshold shifts are estimated to occur when the mammal has received a sound exposure level of 178 dB re 1 μPa^2 s over a 24-hour period. Based on transmission loss calculations (Urick, 1983), open water propagation of noise produced by typical sources with intermittent use of DP thrusters during offshore operations, are not expected to produce received root-mean-square sound pressure levels greater than 160 dB re 1 µPa beyond 105 ft (32 m) from the source. Due to the short propagation distance of high root-mean-square sound pressure levels, the transient nature of marine mammals and the stationary nature of the proposed activites, it is not expected that any marine mammals will receive exposure levels necessary for the onset of auditory threshold shifts. NOAA Fisheries West Coast Region (2018) presents criteria that are used in the interim to determine behavioral disturbance thresholds for marine mammals and are applied equally across all functional hearing groups. Received root-mean-square sound pressure levels of 120 dB re 1 µPa from a non-impulsive source are considered high enough to elicit a behavioral reaction in some marine mammal species. The 120 dB isopleth may extend tens to hundreds of kilometers from the source depending on the propagation environment.

Some odontocetes have shown increased feeding activity around lighted platforms at night (Todd et al., 2009). Even temporary MODUs present an attraction to pelagic food sources that may attract cetaceans (and sea turtles). Therefore, prey congregation could pose an attraction to protected species that would expose them to higher levels or longer durations of noise that might otherwise be avoided.

There are other OCS facilities and activities near the project area, and the region as a whole has a large number of similar sources. Due to the limited scope, timing, and geographic extent of drilling activities, this project would represent a small temporary contribution to the overall noise regime, and any short-term impacts are not expected to be biologically significant to marine mammal populations.

MODU lighting and presence are not identified as IPFs for marine mammals by BOEM (2016b, 2017a). Therefore, no significant impacts are expected from these IPF's.

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 by BOEM (2017a). To reduce the potential for vessel strikes, BOEM has issued NTL BOEM-2016-G01 (see **Table 1**), 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 300 ft (91 m) or greater from whales and 148 ft (45 m) or greater from small cetaceans and sea turtles (NTL BOEM-2016-G01). 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. Although vessel strike avoidance measures described in NMFS (2020) are only applicable to ESA-listed species, complying with them may provide additional indirect protections to non-listed species as well. Use of these measures will minimize the likelihood of vessel strikes as well as reduce the chance for disturbing marine mammals, and therefore no significant impacts are expected.

Helicopter traffic also has the potential to disturb marine mammals (Würsig et al., 1998). However, while flying offshore, helicopters maintain altitudes above 700 ft (213 m) during transit to and from the working area. In addition, guidelines and regulations issued by NMFS under the authority of the MMPA specify that helicopters maintain an altitude of 1,000 ft (305 m) within 300 ft (91 m) of marine mammals (BOEM, 2017a; NMFS, 2020). Maintaining this altitude will minimize the potential for disturbing marine mammals, and no significant impacts are expected.

Impacts of a Small Fuel Spill

Potential spill impacts on marine mammals are discussed by BOEM (2016b, 2017a), and oil impacts on marine mammals in general are discussed by Geraci and St. Aubin (1990). For the EIA, there are no unique site-specific issues with respect to spill impacts on these animals.

The probability of a fuel spill will be minimized by Shell's preventative measures, including fuel transfer. In the unlikely event of a spill, implementation of Shell's OSRP is expected to mitigate and reduce the potential for impacts on marine mammals. EP Section 9b provides detail on spill response measures. Given the open ocean location of the project area and the duration of a small spill, the opportunity for impacts to occur would be very brief.

A small fuel spill in offshore waters would produce a thin slick on the water surface and introduce 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.9.1** discusses the likely fate of a small fuel spill and indicates that over 90% would evaporate or disperse naturally within 24 hours. The area of diesel fuel on the sea surface would range from 1.2 to 12 ac (0.5 to 5 ha), 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, 2011). However, due to the limited areal extent and short duration of water quality impacts from a small fuel spill, as well as the mobility of marine mammals, no significant impacts would be expected.

Impacts of a Large Oil Spill

Potential spill impacts on marine mammals are discussed by BOEM (2016b, 2017a). For the EIA, there are no unique site-specific issues.

Impacts of oil spills on marine mammals can include direct impacts from oil exposure as well as indirect impacts due to response activities and materials (e.g., vessel traffic, noise, and dispersants) (MMC, 2011). Direct physical and physiological effects can include skin irritation, inflammation, or necrosis; chemical burns of skin, eyes, and mucous membranes; inhalation of toxic fumes; ingestion of oil (and dispersants) directly or via contaminated prey; and stress from the activities and noise of response vessels and aircraft. Complications of the above may lead to dysfunction of immune and reproductive systems (DeGuise et al., 2017), physiological stress, declining physical condition, and death. Kellar et al. (2017) estimated reproductive success rates for two northern Gulf of Mexico stocks affected by oil were less than a third (19.4%) of those previously reported in other areas (64.7%) not impacted. Behavioral responses can include displacement of animals from prime habitat (McDonald et al., 2017a); disruption of social structure; changing prey availability and foraging distribution and/or patterns; changing reproductive behavior/productivity; and changing movement patterns or migration (MMC, 2011).

Data from the *Deepwater Horizon* incident, as analyzed and summarized by NOAA (2016b) indicate the scope of potential impacts from a large spill. Tens of thousands of marine mammals were exposed to oil, where they likely inhaled, aspirated, ingested, physically contacted, and absorbed oil components (NOAA, 2016b, Takeshita et al., 2017). Nearly all of the marine mammal stocks in the northern Gulf of Mexico were affected. The oil's physical, chemical, and toxic effects damaged tissues and organs, leading to a constellation of adverse health effects, including reproductive failure, adrenal disease, lung disease, and poor body condition (NOAA, 2016b). According to the National Wildlife Federation (2016a), nearly all of the 20 species of dolphins and whales that live in the northern Gulf of Mexico had demonstrable, quantifiable injuries. NMFS (2014a) documented 13 dolphins and whales live-stranded, and over 150 dolphins and whales dead during the oil spill response. Because of known low detection rates of carcasses (Williams et al., 2011), it is possible that the number of marine mammal deaths is underestimated. Also, necropsies to confirm the cause of death could not be conducted for many of these marine mammals, therefore some cause of deaths reported as unknown are likely attributable to oil interaction. Schwacke et al. (2014a) reported that 1 year after the spill, many dolphins in Barataria Bay, Louisiana, showed evidence of disease conditions associated with petroleum exposure and toxicity. Lane et al. (2015) noted a decline in pregnancy success rate among dolphins in the same region. BOEM (2012a) concluded that potential effects from a large spill could potentially contribute to more significant and longer-lasting impacts including mortality and longer-lasting chronic or sublethal effects than a small, but severe accidental spill.

In the event of a large spill, response activities that may impact marine mammals include increased vessel traffic, use of dispersants, and remediation activities (e.g., controlled burns, skimmers, boom) (BOEM, 2017a). The increased level of vessel and aircraft activity associated with spill response could disturb marine mammals, potentially resulting in behavioral changes. The large number of response vessels could result in vessel strikes, entanglement or other injury, or stress. Response vessels would operate in accordance with NTL BOEM-2016-G01 to reduce the potential for striking or disturbing these animals, and therefore no significant impacts are expected.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the event of oil from a large spill, it is expected that impacts resulting in the injury or death of individual marine mammals could be significant at the population level depending on the level of oiling and the species affected. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

C.3.5 Sea Turtles (Endangered/Threatened)

As listed in EP Section 6h, five species of Endangered or Threatened sea turtles may be found near the project area. Endangered species are the leatherback, Kemp's ridley, and hawksbill turtles. As of May 6, 2016, the entire North Atlantic DPS of the green turtle is listed as threatened (81 *Federal Register* [FR] 20057). The DPS of loggerhead turtle that occurs in the Gulf of Mexico is listed as threatened, although other DPSs are Endangered. Of the sea turtle species that may be found in the project area, only the Kemp's ridley relies on the Gulf of Mexico as its sole breeding ground. Species descriptions are presented by (BOEM, 2017a).

Critical habitat has been designated for the loggerhead turtle in the Gulf of Mexico as shown in **Figure 1**. Critical habitat in the northern Gulf of Mexico includes nesting beaches in Mississippi, Alabama, and the Florida Panhandle; nearshore reproductive habitat seaward from these beaches; and a large area of *Sargassum* habitat. The nearest designated nearshore reproductive critical habitat for loggerhead sea turtles is approximately 153 miles (246 km) from the project area.

Loggerhead turtles in the Gulf of Mexico are part of the Northwest Atlantic Ocean DPS (NMFS, 2014b). In July 2014, NMFS and the USFWS designated critical habitat for this DPS. The USFWS designation (79 FR 39756) includes nesting beaches in Jackson County, Mississippi; Baldwin County, Alabama; and Bay, Gulf, and Franklin Counties in the Florida Panhandle as well as several counties in southwest Florida and the Florida Keys (and other areas along the Atlantic coast). The NMFS designation (79 FR 39856) includes nearshore reproductive habitat within 1 mile (1.6 km) seaward of the mean high water line along these same nesting beaches. NMFS also designated a large area of shelf and oceanic waters, termed *Sargassum* habitat, in the Gulf of Mexico (and Atlantic Ocean) as critical habitat. *Sargassum* is a genus of brown alga (Class Phaeophyceae) that has a pelagic existence. Rafts of *Sargassum* spp. serve as important foraging and developmental habitat for numerous fishes, and young sea turtles, including loggerhead turtles. NMFS also designated three other categories of critical habitat: of these, two (migratory habitat and overwintering habitat) are along the Atlantic coast, and the third (breeding habitat) is found in the Florida Keys and along the Florida east coast (NMFS, 2014b).

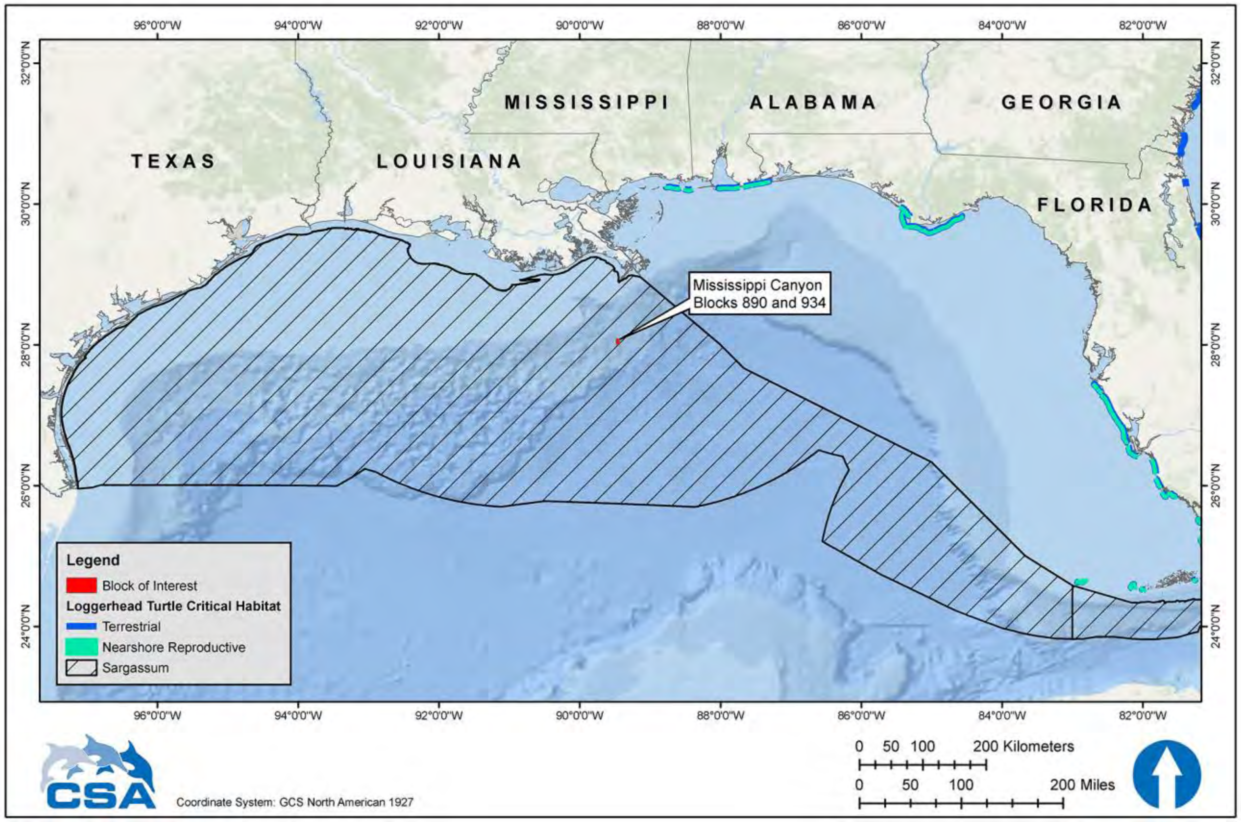

Figure 1. Location of loggerhead turtle critical habitat in the northern Gulf of Mexico in relation to the project area. The critical habitat includes terrestrial habitat (nesting beaches) and nearshore reproductive habitat in Mississippi, Alabama, and the Florida Panhandle as well as *Sargassum* habitat.

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

All five sea turtle species in the Gulf of Mexico are migratory and use different marine habitats according to their life stage. These habitats include high-energy beaches for nesting females and emerging hatchlings and pelagic convergence zones for hatchling and juvenile turtles. As adults, green, hawksbill, Kemp's ridley, and loggerhead turtles forage primarily in shallow benthic habitats. Leatherbacks are the most pelagic of the sea turtles, feeding primarily on jellyfish.

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

- Loggerhead turtles—Loggerhead turtles nest in significant numbers along the Florida Panhandle (Florida Fish and Wildlife Conservation Commission, 2017a) and, to a lesser extent, from Texas through Alabama (NMFS and USFWS, 2008);
- Green and leatherback turtles—Green and leatherback turtles infrequently nest on Florida Panhandle beaches (Florida Fish and Wildlife Conservation Commission, 2017b, c);
- Kemp's ridley turtles—The main nesting site is Rancho Nuevo beach in Tamaulipas, Mexico (NMFS et al., 2011). A total of 190 Kemp's ridley turtle nests were counted on Texas beaches during the 2019 nesting season and a total of 250 Kemp's ridley turtle nests were counted on Texas beaches during the 2018 nesting season. In 2017, 353 Kemp's ridley turtle nests were counted, an increase from the 185 counted in 2016; 159 counted in 2015; and 118 counted in 2014 (Turtle Island Restoration Network, 2019). Padre Island National Seashore, along the coast of Willacy, Kenedy, and Kleberg Counties in southern Texas, is the most important nesting location for this species in the U.S.; and
- Hawksbill turtles—Hawksbill turtles typically do not nest anywhere near the project area, with most nesting in the region located in the Caribbean Sea and on beaches of the Yucatán Peninsula (U.S. Fish and Wildlife Service, 2016).

IPFs that could potentially affect sea turtles include MODU presence, noise, and lights; support vessel and helicopter traffic; and two types of accidents (a small fuel spill and a large oil 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.

Though NMFS (2020) stated marine debris as an IPF, compliance with NTL BSEE 2015-G013 (See **Table 1**) and NMFS (2020) Appendix B will minimize the potential for marine debris-related impacts on sea turtles. NMFS (2020) estimated a small proportion of individual sea turtles would be adversely affected from exposure to marine debris. Therefore, marine debris is likely to have negligible impacts on sea turtles and is not further discussed (See **Table 2**).

Impacts of Mobile Offshore Drilling Unit Presence, Noise, and Lights

Offshore drilling activities produce broadband sounds at frequencies and intensities that may be detected by sea turtles (Samuel et al., 2005, Popper et al., 2014). Potential impacts could include behavioral disruption and displacement from the area near the sound source. There is scarce information regarding hearing and acoustic thresholds for marine turtles. Sea turtles can hear low to mid-frequency sounds and they appear to hear best between 200 and 750 Hz and do not respond well to sounds above 1,000 Hz (Ketten and Bartol, 2005). The currently accepted hearing and response estimates are derived from fish hearing data rather than from marine mammal hearing data in combination with the limited experimental data available (Popper et al., 2014). NMFS Biological Opinion (NMFS, 2015) lists the sea turtle underwater acoustic root-mean-square sound pressure level injury threshold as 207 dB re 1 µPa; Blackstock et al. (2018) identified the sea turtle underwater acoustic root-mean-square sound pressure level behavioral threshold as 175 dB re 1 µPa. No distinction is made between impulsive and non-impulsive sources for these thresholds. Based on transmission loss calculations (Urick, 1983), open water propagation of noise produced by typical sources with DP thrusters in use during drilling, are not expected to produce root-mean-square sound pressure levels greater than 160 dB re 1 µPa beyond 32 m from the source. Certain sea turtles, especially loggerheads, may be attracted to offshore structures (Lohoefener et al., 1990, Gitschlag et al., 1997) and thus, may be more susceptible to impacts from sounds produced during routine drilling and completion activities. Helicopters and support vessels may also affect sea turtles because of machinery noise or visual disturbances. Any impacts would likely be short-term behavioral changes such as diving and evasive swimming, disruption of activities, or departure from the area. Because of the limited scope and short duration of drilling activities, 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 (Tuxbury and Salmon, 2005, Berry et al., 2013, Simões et al., 2017). However, hatchlings may rely less on light cues when they are offshore than when they are emerging on the beach (Salmon and Wyneken, 1990). NMFS (2007) concluded that the effects of lighting from offshore structures on sea turtles are insignificant. Therefore, no significant impacts are expected.

NMFS (2020) stated sea turtles have the potential to be entangled or entrapped in moon pools, and though many sea turtles could exit the moon pool under their own volition, sublethal effects could occur. Based on the moon pool entrapment cases of sea turtles reported and successful rescues and releases that have occurred, NMFS (2020) estimated approximately about one sea turtle will be sub-lethally entrapped in moon pools every year. Therefore, no significant impacts are expected.

Impacts of 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; NMFS, 2020). 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, BOEM issued NTL BOEM-2016-G01, 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 164 ft (50 m) or greater whenever possible (NMFS [2020] Appendix C). Compliance with these mitigation measures will minimize the likelihood of vessel strikes as well as reduce the chance for disturbing sea turtles. Therefore, no significant impacts are expected.

Helicopter traffic also has the potential to disturb sea turtles. However, while flying offshore, helicopters maintain altitudes above 700 ft (213 m) during transit to and from the working area. This altitude will minimize the potential for disturbing sea turtles, and no significant impacts are expected (NMFS, 2020, BOEM, 2012a).

Impacts of a Small Fuel Spill

Potential spill impacts on sea turtles are discussed by NMFS (2020) and BOEM (2017a). For this EP, there are no unique site-specific issues with respect to spill impacts on sea turtles. **Section A.9.1** discusses the size and fate of a potential small diesel fuel spill as a result of Shell's proposed activities. EP Section 9b provides detail on spill response measures. Given the open ocean location of the project area, the duration of a small spill and opportunity for impacts to occur would be very brief.

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 (NMFS, 2014a). As discussed in **Section A.9.1**, more than 90% of a small diesel spill in offshore waters would evaporate or disperse naturally within 24 hours. Therefore, due to the limited areal extent and short duration of water quality impacts from a small fuel spill, no significant impacts to sea turtles from direct or indirect exposure would be expected.

Loggerhead Critical Habitat – Nesting Beaches. A small fuel spill in the project area would be unlikely to affect sea turtle nesting beaches because the project area is 53 miles (85 km) from the nearest shoreline (Louisiana). Loggerhead turtle nesting beaches and nearshore reproductive habitat designated as critical habitat are located in Mississippi, Alabama, and the Florida Panhandle, at least 153 miles (246 km) from the project area. As explained in **Section A.9.1**, a small fuel spill would not be expected to make landfall or reach coastal waters prior to breaking up.

Loggerhead Critical Habitat – *Sargassum* Habitat. The project area is within the *Sargassum* portion of the loggerhead turtle critical habitat (**Figure 1**). A small fuel spill could affect *Sargassum* spp. and juvenile turtles by contaminating this habitat. Juvenile sea turtles could come into contact with or ingest oil, resulting in death, injury, or other sublethal effects. Affects would be limited to the small area (1.2 to 12 ac [0.5 to 5 ha]) likely to be impacted by a small spill. A 12-acre (5-hectare) impact would represent a negligible portion of the 96,776,959 ac (39,164,246 ha) designated *Sargassum* habitat for loggerhead turtles in the northern Gulf of Mexico.

Impacts of a Large Oil Spill

Impacts of oil spills on sea turtles can include direct impacts from oil exposure as well as indirect impacts due to response activities and materials (e.g., vessel traffic, noise, and dispersants). Direct physical and physiological effects can include skin irritation, inflammation, or necrosis; chemical burns of skin, eyes, and mucous membranes; inhalation of toxic fumes and smoke (e.g., from *in situ* burning of oil); ingestion of oil (and dispersants) directly or via contaminated food; and stress from the activities and noise of response vessels and aircraft. Complications of the above may lead to dysfunction of immune and reproductive systems, physiological stress, declining physical condition, and death. Behavioral responses can include displacement of animals from prime habitat, disruption of social structure, change in food availability and foraging distribution and/or patterns, changing reproductive behavior/productivity, and changing movement patterns or migration (MMC, 2011, NMFS, 2014b). In the unlikely event of a spill, implementation of Shell's OSRP is expected to mitigate and reduce the potential for these types of impacts on sea turtles. EP Section 9b provides detail on spill response measures.

Studies of oil effects on loggerheads in a controlled setting (Lutcavage et al., 1995, NOAA, 2010) suggest that sea turtles show no avoidance behavior when they encounter an oil slick, and any sea turtle in an affected area would be expected to be exposed. Sea turtles' diving behaviors also put them at risk. Sea turtles rapidly inhale a large volume of air before diving and continually resurface over time, which may result in repeated exposure to volatile vapors and oiling (NMFS, 2020).

Results of *Deepwater Horizon* incident studies provide an indication of potential effects of a large oil spill on sea turtles. NOAA (2016b) estimated that between 4,900 and 7,600 large juvenile and adult sea turtles (Kemp's ridleys, loggerheads, and hardshelled sea turtles not identified to species) and between 56,000 and 166,000 small juvenile sea turtles (Kemp's ridleys, green turtles, loggerheads, hawksbills, and hardshelled sea turtles not identified to species) were killed by the *Deepwater Horizon* incident. Nearly 35,000 hatchling sea turtles (loggerheads, Kemp's ridleys, and green turtles) were also injured by response activities (NOAA, 2016b). Evidence from (McDonald et al., 2017b) suggests 402,000 turtles were exposed to oil in the aftermath of the *Deepwater Horizon* incident, including 54,800 which were likely to have been heavily oiled.

Spill response activities could also kill sea turtles and interfere with nesting. NOAA (2016b) concluded that after the *Deepwater Horizon* incident, hundreds of sea turtles were likely killed by response activities such as increased boat traffic, dredging for berm construction, increased lighting at night near nesting beaches, and oil cleanup operations on nesting beaches. In addition, it is estimated that oil cleanup operations on Florida Panhandle beaches following the spill deterred adult female loggerheads from coming ashore and laying their eggs, resulting in a decrease of approximately 250 loggerhead nests or a reduction of 43.7% in 2010 (NOAA, 2016b, Lauritsen et al., 2017). Impacts from a large oil spill resulting in the death of individual listed sea turtles would be significant to local populations.

Loggerhead Critical Habitat – Nesting Beaches. Spilled oil reaching sea turtle nesting beaches could affect nesting sea turtles and egg development (NMFS, 2020). An oiled beach could affect nest site selection or result in no nesting at all (e.g., false crawls). Upon hatching and successfully reaching the water, hatchlings would be subject to the same types of oil spill exposure hazards as adults. Hatchlings that contact oil residues while crossing a beach could exhibit a range of effects, from acute toxicity to impaired movement and normal bodily functions (NMFS, 2007).

Based on the 30-day OSRA modeling (**Table 3**), Plaquemines Parish, Louisiana is the coastal area most likely to be affected (4% probability within 10 days and 8% probability within 30 days). Other Louisiana shorelines may be affected within 10 days (Terrebonne and Lafourche parishes), and shorelines in Texas, Louisiana, and Florida could be affected within 30 days (1% to 8% conditional probability). The nearest nearshore reproductive critical habitat for loggerhead turtles is 153 miles (246 km) from the project area.

Loggerhead Critical Habitat – *Sargassum* Habitat. The project area is within the *Sargassum* habitat portion of the loggerhead turtle critical habitat (**Figure 1**). Due to the large area covered by the designated *Sargassum* habitat for loggerhead turtles, a large spill could result in oiling of a substantial part of the *Sargassum* habitat in the northern Gulf of Mexico. The catastrophic 2010 Macondo spill affected approximately one-third of the *Sargassum* habitat in the northern Gulf of Mexico (BOEM, 2016b). It is extremely unlikely that the entire *Sargassum* habitat would be affected by a large spill. Because *Sargassum* spp. are floating, pelagic species, it would only be affected by oil that is present near the surface.

The effects of oiling on *Sargassum* spp. vary with severity, but moderate to heavy oiling as could occur during a large spill could cause complete mortality to *Sargassum* spp. and its associated communities (BOEM, 2017a). *Sargassum* spp. also has the potential to sink during a large spill; thus temporarily removing the habitat and possibly being an additional pathway of exposure to the benthic environment (Powers et al., 2013). Lower levels of oiling may cause sublethal affects, including reduced growth, productivity, and recruitment of organisms associated with *Sargassum* spp. The *Sargassum* spp. algae itself could be less impacted by light to moderate oiling than associated organisms because of a waxy outer layer that might help protect it from oiling (BOEM, 2016b). *Sargassum* spp. have a yearly seasonal cycle of growth and a yearly cycle of dispersal from the Gulf of Mexico to the western Atlantic. A large spill could affect a large portion of the annual crop of the algae; however, because of its ubiquitous distribution and seasonal cycle, recovery of the *Sargassum* spp. community would be expected to take one to two years (BOEM, 2017a).

Impacts to sea turtles from a large oil spill and associated cleanup activities would depend on spill extent, duration, and season (relative to turtle nesting season); the amount of oil reaching the shore; the importance of specific beaches to sea turtle nesting; and the level of cleanup vessel and beach crew activity required. A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the event of oil from a large spill, it is expected that impacts resulting in the injury or death of individual sea turtles would be adverse but not likely significant at the population level. In the unlikely event of a spill, implementation of Shell's OSRP would mitigate and reduce direct and indirect impacts to turtles from oil exposure and response activities and materials. EP Section 9b provides detail on spill response measures.

C.3.6 Piping Plover (Threatened)

The Piping Plover is a migratory shorebird 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). However, as a result of intensive conservation and management, populations of Piping Plover appear to have been increasing since 1991 throughout its range (Bird Life International, 2018). Critical overwintering habitat has been designated, including beaches in Texas, Louisiana, Mississippi, Alabama, and Florida (**Figure 2**). 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, 2010). A species description is presented by BOEM (2017a).

A large oil spill is the only IPF that could potentially affect Piping Plovers. There are no IPFs associated with routine project activities that could affect these birds. A small fuel spill in the project area would be unlikely to affect Piping Plovers because a small fuel spill would not be expected to make landfall or reach coastal waters prior to breaking up (see explanation in **Section A.9.1**).

Impacts of a Large Oil Spill

The project area is 65 miles (105 km) from the nearest shoreline designated as Piping Plover critical habitat. The 30-day OSRA modeling (**Table 3**) predicts that Piping Plover critical habitat in Plaquemines Parish, Louisiana could be contacted within 10 days of a spill (4% conditional probability). Within 30 days of a spill the model predicts conditional probabilities of shoreline contact of 8%.

Piping Plovers could become externally oiled while foraging on oiled shores or become exposed internally through ingestion of oiled intertidal sediments and prey (BOEM, 2017a). They congregate and feed along tidally exposed banks and shorelines, following the tide out and foraging at the water's edge. It is possible that some deaths of Piping Plovers could occur, especially if spills occur during winter months when the birds are most common along the coastal Gulf or if spills contacted critical habitat. Impacts could also occur from vehicular traffic on beaches and other activities associated with spill cleanup. Shell has extensive resources available to protect and rehabilitate wildlife in the event of a spill reaching the shoreline, as detailed in the OSRP.

However, a large spill that contacts shorelines would not necessarily impact Piping Plovers. In the aftermath of the *Deepwater Horizon* incident, Gibson et al. (2017) completed thorough surveys of coastal Piping Plover habitat in coastal Louisiana, Mississippi, and Alabama and found that only 0.89% of all observed Piping Plovers were visibly oiled, leaving the authors to conclude that the *Deepwater Horizon* incident did not substantially affect Piping Plover populations.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the event of oil from a large spill contacting beaches inhabited by Piping Plovers, it is expected that impacts resulting in the injury or death of individual Piping Plovers could be significant at the population level. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

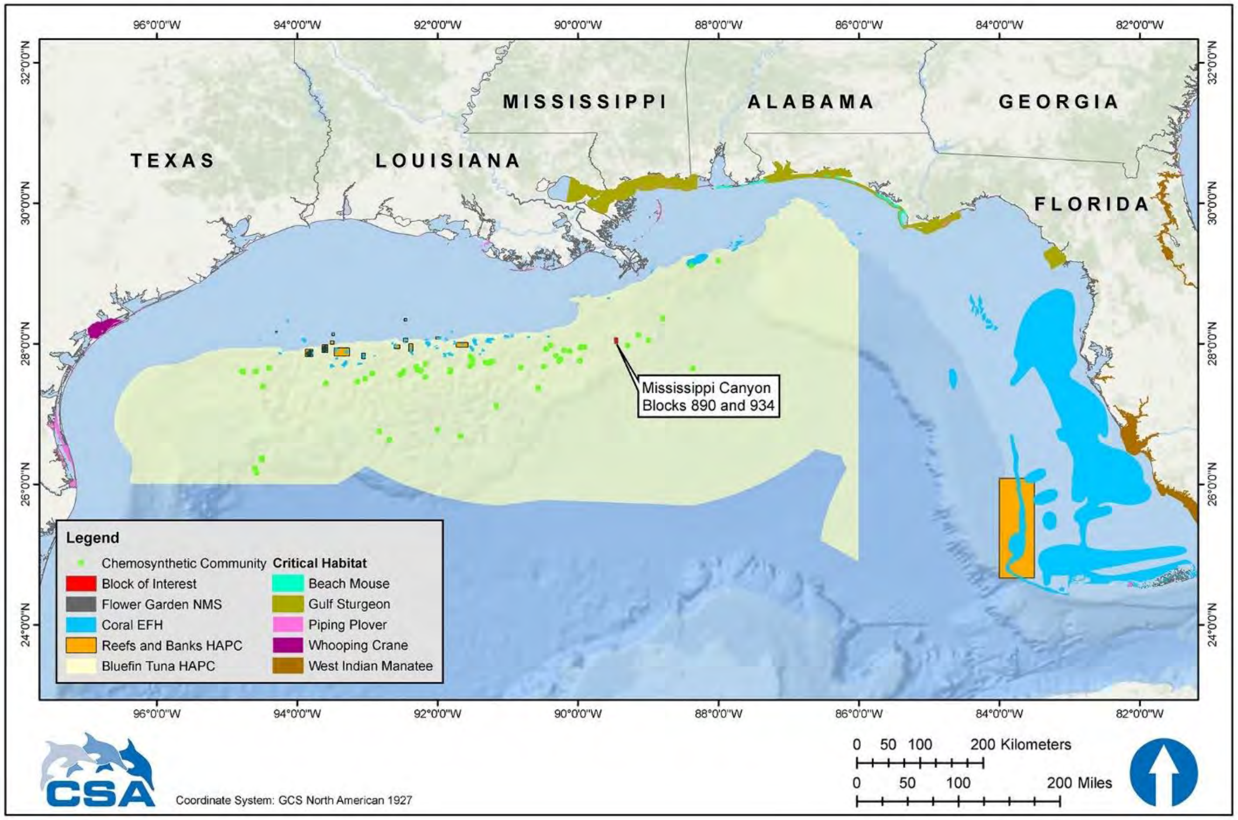

Figure 2. Location of selected environmental features in relation to the project area. EFH = Essential Fish Habitat; HAPC = Habitat Area of Particular Concern.

C.3.7 Whooping Crane (Endangered)

The Whooping Crane is a large omnivorous wading bird and a listed endangered species. Three wild populations live in North America (National Wildlife Federation, 2016b). One of these populations 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, reaching an estimated population of 504 at Aransas NWR during the 2018 to 2019 winter (USFWS, 2019). A reintroduced population summers in Wisconsin and migrates to the southeastern U.S. for the winter (Whooping Crane Eastern Partnership, 2019). 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 22,240 ac (9,000 ha) of salt flats in 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 2). A species description is presented by (BOEM, 2012a).

A large oil spill is the only IPF that could potentially affect Whooping Cranes due to the distance of the project area from Aransas NWR.

Impacts of a Large Oil Spill

The 30-day OSRA modeling (**Table 3**) predicts a <0.5% or less chance of oil contacting Whooping Crane critical habitat (Calhoun or Aransas Counties, Texas) within 30 days of a spill.

In the event of oil exposure, Whooping Cranes could physically oil themselves while foraging in oiled areas or secondarily contaminate themselves through ingestion of contaminated shellfish, frogs, and fishes. It is possible that some deaths of Whooping Cranes could occur if the spill contacts their critical habitat in Aransas NWR, especially if spills occur during winter months when Whooping Cranes are most common along the Texas coast. Impacts could also occur from vehicular traffic on beaches and other activities associated with spill cleanup. Shell has extensive resources available to protect and rehabilitate wildlife in the event of a spill reaching the shoreline, as detailed in the OSRP. Impacts leading to the death of individual Whooping Cranes would be significant at a species level.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the event of oil from a large spill contacting Whooping Crane habitat, it is expected that impacts resulting in the injury or death of individual Whooping Cranes could be significant at the population level. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

C.3.8 Oceanic Whitetip Shark (Threatened)

The oceanic whitetip shark was listed as Threatened under the ESA in 2018 by NMFS (83 FR 4153). Oceanic whitetip sharks are found worldwide in offshore waters between approximately 30° N and 35° S latitude, and historically were one of the most widespread and abundant species of shark (Baum et al., 2015). However, based on reported oceanic whitetip shark catches in several major long-line fisheries, the global population appears to have suffered substantial declines (Camhi et al., 2008) and the species is now only occasionally reported in the Gulf of Mexico (Baum et al., 2015).

A comparison of historical shark catch rates in the Gulf of Mexico by Baum and Myers (2004) noted that most recent papers dismissed the oceanic whitetip shark as rare or absent in the Gulf of Mexico. NMFS (2018a) noted that there has been an 88% decline in abundance of the species in the Gulf of Mexico since the mid-1990s due to commercial fishing pressure.

IPFs that could affect the oceanic whitetip shark include MODU presence, noise, and lights, and a large oil spill. Though NMFS (2020) lists a small diesel fuel spill as an IPF, in the project area, a small diesel fuel spill would be unlikely to affect oceanic whitetip sharks due to rapid natural dispersion of diesel fuel and the low density of oceanic whitetip sharks potentially present in the project area. Therefore, no significant impacts are expected from small diesel fuel spills and they are not further discussed (**Table 2**).

Impacts of Mobile Offshore Drilling Unit Presence, Noise, and Lights

Offshore drilling activities produce a broad array of sounds at frequencies and intensities that may be detected by elasmobranchs including the threatened oceanic whitetip shark. The general frequency range for elasmobranch hearing is approximately between 20 Hz and 1 kHz (Ladich and Fay, 2013), which includes frequencies exhibited by individual species such as the nurse shark (*Ginglymostoma cirratum*; 300 and 600 Hz) and the lemon shark (*Negaprion brevirostris*; 20 Hz to 1 kHz) (Casper and Mann, 2006). These frequencies overlap with sound pressure levels associated with drilling activities (typically 10 Hz to 10 kHz) (Hildebrand, 2005). Impacts from offshore drilling activities (i.e., non-impulsive sound) could include masking or behavioral change (Popper et al., 2014). However, because of the limited propagation distances of high sound pressure levels from the drilling rig, impacts would be limited in geographic scope and no population level impacts on oceanic whitetip sharks are expected.

Impacts of a Large Oil Spill

Information regarding the direct effects of oil on elasmobranchs, including the oceanic whitetip shark are largely unknown. However, in the event of a large oil spill, oceanic whitetip sharks could be affected by direct ingestion, ingestion of oiled prey, or the absorption of dissolved petroleum products through the gills. Because oceanic whitetip sharks may be found in surface waters, they could be more likely to be impacted by floating oil than other species which only reside at depth.

It is possible that a large oil spill could affect individual oceanic whitetip sharks and result in injuries or deaths. However, due to the low density of oceanic whitetip sharks thought to exist in the Gulf of Mexico, it is unlikely that a large spill would result in population-level effects.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

C.3.9 Giant Manta Ray (Threatened)

The giant manta ray was listed as Threatened under the ESA in 2018 by NMFS (83 FR 2916). The species is a slow-growing, migratory, and planktivorous, inhabiting tropical, subtropical, and temperate bodies of water worldwide (NOAA, 2018a).

Commercial fishing is the primary threat to giant manta rays (NOAA, 2018a). The species is targeted and caught as bycatch in several global fisheries throughout its range. Although protected in U.S. waters, protection of populations is difficult as they are highly migratory with sparsely distributed and fragmented populations throughout the world. Some estimated regional population sizes are small (between 100 to 1,500 individuals) (Marshall et al., 2018, NOAA, 2018a). Stewart et al. (2018) recently reported evidence that the Flower Garden Banks serves as nursery habitat for aggregations of juvenile manta rays. At least 74 unique individuals have been positively identified at the Flower Garden Banks based on unique underbelly coloration (Flower Garden Banks National Marine Sanctuary, 2018). Genetic and photographic evidence in the Flower Garden Banks over 25 years of monitoring showed that 95% of identified giant manta ray male individuals were smaller than mature size (Stewart et al., 2018).

IPFs that may affect giant manta rays include MODU presence, noise, and lights, and a large oil spill. Though NMFS (2020) lists a small diesel fuel spill as an IPF, in the project area a small diesel fuel spill would be unlikely to affect giant manta rays due to rapid natural dispersion of diesel fuel and the low density of giant manta rays potentially present in the project area. Therefore, no significant impacts are expected from small diesel fuel spills and they are not further discussed (See **Table 2**).

Impacts of Mobile Offshore Drilling Unit Presence, Noise, and Lights

Offshore drilling activities produce a broad array of sounds at frequencies and intensities that may be detected by elasmobranchs including the giant manta ray. The general frequency range for elasmobranch hearing is approximately between 20 Hz and 1 kHz (Ladich and Fay, 2013). Studies indicate that the most sensitive hearing ranges for individual species were 300 and 600 Hz (yellow stingray [*Urobatis jamaicensis*]) and 100 to 300 Hz (little skate [*Erinacea raja*]) (Casper et al., 2003, Casper and Mann, 2006). These frequencies overlap with sound pressure levels associated with drilling activities (typically 10 Hz to 10 kHz) (Hildebrand, 2005). Impacts from offshore drilling activities (i.e., continuous sound) could include masking or behavioral change (Popper et al., 2014). However, because of the limited propagation distances of high sound pressure levels from the drilling rig, impacts would be limited in geographic scope and no population level impacts on giant manta rays are expected.

Impacts of a Large Oil Spill

A large oil spill in the project area could reach coral reefs at the Flower Garden Banks which is the only known location of giant manta ray aggregations in the Gulf of Mexico. Individuals may occur anywhere in the Gulf. In the unlikely event of a large oil spill impacting areas with giant manta rays, individual rays could be affected by direct ingestion of oil which could cover their gill filaments or gill rakers, or by ingestion of oiled plankton. Giant manta rays typically feed in shallow waters of less than 33 ft (10 m) depth (NOAA, 2018). Because of this shallow water feeding behavior, giant manta rays may be more likely to be impacted by floating oil than other species which only reside at depth.

In the event of a large oil spill, due to the distance between the project area and the Flower Garden Banks (approximately 249 miles [401 km]), it is unlikely that oil would impact the giant manta ray nursery habitat. It is possible that a large oil spill could contact individual giant manta rays, but due to the low density of individuals thought to occur in the Gulf of Mexico, there would not likely be any population-level effects.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

C.3.10 Gulf Sturgeon (Threatened)

The Gulf sturgeon 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). The Gulf sturgeon is anadromous, migrating from the sea upstream into coastal rivers to spawn in freshwater. The historic range of the species extended from the Texas/Louisiana border to Tampa Bay, Florida (Pine and Martell, 2009). This range has contracted to encompass major rivers and inner shelf waters from the Lake Pontchartrain and the Pearl River system in Louisiana and Mississippi to the Suwannee River, Florida (NOAA, 2018b). 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). Rudd et al. (2014) reconfirmed the spatial distribution and movement patterns of Gulf Sturgeon by surgically implanting acoustic telemetry tags. Critical habitat in the Gulf extends from Lake Borgne, Louisiana (St. Bernard Parish), to Suwannee Sound, Florida (Levy County) (NMFS, 2014c) (**Figure 2**). Species descriptions are presented by (BOEM, 2012a) and in the recovery plan for this species (USFWS et al., 1995).

A large oil spill is the only IPF that could potentially affect Gulf sturgeon. There are no IPFs associated with routine project activities that could affect this species. A small fuel spill in the project area would be unlikely to affect Gulf sturgeon because a small fuel spill would not be expected to make landfall or reach coastal waters prior to breaking up (see explanation in **Section A.9.1**). Vessel strikes to Gulf sturgeon would be unlikely based on the location of the support vessel base and that NMFS (2020) estimated one non-lethal Gulf sturgeon strike in the 50 years of proposed action. Due to the distance of the project area from the nearest Gulf Sturgeon critical habitat (146 miles [235 km]) and the support vessel base being in Port Fourchon, Louisiana, it is anticipated impacts from vessel strikes due to project activities will be negligible. The large oil spill IPF with potential impacts listed in **Table 2** is discussed below.

Impacts of a Large Oil Spill

Potential spill impacts on Gulf sturgeon are discussed by BOEM (2016b, 2017a) and NMFS (2007). For this EP, there are no unique site-specific issues with respect to this species.

The project area is approximately 146 miles (235 km) from the nearest Gulf sturgeon critical habitat. The 30-day OSRA modeling (**Table 3**) predicts that a spill in the project area has 1% or less conditional probability of contacting any coastal areas containing Gulf sturgeon critical habitat within 30 days of a spill.

In the event of oil reaching Gulf sturgeon habitat, the fish could be affected by direct ingestion, ingestion of oiled prey, or the absorption of dissolved petroleum products through the gills. Based on the life history of this species, sub-adult and adult Gulf sturgeon would be most vulnerable to an estuarine or marine oil spill, and would be vulnerable primarily during winter months (from October through April) when this species is foraging in estuarine and marine habitats (NMFS, 2020).

NOAA (2016b) estimated that 1,100 to 3,600 Gulf sturgeon were exposed to oil from the *Deepwater Horizon* incident. Overall, 63% of the Gulf sturgeon from six river populations were potentially exposed to the spill. Although the number of dead or injured Gulf sturgeon was not estimated, laboratory and field tests indicated that Gulf sturgeon exposed to oil displayed both genotoxicity and immunosuppression, which can lead to malignancies, cell death, susceptibility to disease, infections, and a decreased ability to heal (NOAA, 2016b).

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the event of oil from a large spill contacting waterways inhabited by Gulf sturgeon, it is expected that impacts resulting in the injury or death of individual sturgeon would be adverse but not likely significant at the population level. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. Shell has extensive resources available to protect coastal and estuarine wildlife and habitats in the event of a spill reaching the shoreline, as detailed in the OSRP. EP Section 9b provides detail on spill response measures.

C.3.11 Nassau Grouper (Threatened)

The Nassau grouper is a Threatened, long-lived reef fish typically associated with hard bottom structures such as natural and artificial reefs, rocks, and underwater ledges (NOAA, nd). Once one of the most common reef fish species in the coastal waters of the United States and Caribbean (Sadovy, 1997), the Nassau grouper has been subject to overfishing and is considered extinct in much of its historical range. Observations of current spawning aggregations compared with historical landings data suggest that the Nassau grouper population is substantially smaller than its historical size (NOAA, nd). The Nassau Grouper was listed as Threatened under the ESA in 2016 (81 FR 42268).

Nassau groupers are found mainly in the shallow tropical and subtropical waters of eastern Florida (rare), the Florida Keys, Bermuda, the Yucatan Peninsula, and the Caribbean, including the U.S. Virgin Island and Puerto Rico (NOAA, nd). There has been one confirmed sighting of Nassau grouper from the Flower Garden Banks in the Gulf of Mexico at a water depth of 118 ft (36 m) (Foley et al., 2007). Three additional unconfirmed reports (i.e. lacking photographic evidence) of Nassau grouper have also been documented from mooring buoys and the coral cap region of the West Flower Garden flats (Foley et al., 2007).

There are no IPFs associated with routine project activities that could affect Nassau grouper. A small fuel spill would not affect Nassau grouper because the fuel would float and dissipate on the sea surface and would not be expected to reach the Flower Garden Banks or the Florida Keys. A large oil spill is the only relevant IPF.

Impacts of a Large Oil Spill

Based on the 30-day OSRA modeling results (**Table 3**), a large oil spill would be unlikely (<0.5% probability) to reach Nassau grouper habitat in the Florida Keys (Monroe County, Florida). A spill would be unlikely to contact the Flower Garden Banks based on the distance between the project area and the Flower Garden Banks (approximately 249 miles [401 km]), and the difference in water depth between the project area (3,622 to 3,833 ft [1,104 to 1,168 m]) and the Banks (approximately 17 to 145 m [56 to 476 ft]). While on the surface, oil would not be expected to contact subsurface fish. Natural or chemical dispersion of oil could cause a subsurface plume which would have the possibility of contacting Nassau groupers.

If a subsurface plume were to occur, impacts to Nassau groupers on the Flower Garden Banks would be unlikely due to the low density of Nassau grouper present on the Banks, the distance between the project area and the Flower Garden Banks (approximately 249 miles [401 km]), and the shallow location of the coral cap of the Banks. Near-bottom currents in the region are predicted to flow along the isobaths (Nowlin et al., 2001) and typically would not carry a plume up onto the continental shelf edge. Valentine et al. (2014) observed the spatial distribution of excess hopane, a crude oil tracer from the *Deepwater Horizon* incident sediment core samples, to be in the deeper waters and not transported up the shelf, thus confirming that near-bottom currents flow along the isobaths.

In the unlikely event that an oil slick should reach Nassau grouper habitat, oil droplets or oiled sediment particles could come into contact with Nassau grouper present on the reefs. Potential impacts include the direct ingestion of oil which could cover their gill filaments or gill rakers, ingestion of oiled prey, or the absorption of dissolved petroleum products through the gills.

In the event of a large oil spill, due to the distance between the project area and the Flower Garden Banks, it is unlikely that oil would impact Nassau grouper habitats. It is possible that a large oil spill could contact individual Nassau grouper fish, but due to the low density of individuals thought to occur in the Gulf of Mexico, there would not likely be any population-level effects.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

C.3.12 Smalltooth Sawfish (Endangered)

The smalltooth sawfish, named due to their flat, saw-like rostrum, is an elasmobranch ray which lives in shallow coastal tropical seas and estuaries where they feed on fish and invertebrates such as shrimp and crabs (NOAA Fisheries, nd). Once found along most of the northern Gulf of Mexico coast from Texas to Florida, their current range in Gulf of Mexico is restricted to areas primarily in southwest Florida (Brame et al., 2019) where several areas of critical habitat have been designated. A species description is presented in the recovery plan for this species (NMFS, 2009b).

Listed as Endangered under the ESA in 2003, population numbers have drastically declined over the past century primarily due to accidental bycatch (Seitz and Poulakis, 2006). Although there are no reliable estimates for smalltooth sawfish population numbers throughout its range (NMFS, 2018c), data from 1989 to 2004 indicated a slight increasing trend in population numbers in Everglades National Park during that time period (Carlson et al., 2007). More recent data resulted in a similar conclusion, with indications that populations were stable or slightly increasing in southwest Florida (Carlson and Osborne, 2012).

There are no IPFs associated with routine project activities that could affect smalltooth sawfish. A small fuel spill would not affect smalltooth sawfish because the fuel would float and dissipate on the sea surface and would not be expected to reach smalltooth sawfish habitat in coastal areas (see **Section A.9.1**). A large oil spill is the only relevant IPF.

Impacts of a Large Oil Spill

The project area is approximately 446 miles (718 km) from the nearest smalltooth sawfish critical habitat in Charlotte County, Florida. Based on the 30-day OSRA modeling (**Table 3**), coastal areas containing smalltooth sawfish critical habitat are unlikely to be affected within 30 days of a spill (<0.5% conditional probability).

Information regarding the direct effects of oil on elasmobranchs, including the smalltooth sawfish are largely unknown. A recent study by Cave and Kajiura (2018) reported that when exposed the crude oil, the Atlantic stingray experienced impaired olfactory function which could lead to decreased fitness. In the event of oil reaching smalltooth sawfish habitats, the smalltooth sawfish could be affected by direct ingestion, ingestion of oiled prey, or the absorption of dissolved petroleum products through the gills. Based on the shallow, coastal habitats preferred by smalltooth sawfish, individuals in areas subject to coastal oiling could be more likely to be impacted than other species that reside at depth.

C.3.13 Beach Mouse (Endangered)

Four subspecies of Endangered beach mouse occur on the barrier islands of Alabama and the Florida Panhandle: the Alabama (*Peromyscus polionotus ammobates*), Choctawhatchee (*Peromyscus polionotus allophrys*), Perdido Key (*Peromyscus polionotus trissyllepsis*), and St. Andrew beach mouse (*Peromyscus polionotus peninsularis*). Critical habitat has been designated for all four subspecies and is shown combined in Figure 2. One additional species of beach mouse in habiting dunes on the western Florida Panhandle, the Santa Rosa beach mouse (*Peromyscus polionotus leucocephalus*), is not listed under the ESA. Species descriptions are presented by (BOEM, 2017a).

A large oil spill is the only IPF that could potentially affect subspecies of beach mouse. There are no IPFs associated with routine project activities that could affect these animals due to the distance from shore and the lack of onshore support activities near their habitat.

Impacts of a Large Oil Spill

Potential spill impacts on endangered beach mouse subspecies are discussed by BOEM (2016b, 2017a). For this EP, there are no unique site-specific issues with respect to these species.

The project area is approximately 170 miles (274 km) from the nearest beach mouse critical habitat. The 30-day OSRA modeling (**Table 3**) predicts that a spill in the project area has 0.5% or less conditional probability of contacting any coastal areas containing beach mouse critical habitat within 30 days of a spill.

In the event of oil contacting these beaches, beach mice could experience several types of direct and indirect impacts. Contact with spilled oil could cause skin and eye irritation and subsequent infection; matting of fur; irritation of sweat glands, ear tissues, and throat tissues; disruption of sight and hearing; asphyxiation from inhalation of fumes; and toxicity from ingestion of oil and oiled food. Indirect impacts could include reduction of food supply, destruction of habitat, and fouling of nests. Impacts could also occur from vehicular traffic and other activities associated with spill cleanup (BOEM, 2017a).

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell’s well control and blowout prevention measures as detailed in EP Section 2j. In the event of oil from a large spill contacting beach mice habitat, it is expected that impacts resulting in the death of individual beach mice would be adverse and potentially significant at the population level. In the unlikely event of a spill, implementation of Shell’s OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

C.3.14 Florida Salt Marsh Vole (Endangered)

The Florida salt marsh vole (*Microtus pennsylvanicus dukecampbelli*) is a small, dark brown or black rodent found only in saltgrass (*Distichlis spicata*) meadows in the Big Bend region of Florida that was listed as Endangered under the ESA in 1991. Only two populations of Florida salt marsh vole are known to exist: one near Cedar Key in Levy County, Florida and one in the Lower Suwanee National Wildlife Refuge in Dixie County, Florida (Florida Fish and Wildlife Conservation Commission, nd). No critical habitat has been established for the Florida salt marsh vole in part due to concerns over illegal trapping or trespassing if the location of the populations were publicly disclosed (U.S. Fish and Wildlife Service, 2001b).

A large oil spill is the only IPF that potentially may affect the Florida salt marsh vole. There are no IPFs associated with routine project activities that could affect these animals due to the distance from the project area to their habitat and the lack of any onshore support activities near their habitat. A small fuel spill in the project area would not affect the Florida salt marsh vole because a small fuel spill would not be expected to reach their habitat prior to dissipating (see **Section A.9.1**).

Impacts of a Large Oil Spill

Florida salt marsh vole habitat in Levy and Dixie counties, Florida is approximately 388 miles (624 km) from the project area. The 30-day OSRA modeling (**Table 3**) predicts that a spill in the project area has

<0.5% or less conditional probability of contacting any coastal areas containing Florida salt marsh voles within 30 days.

In the event of oil contacting beaches containing these animals, Florida salt marsh voles could experience several types of direct and indirect impacts. Contact with spilled oil could cause skin and eye irritation and subsequent infection; matting of fur; irritation of sweat glands, ear tissues, and throat tissues; disruption of sight and hearing; asphyxiation from inhalation of fumes; and toxicity from ingestion of oil and contaminated food. Indirect impacts could include reduction of food supply, destruction of habitat, and fouling of nests. Impacts could also occur from vehicular traffic and other activities associated with spill cleanup. Impacts associated with an extensive oiling of coastal habitat containing Florida salt marsh voles from a large oil spill are expected to be significant. Due to the extremely low population numbers, extensive oiling of Florida salt marsh vole habitat could result in the extinction of the species.

However, any such impacts are unlikely due to the distance from the project area to Florida salt marsh vole habitat and response actions that would occur in the event of a spill.

C.3.15 Threatened Coral Species

Seven Threatened coral species are known from the northern Gulf of Mexico: elkhorn coral, staghorn coral, lobed star coral, mountainous star coral, boulder star coral, pillar coral, and rough cactus coral. Elkhorn coral, lobed star coral, mountainous star coral, and boulder star coral have been reported from the coral cap region of the Flower Garden Banks (NOAA, 2014), but are unlikely to be present as regular residents in the northern Gulf of Mexico because they typically inhabit coral reefs in shallow, clear tropical, or subtropical waters. Staghorn coral, pillar coral, and rough cactus coral are not known to inhabit reefs of the Flower Garden Banks, but are present on reefs in the Florida Keys and Dry Tortugas (Florida Fish and Wildlife Conservation Commission, 2018). Other Caribbean coral species evaluated by NMFS in 2014 (79 *FR* 53852) either do not meet the criteria for ESA listing or are not known from the Flower Garden Banks, Florida Keys, or Dry Tortugas. Critical habitat has been designated for elkhorn coral and staghorn coral in the Florida Keys (Monroe County, Florida) and Dry Tortugas, but none has been designated for the other Threatened coral species included here.

There are no IPFs associated with routine project activities that could affect Threatened corals in the northern Gulf of Mexico. A small fuel spill would not affect Threatened coral species because the oil would float and dissipate on the sea surface. A large oil spill is the only relevant IPF (potential impacts listed in Table 2) and is discussed below.

Impacts of a Large Oil Spill

A large oil spill would be unlikely to reach coral reefs at the Flower Garden Banks or elkhorn coral critical habitat in the Florida Keys (Monroe County, Florida) or Dry Tortugas. The 30-day OSRA modeling (**Table 3**) predicts the conditional probability of oil contacting the Florida Keys is <0.5% within 30 days of a spill. A surface slick would not contact corals on the seafloor. If a subsurface plume were to occur, impacts on the Flower Garden Banks would be unlikely due to the distance and the difference in water depth.

Near-bottom currents in the region are predicted to flow along the isobaths (Nowlin et al., 2001) and typically would not carry a plume up onto the continental shelf edge. Valentine et al. (2014) observed the spatial distribution of excess hopane, a crude oil tracer from *Deepwater Horizon* incident sediment core samples, to be in the deeper waters and not transported up the shelf, thus confirming near-bottom currents flow along the isobaths.

In the unlikely event that an oil slick reached reefs at the Flower Garden Banks or other Gulf of Mexico reefs, oil droplets or oiled sediment particles could come into contact with reef organisms or corals. As discussed by BOEM (2017a) impacts could include loss of habitat, biodiversity, and live coral coverage; destruction of hard substrate; change in sediment characteristics; and reduction or loss of one or more commercial and recreational fishery habitats. Sublethal effects could be long-lasting and affect the resilience of coral colonies to natural disturbances (e.g., elevated water temperature and diseases) (BOEM, 2017a).

Due to the distance between the project area and coral habitats, there is a low chance of oil contacting threatened coral habitat in the event of a spill and no significant impacts on threatened coral species are expected.

C.4 Coastal and Marine Birds

C.4.1 Marine Birds

Marine birds include seabirds and other species that may occur in the pelagic environment of the project area (Clapp et al., 1982a,b, Clapp et al., 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 on islands and along the coast. Other waterbirds, such as waterfowl, marsh birds, and shorebirds may occasionally be present over open ocean areas. No Endangered or Threatened bird species are likely to occur at the project area. For a discussion of coastal birds, see **Section C.4.2**.

Seabirds of the northern Gulf of Mexico were surveyed from ships during the GulfCet II program (Davis et al., 2000). Davis et al. (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 (shearwaters, storm-petrels, boobies); summer residents that breed along the Gulf coast (Sooty Tern, Least Tern, Sandwich Tern, Magnificent Frigatebird); winter residents (gannets, gulls, jaegers); and permanent resident species (Laughing Gulls, Royal Terns, Bridled Terns) (Davis et al., 2000). The GulfCet II study did not estimate bird densities; however, seabird densities over the open ocean have been estimated to be 1.6 birds km^{-2} (Haney et al., 2014).

The distributions and relative densities of seabirds within the deepwater areas of the Gulf of Mexico, including the project area, vary temporally (i.e., seasonally) and spatially. In GulfCet II studies (Davis et al., 2000), species diversity and density varied by hydrographic environment and by the presence and relative location of mesoscale features such as Loop Current eddies that may enhance nutrient levels and productivity of surface waters where these seabird species forage (Davis et al., 2000).

Trans-Gulf migrant birds including shorebirds, wading birds, and terrestrial birds may also be present in the project area. Migrant birds may use offshore structures, including platforms and semisubmersibles for resting, feeding, or as temporary shelter from inclement weather (Ronconi et al., 2015). Some birds may be attracted to offshore structures because of the lights and the fish populations that aggregate around these structures.

IPFs that could potentially affect marine birds include MODU presence, noise, and lights; support vessel and helicopter traffic; and two types of accidents (a small fuel spill and a large oil spill). Effluent discharges permitted under the NPDES general permit 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 BSEE NTL 2015-G013 (See **Table 1**) will minimize the potential for marine debris-related impacts on birds.

Impacts of Mobile Offshore Drilling Unit Presence, Noise, and Lights

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 to avoid it. In other cases, navigation may be disrupted by noise or lighting (Russell, 2005, Ronconi et al., 2015). However, offshore structures may in some cases serve as suitable stopover habitats for trans-Gulf migrant species, particularly in the spring (Russell, 2005, Ronconi et al., 2015).

Overall, potential negative impacts to birds from MODU lighting, potential collisions, or other adverse effects are highly localized, temporary in nature, and may be expected to affect only small numbers of birds during migration periods. Therefore, these potential impacts are not expected to affect birds at the population or species level and are not significant (BOEM, 2012a).

Impacts of Support Vessel and Helicopter Traffic

Support vessels and helicopters are unlikely to substantially disturb marine birds in open, offshore waters. Schwemmer et al. (2011) showed that several sea birds showed behavioral responses and altered distribution patterns in response to ship traffic, which could potentially cause loss of foraging time and resting habitat. However, it is likely that individual birds would experience, at most, only short-term behavioral disruption resulting from support vessel and helicopter traffic, and the impact would not be significant.

Impacts of a Small Fuel Spill

Potential spill impacts on marine birds are discussed by BOEM (2016b, 2017a). For this EP, there are no unique site-specific issues with respect to spill impacts on marine birds.

The probability of a fuel spill will be minimized by Shell's preventative measures implemented during routine operations, including fuel transfer. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the potential for impacts on marine birds. EP Section 9b provides detail on spill response measures. Given the open ocean location of the project area and the short duration of a small spill, the potential exposure for pelagic marine birds would be brief.

A small fuel spill in offshore waters would produce a thin slick on the water surface and introduce 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.9.1** discusses the likely fate of a small fuel spill and indicates that more than 90% would evaporate or disperse naturally within 24 hours. The area of diesel fuel on the sea surface would range from 1.2 to 12 ac (0.5 to 5 ha), 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 VOCs. Because of the limited areal extent and short duration of water quality impacts from a small fuel spill, secondary impacts due to ingestion of oil 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 marine birds are expected.

Impacts of a Large Oil Spill

Potential spill impacts on marine birds are discussed by BOEM (2016b, 2017a). For this EP, there are no unique site-specific issues with respect to spill impacts on marine birds.

Pelagic seabirds could be exposed to oil from a spill at the project area. Hess and Ribic (2000) reported that terns, storm-petrels, shearwaters, and jaegers were the most frequently sighted seabirds in the deepwater Gulf of Mexico (>200 m). Haney et al. (2014) estimated that seabird densities over the open ocean are approximately 1.6 birds km^{-2}. The number of marine birds that could be affected in open, offshore waters would depend on the extent and persistence of the oil slick.

Data following the *Deepwater Horizon* incident provide relevant information about the species of marine birds that may be affected in the event of a large oil spill. Birds that have been treated for oiling include several pelagic species such as the Northern Gannet, Magnificent Frigatebird, and Masked Booby (USFWS, 2011). The Northern Gannet was among the species with the largest numbers of individuals affected by the spill. NOAA reported that at least 93 resident and migratory bird species across all five Gulf Coast states were exposed to oil from the *Deepwater Horizon* incident in multiple habitats, including offshore/open waters, island waterbird colonies, barrier islands, beaches, bays, and marshes (NOAA, 2016b). Exposure of marine birds to oil can result in adverse health with severity, depending on the level of oiling. Effects can range from plumage damage and loss of buoyancy for external oiling to more severe effects such as organ damage, immune suppression, endocrine imbalance, reduced aerobic capacity and death as a result of oil inhalation or ingestion (NOAA, 2016b).

However, a blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. It is expected that impacts to marine birds from a large oil spill resulting in the death of individual birds would be adverse but likely not significant at population levels. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

C.4.2 Coastal Birds

Threatened and Endangered bird species present in the Gulf of Mexico (Piping Plover and Whooping Crane) are discussed in **Section C.3**. Various species of non-endangered birds are also found along the northern Gulf Coast, including diving birds, shorebirds, marsh birds, wading birds, and waterfowl. Gulf Coast marshes and beaches also provide important feeding grounds and nesting habitats. Species that nest on beaches, flats, dunes, bars, barrier islands, and similar coastal and nearshore habitats include the Sandwich Tern, Wilson's Plover, Black Skimmer, Forster's Tern, Gull-Billed Tern, Laughing Gull, Least Tern, and Royal Tern (USFWS, 2010). Additional information is presented by BOEM (2012a, 2017a).

The Brown Pelican was delisted from federal Endangered status in 2009 (USFWS, 2016) and was delisted from state species of special concern status by the State of Florida in 2017 (Florida Fish and Wildlife Conservation Commission, 2016). However, this species remains listed as endangered by both Louisiana and Mississippi (Mississippi Natural Heritage Program, 2018). 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 (Davis et al., 2000) indicate that Brown Pelicans do not occur over deep offshore waters (Fritts and Reynolds, 1981, Peake, 1996). Nearly half the southeastern population of Brown Pelicans lives in the northern Gulf Coast, generally nesting on protected islands (USFWS, 2010).

The Bald Eagle was delisted from its federal Threatened status in 2007. However, this species is listed as endangered in Louisiana (Louisiana Department of Wildlife and Fisheries, 2017) and Mississippi (Mississippi Natural Heritage Program, 2018). The bald eagle is also listed as threatened in Texas (Texas Parks and Wildlife Department, 2017). The Bald Eagle still receives protection under the Migratory Bird Treaty Act of 1918 and the Bald and Golden Eagle Protection Act of 1940 (USFWS, 2015b). 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 (Buehler, 2000).

IPFs that could potentially affect coastal birds include support vessel and helicopter traffic and a large oil spill. As explained in **Section A.9.1**, a small fuel spill would not be expected to make landfall or reach coastal waters prior to breaking up. Compliance with NTL BSEE 2015-G013 will minimize the potential for marine debris-related impacts on shorebirds.

Impacts of Support Vessel and Helicopter Traffic

Support vessels and helicopters will transit coastal areas where coastal 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. Flushing distances vary among species and individuals (Rodgers and Schwikert, 2002, Schwemmer et al., 2011). The disturbances will be limited to flushing birds away from vessel pathways; known distances are from 65 to 160 ft (20 to 49 m) for personal watercraft and 75 to 190 ft (23 to 58 m) for outboard-powered boats (Rodgers and Schwikert, 2002). Flushing distances may be similar or less for the support vessels to be used for this project, and some species such as gulls are attracted to boats. Support vessels will not approach nesting or breeding areas on the shoreline, so nesting birds, eggs, and chicks will not be disturbed. Vessel operators will use designated navigation channels and comply with posted speed and wake restrictions while transiting sensitive inland waterways. Due to the limited scope, duration, and geographic extent of drilling activities, any short-term impacts are not expected to be significant to coastal bird populations.

Helicopter traffic can cause some disturbance to birds on shore and off shore. Responses highly depend on the type of aircraft, bird species, activities that animals were previously engaged in, and previous exposures to overflights (Efroymson et al., 2000). Helicopters seem to cause the most intense responses over 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 2,000 ft (610 m) 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 in Efroymson et al. (2000). With these guidelines in effect, it is likely that individual birds would experience, at most, only short-term behavioral disruption. The potential impacts are not expected to be significant to bird populations or species in the project area.

Impacts of Large Oil Spill

Coastal birds can be exposed to oil as they float on the water surface, dive during foraging, or wade in oiled coastal waters. The Brown Pelican and Bald Eagle could be impacted by the ingestion of contaminated fish or birds (BOEM, 2012a, 2016b). In the event of a large oil spill reaching coastal habitats, cleanup personnel and equipment could create short-term disturbances to coastal birds. Indirect effects could occur from restoration efforts, resulting in habitat loss, alteration, or fragmentation (BOEM, 2017a). Based on the 30-day OSRA results summarized in **Table 3,** shorelines in Plaquemines Parish could be contacted within 10 days of a spill (4% conditional probability). Terrebonne and Lafourche parishes in Louisiana could also be contacted within 10 days (1% to 2% conditional probabilities). Other Texas, Louisiana, and Florida shorelines could be affected within 30 days (1% to 8% conditional probability).

Studies concerning the *Deepwater Horizon* incident provide additional information regarding impacts on coastal birds that may be affected in the event that a large oil spill reaches coastal habitats. According to NOAA (2016b), an estimated 51,600 to 84,500 birds were killed by the spill, and the reproductive output lost as a result of breeding adult bird mortality was estimated to range from 4,600 to 17,900 fledglings that would have been produced in the absence of premature deaths of adult birds (NOAA, 2016b). Species with the largest numbers of estimated mortalities were American White Pelican, Black Skimmer, Black Tern, Brown Pelican, Laughing Gull, Least Tern, Northern Gannet, and Royal Tern (NOAA, 2016b). A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. However, if oil from a large spill reaches coastal bird habitats, significant injuries or mortalities to coastal birds are possible and could be significant at the population level. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

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, Richards et al., 1993). A study by Ross et al. (2012) on midwater fauna to characterize vertical distribution of mesopelagic fishes in selected deepwater areas in the Gulf of Mexico substantiated high species richness, but the community was dominated by relatively few families and species.

IPFs that could potentially affect pelagic communities and ichthyoplankton include MODU presence, noise, and lights; effluent discharges; water intakes; and two types of accidents (a small fuel spill and a large oil spill).

Impacts of Mobile Offshore Drilling Unit Presence, Noise, and Lights

The MODU, as a floating structure in the deepwater environment, will act as a fish-aggregating device (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, 1990, Higashi, 1994, Relini et al., 1994). Positive fish associations with offshore rigs and platforms in the Gulf of Mexico are well documented (Gallaway and Lewbel, 1982, Wilson et al., 2003, Wilson et al., 2006). The FAD effect could possibly enhance the feeding of epipelagic predators by attracting and concentrating smaller fish species. MODU noise could potentially cause acoustic masking in fishes, thereby reducing their ability to hear biologically relevant sounds (Radford et al., 2014). The only defined acoustic threshold levels for continuous noise are given by Popper et al. (2014)

and apply only to species of fish with swim bladders that provide some hearing (pressure detection) function. Popper et al. (2014) estimated threshold root-mean-square sound pressure levels of 170 dB re 1 µPa accumulated over a 48-hour period for onset of recoverable injury and 158 dB re 1 µPa accumulated over a 12-hour period for onset temporary auditory threshold shifts. However, no consistent behavioral thresholds for fish have been established (Popper et al., 2014). Noise may also influence fish behaviors, such as predator-avoidance, foraging, reproduction, and intraspecific interactions (Picciulin et al., 2010, Bruintjes and Radford, 2013, McLaughlin and Kunc, 2015). Because the MODU is a single, temporary structure, impacts on fish populations, whether beneficial or adverse, are not expected to be significant.

Few data exist regarding the impacts of noise on pelagic larvae and eggs. Generally, it is believed that larval fish will have similar hearing sensitivities as adults, but may be more susceptible to barotrauma injuries associated with impulsive noise (Popper et al., 2014). Larval fish were experimentally exposed to simulated impulsive sounds by Bolle et al. (2012). The controlled playbacks produced sound exposure levels of 206 dB re 1 μPa^2 s but resulted in no increased mortality between the exposure and control groups. Non-impulsive noise sources (such as MODU operations) are expected to be far less injurious than impulsive noise. Based on transmission loss calculations (Urick, 1983), open water propagation of noise produced by typical sources with DP thrusters in use during drilling, are not expected to produce received root-mean-square sound pressure levels greater than 160 dB re 1 µPa beyond 105 ft (32 m) from the source. Because of the limited propagation distances of high sound pressure levels and the periodic and transient nature of ichthyoplankton, no impacts to these life stages are expected.

Impacts of Effluent Discharges

Discharges of treated WBM- and SBM-associated cuttings will produce temporary, localized increases in suspended solids in the water column around the MODU. In general, turbid water can be expected to extend between a few hundred meters and several kilometers down current from the discharge point (National Research Council, 1983, Neff, 1987). NPDES permit limits and requirements will be met.

WBM and cuttings will be released at the seafloor during the initial well intervals before the marine riser is set, that allows their return to the surface vessel. Excess cement slurry and blowout preventer fluid will also be released at the seafloor. These discharges could smother or cover benthic communities in the vicinity of the discharge location. Impacts will be limited to the immediate area of the discharge, with little or no impact to fisheries resources.

Treated sanitary and domestic wastes may have little or no effect 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 dilute rapidly to undetectable levels within tens to hundreds of meters from the source. As a result of quick dilution, minimal impacts on water quality, plankton, and nekton are anticipated.

Deck drainage will have little or no impact on the pelagic environment in the immediate vicinity of these discharges. Deck drainage from oily 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 dilute rapidly to undetectable levels within tens to hundreds of meters from the source. Minimal impacts on water quality, plankton, and nekton are anticipated.

Other effluent discharges from the MODU and support vessels are expected to include desalination unit discharge, non-contaminated well treatment and completion fluids, blowout preventer fluid, ballast water, bilge water, cement slurry, fire water, hydrate inhibitor, and non-contact cooling water. The MODU and support vessel discharges are expected to be in compliance with NPDES permit and USCG regulations, as applicable, and are not expected to cause significant impacts on water quality (BOEM, 2012a).

Impacts of Water Intakes

Seawater will be drawn from several meters below the ocean surface for various services, including firewater and once-through non-contact cooling of machinery on the MODU (EP Table 7a). Section 316(b) of the Clean Water Act requires NPDES permits to ensure that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available to minimize adverse environmental impact from impingement and entrainment of aquatic organisms. The current general NPDES Permit No. GMG290103 specifies requirements for new facilities for which construction commenced after 17 July 2006, with a cooling water intake structure having a design intake capacity of greater than two million gallons of water per day, of which at least 25% is used for cooling purposes.

The MODU selected for this project meets the described applicability for new facilities, and the vessel's water intakes are expected to be in compliance with the design, monitoring, and recordkeeping requirements of the NPDES permit.

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 except for 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). Because of the limited scope and short duration of drilling activities, any short-term impacts of entrainment are not expected to be biologically significant to plankton or ichthyoplankton populations (BOEM, 2017a).

Impacts of a Small Fuel Spill

Potential spill impacts on fisheries resources are discussed by BOEM (2016b, 2017a). For this EP, there are no unique site-specific issues with respect to spill impacts.

The probability of a fuel spill will be minimized by Shell's preventative measures during routine operations, including fuel transfer. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the potential for impacts on pelagic communities, including ichthyoplankton. EP Section 9b provides detail on spill response measures. Given the open ocean location of the project area, the duration of a small spill and opportunity for impacts to occur would be very brief.

A small fuel spill in offshore waters would produce a thin slick on the water surface and introduce 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.9.1** discusses the likely fate of a small fuel spill and indicates that more than 90% would evaporate or disperse naturally within 24 hours. The area of diesel fuel on the sea surface would range from 1.2 to 12 ac (0.5 to 5 ha), depending on sea state and weather conditions.

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

Impacts of a Large Oil Spill

Potential spill impacts on pelagic communities and ichthyoplankton are discussed by BOEM (2016b, 2017a). For this EP, there are no unique site-specific issues.

A large oil spill could directly affect water column biota including phytoplankton, zooplankton, ichthyoplankton, and nekton. A large spill that persisted for weeks or months would be more likely to affect these communities. While adult and juvenile fishes may actively avoid a large spill, planktonic eggs and larvae would be unable to avoid contact. Eggs and larvae of fishes in the upper layers of the water column are especially vulnerable to oiling; certain toxic fractions of spilled oil may be lethal to these life stages. Impacts would be potentially greater if local scale currents retained planktonic larval assemblages (and the floating oil slick) within the same water mass. Impacts to ichthyoplankton from a large spill would be greatest during spring and summer when concentrations of ichthyoplankton on the continental shelf peak (BOEM, 2014, 2015, 2016b).

Oil spill impacts to phytoplankton include changes in community structure and increases in biomass, which have been attributed to the effects of oil contamination and of decreased predation due to zooplankton mortality (Abbriano et al., 2011, Ozhan et al., 2014). Ozhan et al. (2014) reported that the formation of oil films on the water surface can limit gas exchange through the air-sea interface and can reduce light penetration into the water column which will limit phytoplankton photosynthesis. Determining the impact of a diesel spill on phytoplankton is a complex issue as some phytoplankton species are more tolerant of oil exposure than others while some species are more tolerant under low concentrations and some under high concentrations (Ozhan et al., 2014). Phytoplankton populations can change quickly on small temporal and spatial scales making it difficult to predict how a phytoplankton community as a whole will respond to an oil spill.

Mortality of zooplankton has been shown to be positively correlated with oil concentrations (Lennuk et al., 2015). Spills that are not immediately lethal can have short- or long-term impacts on biomass and community composition, behavior, reproduction, feeding, growth and development, immune response and respiration (Harvell et al., 1999, Wootton et al., 2003, Auffret et al., 2004, Hannam et al., 2010, Bellas et al., 2013, Blackburn et al., 2014). Zooplankton are especially vulnerable to acute oil pollution, showing increased mortality and sublethal changes in physiological activities (e.g., egg production; Moore and Dwyer, 1974, Linden, 1976, Lee et al., 1978, Suchanek, 1993). Zooplankton may also accumulate PAHs through diffusion from surrounding waters, direct ingestion of micro-droplets (e.g., Berrojalbiz et al., 2009, Lee et al., 2012, Lee, 2013), and by ingestion of droplets that are attached to phytoplankton (Almeda et al., 2013). Bioaccumulation of hydrocarbons can lead to additional impacts among those higher trophic level consumers that rely on zooplankton as a food source (Almeda et al., 2013, Blackburn et al., 2014).

Planktonic communities have a high capacity for recovery from the effects of oil spill pollution due to their short life cycle and high reproductive capacity (Abbriano et al., 2011). Planktonic communities drift with water currents and recolonize from adjacent areas. Because of these attributes, plankton usually recover relatively rapidly to normal population levels following hydrocarbon spill events. Research in the aftermath of the *Deepwater Horizon* incident found that phytoplankton population recovered within weeks to months and zooplankton populations may have only been minimally affected (Abbriano et al., 2011).

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell’s well control and blowout prevention measures as detailed in EP Section 2j. It is expected that impacts to pelagic communities and ichthyoplankton from a large oil spill would be adverse but not significant at population levels. In the unlikely event of a spill, implementation of Shell’s OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

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, 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 600 ft (183 m). 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 located approximately 38 miles (61 km) from the project area.

EFH has been identified in the deepwater Gulf of Mexico for highly migratory pelagic fishes, which occur as transients in the project area. Species in this group, including tunas, swordfishes, billfishes, and sharks, are managed by NMFS. Highly migratory species with EFH within or near the project area include the following (NMFS, 2009c):

- Bigeye thresher shark (all)
- Blue marlin (juveniles, adults)
- Bluefin tuna (spawning, eggs, larvae)
- Longbill spearfish (juveniles, adults)
- Longfin mako shark (all)
- Oceanic whitetip shark (all)
- Skipjack tuna (spawning)
- Swordfish (larvae, juveniles, adults)
- Whale shark (all)
- White marlin (juveniles)
- Yellowfin tuna (spawning, juveniles, adults)

Research indicates the central and western Gulf of Mexico may be important spawning habitat for Atlantic bluefin tuna (*Thunnus thynnus*) (Theo and Block, 2010), and NMFS (2009c) has designated a Habitat Area of Particular Concern (HAPC) for this species. The HAPC covers much of the deepwater Gulf of Mexico, including the project area (**Figure 2**). The areal extent of the HAPC is approximately 115,830 miles^2 (300,000 km^2). The prevailing assumption is that Atlantic bluefin tuna follow an annual cycle of foraging in June through March off the eastern U.S. and Canadian coasts, followed by migration to the Gulf of Mexico to spawn in April, May, and June (NMFS, 2009c). The Atlantic bluefin tuna has also been designated as a species of concern (NMFS, 2011).

NTLs 2009-G39 and 2009-G40 provide guidance and clarification of regulations for biologically sensitive underwater features and areas and benthic communities that are considered EFH. As part of an agreement between BOEM and NMFS to complete a new programmatic EFH consultation for each new Five-Year Program, an EFH consultation was initiated between BOEM's Gulf of Mexico Region and NOAA's Southeastern Region during the preparation, distribution, and review of BOEM's 2017-2022 WPA/CPA Multisale EIS (BOEM, 2017a). The EFH assessment was completed and there is ongoing coordination among NMFS, BOEM, and BSEE, including discussions of mitigation (BOEM, 2016c).

Other HAPCs have been designated in the Gulf of Mexico Fishery Management Council (2005, 2010). These include the Florida Middle Grounds, Madison-Swanson Marine Reserve, Tortugas North and South Ecological Reserves, Pulley Ridge, and several other reefs and banks of the northwestern Gulf of Mexico (**Figure 2**). The nearest HAPC is Jakkula Bank, which is located approximately 127 miles (204 km) from the project area.

Routine IPFs that could potentially affect EFH and fisheries resources include MODU presence, noise, and lights; effluent discharges; and water intakes. In addition, two types of accidents (a small fuel spill and a large oil spill) may potentially affect EFH and fisheries resources.

Impacts of Mobile Offshore Drilling Unit Presence, Noise, and Lights

The MODU, as a floating structure in the deepwater environment, will act as a 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, 1990, Higashi, 1994, Relini et al., 1994). The FAD effect would possibly enhance feeding of epipelagic predators by attracting and concentrating smaller fish species.

MODU noise could potentially cause acoustic masking for fishes, thereby reducing their ability to hear biologically relevant sounds (Radford et al., 2014). Noise may also influence fish behaviors such as predator avoidance, foraging, reproduction, and intraspecific interactions (Picciulin et al., 2010, Bruintjes and Radford, 2013, McLaughlin and Kunc, 2015, Nedelec et al., 2017). Further discussion on impact to fish from sound and injury criteria are discussed in **Section C.5.1**. Any impacts on EFH for highly migratory pelagic fishes are not expected to be significant.

Impacts of Effluent Discharges

Effluent discharges affecting EFH by diminishing ambient water quality include drilling muds and cuttings, treated sanitary and domestic wastes, deck drainage, and miscellaneous discharges such as desalination unit discharge, blowout preventer fluid, non-contaminated well treatment and completion fluids, ballast water, bilge water, cement slurry, fire water, hydrate inhibitor, and cooling water. Impacts on EFH from effluent discharges are anticipated to be similar to those described in **Section C.5.1** for pelagic communities. 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). Due to the limited scope, timing, and geographic extent of drilling activities, any short-term impacts on EFH for highly migratory pelagic fishes are not expected to be biologically significant.

Impacts of a Small Fuel Spill

Potential spill impacts on EFH are discussed by BOEM (2016b, 2017a). For this EP, there are no unique site-specific issues with respect to spill impacts.

The probability of a fuel spill will be minimized by Shell's preventative measures during routine operations, including fuel transfer. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the potential for impacts on EFH. EP Section 9b provides detail on spill response measures. Given the open ocean location of the project area, the duration of a small spill and opportunity for impacts to occur would be very brief.

A small fuel spill in offshore waters would produce a thin slick on the water surface and introduce 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.9.1** discusses the likely fate of a small fuel spill and indicates that more than 90% would evaporate or disperse naturally within 24 hours. The area of diesel fuel on the sea surface would range from 1.2 to 12 ac (0.5 to 5 ha), depending on sea state and weather conditions.

A small 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 project area. A spill would also produce short-term impact on surface and near-surface water quality in the HAPC for spawning Atlantic bluefin tuna, which covers much of the deepwater Gulf of Mexico. The affected area would represent a negligible portion of the HAPC, which covers approximately 115,830 miles^2 (300,000 km^2) of the Gulf of Mexico. Therefore, no significant spill impacts on EFH for highly migratory pelagic fishes are expected.

A small fuel spill would not affect EFH for corals or coral reefs; the nearest of which is located approximately 38 miles (61 km) from the project area. A small fuel spill would float and dissipate on the sea surface and would not contact these seafloor features. Therefore, no significant spill impacts on EFH for corals and coral reefs are expected.

Impacts of a Large Oil Spill

Potential spill impacts on EFH are discussed by BOEM (2016b, 2017a). For this EP, there are no unique site-specific issues with respect to EFH.

An oil spill in offshore waters would temporarily increase hydrocarbon concentrations on the water surface and potentially the subsurface as well. Given the extent of EFH designations in the Gulf of Mexico (GMFMC, 2005, NMFS, 2009c), some impact on EFH would be unavoidable.

A large spill could affect the EFH for many managed species, including shrimps, spiny lobster, reef fishes, coastal migratory pelagic fishes, and red drum. It would result in adverse impacts on water quality and water column biota including phytoplankton, zooplankton, ichthyoplankton, and nekton. In coastal waters, sediments could be oiled and result in persistent degradation of the seafloor habitat for managed demersal fish and shellfish species.

The project area is within the HAPC for spawning bluefin tuna (NMFS, 2009c). A large spill could temporarily degrade the HAPC due to increased hydrocarbon concentrations in the water column, with the potential for lethal or sublethal impacts on spawning tuna. Potential impacts would depend in part on the timing of a spill, as this species migrates to the Gulf of Mexico to spawn in April, May, and June (NMFS, 2009c).

The nearest feature designated as EFH for corals is located 38 miles (61 km) from the project area. An accidental spill could reach or affect this feature, although near-bottom currents in the region are expected to flow along the isobaths (Nowlin et al., 2001, Valentine et al., 2014) and typically would not carry a plume up onto the continental shelf edge.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the event of oil from a large spill contacting EFH for managed species, it is expected that impacts could be significant but would likely be temporary and short-term. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

C.6 Archaeological Resources

C.6.1 Shipwreck Sites

In BOEM (2012a), information was presented that altered the impact conclusion for archaeological resources which came to light as a result of BOEM-sponsored studies and industry surveys. 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 project areas >656 ft (200 m) water depth that have been exempted from high-resolution surveys. Since significant historic shipwrecks have recently been discovered outside the previously designated high-probability areas (some of which show evidence of impacts from permitted activities prior to their discovery), a survey is now required for exploration and development projects.

Based on NTL 2011-JOINT-G01, the project area is on BOEM's list of archaeological survey blocks determined to have a high potential for containing archaeological properties (BOEM, 2011). The shallow hazard assessment identified no sonar contacts within 2,000 ft (610 m) of proposed wellsites considered to have archaeological potential. No archaeological impacts are expected from routine activities in the project area.

Because no historic shipwreck sites are present in the project area (see EP Section 6), there are no routine IPFs that are likely to affect these resources. A small fuel spill would not affect shipwrecks in adjoining blocks because the oil would float and dissipate on the sea surface. The only IPF considered would be the impact from a large oil spill that could contact shipwrecks in other blocks.

Impacts of a Large Oil Spill

BOEM (2012a) estimated that a severe subsurface blowout could resuspend and disperse sediments within a 984 ft (300 m) radius. Because there are no historic shipwrecks in the project area, this impact would not be relevant.

Beyond the seafloor blowout radius, there is the potential for impacts from oil, dispersants, and depleted oxygen levels (BOEM, 2017a). These impacts could include chemical contamination, alteration of the rates of microbial activity (BOEM, 2017a), and reduced biodiversity as shipwreck-associated sediment microbiomes (Hamdan et al., 2018). During the *Deepwater Horizon* incident, subsurface plumes were reported at a water depth of approximately 3,600 ft (1,100 m), extending at least 22 miles (35 km) from the wellsite and persisting for more than a month (Camilli et al., 2010). The subsurface plumes apparently resulted from the use of dispersants at the wellhead (NOAA, 2011b). While the behavior and impacts of subsurface plumes are not well known, a subsurface plume could contact shipwreck sites beyond the 984-foot (300-meter) radius estimated by BOEM (2012a), depending on its extent, trajectory, and persistence (Spier et al., 2013). If oil from a subsea spill should contact wooden shipwrecks on the seafloor, it could adversely affect their condition or preservation.

A spill entering shallow coastal waters could conceivably contaminate undiscovered or known historic shipwreck sites. Based on the 30-day OSRA modeling (**Table 3**), coastal areas in Plaquemines Parish could be affected within 10 days of a spill (4% conditional probability). Terrebonne and Lafourche parishes may also be affected within 10 days of a spill (up to 2% conditional probability). Coastal areas between Galveston County, Texas, and Okaloosa County, Florida, may be affected within 30 days (1% to 8% conditional probability). If an oil spill contacted a coastal historic site, such as a fort or a lighthouse, the impacts may be temporary and reversible (BOEM, 2017a). Undiscovered shipwreck sites on or nearshore could also be impacted by foot or vehicle traffic during response and clean-up efforts in the aftermath of a spill.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

C.6.2 Prehistoric Archaeological Sites

With water depth estimates ranging from 3,622 to 3,833 ft (1,104 to 1,168 m), the project area is well beyond the 197 ft (60 m) depth contour used by BOEM as the seaward extent for prehistoric archaeological site potential in the Gulf of Mexico. Because prehistoric archaeological sites are not found in the project area, the only relevant IPF is a large oil spill that would reach coastal waters within the 197 ft (60 m) depth contour.

Impacts of a Large Oil Spill

Because of the water depth and the lack of prehistoric archaeological sites found in the project area, it is highly unlikely that any such resources would be affected by the physical effects of a subsea blowout. BOEM (2012a) estimates that a severe subsurface blowout could resuspend and disperse sediments within a 984 ft (300 m) radius.

Along the northern Gulf Coast, prehistoric sites occur frequently along the barrier islands and mainland coast and along the margins of bays and bayous (BOEM, 2012a). Based on the 30-day OSRA modeling (**Table 3**), coastal areas in Plaquemines Parish could be affected within 10 days of a spill (4% conditional probability). Terrebonne and Lafourche parishes may also be affected within 10 days of a spill (up to 2% conditional probability). Coastal areas between Galveston County, Texas, and Okaloosa County, Florida, may be affected within 30 days (1% to 8% conditional probability). A spill reaching a prehistoric site along these shorelines could coat fragile artifacts or site features and compromise the potential for radiocarbon dating organic materials in a site (although other dating methods are available, and it is possible to decontaminate an oiled sample for radiocarbon dating). Coastal prehistoric sites could also be damaged by spill cleanup operations (e.g., by destroying fragile artifacts and disturbing the provenance of artifacts or site features). BOEM (2017a) notes that some unavoidable direct and indirect impacts on coastal historic resources could occur, resulting in the loss of information.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

C.7 Coastal Habitats and Protected Areas

Coastal habitats in the northern Gulf of Mexico that may be affected by oil and gas activities are described in previous EISs (BOEM, 2012a, 2013, 2014, 2015, 2016b, 2017a) and are tabulated in the OSRP. Coastal habitats inshore of the project area include coastal and barrier island beaches and dunes, wetlands, oyster reefs, and submerged seagrass beds. Most of the northern Gulf of Mexico is fringed by coastal and barrier island beaches, with wetlands, oyster reefs, and submerged seagrass beds occurring in sheltered areas behind the barrier islands and in estuaries.

Because of the distance from shore, the only IPF associated with routine activities in the project area that could affect beaches and dunes, wetlands, oyster reefs, seagrass beds, coastal wildlife refuges, wilderness areas, or any other managed or protected coastal area is support vessel traffic. The support bases at Port Fourchon, Boothville, and Houma, Louisiana are not located in wildlife refuges or wilderness areas. Potential impacts of support vessel traffic are briefly addressed below.

A large oil spill is the only accidental IPF that could affect coastal habitats and protected areas. A small fuel spill in the project area would be unlikely to affect coastal habitats because the project area is 53 miles (85 km) from the nearest shoreline (Louisiana). As explained in **Section A.9.1**, a small fuel spill would not be expected to make landfall or reach coastal waters prior to natural dispersion.

Impacts of Support Vessel Traffic

Support operations, including the crew boats and supply boats as detailed in EP Section 14, may have a minor incremental impact on coastal and barrier island beaches, wetlands, oyster reefs, and protected habitats. Over time with a large number of vessel trips, vessel wakes can erode shorelines along inlets, channels, and harbors, resulting in localized land loss. Impacts will be minimized by following the speed and wake restrictions in harbors and channels.

Support operations, including crew boats and supply boats are not anticipated to have a significant impact on submerged seagrass beds. While submerged seagrass beds have the potential to be uprooted, scarred, or lost due to direct contact from vessels, use of navigation channels and adherence to local requirements and implemented programs will decrease the likelihood of impacts to submerged seagrass beds BOEM (2017a, 2017c)

Impacts of a Large Oil Spill

Potential spill impacts on coastal habitats are discussed by BOEM (2016b, 2017a). Coastal habitats inshore of the project area include coastal and barrier island beaches, wetlands, oyster reefs, and submerged seagrass beds. For this EP, there are no unique site-specific issues with respect to coastal habitats.

Based on the 30-day OSRA modeling (**Table 3**), coastal areas in Plaquemines Parish could be affected within 10 days of a spill (4% conditional probability). Terrebonne and Lafourche parishes may also be affected within 10 days of a spill (up to 2% conditional probability). Coastal areas between Galveston County, Texas, and Okaloosa County, Florida, may be affected within 30 days (1 to 8% conditional probability).

NWRs and other protected areas such as Wildlife Management Areas (WMAs) along the coast are discussed in the lease sale EIS (BOEM, 2017a) and Shell's OSRP. Based on the 30-day OSRA, coastal and near-coastal wildlife refuges, wilderness areas, and state and national parks within the geographic range of the potential shoreline contacts within 30 days are listed in **Table 6**.

Table 6. Wildlife refuges, wilderness areas, and state and national parks and preserves within the geographic range of 1% or greater conditional probability of shoreline contacts within 30 days of a hypothetical spill from Launch Point 58 based on the 30-day Oil Spill Risk Analysis (OSRA) model.

County or Parish, State	Wildlife Refuge, Wilderness Area, or State/National Park
Galveston, Texas	Anahuac National Wildlife Refuge
	Bolivar Flats Shorebird Sanctuary
	Fort Travis Seashore Park
	Galveston Island State Park
	Horseshoe Marsh Bird Sanctuary
	Mundy Marsh Bird Sanctuary
	R.A. Apffel Park
	Seawolf Park

County or Parish, State	Wildlife Refuge, Wilderness Area, or State/National Park
Jefferson, Texas	McFaddin National Wildlife Refuge
	Sea Rim State Park
	Texas Point National Wildlife Refuge
Cameron, Louisiana	Sabine National Wildlife Refuge
	Rockefeller State Wildlife Refuge and Game Preserve
	Peveto Woods Sanctuary
Vermilion, Louisiana	Paul J. Rainey Wildlife Refuge and Game Preserve
	Rockefeller State Wildlife Refuge and Game Preserve
	State Wildlife Refuge
Iberia, Louisiana	Marsh Island Wildlife Refuge
	Shell Key National Wildlife Refuge
Terrebonne, Louisiana	Isles Dernieres Barrier Islands Refuge
	Pointe aux Chenes Wildlife Management Area
Lafourche, Louisiana	Pointe aux Chenes Wildlife Management Area
	Wisner Wildlife Management Area (Includes Picciola Tract)
Jefferson, Louisiana	Grand Isle State Park
Plaquemines, Louisiana	Breton National Wildlife Refuge
	Delta National Wildlife Refuge
	Pass a Loutre Wildlife Management Area
St. Bernard, Louisiana	Biloxi State Wildlife Management Area
	Breton National Wildlife Refuge
Okaloosa, Florida	Eglin Beach Park
	Fred Gannon Rocky Bayou State Park
	Gulf Islands National Seashore
	Henderson Beach State Park
	Rocky Bayou Aquatic Preserve
	Yellow River Wildlife Management Area

The level of impacts from oil spills on coastal habitats depends on many factors, including the oil characteristics, the geographic location of the landfall, and the weather and oceanographic conditions at the time of the spill (BOEM, 2017a). Oil that makes it to beaches may be liquid, weathered oil, an oil-and-water mousse, or tarballs. Oil is generally deposited on beaches in lines defined by wave action at the time of landfall. Oil that remains on the beach will thicken as its volatile components are lost. Thickened oil may form tarballs or aggregations that incorporate sand, shell, and other materials into its mass. Tar may be buried to varying depths under the sand. On warm days, both exposed and buried tarballs may liquefy and ooze. Oozing may also serve to expand the size of a mass as it incorporates beach materials. Oil on beaches may be cleaned up manually, mechanically, or both. Some oil can remain on the beach at varying depths and may persist for several years as it slowly biodegrades and volatilizes (BOEM, 2017a). Impacts associated with an extensive oiling of coastal and barrier island beaches from a large oil spill are expected to be adverse.

Coastal wetlands are highly sensitive to oiling and can be significantly impacted because of the inherent toxicity of hydrocarbon and non-hydrocarbon components of the spilled substances (Mendelssohn et al., 2012, Lin et al., 2016). Numerous variables such as oil concentration and chemical composition, vegetation type and density, season or weather, preexisting stress levels, soil types, and water levels may influence the impacts of oil exposure on wetlands. Light oiling could cause plant die-back, followed by recovery in a fairly short time. Vegetation exposed to oil that persists in wetlands could take years to recover (BOEM, 2017a). However, in a study in Barataria Bay, Louisiana, after the *Deepwater Horizon* spill, Silliman et al. (2012) reported that previously healthy marshes largely recovered to a pre-oiling state within 18 months. At 103 salt marsh locations that spanned 267 miles (430 km) of shoreline in Louisiana, Mississippi, and Alabama, Silliman et al. (2016) determined a threshold for oil impacts on marsh edge erosion with higher erosion rates occurring for approximately 1 to 2 years after the *Deepwater Horizon* spill at sites with the highest amounts of plant stem oiling (90% to 100%). Thus, displaying a large-scale ecosystem loss. In addition to the direct impacts of oil, cleanup activities in marshes may accelerate rates of erosion and retard recovery rates (BOEM, 2017a). Impacts associated with an extensive oiling of coastal wetland habitat are expected to be significant.

In addition to the direct impacts of oil, cleanup activities in marshes may accelerate rates of erosion and retard recovery rates (BOEM, 2017a). A recent review of the literature and new studies indicated that oil spill impacts to seagrass beds are often limited and may be limited to when oil is in direct contact with these plants (Fonseca et al., 2017). Impacts associated with an extensive oiling of coastal wetland habitat are expected to be significant.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

C.8 Socioeconomic and Other Resources

C.8.1 Recreational and Commercial Fishing

Potential impacts to recreational and commercial fishing are analyzed by BOEM (2017a). The major species sought by commercial fishermen in federal waters of the Gulf of Mexico include shrimp, menhaden, red snapper, tunas, and groupers (BOEM, 2017a). However, most of the fishing effort for these species is on the continental shelf in shallow waters. 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, 2002, Beerkircher et al., 2009). Pelagic longlining has occurred historically in the project area, primarily during spring and summer.

It is unlikely that any commercial fishing activity other than longlining will occur at or near the project area due to the water depth at the project area. Benthic species targeted by commercial fishers occur on the upper continental slope, well inshore of the project area. Royal red shrimp (*Pleoticus robustus*) are caught by trawlers in water depths of approximately 820 to 1,804 ft (250 to 550 m) (Stiles et al., 2007). Tilefishes (primarily *Lopholatilus chamaeleonticeps*) are caught by bottom longlining in water depths from approximately 540 to 1,476 ft (165 to 450 m) (Continental Shelf Associates, 2002) .

Most recreational fishing activity in the region occurs in water depths less than 656 ft (200 m) (Continental Shelf Associates, 1997, 2002, Keithly and Roberts, 2017). In deeper water, the main attraction to recreational fishers is petroleum rigs offshore Texas and Louisiana. Due to the project site's distance from shore, it is unlikely that recreational fishing activity is occurring in the project area.

The only routine IPF that could potentially affect fisheries (commercial and recreational) is MODU presence (including noise and lights). Two types of potential accidents are also addressed in this section: a small fuel spill and a large oil spill.

Impacts of Mobile Offshore Drilling Unit Presence, Noise, and Lights

There is a slight possibility of pelagic longlines becoming entangled in the MODU. 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, 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.

No other adverse impacts on fishing activities are anticipated. The presence of the MODU would result in a limited area being unavailable for fishing activity, but this effect is considered negligible. 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 Small Fuel Spill

The probability of a fuel spill will be minimized by Shell's preventative measures during routine operations, including fuel transfer. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the potential for impacts. EP Section 9b provides details on Shell's spill response measures. Given the open ocean location of the project area and the short duration of a small spill, the opportunity for impacts to occur would be very brief.

Pelagic longlining activities in the project area, if any, could be interrupted in the event of a small fuel spill. The area of diesel fuel on the sea surface would range from 1.2 to 12 ac (0.5 to 5 ha), depending on sea state and weather conditions. Fishing activities could be interrupted due to the activities of response vessels operating in the project area. A small 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 (**Section A.9.1**).

Impacts of a Large Oil Spill

Potential spill impacts on fishing activities are discussed by BOEM (2016b, 2017a). For this EP, there are no unique site-specific issues with respect to this activity.

Pelagic longlining activities in the project area and other fishing activities in the northern Gulf of Mexico could be interrupted in the event of a large oil spill. A spill may or may not result in fishery closures, depending on the duration of the spill, the oceanographic and meteorological conditions at the time, and the effectiveness of spill response measures. Data from the *Deepwater Horizon* incident provide information about the maximum potential extent of fishery closures in the event of a large oil spill in the Gulf of Mexico (NMFS, 2010b). At its peak on 12 July 2010, closures encompassed 84,101 miles^2 (217,821 km^2), or 34.8% of the U.S. Gulf of Mexico EEZ. BOEM (2012a) notes that fisheries closures from a large spill event could have a negative effect on short-term fisheries catch and marketability.

According to BOEM (2012a, 2017a), the potential impacts on commercial and recreational fishing activities from an accidental oil spill are anticipated to be minimal because the potential for oil spills is very low; the most typical events are small and of short duration; and the effects are so localized that fishes are typically able to avoid the affected area. Fish populations may be affected by an oil spill event should it occur, but they would be primarily affected if the oil reaches the productive shelf and estuarine areas where many fishes spend a portion of their life cycle. However, most species of commercially valuable fish in the Gulf of Mexico have planktonic eggs or larvae which may be affected by a large oil spill in deep water (BOEM, 2017a). The probability of an offshore spill affecting these nearshore environments is also low.

Should a large oil spill occur, economic impacts on commercial and recreational fishing activities would likely occur, but are difficult to predict because impacts would differ by fishery and season (BOEM, 2017a, 2017c). Loss of consumer confidence and public health concerns can lead to the potential for economic loss since it is likely to result in seafood being withdrawn from the market. A loss of consumer confidence may also lead to price reductions or outright rejection of seafood products by commercial buyers and consumers. Quantifying financial loss due to loss in market confidence can be difficult, because it depends on reliable data being available to demonstrate both that sales have been lost and that prices have fallen as a direct consequence of the spill (International Tanker Owners Pollution Federation Limited, 2014). An analysis of the effects of the *Deepwater Horizon* incident on the seafood industry in the Gulf of Mexico estimated that the spill reduced total seafood sales by \$51.7 to \$952.9 million, with an estimated loss of 740 to 9,315 seafood related jobs (Carroll et al., 2016).

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the event of a large spill, impacts to recreational and commercial fishing are expected to be adverse, but likely temporary. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

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 small fuel spill that is dissipated within a few days would have little or no impact on public health and safety, as the spill response would be completed entirely offshore, 53 miles (85 km) from the nearest shoreline (Louisiana). A large oil spill is the only IPF that has the potential to affect public health and safety.

Impacts of a Large Oil Spill

In the event of a large spill from a blowout, the main safety and health concerns are those of the offshore personnel involved in the incident and those responding to the spill. The proposed activities will be covered by the OSRP and, in addition, the MODU maintains a Shipboard Oil Pollution Emergency Plan as required under MARPOL 73/78.

Depending on the spill rate and duration, the physical and chemical characteristics of the oil, the meteorological and oceanographic conditions at the time, and the effectiveness of spill response measures, the public could be exposed to oil on the water and along the shoreline, through skin contact or inhalation of VOCs. Crude oil is a highly flammable material, and any smoke or vapors from a crude oil fire can cause irritation. Exposure to large quantities of crude oil may pose a health hazard.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures. No significant spill impacts on public health and safety are expected.

C.8.3 Employment and Infrastructure

There are no IPFs associated with routine operations that are expected to affect employment and infrastructure. The project involves drilling with support from existing shore-based facilities in Texas and Louisiana. 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 and existing offshore and coastal infrastructure (including major sources of supplies, services, energy, and water). A small fuel spill that is dissipated within a few days would have little or no economic impact, as the spill response would use existing facilities, resources, and personnel. A large oil spill is the only IPF that has the potential to affect employment and infrastructure.

Impacts of a Large Oil Spill

Potential socioeconomic impacts of an oil spill are discussed by BOEM (2016b, 2017a). For this EP, there are no unique site-specific issues with respect to employment and coastal infrastructure. A large spill could cause several types of economic impacts: extensive fishery closures could put fishermen out of work; temporary employment could increase as part of the response effort; adverse publicity could reduce employment in coastal recreation and tourism industries; and OCS drilling activities, including service and support operations that are an important part of local economies, could be suspended.

Nonmarket effects such as traffic congestion, strains on public services, shortages of commodities or services, and disruptions to the normal patterns of activities or expectations could also occur in the short term. These negative, short-term social and economic consequences of a spill are expected to be modest in terms of projected cleanup expenditures and the number of people employed in cleanup and remediation activities (BOEM, 2017a). Net employment impacts from a spill would not be expected to exceed 1% of baseline employment in any given year (BOEM, 2017a).

The project area is 53 miles (85 km) from the nearest shoreline (Louisiana). Based on the 30-day OSRA modeling (**Table 3**), coastal areas in Plaquemines Parish could be affected within 10 days of a spill (4% conditional probability). Terrebonne and Lafourche parishes may also be affected within 10 days of a spill (up to 2% conditional probability). Coastal areas between Galveston County, Texas, and Okaloosa County, Florida, may be affected within 30 days (1% to 8% conditional probability).

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures. No significant spill impacts on employment and infrastructure are expected.

C.8.4 Recreation and Tourism

For this EP, there are no unique site-specific issues with respect to recreation and tourism. There are no known recreational or tourism uses in the project area. Recreational resources and tourism in coastal areas would not be affected by routine activities due to the distance from shore. Compliance with NTL BSEE-2015-G013 (See **Table 1**) will minimize the chance of trash or debris being lost overboard from the MODU and subsequently washing up on beaches. As explained in **Section A.9.1**, a small fuel spill would not be expected to make landfall or reach coastal waters prior to breaking up. Therefore, a small fuel spill in the project area would be unlikely to affect recreation and tourism. A large oil spill is the only IPF that has the potential to affect recreation and tourism.

Impacts of a Large Oil Spill

Potential impacts of an oil spill on recreation and tourism are discussed by BOEM (2017a). For this EP, there are no unique site-specific issues with respect to these impacts.

Impacts on recreation and tourism would vary depending on the duration of the spill and its fate including the effectiveness of response measures. A large spill that reached coastal waters and shorelines could adversely affect recreation and tourism by contaminating beaches and wetlands, resulting in negative publicity that encourages people to stay away. Loss of tourist confidence and public health concerns can then lead to the potential for economic loss. Media coverage of oil contamination, or word-of-mouth, can have implications on public perception of the incident. However, quantifying financial loss due to loss in confidence can be difficult, because it depends on implementation of an effective response plan as well as a strategy to restore any loss of appeal to tourists that the area may have suffered.

Based on the 30-day OSRA modeling (**Table 3**), coastal areas in Plaquemines Parish could be affected within 10 days of a spill (4% conditional probability). Terrebonne and Lafourche parishes may also be affected within 10 days of a spill (up to 2% conditional probability). Coastal areas between Galveston County, Texas, and Okaloosa County, Florida, may be affected within 30 days (1% to 8% conditional probability).

According to BOEM (2017a), should an oil spill occur and contact a beach area or other recreational resource, it would cause some disruption during the impact and cleanup phases of the spill. However, these effects are also likely to be small in scale and of short duration, in part because the probability of an offshore spill contacting most beaches is small. In the unlikely event that a spill occurs that is sufficiently large to affect large to affect areas of the coast and, through public perception, have effects that reach beyond the damaged area, effects to recreation and tourism could be significant (BOEM, 2017a).

Impacts of the *Deepwater Horizon* incident on recreation and tourism provide some insight into the potential effects of a large spill. NOAA (2016b) estimated that the public lost 16,857,116 user-days of fishing, boating, and beach-going experiences as a result of the spill. The U.S. Travel Association has estimated the economic impact of the *Deepwater Horizon* incident on tourism across the Gulf Coast over a 3-year period at $22.7 billion (Oxford Economics, 2010). Hotels and restaurants were the most affected tourism businesses, but charter fishing, marinas, and boat dealers and sellers were among the others affected (Eastern Research Group, 2014).

However, a blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the event of a large spill, impacts to recreation and tourism are expected to be adverse, but likely temporary. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures.

C.8.5 Land Use

Land use along the northern Gulf Coast is discussed by BOEM (2016b, 2017a). There are no routine IPFs potentially affecting land use. The project will use existing onshore support facilities in Texas and

Louisiana. The land use at the existing shorebase sites is industrial. The project will not involve new construction or changes to existing land use and, therefore, will not have any impacts. Levels of boat and helicopter traffic as well as demand for goods and services, including scarce coastal resources, will represent a small fraction of the level of activity occurring at the shorebases.

A large oil spill is the only relevant accidental IPF. A small fuel spill would not have impacts on land use, as the response would be staged out of existing shorebases and facilities.

Impacts of a Large Oil Spill

The initial response for a large oil spill would be staged out of existing facilities, with no effect on land use. A large spill could have limited temporary impacts on land use along the coast if additional staging areas were needed. For example, during the *Deepwater Horizon* incident, 25 temporary staging areas were established in Louisiana, Mississippi, Alabama, and Florida for spill response and cleanup efforts (BOEM, 2012a). In the event of a large spill in the project area, similar temporary staging areas could be needed. These areas would eventually return to their original use as the response is demobilized.

An oil spill is not likely to significantly affect land use and coastal infrastructure in the region, in part because an offshore spill would have a small probability of contacting onshore resources. BOEM (2016b) states that landfill capacity would probably not be an issue at any phase of an oil spill event or the long-term recovery. In the case of the *Deepwater Horizon* incident and response, USEPA reported that existing landfills receiving oil spill waste had sufficient capacity to handle waste volumes; the wastes that were disposed of in landfills represented less than 7% of the total daily waste normally accepted at these landfills (USEPA, 2016).

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures. No significant spill impacts on land use are expected.

C.8.6 Other Marine Uses

The project area is not located within any USCG-designated fairway, shipping lane, or Military Warning Area. Shell will comply with BOEM requirements and lease stipulations to avoid impacts on uses of the area by military vessels and aircrafts.

The wellsite assessments did not indicate seafloor infrastructure within 2,000 ft (610 m) of the proposed wellsites (C&C Technologies, 2010; Ocean Geo Solutions, 2019). The closest existing seafloor infrastructure is a well located approxaimtely 5,880 ft (1,792 m) to the northeast of the proposed A and A-Alt wellsites.

The shallow hazard assessment identified no sonar contacts within 2,000 ft (610 m) of proposed wellsites that were determined to have archaeological potential. However, 16 sonar contacts for proposed wellsites A and A-Alt; 44 sonar contacts for proposed wellsites B and B-Alt; 43 sonar contacts for proposed wellsites C and C-Alt; and 41 sonar contacts for proposed wellsite DD were identified within 2,000 ft (610 m). These sonar contacts were identified as either potential modern barrels or containers related to industrial waste disposal activities in the area with 32.8 ft (10 m) avoidance radius or non-container modern debris with a standard 100 ft (30 m) avoidance radius. No archaeological impacts are expected from routine activities in the project area. A large oil spill is the only relevant IPF. A small fuel spill would not have impacts on other marine uses because the spill and response activities would be mainly within the project area, and the duration would be brief.

Impacts of a Large Oil Spill

An accidental spill would be unlikely to significantly affect shipping or other marine uses. The lease block is not located within any USCG-designated fairway, shipping lane, or Military Warning Area. In the event of a large spill requiring numerous response vessels, coordination would be required to manage the vessel traffic for safe operations.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in EP Section 2j. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures. No significant spill impacts on other marine uses are expected.

C.9 Cumulative Impacts

For purposes of NEPA, cumulative impact is defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR 1508.7). Any single activity or action may have a negligible impact(s) by itself, but when combined with impacts from other activities in the same area and/or time period, substantial impacts may result.

Prior Studies. Prior to the lease sales, BOEM and its predecessors prepared multisale EISs to analyze the environmental impact of activities that might occur in the multisale area. BOEM and its predecessors also analyzed the cumulative impacts of OCS exploration activities similar to those planned in this EP in several documents. The level and types of activities planned in Shell's EP are within the range of activities described and evaluated by BOEM (2012a, b, 2013, 2014, 2015, 2016a, b, 2017a). Past, present, and reasonably foreseeable activities were identified in the cumulative effects scenario of these documents, which are incorporated by reference. The proposed action will not result in any additional impacts beyond those evaluated in the multisale and Final EISs.

Description of Activities Reasonably Expected to Occur in the Vicinity of Project Area. Shell does not anticipate other projects in the vicinity of the project area beyond the types of projects analyzed in the lease sale and Supplemental EISs (BOEM, 2012a, 2013, 2014, 2015, 2016b, 2017a).

Cumulative Impacts of Activities in the Exploration Plan. The BOEM (2017a) Final EIS included a lengthy discussion of cumulative impacts, which analyzed the environmental and socioeconomic impacts from the incremental impact of the 10 proposed lease sales, in addition to all activities (including non-OCS activities) projected to occur from past, proposed, and future lease sales. The EISs considered exploration, delineation, and development wells; platform installation; service vessel trips; and oil spills. The EISs examined the potential cumulative effects on each specific resource for the entire Gulf of Mexico.

The EIA incorporates and builds on these analyses by examining the potential impacts on physical, biological, and socioeconomic resources from the work planned in this EP, in conjunction with the other reasonably foreseeable activities expected to occur in the Gulf of Mexico. Thus, for all impacts, the incremental contribution of Shell's proposed actions to the cumulative impacts analysis in these prior analyses is not significant.

C.9.1 Cumulative Impacts to Physical/Chemical Resources

The work planned in this EP is limited in geographic scope and the impacts on the physical/chemical environment will be correspondingly limited.

Air Quality. Emissions from pollutants into the atmosphere from activities are not projected to have significant effects on onshore air quality because of the distance from shore, the prevailing atmospheric conditions, emission rates and heights, and resulting pollutant concentrations. As BOEM found in the multisale EISs, the incremental contribution of activities similar to Shell's proposed activities to the cumulative impacts is not significant and will not cause or contribute to a violation of NAAQS (BOEM, 2012a, 2013, 2014, 2015, 2016b, 2017a). In addition, the cumulative contribution to visibility impairment is also very small. As mentioned in previous sections, projected emissions meet BOEM's exemption criteria and would not contribute to cumulative impacts on air quality.

Climate Change. CO_2 and CH_4 emissions from the project would constitute a negligible contribution to greenhouse gas emissions from all OCS activities. According to BOEM (2013), greenhouse gas emissions from all OCS oil and gas activities make up a very small portion of national CO_2 emissions, and BOEM does not believe that emissions directly attributable to OCS activities are a significant contributor to global greenhouse gas levels. Greenhouse gas emissions identified in this EP represent a negligible contribution to the total greenhouse gas emissions from reasonably foreseeable activities in the Gulf of Mexico area and would not significantly alter any of the climate change impacts evaluated in the previous EISs.

Water Quality. Shell’s project may result in some minor water quality impacts due to the NPDES-permitted discharge of water based drilling fluids and associated cuttings, cuttings wetted with SBM, treated sanitary and domestic wastes, deck drainage, desalination unit discharge, blowout preventer fluid, non-contaminated well treatment and completion fluids, ballast water, bilge water, hydrate inhibitor, excess cement slurry, fire water and non-contact cooling water. These effects are expected to be minor (localized to the area within a few hundred meters of the MODU) and temporary (lasting only hours longer than the disturbance or discharge). Any cumulative effects to water quality are expected to be negligible.

Archaeological Resources. The lease blocks are on the list of archaeology survey blocks (BOEM, 2011). No known shipwrecks or other archaeological artifacts were identified during the archaeological assessment (C&C Technologies, 2010; Ocean Geo Solutions, 2019). The project area is well beyond the 197 ft (60 m) depth contour used by BOEM as the seaward extent for prehistoric archaeological site potential in the Gulf of Mexico. Therefore, Shell’s operations will have no cumulative impacts on historic shipwrecks or prehistoric archaeological resources.

New Information. New information included in the most recent Programmatic, Supplemental, and Final EISs (BOEM, 2012a, 2013, 2014, 2015, 2016a, 2016b, 2017a) has been incorporated into the EIA, where applicable.

C.9.2 Cumulative Impacts to Biological Resources

The work planned in this EP is limited in geographic scope and duration, and the impacts on biological resources will be correspondingly limited.

Seafloor Habitats and Biota. Effects on seafloor habitats and biota from discharges of drilling mud and cuttings are expected to be minor and limited to a small area. The geophysical survey data did not identify any features that could support high-density deepwater benthic communities within 2,000 ft (610 m) of the proposed wellsite locations (C&C Technologies, 2010; Ocean Geo Solutions, 2019).

Areas that may support high-density deepwater benthic communities will be avoided as required by NTL 2009-G40. Soft bottom communities are ubiquitous along the northern Gulf of Mexico continental slope, and the extent of benthic impacts during this project is insignificant regionally. As noted in the multisale EISs, the incremental contributions of activities similar to Shell’s proposed activities to the cumulative impacts is not determined to be significant (BOEM, 2012a, b, 2013, 2014, 2015, 2016b, 2017a).

Threatened, Endangered, and Protected Species. Threatened, Endangered, and protected species that could occur in the project area include the sperm whale, Bryde’s whale, oceanic whitetip shark, giant manta ray, and five species of sea turtles. Potential impact sources include vessel presence including noise and lights, marine debris, and support vessel and aircraft traffic. Potential effects for these species would be limited and temporary and would be reduced by Shell’s compliance with BOEM-required mitigation measures, including NTLs BSEE-2015-G013 and BOEM-2016-G01 and NMFS (2020) Appendix B and C. No significant cumulative impacts are expected.

Coastal and Marine Birds. Birds may be exposed to contaminants, including air pollutants and routine discharges, but significant impacts are unlikely due to rapid dispersion. Shell’s compliance with NTL BSEE-2015-G013 will minimize the likelihood of debris-related impacts on birds. Support vessel and helicopter traffic may disturb some foraging and resting birds; however, it is likely that individual birds would experience, at most, only short-term behavioral disruption.

Due to the limited scope, timing, and geographic extent of drilling activities, collisions or other adverse effects are unlikely, and no significant cumulative impacts are expected.

Fisheries Resources. Exploration and production structures occur in the vicinity of the project area. The additional effect of the proposed drilling activity would be negligible.

Coastal Habitats. Due to the distance of the wellsites from shore, routine activities are not expected to have any impacts on beaches and dunes, wetlands, seagrass beds, coastal wildlife refuges, wilderness areas, or any other managed or protected coastal area. The support bases are not in wildlife refuges or wilderness areas. Support operations, including the crew boat and supply boats, may have a minor incremental impact on coastal habitats. Over time with a large number of vessel trips, vessel wakes can erode shorelines along inlets, channels, and harbors. Impacts will be minimized by following the speed and wake restrictions in harbors and channels.

New Information. New information included in the most recent Programmatic, Supplemental, and Final EISs (BOEM, 2012a, b, 2013, 2014, 2015, 2016a, 2016b, 2017a) has been incorporated into the EIA, where applicable.

C.9.3 Cumulative Impacts to Socioeconomic Resources

The work planned in this EP is limited in geographic scope and duration, and the impacts on socioeconomic resources will be correspondingly limited.

The multisale and Supplemental and Final EISs analyzed the cumulative impacts of oil and gas exploration and development in the project area, in combination with other impact-producing activities, on commercial fishing, recreational fishing, recreational resources, historical and archaeological resources, land use and coastal infrastructure, demographics, and environmental justice (BOEM, 2012a, 2013, 2014, 2015, 2016b, 2017a). BOEM also analyzed the economic impact of oil and gas activities on the Gulf States, finding only minor impacts in most of Texas, Mississippi, Alabama, and Florida, more significant impacts in parts of Texas, and substantial impacts on Louisiana.

Shell’s proposed activities will have negligible cumulative impacts on socioeconomic resources. There are no IPFs associated with routine operations that are expected to affect public health and safety, employment and infrastructure, recreation and tourism, land use, or other marine uses. Due to the distance from shore, it is unlikely that any recreational fishing activity is occurring in the project area, and it is unlikely that any commercial fishing activity other than longlining occurs at or near the project area. The project will have negligible impacts on fishing activities.

New Information. New information included in the most recent Programmatic, Supplemental, and Final EISs (BOEM, 2012a, b, 2013, 2014, 2015, 2016a, 2016b, 2017a) has been incorporated into the EIA, where applicable.

D. Environmental Hazards

D.1 Geologic Hazards

The wellsite assessment reports prepared by C&C Technologies (2010) and Ocean Geo Solutions (2019) concluded that wellsite locations are suitable for the proposed exploratory drilling activities and no seafloor obstructions or conditions were found that would constrain the proposed project activities.

See EP Section 6a for supporting geological and geophysical information.

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 MODU. High winds and limited visibility during a severe storm could disrupt communication and support activities (vessel and helicopter traffic) and make it necessary to suspend some activities on the MODU for safety reasons until the storm or weather event passes. In the event of a hurricane, procedures in Shell's Hurricane Evacuation Plan would be followed.

D.3 Currents and Waves

A rig-based acoustic Doppler current profiler will be used to continuously monitor the current beneath the MODU. Metocean conditions, such as sea state, wind speed, ocean currents, etc., will also be continuously monitored. Under most circumstances, physical oceanographic conditions are not expected to have any effect on the proposed activities. Strong currents (caused by Loop Current eddies and intrusions) and large waves were considered in the design criteria for the MODU. 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 MODU for safety reasons until the storm or weather event passes.

E. Alternatives

No formal alternatives were evaluated in this EP. However, various technical and operational options, including the location of the wellsites and the selection of a MODU, were considered by Shell in developing the proposed action. There are no other reasonable alternatives to accomplish the goals of this project.

F. Mitigation Measures

The proposed action includes numerous mitigation measures required by laws, regulations, and BOEM lease stipulations and NTLs. The project will comply with applicable federal, state, and local requirements concerning air pollutant emissions, discharges to water, and solid waste disposal. Project activities will be conducted under Shell's OSRP and will include the measures described in **EP Section 2J**.

G. Consultation

No persons beyond those cited as Preparers (**Section H.**, **Preparers**) or agencies were consulted regarding potential impacts associated with the proposed activities during the preparation of the EIA.

H. Preparers

The EIA was prepared for Shell Offshore Inc. by its contractor, CSA Ocean Sciences Inc. Contributors included the following:

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SECTION 19: ADMINISTRATIVE INFORMATION

A. Exempted Information Description (Public Information Copies Only)

The following attachments were excluded from the public information copies of this plan:

Section 1: OCS Plan Information form – Bottom-hole locations & proposed total depth & BHL Plat
Section 2: Worst case discharge assumptions/calculations
Section 3: Geologic Description, Structure Map, Seismic lines, Cross Sections & Strat. Columns
Section 4: H_2S Classification Information

B. Bibliography

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