

UNITED STATES GOVERNMENT
MEMORANDUM

July 22, 2022

To: Public Information (MS 5030)
From: Plan Coordinator, FO, Plans Section (MS
5231)

Subject: Public Information copy of plan
Control # - S-08087
Type - Supplemental Exploration Plan
Lease(s) - OCS-G17001 Block - 508 Walker Ridge Area
Operator - Shell Offshore Inc.
Description - Subsea wells CC, DD, CC-Alt1 and CC-Alt2
Rig Type - Not Found

Attached is a copy of the subject plan.

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

Leslie Wilson
Plan Coordinator

Site Type/Name	Botm Lse/Area/Blk	Surface Location	Surf Lse/Area/Blk
WELL/CC	G17001/WR/508	4320 FSL, 5327 FWL	G17001/WR/508
WELL/CC-ALT1	G17001/WR/508	4351 FSL, 5411 FWL	G17001/WR/508
WELL/CC-ALT2	G17001/WR/508	4301 FSL, 5461 FWL	G17001/WR/508
WELL/DD	G17001/WR/508	4515 FSL, 5435 FWL	G17001/WR/508



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Public Information Copy

July 6, 2022

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

Attn: Plans Group GM 235D

SUBJECT: Supplemental Exploration Plan
Walker Ridge 508, OCS-G 17001
Unit Contract No. 754306006
Offshore Louisiana

Dear Mrs. Picou:

In compliance with 30 CFR 550.211 and NTLs 2008-G04, 2009-G27, 2015-N01 & BOEM 2020-N01, giving Exploration Plan guidelines, Shell Offshore Inc. (Shell) requests your approval of this Supplemental Exploration Plan for drilling and completion of two (2) subsea wells, wells CC-Alt1 and CC-Alt2.

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 is attached to the Proprietary copy of the plan.

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

Sincerely,

A handwritten signature in blue ink that reads "Tracy Albert".

Tracy W. Albert
Sr. Regulatory Specialist



SHELL OFFSHORE INC.

SUPPLEMENTAL EXPLORATION PLAN

For

Walker Ridge Block 508, OCS-G 17001

Unit Contract No. 754306006

PUBLIC INFORMATION COPY

JULY 2022

PREPARED BY:

Tracy W. Albert
Sr. Regulatory Specialist

504.425.4652

tracy.albert@shell.com

REVISIONS TABLE:

Date of Request	Plan Section	What was Corrected	Date Resubmitted
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**SUPPLEMENTAL EXPLORATION PLAN
OFFSHORE LOUISIANA**

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SECTION 1: PLAN CONTENTS

A. DESCRIPTION, OBJECTIVES & SCHEDULE

Shell Offshore Inc. (Shell) is submitting this Supplemental Exploration Plan (EP/plan) for Walker Ridge (WR) Block 508, OCS-G 17001. This plan is requesting to drill and complete two subsea wells: CC-Alt1 and CC-Alt2, at Drill Center 1. We are also extending the air emissions from Plan S-7948, which expire in 2022. That Plan covered wells AA, BB, CC and DD at Drill Center 1. Wells AA and BB have been drilled but CC and DD have not. We are only including CC and DD in this SEP to extend the air emissions. We are adding the new Alt wells to be back-up wells to the primary well CC and DD. The wells will be drilled, completed and tree installed in accordance with 30 CFR 250.1721 until the well(s) are developed under a future DOCD. If the wells are unsuccessful, they will be permanently plugged and abandoned in accordance with the Bureau of Safety and Environmental Enforcement (BSEE) regulations.

The proposed rig is either a dynamically positioned (DP) semi-submersible or a Drill Ship. Both are self-contained drilling vessels with accommodations for a crew which include 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 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 Oil Spill Response Plan (OSRP) is designed to contain and respond to a spill that meets or exceeds the worst-case discharge (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 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 plat (Attachments 1A and 1B) and BOEM forms (Attachments 1D through 1G).

C. RIG SAFETY AND POLLUTION FEATURES

The rig 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 can be discharged directly overboard. These are mostly located around the main deck and outboard in places where it is unlikely that hydrocarbons will be found.

Drains within 50 feet of a designated chemical storage area which uses the weather deck as a primary containment means shall be designated "normally plugged." An adequate number of drains around the rig shall be designated as "normally open" to allow run-off of rain water. Normally open drains shall have a plug located in a conspicuous area near the drain which can be easily installed in the event of a spill.

The rig's drain plug program consists at a minimum of a weekly check of all deck drains leading to the sea to verify that their status is as designated. If normally open they shall verify that the drain is open and that the plug is available in the area. If normally closed they shall verify that the plug is securely installed in the drain.

In the event a leak or spill is observed, the event shall be contained (drain plug installation and/or spill kit deployment as appropriate) and reported immediately.

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 contain hydrocarbons and cannot be discharged overboard. When oil-based mud is used for drilling it will have to be collected in portable tanks and sent to shore for processing.

3) Mud Drain System

None

4) Oily Water Processing

Oily 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 has to be sent ashore for disposal. On board the MODU an oil record log has to be kept according to instructions included in the log. Any and all pollution pans are subjected to a sheen test before being pumped out. If the water passes the sheen test then it is pumped overboard. If it does not pass the sheen test then the water/oil mixture is pumped to a dirty oil tank and sent to shore for disposal. 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.

5) Lower Hull Bilge System

- The main bilge system is designed to drain the pontoons. There are Goulds electrically driven, self-priming centrifugal pumps - one for each main pump room. The aux pumps can be pump out with the bilge pump but has to be lined up manually from the main pump room.
- Bilge water is pumped overboard after a sheen test has been completed.
- The pontoon bilge pumps are operable from the Bridge and have audible and visual bilge alarms set for high and low levels.
- Portable submersible pumps are carried onboard the rig to service all column void spaces and are also used for emergency bilge pumps in the event of the main pump room flooding.
- Alternate means of pumping the bilges in each pontoon pump room include the use of:
 - The ballast system emergency bilge valve which is operated from the control panel.
 - Portable submersible pumps
 - Emergency bilge suction line connected directly to the ballast manifold. (Main Pump rooms only)

The Bilge pumps are manual/automatic type pumps. They are equipped with sensors that give a high and a high- 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.

6) Emergency Bilge System

Main ballast pumps may also be used for emergency bilge pumping directly from the pump rooms via remotely actuated direct bilge suction valves on the ballast system. These valves will operate in a fully flooded compartment. The ballast pumps can be supplied from the emergency switchboard.

7) 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 has to be sent ashore for disposal. On board all drilling Units, an oil record log has to be kept according to instructions included in the log. The rig floor has two skimmer tanks and each is subjected to a sheen test before pumping overboard to ensure environmental safety. All three anchor winch windlasses have skimmer tanks and are subjected to sheen tests before discharge as well.

8) 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.

9) Rig Floor Drainage

The rig floor is typically outfitted with a Facet International MAS 34-3 separator. The separator has coalescent plates that remove the solids from the drainage and the remaining drainage goes to a skimmer tank. From the skimmer tank it is drained to one of the column dirty oil tank systems where it is then sent through 2 separators and cleaned further to reduce oil content to less than 15 ppm.

10) Columns #3 & 4

The drains on the decks and machinery spaces are separated at mid ship and directed to either the #3 or #4 columns. The separators in these columns go through three cycles of circulation and remove oil to <15 ppm, then discharge the clean product to sea.

11) 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.

12) 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 has to be filled out.

- The oily water collection tank overflow valve is closed.
- The drill floor drains are lined-up to the drill floor skimmer tank. The kimmer tanks have a high alarm which sounds by means of an air horn. Before tanks are pumped out a sheen test is performed. Water is pumped out the skimmer tanks down the shunt line. Oil containment side is pumped out into 550 gal tote tanks.
- The BOP test area drains are normally lined-up to drain overboard.
- 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.
- The bilge system is normally pumped directly overboard after a sheen test has been performed.
- The engine dirty oil sump can be drained down in port column oily water separator which discharges water overboard from the water side and oil being pumped out into a 550 gal tote tank oil containment side. There is a high audible alarm on the ballast control panel

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 – Development Driller III (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		Marine Diesel (0.91 SG)
Diesel Tank in stbd 2	Drilling Rig	2713	1		Marine Diesel (0.91 SG)
Diesel Tank in stbd 3	Drilling Rig	3456	1		Marine Diesel (0.91 SG)
Diesel Tank in stbd 4	Drilling Rig	653	1		Marine Diesel (0.91 SG)
Diesel Tank in port 1	Drilling Rig	2090	1		Marine Diesel (0.91 SG)
Diesel Tank in port 2	Drilling Rig	1366	1		Marine Diesel (0.91 SG)
Diesel Tank in port 3	Drilling Rig	4787	1		Marine Diesel (0.91 SG)
Diesel Tank in port 4	Drilling Rig	3456	1		Marine Diesel (0.91 SG)
Diesel Settling Tanks	Drilling Rig	129	1		Marine Diesel (0.91 SG)
Diesel Settling Tanks	Drilling Rig	129	1		Marine Diesel (0.91 SG)
Diesel Settling Tanks	Drilling Rig	139	1		Marine Diesel (0.91 SG)
Diesel Settling Tanks	Drilling Rig	129	1		Marine Diesel (0.91 SG)
Diesel Day Tank	Drilling Rig	100	1		Marine Diesel (0.91 SG)
Diesel Day Tank	Drilling Rig	115	1		Marine Diesel (0.91 SG)
Diesel Day Tank	Drilling Rig	114	1		Marine Diesel (0.91 SG)
Diesel Day Tank	Drilling Rig	115	1		Marine Diesel (0.91 SG)
Lube Oil Tank	Drilling Rig	86.25	4	345	Lube Oil (0.91 SG)

E. Pollution Prevention Measures

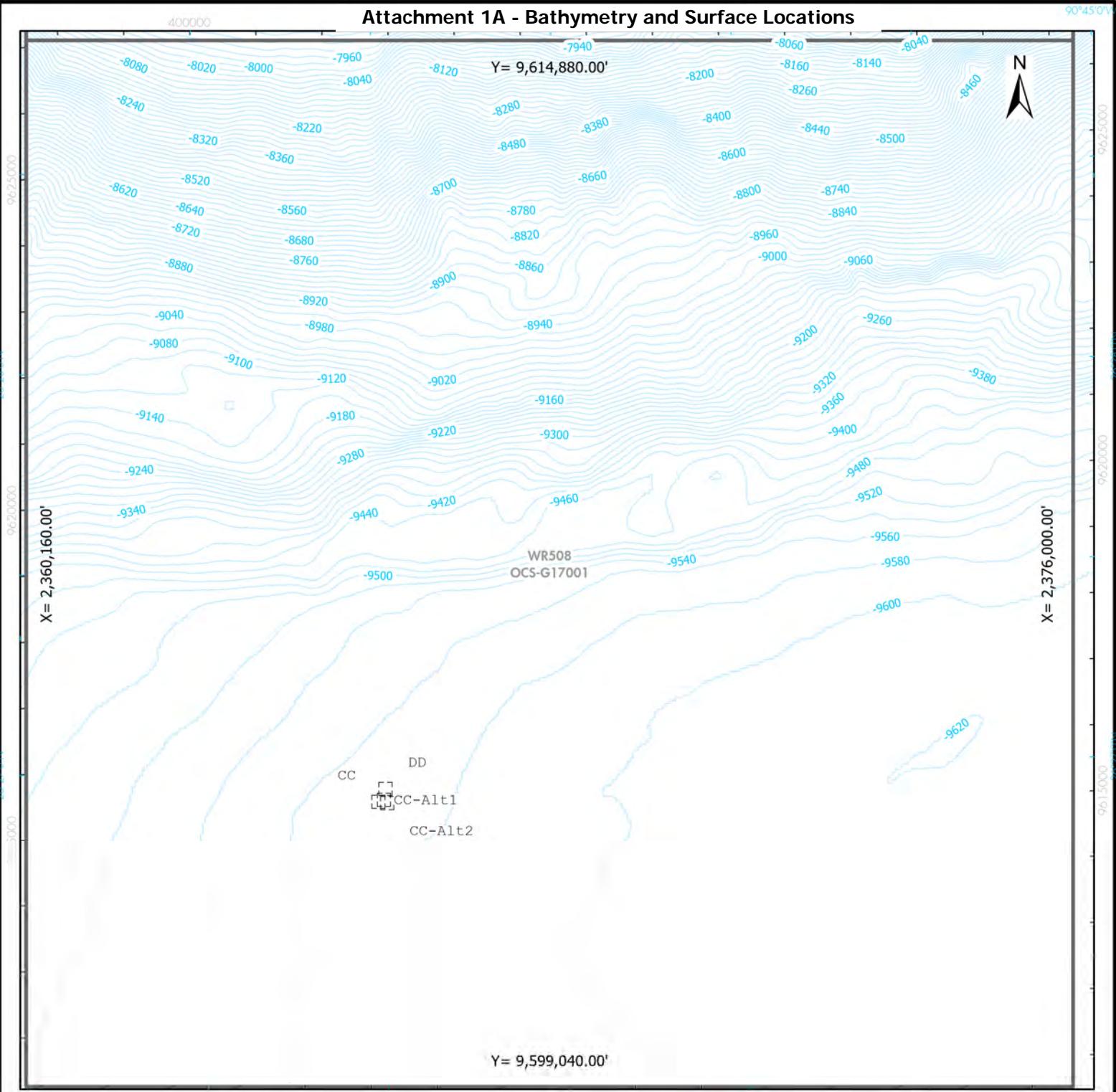
Pursuant to NTL 2008-G04 the proposed operations covered by this EP do not require Shell to specifically address the discharges of oil and grease from the rig during rainfall or routine operations. Nevertheless, Shell has provided this information as part of its response to 1(c) above.

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 on a checklist. The checklist is used daily to verify drain plugs are installed.
- 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.
- The rig is involved in a recycling program for cardboard, plastic, paper, glass and aluminum.
- Fuel hoses and SBM are changed on annual basis.
- TODO spill prevention fittings are installed on all liquid take on hoses.
- Waste paint thinner is recycled on board with a solvent still to reduce hazard of shipping and storage.
- All equipment on board utilizes Envirorite hydraulic fluid as opposed to hydraulic oil.
- Shell has obtained ISO14001 certification.
- Shell uses low sulfur fuel.

G. Description of Previously Approved Lease Activities

The lease has previous drilling activity at Drill Centers 1 and 2. They are part of a Unit.



MAP INFORMATION					SHELL EXPLORATION & PRODUCTION COMPANY	
<input type="checkbox"/>	Proposed Surface Locations					
	Bathymetry Depth Contour (ft)				ATTACHMENT	
<input checked="" type="checkbox"/>	Lease Block				OCS-G-17001, Walker Ridge Block 508 Offshore Louisiana	
					Stones Proposed Surface Hole Locations Exploration Plan	
					GEODETIC PARAMETERS	
					Horizontal Coordinate Reference System CRS name (ESRI): NAD 1927 BLM Zone 15N CRS name (Shell): NAD27 / UTM zone 15N (IUS) [1241_32065] CRS code (EPSG): 32065 Geodetic datum: North American 1927 Projection name: Transverse Mercator Horizontal units: Foot US	
					Author: Janice Cooley Date: 13 Apr 2022 Reviewed By: Tracy Albert EP Catalog No.:	
Well Name X (ftUS) Y (ftUS) Latitude (DD) Longitude (DD) Block Calls CC 2,365,487.12 9,603,359.78 26.4486462 -90.7835842 5327.12' FWL & 4319.78' FSL of BLK WR508 CC-Alt1 2,365,570.9 9,603,391.2 26.4487287 -90.7833266 5410.9' FWL & 4351.2' FSL of BLK WR508 CC-Alt2 2,365,620.9 9,603,341.2 26.4485888 -90.7831765 5460.9' FWL & 4301.2' FSL of BLK WR508 DD 2,365,594.8 9,603,555.57 26.4491796 -90.783245 5434.8' FWL & 4515.57' FSL of BLK WR508						
MAP SCALE						
0	1,000	2,000	4,000	1 25,000	Print size: 8.5" x 11" (ANSI A)	
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Attachment 1B - Bottom-Hole Locations

Proprietary Data

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., Room 2418					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: \$3,673			Receipt Nos. 26VQCHUF			
Project and Worst-Case Discharge (WCD) Information											
Lease(s) OCS-G 17001			Area: WR			Block(s): 508		Project Name: Stones			
Objectives(s):	X	Oil		Gas		Sulphur		Onshore Support Base(s) Fourchon & Houma, LA or Kiln & Gulfport, MS			
Platform/Well Name: K				Total Volume of WCD: 47,114 BOPD				API Gravity: 28°			
Distance to Closest Land (Miles): 178					Volume from uncontrolled blowout: 5.8 MMBBL						
Have you previously provided information to verify the calculations and assumptions of your WCD?								X	Yes		No
If so, provide the Control Number of the EP or DOCD with which this information was provided								S-7599			
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, Development Driller III or Similar											
Description of Lease Term Pipelines											
From (Facility/Area/Block)		To (Facility/Area/Block)			Diameter (Inches)			Length (Feet)			
NA											

Attachment 1C.1 Schedule

Schedule to drill, complete and install tree:

Well	Start date	Duration	End date
*CC	1/1/2023	225	8/14/2023
*DD	1/1/2024	225	8/13/2024
CC-Alt1	1/1/2025	225	8/14/2025
CC-Alt2	1/1/2026	225	8/14/2026

* Wells CC and DD were cleared to be drilled/completed in plan S-7948. They are being added to this schedule for air emissions only.

Attachment 1D

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? S-7948				<input checked="" type="checkbox"/>	Yes	No		
Is this an existing well or structure?		<input type="checkbox"/>	Yes	<input checked="" type="checkbox"/>	X	<input type="checkbox"/>	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?										<input checked="" type="checkbox"/>	Yes	<input type="checkbox"/>	No
WCD Info	For wells, volume of uncontrolled Blowouts (bbls/day): 47,114 BOPD			For structures, volume of all storage and pipelines (bbls): NA				API Gravity of fluid		25°			
	Surface Location			Bottom Hole Location (for Wells)				Completion (for multiple enter separate lines)					
Lease Number	OCS-G 17001			OCS-G 17001				OCS OCS					
Area Name	WR			WR									
Block No.	508			508									
Blockline Departure (in feet)	N/S Departure: 4,320' FSL							N/S Departure: N/S Departure:					
	E/W Departure 5,327' FWL							E/W Departure: E/W Departure:					
Lambert X-Y Coord.	X: 2,365,487							X:					
	Y: 9,603,360							Y:					
Lat/Long	Latitude: 26.4486462							Latitude					
	Longitude: -90.7835842							Longitude					
Water Depth (Feet): 9,554'								MD (Feet)	TVD (Feet)				
Anchor Radius (if applicable) in 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=									

Attachment 1E

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? S-7948			<input checked="" type="checkbox"/>	Yes	No		
Is this an existing well or structure?		<input type="checkbox"/>	Yes	<input checked="" type="checkbox"/>	X	<input type="checkbox"/>	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?										<input checked="" type="checkbox"/>	Yes	<input type="checkbox"/>	No
WCD Info	For wells, volume of uncontrolled Blowouts (bbls/day): 47,114 BOPD			For structures, volume of all storage and pipelines (bbls): NA				API Gravity of fluid		25°			
	Surface Location			Bottom Hole Location (for Wells)				Completion (for multiple enter separate lines)					
Lease Number	OCS-G 17001			OCS-G 17001				OCS OCS					
Area Name	WR			WR									
Block No.	508			508									
Blockline Departure (in feet)	N/S Departure: 4,515' FSL							N/S Departure: N/S Departure:					
	E/W Departure 5,435' FWL							E/W Departure: E/W Departure:					
Lambert X-Y Coord.	X: 2,365,595							X:					
	Y: 9,603,556							Y:					
Lat/Long	Latitude: 26.4491796							Latitude					
	Longitude: -90.7832450							Longitude					
Water Depth (Feet): 9,554'									MD (Feet)	TVD (Feet)			
Anchor Radius (if applicable) in 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=								

Attachment 1F – New Well

Proposed Well/Structure Location														
Well or Structure Name/Number (if renaming well or structure, reference previous name): CC-Alt1						Previously reviewed under an approved EP or DOCD?				<input type="checkbox"/>	Yes	<input checked="" type="checkbox"/>	X	No
Is this an existing well or structure?		<input type="checkbox"/>	Yes	<input checked="" type="checkbox"/>	X	<input type="checkbox"/>	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?											<input type="checkbox"/>	Yes	<input type="checkbox"/>	No
WCD Info	For wells, volume of uncontrolled Blowouts (bbls/day): 47,114 BOPD			For structures, volume of all storage and pipelines (bbls): NA				API Gravity of fluid		25°				
	Surface Location			Bottom Hole Location (for Wells)				Completion (for multiple enter separate lines)						
Lease Number	OCS-G 17001			OCS-G 17001				OCS OCS						
Area Name	WR			WR										
Block No.	508			508										
Blockline Departure (in feet)	N/S Departure: 4,351' FSL							N/S Departure: N/S Departure:						
	E/W Departure 5,411' FWL							E/W Departure: E/W Departure:						
Lambert X-Y Coord.	X: 2,365,571							X:						
	Y: 9,603,391							Y:						
Lat/Long	Latitude: 26.4487287							Latitude						
	Longitude: -90.7833266							Longitude						
Water Depth (Feet): 9,554'									MD (Feet)	TVD (Feet)				
Anchor Radius (if applicable) in 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=									

Attachment 1G – New Well

Proposed Well/Structure Location														
Well or Structure Name/Number (if renaming well or structure, reference previous name): CC-Alt2						Previously reviewed under an approved EP or DOCD?				<input type="checkbox"/>	Yes	<input checked="" type="checkbox"/>	X	No
Is this an existing well or structure?		<input type="checkbox"/>	Yes	<input checked="" type="checkbox"/>	X	<input type="checkbox"/>	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?											<input type="checkbox"/>	Yes	<input type="checkbox"/>	No
WCD Info	For wells, volume of uncontrolled Blowouts (bbls/day): 47,114 BOPD			For structures, volume of all storage and pipelines (bbls): NA				API Gravity of fluid		25°				
	Surface Location			Bottom Hole Location (for Wells)				Completion (for multiple enter separate lines)						
Lease Number	OCS-G 17001			OCS-G 17001				OCS OCS						
Area Name	WR			WR										
Block No.	508			508										
Blockline Departure (in feet)	N/S Departure: 4,301' FSL							N/S Departure: N/S Departure:						
	E/W Departure 5,461' FWL							E/W Departure: E/W Departure:						
Lambert X-Y Coord.	X: 2,365,621							X:						
	Y: 9,603,341							Y:						
Lat/Long	Latitude: 26.4485888							Latitude						
	Longitude: -90.7831765							Longitude						
Water Depth (Feet): 9,554'									MD (Feet)	TVD (Feet)				
Anchor Radius (if applicable) in 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=									

SECTION 2: GENERAL INFORMATION

A. Application and Permits

There are no individual or site-specific permits other than general NPDES permit and rig move notification that need to be obtained. Prior to beginning exploration operations, an Application for Permit to Drill (APD) will be submitted and approved by the Bureau of Safety and Environmental Enforcement (BSEE).

B. Drilling Fluids

See Section 7, Tables 7A and 7B for 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, Subpart I-Bonding and NTL No. 2015-N04, "General Financial Assurance."

G. Oil Spill Financial Responsibility (OSFR)

Shell Offshore Inc., BOEM Operator Number 0689, has demonstrated oil spill financial responsibility for the activities proposed in this 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., BOEM Operator Number 0689, has the financial capability to drill a relief well and conduct other emergency well control operations if required.

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.

J. Blowout scenario

The section below was reviewed and accepted by BOEM in plan S-7599. The wells in this plan do not exceed this WCD number.

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 penetration K of the target sand and based on the guidelines outlined in NTL No. 2010-N06 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)	47,114 BOPD
Uncontrolled blowout rate (first 30 days average daily rate)	37,318 BOPD
Duration of flow (days) based on relief well	180 Days
Total volume of spill (bbls) until relief well drilled	5.8 MMBO

Table 1: Worst Case Discharge Summary

Stones Project Overview

The Stones discovery is located in the Gulf of Mexico (GOM), approximately 200 miles south of New Orleans, Louisiana, in water depths of 7,500 to 9,500 feet across the discovery. Additional WCD scenarios were evaluated for all proposed well locations at Stones; however, the WCD numbers for these wells are lower than the WCD number calculated for the Stones K well, as these wells are expected to encounter less net pay and/or encounter the target formation at a deeper TVD depth, thus generating greater flowing bottom hole pressures. Therefore, Stones K was selected as the well which represented the highest possible worst case discharge rate.

A structural reservoir model has been constructed for the target horizons at Stones based on interpretation of a wide azimuth seismic survey. Stratigraphically, the target section was subdivided into 14 individual reservoir packages based on log correlations of the Stones #1 and #3 wells. The 14 reservoir packages can be grouped into 5 hydraulic units, based on MDT pressure and seismic interpretation.

The reservoir model was populated with rock and fluid properties based on data from the Stones #1, #3, and other regional penetrations. This model was then used in the CMG simulation software to develop a dynamic simulation of hydrocarbon production from the Stones reservoir at the proposed well locations. An out-flow model for the Stones K well was constructed in Petroleum Experts' Prosper software and was coupled with the dynamic reservoir simulation.

This document is a summary of the results of this modeling. Electronic copies of the reservoir model and its output can be provided to the BOEM upon request. For the Stones K WCD scenario, the model did not constrain the well's drainage area, with the exception that the large trapping fault up dip from the Stones K location is sealing. The aquifer extent was modeled as per the expectation extent and magnitude.

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 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 Stones K deviated well with a bottom hole location on the crest of the Stones structure represented the highest 30 day average well flow potential. The Stones K well will be drilled through the reservoirs as outlined in the Geological and Geophysical Information Section of the Stones EP, and described above, utilizing a typical subsea wellhead system, conductor, surface and intermediate casing program, and using a DP rig with a marine riser and subsea Blowout Preventer. A hydrocarbon influx and a well control event are modeled to occur from the reservoirs. 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, 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)	WR-508
Facility Designation	DP
Distance to Nearest Shoreline (miles)	178 statute miles
Uncontrolled blowout volume (first day)	47,114 BBL
Uncontrolled blowout volume (first 30 day average daily rate)	37,318 BOPD

Table 2: Estimated Flow Rates of a Potential Blowout

c) Total volume and maximum duration of the potential blowout

Duration of flow (days)	180 days total duration to drill relief well (14 rig mob, 3 transit, 130 spud to top of target, 33 ranging)
Total volume of spill (bbls)	5.8 MMBO based on 180 days flowing. Note: From CMG dynamic reservoir model

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 WR 508 (Proprietary data – See Plan S-7599**)**

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 always 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. 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 Stones water depths and reservoir depths without technical constraints are shown in the table below.

Rig Name	Rig Type
TO Deepwater Poseidon	Dynamically Positioned Drill ship
TO Deepwater Thalassa	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 tabled above. It is expected to take an average of 14 days to safely secure the well that the rig is working on; up to the point the rig departs location, and a further 3 days transit to mobilize to the relief well site depending on distance to travel. The relief well will take approximately 130 days to drill down to the last casing string above the blowout zone plus approximately 33 days for precision ranging activity to intersect the blowout well bore. Total time to mobilize and drill a relief well would be approximately 180 days for this well.

Although unlikely, 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.

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 Stones SW. 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 2019-2022 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.

4. Chemical Products

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

SECTION 3: GEOLOGICAL AND GEOPHYSICAL INFORMATION

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. Stratigraphic Column

F. Shallow Hazards Report

- Fugro Geoconsulting Inc., 2010, "Integrated geophysical and geotechnical field development planning study stones development area, Walker Ridge, Gulf Of Mexico, report #27.2009-2328.
- Fugro Geoconsulting Inc., 2011, Stones technical memorandum recommendations for further site investigation Walker Ridge Area, Blocks 464 and 508, Gulf of Mexico, report #27.2010-2386-1.
- Fugro Geoconsulting Inc., 2011, Archeological assessment stones development area blocks 420, 464, 508 552 Walker Ridge area, Gulf of Mexico, Report #2411-1019
- Forum Energy Technologies, 2012, Stones define phase slope stability and mass gravity flow risk assessment: geological framework and mass gravity flow risk, stones development area, Walker Ridge Area, Gulf of Mexico, Project #0911-2008.
- C&C technologies, 2011, "Hazard Assesment blocks 507 (OCG-G-18730), 508 (OCG-G17001), 550 (OCG-G-25254), 551 (OCG-G-G-21861), 552 (OCG-G-18737) and vicinity walker ridge area of Gulf of Mexico", Project #110394.
- BP America Inc, 2004, 3D geohazard assessment Walker ridge, blocks 463-465, 506-510, 550-554, 594-598, gradline project ref 6092.

G. Shallow Hazards Assessment

See Section 6A of this plan for detailed site assessment, Power Spectrums and Top-hole Prognosis.

H. Geochemical Information

This information is not required for plans submitted in the GoM Region.

I. Future G&G Activities

This information is not required for plans submitted in the GoM Region.

SECTION 4: HYDROGEN SULFIDE (H₂S)

A. Concentration

0 ppm

B. Classification

Based on 30 CFR 250.490 Shell requests that the Regional Supervisor, Field Operations, determine the zones in the proposed drilling and completion operations in this plan to be classified as an area where the **absence** of H₂S has been confirmed.

C. Modeling Report

We do not anticipate encountering or handling H₂S at concentrations greater than 500 parts per million (ppm) and therefore have not included modeling for H₂S.

SECTION 5: MINERAL RESOURCE CONSERVATION INFORMATION

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. Wellsite, Geohazards and Archaeological Assessment

Shell Offshore Inc. (Shell) is submitting a Supplemental Exploration Plan for Walker Ridge Block 508 (WR 508) for the addition of new proposed locations. The SEP will add new locations to previously approved Plan N-09875, R-06637 and S-7948. These assessments address the seafloor and subsurface conditions within a 2,000-ft radius around the proposed wellsite locations, to the depth of approximately 2700 ft BML or to the depth of Horizon H08.

Seafloor conditions appear favorable within the vicinity of the proposed surface locations. There are no potential sites for deepwater high-density benthic communities within 2,000 ft of the surface hole locations and no sonar targets of archaeological significance were identified in the vicinity of any of the proposed wellsites. There is low potential for encountering minor overpressured sands within the limit of investigation based on the stratigraphy and the drilling history in the area. There is a low potential for significant shallow gas at the proposed locations based on seismic attributes and amplitude analysis.

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), 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 report, which were previously submitted:

- Fugro Geoconsulting Inc., 2010, "Integrated geophysical and geotechnical field development planning study stones development area, Walker Ridge, Gulf of Mexico, report #27.2009-2328.
- Fugro Geoconsulting Inc., 2011, Stones technical memorandum recommendations for further site investigation Walker Ridge Area, Blocks 464 and 508, Gulf of Mexico, report #27.2010-2386-1.
- Fugro Geoconsulting Inc., 2011, Archeological assessment stones development area blocks 420, 464, 508 552 Walker Ridge area, Gulf of Mexico, Report #2411-1019
- Forum Energy Technologies, 2012, Stones define phase slope stability and mass gravity flow risk assessment: geological framework and mass gravity flow risk, stones development area, Walker Ridge Area, Gulf of Mexico, Project #0911-2008.
- C&C technologies, 2011, "Hazard Assesment blocks 507 (OCG-G-18730), 508 (OCG-G17001), 550 (OCG-G-25254), 551 (OCG-G-G-21861), 552 (OCG-G-18737) and vicinity walker ridge area of Gulf of Mexico," Project #110394.
- BP America Inc., 2004, 3D geohazard assessment Walker ridge, blocks 463-465, 506-510, 550-554, 594-598, gradline project ref 6092.

Available Data. Assessments are based on the analysis of the data from AUV (Autonomous Underwater Vehicle) geophysical survey data (sub-bottom profiler, side-scan sonar and multi-beam echo-sounder), and 3D seismic data volumes. A power spectrum of the 3D seismic data is presented in Figure 1.

Existing Infrastructure and Shipping Activity. Infrastructure consisting of previously drilled wells, pipelines, sleds and other equipment used in developing the field are within 500 ft. of the proposed wellsites. Operations will be conducted using state of the art DGP for positioning to depict all existing pipelines, wells, and other equipment located within 500 ft. of proposed wellsites.

Proposed Wellsite CC-Alt1 and CC-Alt2, Walker Ridge Block 508 (OCS-G-17001)

Shell will drill this well using a dynamically positioned drilling vessel. This assessment addresses the seafloor conditions within 2000 ft. around the proposed wellsite locations. The surface locations of the proposed wellsites are located in the west-central region of block WR508. All proposed wells reside within 500 ft. of previously approved surface locations AA, BB, CC, and DD, of which AA and BB have been drilled. Due to the close proximity the surface locations will be discussed together.

Table A-1. Proposed Well Location Coordinates

Well Name	Spheroid & Datum: Clarke 1866 NAD27 Projection: BLM Zone 15 North	
CC-Alt1	X: 2,365,570.90	Y: 9,603,391.20
CC-Alt2	X: 2,365,620.90	Y: 9,603,341.20

Water Depth and Seafloor Conditions. Based on the AUV multibeam echo-sounder data, the water depth at the proposed well location is 9,554 ft, and the seafloor slopes at 1.0° down to the SE. The proposed wellsite is located approximately 3100 ft. from the edge of the Sigsbee Escarpment. The wellsite is located in an area of irregular and eroded seafloor furrows with older and stiffer sediment exposure. The possibility for seafloor currents should be anticipated, as suggested by the presence of the seafloor furrows. The seafloor sediments are interpreted to consist of muds and silts with occasional sandy interbeds with depth (see Figure-3).

Deepwater Benthic Communities. There is no potential for high-density benthic communities within 2,000 ft of the proposed location. The seafloor amplitudes from 3D seismic data, the sidescan sonar, and the multibeam backscatter data, all show ambient amplitudes or backscatter at the seafloor with no indications of hardgrounds or fluid expulsion features. A few areas of slightly higher amplitude are related to the seafloor-furrows, but these are not evidence of fluid venting at the seafloor or the presence of benthic communities (Figure-2).

Stratigraphy. Stratigraphic conditions from the seafloor to Horizon H08 are shown on the Tophole Prognosis Chart (Figure-3). Subsurface depths are determined using an earth model for time-to-depth conversion.

Unit A (Seafloor to Horizon 01). Unit A is 223-ft thick at the proposed wellbore. The upper sediments at the seafloor are interpreted to consist of hemipelagic silty clays. At the base of Unit 1 is an interval of chaotic, mass-transport deposits. The mass-transport deposits are predominantly clay and silty clay

Unit B (Horizon 01 to Horizon H02). Unit B, between 223 ft and 552 ft BML (329-ft thick) presents as low-amplitude reflectors interpreted as well-layered turbidites with silts and clays, and occasional possible thin sands.

Unit C (Horizon H02 to Horizon H03). Unit C, between 552 ft and 718 ft BML (166-ft thick). The interval consists of parallel and continuous, seismic reflections interpreted as turbidites deposits. The turbidites are expected to be mud-dominated with only thin seams of sand.

Unit D (Horizon H03 to Horizon H04). Unit D, between about 718 ft and 1318 ft BML (600-ft thick), Unit D consists of parallel, continuous, low-amplitude reflections. The low-amplitude reflections are interpreted as mud-dominated turbidites, with possible thin sand seams.

Unit E (Horizon H04 to Horizon H05). Unit E, between about 1318 ft and 1589 ft BML (271-ft thick), is interpreted to be mud-rich turbidites with silts and clays. Potential presence of channelized features and associated sands. The lower section of unit E consists of mass-transport deposits composed predominately of clays and silts.

Unit F (Horizon H05 to Horizon H07). Unit F, between about 1589 ft and 2223 ft BML (634-ft thick). The topmost part of the unit consists of low-amplitude, chaotic reflections representing mud-rich, mass-transport deposits. The lower half of Unit F contains stratified, mud-dominated turbidites, with only thin seams of sand/silt.

Unit G (Horizon H07 to Horizon H08). Unit G, between about 2223 ft and 2768 ft BML (545-ft thick), The unit consists of relatively low-amplitude, parallel and continuous reflections. Thin intervals of low-amplitude, mass-transport deposits occur within the otherwise stratified section. This interval contains mud-dominated sediments with occasional silts and thin sands.

Faults. There are no mapped faults along the proposed well path to (Horizon H08) 2768 ft BML.

Gas Hydrates. The shallow section at the proposed wellsite falls above the gas hydrate stability zone. No geophysical indications of gas hydrates within hydrate stability zone have been 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 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 low sedimentation rates compared with Green Canyon and Mississippi Canyon, and so shallow water flow potential is generally much lower in the Walker Ridge Area. This is evident in the BOEM shallow water flow database, in which there are very few shallow water flow events reported in Walker Ridge. Interpretation of the 3D seismic data indicates there are no regionally continuous, permeable sand accumulations in the shallow section at the proposed wellsite. Sand interbeds less than about 10-40-ft thick (below the resolution of the seismic data) are possible, but such sand lenses are unlikely to support a sustained shallow water flow. In addition to low regional sedimentation rates, there is an absence of geologically recent, thick mass transport deposits at the wellsite that could induce overpressure. Those observations are also supported by the past drilling experience at the Drill Centers 1 and 2 in the Stones development area. For these reasons, there is unlikely to be any significant overpressured sand in the shallow section. **The potential for shallow water flow at this well is assessed to be low (see Figure-3).**

Archaeological Assessment. There are no archaeologically significant sonar contacts within 2,000 ft of the proposed wellsite. One sonar contact was reported within 2000 ft. of the proposed surface location. The contact was reported as likely debris. The standard avoidance distance of 100 ft. is recommended. Contact #1 is located approximately 1364 ft. to the north of the proposed wellsite. See C&C, 2011 Project No. 110394 for details (Figure-2).

Proposed Wellsite WR508 CC-Alt1 and CC-Alt2 Concluding Remarks. Seafloor conditions appear favorable in the vicinity of the proposed surface locations. However, the presence of shallow mass transport deposits and erosional seafloor furrows may result in stiffer soils and might affect jet-in of conductor. The possibility for an increase in seafloor currents should be anticipated at the proposed well due to the presence of current erosion features (seafloor-furrows). There are no potential sites for deepwater benthic communities within 2,000 ft, and no sonar targets of archaeological significance were identified.

B. Topographic Features Map

The proposed activities are not within 1,000' of a no-activity zone or within the 3-mile radius zone of an identified topographic feature. Therefore, no map is required per NTL No. 2008-G04.

C. Topographic Features Statement (Shunting)

Shell does not plan to drill more than two wells from the same surface location within the Protective Zone of an identified topographic feature. Therefore, the topographic features statement required by NTL No. 2008-G04 is not applicable.

D. Live Bottoms (Pinnacle Trend) Map

The activities proposed in this plan are not within 200' of any pinnacle trend features with vertical relief equal to or greater than 8'. Therefore, no map is required per NTL No. 2008-G04.

E. Live Bottoms (Low Relief) Map

The activities proposed in this plan are not within 100' of any live bottom low relief features. Therefore, no map is required per NTL No. 2008-G04.

F. Potentially Sensitive Biological Features

The activities proposed in this plan are not within 200' of any potentially sensitive biological features. Therefore, no map is required per NTL No. 2008-G04.

G. Remotely Operated Vehicle (ROV) Monitoring Plan

This information is no longer required by BOEM GoM.

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 proposed 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	<i>Eretmochelys imbricata</i>	E
Green Turtle	<i>Chelonia mydas</i>	T/E
Kemp's Ridley Turtle	<i>Lepidochelys kempii</i>	E
Leatherback Turtle	<i>Dermochelys coriacea</i>	E
Loggerhead Turtle	<i>Caretta caretta</i>	T

Table 6.6 – 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	<i>Stenella frontalis</i>	
Blainville's Beaked Whale	<i>Mesoplodon densirostris</i>	
Blue Whale	<i>Balaenoptera musculus</i>	E
Bottlenose Dolphin	<i>Tursiops truncatus</i>	
Bryde's Whale	<i>Balaenoptera ricei</i>	E
Clymene Dolphin	<i>Stenella clymene</i>	
Cuvier's Beaked Whale	<i>Ziphius cavirostris</i>	
Dwarf Sperm Whale	<i>Kogia simus</i>	
False Killer Whale	<i>Pseudorca crassidens</i>	
Fin Whale	<i>Balaenoptera physalus</i>	E
Fraser's Dolphin	<i>Lagenodelphis hosei</i>	
Gervais' Beaked Whale	<i>Mesoplodon europaeus</i>	
Humpback Whale	<i>Megaptera novaeangliae</i>	E
Killer Whale	<i>Orcinus orca</i>	
Melon-headed Whale	<i>Peponocephala electra</i>	
Minke Whale	<i>Balaenoptera acutorostrata</i>	
North Atlantic Right Whale	<i>Eubalaena glacialis</i>	E
Pantropical Spotted Dolphin	<i>Stenella attenuata</i>	
Pygmy Killer Whale	<i>Feresa attenuata</i>	
Pygmy Sperm Whale	<i>Kogia breviceps</i>	
Risso's Dolphin	<i>Grampus griseus</i>	
Rough-toothed Dolphin	<i>Steno bredanensis</i>	
Sei Whale	<i>Balaenoptera borealis</i>	E
Short-finned Pilot Whale	<i>Globicephala macrorhynchus</i>	
Sowerby's Beaked Whale	<i>Mesoplodon bidens</i>	
Sperm Whale	<i>Physeter macrocephalus</i>	E
Spinner Dolphin (Long-snouted)	<i>Stenella longirostris</i>	
Striped Dolphin	<i>Stenella coeruleoalba</i>	
Florida manatee	<i>Trichechus manatus</i>	E

Table 6.7 – 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.

I. Archaeological Report

See previous Section for this data.

J. Air and Water Quality Information

Drilling/completion operations will produce air pollutant emissions, but as provided in the Air Emissions Spreadsheet (see Section 8 of this Plan), these operations are below the exemption levels.

These drilling operations will result in the discharge of authorized effluents under the EPA Region VI General permit. Impacts of these discharges are expected to be minimal on water quality in the area.

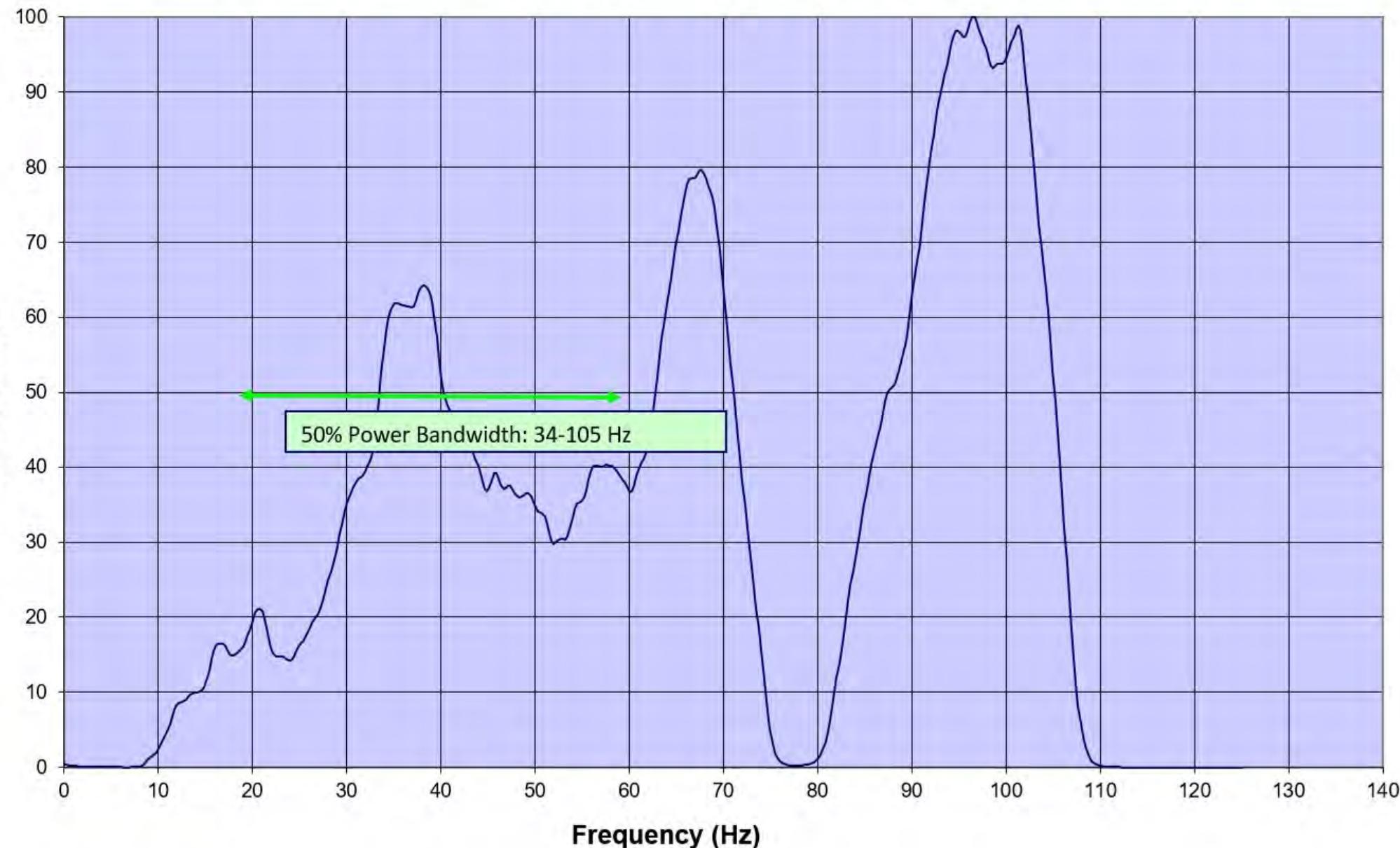
For specific information relating to air and water quality information please refer to Section 18.

K. Socioeconomic Information

- 1) Shell will utilize its existing shorebase located in Fourchon, Louisiana which is fully staffed and operational and does not expect to employ persons from within the State of Florida.
- 2) Shell does not expect to purchase major supplies, services, energy, water or other resources from within the State of Florida for these operations.
- 3) Shell does not expect to hire contractors or vendors from within the State of Florida.

For specific information relating to socioeconomic information please refer to Section 18 in this Plan.

**3D Seismic Power Spectrum
Stones 14 Wellsite AA(QAY-85107)**



Attachment 6B - Tophole Prog - CC-Alt1 & CC-Alt 2

Tophole Summary			Event	Unit	Depth BML (ft)	Depth SS (ft)	TWTT SS (ms)	Unit Thickness (ft)	Predicted Lithology and Potential of Geohazard Occurrence		
X: 2365595 ft	Y: 9603483 ft	Stones WR508-AA							Water Depth= 9554 ft Seafloor Slope = 1. ^o		
849.1	822.5	796.0	H00 (Seafloor)		0	9554	1712				
779.5	742.9	716.4	H01	A	223	9777	1901	223	Hemipelagic Drape, mass transport deposits Potential slow jetting or refusal due to MTD	Low	Low
663.3	636.8	610.3	H02	B	552	10106	2172	329	Muds and Silts, possible thin sands	Low	Low
557.2	530.7	504.1	H03	C	718	10272	2356	166	Muds and Silts	Low	Low
477.6	451.1	424.5	H04	D				600	Muds, turbiditic channels	Low	Low
398.0	371.5	344.9	H05	E	1318	10872	2539		Muds, turbiditic channels, mass transport deposits	Low	Low
318.4	291.9	265.3	H07	F				271			
238.8	212.3	185.7	H08	G	2223	11777	3143	634	Muds and Silts,interbedded mass transport deposits	Low	Low
212.3	185.7	159.2									
185.7	159.2	132.7									
159.2	132.7	106.1									
132.7	106.1	79.6									
106.1	79.6	53.1									
79.6	53.1	26.5									
53.1	26.5	0.0									
0.0	-26.5	-53.1									
-26.5	-53.1	-79.6									
-53.1	-79.6	-106.1									
-79.6	-106.1	-132.7									
-106.1	-132.7	-159.2									
-132.7	-159.2	-185.7									
-159.2	-185.7	-212.3									
-212.3	-238.8	-265.3									
-238.8	-265.3	-291.9									
-265.3	-291.9	-318.4									
-318.4	-344.9	-371.5									
-344.9	-371.5	-398.0									
-398.0	-424.5	-451.1									
-424.5	-451.1	-477.6									
-477.6	-504.1	-530.7									
-504.1	-530.7	-557.2									
-530.7	-557.2	-583.7									
-557.2	-583.7	-610.3									
-610.3	-636.8	-663.3									
-636.8	-663.3	-689.9									
-689.9	-716.4	-742.9									
-716.4	-742.9	-769.5									
-769.5	-796.0	-822.5									
-822.5	-849.1	-849.1									
Seismic: 999.37-stkqc_flip_con.vt Depth Conversion: "WGE_EOCTP6_ED_STONES_FNLVTI.bin"			Sand	Chance of Occurrence	Low	Moderately Low	Moderate	Moderately High	High		
			Mud rocks		<10%	10-20%	20-30%	30-40%	>40%		

Attachment 6C - ESR - CC-Alt1 & CC-Alt 2

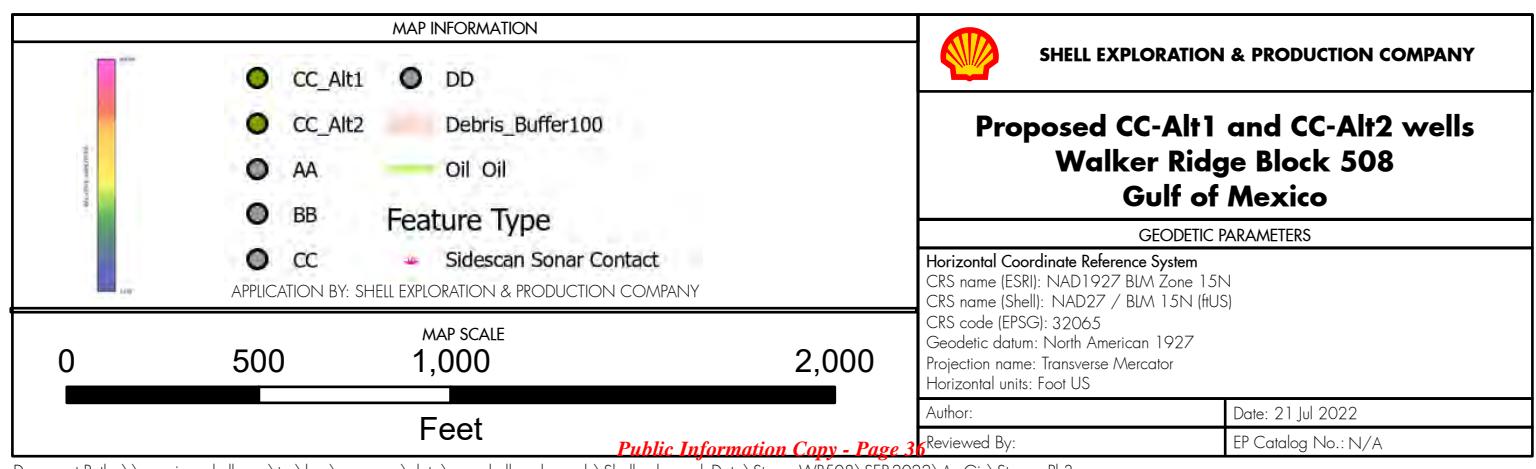
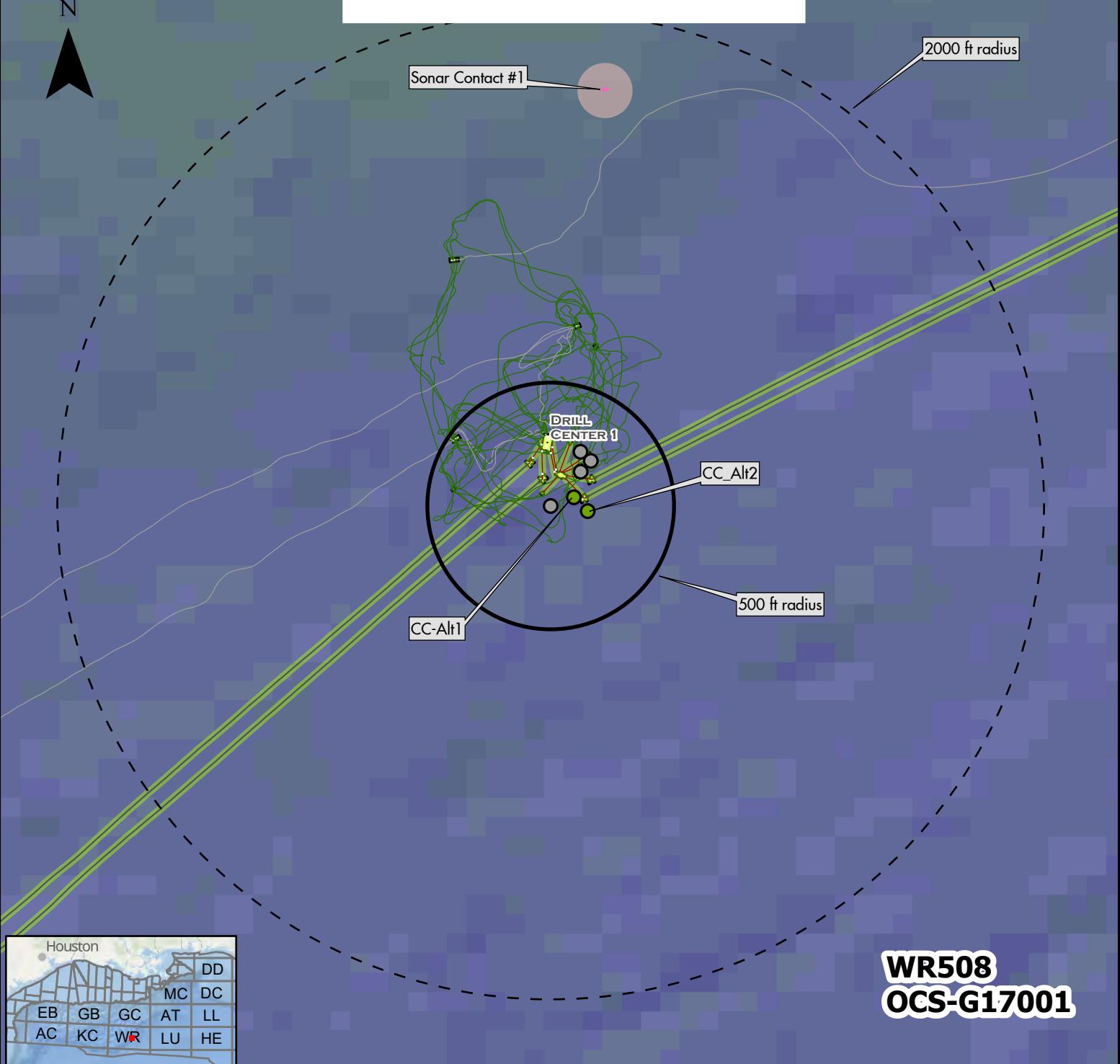


TABLE 7A: WASTES YOU WILL GENERATE, TREAT AND DOWNHOLE DISPOSE OR DISCHARGE TO THE GOM

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					
<i>EXAMPLE: Cuttings wetted with synthetic based fluid</i>	<i>Cuttings generated while using synthetic based drilling fluid.</i>	<i>X bbl/well</i>	<i>X bbl/day/well</i>	<i>discharge pipe</i>	<i>No</i>
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.	28630 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	2100 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	Water-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					
<i>EXAMPLE: Sanitary waste water</i>		<i>X liter/person/day</i>	<i>NA</i>	<i>chlorinate and discharge</i>	<i>No</i>
Domestic waste (kitchen water, shower water)	grey water	30000 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	22500 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	3000 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	600 bbls/well	10 bbls/day	Overboard discharge line below the water level if oil and grease free and meets LC50 requirements.	No
well completion fluids	Completion brine contaminated with WBDM and displacement spacers	900 bbls/well	15 bbls/day	Overboard discharge line below the water level if oil and grease 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.					
Desalination unit discharge	Rejected water from watermaker unit	60000 bbls/well	400 bbls/day/well	RO Desalination Unit Discharge Line below waterline	No
Blowout preventer fluid	Water based	30 bbls/well	0 bbls/day	Discharge Line @ Subsea BOP @ seafloor	No
Ballast water	Uncontaminated seawater	491400 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).	231450 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	18000 bbls/well (assume planned 100% excess is discharged)	200 bbls/day	Discharged at seafloor.	No
Fire water	Treated seawater	10000 bbls/well	2000 bbls/month	Discharged below waterline	No
Cooling water	Treated seawater	68451450 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	

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.					
<i>EXAMPLE: Oil-based drilling fluid or mud</i>	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; 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.	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, Newpark, or Tetra - Fourchon, LA; 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 (Jeanerette, 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.					
<i>EXAMPLE: trash and debris</i>	<i>cardboard, aluminum,</i>	<i>barged in a storage bin</i>	<i>shorebase</i>	<i>z tons total</i>	<i>recycle</i>
Trash and debris - recyclables	trash and debris	various storage containers on supply boat	Omega Waste Management, Patterson, LA	200 lbs/month	Recycle
Trash and debris - non-recyclables	trash and debris	various storage containers on supply boat	Riverbirch Landfill, Avondale, LA	400 lbs/month	Landfill
E&P Wastes	Completion, treatment, and production wastes	various storage containers on supply boat	R360 Environmental Solutions, Fourchon, LA; Clean Waste, Fourchon, LA	200 bbls / well	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 Management, Patterson, LA; Chemical Waste Management, Sulphur, LA	20 bbls/month	Recycle or RCRA Subtitle C landfill
Non-Hazardous Waste	paints, insulation, chemicals, completion and treatment fluids	various storage containers on supply boat	Waste Management Woodside Landfill Walker, La.	60 bbls/mo	RCRA Subtitle D landfill
Non-Hazardous Oilfield Waste	Chemicals, completion and treatment fluids	various storage containers on supply boat	Chemical Waste Management Sulphur, LA;	60 bbls/mo	Deep Well Injected
Hazardous Waste	paints, solvents, chemicals, pyrotechnics, completion and treatment, commissioning fluids	various storage containers on supply boat	Chemical Waste Management Sulphur, LA; Clean Harbors, Colfax, LA	60 bbls/mo	Recycle, treatment, incineration, or RCRA Subtitle C landfill
Universal Waste Items	Batteries, lamps, glass, and mercury-contaminated waste	various storage containers on supply boat	Chemical Waste Management Sulphur, 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**

The proposed activities under this plan do not meet the U.S. Environmental Protection Agency requirements for an individual NPDES permit. Therefore, modeling report requirements per NTL No. 2008-G04 is not applicable to this EP.

SECTION 8: AIR EMISSIONS INFORMATION

A. Emissions Worksheet and Screening Questions

Screening Questions for EP's	Yes	No
Is any calculated Complex Total (CT) Emission amount (in 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° W longitude?		x
Do you expect to encounter H ₂ S 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

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

- (1) Summary information regarding the peak year emissions for both Plan Emissions and Complex Total Emissions, if applicable. This information is compiled on the summary form of the two sets of worksheets. You can submit either these summary forms or use the format below. You do not need to include the entire set of worksheets.

Air Pollutant	Plan Emission Amounts (tons)	Calculated Exemption Amounts (tons)	Calculated Complex Total Emission Amounts (tons)
PM			
SO _x			
NO _x			
VOC			
CO			

(2) Contact: Josh O'Brien, (504) 425-9097, Joshua.E.OBrien@shell.com

B. Worksheets

See attached worksheets. The schedule in Form BOEM-0137 will not match the days presented in the AQR, as the AQR contains extra days for contingency delays. Note: The air emissions in this plan were previously approved in Plan S-7948 on June 13, 2019 and do change by the operations proposed in this plan. The emissions will remain below the 270 per day per year durations as proposed and approved in Plan S-7948.

C. Emissions Reduction Measures

Emission Source	Reduction Control Method	Amount of Reduction	Monitoring System
N/A			

COMPANY	Shell Offshore Inc
AREA	Walker Ridge
BLOCK	508 (Surface Location)
LEASE	OCS-G17001
FACILITY	MODU (Semi-sub or Drillship)
WELL	DC1 Wells CC, DD, CC-Alt1, and CC-Alt2
COMPANY CONTACT	504-425-9097
TELEPHONE NO.	Josh O'Brien
	Supplemental EP MODU (Drillship or DP Semi-sub) No non-default emission factors or emission reduction measures were used in this AQR.
REMARKS	Stones-AQR-sEP-DPMODU-20220527-BOEM.xlsx

AIR EMISSIONS COMPUTATION FACTORS

Fuel Usage Conversion Factors	Natural Gas Turbines		Natural Gas Engines		Diesel Recip. Engine		Diesel Turbines		
	SCF/hp-hr	9.524	SCF/hp-hr	7.143	GAL/hp-hr	0.0514	GAL/hp-hr	0.0514	

Equipment/Emission Factors	units	TSP	PM10	PM2.5	SOx	NOx	VOC	Pb	CO	NH3	REF.	DATE	Reference Links
Natural Gas Turbine	g/hp-hr		0.0086	0.0086	0.0026	1.4515	0.0095	N/A	0.3719	N/A	AP42 3.1-1 & 3.1-2a	4/00	https://www3.epa.gov/ttnchie1/ap42/ch03/final/c03s01.pdf
RECIP. 2 Cycle Lean Natural Gas	g/hp-hr	0.1293	0.1293	0.0020	6.5998	0.4082	N/A	1.2009	N/A		AP42 3.2-1	7/00	https://www3.epa.gov/ttnchie1/ap42/ch03/final/c03s02.pdf
RECIP. 4 Cycle Lean Natural Gas	g/hp-hr	0.0002	0.0002	2.8814	0.4014	N/A	1.8949	N/A		AP42 3.2-2	7/00	https://www3.epa.gov/ttnchie1/ap42/ch03/final/c03s02.pdf	
RECIP. 4 Cycle Rich Natural Gas	g/hp-hr	0.0323	0.0323	0.0020	7.7224	0.1021	N/A	11.9408	N/A		AP42 3.2-3	7/00	https://www3.epa.gov/ttnchie1/ap42/ch03/final/c03s02.pdf
Diesel Recip. < 600 hp	g/hp-hr	1	1	1	0.0279	14.1	1.04	N/A	3.03	N/A	AP42 3.3-1	10/96	https://www3.epa.gov/ttnchie1/ap42/ch03/final/c03s03.pdf
Diesel Recip. > 600 hp	g/hp-hr	0.32	0.182	0.178	0.0055	10.9	0.29	N/A	2.5	N/A	AP42 3.4-1 & 3.4-2	10/96	https://www3.epa.gov/ttnchie1/ap42/ch03/final/c03s04.pdf
Diesel Boiler	lbs/bbl	0.0840	0.0420	0.0105	0.0089	1.0080	0.0084	5.14E-05	0.2100	0.0336	AP42 1.3-6; Pb and NH3: WebFIRE (08/2018)	9/98 and 5/10	
Diesel Turbine	g/hp-hr	0.0381	0.0137	0.0137	0.0048	2.7941	0.0013	4.45E-05	0.0105	N/A	AP42 3.1-1 & 3.1-2a	4/00	https://www3.epa.gov/ttnchie1/ap42/ch03/final/c03s01.pdf
Dual Fuel Turbine	g/hp-hr	0.0381	0.0137	0.0137	0.0048	2.7941	0.0095	4.45E-05	0.3719	0.0000	AP42 3.1-18 & 3.1-2a; AP42 3.1-1 & 3.1-2a	4/00	https://cfpub.epa.gov/webfire/
Vessels – Propulsion	g/hp-hr	0.320	0.1931	0.1873	0.0047	7.6669	0.2204	2.24E-05	1.2025	0.0022	USEPA 2017 NEI; TSP refer to Diesel Recip. > 600 hp reference	3/19	
Vessels – Drilling Prime Engine, Auxiliary	g/hp-hr	0.320	0.1931	0.1873	0.0047	7.6669	0.2204	2.24E-05	1.2025	0.0022	USEPA 2017 NEI; TSP refer to Diesel Recip. > 600 hp reference	3/19	https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-nei-data
Vessels – Diesel Boiler	g/hp-hr	0.0466	0.1491	0.1417	0.4400	1.4914	0.0820	3.73E-05	0.1491	0.0003	USEPA 2017 NEI; TSP (units converted) refer to Diesel Boiler Reference	3/19	
Vessels – Well Stimulation	g/hp-hr	0.320	0.1931	0.1873	0.0047	7.6669	0.2204	2.24E-05	1.2025	0.0022	USEPA 2017 NEI; TSP refer to Diesel Recip. > 600 hp reference	3/19	
Natural Gas Heater/Boiler/Burner	lbs/MMscf	7.60	1.90	1.90	0.60	190.00	5.50	5.00E-04	84.00	3.2	AP42 1.4-1 & 1.4-2; Pb and NH3: WebFIRE (08/2018)	7/98 and 8/18	https://www3.epa.gov/ttnchie1/ap42/ch01/final/c01s04.pdf
Combustion Flare (no smoke)	lbs/MMscf	0.00	0.00	0.00	0.57	71.40	35.93	N/A	325.5	N/A	AP42 13.5-1, 13.5-2	2/18	
Combustion Flare (light smoke)	lbs/MMscf	2.10	2.10	2.10	0.57	71.40	35.93	N/A	325.5	N/A	AP42 13.5-1, 13.5-2	2/18	
Combustion Flare (medium smoke)	lbs/MMscf	10.50	10.50	10.50	0.57	71.40	35.93	N/A	325.5	N/A	AP42 13.5-1, 13.5-2	2/18	https://www3.epa.gov/ttn-chief/ap42/ch13/final/C13S05_02-05-18.pdf
Combustion Flare (heavy smoke)	lbs/MMscf	21.00	21.00	21.00	0.57	71.40	35.93	N/A	325.5	N/A	AP42 13.5-1, 13.5-2	2/18	
Liquid Flaring	lbs/bbl	0.42	0.0966	0.0651	5.964	0.84	0.01428	5.14E-05	0.21	0.0336	AP42 1.3-1 through 1.3-3 and 1.3-5	5/10	https://www3.epa.gov/ttnchie1/ap42/ch01/final/c01s03.pdf
Storage Tank	tons/yr/tank						4.300				2014 Gulfwide Inventory; Avg emiss (upper bound of 95% CI)	2017	https://www.boem.gov/environment/environmental-studies/2014-gulfwide-emission-inventory
Fugitives	lbs/hr/component						0.0005				API Study	12/93	https://www.api.org/
Glycol Dehydrator	tons/yr/dehydrator						19.240				2011 Gulfwide Inventory; Avg emiss (upper bound of 95% CI)	2014	https://www.boem.gov/environment/environmental-studies/2011-gulfwide-emission-inventory
Cold Vent	tons/yr/vent						44.747				2014 Gulfwide Inventory; Avg emiss (upper bound of 95% CI)	2017	https://www.boem.gov/environment/environmental-studies/2014-gulfwide-emission-inventory
Waste Incinerator	lb/ton		15.0	15.0	2.5	2.0	N/A	20.0	N/A		AP 42 2.1-12	10/96	https://www3.epa.gov/ttnchie1/ap42/ch02/final/c02s01.pdf
On-Ice – Loader	lbs/gal	0.043	0.043	0.043	0.040	0.604	0.049	N/A	0.130	0.003	USEPA NONROAD2008 model; TSP (units converted) refer to Diesel Recip. <600 reference	2009	
On-Ice – Other Construction Equipment	lbs/gal	0.043	0.043	0.043	0.040	0.604	0.049	N/A	0.130	0.003	USEPA NONROAD2008 model; TSP (units converted) refer to Diesel Recip. <600 reference	2009	
On-Ice – Other Survey Equipment	lbs/gal	0.043	0.043	0.043	0.040	0.604	0.049	N/A	0.130	0.003	USEPA NONROAD2008 model; TSP (units converted) refer to Diesel Recip. <600 reference	2009	https://www.epa.gov/moves/nonroad2008a-installation-and-updates
On-Ice – Tractor	lbs/gal	0.043	0.043	0.043	0.040	0.604	0.049	N/A	0.130	0.003	USEPA NONROAD2008 model; TSP (units converted) refer to Diesel Recip. <600 reference	2009	
On-Ice – Truck (for gravel island)	lbs/gal	0.043	0.043	0.043	0.040	0.604	0.049	N/A	0.130	0.003	USEPA NONROAD2008 model; TSP (units converted) refer to Diesel Recip. <600 reference	2009	
On-Ice – Truck (for surveys)	lbs/gal	0.043	0.043	0.043	0.040	0.604	0.049	N/A	0.130	0.003	USEPA NONROAD2008 model; TSP (units converted) refer to Diesel Recip. <600 reference	2009	
Man Camp - Operation (max people/day)	tons/person/day		0.0004	0.0004	0.0004	0.006	0.001	N/A	0.001	N/A	BOEM 2014-1001	2014	https://www.boem.gov/sites/default/files/uploadedFiles/BOEM/BOEM_Newsroom/Library/Publications/2014-1001.pdf
Vessels - Ice Management Diesel	g/hp-hr	0.320	0.1931	0.1873	0.0047	7.6669	0.2204	2.24E-05	1.2025	0.0022	USEPA 2017 NEI; TSP refer to Diesel Recip. > 600 hp reference	3/19	https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-nei-data
Vessels - Hovercraft Diesel	g/hp-hr	0.320	0.1931	0.1873	0.0047	7.6669	0.2204	2.24E-05	1.2025	0.0022	USEPA 2017 NEI; TSP refer to Diesel Recip. > 600 hp reference	3/19	https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-nei-data

Sulfur Content Source	Value	Units
Fuel Gas	3.38	ppm
Diesel Fuel (6)	0.0015	% weight
Produced Gas (Flare)	3.38	ppm
Produced Oil (Liquid Flaring)	1	% weight

Density and Heat Value of Diesel Fuel		
Density	7.05	lbs/gal
Heat Value	19,300	Btu/lb

Heat Value of Natural Gas		
Heat Value	1,050	MMBtu/MMscf

Natural Gas Flare Parameters	Value	Units
VOC Content of Flare Gas	0.6816	lb VOC/lb-mol gas
Natural Gas Flare Efficiency	98	%

Notes:

1. Reserved.
2. Reserved.

AIR EMISSIONS CALCULATIONS - 2021-2025

COMPANY	AREA	BLOCK	LEASE	FACILITY	WELL	CONTACT	PHONE	REMARKS																	
Shell Offshore Inc	Walker Ridge	508 (Surface Location)	OCS-G17001	MODU (Semi-sub or Drillship)	DC1 Wells CC, DD, CC-Alt1, and CC-Alt2	504-425-9097	Josh O'Brien	Supplemental EPMODU (Drillship or DP Semi-sub) No non-default emission factors or emission reduction measures were used in this AQR. Stories-AQR-sEP-DPMODU-20220527-BOEM.xlsx																	
OPERATIONS	EQUIPMENT	EQUIPMENT ID	RATING	MAX. FUEL	ACT. FUEL	RUN TIME	MAXIMUM POUNDS PER HOUR								ESTIMATED TONS										
	Diesel Engines		HP	GAL/HR	GAL/D																				
	Nat. Gas Engines		HP	SCF/HR	SCF/D																				
	Burners		MMBTU/HR	SCF/HR	SCF/D	HR/D	D/YR	TSP	PM10	PM2.5	SOx	NOx	VOC	Pb	CO	NH3	TSP	PM10	PM2.5	SOx	NOx	VOC	Pb	CO	NH3
DRILLING	VESSELS- Drilling - Propulsion Engine - Diesel	9387	482.9	11590.2	24	270	6.62	4.00	3.88	0.10	158.67	4.56	0.00	24.89	0.05	21.46	12.95	12.56	0.31	514.08	14.78	0.00	80.63	0.15	
	VESSELS- Drilling - Propulsion Engine - Diesel		482.9	11590.2	24	270	6.62	4.00	3.88	0.10	158.67	4.56	0.00	24.89	0.05	21.46	12.95	12.56	0.31	514.08	14.78	0.00	80.63	0.15	
	VESSELS- Drilling - Propulsion Engine - Diesel		482.9	11590.2	24	270	6.62	4.00	3.88	0.10	158.67	4.56	0.00	24.89	0.05	21.46	12.95	12.56	0.31	514.08	14.78	0.00	80.63	0.15	
	VESSELS- Drilling - Propulsion Engine - Diesel		482.9	11590.2	24	270	6.62	4.00	3.88	0.10	158.67	4.56	0.00	24.89	0.05	21.46	12.95	12.56	0.31	514.08	14.78	0.00	80.63	0.15	
	VESSELS- Drilling - Propulsion Engine - Diesel		482.9	11590.2	24	270	6.62	4.00	3.88	0.10	158.67	4.56	0.00	24.89	0.05	21.46	12.95	12.56	0.31	514.08	14.78	0.00	80.63	0.15	
	Vessels - Diesel Boiler		0			0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	Vessels - Drilling Prime Engine, Auxiliary		0	0.0	0.0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	RECIP.<600hp Diesel		2547	131.0	3144.8	1	270	1.80	1.02	1.00	0.03	61.21	1.63	--	14.04	--	0.24	0.14	0.13	0.00	8.26	0.22	--	1.90	--
	RECIP.>600hp Diesel		Emergency Air C	26	1.3	32.1	1	270	0.06	0.06	0.00	0.81	0.06	--	0.17	--	0.01	0.01	0.00	0.11	0.01	--	0.02	--	
	VESSELS - Well Completion/Fracturing		37500	1929.2	46301.4	24	20	26.46	15.96	15.48	0.39	633.85	18.22	0.00	99.42	0.18	6.35	3.83	3.72	0.09	152.12	4.37	0.00	23.86	0.04
	VESSELS - Multi-Purpose Service		13000	668.8	16051.2	24	20	9.17	5.53	5.37	0.13	219.74	6.32	0.00	34.46	0.06	2.20	1.33	1.29	0.03	52.74	1.52	0.00	8.27	0.02
2023-2026 Annual Facility Total Emissions								77.21	46.55	45.16	1.13	1,867.59	53.60	0.01	297.41	0.53	137.54	82.98	80.49	2.00	3,297.69	94.80	0.01	517.84	0.96
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES																5,927.40		5,927.40	5,927.40	5,927.40			107,586.78	
DRILLING	178.0																							0.56	
	VESSELS- Fast/Crew Diesel	8000	411.57	9877.63	24	81	5.64	3.41	3.30	0.08	135.22	3.89	0.00	21.21	0.04	5.49	3.31	3.21	0.08	131.44	3.78	0.00	20.62	0.04	
	VESSELS - Supply Diesel		10100	519.60	12470.51	24	270	7.13	4.30	4.17	0.10	170.72	4.91	0.00	26.78	0.05	23.09	13.93	13.51	0.34	553.12	15.90	0.00	86.76	0.16
	VESSELS - Supply Diesel		10100	519.60	12470.51	24	41	7.13	4.30	4.17	0.10	170.72	4.91	0.00	26.78	0.05	3.46	2.09	2.03	0.05	82.97	2.39	0.00	13.01	0.02
	VESSELS - Supply Diesel		10100	519.60	12470.51	24	41	7.13	4.30	4.17	0.10	170.72	4.91	0.00	26.78	0.05	3.46	2.09	2.03	0.05	82.97	2.39	0.00	13.01	0.02
	VESSELS - Supply Diesel		10100	519.60	12470.51	24	0	7.13	4.30	4.17	0.10	170.72	4.91	0.00	26.78	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	VESSELS - Supply Diesel		13000	668.80	16051.15	24	0	9.17	5.53	5.37	0.13	219.74	6.32	0.00	34.46	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	VESSELS - Supply Diesel							43.32	26.13	25.35	0.63	1,037.83	29.84	0.00	162.78	0.30	35.50	21.42	20.77	0.52	850.50	24.45	0.00	133.40	0.25
2023-2026 Annual Non-Facility Total Emissions																									

AIR EMISSIONS CALCULATIONS

COMPANY	AREA	BLOCK	LEASE	FACILITY	WELL				
Shell Offshore Inc	Walker Ridge	508 (Surface Location)	OCS-G17001	MODU (Semi-sub or Drillship)	DC1 Wells CC, DD, CC-Alt1, and CC-Alt2				
Facility Emitted Substance									
Year	TSP	PM10	PM2.5	SOx	NOx	VOC	Pb	CO	NH3
2023-2026	137.54	82.98	80.49	2.00	3297.69	94.80	0.01	517.84	0.96
Allowable	5927.40	0.00	0.00	5927.40	5927.40	5927.40	0.00	107586.78	0.00

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 254.47 and NTL 2013-N02. Shell's regional OSRP was approved by BSEE in June 2017. The bi-annual review was updated December 2021 and is in BSEE review.

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

Table 9.1 – Response Equipment and Staging Areas

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.) and Shell also has the option to pull from their trained personnel as needed for assistance/expertise in the Command Post and in the field.

Category	Regional OSRP	EP
Type of Activity	Exploratory Drilling	Exploratory Drilling
Facility Location (area/block)	MC 812	WR 508
Facility Designation	Subsea well B♦	Subsea well K♦♦
Distance to Nearest Shoreline (miles)	56	178
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)	<u>468,000* BOPD</u>	<u>47,114** BOPD</u>
Total Volume	468,000 Bbls	47,114 Bbls
Type of Oil(s) - (crude oil, condensate, diesel)	Crude oil	Crude oil
API Gravity(s)	31°	28°

Table 9.2 - Worst Case Scenario Determination

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

♦ This well was accepted by BOEM in plan N-9840.

** 24-hour rate (37,318 BOPD 30-day average)

♦♦ This well was accepted by BOEM in plan S-7599

Certification: Since Shell Offshore Inc. has the capability to respond to the appropriate worst-case spill scenario included in its regional OSRP, approved by BSEE June 2017. The bi-annual review was updated December 2021 and is in BSEE review. Since the worst-case scenario determined for our Plan does not replace the appropriate worst-case scenario in our regional OSRP, I hereby certify that Shell Offshore Inc. 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 plan.

Modeling: Based on the requirement per BSEE NTL 2008-G04 and the outcome of the OSRAM Model, Shell 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 WR508	17001	48	Matagorda, TX	1		
			Brazoria, TX	1		
			Galveston, TX	2		
			Jefferson, TX	1		
			Cameron, LA	2		
			Vermilion, LA	1		
			Iberia, LA	-		
			St. Mary, LA	-		
			Terrebonne, LA	1		
			Lafourche, LA	-		
			Jefferson, LA	-		
			Plaquemines, LA	2		

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 Walker Ridge 508 WCD scenario.

Onshore/Nearshore: Galveston County is located on the plains of the Texas Gulf Coast in the southeastern part of the state. The county is bounded on the northeast by Galveston Bay and on the northwest by Clear Creek and Clear Lake. Much of the county covers Galveston Bay, and is bounded to the south by the Galveston Seawall and beaches on the Gulf of Mexico. Galveston County has a total area of 873 square miles which 398 square miles is land and 474 square miles (54.35%) is water.

Cameron Parish is located in the southwest corner of Louisiana and has a total area of 1,932 square miles of which, 1,313 square miles of it is land and 619 square miles is water. Cameron Parish includes four National Wildlife Refuges including the Cameron Prairie National Wildlife Refuge, East Cove National Wildlife Refuge, Sabine National Wildlife Refuge and part of the Lacassine National Wildlife Refuge.

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. Example ESI maps for Plaquemines Parish and the legend are shown in Figures 9.C.1through 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 WR 508 Worst Case Discharge as effectively as possible. Below is a table outlining the applicable evaporation and surface dispersion quantity:

Walker Ridge Block 508		Calculations (BBLS)
i.	TOTAL WCD (based on 30-day average (per day))	~37,318
ii.	Loss of volume of oil to natural surface dispersion and evaporation base (approximate bbls per day)* (16% Natural surface evaporation and dispersion in 24 hrs)	-5,971
TOTAL REMAINING		~31,347

Table 9.D.1 Oil Remaining After Subsurface and 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 35 hours (based on the equipment's Estimated Daily Response Capacity (EDRC) and storage). 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 WR 508 will be addressed in Shell's NTL10 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 590,000 barrels/day. Temporary storage associated with the identified skimming and temporary storage equipment equals approximately 459,000 barrels.

	De-rated Recovery Rate (bopd)	Storage (bbls)
Offshore Recovery and Storage	275,627	443,121
Nearshore Recovery and Storage	315,008	15,979
Total	590,635	459,100

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 Activation 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 OSRL'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 MWCC and 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, these systems have 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] EXPOSED WAVE-CUT PLATFORMS IN CLAY
- [2B] EXPOSED SCARPS AND STEEP SLOPES IN CLAY
- [3A] FINE- TO MEDIUM-GRAINED SAND BEACHES
- [3B] 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] SHELTERED TIDAL FLATS
- [9B] 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

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HUMAN-USE FEATURES

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Figure 9.C.1 Environmental Sensitivity Index Map Legend

ENVIRONMENTAL SENSITIVITY INDEX MAP

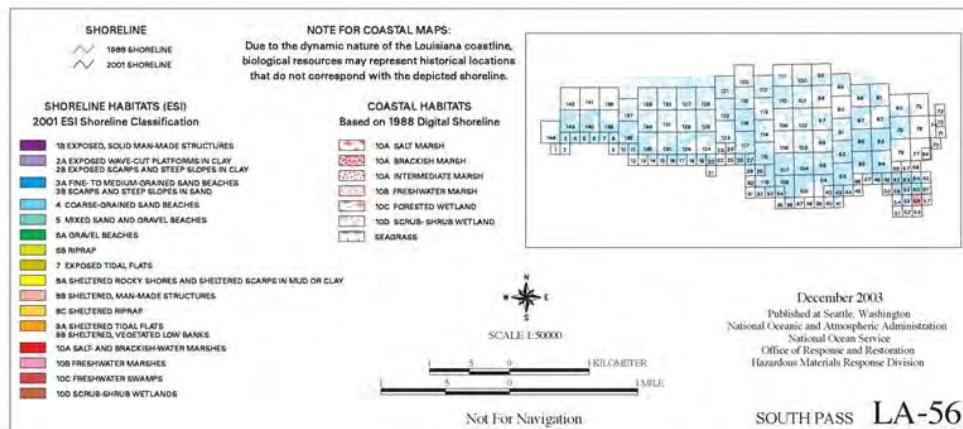
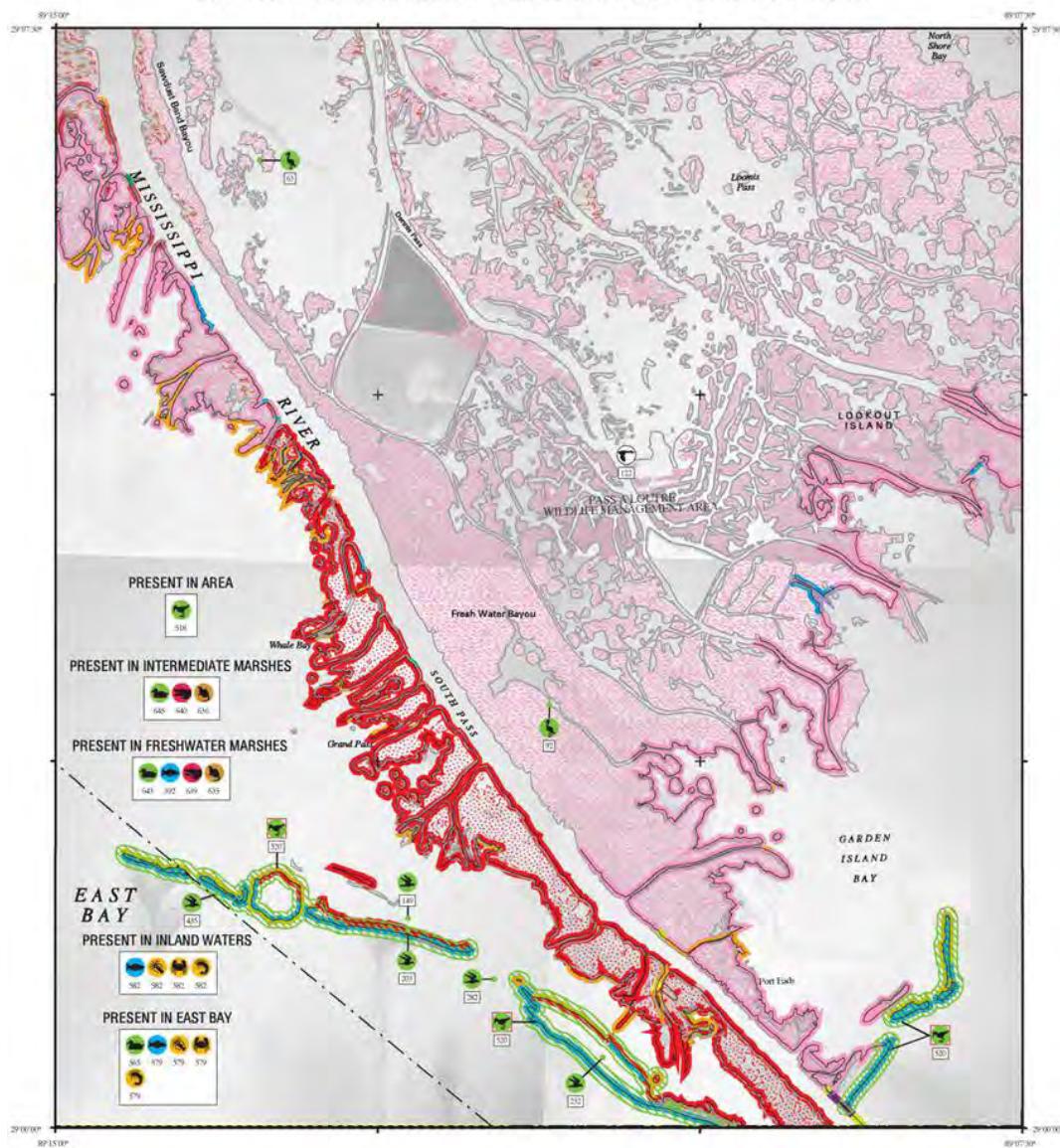


Figure 9.C.2 South Pass ESI Map

ENVIRONMENTAL SENSITIVITY INDEX MAP

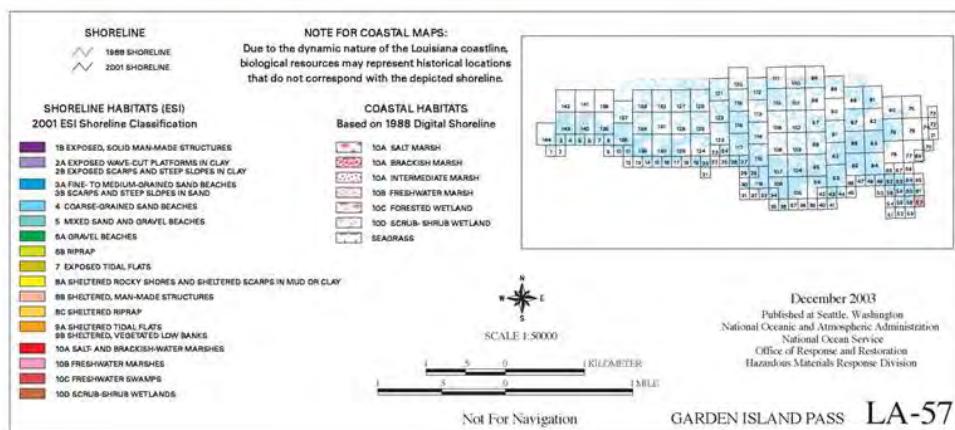
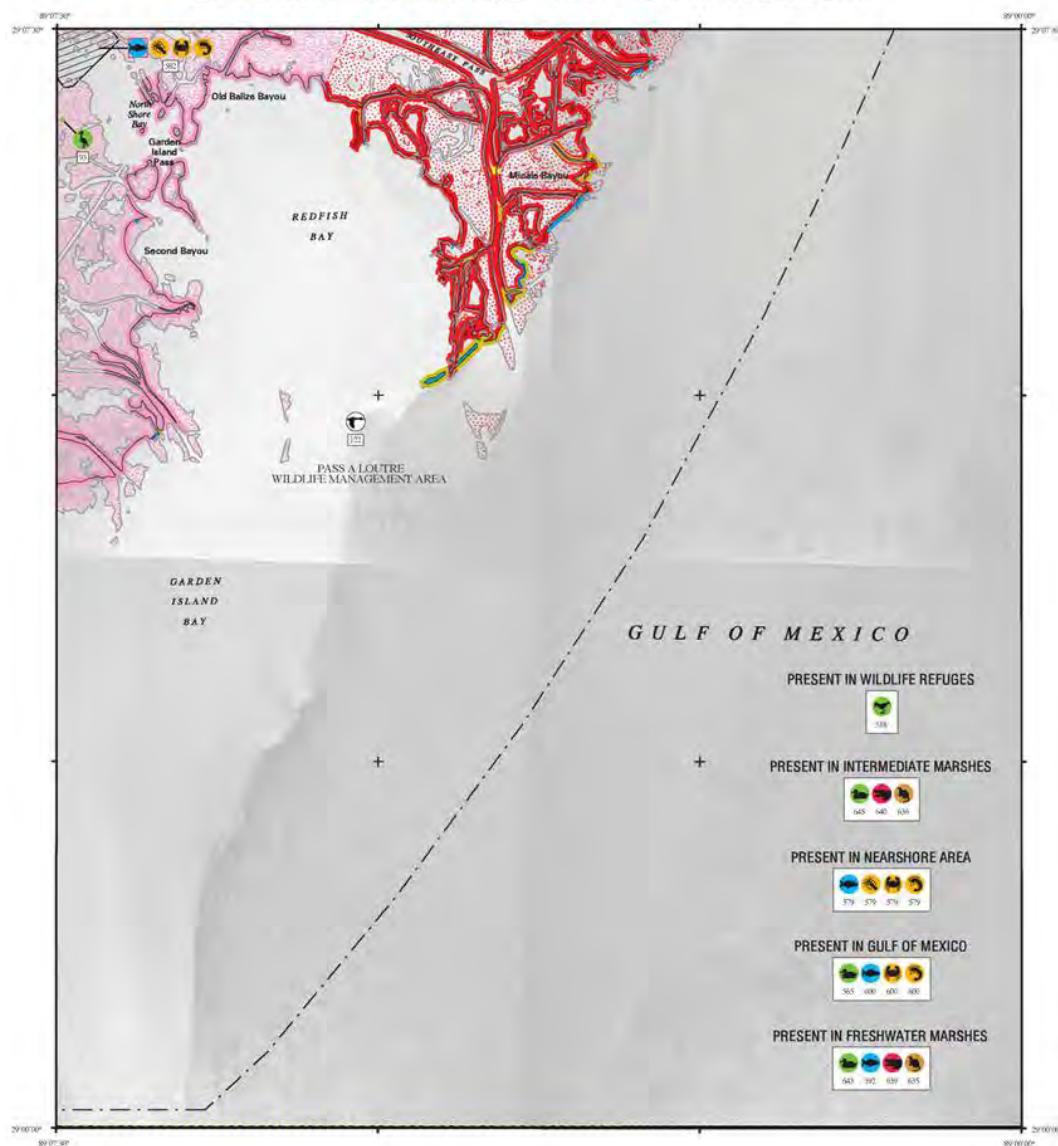
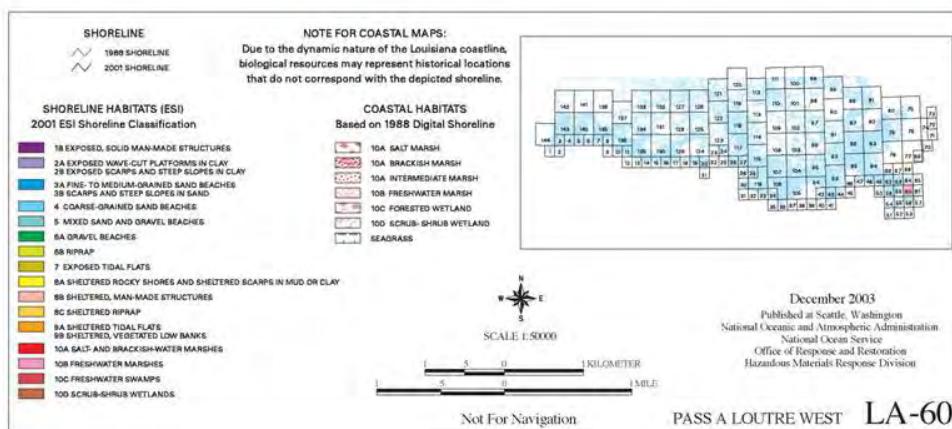
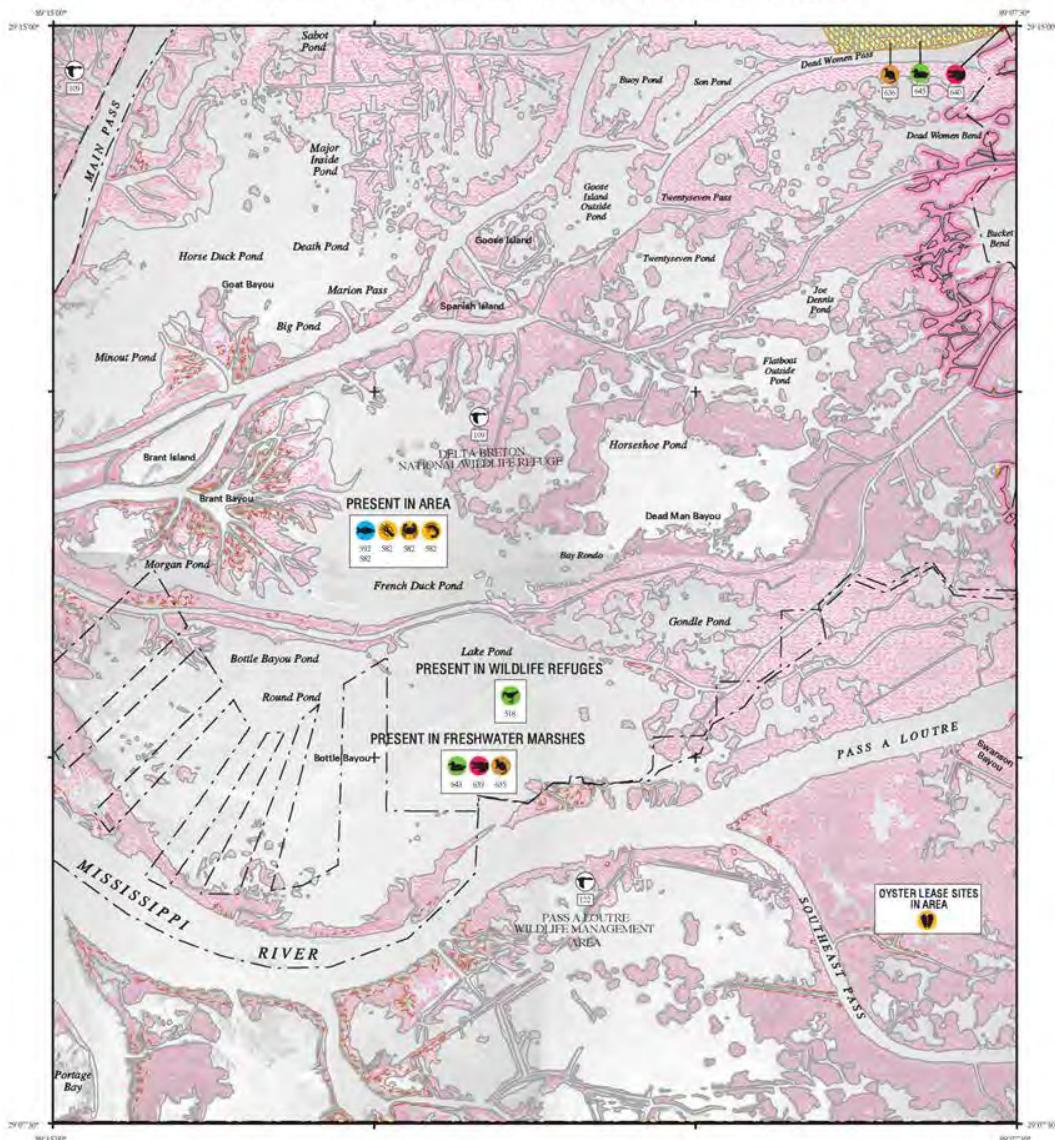


Figure 9.C.3 Garden Island Pass ESI Map

ENVIRONMENTAL SENSITIVITY INDEX MAP



ENVIRONMENTAL SENSITIVITY INDEX MAP

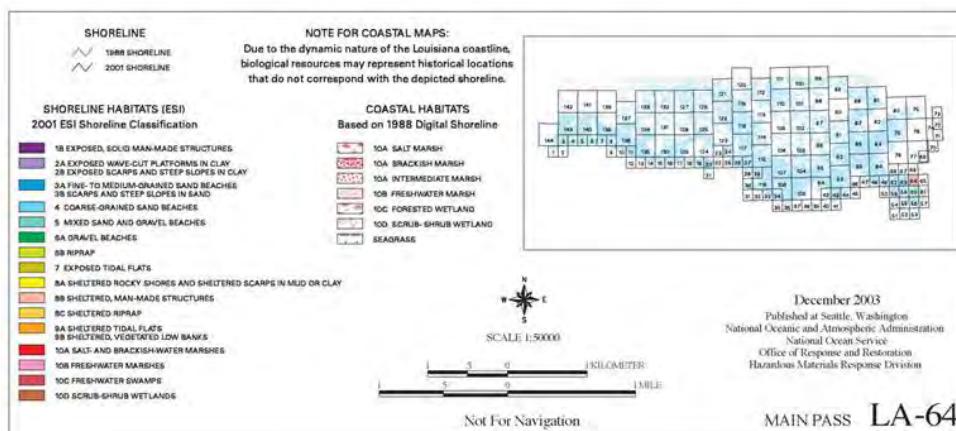
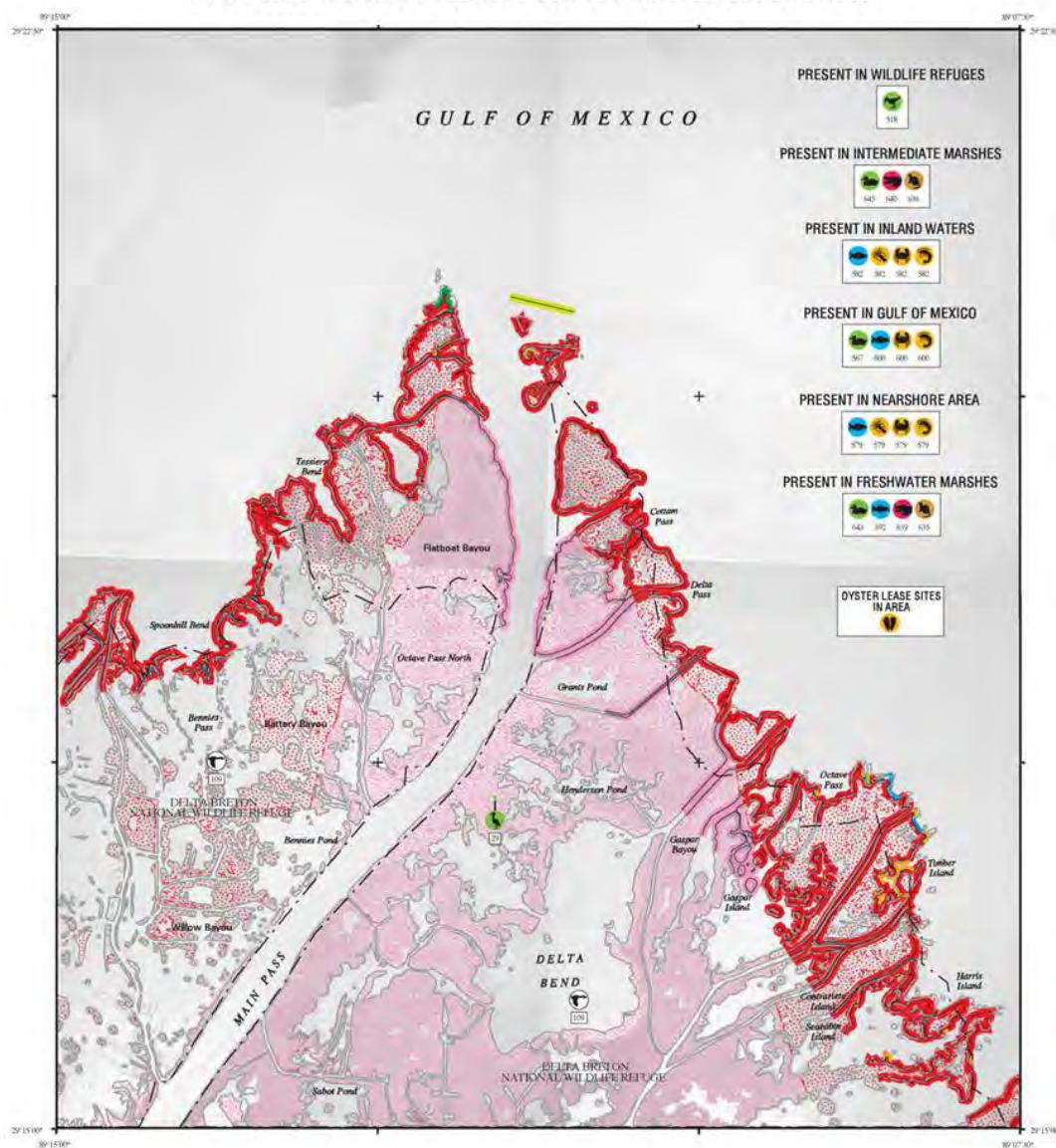


Figure 9.C.5 Main Pass ESI Map

Walker Ridge 508
Sample Offshore On-Water Recovery & Storage Activation List

Skimming System	Supplier & Phone	Warehouse	Skimming Package	Quantity	Est. Derated 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 H.I. Rich	CGA 888-CGA-2007	Leeville, LA	Lamor Brush Skimmer 42' Boom 95' Vessel X Band Radar Personnel	2 40 1 1 4	12,342	249	Leeville, LA	188	2	0	8.5	1	11.5
FRV Breton Island	CGA 888-CGA-2007	Venice, LA	Lamor Brush Skimmer 42' Boom 95' Vessel X Band Radar Personnel	2 40 1 1 4	12,342	249	Venice, LA	219	2	0	10	1	13
Deep Blue Responder LFF 100 Brush	MSRC 800-OIL-SPIL	Port Fourchon, LA	LFF 100 Brush Skimmer 67' Boom 210' Vessel Personnel 32' Support Boat	1 7260' 1 12 1	18,086	4,000	Port Fourchon, LA	188	2	1	13.5	1	17.5
FRV Galveston Island	CGA 888-CGA-2007	Galveston, TX	Lamor Brush Skimmer 42' Boom 95' Vessel X Band Radar Personnel	2 40 1 1 4	12,342	249	Galveston, TX	320	2	0	14.5	1	17.5
M/V Recovery MOSS Unit w/ GT-185	AMPOL 800-482-6765	Port Fourchon, LA	GT-185 Skimmer 36" Expandi Boom Personnel 110' Utility Boat Crew Boat - >65'	1 720' 8 1 1	1,371	200	Port Fourchon, LA	188	2	1	13.5	1	17.5
FOILEX 250	MSRC 800-OIL-SPIL	Belle Chasse, LA	Offshore Skimmer 43' Offshore Boom Personnel *>110' Utility Boat Towable Bladder	1 100' 4 1 1	3,977	500	Port Fourchon, LA	188	4.25	1	13.5	1	19.75
DESMI OCEAN	MSRC 800-OIL-SPIL	Belle Chasse, LA	Offshore Skimmer 67" Offshore Boom Personnel * Crew Boat * >110' Utility Boat Towable Bladder	1 330' 4 1 1 1	3,017								
W-4	MSRC 800-OIL-SPIL	Belle Chasse, LA	Offshore Skimmer 67" Offshore Boom Personnel * Crew Boat >110' Utility Boat w/crane Towable Bladder	1 330' 4 1 1 1	3,017	500	Port Fourchon, LA	188	4.25	1	13.5	1	19.75
Fast Response Unit "FRU" 1.0	CGA 888-CGA-2007	Harvey, LA	Foilex 250 Skimmer Personnel Utility Boat ** 67" Sea Sentry ** Crew Boat ** Add'l Storage	1 4 1 440' 1 1 1	4,251								
Fast Response Unit "FRU" 1.0	CGA 888-CGA-2007	Leeville, LA	Foilex 250 Skimmer Personnel Utility Boat ** 67" Sea Sentry ** Crew Boat ** Add'l Storage	1 4 1 440' 1 1 1	4,251	100	Port Fourchon, LA	188	4	1	13.5	1	20
Fast Response Unit "FRU" 1.0	CGA 888-CGA-2007	Leeville, LA	Foilex 250 Skimmer Personnel Utility Boat ** 67" Sea Sentry ** Crew Boat ** Add'l Storage	1 4 1 440' 1 1 1	4,251								
Fast Response Unit "FRU" 1.0	CGA 888-CGA-2007	Leeville, LA	Foilex 250 Skimmer Personnel Utility Boat ** 67" Sea Sentry ** Crew Boat ** Add'l Storage	1 4 1 440' 1 1 1	4,251	100	Port Fourchon, LA	188	4	1	13.5	1	20
Fast Response Unit "FRU" 1.0	CGA 888-CGA-2007	Morgan City, LA	Foilex 250 Skimmer Personnel Utility Boat ** 67" Sea Sentry ** Crew Boat ** Add'l Storage	1 4 1 440' 1 1 1	4,251								
Louisiana Responder LFF 100 Brush	MSRC 800-OIL-SPIL	Fort Jackson, LA	LFF 100 Brush Skimmer 67' Boom 210' Vessel Personnel 32' Support Boat	1 7920' 1 12 1	18,086	4,000	Fort Jackson, LA	228	2	1	16.5	1	20.5

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

Walker Ridge 508
Sample Offshore On-Water Recovery & Storage Activation List

Skimming System	Supplier & Phone	Warehouse	Skimming Package	Quantity	Est. Derated Recovery Capacity (EDRRC in Bbls./Day)	Storage (Barrels)	Staging Area	Distance to Site from Staging (Miles)	Response Times (Hours)														
									Staging ETA	Leadout Time	ETA to Site	Deployment Time	Total ETA										
WP-1	MSRC 800-OIL-SPIL	Pascagoula, MS	Offshore Skimmer	1	3,017	500	Port Fourchon, LA	188	5.75	1	13.5	1	21.25										
			87' Offshore Boom	330'																			
			Personnel	4																			
			* Crew Boat	1																			
			* >110' Utility Boat	1																			
			Towable Bladder	1																			
Stress 1	MSRC 800-OIL-SPIL	Lake Charles, LA	Offshore Skimmer	1	15,840	500	Port Fourchon, LA	188	6.25	1	13.5	1	21.75										
			87' Offshore Boom	330'																			
			Personnel	4																			
			* Crew Boat	1																			
			* >110' Utility Boat	1																			
			Towable Bladder	1																			
FOILEX 250	MSRC 800-OIL-SPIL	Lake Charles, LA	Offshore Skimmer	1	3,977	500	Port Fourchon, LA	188	6.25	1	13.5	1	21.75										
			43' Offshore Boom	100'																			
			Personnel	4																			
			* >110' Utility Boat	1																			
			Towable Bladder	1																			
			Offshore Skimmer	1																			
DESMI OCEAN	MSRC 800-OIL-SPIL	Lake Charles, LA	87' Offshore Boom	330'	3,017	500	Port Fourchon, LA	188	6.25	1	13.5	1	21.75										
			* Crew Boat	1																			
			Personnel	4																			
			* >110' Utility Boat	1																			
			Towable Bladder	1																			
			Offshore Skimmer	1																			
Fast Response Unit "FRU" 1.0	CGA 888-CGA-2007	Venice, LA	Foilex 250 Skimmer	1	4,251	100	Port Fourchon, LA	188	5.75	1	13.5	1	22										
			Personnel	4																			
			Utility Boat	1																			
			** 67' Sea Sentry	440'																			
			** Crew Boat	1																			
			** Add'l Storage	1																			
Fast Response Unit "FRU" 1.0	CGA 888-CGA-2007	Lake Charles, LA	Foilex 250 Skimmer	1	4,251	100	Port Fourchon, LA	188	6.25	1	13.5	1	22										
			Personnel	4																			
			Utility Boat	1																			
			** 67' Sea Sentry	440'																			
			** Crew Boat	1																			
			** Add'l Storage	1																			
Fast Response Unit "FRU" 1.0	CGA 888-CGA-2007	Venice, LA	Foilex 250 Skimmer	1	4,251	100	Port Fourchon, LA	188	5.75	1	13.5	1	22										
			Personnel	4																			
			Utility Boat	1																			
			** 67' Sea Sentry	440'																			
			** Crew Boat	1																			
			** Add'l Storage	1																			
Gulf Coast Responder Transrec-350	MSRC 800-OIL-SPIL	Lake Charles, LA	Transrec/Stress 1 Skimmer	2	10,567	4,000	Lake Charles, LA	302	2	1	21.5	1	25.5										
			87' Boom	2840'																			
			210' Vessel	1																			
			Personnel	12																			
			32' Support Boat	1																			
			Transrec/Stress 1 Skimmer	2																			
Mississippi Responder Transrec-350	MSRC 800-OIL-SPIL	Pascagoula, MS	87' Boom	2840'	10,567	4,000	Pascagoula, MS	316	2	1	22.5	1	26.5										
			210' Vessel	1																			
			Personnel	12																			
			32' Support Boat	1																			
			Offshore Barge	1																			
			Personnel	11																			
OSG 192 Offshore Barge	MSRC 800-OIL-SPIL	New Orleans, LA	* Offshore Tug	1	N/A	165,000	New Orleans, LA	302	4	0	36	1	41										
			Offshore Barge	1																			
			Personnel	11																			
DERATED RECOVERY RATE (BBLS/DAY)										161,322													
STORAGE CAPACITY INCLUDING SKIMMING VESSELS (BARRELS)										186,847													
<small>* - These components are additional operational requirements that must be procured by OSROs in addition to the system identified.</small> <small>** - These components are required to use the associated packages in an "enhanced skimming" configuration.</small>																							

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

Walker Ridge 508
Sample Nearshore On-Water Recovery Activation List

Skimming System	Supplier & Phone	Warehouse	Skimming Package	Quantity	Est. Derated Recovery Capacity (EDRRC 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 RW Armstrong	CGA 888-CGA-2007	Leeville, LA	Lori Brush Skimmer 32' Boom 46' Vessel Personnel	2 50' 1 4	5,000	65	Leeville, LA	198	2	0	9	0.5	11.5
SWS CGA-73 Trinity Shallow Water Skimmer	CGA 888-CGA-2007	Leeville, LA	Marco Belt Skimmer 30" Auto Boom Personnel 56' SWS Vessel 14'-16' Aluminum Flatboa	2 150' 5 1 2	21,500	249	Leeville, LA	198	2	1	9	1	13
FRV M/V Grand Bay	CGA 888-CGA-2007	Venice, LA	Lori Brush Skimmer 32' Boom 46' Vessel Personnel	2 50' 1 4	5,000	65	Venice, LA	219	2	0	10	1	13
SWS CGA-74 Trinity Shallow Water Skimmer	CGA 888-CGA-2007	Venice, LA	Marco Belt Skimmer 30" Auto Boom Personnel 56' SWS Vessel 14'-16' Aluminum Flatboa	2 150' 5 1 2	21,500	249	Venice, LA	219	2	1	10	1	14
SWS CGA-72 Trinity Shallow Water Skimmer	CGA 888-CGA-2007	Morgan City, LA	Marco Belt Skimmer 30" Auto Boom Personnel 56' SWS Vessel 14'-16' Aluminum Flatboa	2 150' 5 1 2	21,500	249	Morgan City, LA	234	2	1	10.5	1	14.5
FRV M/V Bastian Bay	CGA 888-CGA-2007	Lake Charles, LA	Lori Brush Skimmer 32' Boom 46' Vessel Personnel	2 50' 1 4	5,000	65	Lake Charles, LA	302	2	0	13.5	1	16.5
FRV CGA 58 Timbalier Bay	CGA 888-CGA-2007	Galveston, TX	Lori Brush Skimmer 32" Boom 46' Vessel Personnel	2 50' 1 4	5,000	65	Galveston, TX	320	2	0	14.5	1	17.5
SWS CGA-71 Trinity Shallow Water Skimmer	CGA 888-CGA-2007	Galveston, TX	Marco Belt Skimmer 30" Auto Boom Personnel 56' SWS Vessel 14'-16' Aluminum Flatboa	2 150' 5 1 2	21,500	249	Galveston, TX	320	2	1	14.5	1	18.5
MSRC "Kvichak"	MSRC 800-OIL-SPIL	Fort Jackson, LA	Marco Skimmer Personnel 30' Fast Response Boat	1 4 1	3,588	24	Fort Jackson, LA	228	2	1	16.5	1	20.5
SBS w/ Queensboro	MSRC 800-OIL-SPIL	Pascagoula, MS	Skimmer 20" Boom Personnel * Push Boat Towable Bladder	1 50' 4 1 1	905	400	Port Fourchon, LA	188	6	1	13.5	1	21.25
SBS w/ GT-185	MSRC 800-OIL-SPIL	Pascagoula, MS	Skimmer 20" Boom Personnel * Push Boat Towable Bladder	1 50' 4 1 1	1,371		Port Fourchon, LA	188	6	1	13.5	1	21.25
VOSS w/ AARDVAC	MSRC 800-OIL-SPIL	Pascagoula, MS	Skimmer 20" Boom Personnel * Utility Boat Towable Bladder	1 50' 4 1 1	3,840	500	Port Fourchon, LA	188	6	1	13.5	1	21.25
SBS w/ Queensboro	MSRC 800-OIL-SPIL	Lake Charles, LA	Skimmer 20" Boom Personnel * Push Boat	1 50' 4 1	905		Port Fourchon, LA	188	6.25	1	13.5	1	21.75
SBS w/ Queensboro	MSRC 800-OIL-SPIL	Lake Charles, LA	Offshore Skimmer 20" Boom Personnel * Push Boat Towable Bladder	1 50' 4 1 1	905	400	Port Fourchon, LA	188	6	1	13.5	1	21.75
SBS w/ Queensboro	MSRC 800-OIL-SPIL	Lake Charles, LA	Skimmer 20" Boom Personnel * Push Boat Towable Bladder	1 50' 4 1 1	905	500	Port Fourchon, LA	188	6	1	13.5	1	21.75

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

Walker Ridge 508
Sample Nearshore On-Water Recovery Activation List

Skimming System	Supplier & Phone	Warehouse	Skimming Package	Quantity	Est. Derated Recovery Capacity (EDRC in Bbs/Day)	Storage (Barrels)	Staging Area	Distance to Nearshore Environment (Miles)	Response Times (Hours)				Total ETA
									Staging ETA	Loadout Time	ETA to Nearshore Environment	Deployment Time	
SBS w/ Queensboro	MSRC 800-OIL-SPIL	Lake Charles, LA	Offshore Skimmer 20' Boom Personnel * Push Boat Towable Bladder	1 50' 4 1 1	905	400	Port Fourchon, LA	188	6	1	13.5	1	21.75
SBS w/ Queensboro	MSRC 800-OIL-SPIL	Galveston, TX	Offshore Skimmer 20' Boom Personnel * Push Boat Towable Bladder	1 50' 4 1 1	905	400	Port Fourchon, LA	188	8.75	1	13.5	1	24.25
SBS w/ Stress 1	MSRC 800-OIL-SPIL	Galveston, TX	Offshore Skimmer 20' Boom Personnel * Push Boat Towable Bladder	1 50' 4 1 1	15,840	400	Port Fourchon, LA	188	8.75	1	13.5	1	24.25
SBS w/ Queensboro	MSRC 800-OIL-SPIL	Memphis, TN	Offshore Skimmer 20' Boom Personnel * Push Boat Towable Bladder	1 50' 4 1 1	905		Port Fourchon, LA	188	9	1	13.5	1	24.75
MSRC "Quick Strike"	MSRC 800-OIL-SPIL	Lake Charles, LA	LOR Brush Skimmer Personnel 47' Fast Response Boat	1 4 1	5,000	50	Lake Charles, LA	302	2	1	21.5	1	25.5
MSRC "Kvichak"	MSRC 800-OIL-SPIL	Pascagoula, MS	Marco Skimmer Personnel 30' Fast Response Boat	1 4 1	3,588	24	Pascagoula, MS	316	2	1	22.5	1	26.5
SWS CGA-55 Egmpol Shallow Water Skimmer	CGA 888-CGA-2007	Morgan City, LA	Belt Skimmer 18" Boom (contractor) Personnel 38' Skimming Vessel Shallow Water Barge	1 100' 3 1 1	3,000	90	Port Fourchon, LA	188	4	1	21	1	27
SBS w/ Stress 1	MSRC 800-OIL-SPIL	Ingleside, TX	Offshore Skimmer 20' Boom Personnel * Push Boat Towable Bladder	1 50' 4 1 1	15,840	400	Port Fourchon, LA	188	11.50	1	13.5	1	27
SWS CGA-53 MARCO Shallow Water Skimmer	CGA 888-CGA-2007	Leeville, LA	Marco Belt Skimmer 18" Boom (contractor) Personnel 38' Skimming Vessel	1 100' 3 1	3,588	34	Port Fourchon, LA	188	4	1	21	1	27
WP-1	MSRC 800-OIL-SPIL	Ingleside, TX	Offshore Skimmer 20' Boom Personnel * Crew Boat * Utility Boat Towable Bladder	1 50' 4 1 1 1	3,017		Port Fourchon, LA	188	11.50	1	13.5	1	27
WP-1	MSRC 800-OIL-SPIL	Tampa, FL	Offshore Skimmer 20' Boom Personnel * Crew Boat Towable Bladder	1 50' 4 1 1	3,017		Port Fourchon, LA	188	13	1	13.5	1	28.75
SWS CGA-52 MARCO Shallow Water Skimmer	CGA 888-CGA-2007	Venice, LA	Marco Belt Skimmer 18" Boom (contractor) Personnel 36' Skimming Vessel Shallow Water Barge	1 100' 3 1 1	3,588	34	Port Fourchon, LA	188	6	1	21	1	28.75
SWS CGA-51 MARCO Shallow Water Skimmer	CGA 888-CGA-2007	Lake Charles, LA	Marco Belt Skimmer 18" Boom (contractor) Personnel 34' Skimming Vessel Shallow Water Barge	1 100' 3 1 1	3,588	20	Port Fourchon, LA	188	6	1	21	1	29.25
CGA-54 Egmpol Shallow Water Skimmer	CGA 888-CGA-2007	Galveston, TX	Egmpol Belt Skimmer 18" Boom (contractor) Personnel 34' Skimming Vessel Shallow Water Barge	1 100' 3 1 1	3,000	90	Port Fourchon, LA	188	9	1	21	1	31.75

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

Walker Ridge 508
Sample Nearshore On-Water Recovery Activation List

Skimming System	Supplier & Phone	Warehouse	Skimming Package	Quantity	Est. Derated 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
WP-1	MSRC 800-OIL-SPIL	Miami, FL	Offshore Skimmer 20' Boom Personnel * Utility Boat Towable Bladder	1 50' 4 2 1	3,017	500	Port Fourchon, LA	188	16	1	13.5	1	31.75
Barge Boat w/ AARDVAC	MSRC 800-OIL-SPIL	Miami, FL	Offshore Skimmer 20' Boom Personnel * Barge Boat Towable Bladder	1 50' 4 1 1	3,840	500	Port Fourchon, LA	188	16	1	13.5	1	31.75
Barge Boat w/ AARDVAC	MSRC 800-OIL-SPIL	Miami, FL	Offshore Skimmer 20' Boom Personnel * Barge Boat Towable Bladder	1 50' 4 1 1	3,840	500	Port Fourchon, LA	188	16	1	13.5	1	31.75
SBS w/ Queensboro	MSRC 800-OIL-SPIL	Whiting, IN	Offshore Skimmer 20' Boom Personnel * Push Boat	1 50' 4 1	905	400	Port Fourchon, LA	188	17.25	1	13.5	1	32.75
MSRC "Kvichak"	MSRC 800-OIL-SPIL	Ingleside, TX	Marco Skimmer Personnel 30' Fast Response Boat	1 4 1	3,588	24	Ingleside, TX	412	2	1	29.5	1	33.5
SBS w/ Queensboro	MSRC 800-OIL-SPIL	Toledo, OH	Offshore Skimmer 20' Boom Personnel * Push Boat	1 50' 4 1	905	400	Port Fourchon, LA	188	18.8	1	13.5	1	34.25
MSRC "Lightning"	MSRC 800-OIL-SPIL	Tampa, FL	LORI Brush Skimmer Personnel 47' Fast Response Boat	1 4 1	5,000	50	Tampa, FL	526	2	1	37.5	1	41.5
DERATED RECOVERY RATE (BBLs/DAY)								240,903					
SKIMMING VESSEL STORAGE CAPACITY (BARRELS)								11,668					
* - These components are additional operational requirements that must be procured by OSROs in addition to the system identified.													

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

Aerial Surveillance System	Supplier & Phone	Warehouse	Aerial Surveillance Package	Quantity	Staging Area	Distance to Site from Staging (nautical miles)	Response Times (Hours)			
							Staging ETA	Loadout Time	ETA to Site	Total ETA
Twin Commander Air Speed - 288 MPH	Airborne Support 985-851-6391	Houma, LA	Surveillance Aircraft	1	Houma, LA	216	1	0.25	0.75	2.00
			Spotter Personnel	2						
			Crew - Pilots	1						
Eurocopter EC-135 Helicopter Air Speed - 141 knots	PHI 985-475-5400	Houma, LA	Surveillance Aircraft	1	Houma, LA	216	1	0.25	0.75	2.00
			Spotter Personnel	2						
			Crew - Pilots	1						
Sikorsky S-76 Helicopter Air Speed - 141 knots	PHI 985-475-5400	Houma, LA	Surveillance Aircraft	1	Houma, LA	216	1	0.25	0.75	2.00
			Spotter Personnel	2						
			Crew - Pilots	1						

Table 9.D.6 Aerial Surveillance Activation List

Walker Ridge 508
Sample Offshore Aerial Dispersant Activation List

Aerial Dispersant System	Supplier & Phone	Warehouse	Aerial 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
Twin Commander Air Speed - 288 MPH	CGA/Airborne Support 985-351-6391	Houma, LA	Aero Commander	1	Houma, LA	216	2	0.4	0.75	0.2	3.35
			Spotter Personnel	2							
			Crew - Pilots	1							
BT-67 (DC-3 Turboprop) Aircraft Air Speed - 194 MPH	CGA/Airborne Support 985-351-6391	Houma, LA	DC-3 Dispersant Aircraft	1	Houma, LA 1st Flight	216	2	0.5	1.11	0.3	3.95
			Dispersant - Gallons	2000							
			Spotter Aircraft	1	Houma, LA 2nd Flight	216	1.11	0.5	1.11	0.3	3.05
			Spotter Personnel	2							
			Crew - Pilots	2							
DC-3 Aircraft Air Speed - 150 MPH	CGA/Airborne Support 985-351-6391	Houma, LA	DC-3 Dispersant Aircraft	1	Houma, LA 1st Flight	216	2	0.5	1.44	0.3	4.25
			Dispersant - Gallons	1200							
			Spotter Aircraft	1	Houma, LA 2nd Flight	216	1.44	0.5	1.44	0.3	3.70
			Spotter Personnel	2							
			Crew - Pilots	2							
DC-3 Aircraft Air Speed - 150 MPH	CGA/Airborne Support 985-351-6391	Houma, LA	DC-3 Dispersant Aircraft	1	Houma, LA 1st Flight	216	2	0.5	1.44	0.3	4.25
			Dispersant - Gallons	1200							
			Spotter Aircraft	1	Houma, LA 2nd Flight	216	1.44	0.5	1.44	0.3	3.70
			Spotter Personnel	2							
			Crew - Pilots	2							
BE-90 King Air Aircraft Air Speed - 213 MPH	MSRC 800-OIL-SPIL	Stennis, MS	BE-90 Dispersant Aircraft	1	Stennis INTL., MS 1st Flight	282	4.00	0.20	1.32	0.20	5.75
			Dispersant - Gallons	250							
			Spotter Aircraft	1	Stennis INTL., MS 2nd Flight	282	1.32	0.20	1.32	0.20	3.05
			Spotter Personnel	2							
			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	282	12.00	0.20	1.32	0.20	13.75
			Dispersant - Gallons	250							
			Spotter Aircraft	1	Stennis INTL., MS 2nd Flight	282	1.32	0.20	1.32	0.20	3.05
			Spotter Personnel	2							
			Crew - Pilots	2							
C130-A Aircraft Air Speed - 342 MPH	MSRC 800-OIL-SPIL	Stennis, MS	C130-A Dispersant Aircraft	1	Stennis INTL., MS 1st Flight	282	4.00	0.3	0.82	0.5	5.70
			Dispersant - Gallons	3250							
			Spotter Aircraft	1	Stennis INTL., MS 2nd Flight	282	0.82	0.3	0.82	0.5	2.50
			Spotter Personnel	2							
			Crew - Pilots	2							
C130-A Aircraft Air Speed - 342 MPH	MSRC 800-OIL-SPIL	Mesa, AZ	C130-A Dispersant Aircraft	1	Ellington Field, TX 1st Flight	345	8	0.3	1.01	0.5	9.85
			Dispersant - Gallons	3250							
			Spotter Aircraft	1	Stennis INTL., MS 2nd Flight	282	0.82	0.3	0.82	0.5	2.50
			Spotter Personnel	2							
			Crew - Pilots	2							
ADDS PACK Air Speed - 330 MPH	Clean Caribbean 985-351-6391	Pt. Everglades, FL	C-130 Aircraft (contractor)	1	Clearwater, FL 1st Flight	544	24-48	1	1.65	0.5	27.15 to 51.15
			ADDS PACK	1							
			Dispersant - Gallons	5000	Stennis INTL., MS 2nd Flight	150	0.45	0.3	0.45	0.5	1.71
			Spotter Aircraft	1							
			Spotter Personnel	2							
ADDS PACK Air Speed - 330 MPH	Oil Spill Response +44 (0) 1224-72-6859	South Hampton, UK	L-382 Hercules Aircraft	1	Stennis INTL., MS 1st Flight	282	6-24	2-4	0.85	0.5	9.4 to 29.4
			ADDS PACK	1							
			Dispersant - Gallons	5000	Stennis INTL., MS 2nd Flight	150	0.45	0.3	0.45	0.5	1.71
			Spotter Aircraft	1							
			Spotter Personnel	2							
ADDS PACK Air Speed - 330 MPH	Oil Spill Response +44 (0) 1224-72-6859	Singapore, SG	Crew - Pilots	2	Stennis INTL., MS 1st Flight	282	6-24	2-4	0.85	0.5	9.4 to 29.4
			ADDS PACK	1							
			Dispersant - Gallons	5000	Stennis INTL., MS 2nd Flight	150	0.45	0.3	0.45	0.5	1.71
			Spotter Aircraft	1							
			Spotter Personnel	2							
			Crew - Pilots	2							

Table 9.D.7 Offshore Aerial Dispersant Activation List

Walker Ridge 508
Sample Offshore Boat Spray Dispersant Activation List

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
Fire Monitor Induction Dispersant Spray System	AMPOL 800-482-6765	Port Fourchon, LA	Dispersant Spray System	1	Port Fourchon, LA	188	4	0.5	13.5	1	19
			Dispersant (Gallons)	500							
			Personnel	4							
			* 110' Utility Boat	1							
USCG SMART Team	USCG	Mobile, AL	Personnel	4	Port Fourchon, LA	188	4.25	1	13.5	0.5	19.25
			* Crew Boat	1							
Fire Monitor Induction Dispersant Spray System	AMPOL 800-482-6765	Cameron, LA	Dispersant Spray System	1	Port Fourchon, LA	188	5	0.5	13.5	1	20
			Dispersant (Gallons)	500							
			Personnel	4							
			* 110' Utility Boat	1							
<i>* - These components are additional operational requirements that must be procured by OSROs in addition to the system identified.</i>											

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

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
"Top Hat" Unit	RP / MWCC	Port Fourchon, LA	Anchor Handling Tug Supply Vessel	1	Port Fourchon, LA	188	13*	1	13.5	3	12
			ROV's	2							
			Multi-Purpose Supply Vessel	1							
			Drill Ship (Processing Vessel)	1							
			"Top Hat"	1							
			Containment Chamber	1							
			Shuttle Barge	1							
Site Assessment and Surveillance	RP	Port Fourchon, LA	Multi-Service Vessel	1	Port Fourchon, LA	188	0	1.5	13.5	0.5	15.5
Subsea Dispersant Application	RP / MWCC	Port Fourchon, LA	ROV's	2	Port Fourchon, LA	188	1.5	1.5	13.5	2	18.5
			Multi-Service Vessel	1							
			ROV's	2							
			Coil Tubing Unit	1							
Capping Stack	RP / MWCC	Houston, TX	Dispersant	200,000 gal	Port Fourchon, LA	188	2	1.5	13.5	3	20
			Manifold	1							
			System	1							
			Anchor Handling Tug Supply Vessel	1							
<i>* - Response time may vary depending on Drill Ship's operations and location at the time of deployment.</i>											

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

Walker Ridge 508
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
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Port Fourchon, LA	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	4	1	13.5	1	19.5
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Port Fourchon, LA	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	4	1	13.5	1	19.5
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Port Fourchon, LA	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	4	1	13.5	1	19.5
Fire Team (In-Situ Burn Fire System)	CGA 888-CGA-2007	Harvey, LA	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	4	1	13.5	1	19.5
Fire Team (In-Situ Burn Fire System)	CGA 888-CGA-2007	Harvey, LA	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	4	1	13.5	1	19.5
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Lake Charles, LA	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	6.25	1	13.5	1	21.75
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Lake Charles, LA	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	6.25	1	13.5	1	21.75
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Lake Charles, LA	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	6.25	1	13.5	1	21.75
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Lake Charles, LA	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	6.25	1	13.5	1	21.75
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Houston, TX	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	8.25	1	13.5	1	23.75
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Houston, TX	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	8.25	1	13.5	1	23.75

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

Walker Ridge 508
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
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Houston, TX	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	8.25	1	13.5	1	23.75
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Houston, TX	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	8.25	1	13.5	1	23.75
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Houston, TX	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	8.25	1	13.5	1	23.75
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Houston, TX	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	8.25	1	13.5	1	23.75
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Houston, TX	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	8.25	1	13.5	1	23.75
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Houston, TX	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	8.25	1	13.5	1	23.75
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Houston, TX	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	8.25	1	13.5	1	23.75
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Houston, TX	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	8.25	1	13.5	1	23.75
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Houston, TX	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	8.25	1	13.5	1	23.75
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Houston, TX	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	8.25	1	13.5	1	23.75

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

Walker Ridge 508
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
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Houston, TX	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	8.25	1	13.5	1	23.75
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Houston, TX	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	8.25	1	13.5	1	23.75
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Houston, TX	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	8.25	1	13.5	1	23.75
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Houston, TX	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	8.25	1	13.5	1	23.75
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Houston, TX	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	8.25	1	13.5	1	23.75
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Houston, TX	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	8.25	1	13.5	1	23.75
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Houston, TX	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	8.25	1	13.5	1	23.75
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Houston, TX	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	8.25	1	13.5	1	23.75
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Houston, TX	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	8.25	1	13.5	1	23.75
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Houston, TX	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	8.25	1	13.5	1	23.75

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

Walker Ridge 508
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
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Houston, TX	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	8.25	1	13.5	1	23.75
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Houston, TX	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	8.25	1	13.5	1	23.75
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Houston, TX	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	8.25	1	13.5	1	23.75
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Houston, TX	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	8.25	1	13.5	1	23.75
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Houston, TX	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	8.25	1	13.5	1	23.75
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Houston, TX	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	8.25	1	13.5	1	23.75
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Houston, TX	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	8.25	1	13.5	1	23.75
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Houston, TX	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	8.25	1	13.5	1	23.75
Fire Team (In-Situ Burn Fire System)	MSRC 800-OIL-SPIL	Houston, TX	Fire Boom (ft) Guide Boom/Tow Line (ft) * Offshore Vessel (0.5 kt capability) Personnel Ignition Device	500 400 2 6 10	Port Fourchon, LA	188	8.25	1	13.5	1	23.75
TOTAL FIRE BOOM AVAILABLE (FEET)							21,000				
<small>* - These components are additional operational requirements that must be procured by OSROs in addition to the system identified.</small>											

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

Walker Ridge 508
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" to 24"	50,000'	Port Fourchon, LA	4	1	1	6
		Containment Boom - 6" to 10"	9,500'					
		Response Boats - 14' to 20'	38					
		Response Boats - 21' to 36'	21					
		Portable Skimmers	6					
		Shallow Water Skimmers	2					
ES&H Environmental 877-437-2634	Golden Meadow, LA	Containment Boom - 18" to 24"		Port Fourchon, LA	4	1	1	6
		Containment Boom - 6" to 10"						
		Response Boats - 14' to 20'						
		Response Boats - 21' to 36'						
		Portable Skimmers						
		Shallow Water Skimmers						
ES&H Environmental 877-437-2634	Houma, LA	Bird Scare Cannons		Port Fourchon, LA	4	1	1	6
		Response Personnel						
		Containment Boom - 18" to 24"	45,600'					
		Containment Boom - 6" to 10"	15,000'					
		Response Boats - 14' to 20'	38					
		Response Boats - 21' to 36'	13					
Oilmop 985-798-1005	Larose, LA	Portable Skimmers	35	Port Fourchon, LA	4	1	1	6
		Shallow Water Skimmers	1					
		Bird Scare Cannons	200					
		Response Personnel	11					
		Containment Boom - 18" to 24"	2500'					
		Containment Boom - 6" to 10"	500'					
ES&H Environmental 877-437-2634	Port Fourchon, LA	Response Boats - 14' to 20'	2	Port Fourchon, LA	4	1	1	6
		Portable Skimmers	3					
		Response Personnel	2					
		Containment Boom - 18" to 24"	1,000'					
		Containment Boom - 6" to 10"	200'					
ES&H Environmental 877-437-2634	Morgan City, LA	Response Boats - 14' to 20'	3	Port Fourchon, LA	4	1	1	6
		Portable Skimmers	3					
		Response Personnel	2					
		Containment Boom - 18" to 24"	2,000'					
		Containment Boom - 6" to 10"	1,200'					
AMPOL 800-482-6765	Harvey, LA	Response Boats - 14' to 20'	7	Port Fourchon, LA	4	1	1	6
		Response Boats - 21' to 36'	8					
		Portable Skimmers	6					
		Response Personnel	6					
		Containment Boom - 18" to 24"	28,600'					
		Containment Boom - 6" to 10"	2,400'					
CGA	Harvey, LA	Response Boats - 14' to 20'	1	Port Fourchon, LA	4	1	1	6
		Response Boats - 21' to 36'	2					
		Portable Skimmers	2					
		Shallow Water Skimmers	1					
USES Environmental 888-279-9930	Harvey, LA	Response Personnel	18	Port Fourchon, LA	4	1	1	6
		Wildlife Rehab Trailer	1					
		Wildlife Husbandry Trailer	1					
		Support Trailer	1					
USES Environmental 888-279-9930	Marrero, LA	Contract Truck (Third Party)	3	Port Fourchon, LA	4	1	1	6
		Containment Boom - 18" to 24"	300'					
		Containment Boom - 6" to 10"	200'					
		Containment Boom - 18" to 24"	600'					
USES Environmental 888-279-9930	Hahnville, LA	Containment Boom - 18" to 24"	500'	Port Fourchon, LA	4	1	1	6
		Containment Boom - 6" to 10"	1,000'					
		Containment Boom - 6" to 10"	500'					
		Response Boats - 14' to 20'	1					
		Portable Skimmers	1					
USES Environmental 888-279-9930	Amelia, LA	Response Personnel	8	Port Fourchon, LA	4	1	1	6
		Containment Boom - 18" to 24"	1000'					
		Containment Boom - 6" to 10"	500'					
		Personnel (Responder/Mechanic)	4					
USES Environmental 888-279-9930	Belle Chasse, LA	Containment Boom - 18" to 24"	600'	Port Fourchon, LA	4.25	1	1	6.25
		Containment Boom - 18" to 24"						
		Containment Boom - 6" to 10"						
		Containment Boom - 18" to 24"						
ES&H Environmental 877-437-2634	Lafayette, LA	Containment Boom - 14' to 20'		Port Fourchon, LA	4.25	1	1	6.25
		Containment Boom - 21' to 36'						
		Portable Skimmers						
		Shallow Water Skimmers						
		Bird Scare Cannons						
		Response Personnel						

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

Walker Ridge 508
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	Belle Chasse, LA	Containment Boom - 18" to 24"		Port Fourchon, LA	4.25	1	1	6.25
		Containment Boom - 8" to 10"						
		Response Boats - 14' to 20'						
		Response Boats - 21' to 36'						
		Portable Skimmers						
		Shallow Water Skimmers						
Oilmop 800-645-6671	Belle Chasse, LA	Bird Scare Cannons		Port Fourchon, LA	4.25	1	1	6.25
		Response Personnel						
		Containment Boom - 18" to 24"	21,000'					
		Containment Boom - 8" to 10"	500'					
		Response Boats - 14' to 20'	6					
		Response Boats - 21' to 36'	5					
USES Environmental 888-279-9930	Lafitte, LA	Portable Skimmers	23	Port Fourchon, LA	4.5	1	1	6.5
		Shallow Water Skimmers	1					
		Bird Scare Cannons	20					
		Response Personnel	18					
		Containment Boom - 18" to 24"	1000'					
		Response Boats - 14' to 20'	2					
USES Environmental 888-279-9930	Meraux, LA	Containment Boom - 18" to 24"	6000'	Port Fourchon, LA	4.25	1	1	6.25
		Containment Boom - 8" to 10"	1000'					
		Response Boats - 14' to 20'	13					
		Response Boats - 21' to 36'	4					
		Portable Skimmers	3					
		Response Personnel	44					
USES Environmental 888-279-9930	Geismar, LA	Containment Boom - 18" to 24"	1000'	Port Fourchon, LA	4.5	1	1	6.5
		Response Boats - 14' to 20'	3					
		Portable Skimmers	1					
		Response Personnel	9 to 18					
		Containment Boom - 8" to 10"	750'					
		Containment Boom - 18" to 24"	4,3950'					
AMPOL 800-482-6765	New Iberia, LA	Response Boats - 14' to 20'	3	Port Fourchon, LA	4.75	1	1	6.75
		Response Boats - 21' to 36'	10					
		Portable Skimmers	27					
		Shallow Water Skimmers	2					
		Bird Scare Cannons	7					
		Response Personnel	70					
Oilmop 800-637-5471	Port Allen, LA	Containment Boom - 18" to 24"	2500'	Port Fourchon, LA	4.75	1	1	6.75
		Containment Boom - 8" to 10"	500'					
		Response Boats - 14' to 20'	3					
		Response Boats - 21' to 36'	3					
		Portable Skimmers	3					
		Response Personnel	18					
Oilmop 800-637-5471	New Iberia, LA	Containment Boom - 18" to 24"	3,500'	Port Fourchon, LA	4.75	1	1	6.75
		Containment Boom - 8" to 10"	500'					
		Response Boats - 14' to 20'	6					
		Response Boats - 21' to 36'	2					
		Portable Skimmers	6					
		Response Personnel	8					
Clean Harbors 1.800.645.8265	New Iberia, LA	Containment Boom - 18" to 24"	33,800'	Port Fourchon, LA	4.75	1	1	6.75
		Containment Boom - 8" to 10"	500'					
		Response Boats - 21' to 36'	4					
		Portable Skimmers	22					
		Shallow Water Skimmers	1					
		Response Personnel	10					
Wildlife of Texas 281-731-8826	Baton Rouge, LA	Wildlife Specialist - Personnel	6 to 20	Port Fourchon,	5	1	1	7
Clean Harbors 1.800.645.8265	Baton Rouge, LA	Containment Boom - 18" to 24"	14,000'	Port Fourchon, LA	5	1	1	7
		Response Boats - 14' to 20'	1					
		Response Boats - 21' to 36'	2					
		Portable Skimmers	3					
USES Environmental 888-279-9930	Biloxi, MS	Response Personnel	10	Port Fourchon, LA	5.25	1	1	7.25
		Containment Boom - 18" to 24"	2,000'					
		Response Boats - 14' to 20'	1					
		Portable Skimmers	2					
USES Environmental 985-534-2744	Venice, LA	Containment Boom - 18" to 24"	10,000'	Port Fourchon, LA	5.75	1	1	7.75
		Response Boats - 14' to 20'	8					
		Response Boats - 21' to 36'	3					
		Portable Skimmers	2					
MSRC 800-OIL-SPIL	Lake Charles, LA	Shallow Water Skimmers	1	Port Fourchon, LA	6.25	1	1	8.25
		Wildlife Trailer	1					
		Contract Truck (Third Party)	1					
		Personnel (Responder/Mechanic)	1					

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

Walker Ridge 508
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 - 18" to 24"	24,000'	Port Fourchon, LA	6.25	1	1	8.25
		Containment Boom - 6" to 10"	600'					
		Response Boats - 14' to 20'	7					
		Response Boats - 21' to 36'	2					
		Portable Skimmers	6					
		Shallow Water Skimmers	1					
Clean Harbors 1.800.645.8265	Lake Charles, LA	Response Personnel	49	Port Fourchon, LA	6.25	1	1	8.25
		Containment Boom - 18" to 24"	3000'					
		Response Boats - 21' to 36'	4					
		Portable Skimmers	1					
ES&H Environmental 877-437-2634	Lake Charles, LA	Response Personnel	18	Port Fourchon, LA	6.25	1	1	8.25
		Containment Boom - 18" to 24"						
		Containment Boom - 6" to 10"						
		Response Boats - 14' to 20'						
		Response Boats - 21' to 36'						
		Portable Skimmers						
USES Environmental 888-279-9930	Mobile, AL	Shallow Water Skimmers		Port Fourchon, LA	6.25	1	1	8.25
		Bird Scare Cannons						
		Response Personnel						
		Containment Boom - 18" to 24"	5,000'					
		Containment Boom - 6" to 10"	800'					
SWS Environmental 1-877-742-4215	Pensacola, FL	Response Boats - 14' to 20'	3	Port Fourchon, LA	7	1	1	9
		Response Boats - 21' to 36'	1					
		Portable Skimmers	3					
		Response Personnel	20					
Miller Env. Services 800-929-7227	Beaumont, TX	Containment Boom - 18" to 24"	14,000'	Port Fourchon, LA	7	1	1	9
		Response Boats - 14' to 20'	2					
		Response Boats - 21' to 36'	2					
		Portable Skimmers	1					
		Response Personnel	47					
Clean Harbors 1.800.645.8265	Port Arthur, TX	Containment Boom - 18" to 24"	3,000'	Port Fourchon, LA	7.25	1	1	9.25
		Response Boats - 14' to 20'	7					
		Response Boats - 21' to 36'	2					
		Portable Skimmers	3					
Oilmop 800-637-5471	Port Arthur, TX	Response Personnel	10	Port Fourchon, LA	7.25	1	1	9.25
		Containment Boom - 18" to 24"	4000'					
		Response Boats - 14' to 20'	6					
		Response Boats - 21' to 36'	2					
		Portable Skimmers	5					
Wildlife of Texas 281-731-8826	Houston, TX	Shallow Water Skimmers	1	Port Fourchon, LA	8.25	1	1	10.25
		Response Personnel	8					
		Containment Boom - 18" to 24"	10,000'					
		Response Boats - 14' to 20'	2					
		Response Boats - 21' to 36'	1					
SWS Environmental 1-877-742-4215	Houston, TX	Portable Skimmers	1	Port Fourchon, LA	8.25	1	1	10.25
		Response Personnel	20					
		Containment Boom - 18" to 24"	5,000'					
		Containment Boom - 6" to 10"	600'					
		Response Boats - 14' to 20'	4					
USES Environmental 888-279-9930	Houston, TX	Response Boats - 21' to 36'	1	Port Fourchon, LA	8.25	1	1	10.25
		Portable Skimmers	1					
		Response Personnel	1					
		Containment Boom - 18" to 24"	28,000'	Port Fourchon, LA	8.25	1	1	10.25
		Containment Boom - 6" to 10"	400'					
Anderson Pollution Control 936-441-2225	Houston, TX	Response Boats - 14' to 20'	3					
		Response Boats - 21' to 36'	5					
		Portable Skimmers	11					
		Containment Boom - 18" to 24"	4000'					
		Response Boats - 14' to 20'	4	Port Fourchon, LA	8.25	1	1	10.25
Phoenix Pollution Control & Environmental Services 281-838-3400	Baytown, TX	Response Boats - 21' to 36'	2					
		Portable Skimmers	1					
		Containment Boom - 18" to 24"	17,000'					
		Containment Boom - 6" to 10"	1,150'					
		Response Boats - 14' to 20'	9					
Miller Env. Services 800-929-7227	Houston, TX	Response Boats - 21' to 36'	3	Port Fourchon, LA	8.25	1	1	10.25
		Portable Skimmers	24					
		Shallow Water Skimmers	2					
		Containment Boom - 18" to 24"	14,000'					
T&T Marine 409-744-1222 281-488-5767	Houston/ Galveston, TX	Containment Boom - 18" to 24"	50,000'	Port Fourchon, LA	8.75	1	1	10.75
		Containment Boom - 6" to 10"	1,000'					
		Response Boats - 14' to 20'	12					
		Portable Skimmers	17					

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

Walker Ridge 508
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
Clean Harbors 1.800.645.8265	Houston, TX	Containment Boom - 18" to 24"	4000'	Port Fourchon, LA	8.25	1	1	10.25
		Response Boats - 14' to 20'	2					
		Response Boats - 21' to 36'	5					
		Portable Skimmers	1					
		Shallow Water Skimmers	1					
		Response Personnel	18					
SWS Environmental 1-877-742-4215	Panama City, FL	Containment Boom - 18" to 24"	12,000'	Port Fourchon, LA	9	1	1	11
		Response Boats - 14' to 20'	2					
		Response Boats - 21' to 36'	1					
		Portable Skimmers	3					
		Bird Scare Cannons	7					
		Response Personnel	20					
Miller Env. Services 800-929-7227	Corpus Christi, TX	Containment Boom - 18" to 24"	50,000'	Port Fourchon, LA	11.5	1	1	13.5
		Containment Boom - 6" to 10"	2,000'					
		Response Boats - 14' to 20'	10					
		Response Boats - 21' to 36'	3					
		Portable Skimmers	6					
		Shallow Water Skimmers	2					
SWS Environmental 1-877-742-4215	St. Petersburg, FL	Response Personnel	142	Port Fourchon, LA	13.75	1	1	15.75
		Containment Boom - 18" to 24"	13,000'					
		Response Boats - 14' to 20'	1					
		Response Boats - 21' to 36'	1					
		Portable Skimmers	1					
SWS Environmental 1-877-742-4215	Tampa, FL	Response Personnel	20	Port Fourchon, LA	13.25	1	1	15.25
		Containment Boom - 18" to 24"	1,700'					
		Response Boats - 21' to 36'	1					
		Portable Skimmers	2					
TRI-STATE 302-737-9643	Newark, DE	Response Personnel	20	Port Fourchon,	21.5	1	1	23.5
		Wildlife Specialist - Personnel	6 to 12					

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

SECTION 10: ENVIRONMENTAL MONITORING INFORMATION

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 in Shell implementing 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. 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 INFORMATION

Walker Ridge Block 508, OCS-G 17001:

Lease OCS-G 17001 was acquired in Lease Sale #157 held on April 24, 1996 and is held by production.

Unit Contract No. 754306006 contracted effective 9/2/2021 and now consists of G17001 and G32690 only.

This lease is not part of a biological sensitive area, known chemosynthetic area, or shipping fairway. See Section 6 of this plan for site specific archeological information. The following stipulations are associated with this lease:

Stipulation No. 8 – Protected Species

This Stipulation is addressed in the following sections of this plan:

Section 6, Threatened or endangered species, critical habitat and marine mammal information

Section 10, Environmental Monitoring Information, Incidental takes

Section 12, Environmental Mitigation Measures Information, Incidental takes

Section 18, Environmental Impact Assessment

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 OSRP. Section 18 of this plan discusses impacts and mitigation measures, including Coastal Habitats and Protected Areas.

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" |

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 EP as such information is only necessary in the case of DOCDs.

SECTION 14: SUPPORT VESSELS AND AIRCRAFT INFORMATION

A. General

Type	Maximum Fuel Tank Storage Capacity (Gals)	Maximum No. In Area at Any Time	Trip Frequency or Duration
Crew Boats	8,000	1	Twice per week
Offshore Support Vessels	120,000	2	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	6 miles from Port Fourchon to the mouth of Bayou Lafourche, then to WR 508

C. Drilling Fluids Transportation

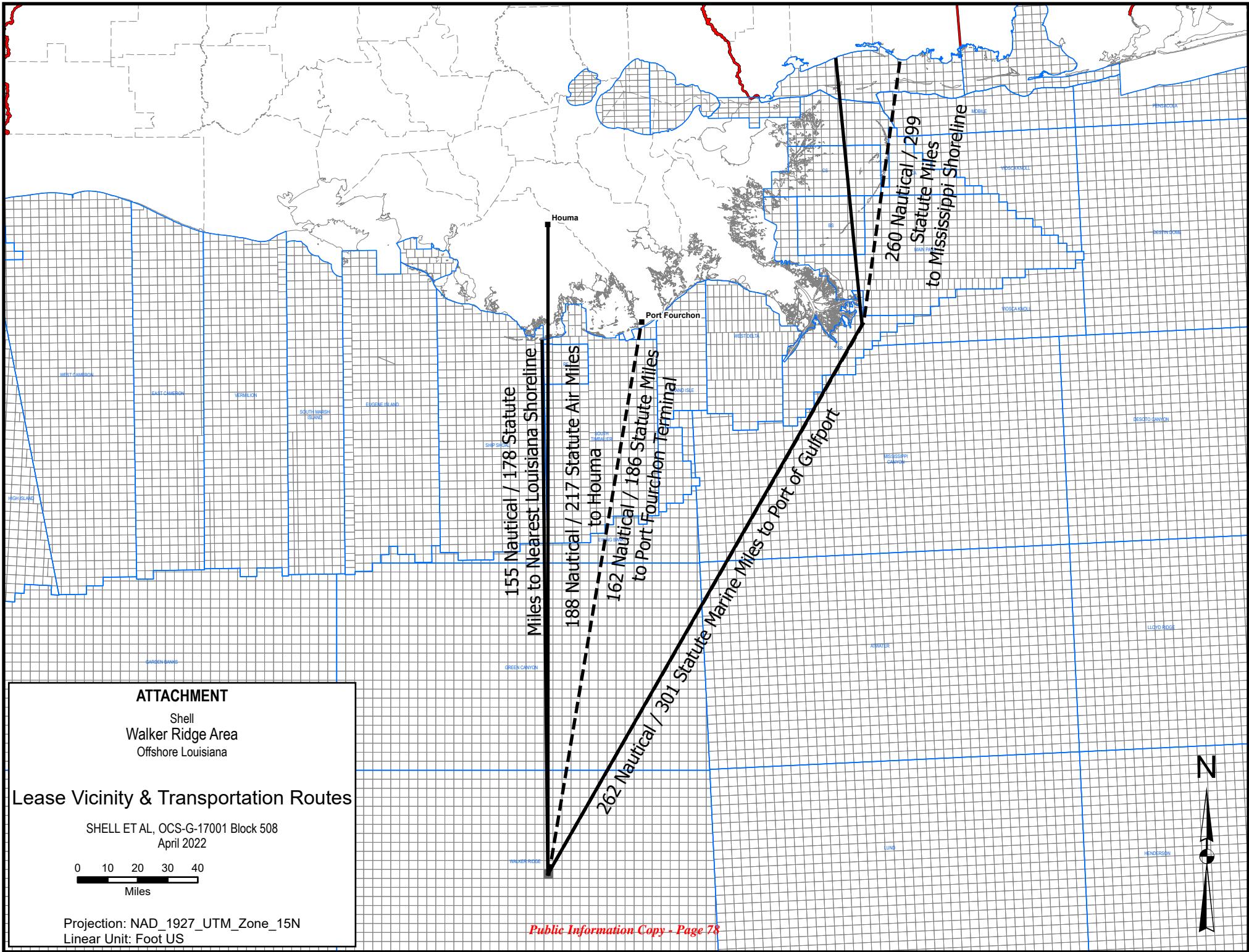
According to NTL 2008-G04, this information is only required when activities are proposed in the State of Florida.

D. Solid and Liquid Wastes Transportation

See Section 7, Table 7B.

E. Vicinity Map

See Attachment 14A for Vicinity Map.



SECTION 15: ONSHORE SUPPORT FACILITIES INFORMATION

A. General

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

The onshore support bases for water and air transportation will be the existing terminals in Houma 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.

However, in the event of an emergency or post-Hurricane events at the Louisiana onshore facilities, Shell is requesting to use the following onshore support facilities in Mississippi:

Name	Location	Existing/New/Modified
PHI	Kiln, MS	Existing
C-Logistics	Gulfport, MS	Existing

Aviation operations will take place at Stennis (HAS) Million Air 7250 Stennis Airport Rd, Kiln, MS 39556 and it is being operated by PHI. Our marine terminal is at Port of Gulfport at 1000 30th Ave in Gulfport, MS 39501 and it is being sourced and operated by C-Logistics LLC.

Once the Louisiana facilities resume normal operations, Shell will return to the Louisiana onshore bases.

B. Support Base Construction or Expansion

This does not apply to this EP 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

Since no onshore support base construction or expansion is planned for these activities, a timetable for land acquisition and construction or expansion is not applicable.

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

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 Consistency was granted in Plan N-8155 and Texas Coastal Zone Consistency was granted in Plan S-7129. Coastal zone consistency for these States are not required for Supplemental Plans.

Mississippi Coastal Zone Consistency is included in this Plan.

MISSISSIPPI
COASTAL ZONE MANAGEMENT
CONSISTENCY CERTIFICATION

Exploration Plan
Type of Plan

Walker Ridge 508 – OCS-G 17001

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

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

SHELL OFFSHORE INC.
Operator



Tracy Albert
Certifying Official

7/6/2022

Date

**Coastal Zone Management Consistency Information
For the State of Mississippi**

Goal 1. To provide for reasonable industrial expansion in the Coastal Area and to ensure the efficient utilization of waterfront industrial sites so that suitable sites are conserved for the water dependent industry.

The proposed activities are located in OCS Federal Waters, Gulf of Mexico, approximately 178 miles from the nearest Louisiana shoreline. Shell will utilize existing facilities in Fourchon, Louisiana; therefore, there should not be any adverse impacts to the Mississippi coastal areas.

However, if the Louisiana onshore base is not available, Shell will utilize existing facilities in Gulfport, Mississippi. This facility is ~299 miles from the nearest Mississippi shoreline and there should not be any adverse impacts to the Mississippi coastal areas.

Goal 2. To favor the preservation of the coastal wetlands and ecosystems, except where a specific alteration of specific coastal wetlands would serve a higher public interest in compliance with the public purposes of the public trust in which the coastal wetlands are held.

The proposed activities are located in OCS Federal Waters, Gulf of Mexico, approximately 178 miles from the nearest Louisiana shoreline. Shell will utilize existing facilities in Fourchon, Louisiana; therefore, there should not be any adverse impacts to the Mississippi coastal areas.

However, if the Louisiana onshore base is not available, Shell will utilize existing facilities in Gulfport, Mississippi. This facility is ~299 miles from the nearest Mississippi shoreline and there should not be any adverse impacts to the Mississippi coastal areas.

Goal 3. To protect, propagate, and conserve the State's seafood and aquatic life in connection with the revitalization, and conserve the State's seafood and aquatic life in connection with the revitalization of the seafloor industry of the State of Mississippi.

The proposed activities are located in OCS Federal Waters, Gulf of Mexico, approximately 178 miles from the nearest Louisiana shoreline. Shell will utilize existing facilities in Fourchon, Louisiana; therefore, there should not be any adverse impacts to the Mississippi coastal areas.

However, if the Louisiana onshore base is not available, Shell will utilize existing facilities in Gulfport, Mississippi. This facility is ~299 miles from the nearest Mississippi shoreline and there should not be any adverse impacts to the Mississippi coastal areas.

Goal 4. To conserve the air and waters of the State, and to protect, maintain and improve the quality thereof for public use, for the proration of wildlife, fish and aquatic life, and for domestic, agricultural, industrial, recreational and other legitimate beneficial uses.

The proposed activities are located in OCS Federal Waters, Gulf of Mexico, approximately 178 miles from the nearest Louisiana shoreline. Shell will utilize existing facilities in Fourchon, Louisiana; therefore, there should not be any adverse impacts to the Mississippi coastal areas.

However, if the Louisiana onshore base is not available, Shell will utilize existing facilities in Gulfport, Mississippi. This facility is ~299 miles from the nearest Mississippi shoreline and there should not be any adverse impacts to the Mississippi coastal areas.

Goal 5. To put the benefit use to the fullest extent of which they are capable to water resources of the State, and to prevent the waste, unreasonable use, or unreasonable method of use of water.

The proposed activities are located in OCS Federal Waters, Gulf of Mexico, approximately 178 miles from the nearest Louisiana shoreline. Shell will utilize existing facilities in Fourchon, Louisiana; therefore, there should not be any adverse impacts to the Mississippi coastal areas.

However, if the Louisiana onshore base is not available, Shell will utilize existing facilities in Gulfport, Mississippi. This facility is ~299 miles from the nearest Mississippi shoreline and there should not be any adverse impacts to the Mississippi coastal areas.

Goal 6. To preserve the State's historical and archaeological resources, to prevent their destruction, and to enhance these resources whenever possible.

The proposed activities are located in OCS Federal Waters, Gulf of Mexico, approximately 178 miles from the nearest Louisiana shoreline. Shell will utilize existing facilities in Fourchon, Louisiana; therefore, there should not be any adverse impacts to the Mississippi coastal areas.

However, if the Louisiana onshore base is not available, Shell will utilize existing facilities in Gulfport, Mississippi. This facility is ~299 miles from the nearest Mississippi shoreline and there should not be any adverse impacts to the Mississippi coastal areas.

Goal 7. To encourage the preservation of natural scenic qualities in the coastal area.

The proposed activities are located in OCS Federal Waters, Gulf of Mexico, approximately 178 miles from the nearest Louisiana shoreline. Shell will utilize existing facilities in Fourchon, Louisiana; therefore, there should not be any adverse impacts to the Mississippi coastal areas.

However, if the Louisiana onshore base is not available, Shell will utilize existing facilities in Gulfport, Mississippi. This facility is ~299 miles from the nearest Mississippi shoreline and there should not be any adverse impacts to the Mississippi coastal areas.

Goal 8. To assist local government in the provision of public facilities services in a manner consistent with the coastal program.

The proposed activities are located in OCS Federal Waters, Gulf of Mexico, approximately 178 miles from the nearest Louisiana shoreline. Shell will utilize existing facilities in Fourchon, Louisiana; therefore, there should not be any adverse impacts to the Mississippi coastal areas.

However, if the Louisiana onshore base is not available, Shell will utilize existing facilities in Gulfport, Mississippi. This facility is ~299 miles from the nearest Mississippi shoreline and there should not be any adverse impacts to the Mississippi coastal areas.

**Environmental Impact Analysis
for a
Supplemental Exploration Plan
Walker Ridge Block 508 (OCS-G 17001)**

Offshore Louisiana

June 2022

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Acronyms and Abbreviations

§	section	OSRP	Oil Spill Response Plan
µPa	micropascal	PAH	polycyclic aromatic hydrocarbon
ac	acre	PM	particulate matter
ADIOS	Automated Data Inquiry for Oil Spills	re	referenced to
AQR	Air Quality Emissions Report	SBM	synthetic-based muds
bbl	barrel	SEL ^{24h}	sound exposure level over 24-hours
BOEM	Bureau of Ocean Energy Management	Shell	Shell Offshore Inc.
BOP	blowout preventer	SPL	root-mean-square sound pressure level
BSEE	Bureau of Safety and Environmental Enforcement	USCG	U.S. Coast Guard
CFR	Code of Federal Regulations	USDOI	U.S. Department of the Interior
dB	decibel	USEPA	U.S. Environmental Protection Agency
DP	dynamic positioning	USFWS	U.S. Fish and Wildlife Service
DPS	distinct population segment	VOC	volatile organic compound
EFH	Essential Fish Habitat	WCD	worst case discharge
EIA	Environmental Impact Analysis	WR	Walker Ridge
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		
ha	hectare		
HAPC	Habitat Area of Particular Concern		
IPF	impact-producing factor		
MARPOL	International Convention for the Prevention of Pollution from Ships		
MMC	Marine Mammal Commission		
MMPA	Marine Mammal Protection Act		
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		
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		

Introduction

Project Summary

Shell Offshore Inc. (Shell) is submitting a Supplemental Exploration Plan (EP) for the drilling and possible completion of two wells in Walker Ridge Block 508 (WR 508) (wells CC-Alt1 and CC-Alt2). The drilling and possible completion of two wells (CC and DD) remain at the locations previously approved in EP S-7948. 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 in the Gulf of Mexico OCS, 178 miles (286 km) from the nearest shoreline (Louisiana), 186 miles (299 km) from the onshore support base at Port Fourchon, Louisiana, and 217 miles (349 km) from the helicopter base at Houma, Louisiana. All miles in the EIA are statute miles. Water depth at the project area is approximately 9,554 ft (2,912 m).

The proposed activities will be completed with a dynamically positioned (DP) drillship or mobile offshore drilling unit (MODU), as detailed in EP Section 14. Drilling and completion of the proposed wells are estimated to take up to 270 days per year from 2023 to 2026. There are no anchors associated with the proposed work in the plan. 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 addressed in the EIA.

Potential impacts have been analyzed at a broad 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 updated environmental baseline information in light of the Macondo (*Deepwater Horizon*) incident and addressed 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. Findings of the post *Deepwater Horizon* incident studies have been incorporated into this report and are supplemented by site-specific analyses, where applicable. The EIA relies on these documents, technical studies, and post *Deepwater Horizon* 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 a sound manner to minimize environmental impacts.

Outer Continental Shelf 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., 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. The NMFS Biological Opinion on the Federally Regulated Oil and Gas Program Activities in the Gulf of Mexico assesses impacts and mitigation measures to listed species (NMFS, 2020a).

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 NTL No. 2020-G01	Air Quality Information Requirements for Exploration Plans, Development Operations Coordination Documents, and Development and Production Plans in the Gulf of Mexico Region	Cancels and supersedes the air emission information portion of NTL 2008-G04, Information Requirement for Exploration Plans and Development Operations Coordination Documents, effective date May 5, 2008.
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. Reissued in June 2020 to address instances where guidance in the 2020 National Marine Fisheries Service (NMFS) Biological Opinion Appendix C (NMFS, 2020a) replaces compliance with this NTL.

NTL	Title	Summary
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. Reissued in June 2020 to address instances where guidance in the 2020 NMFS Biological Opinion Appendix B (NMFS, 2020a) replaces compliance with this NTL.
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.
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.

NTL	Title	Summary
2010-N10	Statement of Compliance with Applicable Regulations and Evaluation of Information Demonstrating Adequate Spill Response and Well Containment Resources	Informs operators using subsea 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 (<i>75 Federal Register</i> 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.
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. Reissued in June 2020 to comply with Executive Order 13891 of October 9, 2019 and to rescind NTL 2011-JOINT-G01.

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 the project activities. 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.

Environmental Impact Analysis Organization

The EIA is organized into **Sections A** through **I** corresponding to the requirements of NTL 2008-G04 (as extended by NTL 2015-N02 and partially amended by 2020-G01), 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 potentially affected environmental resources and identifies IPFs associated with the proposed project. **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 on the resource (**Table 2**). Where there may be an effect from an IPF on an environmental resource, 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									Accidents	
	MODU Presence (including noise & lights)	Physical Disturbance to Seafloor	Air Pollutant Emissions	Effluent Discharges	Water Intake	Onshore Waste Disposal	Marine Debris	Support Vessel/Helicopter Traffic	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)	
Rice's whale (Endangered) ¹	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)	
Panama City crayfish (Threatened)	--	--	--	--	--	--	--	--	--	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)	

¹The Rice's whale was recently identified as a new species of baleen whale in the Gulf of Mexico (86 FR 47022; effective October 22, 2021) and not a subspecies of the Bryde's whale as previously classified. 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. The wellsit clearance assessments identified no features indicative of high-density chemosynthetic communities or coral communities within 2,000 ft (610 m) of the proposed wellsites (BP America Inc., 2004; Fugro GeoConsulting, 2010; C&C Technologies, 2011; Fugro GeoConsulting, 2011ab; Forum Energy Technologies, 2012).
- (5) Exploration or production activities where hydrogen sulfide (H_2S) concentrations greater than 500 parts per million might be encountered.
- Walker Ridge Block 508 is 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 the planned activity will occur. If the proposed activities are located at a sufficient distance from a shipwreck or prehistoric site that no impact would occur, this will be noted in the EIA.
- No impacts on archaeological resources are expected from routine activities. The locations of the proposed activities are well beyond the 197-foot (60-meter) depth contour used by BOEM as the seaward extent for prehistoric archaeological site potential in the Gulf of Mexico. As discussed in **Section C.6**, the shallow hazard assessment did not identify any archaeologically significant sonar contacts within 2,000 ft (610 m) of the proposed wellsites (BP America Inc., 2004; Fugro GeoConsulting, 2010; C&C Technologies, 2011; Fugro GeoConsulting, 2011ab; Forum Energy Technologies, 2012).
- (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)

Drilling activities will be accomplished with a DP MODU. DP vessels are self-propelled and maintains 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 presence of the MODU include the physical presence of the MODU and support vessels in the ocean, increased light from working and safety lighting on the vessel, and audible noise above and below the water's surface.

The physical presence of the MODU in the ocean can attract pelagic fishes and other marine life. The vessels 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, 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, vessel thruster specifications, and operational requirements. Representative source levels for vessels in DP mode range from 184 to 190 decibels (dB) referenced to (re) 1 micropascal (μPa) m with a primary frequency below 600 Hz (Blackwell and Greene Jr., 2003; McKenna et al., 2012b; Kyhn et al., 2014). Zykov (2016) characterized a noisier MODU thruster with source levels from 190 to 195 dB re 1 μPa m expressed as root-mean-square sound pressure level (SPL). The source level for the thrusters used by Zykov (2016) were estimated for power output close to the nominal value (the maximum sustainable) for all thrusters; it is highly unlikely that all the thrusters of all vessels will be operated at such conditions for a prolonged period of time.

Positioning of the MODU requires the use of a vessel-mounted transducer and a series of transceivers placed on the seafloor. The transducer employs a high-frequency acoustic signal (i.e., main energy between 21 and 31 kHz) throughout the operation. While the acoustic signal emitted by the transducer is similar to that emitted by a commercial echosounder, its source level will vary depending upon water depth (i.e., higher source levels required in deeper water). Source levels for the vessel-mounted transceiver are estimated to be >200 dB re 1 μPa m expressed as SPL, with energy focused toward the seafloor (Equinor, 2019). However, the directionality and frequency of the source results in minimal propagation outside the main beam of the pulse.

The response of marine mammals, sea turtles, and fishes to a perceived marine noise depends on a range of factors, including 1) the SPL, frequency, duration, and novelty of the noise; 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

Drilling activities will be accomplished with a DP MODU; no vessel will use anchors. There will be minimal disturbance to the seafloor and soft bottom communities during positioning of the equipment. Physical disturbance of the seafloor will be limited to the proximal area where the wellbore penetrates the substrate, where mud and drill cuttings will be deposited. The total disturbed area is estimated to be 0.62 acres (ac) (0.25 hectares [ha]) per well (BOEM, 2012a) but may vary depending on the specific well configuration.

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 ($PM_{2.5}$ and PM_{10}), sulfur oxides (SO_x), nitrogen oxides (NO_x), volatile organic compounds (VOCs), carbon monoxide (CO) (Reşitoğlu et al., 2015), and ammonia (NH_3), and lead (Pb) per NTL 2020-G01.

The project area 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 Part 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 the MODU are required to comply with the National Pollutant Discharge Elimination System (NPDES) General Permit for Oil and Gas Activities (General Permit No. GMG290000). 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. Excess cement slurry and blowout preventer (BOP) 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 and their subsequent processing aboard the surface vessel. 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, ballast water, bilge water, fire water, hydrate inhibitor, BOP fluid, excess cement, 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. GMG290000 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 that will be selected for this project will meet 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 General 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, or R360 Environmental Solutions, in Port Fourchon, Louisiana. Cuttings wetted with SBMs will be transported to shore for deep well injection or landfarm at 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. Completion fluids will be transported to shore for recycling/reconditioning or deep well injection at Halliburton Drilling Fluids, Baker Hughes, Newpark Drilling Fluids, Tetra, or R360 Environmental Solutions, in Port Fourchon, Louisiana.

Recyclable trash and debris will be generated during the proposed project and will be recycled at Omega Waste Management in West Patterson, Louisiana, or at a similarly permitted facility. Non-recyclable trash and debris will be transported to the Riverbirch landfill in Avondale, Louisiana; or to a similarly permitted facility. Exploration and production wastes will be transported to R360 Environmental Solutions or Clean Waste in Port Fourchon, Louisiana. Used oil and glycol will be transported to Omega Waste Management in West Patterson, Louisiana; to Chemical Waste Management in Sulphur, Louisiana; or at a similarly permitted facility. Non-hazardous waste will be transported to the Waste Management Woodside landfill in Walker, Louisiana; or to a similarly permitted facility. Non-hazardous oilfield waste will be transported to Chemical Waste Management in Sulphur, Louisiana. Universal waste items such as batteries, lamps, glass, and mercury contaminated waste will be sent to Chemical Waste Management in Sulphur, Louisiana, for processing. Hazardous waste will be sent to Chemical Waste Management in Sulphur, Louisiana; Clean Harbors in Colfax, 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 accidentally 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, 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 [2020a] 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 in Port Fourchon, Louisiana, for onshore support of vessels, and in Houma, Louisiana for air transportation support. No terminal expansion or construction is planned at either location.

IPFs associated with support vessel and helicopter traffic include their physical presence and operational noise. Each factor is discussed in the following subsections.

A.8.1 Physical Presence

The supply base in 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 (2020a) has found that support vessel traffic has the potential to disturb protected species (e.g., marine mammals, sea turtles, 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 (Laist et al., 2001; Jensen and Silber, 2004; Hazel et al., 2007; Vanderlaan and Taggart, 2007; Conn and Silber, 2013; NMFS, 2020a). 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, 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 (100 m) of marine mammals (NMFS, 2020a).

A.8.2 Noise

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 sounds (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 unladen 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 μ Pa 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 underwater SPLs of 109 dB re 1 µPa from a Bell 212 helicopter flying at an altitude of 500 ft (152 m). Penetration of helicopter 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 noise 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 H₂S 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 specific to these various accidental events 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, 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 activities (BP America Inc., 2004; Fugro GeoConsulting, 2010; C&C Technologies, 2011; Fugro GeoConsulting, 2011ab; Forum Energy Technologies, 2012).

Vessel Collisions. BSEE data show that there were 188 OCS-related collisions between 2007 and 2020 (BSEE, 2020). 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).

H₂S Release. WR 508 is classified as H₂S absent. Based on the H₂S absent classification, no further discussion on H₂S impacts is warranted.

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, 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.

The project area is 178 miles (286 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 plans.

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. The baseline risk of loss of well control spill >10,000 bbl on the OCS is estimated to be once every 27.5 years (ABSG Consulting, 2018).

Spill Size. Shell has calculated the WCD for this EP using the requirements prescribed by NTL 2015-N01. The calculated initial release volume is 47,114 bbl of oil during the first day, and the calculated 30-day average WCD rate is 37,318 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 C048 (the launch area which includes the project area) are presented in **Table 3**. The 30-day OSRA model predicts a <0.5% chance of shoreline contact within 3 and 10 days of a spill. Within 30 days of a spill, a 1% to 2% chance of shoreline contact is predicted from Matagorda County, Texas to Plaquemines Parish, Louisiana. 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 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 C048) could contact shoreline segments within 3, 10, or 30 days.

Shoreline Segment	County or Parish and State	Conditional Probability of Contact ¹ (%)		
		3 Days	10 Days	30 Days
C08	Matagorda County, Texas	--	--	1
C09	Brazoria County, Texas	--	--	1
C10	Galveston County, Texas	--	--	2
C12	Jefferson County, Texas	--	--	1
C13	Cameron Parish, Louisiana	--	--	2
C14	Vermilion Parish, Louisiana	--	--	1
C17	Terrebonne Parish, Louisiana	--	--	1
C20	Plaquemines Parish, Louisiana	--	--	2

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-ft x 20-ft 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 3,500-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 in the Gulf of Mexico OCS, approximately 178 miles (286 km) from the nearest shoreline (Louisiana), 186 miles (299 km) from the onshore support base at Port Fourchon, Louisiana, and 217 miles (349 km) from the helicopter base at Houma, Louisiana. Estimated water depth at the project area is 9,554 ft (2,912 m).

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; impacts from all planned activities 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 in coastal counties along the Gulf of Mexico is relatively good (BOEM, 2012a). As of May 2022, Mississippi, Alabama, and Florida Panhandle coastal counties are in attainment of the National Ambient Air Quality Standards (NAAQS) for all criteria pollutants (USEPA, 2022). St. Bernard Parish in Louisiana is a nonattainment area 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, 2022).

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 and both types of accidents: a small fuel spill and a large oil spill.

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, CO, NH₃, and Pb.

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.

WR 508 is 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 Part 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. BOEM coordinates with the USFWS if emissions from proposed projects may affect the Breton Class I area. The project area is approximately 226 miles (364 km) from the Breton Wilderness Area. Shell intends to comply with all BOEM requirements regarding air emissions. No further analysis or control measures are required.

There are three Class I air quality areas on the west coast of Florida: St Mark's Wildlife Refuge in Wakulla County, Chassahowitzka Wilderness Area in Hernando County, and Everglades National Park in Monroe, Miami-Dade, and Collier Counties. The project area is approximately 452 miles (727 km) from the closest Florida Class I air quality area (Saint Mark's Wildlife Refuge Class I Air Quality 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 contributing to degradation/loss of ecosystems, ocean acidification, and sea level rise (Intergovernmental Panel on Climate Change, 2014, 2022). Carbon dioxide (CO₂) and methane (CH₄) emissions from the project would constitute a very small incremental contribution to greenhouse gas emissions from all OCS activities. According to the Programmatic EIS (BOEM, 2016a) and OCS lease sale EISs (BOEM, 2017a), estimated CO₂ 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**), coastal areas would not likely be affected within 10 days; however, coastal areas between Matagorda County, Texas, and Plaquemines Parish, Louisiana, may be affected within 30 days of a spill (1% to 2% 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 large oil spill, implementation of Shell's OSRP will mitigate and reduce the impacts. EP Section 9b provides detail on spill response measures. Based on OSRA modeling, and the low likelihood of a large oil spill event, significant spill impacts on coastal air quality are not 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 (i.e., a small fuel spill and a large oil spill).

Impacts of Effluent Discharges

As described in **Section A.4**, NPDES General Permit No. GMG290000 establishes permit limits and monitoring requirements for effluent discharges from the MODU and support vessels.

WBM and cuttings, excess cement slurry, and BOP fluid will 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). An EIS published by BOEM in 2017 concluded that the discharge of treated SBM cuttings will not cause persistent impacts on water quality (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 decks 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 desalination unit brine and non-contact cooling water, non-contaminated well treatment and completion fluids, BOP fluid, excess cement, hydrate inhibitor, treated seawater, fire water, bilge water, and ballast 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 to 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**).

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).

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). Though White et al. (2014) found that dispersants could remain associated with oil in the environment for up to 4 years. 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, hydrocarbon levels were reduced in the surface waters from May 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 CH₄ 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**), coastal areas would not

likely be affected within 10 days; however, coastal areas between Matagorda County, Texas, and Plaquemines Parish, Louisiana, may be affected within 30 days of a spill (1% to 2% 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 would be temporarily affected, but no long-term detectable 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 project area is approximately 9,554 ft (2,912 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 wellsite locations (BP America Inc., 2004; Fugro GeoConsulting, 2010; C&C Technologies, 2011; Fugro GeoConsulting, 2011ab; Forum Energy Technologies, 2012). As a result, proposed activities are not expected to have an impact on regionally present high-density deepwater benthic communities.

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; Spies et al., 2016), which can be used to describe typical baseline benthic communities that could be present in vicinity of the proposed activities. **Table 4** summarizes data from two stations in the vicinity of the proposed activities. Sediments at these two stations were similar, predominantly clay (55% at Station NB5 and 53% at Station GKF) and silt (41% at Station NB5 and 45% at Station GKF) (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	Distance from Lease Area	Water Depth (m)	Density		
			Meiofauna (individuals m ⁻²)	Macrofauna (individuals m ⁻²)	Megaфаuna (individuals ha ⁻¹)
NB5	29 miles (47 km)	2,063	117,263	706	1,600
GKF	47 miles (76 km)	2,460	84,348	737	--

-- = No data available.

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 ranged from approximately 84,000 to 117,000 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 macrofauna 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 macrofaunal density in the water depth of the project area is estimated to be approximately 787 individuals m^{-2} ; however, actual densities at the project area are unknown and often highly variable.

Polychaetes are typically the most abundant macrofaunal 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 3W, which includes stations on the mid Texas-Louisiana Slope. The most abundant species in this zone were the polychaetes *Levinenia uncinata*, *Paraonides monilaris*, and *Tachytrypane* sp.; the bivalve *Heterodonta* sp.; and the isopod *Macrostylis* sp. (Wei, 2006, Wei et al., 2010).

Megafaunal density at a nearby station in the vicinity of the proposed wellsites was approximately 1,600 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). 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). In deep-sea sediments, Main et al. (2015) observed that microbial oxygen consumption rates increased and bacterial biomass decreased with hydrocarbon contamination.

IPFs that could potentially affect benthic communities are physical disturbance to the seafloor, 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

Drilling activities will be accomplished with a DP MODU; no vessel will use anchors. There will be minimal disturbance to the seafloor and soft bottom communities during positioning of the equipment. 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. The total disturbed area is estimated to be 0.62 ac (0.25 ha) per well (BOEM, 2012a) but may vary depending on the specific well configuration. Physical disturbance to the seafloor during this project will have no significant impact on soft bottom benthic communities on a regional basis.

Impacts of Effluent Discharges

Drilling muds and cuttings are the only effluents likely to affect these soft bottom benthic communities that could be present in vicinity of the wellsites. During drilling activities, cuttings and seawater-based "spud mud" may 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; Fink, 2015). 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 BOP 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 wellsites (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 BOP 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 drill sites. 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 density may increase and diversity may decrease as opportunistic species that tolerate low oxygen and high H₂S predominate (Continental Shelf Associates, 2006). As the base SBM 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-foot (300-meter) 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 activities' location. Sediments at these two stations were similar, predominantly clay (55% at Station NB5 and 53% at Station GKF) and silt (41% at Station NB5 and 45% at Station GKF) (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-foot (300-meter) 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 miles² (24 km²). 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 miles² (148 km²). NOAA (2016b) documented a footprint of over 772 miles² (2,000 km²) of impacts to benthic habitats surrounding the *Deepwater Horizon* incident site. The analysis also identified a larger area of approximately 3,552 miles² (9,200 km²) of potential exposure and uncertain impacts to benthic communities (NOAA, 2016b). Stout and Payne (2018) also noted that SBM released as a result of the blowout covered a seafloor area of 2.5 miles² (6.5 km²).

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 0.62 miles (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. Noirungsee et al. (2020) observed that pressure has a significant influence on deep-sea sediment microbial communities with the addition of dispersant and oil with dispersants being shown to have an inhibitory effect on hydrocarbon degraders. Thus, the dispersant persistence due to hydrostatic pressure could further limit microbial oil biodegradation (Noirungsee et al., 2020). While there are some indications of partial recovery of benthic fauna, as of 2015, full recovery had 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. A large oil spill could have impacts on soft bottom communities but significant impacts on a regional basis are not 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.

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**). The nearest known high-density deepwater benthic community is located approximately 81 miles (130 km) from the project area. A high-resolution geophysical survey, including an autonomous underwater vehicle, multi-beam echosounder and three-dimensional seismic data, has been conducted in the project area as part of the assessment of archaeological resources and shallow hazards (BP America Inc., 2004; Fugro GeoConsulting, 2010; C&C Technologies, 2011; Fugro GeoConsulting, 2011ab; Forum

Energy Technologies, 2012). The survey found no evidence of high-density deepwater benthic communities.

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

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 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-foot (300-meter) 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, loss of tissue mass) or long lasting and could 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. (2014a) 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., 2014b).

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 Ewing Bank Block 947, located approximately 105 miles (169 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 234 miles (377 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 270 miles (435 km) 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. To provide reference for potential impacts to Threatened, Endangered, and protected species, the following sections include discussions of individual- (i.e., effect on single individual), population- (i.e., effect on localized population of individuals) and species-level (i.e., effect on entire species as a whole) impacts for select species. It is understood that contact with potential IPFs, particularly large oil spills, does not necessarily result in mortality. However, the size of the population, along with its status as Threatened, Endangered, or protected were considered when determining if potential individual mortality may result in impacts at the individual, population, or species level.

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 (*Trichechus manatus*). 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. Adapted from U.S. Fish and Wildlife Service (2020a) and National Oceanic and Atmospheric Administration Fisheries (2020).

Species	Scientific Name	Status	Potential Presence		Critical Habitat Designated in Gulf of Mexico
			Project Area	Coastal	
Marine Mammals					
Rice's whale ¹	<i>Balaenoptera ricei</i>	E	X	--	None
Sperm whale	<i>Physeter macrocephalus</i>	E	X	--	None
West Indian manatee	<i>Trichechus manatus</i> ²	T	--	X	Florida (Peninsular)
Sea Turtles					
Loggerhead turtle	<i>Caretta caretta</i>	T, E ³	X	X	Nesting beaches and nearshore reproductive habitat in Mississippi, Alabama, and Florida; <i>Sargassum</i> habitat including most of the central & western Gulf of Mexico.
Green turtle	<i>Chelonia mydas</i>	T	X	X	None
Leatherback turtle	<i>Dermochelys coriacea</i>	E	X	X	None
Hawksbill turtle	<i>Eretmochelys imbricata</i>	E	X	X	None
Kemp's ridley turtle	<i>Lepidochelys kempii</i>	E	X	X	None
Birds					
Piping Plover	<i>Charadrius melanotos</i>	T	--	X	Coastal Texas, Louisiana, Mississippi, Alabama, and Florida
Whooping Crane	<i>Grus americana</i>	E	--	X	Coastal Texas (Aransas National Wildlife Refuge)
Fishes					
Oceanic whitetip shark	<i>Carcharhinus longimanus</i>	T	X	--	None
Giant manta ray	<i>Mobula birostris</i>	T	X	X	None
Gulf sturgeon	<i>Acipenser oxyrinchus desotoi</i>	T	--	X	Coastal Louisiana, Mississippi, Alabama, and Florida
Nassau grouper	<i>Epinephelus striatus</i>	T	--	X	None
Smalltooth sawfish	<i>Pristis pectinata</i>	E	--	X	Southwest Florida
Invertebrates					
Elkhorn coral	<i>Acropora palmata</i>	T	--	X	Florida Keys and the Dry Tortugas
Staghorn coral	<i>Acropora cervicornis</i>	T	--	X	Florida Keys and the Dry Tortugas
Pillar coral	<i>Dendrogyra cylindrus</i>	T	--	X	None
Rough cactus coral	<i>Mycetophyllia ferox</i>	T	--	X	None
Lobed star coral	<i>Orbicella annularis</i>	T	--	X	None
Mountainous star coral	<i>Orbicella faveolata</i>	T	--	X	None
Boulder star coral	<i>Orbicella franksi</i>	T	--	X	None
Panama City crayfish	<i>Procambarus econfiniae</i>	T ⁴	--	X	South-central Bay County, Florida ⁴
Terrestrial Mammals					
Beach mice (Alabama, Choctawhatchee, Perdido Key, St. Andrew)	<i>Peromyscus polionotus</i>	E	--	X	Alabama and Florida (Panhandle) beaches
Florida salt marsh vole	<i>Microtus pennsylvanicus dukemcampbelli</i>	E	--	X	None

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

¹ In 2021, NMFS recognized that what had previously been accepted as a subspecies of the Bryde's whale is actually a separate species. The reclassification is formerly recognized under 86 FR 47022 effective date October 22, 2021 as the Rice's whale (*Balaenoptera ricei*).

² 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.

³ 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).

⁴ The Threatened status and critical habitat designation for the Panama City crayfish were effective February 4, 2022.

Coastal Endangered or Threatened species that may occur along the U.S. Gulf Coast include the West Indian manatee, Piping Plover (*Charadrius melanotos*), Florida salt marsh vole (*Microtus pennsylvanicus dukecampbelli*), Panama City crayfish (*Procambarus econfinae*), Whooping Crane (*Grus americana*), Gulf sturgeon (*Acipenser oxyrinchus desotoi*), smalltooth sawfish (*Pristis pectinata*), 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 Rice's whale (*Balaenoptera ricei*), sperm whale (*Physeter macrocephalus*), oceanic whitetip shark (*Carcharhinus longimanus*), and giant manta ray (*Mobula birostris*) are the only Endangered or Threatened species that could potentially 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, 2017); no critical habitat has been designated for the sperm whale. The Rice's whale exists in the Gulf of Mexico as a small, resident population. This species was formerly known as a subspecies to the Bryde's whale (*Balaenoptera edeni brydei*) until recent DNA studies identified it as a separate species (Rosel et al., 2021). It is the only baleen whale known to be resident of the Gulf. The species is severely restricted in range, being found only in the northeastern Gulf in the waters of the DeSoto Canyon (Waring et al., 2016; Rosel et al., 2021) and are therefore not likely to occur within the project area. The giant manta ray 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.

Four Endangered mysticete whales (blue whale [*Balaenoptera musculus*], fin whale [*Balaenoptera physalus*], North Atlantic right whale [*Eubalaena glacialis*], and sei whale [*Balaenoptera borealis*]) have been reported in 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., 2021) 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 to be present in the Gulf of Mexico: elkhorn coral (*Acropora palmata*), staghorn coral (*Acropora cervicornis*), 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.3.16**).

There are no other Threatened or Endangered species in the Gulf of Mexico that are likely to be affected by either routine or accidental events associated with project activities.

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 Minerals Management Service-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 (2020a) identified marine debris as an IPF for sperm whales, compliance with BSEE NTL 2015-G03 and NMFS (2020a) Appendix B will minimize the potential for marine debris-related impacts on sperm whales. NMFS (2020a) 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 (including noise and lights)

Some noises 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 activities are relatively weak in intensity, and an individual animal's sound exposure

would be transient. As discussed in **Section A.1**, an actively drilling MODU can produce a maximum broadband (10 Hz to 10 kHz) source level of approximately 190 dB re 1 μPa m (Hildebrand, 2005).

NMFS (2018a) 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, sperm whales would move away from the proposed operations area, and sound 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 noise (Jochens et al., 2008). Most observations of behavioral responses of marine mammals to anthropogenic noises, in general, have been limited to short-term behavioral responses, which included the cessation of feeding, resting, or social interactions (NMFS, 2015b). Animals can determine the direction from which a noise 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 sound sources (National Research Council, 2003b).

NMFS (2018a) presents criteria that are used to determine physiological (i.e., injury) thresholds for marine mammals. Behavioral disturbance thresholds have not been updated in the most recent acoustic guidance (NMFS, 2018a) and therefore, revert to thresholds established and published by NMFS in *70 Federal Register (FR)* 1871. Behavioral disturbance thresholds for marine mammals are applied equally across all functional hearing groups. Received SPL of 120 dB re 1 μPa from a non-impulsive, continuous source is 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, in the case of behavioral responses, received levels alone do not indicate a behavioral response and, more importantly, do not equate to biologically important responses (Ellison et al., 2012; Southall et al., 2016, 2021).

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 over 24-hours ($\text{SEL}_{24\text{h}}$) of 198 dB re 1 $\mu\text{Pa}^2 \text{ s}$ (NMFS, 2018a). Similarly, temporary threshold shifts are estimated to occur when the mammal has received an $\text{SEL}_{24\text{h}}$ of 178 dB re 1 $\mu\text{Pa}^2 \text{ s}$. Due to the short propagation distance of above-threshold $\text{SEL}_{24\text{h}}$, 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 and continuous, with some variability in sound level. This analysis assumes that the non-impulsive, continuous nature of noise 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 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 presence are not identified as an IPF for sperm whales (NMFS, 2007, 2015a, 2020b; BOEM, 2016c, 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. This NTL was reissued in June 2020 to address instances where guidance in the 2020 NMFS Biological Opinion was updated (NMFS, 2020a). 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, 2020a). 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 [2020a] 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 (2020a) 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 (2020a) in addition to the NTL BOEM-2016-G01, NMFS concluded that the likelihood of collisions between vessels and sperm whales would be reduced during daylight hours. During nighttime and during periods of poor visibility, it is assumed that vessel noise and sperm whale avoidance of moving vessels would reduce the chance of vessel strikes with this species. It is, however, likely that a collision between a sperm whale and a moving support vessel would result in severe injury or mortality of the stricken animal. The current Potential Biological Removal (PBR) level for the Gulf of Mexico stock of sperm whales is 2.0 (Hayes et al., 2021). The PBR level is defined by the MMPA as the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population. Based on its Endangered status, mortality of a single sperm whale would constitute a significant impact to the local (Gulf of Mexico) population of sperm whales but would not likely be significant at the species level.

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 noise, 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. If 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, 2020a). Although whales may respond to helicopters (Smultea et al., 2008), NMFS (2020a) 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 (2020a) 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 (2020a). 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, 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 (Waring et al., 2016). 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. Based on the current PBR level for the Gulf of Mexico stock of sperm whales (2.0), mortality of a single sperm whale would constitute a significant impact to the local (Gulf of Mexico) population of sperm whales but would not be significant at species 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 Rice's Whale (Endangered)

A recent study by Rosel et al. (2021), identified the genetically distinct Northern Gulf of Mexico Bryde's whale stock as a new species of baleen whale named the Rice's whale (*Balaenoptera ricei*) through DNA analysis. The reclassification was approved by NMFS under 86 FR 47022 and became effective October 22, 2021. The designated Rice's whale distribution area as presented by NMFS is presented in **Figure 1** for reference and is approximately 58 miles (93 km) from the project area.

The Rice's whale is the only year-round resident baleen whale in the northern Gulf of Mexico with the population estimated to be fewer than 100 individuals (NOAA, 2022). NOAA, in partnership with Scripps Institution of Oceanography and Florida International University, created the Gulf of Mexico Rice's Whale Trophic Ecology Project to develop a comprehensive ecological understanding of the newly identified species (NOAA, 2022). The group is working on building a photo-identification catalog, conducting animal telemetry, biological sampling, and understanding their prey/distribution. Through animal telemetry, they have identified that Rice's whales make foraging dives during the day near the seafloor.

The Rice's whale is sighted most frequently in the waters over DeSoto Canyon between the 328-and 3,280-foot (100- and 1,000-meter) isobaths (Rosel et al., 2016; Hayes et al., 2021). 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, although unlikely, that Rice's whales could occur in the project area.

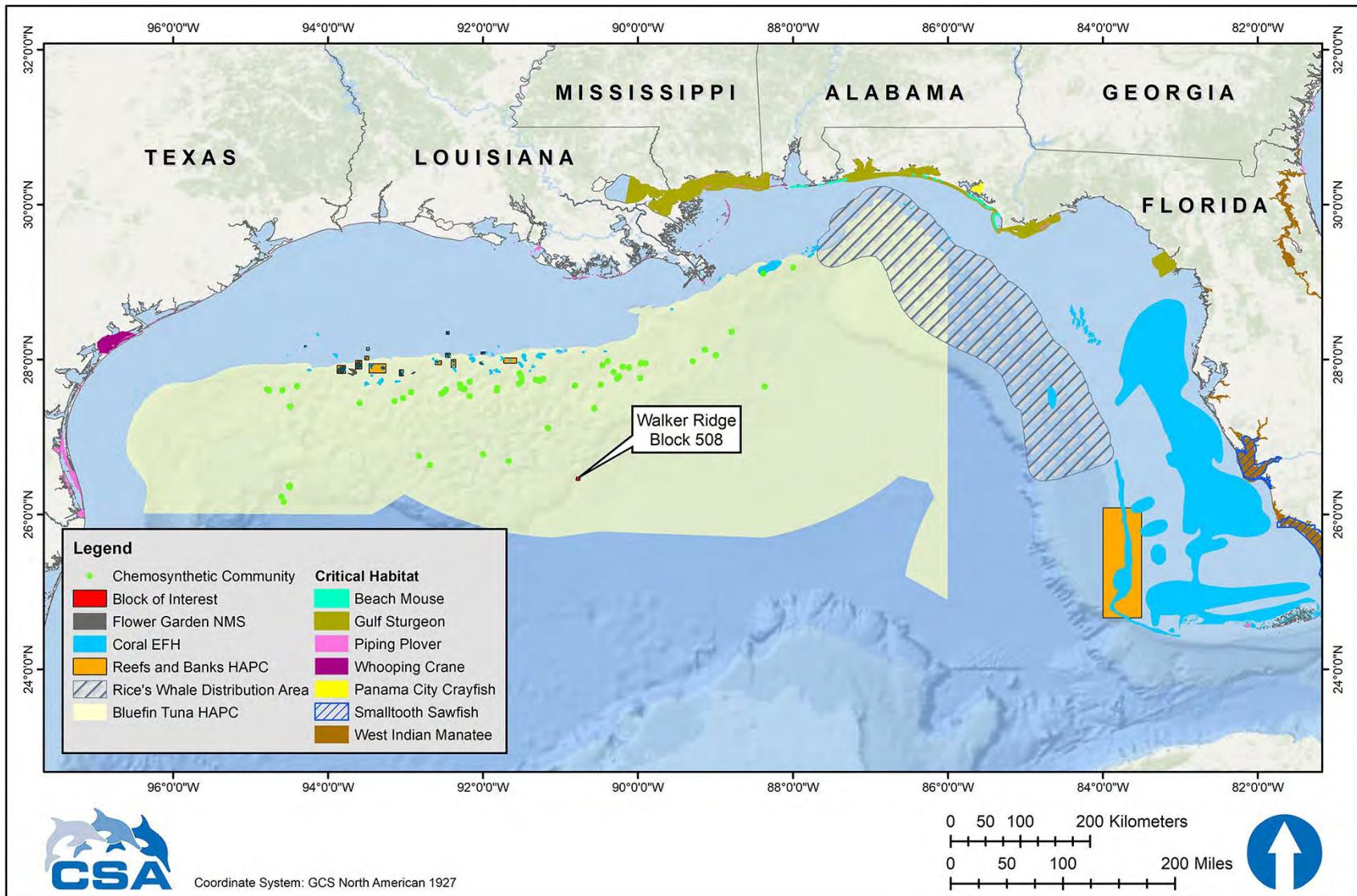


Figure 1. Location of selected environmental features in relation to the project area. EFH = Essential Fish Habitat; HAPC = Habitat Area of Particular Concern; NMS = National Marine Sanctuary.

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. NMFS final rule on the reclassification (86 *FR* 47022) does not affect the ESA standing; thus, the Rice's whale is listed as an Endangered species.

IPFs that could affect the Rice'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 Rice'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 Rice's whales in the Gulf of Mexico.

Though NMFS (2020a) stated marine debris as an IPF, compliance with BSEE NTL 2015-G03 and NMFS (2020a) Appendix B will minimize the potential for marine debris-related impacts on Rice's whales. NMFS (2020a) estimated one sublethal take and no lethal takes of Rice's whale (Bryde's whales at the time of publication) from marine debris over 50 years of proposed action. Therefore, marine debris is likely to have negligible impacts on Rice's whales and is not further discussed (See **Table 2**).

Impacts of Mobile Offshore Drilling Unit Presence (including noise and lights)

Some noise 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 sound exposure would be transient. As discussed in **Section A.1**, an actively drilling MODU can produce noise with a maximum broadband (10 Hz to 10 kHz) source level of approximately 177 to 190 dB re 1 μPa m expressed as SPL (Hildebrand, 2005).

NMFS (2018a) lists Rice's whales (Bryde's whales at the time of publication) 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 Rice's whales.

It is expected that, due to the relatively stationary nature of the MODU operations, Rice's whales would move away from the proposed operations area, and sound levels that could cause auditory injury would be avoided. Noise associated with proposed vessel operations may cause behavioral (disturbance) effects to individual Rice's whales. NMFS (2018a) presents criteria that are used to determine physiological (i.e., injury) thresholds for marine mammals. Behavioral disturbance thresholds have not been updated in the most recent acoustic guidance (NMFS, 2018a) and therefore, revert to thresholds established and published by NMFS in 70 *FR* 1871. Received SPL of 120 dB re 1 μPa from a non-impulsive, continuous source is 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 SPL of 120 dB re 1 μPa alone 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 (Ellison et al., 2012; Southall et al., 2016, 2021).

For low-frequency cetaceans, specifically the Rice's whale, permanent and temporary threshold shift onset from non-impulsive sources is estimated to occur at SEL_{24h} of 199 dB re 1 μPa^2 s and 179 re 1 μPa^2 s, respectively. MODU operations and DP thrusters are not expected to reach permanent or temporary threshold shift values, and due to the short propagation distance of above-threshold SEL_{24h} and the stationary nature of the proposed activities, it is not expected that any Rice's whales will receive exposure levels necessary for the onset of auditory threshold shifts.

The MODU will be located within a deepwater, open ocean environment. This analysis assumes that the non-impulsive, continuous nature of noise 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 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 Rice's whales and due to the low density of Rice'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 Rice's whales and creates a potential for 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, 2020a). 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 Rice'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 [2020a] Appendix C).

Compliance with these mitigation measures will minimize the likelihood of vessel strikes as well as reduce the chance for disturbing Rice's whales. The current PBR level for the Gulf of Mexico stock of Rice's whale is 0.1 (Hayes et al., 2021). Mortality of a single Rice's whale would constitute a significant impact to the local (Gulf of Mexico) stock of Rice's whales. However, it is very unlikely that Rice's whales occur within the project area, including the transit corridor for support vessels; consequently, the probability of a vessel collision with this species is extremely low. Compliance with these mitigation measures will minimize the likelihood of vessel strikes as well as reduce the chance for disturbing Rice's whales.

Helicopter traffic also has the potential to disturb Rice's whales. Based on studies of cetacean responses to noise, the observed reactions to brief overflights by aircraft were short-term and limited to behavioral disturbances (Smulter 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, 2020a). Due to the brief potential for disturbance the low density of Rice'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 (2020a) 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

Rice'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 Rice's whales and the unlikelihood of Rice'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 (2020a). 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 Rice'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, 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 Rice'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 Rice's whales, it is expected that impacts resulting in the injury or death of individual Rice's whales would be significant based on the current PBR level for the Gulf of Mexico subspecies and stock (0.1) (Hayes et al., 2021). Mortality of a single Rice's whale would constitute a significant population- and species-level impact. The core distribution area for Rice's whales is within the eastern Gulf of Mexico OCS Planning Area; therefore, it is unlikely that Rice's whales occur within the project area and surrounding waters. Consequently, the probability of spilled oil from a project-related well blowout reaching Rice's whales is extremely low.

C.3.3 West Indian Manatee (Threatened)

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 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 178 miles (286 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 dissipating. Compliance with NTL BSEE 2015-G013 (see **Table 1**) will minimize the potential for marine debris-related impacts on manatees. In certain cases, guidance in Appendix A of NMFS (2020a) replaces guidance in the NTL per the June 2020 reissued BSEE-NTL-2015-G03. 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 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 (2020a) 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. The current PBR level for the Florida subspecies of Antillean manatee is 14 (USFWS, 2014). In the event of a vessel strike during support vessel transits, the mortality of a single manatee would constitute an adverse but insignificant impact to the subspecies.

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, 2020a). 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**), coastal areas would not likely be affected within 10 days; however, coastal areas between Matagorda County, Texas, and Plaquemines Parish, Louisiana, may be affected within 30 days of a spill (1% to 2% 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, 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. The current PBR level for the Florida subspecies of Antillean manatee is 14 (USFWS, 2014). It is not anticipated that groups of manatees would occur in coastal waters of the north central Gulf of Mexico; therefore, in the event of mortality of individual manatees from a large oil spill would constitute an adverse but insignificant impact at the population level to the subspecies. 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 (*Kogia sima* and *K. breviceps*, respectively), 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 (*Stenella attenuata*), spinner dolphin (*Stenella longirostris*), and Clymene dolphin (*Stenella clymene*). 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 from pygmy sperm whales, 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; Hayes et al., 2019; 2021). 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 one documented stranding reported in the Gulf of Mexico by Bonde and O'Shea (1989). There are a number of extralimital strandings and sightings reported beyond the recognized range of Sowerby's beaked whale (e.g., Canary Islands, Mediterranean Sea), including from the eastern Gulf of Mexico (Pitman and Brownell, 2020). Blainville's beaked whales are rare, with only four documented strandings in the northern Gulf of Mexico (Würsig et al., 2000) and three sightings in the Gulf of Mexico (Hayes et al., 2021).

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 (Hayes et al., 2021).

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, killer whale (*Orcinus orca*), false killer whale (*Pseudorca crassidens*), Fraser's dolphin (*Lagenodelphis hosei*), melon-headed whale (*Peponocephala electra*), pantropical spotted dolphin, pygmy killer whale (*Feresa attenuata*), short-finned pilot whale (*Globicephala macrorhynchus*), Risso's dolphin (*Grampus griseus*), rough-toothed dolphin (*Steno bredanensis*), spinner dolphin, 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. Any of these delphinid species could occur in the project area (Waring et al., 2016; Hayes et al., 2021).

The bottlenose dolphin 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., 2021).

Bottlenose dolphins in the northern Gulf of Mexico are categorized into three stocks by NMFS (2016): Bay, Sound, and Estuary; Continental Shelf; and Coastal and Oceanic. The Bay, Sound, and Estuary Stock is considered to be a strategic stock. 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, 2016c) 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. (2014a) 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 (including 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, 2018a). 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, 2018a). Thruster noise will affect each group differently depending on the frequency bandwidths 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 an SEL_{24h} of 198 dB re 1 $\mu\text{Pa}^2 \text{ s}$. Similarly, temporary threshold shifts are estimated to occur when the mammal has received an SEL_{24h} of 178 dB re 1 $\mu\text{Pa}^2 \text{ s}$. Due to the short propagation distance of above-threshold SEL_{24h}, the transient nature of marine mammals and the stationary nature of the proposed activities, it is not expected that any marine mammals will receive exposure levels necessary for the onset of auditory threshold shifts. NMFS (2018a) presents criteria that are used to determine physiological (i.e., injury) thresholds for marine mammals. Behavioral disturbance thresholds have not been updated in the most recent acoustic guidance (NMFS, 2018a) and therefore, revert to thresholds established and published by NMFS in 70 FR 1871. Received SPL of 120 dB re 1 μPa from a non-impulsive, continuous source is 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, in the case of behavioral responses, received levels alone do not indicate a behavioral response and, more importantly, do not equate to biologically important responses (Ellison et al., 2012; Southall et al., 2016, 2021).

BOEM (2012a) stated the source level from oil and gas production platforms are low with a frequency range of 50 to 500 Hz. The operation of the MODU would represent an incremental contribution of noise to the ambient levels. It is expected that marine mammals within or near the project area would be able to detect the presence of the MODU to avoid exposure to higher energy sounds, particularly within an open ocean environment.

Some odontocetes have shown increased feeding activity around lighted platforms at night (Todd et al., 2009). Even the temporary presence of the MODU 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 an IPF for marine mammals by BOEM (2016b, 2017a). Therefore, no significant impacts are expected from this IPF.

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 (2020a) 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.

The current PBR level for several non-endangered cetacean species in the Gulf of Mexico are less than three individuals (e.g., rough-toothed dolphin = undetermined, Clymene dolphin = 2.5, Fraser's dolphin = 1.0, killer whale = 1.5, pygmy and false killer whale = 2.8, dwarf and pygmy sperm whales = 2.5) (Hayes et al., 2021). Mortality of individuals equal to or in excess of their PBR level would constitute a significant impact at a population level to the local (Gulf of Mexico) stocks of these species.

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 328 ft (100 m) of marine mammals (BOEM, 2017a; NMFS, 2020a). 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, 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 non-endangered dolphins and whales that live in the northern Gulf of Mexico had demonstrable, quantifiable injuries. Because of known low detection rates of carcasses (Williams et al., 2011), it is possible that the number of marine mammal deaths was 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 were likely attributable to oil interaction. Schwacke et al. (2014b) 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. Based on the current PBR level for several non-endangered cetacean species in the Gulf of Mexico that are less than 3 individuals (e.g., rough-toothed dolphin = undetermined, Clymene dolphin = 2.5, Fraser's dolphin = 1.0, killer whale = 1.5, pygmy and false killer whale = 2.8, dwarf and pygmy sperm whales = 2.5) (Hayes et al., 2021), mortality of individuals equal to or in excess of their PBR level would constitute a significant impact at the population level to the local (Gulf of Mexico) stocks of these species. 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 *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 2**. 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 285 miles (459 km) from the project area.

Loggerhead turtles in the Gulf of Mexico are part of the Northwest Atlantic Ocean DPS (NMFS, 2014a). 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, 2014a).

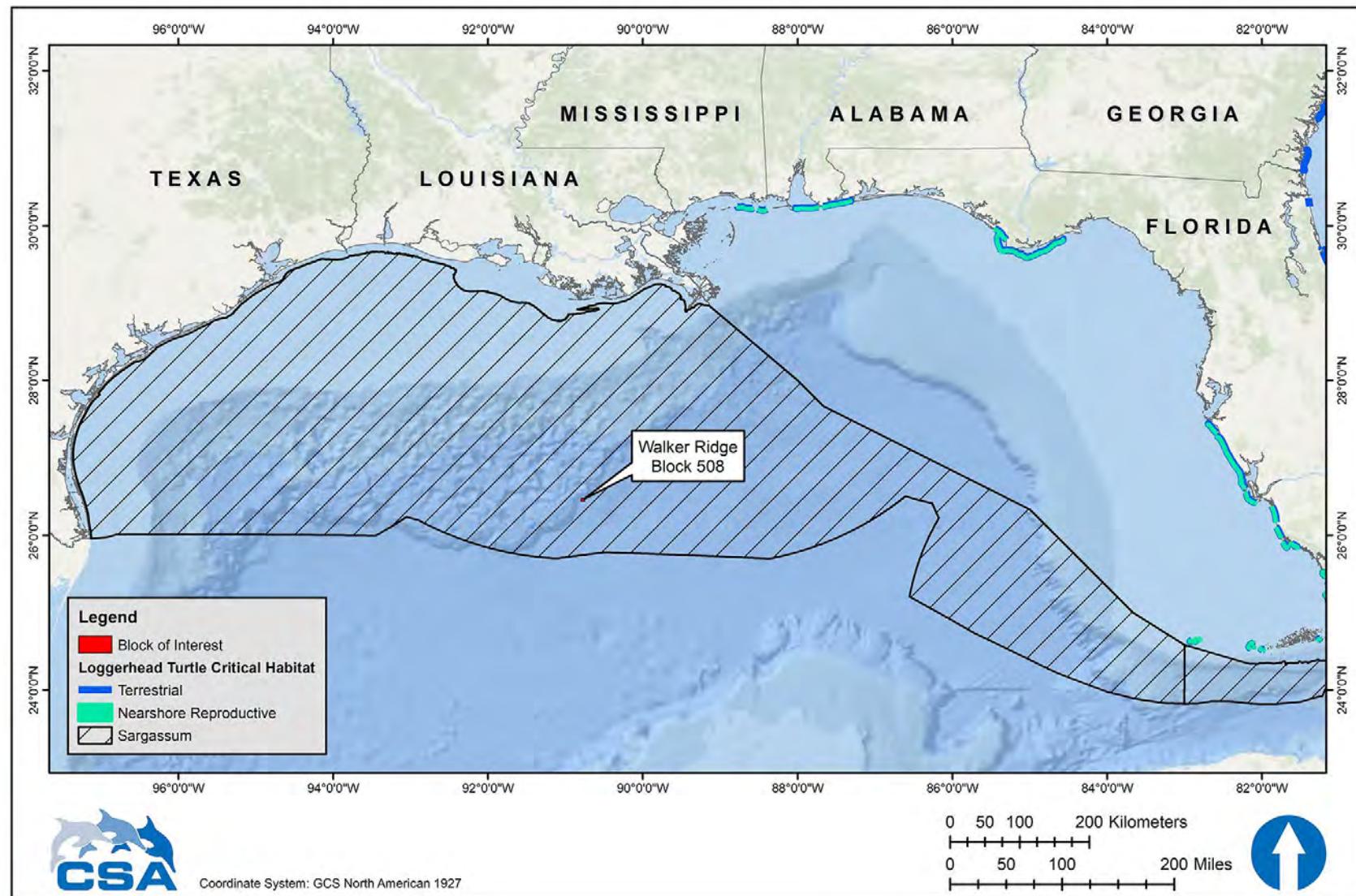


Figure 2. Location of loggerhead turtle critical habitat in the northern Gulf of Mexico in relation to the project area. The critical habitat includes terrestrial habitat (nesting beaches) and nearshore reproductive habitat in Mississippi, Alabama, and the Florida Panhandle as well as Sargassum habitat.

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, nd-a) 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, nd-b,-c);
- Kemp's ridley turtles—the main nesting site is Rancho Nuevo beach in Tamaulipas, Mexico (NMFS et al., 2011). As of May 2022, 182 Kemp's ridley turtle nests have been counted on Texas beaches for the 2022 nesting season. A total of 194 Kemp's ridley turtle nests were counted on Texas beaches during the 2021 nesting season (Turtle Island Restoration Network, 2022). 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 (USFWS, 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 (2020a) stated marine debris as an IPF, compliance with NTL BSEE 2015-G03 (See **Table 1**) and NMFS (2020a) Appendix B will minimize the potential for marine debris-related impacts on sea turtles. NMFS (2020a) 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 (including noise and lights)

Offshore activities produce broadband noise 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 noise and they appear to hear best between 200 and 750 Hz and do not respond well to noise 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). The NMFS 2020 Biological Opinion (NMFS, 2020a) lists the sea turtle underwater acoustic SEL_{24h} PTS and TTS thresholds as 204 and 189 dB re 1 $\mu\text{Pa}^2 \text{ s}$, respectively, and the SPL behavioral threshold as 175 dB re 1 μPa . However, these thresholds were developed for impulsive sound sources based on work by Finneran et al. (2017). Based on the assessment conducted in the NMFS Biological Opinion (NMFS,

2020a), there is a minimal likelihood of acoustic injury such as PTS in sea turtles, and behavioral responses to noise produced by activities such as vessel operations are not expected beyond 10 m from the source. Certain sea turtles, especially loggerheads, may be attracted to offshore structures (Lohoefer et al., 1990; Gitschlag et al., 1997; Colman et al., 2020) and thus, may be more susceptible to impacts from noise produced during routine drilling 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, these short-term impacts are not expected to be biologically significant to sea turtle populations.

BOEM (2012a) stated the source level from oil and gas production platforms are low with a frequency range of 50 to 500 Hz. The operation of the MODU would represent an incremental contribution of noise to the ambient levels. This noise will be of variable duration and intensity, depending on the type of machinery used.

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 (2020a) 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 (2020a) estimated approximately 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, 2020a). 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 [2020a] 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, 2020a, BOEM, 2012a).

Impacts of a Small Fuel Spill

Potential spill impacts on sea turtles are discussed by NMFS (2020a) 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, 2020b). 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 178 miles (286 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 285 miles (459 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 dissipating.

Loggerhead Critical Habitat – *Sargassum* Habitat. The project area is within the *Sargassum* portion of the loggerhead turtle critical habitat (**Figure 2**). Juvenile sea turtles could come into contact with or ingest diesel fuel, resulting in death, injury, or other sublethal effects. Effects 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-ac (5-ha) 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, 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, 2014a). 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, 2020a).

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, 2020a). 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**), coastal areas would not likely be affected within 10 days; however, coastal areas between Matagorda County, Texas, and Plaquemines Parish, Louisiana, may be affected within 30 days of a spill (1% to 2% conditional probability). The nearest nearshore reproductive critical habitat for loggerhead turtles is 285 miles (459 km) from the project area.

Loggerhead Critical Habitat – *Sargassum* Habitat. The project area is within the *Sargassum* portion of the loggerhead turtle critical habitat (**Figure 2**). 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 *Deepwater Horizon* incident 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 that 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 experienced declines in population 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 (BirdLife International, 2020). Critical overwintering habitat has been designated, including beaches in Texas, Louisiana, Mississippi, Alabama, and Florida (**Figure 1**). 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 dissipating (see explanation in **Section A.9.1**).

Impacts of a Large Oil Spill

The project area is 176 miles (283 km) from the nearest shoreline designated as Piping Plover critical habitat. The 30-day OSRA modeling (**Table 3**) predicts that Piping Plover critical habitat would have an 1% to 2% conditional probability of contact within 30 days of a spill.

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.

C.3.7 Whooping Crane (Endangered)

The Whooping Crane (*Grus americana*) is a large omnivorous wading bird and a federally listed Endangered species. Four wild populations live in North America (National Wildlife Federation, 2016b; USFWS, 2020b). 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 543 in the 2021 to 2022 winter at Aransas NWR (USFWS, 2022), an increase from the 2019 to 2020 winter survey (506) (USFWS, 2020b). Another reintroduced population summers in Wisconsin and migrates to Florida for the winter (USFWS, 2020c). 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 1). 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% chance of oil contacting Whooping Crane critical habitat (Calhoun or Aransas Counties, Texas) within 30 days of a spill. The nearest Whooping Crane critical habitat is approximately 370 miles (595 km) from the project area.

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 population and species levels.

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.3.8 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 (Rigby et al., 2019). 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 (Rigby et al., 2019).

Oceanic whitetip shark management is complicated due to it being globally distributed, highly migratory, and overlapping in areas of high fishing; thus, leaving assessment of population trends on fishery dependent catch-and-effort data rather than scientific surveys (Young and Carlson, 2020). 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

(2018b) 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 (2020a) 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 a small diesel fuel spill and they are not further discussed (**Table 2**).

Impacts of Mobile Offshore Drilling Unit Presence (including noise and lights)

Offshore drilling activities produce a broad array of noise 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 noise associated with production activities (source levels of 195 dB re 1 μ Pa m with peak frequencies at 40 to 100 Hz) (Hildebrand, 2005). Impacts from offshore activities (i.e., non-impulsive sound from MODU activities) could include masking or behavioral change (Popper et al., 2014). However, because the propagation distances of high SPLs from the MODU would be limited in geographic scope, 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. A study by Cave and Kajiura (2018) reported that when exposed to crude oil, the Atlantic stingray (*Hypanus sabinus*) experienced impaired olfactory function which could lead to decreased fitness. 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. 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 come in contact with oceanic whitetip sharks. However, if contact resulted in individual mortality, regional population-level effects on the species could be observed.

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 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 (less than 1,000 individuals) (NOAA, 2018a; Marshall et al., 2020). Stewart et al. (2018) reported evidence that the Flower Garden Banks serves as nursery habitat for aggregations of juvenile manta

rays. Approximately 100 unique individuals have been positively identified at the Flower Garden Banks based on unique underbelly coloration (Belter et al., 2020). 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 (2020a) 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 a small diesel fuel spill and they are not further discussed (See **Table 2**).

Impacts of Mobile Offshore Drilling Unit Presence (including noise and lights)

Offshore drilling activities produce a broad array of noise 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 [*Urotrygon jamaicensis*]) and 100 to 300 Hz (little skate [*Leucoraja erinacea*]) (Casper et al., 2003; Casper and Mann, 2006). These frequencies overlap with noise associated with production activities (source levels of 195 dB re 1 μ Pa m with peak frequencies at 40 to 100 Hz) (Hildebrand, 2005). Impacts from offshore activities (i.e., non-impulsive sounds from MODU activities) could include masking or behavioral change (Popper et al., 2014). However, because the propagation distances of high SPLs from the MODU would be limited in geographic scope, 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; although, individuals may occur anywhere in the Gulf. Information regarding the direct effects of oil on elasmobranchs, including the giant manta ray, are largely unknown. 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. A study by Cave and Kajiura (2018) reported that when exposed to crude oil, the Atlantic stingray experienced impaired olfactory function which could lead to decreased fitness. Giant manta rays typically feed in shallow waters of less than 33 ft (10 m) depth (NOAA, 2022a). 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 196 miles [315 km]), it is unlikely that oil would impact the giant manta ray nursery habitat. It is possible that a large oil spill could impact individual giant manta rays, and due to the low density of individuals thought to occur in the Gulf of Mexico, there would likely be regional population-level effects on the species if mortality is observed.

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, 2022b). 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, 2014b) (**Figure 1**). 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 dissipating (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 (2020a) 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 (274 miles [441 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 274 miles (441 km) from the nearest Gulf sturgeon critical habitat. The 30-day OSRA modeling (**Table 3**) predicts that a spill in the project area has a <0.5% conditional probability of contacting any coastal areas containing Gulf sturgeon critical habitat in St. Bernard Parish, Louisiana 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 from October through April when this species is foraging in estuarine and marine habitats (NMFS, 2020a).

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 Yucatán 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, 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 196 miles [315 km]), and the difference in water depth between the project area (9,554 ft [2,912 m]) and the Banks (approximately 56 to 476 ft [17 to 145 m]). 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 196 miles [315 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. Due to the low density of individuals thought to occur in the Gulf of Mexico, there is a very low probability for Nassau groupers to be exposed to oil from the spill. Impacts to Nassau grouper from a large oil spill would be considered at an individual level and very unlikely at a population 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

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 after 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 the Gulf of Mexico is restricted to areas primarily in southwest Florida (Brame et al., 2019) where several areas of critical habitat have been designated (**Figure 1**). A species description is presented in the recovery plan for this species (NMFS, 2009a).

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 523 miles (842 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 study by Cave and Kajiura (2018) reported that when exposed to 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. Due to its Endangered status, a large oil spill with death to individuals could have impacts to smalltooth sawfish at population and species levels.

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 (*P. p. allophys*), Perdido Key (*P. p. trissyllepsis*), and St. Andrew beach mouse (*P. p. peninsulae*). Critical habitat has been designated for all four subspecies and is shown combined in **Figure 1**. One additional species of beach mouse inhabiting dunes on the western Florida Panhandle, the Santa Rosa beach mouse (*P. p. 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 306 miles (492 km) from the nearest beach mouse critical habitat. The 30-day OSRA modeling predicts that a spill in the project area has a <0.5% 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 due to its Endangered status potentially significant at the population and species 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.3.14 Florida Salt Marsh Vole (Endangered)

The Florida salt marsh vole 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-d). 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 (USFWS, 2001b).

A large oil spill is the only IPF that may potentially 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 490 miles (789 km) from the project area. The 30-day OSRA modeling 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 of a spill.

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 Panama City crayfish (Threatened)

The USFWS issued a Final Rule designating the Panama City crayfish as Threatened under the ESA on 5 January 2022 (effective 4 February 2022). The Panama City crayfish is a semi-terrestrial crayfish that grows up to 2 inches (51 mm) in size and is found in south-central Bay County, Florida. Medium to dark brown in color, the crayfish prefers areas dominated by herbaceous vegetation and shallow or fluctuating water levels (Keppner and Keppner, 2004). Historically prevalent in shallow freshwater bodies in pine and prairie communities, development has largely replaced these habitats with commercial or residential buildings. The Panama City crayfish is now generally found in wet or semi-wet swales, ditches, slash pine plantations, undeveloped utility rights-of-way, and remnant wetlands (Florida Fish and Wildlife Conservation Commission, 2016).

A large oil spill is the only IPF that may potentially affect the Panama City crayfish. 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 Panama City crayfish because a small fuel spill would not be expected to reach their habitat prior to dissipating (**Section A.9.1**).

Impacts of a Large Oil Spill

Panama City crayfish critical habitat in Bay County, Florida is approximately 399 miles (642 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 Panama City crayfish critical habitat within 30 days.

Effects of oiling on the Panama City crayfish are largely unknown. In general, crayfishes use chemoreception to orient themselves in their environment and find food, and avoid predators (Bergman and Moore, 2005). Exposure to hydrocarbons has been shown to damage receptor cells that crayfish use for chemoreception, thus decreasing their fitness (Tierney et al., 2010). Similar experiments in American lobsters (*Homarus americanus*) have also shown exposure to hydrocarbons disrupts feeding and mating behaviors by confusing their chemoreception system (Gulf of Maine Research Institute, 2012).

Indirect impacts could include reduction of food supply, destruction of habitat, and fouling of burrows. Impacts could also occur from vehicular traffic and other activities associated with spill cleanup. Impacts associated with an extensive oiling of coastal habitat containing Panama City crayfish from a large oil spill are expected to be significant. Due to the low population numbers and restricted range, extensive oiling of Panama City crayfish habitat could be significant at the species level. However, any such impacts are unlikely due to the distance from the project area to Panama City crayfish habitat and response actions that would occur in the event of a spill.

C.3.16 Threatened Coral Species

Seven Threatened coral species are known from the 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 (proximity to project area) 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, nd-e). 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.

In November 2020, NMFS proposed to designate critical habitat for the boulder star coral, lobed star coral, mountainous star coral, pillar coral, and rough cactus coral in the Atlantic Ocean, Gulf of Mexico, and Caribbean Sea. For the areas in the Gulf of Mexico this includes the Flower Garden Banks and the waters near Miami-Dade and Monroe counties, Florida, and the Dry Tortugas.

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, 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**.

Marine birds 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 [*Onychoprion fuscatus*], Least Tern [*Sternula antillarum*], Sandwich Tern [*Thalasseus sandvicensis*], Magnificent Frigatebird [*Fregata magnificens*])); winter residents (gannets, gulls, jaegers); and permanent resident species (Laughing Gulls [*Leucophaeus atricilla*], Royal Terns [*Thalasseus maximus*], Bridled Terns [*Onychoprion anaethetus*]) (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 0.62 birds mile⁻² (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 (including noise and lights)

Marine 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 marine birds from MODU lighting, potential collisions, or other adverse effects are highly localized 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 level and are not significant (BOEM, 2012a). Any impacts on populations of marine and pelagic birds are not expected to be significant.

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 fuel 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 (*Morus bassanus*), Magnificent Frigatebird, and Masked Booby (*Sula dactylatra*) (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 coastal 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 (*Charadrius wilsonia*), Black Skimmer (*Rynchops niger*), Forster's Tern (*Sterna forsteri*), Gull-Billed Tern (*Gelochelidon nilotica*), 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, 2021) and was delisted from state species of special concern status by the State of Florida in 2017 (Florida Fish and Wildlife Conservation Commission, 2021) and Louisiana (Louisiana Wildlife & Fisheries, 2020). However, this species remains listed as Endangered by 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. 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, 2015). 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 dissipating. 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; Mendel et al., 2019). 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 the project 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 offshore. Responses highly depend on the type of aircraft, bird species, activities that animals were previously engaged in, and previous exposures to overflights (Efroyimson et al., 2001). Helicopters seem to cause the most intense responses over other human disturbances for some species (Bélanger and Bédard, 1989; Rojek et al., 2007; Fuller et al., 2018). 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 Efroyimson et al. (2001). 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 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 modeling (**Table 3**), coastal areas would not likely be affected within 10 days; however, coastal areas between Matagorda County, Texas, and Plaquemines Parish, Louisiana, may be affected within 30 days of a spill (1% to 2% conditional probability).

Studies concerning the *Deepwater Horizon* incident provide additional information regarding impacts on coastal birds that may be affected in the event 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 (*Pelecanus erythrorhynchos*), Black Skimmer, Black Tern (*Chlidonias niger*), 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 (including noise and lights)

The MODU, as a floating structure in the deepwater environment, will act as 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; Edwards and Sulak, 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 non-impulsive sounds 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 SPL of 170 dB re 1 μ Pa accumulated over a 48-hour period for onset of recoverable injury and 158 dB re 1 μ Pa 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 temporary structure, impacts on fish populations, whether beneficial or adverse, are not expected to be significant since it would be short term.

Limited 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 sounds (Popper et al., 2014). Larval fish were experimentally exposed to simulated impulsive sounds by Bolle et al. (2012). The controlled playbacks produced SEL_{24h} of 206 dB re 1 μ Pa² s but resulted in no increased mortality between the exposure and control groups. Non-impulsive sound sources (such as MODU operations) are expected to be far less injurious than impulsive sounds. Because of the limited propagation distances of above-threshold SEL_{24h} 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. Excess cement slurry and BOP 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 brine and non-contact cooling water, non-contaminated well treatment and completion fluids, BOP fluid, excess cement, hydrate inhibitor, treated seawater, fire water, bilge water, and ballast 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. GMG290000 specifies requirements for new facilities for which construction commenced after July 17, 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 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 (Abriano 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 (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 (Abriano 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 (*Sciaenops ocellatus*). 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 100 miles (161 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, 2009b):

- Albacore tuna (*Thunnus alalunga*) (adults);
- Bigeye tuna (*Thunnus obesus*) (adults);
- Blue marlin (*Makaira nigricans*) (juveniles, adults);
- Bluefin tuna (*Thunnus thynnus*) (spawning, eggs, larvae, adults);
- Common thresher shark (*Alopias vulpinus*) (all);
- Longbill spearfish (*Tetrapturus pfluegeri*) (juveniles, adults);
- Longfin mako shark (*Isurus paucus*) (all);
- Oceanic whitetip shark (*Carcharhinus longimanus*) (all);
- Skipjack tuna (*Katsuwonus pelamis*) (spawning, adults);
- Swordfish (*Xiphias gladius*) (larvae, juveniles, adults);
- White marlin (*Kajikia albida*) (juveniles, adults); and
- Yellowfin tuna (*Thunnus albacares*) (spawning, juveniles, adults).

Research indicates the central and western Gulf of Mexico may be important spawning habitat for Atlantic bluefin tuna (Theo and Block, 2010), and NMFS (2009b) 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 1**). The areal extent of the HAPC is approximately 115,830 miles² (300,000 km²). 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, 2009b). 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 GMFMC (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 1**). The nearest HAPC is Jakkula Bank, which is located approximately 112 miles (180 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 (including noise and lights)

The MODU, 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; Gates et al., 2017). 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 noise 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 treated sanitary and domestic wastes, deck drainage, and miscellaneous discharges such as desalination unit brine and non-contact cooling water, BOP fluid, excess cement, hydrate inhibitor, treated seawater, non-contaminated well treatment and completion fluids, fire water, bilge water, and ballast 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 or coral 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 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 miles² (300,000 km²) 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 100 miles (161 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, 2009b), 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, 2009b). 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, 2009b).

The nearest feature designated as EFH for corals is located 100 miles (161 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 the duration of these impacts would likely be 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.

The shallow hazard assessment identified no sonar contacts within 2,000 ft (610 m) of proposed wellsites considered to have archaeological significance (BP America Inc., 2004; Fugro GeoConsulting, 2010; C&C Technologies, 2011; Fugro GeoConsulting, 2011ab; Forum Energy Technologies, 2012). No archaeological impacts are expected from routine activities in the project area.

Because no historic shipwreck sites are known to be 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-foot (300-meter) radius. Because there are no known 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 and *in situ* 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 would not likely be affected within 10 days; however, coastal areas between Matagorda County, Texas, and Plaquemines Parish, Louisiana, may be affected within 30 days of a spill (1% to 2% 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 a water depth estimate of approximately 9,554 ft (2,912 m), the project area is well beyond the 197-foot (60-meter) 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-meter) 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-foot (300-meter) 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 would not likely be affected within 10 days; however, coastal areas between Matagorda County, Texas, and Plaquemines Parish, Louisiana, may be affected within 30 days of a spill (1% to 2% 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., destroying fragile artifacts; disturbing the provenance of artifacts or site features). BOEM (2017a) notes that some unavoidable direct and indirect impacts on coastal historic resources could occur.

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 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 178 miles (286 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,c).

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.

NWRs and other protected areas such as Wildlife Management Areas 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**.

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 significant.

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 contact within 30 days of a hypothetical spill from Launch Area C048 based on the 30-day Oil Spill Risk Analysis (OSRA) model.

County or Parish, State	Wildlife Refuge, Wilderness Area, or State/National Park
Matagorda County, Texas	Big Boggy National Wildlife Refuge
	Chamber Park
	Matagorda Bay Nature Park
	Oyster Lake Park
	San Bernard National Wildlife Refuge
	West Moring Dock Park
Brazoria County, Texas	Brazoria National Wildlife Refuge
	Christmas Bay Coastal Preserve
	Justin Hurst Wildlife Management Area
	San Bernard National Wildlife Refuge
Galveston County, 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
Jefferson County, Texas	McFaddin National Wildlife Refuge
	Sea Rim State Park
	Texas Point National Wildlife Refuge
Cameron Parish, Louisiana	Peveto Woods Sanctuary
	Rockefeller State Wildlife Refuge and Game Preserve
	Sabine National Wildlife Refuge
Vermilion Parish, Louisiana	Paul J. Rainey Wildlife Refuge and Game Preserve
	Rockefeller State Wildlife Refuge and Game Preserve
	State Wildlife Refuge
Terrebonne Parish, Louisiana	Isles Dernieres Barrier Islands Refuge
	Pointe aux Chenes Wildlife Management Area
Plaquemines Parish, Louisiana	Breton National Wildlife Refuge
	Delta National Wildlife Refuge
	Pass a Loutre Wildlife Management Area

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 (Mendelsohn 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). A 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 (*Lutjanus campechanus*), 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 (including 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 dissipating (**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 miles² (217,821 km²), or 34.8% of the U.S. Gulf of Mexico Exclusive Economic Zone. 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,c). 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 significantly adverse for up to several years. 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, 178 miles (286 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 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 178 miles (286 km) from the nearest shoreline (Louisiana) and based on the 30-day OSRA modeling (**Table 3**), coastal areas would not likely be affected within 10 days; however, coastal areas between Matagorda County, Texas, and Plaquemines Parish, Louisiana, may be affected within 30 days of a spill (1% to 2% 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 dissipating. 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.

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. Based on the 30-day OSRA modeling (**Table 3**), coastal areas would not likely be affected within 10 days; however, coastal areas between Matagorda County, Texas, and Plaquemines Parish, Louisiana, may be affected within 30 days of a spill (1% to 2% conditional probability). In the unlikely event that a spill occurs that is sufficiently 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 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 wells site assessments indicated existing seafloor infrastructure exists within 500 ft (152 m) of the proposed wellsites and one sonar contact was identified as potential debris within 2,000 ft (610 m). The standard avoidance distance of 100 ft (30 m) is recommended. Operations will be conducted using state of the art differential global positioning to avoid all existing pipelines, wells, and other equipment located within 500 ft (152 m) of the proposed wellsites (BP America Inc., 2004; Fugro GeoConsulting, 2010; C&C Technologies, 2011; Fugro GeoConsulting, 2011a; Forum Energy Technologies, 2012). A large oil spill is the only relevant IPF that could affect other marine uses. 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. 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 Planned Actions¹

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 impacts from all planned activities 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 these

¹ On July 16, 2020, the Council on Environmental Quality (CEQ), which is responsible for Federal agency implementation of NEPA, updated the regulations for implementing the procedural provisions of NEPA (85 FR 43304–43376). The new implementing regulations went into effect on September 14, 2020. The update eliminated explicit references to "cumulative impacts" from the regulations. Instead, "the environmental impact statement shall succinctly describe the environment of the area(s) to be affected or created by the alternatives under consideration, including the reasonably foreseeable environmental trends and planned actions in the area(s)." As such, the term "cumulative" has been replaced by planned actions throughout the EIA.

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 Planned Actions 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).

Impacts of Other Planned Activities in the Exploration Plan. The BOEM (2017a) Final EIS included a lengthy discussion of impacts of planned activities, 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 effects of the planned actions 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 impacts from all planned activities in these prior analyses is not considered significant.

C.9.1 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 is not significant and will not cause or contribute to a violation of NAAQS (BOEM, 2012a, 2013, 2014, 2015, 2016b, 2017a). In addition, the planned actions 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 the impacts from all planned activities on air quality.

Climate Change. CO₂ and CH₄ 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 CO₂ 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 drilling muds and cuttings, treated sanitary and domestic wastes, non-contact cooling water, deck drainage, desalination unit brine, non-contaminated well treatment and completion fluids, BOP fluid, excess cement, hydrate inhibitor, uncontaminated fire water, bilge water and ballast 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 impacts from all planned activities to water quality are unquantifiable and expected to be negligible.

Archaeological Resources. No known shipwrecks or other archaeological artifacts were identified in the project area (BP America Inc., 2004; Fugro GeoConsulting, 2010; C&C Technologies, 2011; Fugro

GeoConsulting, 2011ab; Forum Energy Technologies, 2012). The project area is well beyond the 197-foot (60-meter) 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 impacts from all planned activities on historic shipwrecks or prehistoric archaeological resources.

New Information. New information included in the most recent Programmatic, Supplemental, and Final EISs (BOEM, 2017a) has been incorporated into the EIA, where applicable.

C.9.2 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 shallow hazards assessment did not identify any features that could support significant high-density deepwater benthic communities within 2,000 ft (610 m) of the proposed wellsites (BP America Inc., 2004; Fugro GeoConsulting, 2010; C&C Technologies, 2011; Fugro GeoConsulting, 2011ab; Forum Energy Technologies, 2012).

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 impacts from all planned activities is not 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, Rice's whale, oceanic whitetip shark, giant manta ray, and five species of sea turtles. Potential impact sources include the MODU 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 (2020a) Appendix B and C. No significant impacts from all planned activities 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 the proposed activities, collisions or other adverse effects are unlikely, and no significant impacts from all planned activities are expected.

Fisheries Resources. Exploration and production structures occur in the vicinity of the project area. The additional effect of the proposed activities would be negligible.

Coastal Habitats. Due to the distance of the project area 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,b, 2017a) has been incorporated into the EIA, where applicable.

C.9.3 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 impacts from all planned activities 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 impacts from all planned activities 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, 2017a) has been incorporated into the EIA, where applicable.

D. Environmental Hazards

D.1 Geologic Hazards

Based on the results of high-resolution geophysical surveys the proposed wellsites appear suitable for the planned activities (BP America Inc., 2004; Fugro GeoConsulting, 2010; C&C Technologies, 2011; Fugro GeoConsulting, 2011ab; Forum Energy Technologies, 2012). 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 proposed wellsites and the selection of a DP 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 1B OCS Plan Information form – Bottom hole locations & proposed total depth
Section 2J Blowout Scenario – confidential information for NTL 2015 N01 calculation
Section 3A Geologic Description
Section 3B Structure Contour Maps
Section 3C Interpreted 2D or 3D seismic line(s)
Section 3D Cross Section(s)
Section 3E Stratigraphic Column with Time vs. depth table

B. Bibliography

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