UNITED STATES GOVERNMENT   October 23, 2019
MEMORANDUM

To: Public Information (MS 5030)

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

Subject: Public Information copy of plan

Control #	-	S-07969
Type	-	Supplemental Development Operations Coordinations Document
Lease(s)	-	OCS-G17001 Block - 508 Walker Ridge Area OCS-G32690 Block - 464 Walker Ridge Area
Operator	-	Shell Offshore Inc.
Description	-	SS Wells AA, BB, CC, DD, SN105, SN109, SN110, SN207, SN208, and SN213 in WR508 and Well 001 in WR464
Rig Type	-	Drillship or DP SemiSubmersible

Attached is a copy of the subject plan.

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

Ronald O'Connor
Plan Coordinator

Shell Offshore Inc.
P. O. Box 61933
New Orleans, LA 70161-1933
United States of America
Tel +1 504 425 7215
Fax +1 504 425 6747
Email Sylvia.bellone@shell.com

Public Information Copy

August 2, 2019

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

Attn: Plans Group GM 235D

SUBJECT: Supplemental Development Operations Coordination Document (DOCD)
Walker Ridge 508, OCS-G 17001
Offshore Louisiana

Dear Mrs. Picou:

In compliance with 30 CFR 550.211 and NTLs 2008-G04, 2009-G27 and 2015-N01, giving DOCD Plan guidelines, Shell Offshore Inc. (Shell) requests your approval of this Supplemental DOCD for the Stones Development located in Walker Ridge Block 551. The Initial DOCD for the development was approved June 25, 2015, Plan Control No. N-9875, and most recently revised on December 4, 2018 (R-06730) to add a flotel.

This Supplement is to add four additional wells to the approved DOCD, the AA, BB, CC and DD wells, which are approved to drill in Exploration Plan S-07948. This SDOCD is to install well jumpers tying into to the existing subsea production system, to initiate production, and to request future well work for these new wells.

The cost recovery fee for this project is attached to the Proprietary Copy of the plan.

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

Sincerely,

Sylvia A Bellone

Sylvia A. Bellone
Sr. Regulatory Specialist

SHELL OFFSHORE INC.

SUPPLEMENTAL DEVELOPMENT OPERATIONS DOCUMENT

For

Walker Ridge Block 508, OCS-G 17001

PUBLIC INFORMATION COPY

AUGUST 2019

PREPARED BY:

Sylvia A. Bellone
Sr. Regulatory Specialist

504.425.7215

sylvia.bellone@shell.com

REVISIONS TABLE

Date of Request	Plan Section	What was Corrected	Date Resubmitted
9/13/19	Section 1 Section 8 Section 13 Section 14A	Corrected OCS Plan Information Forms Corrections to Section 1 Replaced AQR pages Added volume loaded per transfer Replaced Vicinity Map	9/17/19

PLAN CONTENTS

A. DESCRIPTION, OBJECTIVES & SCHEDULE

Shell Offshore Inc. (Shell) is submitting this Supplemental Development Operations Coordination Document (DOCD/SDOCD) for the Stones Unit. This Supplement is to add four additional wells to the approved DOCD, the AA, BB, CC and DD wells, which were approved to drill in Exploration Plan S-07948. This SDOCD is to install well jumpers tying into to the existing subsea production system, to initiate production, and to request future well work for these new wells.

The Stones project consisted initially of a nine-well subsea development tied back to a Floating Production Storage and Offloading vessel (FPSO). The drilling and completion of these wells were covered in Shell's Exploration Plan S-07599. The initial DOCD N-09718 covered the installation of the manifold (Drill Center 1), the FPSO and commencing production of these wells. Plan R-6455 was a revision to exploration plan S-7599 to add a drill ship only.

Due to drilling issues at Drill Center 1, Shell filed an Exploration Plan N-9875 for the drilling and completion of eight additional wells and associated drill center manifold (Drill Center 2) in March 2015. These wells and manifold were covered in SDOCD S-7790.

The wells that have been drilled and producing to date are as follows:

Well Name	Plan	EP Name	API Number
WR 508 006 (SN105)	S-7599	J	6081240095
WR 508 007 (SN109)	S-7599	L	6081240099
WR 508 011 (SN110)	R-6455	M	6081240110
WR 508 013 (SN207)	N-9875	R	6081240117
WR 508 010 (SN208)	N-9875	U	6081240104
WR 464 001	N-9875	W & T	6081240112
WR 508 014 (SN213)	R-6637	P	6081240123

The Stones Unit area covers Walker Ridge Blocks 454, 507, 508, 509, 551, 552, 553, 596, and 597. The development area is 178 miles from the nearest shoreline, 193 miles from the onshore support base at Port Fourchon, Louisiana, and 221 miles from the helicopter base at Amelia, Louisiana. The water depths at the well site ranges from 9,550' to 9,558'.

The proposed well work rig will be either with a dynamically positioned (DP) semi-submersible (Atwood Condor or similar) or a Drill Ship (Noble Don Taylor or similar). 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 plats (Attachments 1A, 1B and 1C) and BOEM forms (Attachments 1D through 1H).

C. RIG SAFETY AND POLLUTION FEATURES

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

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

DRAIN SYSTEM POLLUTION FEATURES

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

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

1) Non-contaminated Drains

Non-contaminated drains are designated as drains that under normal circumstances do not contain hydrocarbons and 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 skimmer 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 – Atwood Condor DP Semi-Submersible or similar:

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)

Storage Tanks – Noble Don Taylor Drillship or similar:

Type of Storage Tank	Type of Facility	Tank Capacity (bbls)	Number of Tanks	Total Capacity (bbls)	Fluid Gravity (Specific)
Fuel oil	Drilling Rig	2,889	4	11,556	Marine Diesel (0.91 SG)
Fuel oil	Drilling Rig	3,225	4	12,900	Marine Diesel (0.91 SG)
Fuel oil	Drilling Rig	2,887	4	11,548	Marine Diesel (0.91 SG)
Fuel oil	Drilling Rig	2,680	4	10,720	Marine Diesel (0.91 SG)
Fuel oil	Drilling Rig	178	8	1,424	Marine Diesel (0.91 SG)

E. Pollution Prevention Measures

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

F. Additional Measures

- HSE (health safety and environment) are the primary topics in pre-tour and pre-job safety meetings. The discussion around no harm to people or environment is a key mindset. All personnel are reminded daily to inspect work areas for safety issues as well as potential pollution issues.
- All tools that come to and from the rig have their pollution pans inspected, cleaned and confirmation of plugs installed prior to leaving dock and prior to loading on the boat.
- Preventive maintenance of rig equipment includes visual inspection of hydraulic lines and reservoirs on routine scheduled basis.
- All pollution pans on rig are inspected daily.
- Containment dikes are installed around all oil containment, drum storage areas, fuel vents and fuel storage tanks.
- All used oil and fuel is collected and sent in for recycling.
- Every drain on the rig is assigned a number 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. Leases are held by production.

Attachment 1C

Bureau of Ocean Energy Management

OMB Control Number: 1010-0151
OMB Approval Expires: 12/31/14

OCS PLAN INFORMATION FORM

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

Company Name: Shell Offshore Inc.	BOEM Operator Number: 0689
Address: 701 Poydras St., Room 2418	Contact Person: Sylvia Bellone
New Orleans, LA 70131	Phone Number: 504.425.7215
	Email Address: Sylvia.bellone@shell.com

If a service fee is required under 30 CFR 550.125(a) provide:	Amount Paid: $16,952	Receipt Nos. 26J6TP26

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		Salt	Onshore Support Base(s) Fourchon & Houma

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			
Development drilling			
Well completion			
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			
Installation of lease term pipelines	See attached		
Commence production	See attached		
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	X	Other (attached description) FPSO

Drilling Rig Name (If known): Noble Don Taylor or similar, Atwood Condor or Similar

Description of Lease Term Pipelines

From (Facility/Area/Block)	To (Facility/Area/Block)	Diameter (Inches)	Length (Feet)
WR 508 Well (4)	WR 508 Manifold	8.625″	62-92′

Attachment 1C.1 Schedule

Proposed Activity	Start Date	End Date	No. of Days
Installation of AA lease term jumper	2/5/2020	2/29/2020	25
Commence production	3/1/2020		
Installation of BB lease term jumper	2/4/2021	2/28/2021	25
Commence production	3/1/2021		
Installation of CC lease term jumper	2/4/2022	2/28/2022	25
Commence production	3/1/2022		
Installation of DD lease term jumper	2/4/2023	2/28/2023	25
Commence production	3/1/2023		
Future well work for all wells at the Drill Centers 1 and 2	2020	2046	270

Attachment 1D

Proposed Well/Structure Location					
Well or Structure Name/Number (if renaming well or structure, reference previous name): AA	Previously reviewed under an approved EP or DOCD? S-7948 EP	X	Yes		No

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

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

WCD Info	For wells, volume of uncontrolled Blowouts (bbls/day): 47,114 BOPD	For structures, volume of all storage and pipelines (bbls): NA	API Gravity of fluid	28°

	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: 4,444' FSL		N/S Departure: N/S Departure:
	E/W Departure 5,436' FWL		E/W Departure: E/W Departure:
Lambert X-Y Coord.	X: 2,365,596		X:
	Y: 9,603,484		Y:
Lat/Long	Latitude: 26.4489813		Latitude
	Longitude: -90.7832466		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=	
			X=	Y=	

Attachment 1E

<table>
<tr><th colspan="6">Proposed Well/Structure Location</th></tr>
<tr><td colspan="3">Well or Structure Name/Number (if renaming well or structure, reference previous name): BB</td><td>Previously reviewed under an approved EP or DOCD? S-7948 EP</td><td>X Yes</td><td>No</td></tr>
<tr><td>Is this an existing well or structure?</td><td>Yes</td><td>X No</td><td colspan="2">If this is an existing well or structure, list the Complex ID or API Number:</td><td>NA</td></tr>
<tr><td colspan="4">Do you plan to use a subsea BOP or a surface BOP on a floating facility to conduct your proposed activities?</td><td>X Yes</td><td>No</td></tr>
<tr><td>WCD Info</td><td>For wells, volume of uncontrolled Blowouts (bbls/day): 47,114 BOPD</td><td>For structures, volume of all storage and pipelines (bbls): NA</td><td>API Gravity of fluid</td><td colspan="2">28°</td></tr>
<tr><td></td><td>Surface Location</td><td>Bottom Hole Location (for Wells)</td><td colspan="3">Completion (for multiple enter separate lines)</td></tr>
<tr><td>Lease Number</td><td>OCS-G 17001</td><td>OCS-G 17001</td><td colspan="3">OCS
OCS</td></tr>
<tr><td>Area Name</td><td>WR</td><td>WR</td><td colspan="3"></td></tr>
<tr><td>Block No.</td><td>508</td><td>508</td><td colspan="3"></td></tr>
<tr><td rowspan="2">Blockline Departure (in feet)</td><td>N/S Departure: 4,483’ FSL</td><td></td><td colspan="3">N/S Departure:
N/S Departure:</td></tr>
<tr><td>E/W Departure 5,472’ FWL</td><td></td><td colspan="3">E/W Departure:
E/W Departure:</td></tr>
<tr><td rowspan="2">Lambert X-Y Coord.</td><td>X: 2,365,632</td><td></td><td colspan="3">X:</td></tr>
<tr><td>Y: 9,603,523</td><td></td><td colspan="3">Y:</td></tr>
<tr><td rowspan="2">Lat/Long</td><td>Latitude: 26.4490870</td><td></td><td colspan="3">Latitude</td></tr>
<tr><td>Longitude: -90.7831325</td><td></td><td colspan="3">Longitude</td></tr>
<tr><td colspan="2">Water Depth (Feet): 9,554’</td><td></td><td></td><td>MD (Feet)</td><td>TVD (Feet)</td></tr>
<tr><td colspan="6">Anchor Radius (if applicable) in feet:</td></tr>
<tr><td colspan="6">Anchor locations for drilling rig or construction barge (if anchor radius is supplied above, not necessary)</td></tr>
</table>

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

Attachment 1F

<table>
<tr><th colspan="8">Proposed Well/Structure Location</th></tr>
<tr><td colspan="4">Well or Structure Name/Number (if renaming well or structure, reference previous name): CC</td><td colspan="2">Previously reviewed under an approved EP or DOCD? S-7948 EP</td><td>X Yes</td><td>No</td></tr>
<tr><td>Is this an existing well or structure?</td><td>Yes</td><td>X No</td><td colspan="3">If this is an existing well or structure, list the Complex ID or API Number:</td><td colspan="2">NA</td></tr>
<tr><td colspan="6">Do you plan to use a subsea BOP or a surface BOP on a floating facility to conduct your proposed activities?</td><td>X Yes</td><td>No</td></tr>
<tr><td>WCD Info</td><td>For wells, volume of uncontrolled Blowouts (bbls/day): 47,114 BOPD</td><td colspan="2">For structures, volume of all storage and pipelines (bbls): NA</td><td>API Gravity of fluid</td><td colspan="3">28°</td></tr>
<tr><td></td><td>Surface Location</td><td colspan="2">Bottom Hole Location (for Wells)</td><td colspan="4">Completion (for multiple enter separate lines)</td></tr>
<tr><td>Lease Number</td><td>OCS-G 17001</td><td colspan="2">OCS-G 17001</td><td colspan="4">OCS
OCS</td></tr>
<tr><td>Area Name</td><td>WR</td><td colspan="2">WR</td><td colspan="4"></td></tr>
<tr><td>Block No.</td><td>508</td><td colspan="2">508</td><td colspan="4"></td></tr>
<tr><td>Blockline Departure (in feet)</td><td>N/S Departure: 4,320’ FSL</td><td colspan="2"></td><td colspan="4">N/S Departure:
N/S Departure:</td></tr>
<tr><td></td><td>E/W Departure 5,327’ FWL</td><td colspan="2"></td><td colspan="4">E/W Departure:
E/W Departure:</td></tr>
<tr><td>Lambert X-Y Coord.</td><td>X: 2,365,487</td><td colspan="2"></td><td colspan="4">X:</td></tr>
<tr><td></td><td>Y: 9,603,360</td><td colspan="2"></td><td colspan="4">Y:</td></tr>
<tr><td>Lat/Long</td><td>Latitude: 26.4486462</td><td colspan="2"></td><td colspan="4">Latitude</td></tr>
<tr><td></td><td>Longitude: -90.7835842</td><td colspan="2"></td><td colspan="4">Longitude</td></tr>
<tr><td colspan="2">Water Depth (Feet): 9,554’</td><td></td><td></td><td>MD (Feet)</td><td colspan="3">TVD (Feet)</td></tr>
<tr><td colspan="8">Anchor Radius (if applicable) in feet:</td></tr>
<tr><td colspan="8">Anchor locations for drilling rig or construction barge (if anchor radius is supplied above, not necessary)</td></tr>
</table>

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

Attachment 1G

<table>
<tr><th colspan="6">Proposed Well/Structure Location</th></tr>
<tr><td colspan="3">Well or Structure Name/Number (if renaming well or structure, reference previous name): DD</td><td>Previously reviewed under an approved EP or DOCD? S-7948 EP</td><td>X Yes</td><td>No</td></tr>
<tr><td>Is this an existing well or structure?</td><td>Yes</td><td>X No</td><td colspan="2">If this is an existing well or structure, list the Complex ID or API Number:</td><td>NA</td></tr>
<tr><td colspan="4">Do you plan to use a subsea BOP or a surface BOP on a floating facility to conduct your proposed activities?</td><td>X Yes</td><td>No</td></tr>
<tr><td>WCD Info</td><td>For wells, volume of uncontrolled Blowouts (bbls/day): 47,114 BOPD</td><td>For structures, volume of all storage and pipelines (bbls): NA</td><td>API Gravity of fluid</td><td colspan="2">28°</td></tr>
<tr><td></td><td>Surface Location</td><td>Bottom Hole Location (for Wells)</td><td colspan="3">Completion (for multiple enter separate lines)</td></tr>
<tr><td>Lease Number</td><td>OCS-G 17001</td><td>OCS-G 17001</td><td colspan="3">OCS
OCS</td></tr>
<tr><td>Area Name</td><td>WR</td><td>WR</td><td colspan="3"></td></tr>
<tr><td>Block No.</td><td>508</td><td>508</td><td colspan="3"></td></tr>
<tr><td rowspan="2">Blockline Departure (in feet)</td><td>N/S Departure: 4,515’ FSL</td><td></td><td colspan="3">N/S Departure:
N/S Departure:</td></tr>
<tr><td>E/W Departure 5,435’ FWL</td><td></td><td colspan="3">E/W Departure:
E/W Departure:</td></tr>
<tr><td rowspan="2">Lambert X-Y Coord.</td><td>X: 2,365,595</td><td></td><td colspan="3">X:</td></tr>
<tr><td>Y: 9,603,556</td><td></td><td colspan="3">Y:</td></tr>
<tr><td rowspan="2">Lat/Long</td><td>Latitude: 26.4491796</td><td></td><td colspan="3">Latitude</td></tr>
<tr><td>Longitude: -90.7832450</td><td></td><td colspan="3">Longitude</td></tr>
<tr><td colspan="2">Water Depth (Feet): 9,554’</td><td></td><td></td><td>MD (Feet)</td><td>TVD (Feet)</td></tr>
<tr><td colspan="6">Anchor Radius (if applicable) in feet:</td></tr>
<tr><td colspan="6">Anchor locations for drilling rig or construction barge (if anchor radius is supplied above, not necessary)</td></tr>
</table>

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

Attachment 1H

<table>
<tr><th colspan="8">Proposed Well/Structure Location</th></tr>
<tr><td colspan="4">Well or Structure Name/Number (if renaming well or structure, reference previous name): SN105 (J)</td><td>Previously reviewed under an approved EP or DOCD? S-7599</td><td>x</td><td>Yes</td><td>No</td></tr>
<tr><td>Is this an existing well or structure?</td><td>X</td><td>Yes</td><td>No</td><td colspan="2">If this is an existing well or structure, list the Complex ID or API Number:</td><td colspan="2">6081240095</td></tr>
<tr><td colspan="5">Do you plan to use a subsea BOP or a surface BOP on a floating facility to conduct your proposed activities?</td><td>x</td><td>Yes</td><td>No</td></tr>
<tr><td>WCD Info</td><td>For wells, volume of uncontrolled Blowouts (bbls/day): 47,114 BOPD</td><td colspan="2">For structures, volume of all storage and pipelines (bbls):</td><td colspan="2">API Gravity of fluid</td><td colspan="2">28°</td></tr>
<tr><td></td><td>Surface Location</td><td colspan="2">Bottom Hole Location (for Wells)</td><td colspan="4">Completion (for multiple enter separate lines)</td></tr>
<tr><td>Lease Number</td><td>OCS-G-17001</td><td colspan="2">OCS-G 17001</td><td colspan="4">OCS
OCS</td></tr>
<tr><td>Area Name</td><td>Walker Ridge</td><td colspan="2">Walker Ridge</td><td colspan="4"></td></tr>
<tr><td>Block No.</td><td>508</td><td colspan="2">508</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Blockline Departure (in feet)</td><td>N/S Departure: 4,549’ FSL</td><td colspan="2"></td><td colspan="4">N/S Departure:
N/S Departure:</td></tr>
<tr><td>E/W Departure: 5,398’ FWL</td><td colspan="2"></td><td colspan="4">E/W Departure:
E/W Departure:</td></tr>
<tr><td rowspan="2">Lambert X-Y Coord.</td><td>X: 2,365,558.05</td><td colspan="2"></td><td colspan="4">X:</td></tr>
<tr><td>Y: 9,603,589.39</td><td colspan="2"></td><td colspan="4">Y:</td></tr>
<tr><td rowspan="2">Lat/Long</td><td>Latitude : 26.44927444</td><td colspan="2"></td><td colspan="4">Latitude</td></tr>
<tr><td>Longitude : -90.78335539</td><td colspan="2"></td><td colspan="4">Longitude</td></tr>
<tr><td colspan="2">Water Depth (Feet): 9,548’</td><td></td><td></td><td colspan="2">MD (Feet)</td><td colspan="2">TVD (Feet)</td></tr>
<tr><td colspan="8">Anchor Radius (if applicable) in feet: NA</td></tr>
<tr><th colspan="8">Anchor locations for drilling rig or construction barge (if anchor radius is supplied above, not necessary)</th></tr>
</table>

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

Attachment 1I

<table>
<tr><th colspan="8">Proposed Well/Structure Location</th></tr>
<tr><td colspan="4">Well or Structure Name/Number (if renaming well or structure, reference previous name): SN109 (L)</td><td>Previously reviewed under an approved EP or DOCD? S-7599</td><td>x</td><td>Yes</td><td>No</td></tr>
<tr><td>Is this an existing well or structure?</td><td>X</td><td>Yes</td><td>No</td><td colspan="2">If this is an existing well or structure, list the Complex ID or API Number:</td><td colspan="2">6081240099</td></tr>
<tr><td colspan="5">Do you plan to use a subsea BOP or a surface BOP on a floating facility to conduct your proposed activities?</td><td>x</td><td>Yes</td><td>No</td></tr>
<tr><td>WCD Info</td><td>For wells, volume of uncontrolled Blowouts (bbls/day): 47,114 BOPD</td><td colspan="2">For structures, volume of all storage and pipelines (bbls):</td><td>API Gravity of fluid</td><td colspan="3">28°</td></tr>
<tr><td></td><td>Surface Location</td><td colspan="2">Bottom Hole Location (for Wells)</td><td colspan="4">Completion (for multiple enter separate lines)</td></tr>
<tr><td>Lease Number</td><td>OCS-G-17001</td><td colspan="2">OCS-G 17001</td><td colspan="4">OCS
OCS</td></tr>
<tr><td>Area Name</td><td>Walker Ridge</td><td colspan="2">Walker Ridge</td><td colspan="4"></td></tr>
<tr><td>Block No.</td><td>508</td><td colspan="2">508</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Blockline Departure (in feet)</td><td>N/S Departure: 4,365’ FSL</td><td colspan="2"></td><td colspan="4">N/S Departure:
N/S Departure:</td></tr>
<tr><td>E/W Departure: 5,296’ FWL</td><td colspan="2"></td><td colspan="4">E/W Departure:
E/W Departure:</td></tr>
<tr><td rowspan="2">Lambert X-Y Coord.</td><td>X: 2,365,456.00</td><td colspan="2"></td><td colspan="4">X:</td></tr>
<tr><td>Y: 9,603,405.00</td><td colspan="2"></td><td colspan="4">Y:</td></tr>
<tr><td rowspan="2">Lat/Long</td><td>Latitude : 26.448772</td><td colspan="2"></td><td colspan="4">Latitude</td></tr>
<tr><td>Longitude : -90.783677</td><td colspan="2"></td><td colspan="4">Longitude</td></tr>
<tr><td colspan="2">Water Depth (Feet): 9,553’</td><td></td><td></td><td>MD (Feet)</td><td colspan="3">TVD (Feet)</td></tr>
<tr><td colspan="8">Anchor Radius (if applicable) in feet: NA</td></tr>
<tr><td colspan="8">Anchor locations for drilling rig or construction barge (if anchor radius is supplied above, not necessary)</td></tr>
</table>

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

Attachment 1J

Proposed Well/Structure Location					
Well or Structure Name/Number (if renaming well or structure, reference previous name): SN110 (M)	Previously reviewed under an approved EP or DOCD? S-7599	x	Yes		No

Is this an existing well or structure?	X	Yes		No	If this is an existing well or structure, list the Complex ID or API Number:	6081240110

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

WCD Info	For wells, volume of uncontrolled Blowouts (bbls/day): 47,114 BOPD	For structures, volume of all storage and pipelines (bbls):	API Gravity of fluid	28°

	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	Walker Ridge	Walker Ridge	
Block No.	508	508	
Blockline Departure (in feet)	N/S Departure 4368' FSL		N/S Departure: N/S Departure:
	E/W Departure: 5368' FWL		E/W Departure: E/W Departure:
Lambert X-Y Coord.	X: 2,365,528		X:
	Y: 9,603,408		Y:
Lat/Long	Latitude : 26.448778		Latitude
	Longitude : -90.783456		Longitude

Water Depth (Feet): 9,558'			MD (Feet)	TVD (Feet)

Anchor Radius (if applicable) in feet: NA

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

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

Attachment 1K

Proposed Well/Structure Location					
Well or Structure Name/Number (if renaming well or structure, reference previous name): SN207 (R)	Previously reviewed under an approved EP or DOCD? N-9875	x	Yes		No

Is this an existing well or structure?	X	Yes		No	If this is an existing well or structure, list the Complex ID or API Number: 6081240117

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

WCD Info	For wells, volume of uncontrolled Blowouts (bbls/day): 47,114 BOPD	For structures, volume of all storage and pipelines (bbls):	API Gravity of fluid	28°	
	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	Walker Ridge	Walker Ridge			
Block No.	508	508			
Blockline Departure (in feet)	N/S Departure: 6,537' FSL		N/S Departure: N/S Departure:		
	E/W Departure: 6,358' FEL		E/W Departure: E/W Departure:		
Lambert X-Y Coord.	X: 2,369,641.82		X:		
	Y: 9,605,577.33		Y:		
Lat/Long	Latitude : N 26° 27' 16.371"		Latitude		
	Longitude : W 90° 46' 14.787"		Longitude		
Water Depth (Feet): 9,592				MD (Feet)	TVD (Feet)
Anchor Radius (if applicable) in feet: NA					

Anchor locations for drilling rig or construction barge (if anchor radius is supplied above, not necessary)					
Anchor Name or No.	Area	Block	X Coordinate	Y Coordinate	Length of Anchor Chain on Seafloor
			X=	Y=	
			X=	Y=	
			X=	Y=	
			X=	Y=	
			X=	Y=	
			X=	Y=	
			X=	Y=	

Attachment 1L

<table>
<tr><td colspan="6">Proposed Well/Structure Location</td></tr>
<tr><td colspan="3">Well or Structure Name/Number (if renaming well or structure, reference previous name): SN208 (U)</td><td>Previously reviewed under an approved EP or DOCD? N-9875</td><td>x Yes</td><td>No</td></tr>
<tr><td colspan="2">Is this an existing well or structure? x Yes / No</td><td colspan="3">If this is an existing well or structure, list the Complex ID or API Number:</td><td>6081240104</td></tr>
<tr><td colspan="4">Do you plan to use a subsea BOP or a surface BOP on a floating facility to conduct your proposed activities?</td><td>x Yes</td><td>No</td></tr>
<tr><td>WCD Info</td><td>For wells, volume of uncontrolled Blowouts (bbls/day): 47,114 BOPD</td><td>For structures, volume of all storage and pipelines (bbls):</td><td>API Gravity of fluid</td><td colspan="2">28°</td></tr>
<tr><td></td><td>Surface Location</td><td>Bottom Hole Location (for Wells)</td><td colspan="3">Completion (for multiple enter separate lines)</td></tr>
<tr><td>Lease Number</td><td>OCS-G-17001</td><td>OCS-G 17001</td><td colspan="3">OCS
OCS</td></tr>
<tr><td>Area Name</td><td>Walker Ridge</td><td>Walker Ridge</td><td colspan="3"></td></tr>
<tr><td>Block No.</td><td>508</td><td>508</td><td colspan="3"></td></tr>
<tr><td>Blockline Departure (in feet)</td><td>N/S Departure: 6,618’ FSL</td><td></td><td colspan="3">N/S Departure:
N/S Departure:</td></tr>
<tr><td></td><td>E/W Departure: 6,283’ FEL</td><td></td><td colspan="3">E/W Departure:
E/W Departure:</td></tr>
<tr><td>Lambert X-Y Coord.</td><td>X: 2,369,717</td><td></td><td colspan="3">X:</td></tr>
<tr><td></td><td>Y: 9,605,658</td><td></td><td colspan="3">Y:</td></tr>
<tr><td>Lat/Long</td><td>Latitude : N 26° 27' 17.16"</td><td></td><td colspan="3">Latitude</td></tr>
<tr><td></td><td>Longitude : W -90° 46' 13.95</td><td></td><td colspan="3">Longitude</td></tr>
<tr><td colspan="2">Water Depth (Feet): 9,591</td><td></td><td>MD (Feet)</td><td colspan="2">TVD (Feet)</td></tr>
<tr><td colspan="6">Anchor Radius (if applicable) in feet: NA</td></tr>
</table>

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

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

Attachment 1M

<table>
<tr><th colspan="6">Proposed Well/Structure Location</th></tr>
<tr><td colspan="2">Well or Structure Name/Number (if renaming well or structure, reference previous name): SN 213 (P)</td><td colspan="2">Previously reviewed under an approved EP or DOCD? R-6637</td><td>x Yes</td><td>No</td></tr>
<tr><td>Is this an existing well or structure?</td><td>Yes / x No</td><td colspan="3">If this is an existing well or structure, list the Complex ID or API Number:</td><td>6081240123</td></tr>
<tr><td colspan="4">Do you plan to use a subsea BOP or a surface BOP on a floating facility to conduct your proposed activities?</td><td>x Yes</td><td>No</td></tr>
<tr><td>WCD Info</td><td>For wells, volume of uncontrolled Blowouts (bbls/day): 47,114 BOPD</td><td>For structures, volume of all storage and pipelines (bbls):</td><td>API Gravity of fluid</td><td colspan="2">28°</td></tr>
<tr><td></td><td>Surface Location</td><td>Bottom Hole Location (for Wells)</td><td colspan="3">Completion (for multiple enter separate lines)</td></tr>
<tr><td>Lease Number</td><td>OCS-G-17001</td><td>OCS-G 17001</td><td colspan="3">OCS
OCS</td></tr>
<tr><td>Area Name</td><td>Walker Ridge</td><td>Walker Ridge</td><td colspan="3"></td></tr>
<tr><td>Block No.</td><td>508</td><td>508</td><td colspan="3"></td></tr>
<tr><td rowspan="2">Blockline Departure (in feet)</td><td>N/S Departure: 6,569’ FSL</td><td></td><td colspan="3">N/S Departure:
N/S Departure:</td></tr>
<tr><td>E/W Departure: 6,244’ FEL</td><td></td><td colspan="3">E/W Departure:
E/W Departure:</td></tr>
<tr><td rowspan="2">Lambert X-Y Coord.</td><td>X: 2,369,756</td><td></td><td colspan="3">X:</td></tr>
<tr><td>Y: 9,605,609</td><td></td><td colspan="3">Y:</td></tr>
<tr><td rowspan="2">Lat/Long</td><td>Latitude : 26.45463</td><td></td><td colspan="3">Latitude</td></tr>
<tr><td>Longitude : -90.770423</td><td></td><td colspan="3">Longitude</td></tr>
<tr><td colspan="2">Water Depth (Feet): 9,583</td><td></td><td>MD (Feet)</td><td colspan="2">MD (Feet)</td></tr>
<tr><td colspan="6">Anchor Radius (if applicable) in feet: NA</td></tr>
<tr><td colspan="6">Anchor locations for drilling rig or construction barge (if anchor radius is supplied above, not necessary)</td></tr>
</table>

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

Attachment 1N

Proposed Well/Structure Location					
Well or Structure Name/Number (if renaming well or structure, reference previous name): No. 001 (W)	Previously reviewed under an approved EP or DOCD? N-9875	x	Yes		No

Is this an existing well or structure?	X	Yes		No	If this is an existing well or structure, list the Complex ID or API Number:	6081240112

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

WCD Info	For wells, volume of uncontrolled Blowouts (bbls/day): 47,114 BOPD	For structures, volume of all storage and pipelines (bbls):	API Gravity of fluid	28°

	Surface Location	**Bottom Hole Location (for Wells)**	**Completion (for multiple enter separate lines)**
Lease Number	OCS-G-17001	OCS-G-32690	OCS OCS
Area Name	Walker Ridge	Walker Ridge	
Block No.	508	464	
Blockline Departure (in feet)	N/S Departure: 6,552' FSL		N/S Departure: N/S Departure:
	E/W Departure: 6,412' FEL		E/W Departure: E/W Departure:
Lambert X-Y Coord.	X: 2,369,588		X:
	Y: 9,605,592		Y:
Lat/Long	Latitude : N 26° 27' 16.522		Latitude
	Longitude : W -90° 46' 15.381"		Longitude

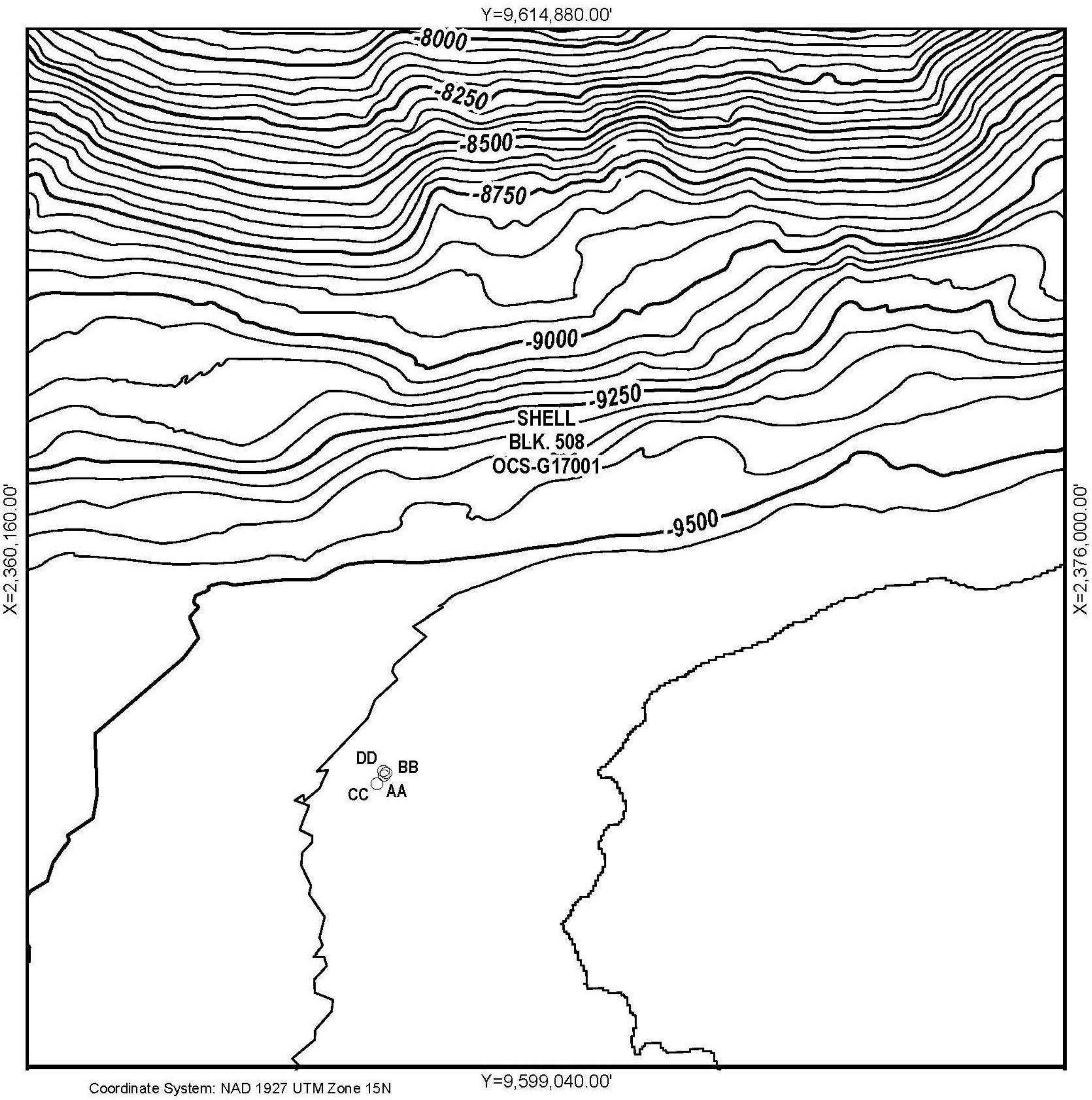
Water Depth (Feet): 9,585			MD (Feet)	TVD (Feet)

Anchor Radius (if applicable) in feet: NA

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

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

Attachment 1A - Bathymetry and Surface Locations



Coordinate System: NAD 1927 UTM Zone 15N

○ PROPOSED SURFACE LOCATIONS

AA 5,435.51' FWL & 4,443.50' FSL OF BLK. WR 508
X=2,365,595.51' Y=9,603,483.50'
Lat=26.4489813 Long=-90.7832466

BB 5,472.19' FWL & 4,482.56' FSL OF BLK. WR 508
X=2,365,632.19' Y=9,603,522.56'
Lat=26.4490870 Long=-90.7831325

CC 5,327.12' FWL & 4,319.78' FSL OF BLK. WR 508
X=2,365,487.12' Y=9,603,359.78'
Lat=26.4486462 Long=-90.7835842

DD 5,434.80' FWL & 4,515.57' FSL OF BLK. WR 508
X=2,365,594.80' Y=9,603,555.57'
Lat=26.4491796 Long=-90.7832450

N

ATTACHMENT
SHELL
PROPOSED SURFACE LOCATIONS
EXPLORATION PLAN
SHELL, OCS-G 17001, WALKER RIDGE BLK 508
WALKER RIDGE AREA
OFFSHORE LOUISIANA

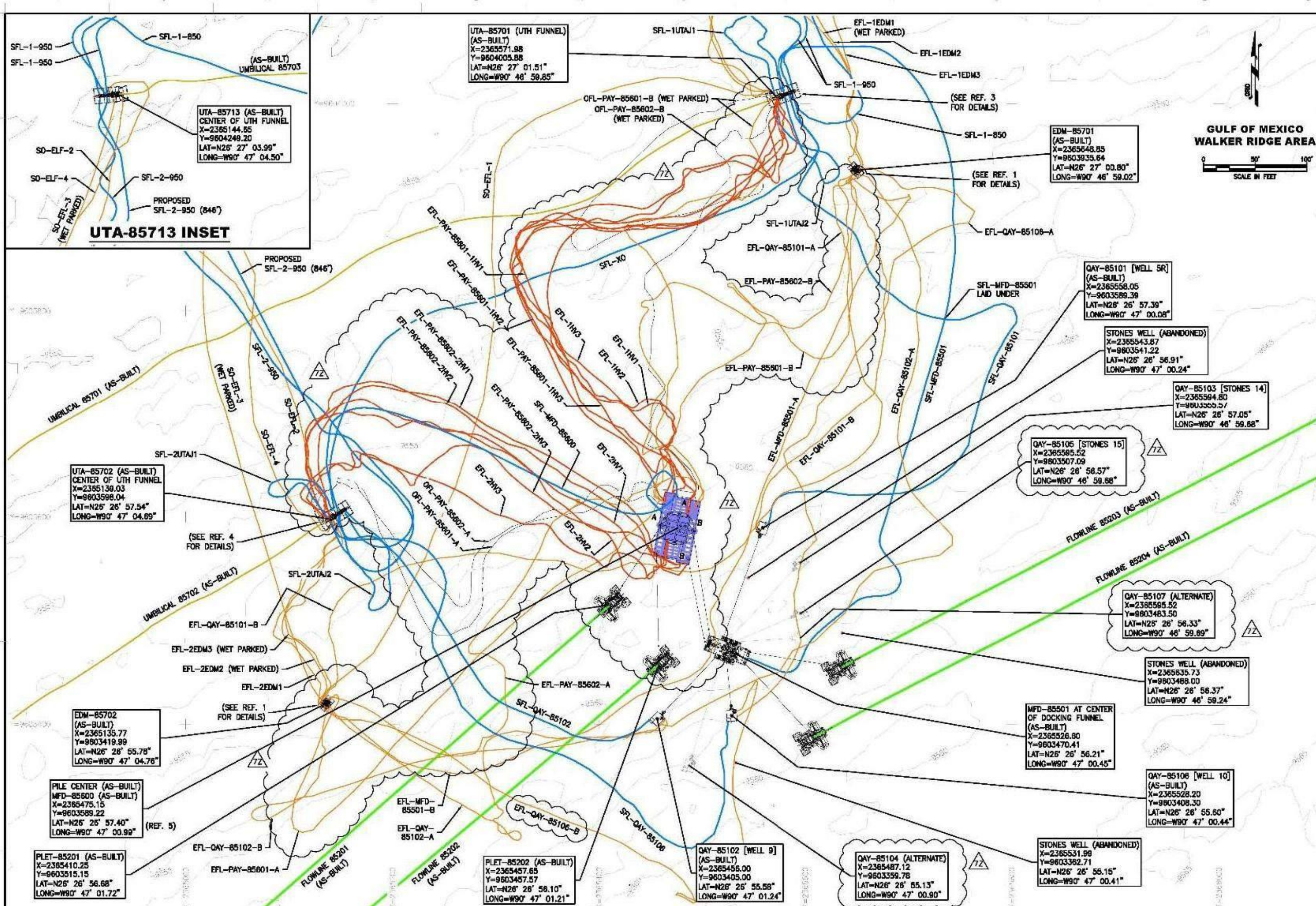
0 500 1,000 2,000 3,000 4,000 Feet

G:\30_Project\CAD_NewOrleans\Maps\Permit Plats\Stones\Stones Proposed Surface Locations Exploration Plan Jan2019.mxd

Attachment 1B - Bottom-Hole Locations

Omitted from Public Information Copies.

Attachment 1C – Subsea Layout



STONES - PH1A & PH1B SEQUENCE LOG					
FROM	TO	TAG	LENGTH	STATUS	VESSEL/DATE
HDM-85702	UTH-85702	SFL P1000119630	200	INSTALLED	IRON HORSE / MAR 2016
HDM-85702	UTH-85702	SFL P1000119629	200	INSTALLED	IRON HORSE / MAR 2016
HDM-85701	HDM-85702	SFL P1000119647	700	INSTALLED	IRON HORSE / MAR 2016
HDM-85701	MFD-85501	SFL P1000119641	900	INSTALLED	IRON HORSE / MAR 2016
HDM-85701	UTH-85701	SFL P1000119628	200	INSTALLED	IRON HORSE / MAR 2016
HDM-85701	UTH-85701	SFL P1000119626	200	INSTALLED	IRON HORSE / MAR 2016
HDM-85701	QAY-85101	SFL P1000119640	750	INSTALLED	IRON HORSE / MAR 2016
HDM-85702	QAY-85102	SFL P1000119637	400	INSTALLED	IRON HORSE / MAR 2016
UTH-85702	EDM-85702	EFL-2EDM-1	450	INSTALLED	SEVEN RIO / DEC 2015
UTH-85702	EDM-85702	EFL-2EDM-2	450	WET PARKED	SEVEN RIO / DEC 2015
UTH-85702	EDM-85702	EFL-2EDM-3	450	WET PARKED	SEVEN RIO / DEC 2015
UTH-85702	EDM-85701	EFL-1EDM-1	450	WET PARKED	SEVEN RIO / DEC 2015
UTH-85702	EDM-85701	EFL-1EDM-2	450	INSTALLED	SEVEN RIO / DEC 2015
UTH-85702	EDM-85701	EFL-1EDM-3	450	INSTALLED	SEVEN RIO / DEC 2015
EDM-85702	QAY-85102	EFL-QAY-85102-A	600	INSTALLED	IRON HORSE / MAR 2016
EDM-85702	QAY-85102	EFL-QAY-85102-B	600	INSTALLED	IRON HORSE / MAR 2016
EDM-85701	QAY-85101	EFL-QAY-85101-A	450	INSTALLED	IRON HORSE / MAR 2016
EDM-85701	QAY-85101	EFL-QAY-85101-B	450	INSTALLED	IRON HORSE / MAR 2016
EDM-85701	MFD-85501	EFL-MFD-85501-A	600	INSTALLED	IRON HORSE / MAR 2016
EDM-85701	MFD-85501	EFL-MFD-85501-B	600	INSTALLED	IRON HORSE / MAR 2016
HDM-85701	HDM-85713	SFL P1000119639	950	INSTALLED	SEVEN PACIFIC / JUL 2016
HDM-85701	HDM-85713	SFL P1000119642	950	INSTALLED	SEVEN PACIFIC / JUL 2016
HDM-85702	HDM-85713	SFL P1000119645	950	INSTALLED	SEVEN PACIFIC / JUL 2016
UTH-85701	UTH-85713	SO-EFL-1	900	INSTALLED	SEVEN PACIFIC / JUL 2016
UTH-85702	UTH-85713	SO-EFL-2	900	INSTALLED	SEVEN PACIFIC / JUL 2016
HDM-85702	QAY-85106	SFL P1000151995	750	INSTALLED	OCEAN ALLIANCE / NOV 2016
EDM-85702	QAY-85106	EFL-QAY-85208-A	900	INSTALLED	OCEAN ALLIANCE / NOV 2016
EDM-85702	QAY-85106	EFL-QAY-85208-B	900	INSTALLED	OCEAN ALLIANCE / NOV 2016
EDM-85702	UTH-85713	SO-EFL-3	900	WET PARKED	OCEAN ALLIANCE / JAN 2017
HDM-85701	HDM-85713	SFL-1-850	850	INSTALLED	ROSS CANDIES / MAY 2018
HDM-85702	HDM-85713	SFL-2-950	950		
UTH-85702	UTH-85713	SO-EFL-4	900	INSTALLED	ROSS CANDIES / MAR 2018
HDM-85702	MFD-85600	SFL-MFD-85600	600	WET PARKED	ROSS CANDIES / MAY 2018
UTH-85701	PAY-85601	EFL-PAY-85601-1HV1	700	WET PARKED	ROSS CANDIES / MAY 2018
UTH-85701	PAY-85601	EFL-PAY-85601-1HV2	700	WET PARKED	ROSS CANDIES / MAY 2018
UTH-85701	PAY-85601	EFL-PAY-85601-1HV3	700	WET PARKED	ROSS CANDIES / MAY 2018
UTH-85702	PAY-85602	EFL-PAY-85602-2HV1	550	WET PARKED	ROSS CANDIES / MAY 2018
UTH-85702	PAY-85602	EFL-PAY-85602-2HV2	550	WET PARKED	ROSS CANDIES / MAY 2018
UTH-85702	PAY-85602	EFL-PAY-85602-2HV3	550	WET PARKED	ROSS CANDIES / MAY 2018
EDM-85701	PAY-85601	EFL-PAY-85601-B	650	WET PARKED	ROSS CANDIES / MAY 2018
EDM-85701	PAY-85602	EFL-PAY-85602-B	650	WET PARKED	ROSS CANDIES / MAY 2018
EDM-85702	PAY-85601	EFL-PAY-85601-A	650	WET PARKED	ROSS CANDIES / MAY 2018
EDM-85702	PAY-85602	EFL-PAY-85602-A	650	WET PARKED	ROSS CANDIES / MAY 2018
UTH-85701	PAY-85601	OFL-PAY-85601-B	558	WET PARKED	ROSS CANDIES / MAY 2018
UTH-85701	PAY-85602	OFL-PAY-85602-B	558	WET PARKED	ROSS CANDIES / MAY 2018
UTH-85702	PAY-85601	OFL-PAY-85601-A	558	WET PARKED	ROSS CANDIES / MAY 2018
UTH-85702	PAY-85602	OFL-PAY-85602-A	558	WET PARKED	ROSS CANDIES / MAY 2018

NOTES:

1. BATHYMETRY CONTOURS GENERATED FROM DATA ACQUIRED ON 25TH JULY 2011.
2. HVEFL BEND RADIUS ILLUSTRATED AS ≥ 10'
   OFL BEND RADIUS ILLUSTRATED AS ≥ 10'
3. FLYING LEAD POSITIONS AT MFD-85600 ARE PRELIMINARY.
4. UMBILICAL TERMINATION HEAD (UTH) AND HYDRAULIC DISTRIBUTION MANIFOLD (HDM) SIT IN WEST AND EAST FUNNELS OF UMBILICAL TERMINATION ASSEMBLY (UTA), RESPECTIVELY.
5. EFL-HVEFL CROSSING SHOULD IDEALLY BE PERPENDICULAR.
6. THE DEFINITION OF EDM, TPF AND LTDF BEARING IS BASED ON BLACK STRIPE ON MUDMAT.
7. FLYING LEADS MARKED "WET PARKED" ARE NOT IN SERVICE.

REFERENCES:

1. DA100147214 SUBSEA CONTROLS ELECTRICAL SCHEMATIC, SHELL STONES DC1
2. DELETED.
3. DA100147211 SUBSEA CONTROLS SCHEMATIC, HYDRAULIC/CHEMICAL SHELL STONES DC1, W/STEP OUT
4. DELETED.
5. STO-501-UA-4180-2503400-005 SUBSEA DISTRIBUTION HARDWARE INTERFACE WITH ARTIFICIAL LIFT MANIFOLD

GEODETIC PARAMETERS

HORIZONTAL COORDINATE REFERENCE SYSTEM

CRS Name (EPSG):	NAD27/ BLM 15N (ftUS)
Alias:	NAD27/ UTM zone 15N (ftUS)
CRS Code (EPSG):	32065
TRANSFORMATION:	NAD27 to NAD83(1) [1241]
Map Units:	US survey feet

VERTICAL COORDINATE REFERENCE SYSTEM

Vertical Datum	Mean Sea Level
Elevation/Depth	Depth
Vertical Units:	Feet

LEGEND

OIL FLOWLINE
UMBILICAL
FUTURE DEVELOPMENT
EFL (AS-BUILT)
SFL (AS-BUILT)
JUMPER (AS-BUILT)
HVEFL (AS-BUILT)
OFL (AS-BUILT)
JUMPER (PROPOSED)
HVEFL (PROPOSED)
OFL (PROPOSED)
EFL (PROPOSED)
SFL (PROPOSED)
CONTOURS
TEMPORARY PARKING FRAME (TPF)
WELL TREE
NOT PLANNED FOR USE

REV	DATE	DESCRIPTION	DRAWN	CHK or TECH REF	DES ENG.	PROJ ENG.
07Z	2019-06-25	AS-BUILT	SC		BD	
06Z	2018-07-26	AS-BUILT	TDG		MS	
05Z	2018-04-03	AS-BUILT	SC		MS	
04Z	2017-05-24	AS-BUILT	SC	KC	MS	MS
03Z	2016-12-07	AS-BUILT	SC	KC	MS	MS
02Z	2016-09-22	AS-BUILT	DL	AT	AT	KC
01Z	2016-08-04	AS-BUILT	DL	KC	KC	KC

SIEP Projects & Technology
Upstream Major Projects - Americas

DRILL CENTER 1 LAYOUT
FLYING LEAD DETAILS

WALKER RIDGE BLOCK 508

DRG No. STO-501-UA-4180-2501301-001 REV. 07Z

Roy.Cutbirth 6/25/2019 9:24:47 AM N:\Drafting_Projects\Walker Ridge\Stones\Subsea\STO-501-FLOWLINES\Dwg\Current\STO-501-UA-4180-2501301-001.dwg

THIS DOCUMENT HAS AN ECCN OF EAR99

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 well work operations, an Application for Permit to Modify (APM) 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

Omitted from Public Information Copies.

D. Oil Characteristics

Area	Walker Ridge	Walker Ridge	Walker Ridge	Walker Ridge
Well	WR 508 #1	WR 508 #1	WR 508 #1	WR 508 #3
Well API	608124001500	608124001500	608124001500	608124003202
Sample Depth	26,666' MD	26,764' MD	27,132' MD	27,880' to 28,733' MD
Sample Date	19-Mar-05	21-Mar-05	19-Mar-05	Nov 11 to Nov 16, 2008
Sample Number	1.03	1.05	1.01	1.01 to 1.26
Gravity (API) ASTM D 1217-93 or 5002-99	25.9	28	23.5	26 to 30
Flash Point (deg C)	Not measured	Not measured	Not measured	Not measured
Pour Point (Deg F) ASTM D 97-02	7 Deg F	15 deg F	11 deg F	Not measured
Viscosity (cP) ASTM D 445-01	55 @ 70° F	26.71 @ 70° F	106.88 @ 70° F	4-5 cP at reservoir conditions
Boiling Point Distribution	Below	Below	Below	Not measured
Sulphur (wt%) ASTM D 4294-02	3.4	3.3	3.6	2.2 to 3.4
Saturates (wt%)	Not measured	Not measured	Not measured	27 to 37
Aromatics (wt%)	Not measured	Not measured	Not measured	51 to 57
Resins (wt%)	Not measured	Not measured	Not measured	7 to 10
Asphaltenes (wt%) ASTM D 4055-01	6.8	4.4	8.2	4 to 6

Boiling Point Distribution	WR508 #1 1.03	WR508 #1 1.05	WR508 #1 1.01
Fraction Recovered	Temp	Temp	Temp
Initial Boiling Point	61	81	94
5	213	209	243
10	303	291	316
15	376	352	382
20	442	416	442
25	501	472	493
30	533	515	539
35	546	542	572
40	572	552	610
45	600	589	657
50	646	623	702
55	695	667	747
60	746	713	791
65	796	759	834
70	845	805	878
75	896	850	926
80	950	898	974
85	1005	949	1024
90	1058	1003	1075
95	1112	1064	1134
Final Boiling Point	1187	1182	1221

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 SDOCD.

F. Bonding

The bond requirement for the activities proposed in this DOCD are satisfied by an area-wide bond furnished and maintained according to 30 CFR Part 556, Subpart I-Bonding; NTL No. 2015-N04, "General Financial Assurance" and 30 CFR 256.53(d) and National NTL No. 2016-N01, "Additional Security."

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 DOCD 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

WR 508 is held by production.

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 DOCD 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 DOCD 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 DOCD, 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	DOCD
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 – Omitted from Public Information Copies**)**

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

A. Geological description
Omitted from Public Information Copies.

B. Structure Contour Map(s)
Omitted from Public Information Copies.

C. Interpreted 2D and/or 3D Seismic line(s)
Omitted from Public Information Copies.

D. Geological Structure Cross-section(s)
Omitted from Public Information Copies.

E. Stratigraphic Column
Omitted from Public Information Copies.

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 Assessment 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 (H_2S)

A. Concentration

0 ppm

B. Classification

Based on CFR 250.490 and CFR 550.215 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 H_2S has been confirmed.

C. Modeling Report

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

SECTION 5: MINERAL RESOURCE CONSERVATION INFORMATION

A. Technology and Reservoir Engineering practices and procedures

The Phase 1 development program recovery mechanism will be a combination of water influx from the aquifer and fluid expansion/formation compaction associated with pressure depletion. Given the lack of production data for the Wilcox formation in this area, it is unknown how effective water influx will be in providing pressure support to production. During Phase 1, reservoir performance will be monitored to quantify the effectiveness of the natural water influx. Depending on the observed results, potential future phases could include water or gas injection to enhance recovery.

Due to the water and reservoir depths at this field, hydrostatic pressure losses in the production system from reservoir to surface are significant. In order to improve production rates and enhance ultimate recovery from the reservoir, the Phase 1 development will include sea floor booster pumps. The pumps will be single phase centrifugal pumps and will enable flowing wellhead pressures on the production wells to be decreased to near bubble point. This will result in increased pressure drawdown to the reservoir and higher production rates from the wells.

B. Technology and recovery practices and procedures

The Phase 1 development wells will be targeted along the crest of the structure as imaged in a recent Wide Azimuth (WAZ) 3D seismic data set. By targeting crestal locations, the program will maximize well exposure to net pay above oil water contacts and minimize the risk of early water breakthrough from the aquifer. A detailed 3D reservoir simulation model has been constructed using available well data from Stones and the 3D seismic data. This model will be used to optimize the inter-well spacing and maximize project recovery.

All Stones wells will be equipped with permanent downhole pressure and temperature (DHPT) gauges. For redundancy, two DHPT gauges will be installed in a mandrel positioned above the permanent production packer. The downhole pressure and temperature data will assist in history matching of the simulation model and improve production surveillance activities. In addition, non-radioactive chemical tracers are being considered for Phase 1 to assist in understanding the zonal contribution to production and completion efficiency of each hydraulic unit with each well. Finally, sand face temperature and pressure sensing technologies are being considered for Phase 1, to provide additional information on zonal production rates and completion efficiencies.

Seafloor multi-phase flow meters (MPFMs) will be provided to allow for well rate measurement. Provisions will be made in the design of the meters to allow subsea retrieval by ROV. In addition, there will be sufficient pressure and temperature gauges located in the wells, trees and manifolds to provide for virtual metering of the wellstreams.

All wells will be produced through the subsea pumps. The addition of these pumps will provide a pressure boost in flowing against the hydrostatic gradient at these water depths and will maximize the pressure drawdown between the reservoir and the well completion, subject to well operating constraints.

All producers are expected to have a string of 4-1/2" tubing with vacuum insulated tubing (VIT) near the mudline to mitigate the potential of trapped annular pressure from thermal fluid expansion.

The flow assurance philosophy for Stones is generally consistent with other deepwater GOM developments, namely avoidance of plugging by deposition of solids in subsea equipment.

The primary strategies for hydrate avoidance are:

- Heat retention (e.g. insulation of jumpers, flowlines and risers) for steady state production conditions
- Dead oil displacement following a system shutdown
- Hydrate inhibitor injection for wells, trees and well jumpers

Corrosion protection of the subsea equipment will be provided through material selection and corrosion inhibitor injection subsea.

Live oil tests have shown no onset of precipitation for asphaltenes. Scale inhibition will be the primary strategy for protection of the subsea equipment from scale build-up, and sand production will be monitored by acoustic sand detectors.

Wax deposition within the flow loops will be managed by a combination of paraffin inhibitor and flowline insulation. Flowline insulation under normal flowing conditions will ensure that the fluid arrival temperature at the host will be above the cloud point.

C. Reservoir Development

The Stones field is located in the Walker Ridge protraction area in the deepwater Gulf of Mexico in water depths ranging from 7,500 - 9,500ft. There are three wellbores at Stones (WR508-#1, WR508-#3BP1, WR508-#3BP2) that provide information for the Upper and Lower Wilcox target intervals. One well (WR508-#2) was not drilled to the Wilcox objective.

WR508-#1 (Stones #1):
The discovery well, WR508-#1 was drilled by BP and reached TD in March 2005. This well was drilled on the south flank of the crest, approximately 400' below the top of the structure. The well encountered approximately 833' of gross sand in the Upper Wilcox with 328' of net oil sand. The entire 1,112' of gross sand penetrated in the Lower Wilcox was wet.

WR508-#2 (Stones #2):
Shell spud the WR508-#2 well near the base of the Sigsbee Escarpment in August 2006, drilling the riser-less portion of the well to a measured depth of 12,600'. The MMS "Exploratory Study of Currents in the Deepwater GOM" suggested higher than anticipated seabed currents near the base of the Sigsbee Escarpment and Transocean chose not to return the rig to the WR508-#2 location at the base of the escarpment for contractual reasons (WD limit of 8000') and the well was temporarily abandoned.

WR508-#3 (Stones #3):
In December 2007, the WR508#3 well was spud from the top of the Sigsbee Escarpment with the bypass #1 wellbore reaching the Wilcox objective in April 2008. This well penetrated the Upper and Lower Wilcox sections on the crest of the structure encountering approximately 700' of net oil sand and no evidence of immobile asphaltenes. A wireline failure during MDT sampling followed by unsuccessful fishing operations resulted in a second bypass well.

The bypass #2 wellbore re-drilled the objective section between September and December 2008 acquiring 530' of conventional core and five oil samples. This well penetrated approximately 750' of net oil sand.

The Stones field forms part of the frontier Lower Tertiary (middle Paleocene to Lower Eocene) play and is characterized by a thick sequence of low permeability inter-bedded sand and shales. The sands contain highly under-saturated oils which have lower GORs, lower APIs, and higher viscosities than typical Gulf of Mexico oils. These reservoir and fluid characteristics require a high producing drawdown to achieve economic rates. Prediction of both well productivity and recovery from the play is challenging given the lack of producing analogues. Given the significant subsurface uncertainty, a phased development approach has been selected for Stones, with subsequent phases contingent on Phase 1 performance.

The Phase 1 development concept that was selected is as follows:

- Floating Production Storage and Offloading (FPSO) system with dis-connectable turret and lazy wave risers located on the bottom of the Sigsbee Escarpment in block WR 551
- Shuttle Tanker oil export
- 8" Gas Export Pipeline
- Mobile Drilling Unit (MODU) subsea (wet tree) wells
- 8 Multi Zone hydraulically fractured and commingled production wells drilled from a single drill center

Multi-stage fracture stimulations will be performed on the wells to maximize the deliverability of the completion, and to ensure that an effective fracture is created in each oil bearing reservoir unit. All hydraulic units encountered in a well will be completed, subject to the presence and proximity of the oil-water contact to the proposed perforations. Based on data gathered to date, it is anticipated that 2-5 fracture stages will be performed per well. Each well completion will include sand control and will be produced with a controlled drawdown limit, in order to maximize completion life. Sand monitoring is accomplished by acoustic monitoring on each of the well jumpers associated with a production well.

Phase 1 average inter-well spacing is ~3,000 feet. Locations were selected utilizing the Stones 3D simulation model. Most of the wells will have some wellbore deviation (up to 50 degrees) to reach their reservoir targets. However, for fracture stimulation purposes, the well angle through the pay zone will be less than 30 degrees to better align the well path with the fracture plane. All targets are planned to be within an 11,000' lateral radius of the drill center.

SECTION 6: BIOLOGICAL, PHYSICAL AND SOCIOECONOMIC INFORMATION

Shell Offshore Inc. (Shell) is submitting a Supplemental DOCD for Walker Ridge Block 508 (WR 508) for the addition of new seafloor equipment to continue its development. The SDOCD will add well jumpers in the area of existing infrastructure approved in previous DOCDs. The new wellsites, AA (85107), BB (85105), CC (85104), DD (85103), are being tied in were approved in SEP Plan No. S-7948. This letter addresses specific seafloor conditions within the area of installation.

The installation site falls within 250 ft. of the previously approved wells, AA, BB, CC, and DD, in SEP No. S-7948. The assessment below addresses the seafloor conditions around the proposed well jumpers and a 2000 ft. radius around the installation site.

Seafloor conditions appear favorable within the vicinity of the proposed equipment installation. There are no potential sites for deepwater high-density benthic communities within 2,000 ft installation location and no sonar targets of archaeological significance were identified in the vicinity.

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

Geohazards and Archaeological Assessment. The following summary of the geohazards and archaeological assessment is based on the findings provided within the following detailed 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 Geo-consulting 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 Geo-consulting 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 Assessment 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, Gardline project ref 6092.

Available Data

This assessment is based on the analysis of: a) high-resolution geophysical datasets b) reprocessed exploration 3D seismic data volume.

Proposed Sled, Jumper, Umbilical and Flying Leads, Walker Ridge 508 (OCS-G 17001)

Shell proposes to install Well Jumper from installed manifold MFD-85501 to proposed well AA (85107) at an approximate length of 70 ft. Shell proposes to install Well Jumper from installed manifold MFD-85501 to proposed well BB (85105) at an approximate length of 120 ft. Shell proposes to install a Well Jumper from installed manifold MFD-85501 to proposed well CC (85104) an approximate length of 118 ft. Shell proposes to install a Well Jumper from installed manifold MFD-85501 to proposed well DD (85103) an approximate length of 115 ft. See Table A-1 for coordinate information.

Proposed Installation Location
The location of the installation area is in the southwestern corner of block WR 508. Table A-1 proposed and as-built location coordinates:

Table A-1. Location Coordinates of Proposed / AS-BUILT Equipment

Equipment / Well Location	Spheroid & Datum: Clarke 1866 NAD27 Projection: BLM Zone 15 North	
85103(DD) proposed	X: 2365594.8 ft.	Y: 9603555.57 ft.
85104(CC) proposed	X: 2365487.12 ft.	Y: 9603359.78 ft.
85105(BB) proposed	X: 2365632.19 ft.	Y: 9603522.56 ft.
85107(AA) proposed	X: 2365595.51 ft.	Y: 9603483.5 ft.
MFD-85501 as-built	X: 2365526.60 ft.	Y: 9603470.41 ft.

Our assessment addresses the seafloor conditions within a 1,000-ft radius around the proposed area of impact. Figure-1, Figure-1a.

Oil Field Infrastructure and Military Warning Areas. Installation Site Conditions.
Infrastructure consisting of previously drilled wells, pipelines, sleds, umbilicals, and other equipment used in developing the field are within 500 ft. of the proposed installation site. There are ten transponder frames within 2000 ft. of the proposed installation site and four pipelines. 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.

Water Depth and Seafloor Conditions. Based on the AUV multibeam echo-sounder data, the water depth at the proposed installation site is -9,554 ft, and the seafloor slopes at 1.0° down to the SE. The water depths within 2000 ft radius around the installation area ranges from -9530 to -9570 ft. The proposed installation site is located approximately 3100 ft. from the edge of the Sigsbee Escarpment. The installation site 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. Figure-1.

Deepwater Benthic Communities. There is no potential for high-density benthic communities within 2,000 ft of the proposed locations. 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, Figure-2a.

Archaeological Assessment. There are no archaeologically significant sonar contacts within 2,000 ft of the proposed installation site. One sonar contact was reported within 2000 ft. of the proposed installation site. 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 installation site. See C&C, 2011 Project No. 110394 for details. Figure-1.

Proposed Seafloor Equipment Installation: Concluding Remarks
Seafloor conditions appear favorable in the vicinity of the proposed surface location. The possibility for an increase in seafloor currents should be anticipated at the proposed installation site 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 feature 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 proposes activities under this plan.

Currently there are no designated critical habitats for the listed species in the Gulf of Mexico Outer Continental Shelf; however, it is possible that one or more of these species could be seen in the area of our operations. The following table reflects the Federally-listed endangered and threatened species in the lease area and along the northern Gulf coast:

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

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

Table 6.7 – 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.

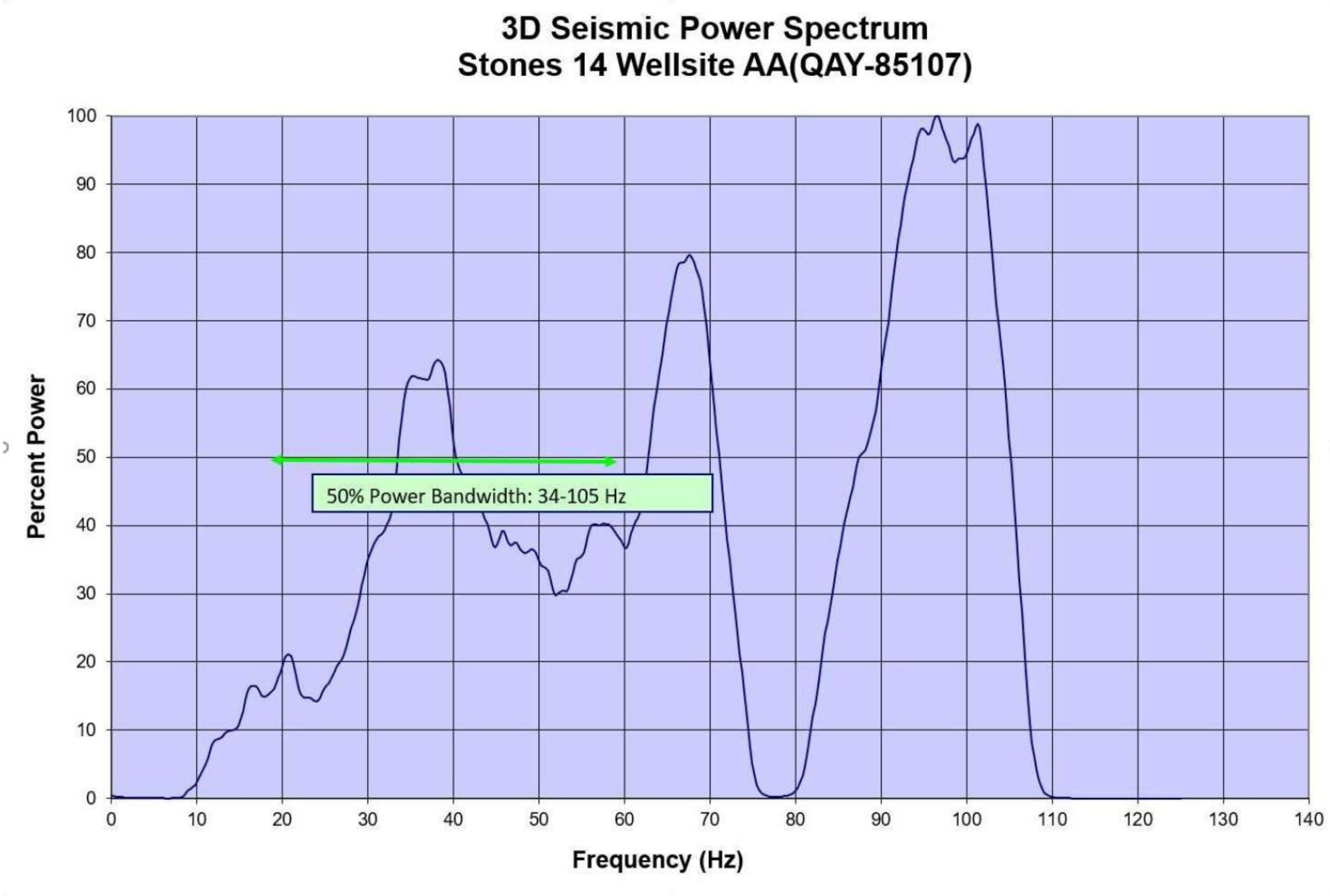
K. Socioeconomic Information

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.

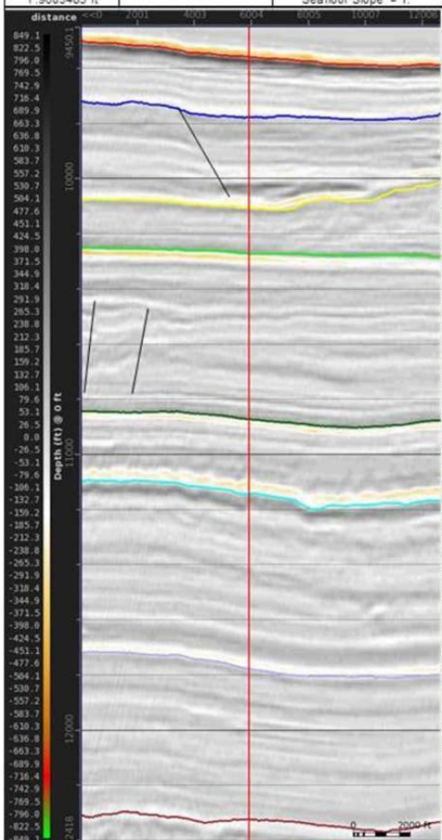
3) Shell does not expect to hire contractors or vendors from within the State of Florida.

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)
Percent Power
Frequency (Hz)
50% Power Bandwidth: 34-105 Hz
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140

Tophole Summary

X: 2365595 ft	Stones WR508-AA	Water Depth= 9554 ft
Y:9603483 ft		Seafloor Slope = 1.°

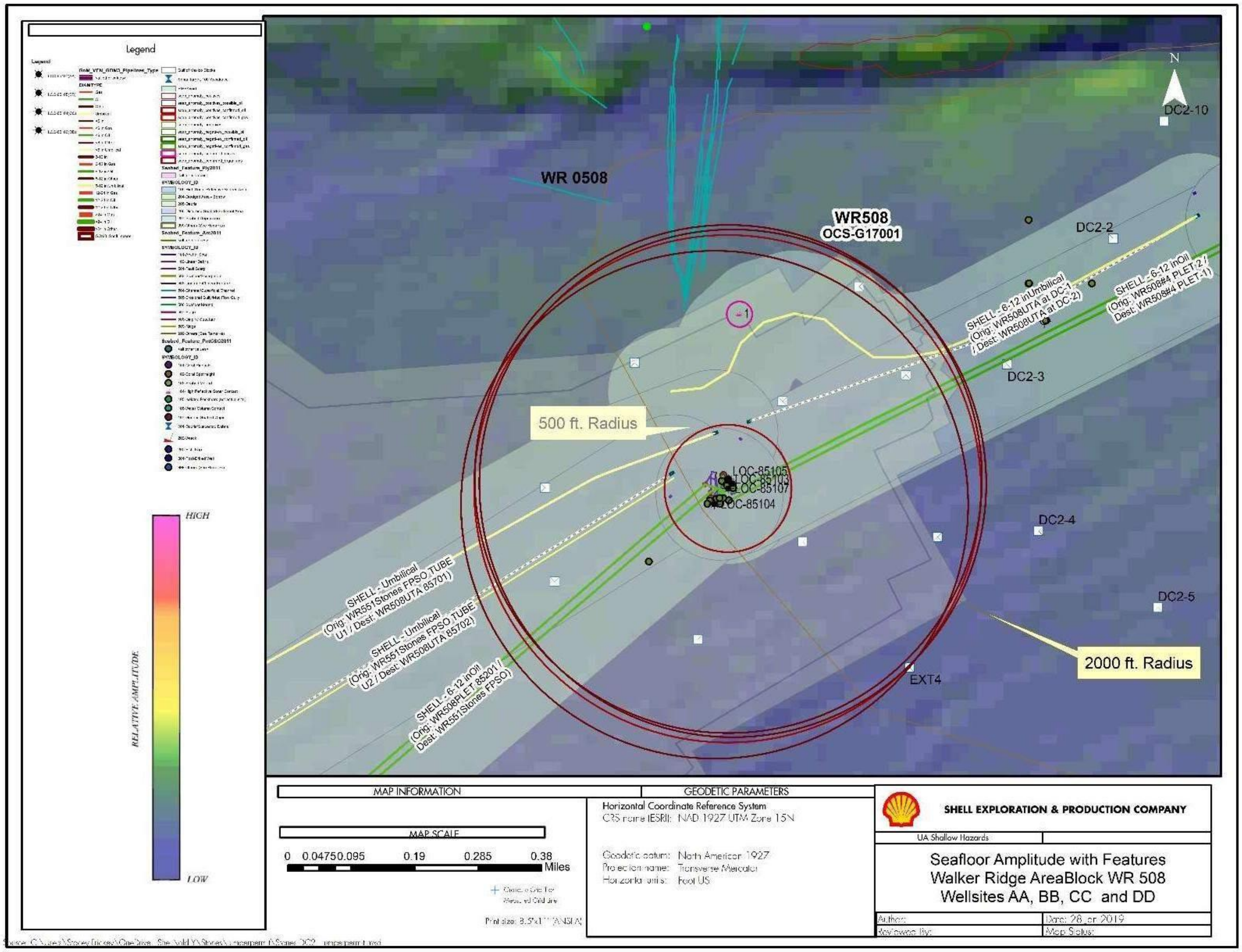


Seismic:999.37-stkqc_flip_con.vt
Depth Conversion:"WGE_EOCTP6_ED_STONES_FNLVTI.bin"

Event	Unit	Depth BML (ft)	Depth SS (ft)	TWTT SS (ms)	Unit Thickness (ft)	Predicted Lithology and Potential of Geohazard Occurrence	SWF/Kick	Shallow gas
H00 (Seafloor)		0	9554	1712				
H01	A	223	9777	1901	223	Hemipelagic Drape, mass transport deposits Potential slow jetting or refusal due to MTD	Low	Low
H02	B	552	10106	2172	329	Muds and Silts, possible thin sands	Low	Low
H03	C	718	10272	2356	166	Muds and Silts	Low	Low
H04	D	1318	10872	2539	600	Muds, turbiditic channels	Low	Low
H05	E	1589	11143	2749	271	Muds, turbiditic channels, mass transport deposits	Low	Low
H07	F	2223	11777	3143	634	Muds and Silts,interbedded mass transport deposits	Low	Low
H08	G	2768	12322	3528	545	Muds and Silts,some possible thin sands in channels, interbedded mass transport deposits	Low	Low

Sand
Mud rocks

Chance of Occurrence	Low	Moderately Low	Moderate	Moderately High	High
	<10%	10-20%	20-30%	30-40%	>40%


Legend
HIGH
RELATIVE AMPLITUDE
LOW
WR 0508
WR508
OCS-G17001
DC2-10
DC2-2
DC2-3
DC2-4
DC2-5
EXT4
500 ft. Radius
2000 ft. Radius
LOC-85105
LOC-85104
SHELL - 6-12 inUmbilical (Orig: WR508UTA at DC-1 / Dest: WR508UTA at DC-2)
SHELL - 6-12 inOil (Orig: WR508#4 PLET-2 / Dest: WR508#4 PLET-1)
SHELL - Umbilical (Orig: WR551Stones FPSO TUBE U1 / Dest: WR508UTA 85701)
SHELL - Umbilical (Orig: WR551Stones FPSO TUBE U2 / Dest: WR508UTA 85702)
SHELL - 6-12 inOil (Orig: WR508PLET 85201 / Dest: WR551Stones FPSO)
N
MAP INFORMATION
MAP SCALE
0 0.04750.095 0.19 0.285 0.38 Miles
GEODETIC PARAMETERS
Horizontal Coordinate Reference System
CRS name (ESRI): NAD 1927 UTM Zone 15N
Geodetic datum: North American 1927
Projection name: Transverse Mercator
Horizontal units: Foot US
SHELL EXPLORATION & PRODUCTION COMPANY
UA Shallow Hazards
Seafloor Amplitude with Features
Walker Ridge AreaBlock WR 508
Wellsites AA, BB, CC and DD
Author:
Date: 28 Jan 2019
Reviewed By:
Map Status:

SECTION 7: WASTE AND DISCHARGE INFORMATION

A. Projected Ocean Discharges

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

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

Projected generated waste			Projected ocean discharges		Projected Downhole Disposal
Type of Waste and Composition	**Composition**	**Projected Amount**	**Discharge rate**	**Discharge Method**	**Answer yes or no**
Will drilling occur ? If yes, you should list muds and cuttings					
EXAMPLE: Cuttings wetted with ynthetic based fluid	*Cuttings generated while using synthetic based drilling fluid.*	*X bbl/well*	*X bbl/day/well*	*discharge pipe*	*No*
Water-based drilling fluid	barite, additives, mud	85000 bbls/well	17000 bbls/day	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 level	No
Synthetic based drilling fluid adhering to washed drill cuttings	Synthetic based drilling fluid adhering to washed drill cuttings	490 bbls/well	7 bbls/day	Overboard discharge line below the water level	No
Spent drilling fluids - synthetic	Synthetic-based drilling mud	0 bbls / well	0 bbls/day	Overboard discharge line below the water level	No
Spent drilling fluids - water based	Synthetic-based drilling mud	0 bbls / well	0 bbls/day	Overboard discharge line below the water level	No
Chemical product waste	Chemical product waste	0 bbls / well	0 bbls/day	Treated to meet NPDES limits and discharged overboard	No
Brine	brine	N/A	N/A	N/A	No
Will humans be there? If yes, expect conventional waste					
EXAMPLE: Sanitary waste water		*X liter/person/day*	*NA*	*chlorinate and discharge*	*No*
Domestic waste (kitchen water, shower water)	grey water	27000 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	20250 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	2700 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	450 bbls/well	10 bbls/day	Overboard discharge line below the water level if oil and greese free.	No
well completion fluids	Completion brine contaminated with WBDM and displacement spacers	675 bbls/well	15 bbls/day	Overboard discharge line below the water level if oil and greese free.	No
workover fluids	Linear Frac Gel Flush Fluids, Crosslinked Frac Fluids carrying ceramic proppant, spacers, flushes, and acidic breaker fluid	675 bbls/well	15 bbls/day	NA	No
Miscellaneous discharges. If yes, only fill in those associated with your activity.					
Desalinization unit discharge	Rejected water from watermaker unit	54000 bbls/well	400 bbls/day/well	RO Desalinization Unit Discharge Line below waterline	No
Blowout preventer fluid	Water based	27 bbls/well	0 bbls/day	Discharge Line @ Subsea BOP @ seafloor	No
Ballast water	Uncontaminated seawater	442260 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).	208305 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	9000 bbls/well	2000 bbls/month	Discharged below waterline	No
Cooling water	Treated seawater	61606305 bbls/well	456343 bbls/day/well	Discharged below waterline	No
Untreated or treated seawater	Treated Seawater	2300 bbls / flowline	300 gpm	Discharged at seafloor.	No
Hydrate Inhibitor	Hydrate Inhibitor	20 bbl glycol plug / flowline 15 bbl methanol / well	300 gpm	Discharged at seafloor.	No
Sub sea Production Control Fluid	Water-based	72 bbls/year	72 bbls/year	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	

B. Projected Generated Wastes

TABLE 7B. WASTES YOU WILL TRANSPORT AND/OR DISPOSE OF ONSHORE					
Note: Please specify whether the amount reported is a total or per well					
Projected generated waste		Solid and Liquid Wastes transportation	Waste Disposal		
Type of Waste	Composition	Transport Method	Name/Location of Facility	Amount	Disposal Method
Will drilling occur ? If yes, fill in the muds and cuttings.					
EXAMPLE: Oil-based drilling fluid or mud	NA	NA	NA	NA	NA
Oil-based drilling fluid or mud	NA	NA	NA	NA	NA
Synthetic-based drilling fluid or mud	used SBF and additives	Drums/tanks on supply boat/barges	Halliburton Drilling Fluids, MiSwaco, Newpark Drilling Fluids - Fourchon, LA; Ecoserv (Fourchon, La.), or R360 Environmental Solutions (Fourchon, La.),	6,500 bbls/well	Recycled/Reconditioned ; Deep Well Injection
Cuttings wetted with Water-based fluid	NA	NA	NA	NA	NA
Cuttings wetted with Synthetic-based fluid	Drill cuttings from synthetic based interval.	storage tank on supply boat.	Ecoserv (Fourchon, La.), or R360 Environmental Solutions (Fourchon, La.),	300 bbls / well	Deep Well Injection, or landfarm
Cuttings wetted with oil-based fluids	NA	NA	NA	NA	NA
Completion Fluids	Completion and treatment fluids	Storage tank on supply boat	Halliburton, Baker Hughes, Superior, or Tetra - Fourchon, LA; Ecoserv (Fourchon, La.), or R360 Environmental Solutions (Fourchon, La.),	4,000 bbls/well	Recycled/Reconditioned ; Deep Well Injection
Salvage Hydrocarbons	Well completion fluids, formation water, formation solids, and hydrocarbon	Barge or vessel tank	PSC Industrial Outsourcing, Inc. (Jeanerette, LA)	<8000 bbl./well	Recycled or Injection
Will you produce hydrocarbons? If yes fill in for produced sand.					
Produced sand	Sand Produced from formation	Drums/tanks on supply boat	Ecoserv (Fourchon, La.), or R360 Environmental Solutions (Fourchon, La.)	200 bbls/year	Disposal or Deep Well Injection
Will you have additional wastes that are not permitted for discharge? If yes, fill in the appropriate rows.					
EXAMPLE: trash and debris	cardboard, aluminum,	barged in a storage bin	shorebase	z tons total	recycle
Trash and debris - recyclables	trash and debris	various storage containers on supply boat	Omega Waste Managment, W. Patterson, LA; Lamp Environmental, Hammond, LA	200 lbs/month	Recycle
Trash and debris - non-recyclables	trash and debris	various storage containers on supply boat	Republic/BFI landfill, Sorrento, LA or the parish landfill, Avondale, LA	400 lbs/month	Landfill
E&P Wastes	Completion and treatment wastes	various storage containers on supply boat	Ecoserv (Fourchon, La.), or R360 Environmental Solutions (Fourchon, La.)	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 Managment, W. Patterson, LA	20 bbls/month	Recycle
Non-Hazardous Waste	paints, solvents, chemicals, completion and treatment fluids	various storage containers on supply boat	Republic/BFI landfill, Sorrento, LA Lamp Environmental, Hammond, LA	60 bbls/mo	Incineration or RCRA Subtitle C landfill
Non-Hazardous Oilfield Waste	Chemicals, completion and treatment fluids	various storage containers on supply boat	Ecoserv (Port Arthur, TX)	60 bbls/mo	Deep Well Injected
Hazardous Waste	paints, solvents, chemicals, completion and treatment fluids	various storage containers on supply boat	Omega Waste Managment, W. Patterson, LA; Lamp Environmental, Hammond, LA	60 bbls/mo	Recycle, treatment, incineration, or landfill
Universal Waste Items	Batteries, lamps, glass and mercury-contaminated waste	various storage containers on supply boat	Lamp Environmental, Independence, LA	50 bbls/mo	Recycle, treatment, incineration, or landfill

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 DOCD.

SECTION 8: AIR EMISSIONS INFORMATION

A. Emissions Worksheet and Screening Questions

Screening Questions for DOCD's	Yes	No
Is any calculated Complex Total (CT) Emission amount (in tons) associated with your proposed development and production 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
Does or will the facility complex associated with your proposed development and production activities process production from eight or more wells?		X
Do you expect to encounter H_2S at concentrations greater than 20 parts per million (ppm)?		X
Do you propose to flare or vent natural gas in excess of the criteria set forth under 250.1105(a)(2) and (3)?		X
Do you propose to burn produced hydrocarbon liquids?		X
Are your proposed development and production activities located within 25 miles from shore?		X
Are your proposed development and production activities located within 200 kilometers of the Breton Wilderness Area?		X

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

If you answer *no* to <u>all</u> 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					
NOx					
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 Stones host's DOCD emissions do not increase because of the operations proposed in this plan. These emissions were approved in Plan R-6730.

C. Emissions Reduction Measures

Emission Source	Reduction Control Method	Amount of Reduction	Monitoring System
Prime mover	Actual fuel consumption	3,365 tons NO_x/year	Fuel log
Supply Vessel	Actual fuel consumption	532 tons NO_x/year	Fuel log
Crew Vessel	Actual fuel consumption	326 tons NO_x/year	Fuel log

COMPANY	Shell Offshore Inc
AREA	Walker Ridge
BLOCK	508 (Surface Location)
LEASE	OCS-G17001
PLATFORM	MODU (Semi-sub or Drillship)
WELL	All Subsea wells
DISTANCE TO LAND	178
COMPANY CONTACT	504-425-9097
TELEPHONE NO.	Josh O'Brien
REMARKS	Stones-AQR-sDOCD-MODU,WW,INST-20190619-BOEM.xlsx

LEASE TERM PIPELINE CONSTRUCTION INFORMATION:		
YEAR	NUMBER OF PIPELINES	TOTAL NUMBER OF CONSTRUCTION DAYS
2020	1	25
2021	1	25
2022	1	25
2023	1	25

Remarks:

Some activities associated with these sources, specifically Service/Support Vessls, are not currently planned but are included as a contingency, per BOEM guidance, Tips to Avoid Common Emissions Spreadsheet Errors, #10, https://www.boem.gov/Air-Quality-Submission-Tips/. Therefore, the schedule in Form BOEM-0137 will not match the days presented in the AQR.

Fuel Limit
Basis

Purpose

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

Step 1 - Determine Typical Operating Loads

Description	Value	Notes
Actual average daily fuel use (gal/day)	13,006	Based on daily fuel records for the Deepwater Thalassa from January 1, 2016 to December 31, 2016.
Contingency factor	1.20	The contingency factor is used to allow for more usage if need be.
Proposed MODU Campaign Average Daily Fuel Use (gal/day)	15,600	Calculated Value - PTE fuel use * Proposed Operating Load and rounded up to nearest thousand (for additional conservatism). This represents total fuel use on the MODU and is allocated equally amongst the six prime movers.
2020-2050 Annual Fuel Limits, gals	4,212,000	Calculated Value - Campaign Average Daily Fuel Use * Campaign Days

Step 2 - Support Vessel Fuel Loads

Description	Value	Notes
Proposed Operating Loads	50%	Shell policy restricts D/P to < 50% near rig. When in standby away from rig but within 25 miles load will be < 50% (conserve fuel). When transiting through field (25 nm), traveling at economical speeds.
OSV - PTE Fuel Use (gal/day)	11,708	Offshore Support Vessels are rated at 10,098hp (rounded to 10,100 hp). The PTE fuel use is then estimated using the AQR conversion factor of 0.0483 gal/hp-hr.

Campaign Average Daily Fuel Use (gal/day)	5,854	Calculated Value - PTE fuel use * Proposed Operating Load.
Crew Vessel - PTE Fuel Use (gal/day)	9,274	Crew Vessels are rated at 7,944 hp (rounded to 8,000 hp). The PTE fuel use is then estimated using the AQR conversion factor of 0.0483 gal/hp-hr.
Crew Vessel - Campaign Average Daily Fuel Use (gal/day)	1,391	Calculated Value - PTE fuel use * Proposed Operating Load. Note that Crew Vessels are only in field 30% of campaign and daily average value has been adjusted accordingly.
Proposed Vessel Campaign Average Daily Fuel Use (gal/day)	7,245	Calculated Value - Average fuel use * Contigency Factor and rounded up to nearest thousand (for additional conservatism). This represents total fuel use on the Support and Crew vessels.
Total Vessel Activity		
2020-2050 Annual Fuel Limits, gals	2,622,493	Sum of (vessel daily fuel use * corresponding campaign days)

Additional Notes

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

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

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL			CONTACT		PHONE	REMARKS					
Shell Offshore Inc	Walker Ridge	(Surface Loca	OCS-G17001		All Subsea wells			504-425-9097		Josh O'Brien	Stones-AQR-sDOCD-MODU,WW,INST-20190619-BOEM.xlsx					
OPERATIONS	**EQUIPMENT**	**RATING**	**MAX. FUEL**	**ACT. FUEL**	**RUN TIME**		**MAXIMUM POUNDS PER HOUR**					**ESTIMATED TONS**				
	Diesel Engines	**HP**	**GAL/HR**	**GAL/D**												
	Nat. Gas Engines	**HP**	**SCF/HR**	**SCF/D**												
	Burners	**MMBTU/HR**	**SCF/HR**	**SCF/D**	**HR/D**	**DAYS**	**PM**	**SOx**	**NOx**	**VOC**	**CO**	**PM**	**SOx**	**NOx**	**VOC**	**CO**
DP MODU	PRIME MOVER>600hp diesel	9387	453	2600	24	270	6.62	0.11	227.44	6.82	49.62	5.12	0.09	176.07	5.28	38.42
DRILLING AND/OR	PRIME MOVER>600hp diesel	9387	453	2600	24	270	6.62	0.11	227.44	6.82	49.62	5.12	0.09	176.07	5.28	38.42
WELLWORK	PRIME MOVER>600hp diesel	9387	453	2600	24	270	6.62	0.11	227.44	6.82	49.62	5.12	0.09	176.07	5.28	38.42
	PRIME MOVER>600hp diesel	9387	453	2600	24	270	6.62	0.11	227.44	6.82	49.62	5.12	0.09	176.07	5.28	38.42
	PRIME MOVER>600hp diesel	9387	453	2600	24	270	6.62	0.11	227.44	6.82	49.62	5.12	0.09	176.07	5.28	38.42
	PRIME MOVER>600hp diesel	9387	453	2600	24	270	6.62	0.11	227.44	6.82	49.62	5.12	0.09	176.07	5.28	38.42
	Energency Generator>600hp diese	2547	123	2952	1	270	1.80	0.03	61.71	1.85	13.46	0.24	0.00	8.33	0.25	1.82
	Emergency Air Compressor< 600h	26	1	30	1	270	0.06	0.00	0.80	0.06	0.17	0.01	0.00	0.11	0.01	0.02
	All other rig-equipment is electric (e.g cranes) or negligible in emissions potential (e.g. life boats, welding equipment, etc.)															
	Supply Vessel>600hp diesel (gene	10100	488	5854	24	270	7.12	0.12	244.71	7.34	53.39	11.53	0.20	396.44	11.89	86.50
	Supply Vessel>600hp diesel (gene	10100	488	5854	24	68	7.12	0.12	244.71	7.34	53.39	2.88	0.05	99.11	2.97	21.62
	Supply Vessel>600hp diesel (gene	10100	488	5854	24	68	7.12	0.12	244.71	7.34	53.39	2.88	0.05	99.11	2.97	21.62
	Crew Vessel>600hp diesel	8000	386	1391	24	181	5.64	0.10	193.83	5.81	42.29	1.84	0.03	63.12	1.89	13.77
	SERVICE/SUPPORT Vessel Diesel - General (1)	13000	628	15070	24	25	9.16	0.16	314.98	9.45	68.72	2.75	0.05	94.49	2.83	20.62
	SERVICE/SUPPORT Vessel Diesel - General (1)	37500	1811	43470	24	25	26.43	0.45	908.59	27.26	198.24	7.93	0.14	272.58	8.18	59.47
	SERVICE/SUPPORT Vessel Diesel - General (1)	21400	1034	24807	24	45	15.08	0.26	518.50	15.56	113.13	8.15	0.14	279.99	8.40	61.09
	SERVICE/SUPPORT Vessel Diesel - General (1)	45000	2174	52164	24	60	31.72	0.55	1090.31	32.71	237.89	22.84	0.39	785.02	23.55	171.28
PIPELINE	PIPELINE LAY BARGE diesel	0	0	0	24	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTALLATION	SERVICE/SUPPORT Vessel Diesel (1)	24500	1183.35	28400	24	30	17.27	0.30	593.61	17.81	129.52	6.22	0.11	213.70	6.41	46.63
	PIPELINE BURY BARGE diesel	0	0	0	24	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SERVICE/SUPPORT Vessel Diesel (1)	17025	822.3075	19735	24	30	12.00	0.21	412.50	12.38	90.00	4.32	0.07	148.50	4.46	32.40
	VESSELS>600hp diesel(crew)	0	0	0	24	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(supply)	0	0	0	24	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2020-2023	**ANNUAL TOTAL**						**180.21**	**3.10**	**6193.61**	**185.85**	**1351.33**	**102.32**	**1.76**	**3516.94**	**105.51**	**767.33**
EXEMPTION CALCULATION	**DISTANCE FROM LAND IN MILES**											**5927.40**	**5927.40**	**5927.40**	**5927.40**	**107586.78**
	178.0															

(1) SERVICE/SUPPORT Vessel Diesel-General: The days allocated per year will be for temporary activities of installation of flowlines, jumpers, flying leads, etc.), inspections, equipment maintenance, stimulations, or other service/support needs; some of which may not occur in any given year and are yet to be planned.

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT			PHONE	REMARKS					
Shell Offshore Inc	Walker Ridge	(Surface Loca	OCS-G17001		All Subsea w ells			504-425-9097		Josh O'Brien	Stones-AQR-sDOCD-MODU,WW,INST-20190619-BOEM.xlsx					
OPERATIONS	**EQUIPMENT**	**RATING**	**MAX. FUEL**	**ACT. FUEL**	**RUN TIME**		**MAXIMUM POUNDS PER HOUR**					**ESTIMATED TONS**				
	Diesel Engines	**HP**	**GAL/HR**	**GAL/D**												
	Nat. Gas Engines	**HP**	**SCF/HR**	**SCF/D**												
	Burners	**MMBTU/HR**	**SCF/HR**	**SCF/D**	**HR/D**	**DAYS**	**PM**	**SOx**	**NOx**	**VOC**	**CO**	**PM**	**SOx**	**NOx**	**VOC**	**CO**
DP MODU	PRIME MOVER>600hp diesel	9387	453	2600	24	270	6.62	0.11	227.44	6.82	49.62	5.12	0.09	176.07	5.28	38.42
DRILLING AND/OR	PRIME MOVER>600hp diesel	9387	453	2600	24	270	6.62	0.11	227.44	6.82	49.62	5.12	0.09	176.07	5.28	38.42
WELLWORK	PRIME MOVER>600hp diesel	9387	453	2600	24	270	6.62	0.11	227.44	6.82	49.62	5.12	0.09	176.07	5.28	38.42
	PRIME MOVER>600hp diesel	9387	453	2600	24	270	6.62	0.11	227.44	6.82	49.62	5.12	0.09	176.07	5.28	38.42
	PRIME MOVER>600hp diesel	9387	453	2600	24	270	6.62	0.11	227.44	6.82	49.62	5.12	0.09	176.07	5.28	38.42
	PRIME MOVER>600hp diesel	9387	453	2600	24	270	6.62	0.11	227.44	6.82	49.62	5.12	0.09	176.07	5.28	38.42
	Energency Generator>600hp diese	2547	123	2952	1	270	1.80	0.03	61.71	1.85	13.46	0.24	0.00	8.33	0.25	1.82
	Emergency Air Compressor< 600h	26	1	30	1	270	0.06	0.00	0.80	0.06	0.17	0.01	0.00	0.11	0.01	0.02
	All other rig-equipment is electric (e.g cranes) or negligible in emissions potential (e.g. life boats, welding equipment, etc.)															
	Supply Vessel>600hp diesel (gene	10100	488	5854	24	270	7.12	0.12	244.71	7.34	53.39	11.53	0.20	396.44	11.89	86.50
	Supply Vessel>600hp diesel (gene	10100	488	5854	24	68	7.12	0.12	244.71	7.34	53.39	2.88	0.05	99.11	2.97	21.62
	Supply Vessel>600hp diesel (gene	10100	488	5854	24	68	7.12	0.12	244.71	7.34	53.39	2.88	0.05	99.11	2.97	21.62
	Crew Vessel>600hp diesel	8000	386	1391	24	181	5.64	0.10	193.83	5.81	42.29	1.84	0.03	63.12	1.89	13.77
	SERVICE/SUPPORT Vessel Diesel - General (1)	13000	628	15070	24	25	9.16	0.16	314.98	9.45	68.72	2.75	0.05	94.49	2.83	20.62
	SERVICE/SUPPORT Vessel Diesel - General (1)	37500	1811	43470	24	25	26.43	0.45	908.59	27.26	198.24	7.93	0.14	272.58	8.18	59.47
	SERVICE/SUPPORT Vessel Diesel - General (1)	21400	1034	24807	24	45	15.08	0.26	518.50	15.56	113.13	8.15	0.14	279.99	8.40	61.09
	SERVICE/SUPPORT Vessel Diesel - General (1)	45000	2174	52164	24	60	31.72	0.55	1090.31	32.71	237.89	22.84	0.39	785.02	23.55	171.28
2024-2050	**ANNUAL TOTAL**						**150.94**	**2.60**	**5187.50**	**155.66**	**1131.82**	**91.78**	**1.58**	**3154.74**	**94.65**	**688.31**
EXEMPTION CALCULATION	**DISTANCE FROM LAND IN MILES**											**5927.40**	**5927.40**	**5927.40**	**5927.40**	**107586.78**
	178.0															

(1) SERVICE/SUPPORT Vessel Diesel-General: The days allocated per year will be for temporary activities of installation of flowlines, jumpers, flying leads, etc.), inspections, equipment maintenance, stimulations, or other service/support needs; some of which may not occur in any given year and are yet to be planned.

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL
Shell Offshore Inc	Walker Ridge	508 (Surface Location)	OCS-G17001	MODU (Semi-sub or Drillship)	All Subsea wells

Year	Emitted		Substance		
	PM	SOx	NOx	VOC	CO
2020-2023	102.32	1.76	3516.94	105.51	767.33
2024-2050	91.78	1.58	3154.74	94.65	688.31
Allowable	5927.40	5927.40	5927.40	5927.40	107586.78

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 found to be in compliance October 3, 2017, and updated April 30, 2019.

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	OSRP >10 Miles	DOCD Production
Type of Activity	Exploratory Drilling	Exploratory Drilling	Production >10 miles to shore	Production >10 miles to shore
Facility Location (area/block)	MC 812	WR 508	MC 812	WR 508
Facility Designation	Subsea well B◇	Subsea well K◇◇	Subsea Well B◇	FPSO
Distance to Nearest Shoreline (miles)	56	182	56	178
Volume				
Storage tanks (total)	N/A	N/A	16,600	16,948
Flowlines (on facility)	N/A	N/A	100	454
Pipelines	N/A	N/A	27,428	775
Uncontrolled blowout (volume per day)	468,000* BOPD	47,114** BOPD	468,000* BOPD	47,114** BOPD
Total Volume	468,000 Bbls	47,114 Bbls	512,128 bbls	68,291 Bbls
Type of Oil(s) - (crude oil, condensate, diesel)	Crude oil	Crude oil	Crude Oil	Crude Oil
API Gravity(s)	31º	28º	31º	28º

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 most recently by BSEE June 2017, and the bi-annual review was found to be in compliance October 2017 and most recently updated April 30, 2019, and 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	%
WR 508	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 5ctivation List

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

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

Table 9.D.6 Aerial Surveillance Activation List

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

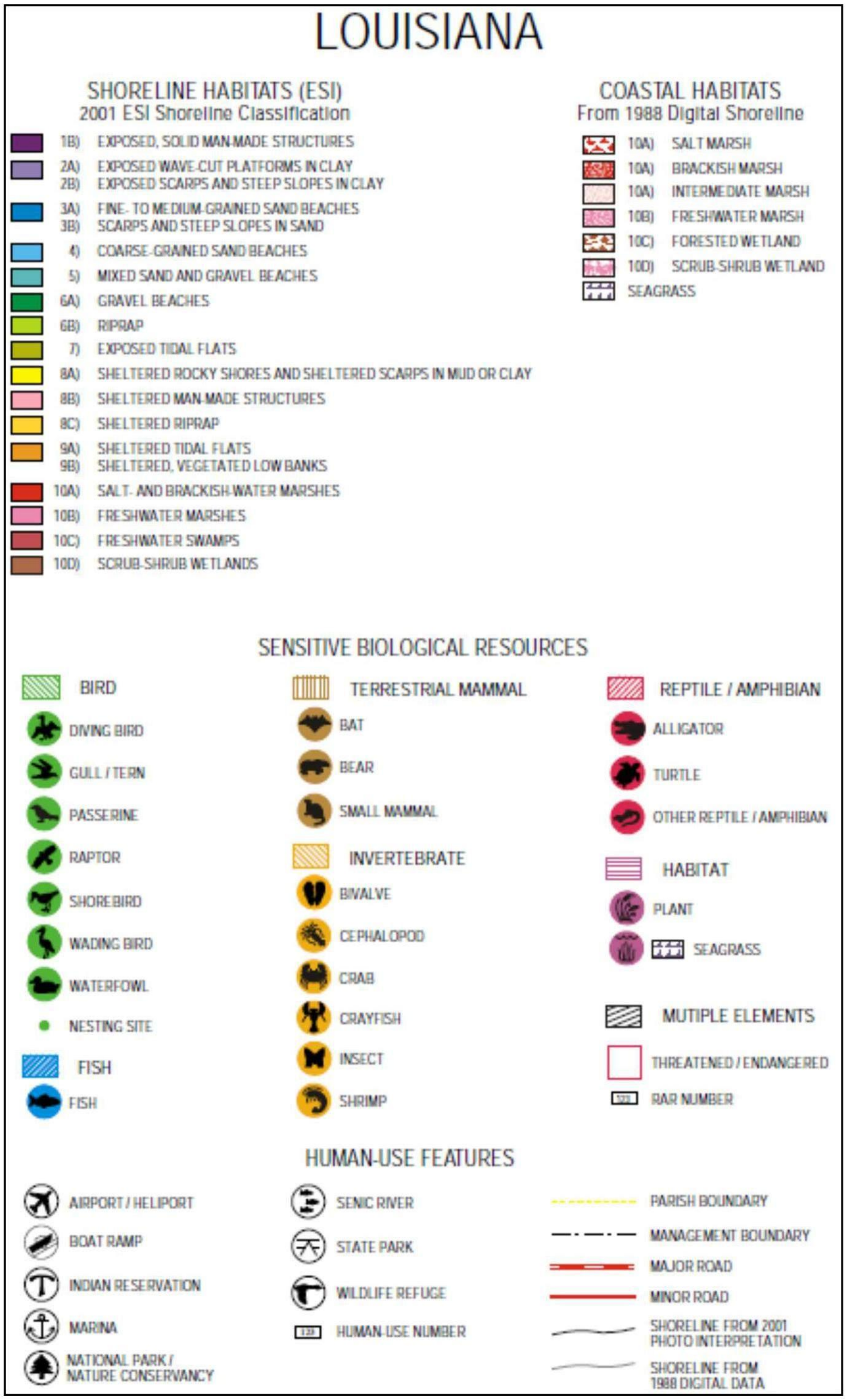


Figure 9.C.1 Environmental Sensitivity Index Map Legend

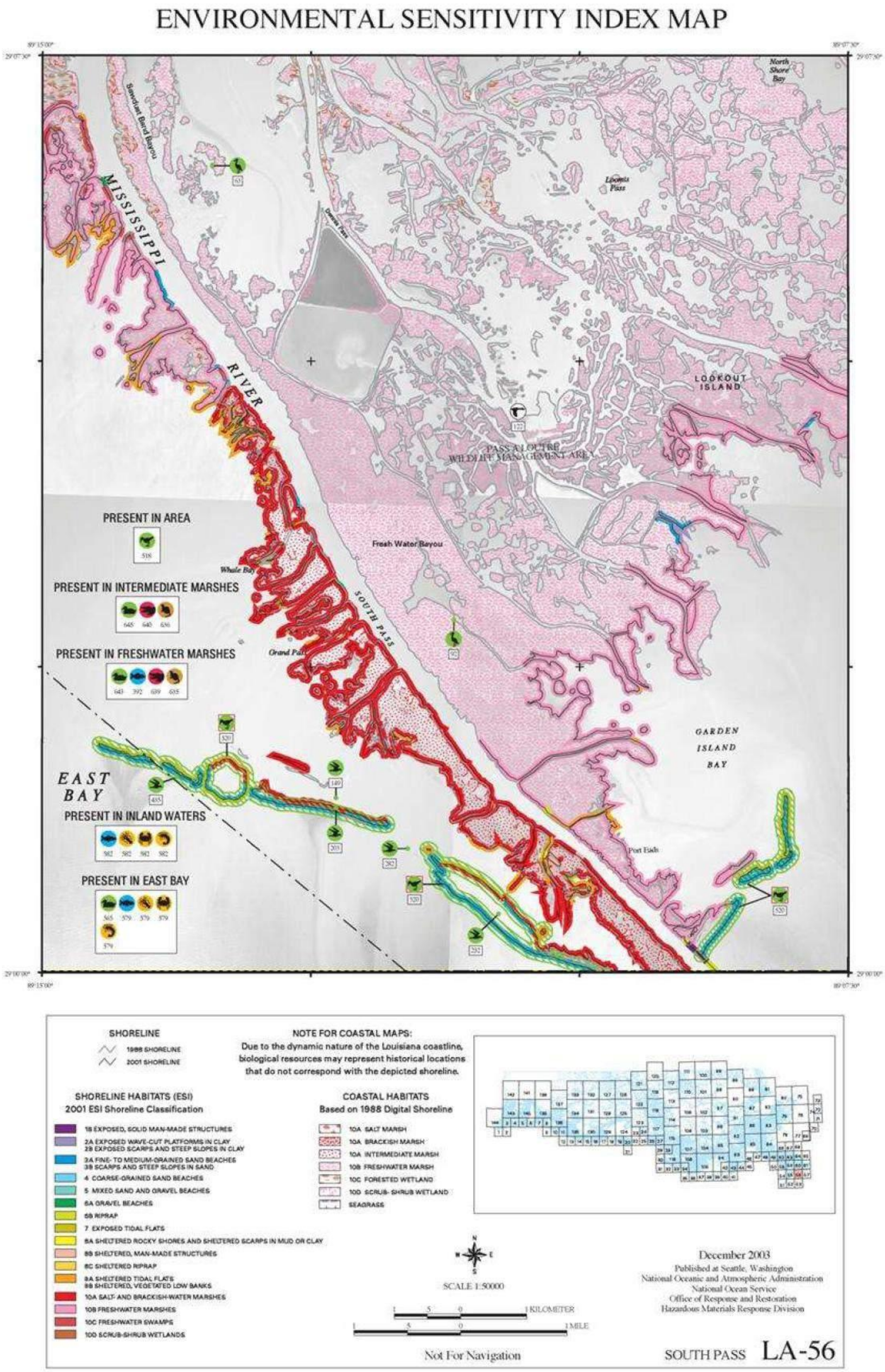


Figure 9.C.2 South Pass ESI Map

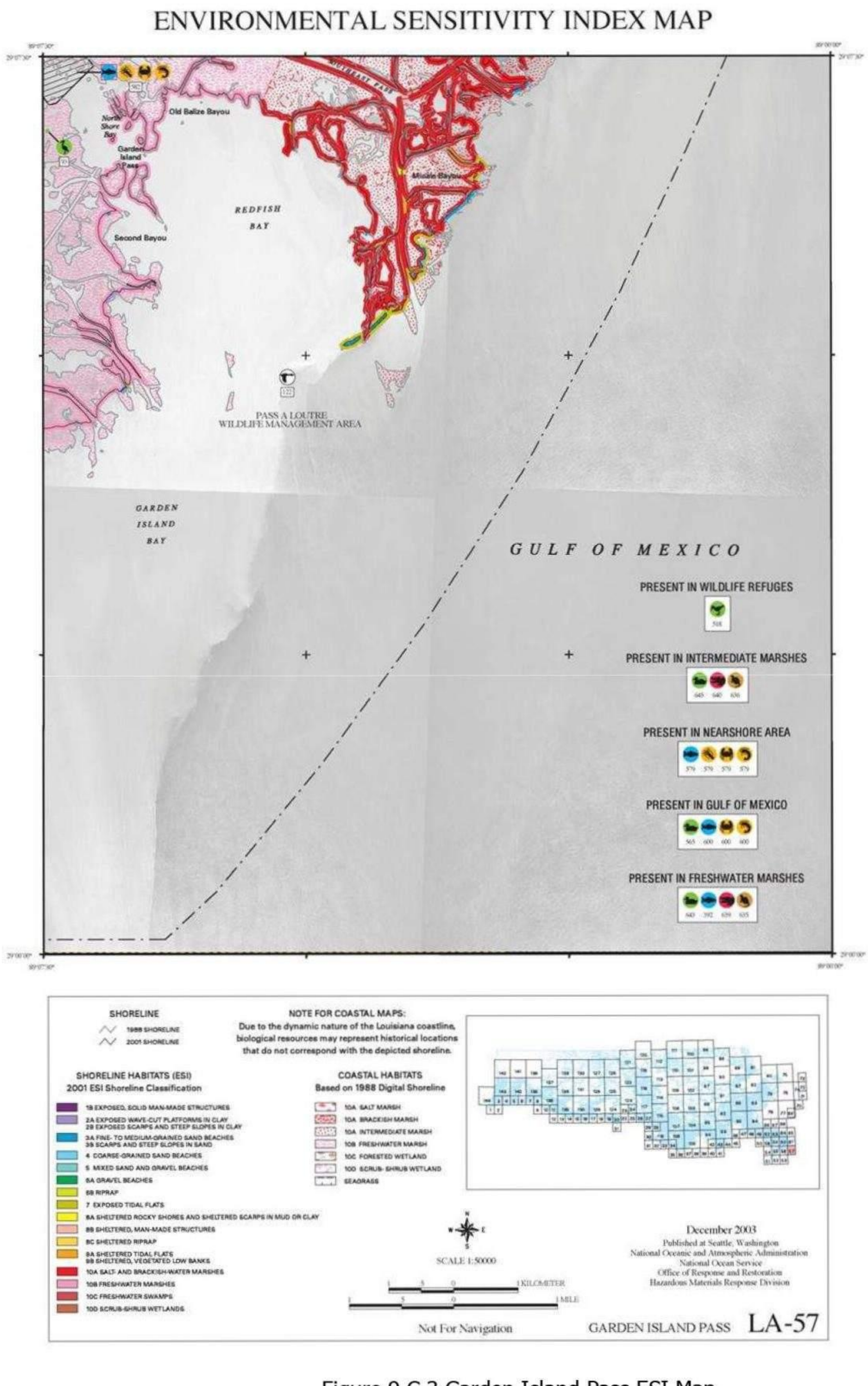


Figure 9.C.3 Garden Island Pass ESI Map

ENVIRONMENTAL SENSITIVITY INDEX MAP

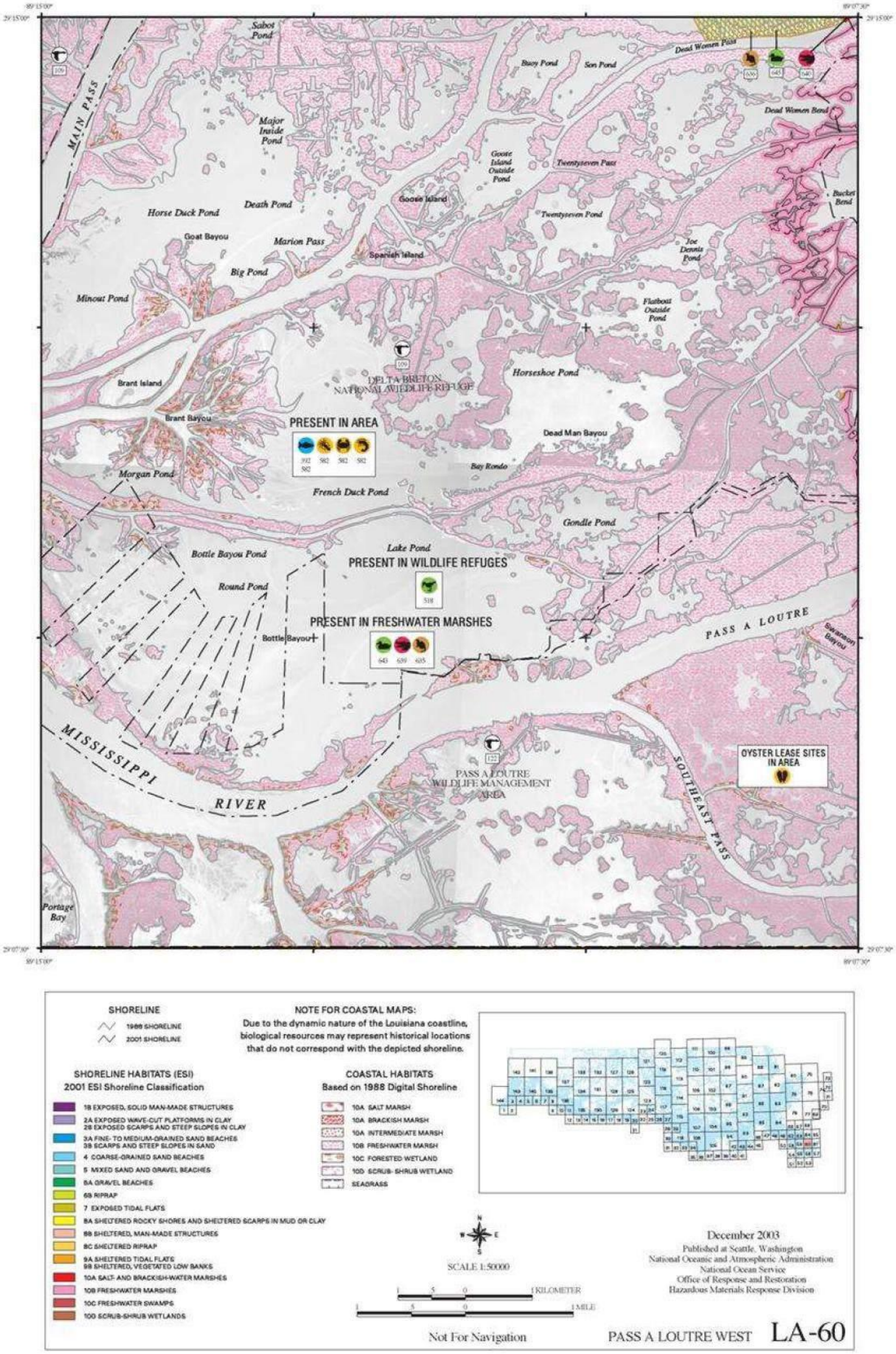


Figure 9.C.4 Pass a Loutre West ESI Map

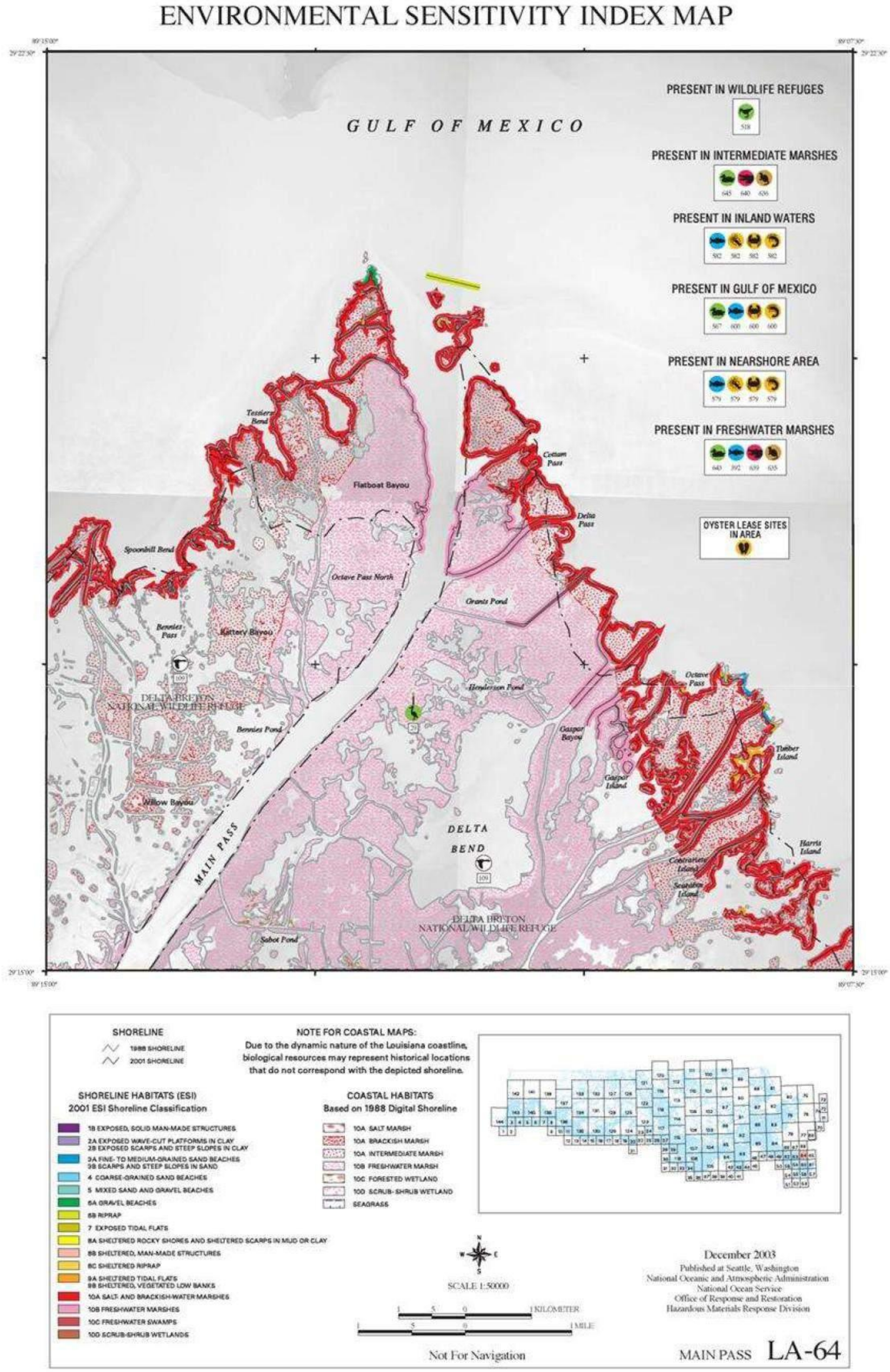


Figure 9.C.5 Main Pass ESI Map

Walker Ridge 595
Sample Offshore On-Water Recovery & Storage Activation List

Skimming System	Supplier & Phone	Warehouse	Skimming Package	Quantity	Effective Daily Recovery Capacity (EDRC in Bbls/Day)	Storage (Barrels)	Staging Area	Distance to Site from Staging (Miles)	Response Times (Hours) Staging ETA	Loadout Time	ETA to Site	Deployment Time	Total ETA
* - These components are additional operational requirements that must be procured in addition to the system identified. ** - These components are additional operational requirements for the packages to be used in an enhanced skimming deployment. *** - Specific barge names may vary.													
FRV JL O'Brien	CGA (888) 242-2007	Leeville, LA	Lamor Brush Skimmer 36" Boom 95' Vessel X Band Radar Personnel	2 64 1 1 6	22,885	249	Leeville, LA	204	2	0	12	1	15
FRV Breton Island	CGA (888) 242-2007	Venice, LA	Lamor Brush Skimmer 36" Boom 95' Vessel X Band Radar Personnel	2 64 1 1 6	22,885	249	Venice, LA	226	2	0	13.5	1	17
S.T. Benz Responder LFF 100 Brush	MSRC (800) OIL-SPIL	Port Fourchon, LA	LFF 100 Brush Skimmer Backup- Stress 1 Skimmer 67" Pressure Inflatable Boom 210' Vessel Personnel 32' Support Boat X Band Radar Infrared Camera FAES #4 "Buster"	1 1 2640' 1 10 1 1 1 1	18,086	4,000	Port Fourchon, LA	194	2	1	14	1	18
FRV H.I. Rich	CGA (888) 242-2007	Vermilion, LA	Lamor Brush Skimmer 36" Boom 95' Vessel X Band Radar Personnel	2 64 1 1 6	22,885	249	Vermilion, LA	280	2	0	16.5	1	20
Louisiana Responder Transec 350	MSRC (800) OIL-SPIL	Fort Jackson, LA	Transrec 67" Pressure Inflatable Boom 210' Vessel Personnel 32' Support Boat X Band Radar Infrared Camera FAES #4 "Buster"	1 2640' 1 10 1 1 1 1	10,567	4,000	Fort Jackson, LA	235	2	1	17	1	21
Gulf Coast Responder Transrec-350	MSRC (800) OIL-SPIL	Lake Charles, LA	Transrec Skimmer Backup - Stress 1 Skimmer 67" Pressure Inflatable Boom 210' Vessel Personnel 32' Support Boat X Band Radar Infrared Camera FAES #4 "Buster"	1 1 2640' 1 10 1 1 1 1	10,567	4,000	Lake Charles, LA	305	2	1	22	1	26
MSRC-452 Offshore Barge	MSRC (800) OIL-SPIL	Fort Jackson, LA	Offshore Barge 67" Pressure Inflatable Boom Crucial Disc Skimmer Desmi Ocean *Appropriate Vessel Personnel * Offshore Tug X Band Radar Infrared Camera	1 2640' 1 1 1 9 2 1 1	11,122 3,017	45,000	Fort Jackson, LA	235	4	1	26	1	32
CGA-200 HOSS Barge (OSRB)	CGA (888) 242-2007	Harvey, LA	Marco Skimmer 67" Sea Sentry Personnel * Tug - 1,200 HP X Band Radar * Tug - 1,800 HP	4 2640' 12 2 1 1	76,285	4,000	Harvey, LA	288	0	4	42.5	1	48
***Moran/ Conneticut	CGA (888) 242-2007	Houma, LA	Offshore Barge Personnel Offshore Tug	1 4 1	N/A	41,454	Houma, LA	224	24-72	0	27.5	1	53 to 101
***Moran/ Portland	CGA (888) 242-2007	Houma, LA	Offshore Barge Personnel Offshore Tug	1 4 1	N/A	91,443	Houma, LA	224	24-72	0	27.5	1	53 to 101
***Moran/ Georgia	CGA (888) 242-2007	Houma, LA	Offshore Barge Personnel Offshore Tug	1 4 1	N/A	118,794	Houma, LA	224	24-72	0	27.5	1	53 to 101
DERATED RECOVERY RATE (BBLS/DAY)													198,299
STORAGE CAPACITY INCLUDING SKIMMING VESSELS (BARRELS)													313,438

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

Walker Ridge 595
Sample Nearshore On-Water Recovery Activation List

Skimming System	Supplier & Phone	Warehouse	Skimming Package	Quantity	Effective Daily Recovery Capacity (EDRC in Bbls/Day)	Storage (Barrels)	Staging Area	Distance to Nearshore Environment (Miles)	Response Times (Hours)				
									Staging ETA	Loadout Time	ETA to Nearshore Environment	Deployment Time	Total ETA
*** - These components are additional operational requirements that must be procured in addition to the system identified.**													
SWS CGA-76 FRV	CGA (888) 242-2007	Leeville, LA	Lori Brush Skimmer	2	22,885	249	Leeville, LA	204	2	0	12	1	15
			36" Boom	150									
			60' Vessel	1									
			X Band Radar	1									
			Personnel	4									
SWS CGA-77 FRV	CGA (888) 242-2007	Venice, LA	Lori Brush Skimmer	2	22,885	249	Venice, LA	226	2	0	13.5	1	17
			36" Boom	150									
			60' Vessel	1									
			X Band Radar	1									
			Personnel	4									
FRV M/V Grand Bay	CGA (888) 242-2007	Venice, LA	Lori Brush Skimmer	2	15,257	65	Venice, LA	226	2	0	13.5	1	17
			36" Boom	46'									
			46' Vessel	1									
			Personnel	4									
FRV M/V RW Armstrong	CGA (888) 242-2007	Morgan City, LA	Lori Brush Skimmer	2	15,257	65	Morgan City, LA	239	2	0	14	1	17
			36" Boom	46'									
			46' Vessel	1									
			Personnel	4									
SW CGA-72 FRV	CGA (888) 242-2007	Morgan City, LA	Marco Belt Skimmer	2	21,500	249	Morgan City, LA	239	2	0	14	1	17
			36" Auto Boom	150'									
			Personnel	4									
			56' SWS Vessel	1									
			* 14'-16' Alum. Flatboat	2									
SWS CGA-53 MARCO Shallow Water Skimmer	CGA (888) 242-2007	Leeville, LA	Marco Belt Skimmer	1	3,588	34	Port Fourchon, LA	194	4	1	11.5	1	18
			* 18" Boom (contractor)	100'									
			Personnel	3									
			38' Skimming Vessel	1									
SWS CGA-52 MARCO Shallow Water Skimmer	CGA (888) 242-2007	Venice, LA	Marco Belt Skimmer	1	3,588	34	Port Fourchon, LA	194	6	1	11.5	1	20
			* 18" Boom (contractor)	100'									
			Personnel	3									
			36' Skimming Vessel	1									
			Shallow Water Barge	1		249							
SW CGA-74 FRV	CGA (888) 242-2007	Vermilion, LA	Marco Belt Skimmer	2	21,500	249	Vermilion, LA	280	2	0	16.5	1	20
			36" Auto Boom	150'									
			Personnel	4									
			56' SW Vessel	1									
			* 14'-16' Alum. Flatboat	2									
SWS CGA-51 MARCO Shallow Water Skimmer	CGA (888) 242-2007	Lake Charles, LA	Marco Belt Skimmer	1	3,588	20	Port Fourchon, LA	194	6	1	11.5	1	20
			* 18" Boom (contractor)	100'									
			Personnel	3									
			34' Skimming Vessel	1									
			Shallow Water Barge	1		249							
FRV M/V Bastian Bay	CGA (888) 242-2007	Lake Charles, LA	Lori Brush Skimmer	2	15,257	65	Lake Charles, LA	305	2	0	18	1	21
			36" Boom	46'									
			46' Vessel	1									
			Personnel	4									
SW CGA-73 FRV	CGA (888) 242-2007	Lake Charles, LA	Marco Belt Skimmer	2	21,500	249	Lake Charles, LA	305	2	0	18	1	21
			36" Auto Boom	150'									
			Personnel	5									
			56' SWS Vessel	1									
			* 14'-16' Alum. Flatboat	2									
SWS CGA-75 FRV	CGA (888) 242-2007	Galveston, TX	Lori Brush Skimmer	2	22,885	249	Galveston, TX	321	2	0	19	1	22
			36" Boom	150									
			60' Vessel	1									
			X Band Radar	1									
			Personnel	4									
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Belle Chasse, LA	Skimmer	1	905	400	Port Fourchon, LA	194	4.25	1	14	1	21
			18" Boom	50'									
			Personnel	4									
			Non-self-propelled barge	1									
			Push Boat	1									
MSRC "Kvichak"	MSRC (800) OIL-SPIL	Belle Chasse, LA	Marco I Skimmer	1	3,588	24	Port Fourchon, LA	194	4.25	1	14	1	21
			Personnel	2									
			30' Shallow Water Vessel	1									

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

Walker Ridge 595
Sample Nearshore On-Water Recovery Activation List

Skimming System	Supplier & Phone	Warehouse	Skimming Package	Quantity	Effective Daily Recovery Capacity (EDRC in Bbls/Day)	Storage (Barrels)	Staging Area	Distance to Nearshore Environment (Miles)	Response Times (Hours)				
									Staging ETA	Loadout Time	ETA to Nearshore Environment	Deployment Time	Total ETA
* - These components are additional operational requirements that must be procured in addition to the system identified.													
SBS w/ GT-185 w/adapter	MSRC (800) OIL-SPIL	Baton Rouge, LA	Skimmer 18" Boom Personnel Non-self-propelled barge Push Boat	1 50' 4 1 1	1,371	400	Port Fourchon, LA	194	5	1	14	1	21
MSRC "Kvichak"	MSRC (800) OIL-SPIL	Pascagoula, MS	Marco I Skimmer Personnel 30' Shallow Water Vessel	1 2 1	3,588	24	Port Fourchon, LA	194	5.75	1	14	1	22
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Pascagoula, MS	Skimmer 18" Boom Personnel Non-self-propelled barge Push Boat	1 50' 4 1 1	905	400	Port Fourchon, LA	194	5.75	1	14	1	22
SBS w/ AardVAC	MSRC (800) OIL-SPIL	Pascagoula, MS	Skimmer 18" Boom Personnel Self-propelled barge	1 50' 4 1	3,840	400	Port Fourchon, LA	194	5.75	1	14	1	22
GT-185	MSRC (800) OIL-SPIL	Pascagoula, MS	Skimmer 18" Boom Personnel *Appropriate Vessel	1 50' 5 2	1,371	*500	Port Fourchon, LA	194	6	1	14	1	22
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Lake Charles, LA	Skimmer 18" Boom Personnel Non-self-propelled barge Push Boat	1 50' 4 1 1	905	400	Port Fourchon, LA	194	6.25	1	14	1	23
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Lake Charles, LA	Skimmer 18" Boom Personnel Non-self-propelled barge Push Boat	1 50' 4 1 1	905	400	Port Fourchon, LA	194	6.25	1	14	1	23
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Lake Charles, LA	Skimmer 18" Boom Personnel Non-self-propelled barge Push Boat	1 50' 4 1 1	905	400	Port Fourchon, LA	194	6.25	1	14	1	23
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Lake Charles, LA	Skimmer 18" Boom Personnel Self-propelled barge	1 50' 4 1	905	400	Port Fourchon, LA	194	6.25	1	14	1	23
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Lake Charles, LA	Skimmer 18" Boom Personnel Self-propelled barge	1 50' 4 1	905	400	Port Fourchon, LA	194	6.25	1	14	1	23
SW CGA-71 FRV	CGA (888) 242-2007	Aransas Pass, TX	Marco Belt Skimmer 36" Auto Boom Personnel 56' SWS Vessel * 14'-16' Alum. Flatboat	2 150' 5 1 2	21,500	249	Port Fourchon, LA	194	12.5	0	11.5	1	25
MSRC "Kvichak"	MSRC (800) OIL-SPIL	Galveston, TX	Marco I Skimmer Personnel 30' Shallow Water Vessel	1 2 1	3,588	24	Port Fourchon, LA	194	8.75	1	14	1	25
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Galveston, TX	Skimmer 18" Boom Personnel Non-self-propelled barge Push Boat	1 50' 4 1 1	905	400	Port Fourchon, LA	194	8.75	1	14	1	25
SBS w/ GT-185 w/adapter	MSRC (800) OIL-SPIL	Galveston, TX	Skimmer 18" Boom Personnel Non-self-propelled barge Push Boat	1 50' 4 1 1	1,371	400	Port Fourchon, LA	194	8.75	1	14	1	25
MSRC "Quick Strike"	MSRC (800) OIL-SPIL	Lake Charles, LA	LORI Brush Skimmer Personnel 47' Fast Response Boat	2 3 1	5,000	50	Lake Charles, LA	305	2	1	22	1	26

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

Walker Ridge 595
Sample Nearshore On-Water Recovery Activation List

Skimming System	Supplier & Phone	Warehouse	Skimming Package	Quantity	Effective Daily Recovery Capacity (EDRC in Bbls/Day)	Storage (Barrels)	Staging Area	Distance to Nearshore Environment (Miles)	Response Times (Hours): Staging ETA	Loadout Time	ETA to Nearshore Environment	Deployment Time	Total ETA
* - These components are additional operational requirements that must be procured in addition to the system identified.													
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Memphis, TN	Skimmer	1	905	400	Port Fourchon, LA	194	9.25	1	14	1	26
			18" Boom	60'									
			Personnel	4									
			Non-self-propelled barge	1									
			Push Boat	1									
FRV CGA 58 Timbalier Bay	CGA (888) 242-2007	Aransas Pass, TX	Lori Brush Skimmer	2	15,257	65	Aransas Pass, TX	402	2	0	23.5	1	27
			36" Boom	46'									
			46' Vessel	1									
			Personnel	4									
MSRC "Kvichak"	MSRC (800) OIL-SPIL	Ingleside, TX	Marco I Skimmer	1	3,588	24	Port Fourchon, LA	194	11.5	1	14	1	28
			Personnel	2									
			30' Shallow Water Vessel	1									
SBS w/ GT-185 w/adapter	MSRC (800) OIL-SPIL	Ingleside, TX	Skimmer	1	1,371	400	Port Fourchon, LA	194	11.5	1	14	1	28
			18" Boom	50'									
			Personnel	4									
			Self-propelled barge	1									
GT-185	MSRC (800) OIL-SPIL	Jacksonville, FL	Skimmer	1	1,371		Port Fourchon, LA	194	12	1	14	1	28
			18" Boom	60'									
			Personnel	5									
			*Appropriate Vessel	2									
			*Temporary Storage	1		500							
SBS w/ GT-185 w/adapter	MSRC (800) OIL-SPIL	Savannah, GA	Skimmer	1	1,371	400	Port Fourchon, LA	194	13.75	1	14	1	30
			18" Boom	50'									
			Personnel	4									
			Non-self-propelled barge	1									
			Push Boat	1									
GT-185 w/adapter	MSRC (800) OIL-SPIL	Tampa, FL	Skimmer	1	1,371		Port Fourchon, LA	194	13	1	14	1	30
			18" Boom	50'									
			Personnel	5									
			*Appropriate Vessel	2									
			*Temporary Storage	1		500							
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Roxana, IL	Skimmer	1	905	400	Port Fourchon, LA	194	14	1	14	1	30
			18" Boom	50'									
			Personnel	4									
			Non-self-propelled barge	1									
			Push Boat	1									
WP-1	MSRC (800) OIL-SPIL	Miami, FL	Skimmer	1	3,017		Port Fourchon, LA	194	16	1	14	1	33
			18" Boom	50'									
			Personnel	5									
			*Appropriate Vessel	2									
			*Temporary Storage	1		500							
AARDVAC	MSRC (800) OIL-SPIL	Miami, FL	Skimmer	1	3,840		Port Fourchon, LA	194	16	1	14	1	33
			18" Boom	50'									
			Personnel	5									
			* Appropriate Vessel	2									
			*Temporary Storage	1		500							
AARDVAC	MSRC (800) OIL-SPIL	Miami, FL	Skimmer	1	3,840		Port Fourchon, LA	194	16	1	14	1	33
			18" Boom	50'									
			Personnel	5									
			* Appropriate Vessel	2									
			*Temporary Storage	1		500							
MSRC "Kvichak"	MSRC (800) OIL-SPIL	Miami, FL	Marco I Skimmer	1	3,588	24	Port Fourchon, LA	194	16.25	1	14	1	33
			Personnel	2									
			30' Shallow Water Vessel	1									
SWS CGA-55 Egmopol Shallow Water Skimmer	CGA (888) 242-2007	Morgan City, LA	Marco Skimmer	1	1,810	100	Port Fourchon, LA	194	4	1	27.5	1	34
			* 18" Boom (contractor)	100'									
			Personnel	3									
			38' Skimming Vessel	1									
			Shallow Water Barge	1		249							
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Whiting, IN	Skimmer	1	905	400	Port Fourchon, LA	194	17.25	1	14	1	34
			18" Boom	60'									
			Personnel	4									
			Non-self-propelled barge	1									
			Push Boat	1									

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

Walker Ridge 595
Sample Nearshore On-Water Recovery Activation List

Skimming System	Supplier & Phone	Warehouse	Skimming Package	Quantity	Effective Daily Recovery Capacity (EDRC in Bbls/Day)	Storage (Barrels)	Staging Area	Distance to Nearshore Environment (Miles)	Response Times (Hours) Staging ETA	Loadout Time	ETA to Nearshore Environment	Deployment Time	Total ETA
* - These components are additional operational requirements that must be procured in addition to the system identified.													
SBS w/ Queensboro	MSRC (800) OIL-SPIL	Toledo, OH	Skimmer	1	905	400	Port Fourchon, LA	194	18.75	1	14	1	35
			18" Boom	50'									
			Personnel	4									
			Non-self-propelled barge	1									
			Push Boat	1									
MSRC "Kvichak"	MSRC (800) OIL-SPIL	Virginia Beach, VA	Marco I Skimmer	1	3,588	24	Port Fourchon, LA	194	20	1	14	1	36
			Personnel	2									
			30' Shallow Water Vessel	1									
SBS w/ AardVAC	MSRC (800) OIL-SPIL	Virginia Beach, VA	Skimmer	1	3,840	400	Port Fourchon, LA	194	20	1	14	1	36
			18" Boom	50'									
			Personnel	4									
			Self-propelled barge	1									
SBS w/ Stress 1	MSRC (800) OIL-SPIL	Chesapeake City, MD	Skimmer	1	15,840	400	Port Fourchon, LA	194	21.5	1	14	1	38
			18" Boom	50'									
			Personnel	4									
			Non-self-propelled barge	1									
			Push Boat	1									
CGA-54 Egmopol Shallow Water Skimmer	CGA (888) 242-2007	Galveston, TX	Marco Belt Skimmer	1	1,810	100	Port Fourchon, LA	194	9	1	27.5	1	39
			* 18" Boom (contractor)	100'									
			Personnel	3									
			34' Skimming Vessel	1									
			Shallow Water Barge	1		249							
SBS w/ Stress 1	MSRC (800) OIL-SPIL	Edison/Perth Amboy, NJ	Skimmer	1	15,840	400	Port Fourchon, LA	194	23	1	14	1	39
			18" Boom	50'									
			Personnel	4									
			Self-propelled barge	1									
MSRC "Kvichak"	MSRC (800) OIL-SPIL	Edison/Perth Amboy, NJ	Marco I Skimmer	1	3,588	24	Port Fourchon, LA	194	23	1	14	1	39
			Personnel	2									
			30' Shallow Water Vessel	1									
SBS w/ GT-185	MSRC (800) OIL-SPIL	Bayonne, NJ	Skimmer	1	1,371		Port Fourchon, LA	194	23	1	14	1	39
			18" Curtain Internal Foam	50'									
			Personnel	4									
			Non-self-propelled barge	1		400							
			*Appropriate Vessel	1									
MSRC "Lightning"	MSRC (800) OIL-SPIL	Tampa, FL	LORI Brush Skimmer	2	5,000	50	Tampa, FL	530	2	1	38	1	42
			Personnel	3									
			47' Fast Response Boat	1									
SBS w/ GT-185	MSRC (800) OIL-SPIL	Providence, RI	Skimmer	1	1,371		Port Fourchon, LA	194	26	1	14	1	42
			18" Curtain Internal Foam	60'									
			Personnel	4									
			Non-self-propelled barge	1		400							
			Push Boat	1									
SBS w/ GT-185	MSRC (800) OIL-SPIL	Everett, MA	Skimmer	1	1,371	400	Port Fourchon, LA	194	26	1	14	1	42
			18" Boom	60'									
			Personnel	4									
			Non-self-propelled barge	1									
			Push Boat	1									
MSRC "Kvichak"	MSRC (800) OIL-SPIL	Portland, ME	Marco I Skimmer	1	3,588	24	Port Fourchon, LA	194	28	1	14	1	44
			Personnel	2									
			30' Shallow Water Vessel	1									
SBS w/ WP-1	MSRC (800) OIL-SPIL	Portland, ME	Skimmer	1	3,017	400	Port Fourchon, LA	194	28	1	14	1	44
			18" Boom	50'									
			Personnel	4									
			Self-propelled barge	1									
DERATED RECOVERY RATE (BBLS/DAY)													346,415
SKIMMING VESSEL STORAGE CAPACITY (BARRELS)													15,679

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

Walker Ridge 595 Sample Aerial Surveillance Activation List											
Aerial Surveillance System	Supplier & Phone	Airport/City, State	Aerial Surveillance Package	Quantity	Staging Location	Distance to Site from Staging (nautical miles)	Response Times (Hours)				
							Staging ETA	Loadout Time	ETA to Site	Total ETA
* - These components are additional operational requirements that must be procured in addition to the system identified.											
Twin Commander Air Speed - 260 Knots	Airborne Support (985) 851-6391	Houma, LA	Surveillance Aircraft	1	Houma, LA	221	1	0.25	0.74	2.00
			Spotter Personnel	2						
			Crew - Pilots	1						
Aztec Piper Air Speed - 150 Knots	Airborne Support (985) 851-6391	Houma, LA	Surveillance Aircraft	1	Houma, LA	221	1	0.25	1.29	2.55
			Spotter Personnel	2						
			Crew - Pilots	1						
Eurocopter EC-135 Helicopter Air Speed - 141 knots	PHI (800) 235-2452	Houma, LA	Surveillance Aircraft	1	Houma, LA	221	1	0.25	1.37	2.65
			Spotter Personnel	2						
			Crew - Pilots	1						
Sikorsky S-76 Helicopter Air Speed - 141 knots	PHI (800) 235-2452	Houma, LA	Surveillance Aircraft	1	Houma, LA	221	1	0.25	1.37	2.65
			Spotter Personnel	2						
			Crew - Pilots	1						

Table 9.D.6 Aerial Surveillance Activation List

Walker Ridge 595
Sample Offshore Aerial Dispersant Activation List

Aerial Dispersant System	Supplier & Phone	Airport/ City, State	Aerial Dispersant Package	Quantity	Staging Location	Distance to Site from Staging (Miles)	Response Times (Hours)				
							Staging ETA	Loadout Time	ETA to Site	Deployment Time	Total ETA
Twin Commander Air Speed - 300 MPH	CGA/Airborne Support (985) 851-6391	Houma, LA	Aero Commander	1	Houma, LA	221	1	0	0.74	0	1.75
			Spotter Personnel	2							
			Crew - Pilots	1							
BT-67 (DC-3 Turboprop) Aircraft Air Speed - 194 MPH	CGA/Airborne Support (985) 851-6391	Houma, LA	DC-3 Dispersant Aircraft	1	Houma, LA 1st Flight	221	2	0.5	1.14	0.5	4.15
			Dispersant - Gallons	2000							
			Spotter Aircraft	1							
			Spotter Personnel	2	Houma, LA 2nd Flight	221	1.14	0.5	1.14	0.3	3.10
			Crew - Pilots	2							
C130-A Aircraft Air Speed - 342 MPH	MSRC (800) OIL-SPIL	Kiln, MS	C130-A Disp Aircraft	1	Stennis INTL., MS 1st Flight	288	3	0.0	0.84	0.5	4.35
			Dispersant - Gallons	4125							
			*Spotter Aircraft	1							
			*Spotter Personnel	2	Stennis INTL., MS 2nd Flight	288	0.50	0.3	0.84	0.5	2.20
			Crew - Pilots	2							
DC-3 Aircraft Air Speed - 150 MPH	CGA/Airborne Support (985) 851-6391	Houma, LA	DC-3 Dispersant Aircraft	1	Houma, LA 1st Flight	221	2	0.5	1.47	0.5	4.50
			Dispersant - Gallons	1200							
			Spotter Aircraft	1							
			Spotter Personnel	2	Houma, LA 2nd Flight	221	1.47	0.5	1.47	0.3	3.75
			Crew - Pilots	2							
DC-3 Aircraft Air Speed - 150 MPH	CGA/Airborne Support (985) 851-6391	Houma, LA	DC-3 Dispersant Aircraft	1	Houma, LA 1st Flight	221	2	0.5	1.47	0.5	4.50
			Dispersant - Gallons	1200							
			Spotter Aircraft	1							
			Spotter Personnel	2	Houma, LA 2nd Flight	221	1.47	0.5	1.47	0.3	3.75
			Crew - Pilots	2							
BE-90 King Air Aircraft Air Speed - 213 MPH	MSRC (800) OIL-SPIL	Kiln, MS	BE-90 Dispersant Aircraft	1	Stennis INTL., MS 1st Flight	288	3	0.00	1.35	0.20	4.60
			Dispersant - Gallons	250							
			* Spotter Aircraft	1							
			*Spotter Personnel	2	Stennis INTL., MS 2nd Flight	288	1.35	0.20	1.35	0.20	3.15
			Crew - Pilots	2							
C130-A Aircraft Air Speed - 342 MPH	MSRC (800) OIL-SPIL	Mesa, AZ	C130-A Disp. Aircraft	1	Stennis INTL., MS 1st Flight	288	7	0.3	0.84	0.5	8.70
			Dispersant - Gallons	4125							
			*Spotter Aircraft	1							
			*Spotter Personnel	2	Stennis INTL., MS 2nd Flight	288	0.50	0.3	0.84	0.5	2.20
			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	288	15	0.30	1.35	0.20	16.90
			Dispersant - Gallons	330							
			* Spotter Aircraft	1							
			*Spotter Personnel	2	Stennis INTL., MS 2nd Flight	288	1.35	0.20	1.35	0.20	3.15
			Crew - Pilots	2							

NOTE: Planholder has access to additional dispersant assets. For a comprehensive list of assets, see Section 18.
** - These components are additional operational requirements that must be procured in addition to the system(s) identified.*
*** The second flight times listed are to demonstrate subsequent sortie and application timeframes.*
**** The dispersants listed is for gallon capacity only not amount stored at each location.*

Table 9.D.7 Offshore Aerial Dispersant Activation List

Walker Ridge 595
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
NOTE: Planholder has access to additional dispersant assets. For a comprehensive list of assets, see Section 18. * - These components are additional operational requirements that must be procured by OSROs in addition to the system(s) identified.											
USCG SMART Team	USCG	Mobile, AL	Personnel	4	Port Fourchon, LA	194	6.25	1	14	0.5	21.75
			* Crew Boat	1							
Vessel Based Dispersant Spray System	CGA (888) 242-2007	Harvey, LA	Dispersant Spray System	1	Port Fourchon, LA	194	4	0.5	19.5	1	25
			Dispersant (Gallons)	330							
			Personnel	4							
			* Utility Boat	1							
Vessel Based Dispersant Spray System	CGA (888) 242-2007	Aransas Pass, TX	Dispersant Spray System	1	Port Fourchon, LA	194	11.5	0.5	19.5	1	32.5
			Dispersant (Gallons)	330							
			Personnel	4							
			* Utility Boat	1							

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

Walker Ridge 595
Sample Control, Containment & Subsea Dispersant Package 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
* - Response time may vary depending on Drill Ship's operations and location at the time of deployment.											
Site Assessment and Surveillance	RP	Port Fourchon, LA	Multi-Service Vessel	1	Port Fourchon, LA	194	0	1.5	14	0.5	16
			ROV's	2							
Subsea Dispersant Application	RP / MWCC	Port Fourchon, LA	Multi-Service Vessel	1	Port Fourchon, LA	194	1.5	1.5	14	2	19
			ROV's	2							
			Coil Tubing Unit	1							
		Houston, TX	Dispersant	200,000 gal							
			Manifold	1							
			Subsea Dispersant Injection System	1							
Capping Stack	RP / MWCC	Port Fourchon, LA	Anchor Handling Tug Supply Vessel	1	Port Fourchon, LA	194	2*	1.5	14	3	21*
			ROV's	1							
		Houston, TX	Hydraulic System	1							
			Capping Stack	1							
"Top Hat" Unit	RP / MWCC	Port Fourchon, LA	Anchor Handling Tug Supply Vessel	1	Port Fourchon, LA	194	13*	1	14	3	31*
			ROV's	2							
			Multi-Purpose Supply Vessel	1							
			Drill Ship (Processing Vessel)	1							
		Houston, TX	"Top Hat"	1							
			Containment Chamber	1							
			Shuttle Barge	1							

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

Walker Ridge 595
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
NOTE: Planholder has access to additional ISB assets. For a comprehensive list of those assets, see Section 19. * - These components are additional operational requirements that must be procured in addition to the system identified. ** - Teams will deploy in sections of 500' at any given time											
ISB Fire-Fighting Team	TBD	TBD	* Offshore Firefighting Vessels	2	Port Fourchon, LA	194	4	1	14	1	20
			* Cranes	2							
			* Roll-off Boxes	2							
			Personnel	8							
			* Air Monitoring Equipment	2							
SMART In-Situ Burn Monitoring Team	USCG	Mobile, AL	* Air Monitoring Equipment	1	Port Fourchon, LA	194	4	1	14	1	20
			* Offshore Vessel	1							
			Personnel	4							
Safety Monitoring Team	TBD	TBD	* Air Monitoring Equipment	1	Port Fourchon, LA	194	4	1	14	1	20
			* Offshore Vessel	1							
			Personnel	4							
Wildlife Monitoring Team	TBD	TBD	* Air Monitoring Equipment	1	Port Fourchon, LA	194	4	1	14	1	20
			* Offshore Vessel	1							
			Personnel	4							
Aerial Spotting Team (per 2 ISB Task Forces)	TBD	TBD	Fixed Wing Aircraft	1	Port Fourchon, LA	194	4	1	14	1	20
			Trained ISB Spotter	2							
			ISB Documenter	1							
Fire Team (In-Situ Burn Fire System)	MSRC (800) OIL-SPIL	Lake Charles, LA	**Fire Boom (ft)	2,000	Port Fourchon, LA	194	6.25	1	14	1	22.25
			Tow Line (ft)	600							
			* Appropriate Vessel	2							
			Personnel	2							
			Ignition Device	25							
Fire Team (In-Situ Burn Fire System)	MSRC (800) OIL-SPIL	Houston, TX	**Fire Boom (ft)	16,000	Port Fourchon, LA	194	8.25	1	14	1	24.25
			Tow Line (ft)	600							
			* Appropriate Vessel	2							
			Personnel	2							
			Ignition Device	155							
Fire Team (In-Situ Burn Fire System)	MSRC (800) OIL-SPIL	Galveston, TX	**Fire Boom (ft)	1,000	Port Fourchon, LA	194	8.75	1	14	1	24.75
			Tow Line (ft)	600							
			* Appropriate Vessel	2							
			Personnel	2							
			Ignition Device	10							
Fire Team (In-Situ Burn Fire System)	MSRC (800) OIL-SPIL	Portland, ME	**Fire Boom (ft)	1,000	Port Fourchon, LA	194	28	1	14	1	44
			Tow Line (ft)	600							
			* Appropriate Vessel	2							
			Personnel	2							
			Ignition Device	10							
Fire Team (In-Situ Burn Fire System)	CGA (888) 242-2007	Harvey, LA	Fire Boom (ft)	500	Port Fourchon, LA	194	0	24	19.5	1	44.5
			Guide Boom/Tow Line (ft)	400							
			* Offshore Vessel (0.5 kt capability)	3							
			Personnel	20							
			Ignition Device	10							
Fire Team (In-Situ Burn Fire System)	CGA (888) 242-2007	Harvey, LA	Fire Boom (ft)	500	Port Fourchon, LA	194	0	24	19.5	1	44.5
			Guide Boom/Tow Line (ft)	400							
			* Offshore Vessel (0.5 kt capability)	3							
			Personnel	20							
			Ignition Device	10							
Supply Team (Supply Vessel System)	MSRC (800) OIL-SPIL	Port Fourchon, LA	*Offshore Vessel 110' - 310'	1	Port Fourchon, LA	194	4	1	39	1	45
			Personnel	6							
						TOTAL FIRE BOOM AVAILABLE (FEET)			21,000		

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

Walker Ridge 595
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
AMPOL (800) 482-6765	Harvey, LA	Containment Boom - 18" to 24"	8,000'	Port Fourchon, LA	4	1	1	6
		Containment Boom - 6" to 10"	3,000'					
CGA (888) 242-2007	Harvey, LA	Wildlife Rehab Trailer	1	Port Fourchon, LA	4	1	1	6
		Wildlife Husbandry Trailer	1					
		Support Trailer	3					
		Bird Scare Cannons	120					
		Contract Truck (Third Party)	3					
		Personnel (Responder/Mechanic)	4					
ES&H Environmental (877) 437-2634	Houma, LA	Containment Boom - 10"	2,000'	Port Fourchon, LA	4	1	1	6
		Containment Boom - 18"	20,000'					
		Containment Boom - 24"	5,000'					
		Jon Boat - 12' to 16'	30					
		Response Boats - 22' to 25'	2					
		Response Boats - 26' to 29'	4					
		Portable Skimmers	23					
		Shallow Water Skimmers	2					
		Wildlife Hazing Cannon	57					
OMI (985) 798-1005	Houma, LA	Containment Boom - 18" to 24"	2,000'	Port Fourchon, LA	4	1	1	6
		Containment Boom - 6" to 10"	500'					
		Response Boats - 16'	2					
		Response Boats - 25' to 28'	1					
		Response Boats - (Cabin Boat) 27' to 30'	1					
		Shallow Water Skimmers	3					
Lawson Environmental Service (985) 876-0420	Houma, LA	Containment Boom - 18"	30,000'	Port Fourchon, LA	4	1	1	6
		Containment Boom - 12"	2,000'					
		Containment Boom - 10"	9,500'					
		Response Boats - 14'	10					
		Response Boats - 16'	6					
		Response Boats - 20'	5					
		Response Boats - 24'	8					
		Response Boats - 26'	4					
		Response Boats - 28'	7					
		Response Boats - 32'	4					
		Portable Skimmers	6					
USES Environmental (888) 279-9930	Hahnville, LA	Containment Boom - 18"	500'	Port Fourchon, LA	4	1	1	6
USES Environmental (888) 279-9930	Amelia, LA	Containment Boom - 18"	500'	Port Fourchon, LA	4	1	1	6
USES Environmental (888) 279-9930	Marrero, LA	Containment Boom - 18"	600'	Port Fourchon, LA	4	1	1	6
OMI (800) 645-6671	Galliano, LA	Containment Boom - 18" to 24"	2,000'	Port Fourchon, LA	4	1	1	6
		Containment Boom - 6" to 10"	500'					
		Response Boats - 16'	1					
		Response Boats (Barge) - 25' to 33'	1					
		Response Boats - 25' to 28'	1					
		Portable Skimmers	3					
ES&H Environmental (877) 437-2634	Morgan City, LA	Containment Boom - 10"	2,000'	Port Fourchon, LA	4	1	1	6
		Containment Boom - 18"	500'					
		Jon Boat - 12' to 16'	3					
		Response Boats - 18' to 21'	2					
		Response Boats - 22' to 25'	1					
		Portable Skimmers	2					
		Wildlife Hazing Cannon	12					
OMI (800) 645-6671	Morgan City, LA	Containment Boom - 18" to 24"	2,500	Port Fourchon, LA	4	1	1	6
		Containment Boom - 6" to 10"	400'					
		Response Boats - 16'	2					
		Response Boats - 25' to 28'	1					
		Portable Skimmers	3					
		Response Personnel	3					

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

Walker Ridge 595
Sample Shoreline Protection & Wildlife Support List

Supplier & Phone	Warehouse	Equipment Listing	Quantity	Staging Area	Response Times (Hours)			
					Staging ETA	Loadout Time	Deployment Time	Total ETA
ES&H Environmental (877) 437-2634	Port Fourchon, LA	Containment Boom - 18"	1000'	Port Fourchon, LA	4	1	1	6
		Response Boats - 22' to 25'	1					
		Portable Skimmers	1					
ES&H Environmental (877) 437-2634	Golden Meadow, LA	Containment Boom - 10"	1,000'	Port Fourchon, LA	4	1	1	6
		Containment Boom - 18"	13,000					
		Jon Boat - 12' to 16'	2					
		Response Boats - 18' to 21'	1					
		Response Boats - 22' to 25'	1					
		Response Boats - 26' to 29'	1					
		Portable Skimmers	5					
		Wildlife Hazing Cannon	12					
AMPOL (800) 482-6765	New Iberia, LA	Containment Boom - 6" to 10"	4,150'	Port Fourchon, LA	4.75	1	1	7
		Containment Boom - 18" to 24"	34,050'					
		Response Boats - 14' to 20'	3					
		Response Boats - 21' to 36'	3					
		Portable Skimmers	27					
Clean Harbors (800) 645-8265	New Iberia, LA	Containment Boom - 18" to 24"	33,800'	Port Fourchon, LA	4.75	1	1	7
		Containment Boom - 6" to 10"	500'					
		Response Boats - 21' to 36'	4					
OMI (800) 645-6671	New Iberia, LA	Containment Boom - 18" to 24"	12,000'	Port Fourchon, LA	4.75	1	1	7
		Containment Boom - 6" to 10"	300'					
		Response Boats - 16'	3					
		Response Boats (Barge) - 25' to 33'	1					
		Response Boats - 25' to 28'	1					
		Portable Skimmers	8					
		Response Personnel	8					
USES Environmental (888) 279-9930	Meraux, LA	Containment Boom - 18"	6,000'	Port Fourchon, LA	4.25	1	1	7
		Containment Boom - 10"	1,000'					
		Response Boats - 16'	23					
		Response Boats - 18'	1					
		Response Boats - 24'	1					
		Response Boats - 26'	2					
		Response Boats - 28'	1					
		Portable Skimmers	2					
USES Environmental (888) 279-9930	Lafitte, LA	Containment Boom - 18"	1,000'	Port Fourchon, LA	4.5	1	1	7
		Response Boats - 18'	2					
USES Environmental (888) 534-2744	Geismar, LA	Containment Boom - 18"	1,000'	Port Fourchon, LA	4.5	1	1	7
		Response Boats - 16'	2					
		Portable Skimmers	1					
Clean Harbors (800) 645-8265	Baton Rouge, LA	Containment Boom - 18" to 24"	14,000'	Port Fourchon, LA	5	1	1	7
		Response Boats - 14' to 20'	1					
		Portable Skimmers	3					
		Response Personnel	13					
SWS Environmental (877) 742-4215	Baton Rouge, LA	Containment Boom - 18"	1,000'	Port Fourchon, LA	5	1	1	7
		Response Boats - 25' to 42'	2					
		Shallow Water Skimmers	1					
		Response Personnel	6					
Wildlife Ctr. of Texas (713) 861-9453	Baton Rouge, LA	Wildlife Specialist - Personnel	6 to 20	Port Fourchon, LA	5	1	1	7
ES&H Environmental (877) 437-2634	Belle Chasse, LA	Containment Boom - 10"	1,500'	Port Fourchon, LA	4.25	1	1	7
		Containment Boom - 18"	15,500'					
		Containment Boom - 24"	5,000'					
		Jon Boat - 12' to 16'	4					
		Response Boats - 18' to 21'	1					
		Response Boats - 22' to 25'	1					
		Response Boats - 26' to 29'	3					
		Portable Skimmers	10					
		Wildlife Hazing Cannon	50					

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

Walker Ridge 595
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
OMI (800) 645-6671	Belle Chasse, LA	Containment Boom - 18" to 24"	4,500'	Port Fourchon, LA	4.25	1	1	7
		Containment Boom - 6" to 10"	500'					
		Response Boats - 20'	1					
		Response Boats - 25' to 28'	2					
		Portable Skimmers	12					
		Shallow Water Skimmers	1					
		Bird Scare Cannons	12					
		Response Personnel	24					
OMI (800) 645-6671	Port Allen, LA	Containment Boom - 18" to 24"	2500'	Port Fourchon, LA	4.75	1	1	7
		Containment Boom - 6" to 10"	500'					
		Response Boats - 16'	2					
		Response Boats - 25 to 33'	1					
		Shallow Water Skimmers	1					
		Response Personnel	6					
ES&H Environmental (877) 437-2634	Lafayette, LA	Containment Boom - 10"	500'	Port Fourchon, LA	4.25	1	1	7
		Containment Boom - 18"	13,000'					
		Jon Boat - 12' to 16'	3					
		Response Boats - 18' to 21'	1					
		Response Boats - 22' to 25'	1					
		Response Boats - 26' to 29'	1					
		Portable Skimmers	4					
		Wildlife Hazing Cannon	12					
ES&H Environmental (877) 437-2634	Venice, LA	Containment Boom - 10"	2,000'	Port Fourchon, LA	5.75	1	1	8
		Containment Boom - 18"	13,000'					
		Containment Boom - 24"	10,000					
		Jon Boat - 12' to 16'	4					
		Response Boats - 22' to 25'	1					
		Response Boats - 26' to 29'	2					
		Portable Skimmers	5					
		Wildlife Hazing Cannon	25					
AMPOL (800) 482-6765	Venice, LA	Containment Boom - 18" to 24"	2,250'	Port Fourchon, LA	5.75	1	1	8
		Response Boats - 14' to 20'	2					
		Response Boats - 21' to 36'	1					
		Portable Skimmers	2					
OMI (800) 645-6671	Venice, LA	Containment Boom - 18" to 24"	1,500'	Port Fourchon, LA	5.75	1	1	8
		Response Boats - 16'	4					
		Response Boats (Barge) - 25' to 33'	1					
		Response Boats - 25' to 28'	2					
		Response Boats - (Cabin Boat) 27' to 30'	1					
		Shallow Water Skimmers	3					
		Portable Skimmers	2					
USES Environmental (888) 279-9930	Venice, LA	Containment Boom - 18"	10,000'	Port Fourchon, LA	5.75	1	1	8
		Response Boats - 16'	15					
		Response Boats - 26'	2					
		Response Boats - 30'	1					
		Portable Skimmers	2					
		Shallow Water Skimmers	1					
USES Environmental (888) 279-9930	Biloxi, MS	Containment Boom - 18"	2,000'	Port Fourchon, LA	5.25	1	1	8
		Response Boats - 16'	1					
USES Environmental (888) 279-9930	Lake Charles, LA	Containment Boom - 10"	100'	Port Fourchon, LA	6.25	1	1	9
		Containment Boom - 18"	7,700'					
		Response Boats - 16'	3					
		Response Boats - 27'	1					
		Response Boats - 37'	1					

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

Walker Ridge 595
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	Lake Charles, LA	Containment Boom - 10"	500'	Port Fourchon, LA	6.25	1	1	9
		Containment Boom - 18"	15,000'					
		Containment Boom - 24"	5,000'					
		Jon Boat - 12' to 16'	3					
		Response Boats - 18' to 21'	2					
		Response Boats - 26' to 29'	2					
		Portable Skimmers	13					
		Wildlife Hazing Cannon	40					
Miller Env. Services (800) 929-7227	Sulphur, LA	Containment Boom - 10"	600'	Port Fourchon, LA	6.25	1	1	9
		Containment Boom - 18"	14,000'					
		Jon Boats - 14' to 16'	2					
		Jon Boats - 16' w/25hp HP Outboard Motor	2					
		Air Boat - 18'	1					
		Work Boat - 18'	2					
		Response Boats - 24' - 28'	4					
		Portable Skimmers	5					
		Shallow Water Skimmers	1					
		Response Personnel	49					
Miller Env. Services (800) 929-7227	Beaumont, TX	Containment Boom - 18"	14,000'	Port Fourchon, LA	7	1	1	9
		Response Boats - 18'	2					
		Response Boats - 24'	2					
		Shallow Water Skimmers	1					
		Response Personnel	47					
USES Environmental (888) 279-9930	Mobile, AL	Containment Boom - 10"	800'	Port Fourchon, LA	6.25	1	1	9
		Containment Boom - 18"	5,000'					
		Response Boats - 16'	1					
		Response Boats - 18'	1					
		Response Boats - 20'	1					
		Response Boats - 26'	1					
		Portable Skimmers	2					
SWS Environmental (877) 742-4215	Pensacola, FL	Containment Boom - 18"	2,500'	Port Fourchon, LA	7	1	1	9
		Response Boats - 16' to 25'	2					
		Shallow Water Skimmers	1					
		Response Personnel	2					
AMPOL (800) 482-6765	Port Arthur, TX	Containment Boom - 18" to 24"	16,000'	Port Fourchon, LA	7.25	1	1	10
		Response Boats - 14' to 20'	2					
		Response Boats - 21' to 36'	1					
		Portable Skimmers	3					
Clean Harbors (800) 645-8265	Port Arthur, TX	Containment Boom - 18" to 24"	3,000'	Port Fourchon, LA	7.25	1	1	10
		Response Boats - 21' to 36'	2					
		Portable Skimmers	2					
		Response Personnel	54					
Garner Environmental (800) 424-1716	Port Arthur, TX	Containment Boom - 6"	22,000'	Port Fourchon, LA	7.25	1	1	10
		Response Boats - 14' to 20'	8					
		Response Boats - 21' to 36'	1					
		Portable Skimmers	3					
OMI (800) 645-6671	Port Arthur, TX	Containment Boom - 18" to 24"	4000'	Port Fourchon, LA	7.25	1	1	10
		Response Boats - 14' to 20'	6					
		Response Boats - 21' to 36'	2					
		Shallow Water Skimmers	1					
Phoenix Pollution Control & Environmental Services (281) 838-3400	Baytown, TX	Containment Boom - 18"	13,000'	Port Fourchon, LA	8	1	1	10
		Containment Boom - 10"	1,150'					
		Response Boats - 16'	6					
		Response Boats - 20'	3					
		Response Boats - 24'	1					
		Response Boats - 35'	2					
		Portable Skimmers	24					
Clean Harbors (800) 645-8265	Houston, TX	Containment Boom - 18" to 24"	4,500'	Port Fourchon, LA	8.25	1	1	11
		Response Boats - 14' to 20'	2					
		Response Boats - 21' to 36'	3					
		Portable Skimmers	1					
		Response Personnel	14					

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

Walker Ridge 595
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	Houston, TX	Containment Boom - 10"	500'	Port Fourchon, LA	8.25	1	1	11
		Containment Boom - 18"	13,000'					
		Containment Boom - 24"	5,000'					
		Jon Boat - 12' to 16'	2					
		Response Boats - 26' to 29'	2					
		Portable Skimmers	2					
		Wildlife Hazing Cannon	12					
SWS Environmental (877) 742-4215	Houston, TX	Containment Boom - 18"	20,000	Port Fourchon, LA	8.25	1	1	11
		Response Boats - 16' to 25'	1					
		Response Boats - 25' to 42'	2					
		Portable Skimmers	2					
		Response Personnel	19					
Miller Env. Services (800) 929-7227	Houston, TX	Containment Boom - 18"	12,000'	Port Fourchon, LA	8.25	1	1	11
		Shallow Water Skimmers	1					
		Response Boats - 28'	1					
		Responder Personnel	38					
OMI (800) 645-6671	Houston, TX	Containment Boom - 18" to 24"	4000'	Port Fourchon, LA	8.25	1	1	11
		Response Boats - 16'	3					
		Response Boats - 25' to 28'	1					
		Portable Skimmers	1					
USES Environmental (888) 279-9930	Houston, TX	Containment Boom - 6"	500'	Port Fourchon, LA	8.25	1	1	11
		Containment Boom - 20"	10,000'					
		Response Boats - 16'	4					
		Response Boats - 26'	1					
		Portable Skimmers	1					
Wildlife Ctr. of Texas (713) 861-9453	Houston, TX	Wildlife Specialist - Personnel	6 to 20	Port Fourchon, LA	8.25	1	1	11
Garner Environmental (800) 424-1716	Deer Park, TX	Containment Boom - 6"	18,900'	Port Fourchon, LA	8.25	1	1	11
		Response Boats - 12'	2					
		Response Boats - 16' to 20'	5					
		Respons Boats - 30'	2					
		Portable Skimmers	25					
		Shallow Water Skimmers	3					
Garner Environmental (800) 424-1716	La Marque, TX	Containment Boom - 6"	9,500'	Port Fourchon, LA	8.75	1	1	11
		Response Boats - 16'	5					
		Response Boats - 24'	1					
		Portable Skimmers	7					
SWS Environmental (877) 742-4215	Panama City, FL	Containment Boom - 18"	7,000'	Port Fourchon, LA	9	1	1	11
		Response Boats - 16' to 25'	3					
		Response Boats - 25' to 42'	1					
		Portable Skimmers	6					
		Response Personnel	10					
SWS Environmental (877) 742-4215	Memphis, TN	Containment Boom - 6"	100'	Port Fourchon, LA	9.25	1	1	12
		Containment Boom - 12"	800'					
		Containment Boom - 18"	800'					
		Response Boats - 25' to 42'	1					
		Shallow Water Skimmers	1					
		Response Personnel	9					
USES Environmental (888) 279-9930	Memphis, TN	Containment Boom - 6"	850'	Port Fourchon, LA	9.25	1	1	12
		Containment Boom - 12"	300'					
		Containment Boom - 18"	5,000'					
		Response Boats - 12'	3					
		Response Boats - 14'	5					
		Response Boats - 16'	2					
		Response Boats - 24'	1					
		Response Boats - 28'	1					
		Portable Skimmers	2					

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

Walker Ridge 595 Sample Shoreline Protection & Wildlife Support List								
					Response Times (Hours)			
Supplier & Phone	Warehouse	Equipment Listing	Quantity	Staging Area	Staging ETA	Loadout Time	Deployment Time	Total ETA
Miller Env. Services (800) 929-7227	Corpus Christi, TX	Containment Boom - 10"	2,000'	Port Fourchon, LA	11.5	1	1	14
		Containment Boom - 18"	30,000'					
		Jon Boats - 14' to 16' w/25hp motor	4					
		Jon Boats - 16' to 18' w/Outboard motor	4					
		Air Boat - 14'	1					
		Response Boats - 24' to 26'	4					
		Portable Skimmers	6					
		Shallow Water Skimmers	2					
		Response Personnel	142					
SWS Environmental (877) 742-4215	Jacksonville, FL	Containment Boom - 18"	1,500'	Port Fourchon, LA	12	1	1	14
		Response Boats - 16' to 25'	2					
		Shallow Water Skimmers	1					
		Response Personnel	8					
SWS Environmental (877) 742-4215	Tampa, FL	Containment Boom - 18"	2,000'	Port Fourchon, LA	13.25	1	1	16
		Response Boats - 16' to 25'	2					
		Response Boats - 25' to 42'	1					
		Portable Skimmers	1					
		Response Personnel	10					
SWS Environmental (877) 742-4215	Tampa, FL	Containment Boom - 18"	2,000'	Port Fourchon, LA	13.25	1	1	16
		Response Boats - 16' to 25'	2					
		Response Boats - 25' to 42'	1					
		Shallow Water Skimmers	1					
		Response Personnel	10					
SWS Environmental (877) 742-4215	St. Petersburg, FL	Containment Boom - 18"	10,800	Port Fourchon, LA	13.75	1	1	16
		Response Boats - 16' to 25'	1					
		Response Boats - 25' to 42'	1					
		Portable Skimmers	1					
		Response Personnel	8					
SWS Environmental (877) 742-4215	Savannah, GA	Containment Boom - 18"	1,400'	Port Fourchon, LA	13.75	1	1	16
		Response Boats - 16' to 25'	3					
		Shallow Water Skimmers	1					
		Response Personnel	7					
SWS Environmental (877) 742-4215	Fort Lauderdale, FL	Containment Boom - 18"	1,000'	Port Fourchon, LA	16	1	1	18
		Response Boats - 16' to 25'	2					
		Response Boats - 25' to 42'	1					
		Shallow Water Skimmers	1					
		Response Personnel	8					
Tri-State Bird Rescue & Research, Inc. (800) 261-0980	Newark, DE	Wildlife Specialist - Personnel	6 to 12	Port Fourchon, LA	21.5	1	1	24

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

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 expanded, effective 3/1/2018. The unit now consists of G17001, G17004, G18730, G18731, G18737, G21861, G21862, G26409, and G32690.

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

The production system consists of two subsea drill centers with subsea wells tied back to manifolds, connected to a Floating Production Storage and Offloading (FPSO) host by dual flow lines with steel lazy wave risers. Oil export will be with shuttle tankers and gas export via a gas export pipeline.

Topsides installed on an FPSO have full offshore processing capabilities including required heat exchangers, separation equipment, gas dehydration equipment, power generation equipment, compression equipment, pumps, flare, water treatment equipment, bulk oil treating equipment, and hull storage. The system will be designed in accordance with Shell standards.

Product	Peak Processing Throughput
Oil (BPD)	60,000 BPD
Produced Water (BPD)	30,000 BPD
Total Fluids (BPD)	90,000 BPD
Gas (MMscfd)	15 MMcfd

The hull configuration for the Floating Production Facility is a ship shaped FPSO based on a converted double hull tanker. The hull, topsides, marine systems, and station keeping systems is classed by the American Bureau of Shipping (ABS). The FPSO is registered with the Bahamas Maritime Authority (BMA).

The FPSO is designed to remain connected during winter storms and sudden hurricanes and to disconnect from its moorings and depart the field, under its own propulsion, for named storms and hurricanes.

The FPSO will be a converted Suezmax-size tank ship which will have been built outside the US and will be transported to the US GOM under its own power. The buoy section of the disconnectable turret, along with moorings, will be pre-installed in the US GOM prior to the arrival of the FPSO.

The FPSO marine systems will include the following:

- A fully functional marine propulsion and navigation system to be used when the FPSO is disconnected.
- Oil export system for offloading produced oil to a shuttle tanker. This system shall consist of a reel mounted floating double carcass oil export hose and a tandem mooring hawser.

The topsides process facilities are similar to existing deepwater facilities in the Gulf of Mexico except they are designed to consider the dynamic motions of the FPSO and include a swivel to allow for vessel weathervaning. The topsides modules will be installed on the FPSO and will provide full offshore processing capabilities including heat exchangers, separation equipment, gas dehydration equipment, power generation equipment, compression equipment, pumps, flare, water treatment equipment, bulk oil treating equipment, and hull storage.

A Distributed Control System (DCS) will be utilized for Process Safety Controls. The Emergency Support System (ESS) and Fire and Gas Detection will be TUV Certified SIL-3.

The major utility services provided by the FPSO are cooling water, electrical power and process heating. Cooling water will be lifted from the sea, filtered and pumped to the main users. Dual fuelled turbine driven generating sets will provide power to all consumers of electricity. Emergency power generation will be provided by a diesel engine driven generator set servicing all safety systems and control functions. Process heat will be provided through a closed loop heat medium system. Process gas will be the primary fuel for the FPSO. Chemical injection systems will be provided. These will inhibit formation of hydrates, corrosion products, foaming, emulsions and scale.

Subsea

Phase 1 of the Stones development will include a single manifold to support the production wells. The manifold will be configured to allow the well to flow under natural flow to the surface facilities in addition to being configured to align the production wells to the artificial lift system (after it is installed).

The Stones artificial lift system is designed to boost the process fluids from the sea floor to the FPSO in single phase. The pumps will be driven by variable frequency drives located on the topsides facility, and will have a dedicated controller located topsides as well. Stones' modular mud-line boosting system consists of three pumps configured in a single pumping station with 3x50% pump units. Each pump module on the pumping station will be retrievable.

The subsea control modules will use an electro hydraulic multiplexed pod with high speed fiber optic communication between topside and subsea. Controls and instrumentation for the booster pumps system will comply with NTL 2011-N11, and will be available for alert, interlock, and shutdown function for certain conditions (e.g. seal failure, loss of communications, high and low pressure). Testing for controls and instrumentation will be performed per regulatory requirements.

Seafloor multiphase meters will be provided to allow for well testing. In addition it is expected that there will be sufficient pressure and temperature gauges located in the wells, trees and manifolds to provide for virtual metering of the well streams.

The flow line system transports fluids from the producing wells via the production manifold and artificial lift system. A dual flow line system is selected. The flow lines will be initiated with a PLET and terminated with a Steel Lazy Wave riser that connects the flow line to the host. Wells, manifold and flow lines will be connected via jumpers with vertical connectors The Stones flow lines will be 8" nominal.

Pipeline	Route	Diameter	Length	Product	Shut-in time in the event of a leak
Gas Export Line	FPSO WR 551 to WR Gathering System in WR 457	8.625"	98717'	Gas	45 seconds
WR 508 FPSO Flowline #1	WR 508 to WR 551 FPSO	8.625"	19586'	Crude oil	45 seconds
Flowline Jumper 85501A	Manifold To WR508 PLET	8.625"	100'	Crude oil	45 seconds
WR 508 FPSO Flowline #2	WR 508 to WR 551 FPSO	8.625"	18973'	Crude oil	45 seconds
Flowline Jumper 85501B	Manifold To WR508 PLET	8.625"	50'	Crude oil	45 seconds
Subsea Manifold	WR 508	8.625"	50'	Crude oil	45 seconds
Well Jumpers (x8)	WR508	8.625"	45' to 100'	Crude oil	45 seconds

Control, power, chemical injection and communication functions for all subsea equipment, including wells, multiphase pumps, trees and associated support structures, shall be provided through electrical-hydraulic umbilicals. The umbilicals will terminate at UTAs on the seafloor.

Product Transport

The oil export will be via dedicated double hull shuttle tanker. The shuttle tanker will be Jones Act and OPA 90 compliant. The shuttle tanker will be a "Veteran" class, or equivalent, tankship, with a nominal crude storage capacity of 330,000 barrels oil, converted for shuttle service. The tanker will be equipped with a conventional diesel engine with a single Controllable Pitch Propeller (CPP) and a bow thruster for enhanced maneuverability.

The shuttle tanker will be moored in tandem behind the FPSO using a mooring hawser. The mooring hawser will be retrieved back to the FPSO when not in use. The oil will be offloaded from the FPSO using the cargo pumps via an export hose to a bow loading system located on the shuttle tanker. The export hose will be stored on a reel located on the stern of the FPSO when not in use. The offloading operation is estimated to take approximately 14 hours not including approach, mooring or disconnect time. Offloading of oil will be performed approximately every 5 days when producing at full capacity. Volume of oil offloaded will range from approximately 211,000 to 305,500 barrels of crude. Shuttle tanker deliveries will be to terminals of choice within the GoM. See table 13.1 below for list of potential refiners for the product.

A secondary (back up) system for offloading produced oil will be provided capable of offloading oil to a tanker equipped with a conventional OCIMF midship manifold in a tandem mooring configuration. This back-up system may be used with a non-dedicated Jones Act tanker when the dedicated shuttle tanker is not available.

An ESD (Emergency Shutdown) system shall be incorporated into the design of the systems located on the FPSO and shuttle tanker to manage the offloading operation.

A field support vessel, with sufficient bollard pull to serve as a pullback tug, will be deployed at Stones and used during offloading operations, primarily as a redundancy measure to cater for the unplanned non availability of the shuttle tanker's main propulsion system.

Gas export shall be via pipeline, with the selected export route via Enbridge's Walker Ridge Gathering System. The Stones lateral pipeline is configured to operate in both export and import modes to allow the Stones JV to backflow gas for fuel late in life. The gas export pipeline shall consist of a Steel Lazy Wave Riser connecting to a pipeline to the planned hub in block WR 457.

Potential USCG Refiners			
	Company Name	**Location**	**State**
1	Marathon	Garyville	LA
2	Chevron	Pascagoula	MS
3	Valero Energy Corp.	Port Arthur	TX
4	ConocoPhillips	Sweeny	TX
5	ExxonMobil	Baytown	TX
6	ConocoPhillips	Lake Charles	LA
7	Motiva Enterprises LLC	Port Arthur	TX
8	Total SA	Port Arthur	TX
9	Valero Energy Corp.	St. Charles (Norco)	LA
10	CITGO	Lake Charles	LA
11	ExxonMobil	Beaumont	TX
12	Valero Energy Corp.	Texas City	TX
13	ExxonMobil/PDVSA	Chalmette	LA
14	ExxonMobil	Baton Rouge	LA
15	Valero Energy Corp.	Corpus Christi	TX
16	CITGO	Corpus Christi	TX
17	Hunt Refining Co.	Tuscaloosa	AL
18	BP	Texas City	TX
19	LyondellBasell	Houston	TX
20	Flint Hills Resources	Corpus Christi	TX

SECTION 14: SUPPORT VESSELS AND AIRCRAFT

A. General

Support Equipment – FPSO Production Operations

Type	Maximum Fuel Tank Storage Capacity (Bbls)	Maximum Number In Area at Any Time	Trip Frequency or Duration
Supply Boat	9750	1	Once per week
Offshore Support Vessel	7500	1	Once every two weeks
Helicopter	22	1	Four times per week.

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	7500	4 weekly	Port Fourchon to FPSO location

Installation and Support Equipment – Subsea

Type	Maximum Fuel Tank Storage Capacity (Gals)	Maximum No. In Area at Any Time	Trip Frequency or Duration
Umbilical Installation Vessel	9,500	1	14 Days/year
Tree Installation	8,945	1	2 Trips – 14 Days Total/year

B. Drilling Fluids Transportation

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

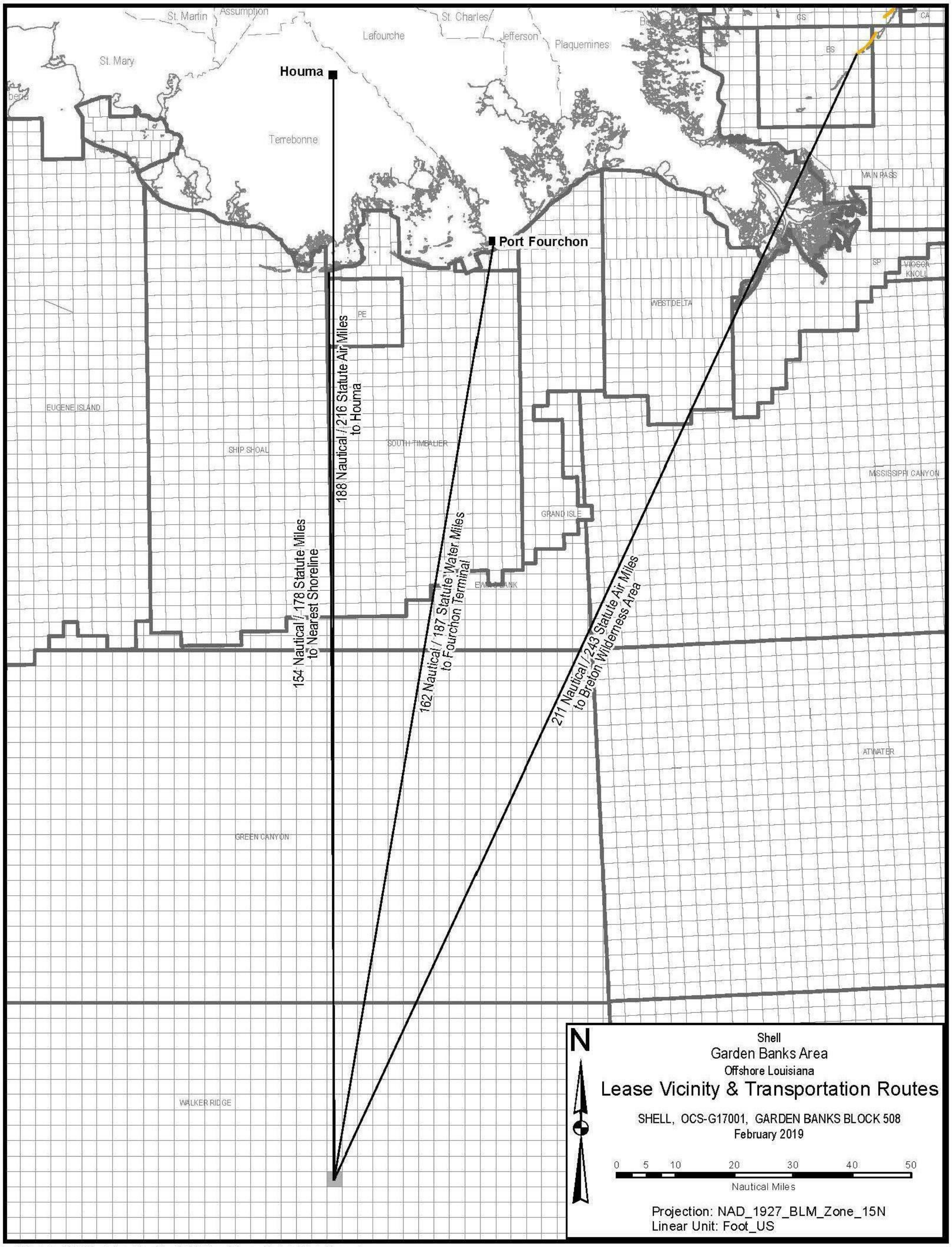
C. Solid and Liquid Wastes Transportation

See Section 7, Table 7B.

D. Vicinity Map

See Attachment 14A for Vicinity Map.

Attachment 14A – Vicinity Map



G:\30_Project\CAD_NewOrleans\Maps\Permit Plats\Stones\Stones - Turritella Vicinity Map.mxd

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.

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 and Texas Coastal Zone Consistency was granted in Plan N-9718. Coastal zone consistancy for these two States is not required for Supplmental Development Plans.

SECTION 18: ENVIRONMENTAL IMPACT ANALYSIS (EIA)

Environmental Impact Analysis

Supplemental DEVELOPMENT OPERATIONS COORDINATION DOCUMENT

for

Walker Ridge Block 508 (OCS-G-17001)

Offshore Louisiana

July 2019

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Acronyms and Abbreviations

ABS	American Bureau of Shipping
ac	acre
ADIOS	Automated Data Inquiry for Oil Spills
AQR	Air Quality Emissions Report
AUV	autonomous underwater vehicle
bbl	barrel
BOEM	Bureau of Ocean Energy Management
BOEMRE	Bureau of Ocean Energy Management, Regulation and Enforcement
BOP	blowout preventer
BOPD	barrels of oil per day
BSEE	Bureau of Safety and Environmental Enforcement
CFR	Code of Federal Regulations
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
dB	decibel
DOCD	Development Operations Coordination Document
DP	dynamically positioned
DPS	distinct population segment
EFH	Essential Fish Habitat
EIA	Environmental Impact Analysis
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FAD	fish-attracting device
FR	Federal Register
GMFMC	Gulf of Mexico Fishery Management Council
H_2S	hydrogen sulfide
ha	hectare
HAPC	Habitat Area of Particular Concern
Hz	hertz
IPF	impact-producing factor
LARS	launch and recovery system
μPa	micropascal
m	meter
MARPOL	International Convention for the Prevention of Pollution from Ships
MMC	Marine Mammal Commission
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
MODU	mobile offshore drilling unit
MWCC	Marine Well Containment Company
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NTL	Notice to Lessees and Operators
NWR	National Wildlife Refuge
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OSRA	Oil Spill Risk Analysis
OSRP	Oil Spill Response Plan
PAH	polycyclic aromatic hydrocarbon
PM	particulate matter
PEIS	Programmatic Environmental Impact Statement
re	referenced to
SEL	sound exposure level
Shell	Shell Offshore Inc.
SO_x	sulfur oxides
SPL	sound pressure level
SPL_{rms}	root-mean-square sound pressure level
TLP	tension leg platform
U.S.C	United States Code
USCG	U.S. Coast Guard
USDOI	U.S. Department of the Interior
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compound
WCD	worst case discharge
WMA	Wildlife Management Area
WR	Walker Ridge

Introduction

Project Summary

Shell Offshore Inc. (Shell) is submitting a supplemental Development Operations Coordination Document (DOCD) for Walker Ridge (WR) Block 508 for the drilling, completion, and/or workovers of four wells (AA, BB, CC, and DD) and associated subsea installation. The wellsites were previously approved in the Supplemental Exploration Plan No. S-7948. This Environmental Impact Analysis (EIA) provides information on potential impacts on environmental resources that could be affected by Shell's proposed activities in the project area.

The project area is in the Central Planning Area, 178 miles (286 km) from the nearest shoreline (Louisiana), 193 miles (311 km) from the onshore support base at Port Fourchon, Louisiana, and 214 miles (344 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).

Drilling, completion, well work activities, and installation of associated subsea equipment will be accomplished with a dynamically positioned (DP) mobile offshore drilling unit (MODU) or installation vessels, as detailed in **Section 14** of the DOCD. Drilling, completion, well work, and associated subsea installation activities and periodic well maintenance are estimated to commence in 2020 and are estimated to take up to 270 days from 2020 to 2023, and 270 days per year over a 27-year period from 2024 to 2050. There are no anchors associated with the proposed work in the plan.

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 (U.S.C.) §§ 1331-1356, and Bureau of Ocean Energy Management (BOEM) regulations, including 30 Code of Federal Regulations (CFR) 550.261. The EIA is a project- and site-specific analysis of Shell's planned activities under the DOCD.

The EIA presents data, analyses, and conclusions to support 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 the impact-producing factors (IPFs), resources, and impacts associated with the proposed project activities. It identifies mitigation measures to be implemented in connection with the planned activities. Potential environmental impacts of a blowout scenario and worst-case discharge (WCD) are also analyzed.

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

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

OCS Regulatory Framework

The regulatory framework for OCS activities in the Gulf of Mexico is summarized by BOEM (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 the authority to govern 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 regulations establish consultation and coordination processes with federal, state, and local agencies (e.g., the ESA, MMPA, Coastal Zone Management Act of 1972, and the Magnuson-Stevens Fishery Conservation and Management Act).

In addition, Notices to Lessees and Operators (NTLs) are formal documents issued by BOEM and BSEE that provide clarification, description, or interpretation of a regulation or standard. **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).

NTL	Title	Summary
BOEM-2016-G01	Vessel Strike Avoidance and Injured/Dead Protected Species Reporting	Recommends protected species identification training; recommends that vessel operators and crews maintain a vigilant watch for marine mammals and slow down or stop their vessel movement to avoid striking protected species; and requires operators to report sightings of any injured or dead protected species. Supersedes NTL 2012-JOINT-G01.
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. Supersedes and replaces NTL 2012-G01.
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 BOEM NTLs currently posted.

NTL	Title	Summary
BOEM 2015-N01	Information Requirements for Exploration Plans, Development and Production Plans, and Development Operations Coordination Documents on the OCS for Worst Case Discharge Blowout Scenarios	Provides guidance regarding information required in worst-case discharge (WCD) descriptions and blowout scenarios. Supersedes NTL 2010-N06.
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-2012-N06	Guidance to Owners and Operators of Offshore Facilities Seaward of the Coast Line Concerning Regional Oil Spill Response Plans	Provides clarification, guidance, and information for preparation of regional Oil Spill Response Plans. Recommends description of response strategy for WCD scenarios to ensure capability to respond to oil discharges is both efficient and effective.
2011-JOINT-G01	Revisions to the List of OCS Blocks Requiring Archaeological Resource Surveys and Reports	Provides new information on which OCS blocks require archaeological surveys and reports and line spacing required in each block. This NTL augments NTL 2005-G07.
2010-N10	Statement of Compliance with Applicable Regulations and Evaluation of Information Demonstrating Adequate Spill Response and Well Containment Resources	Informs operators using subsea blowout preventers (BOPs) or surface BOPs on floating facilities that applications for well permits must include a statement signed by an authorized company official stating that the operator will conduct all activities in compliance with all applicable regulations, including the increased safety measures regulations (75 *Federal Register* [FR] 63346). Informs operators that BOEM 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 Outer Continental Shelf (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 ESA and MMPA.
2005-G07	Archaeological Resource Surveys and Reports	Provides guidance on regulations regarding archaeological discoveries, specifies requirements for archaeological resource surveys and reports, and outlines options for protecting archaeological resources.

Oil Spill Prevention and Contingency Planning

Shell has an approved Gulf of Mexico Regional Oil Spill Response Plan (OSRP) as a fundamental component of the planned subsea equipment installation and drilling activities program that certifies Shell's capability to respond to a WCD (30 CFR 254.2) to the maximum extent practicable (see **DOCD Section 9**). The OSRP demonstrates Shell's capabilities to rapidly and effectively manage oil spills that may result from drilling operations; in this case, Shell's OSRP is applicable to the proposed drilling, completion, well work, and associated subsea installation. 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 range 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 and dedicated response assets, potential spill risks, and local environmental sensitivities. The OSRP presents specific information on the response program that includes a description of personnel and equipment mobilization, the incident management team organization, and the strategies and tactics used to implement effective and sustained spill containment and recovery operations.

EIA Organization

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

A. Impact-Producing Factors

Based on the description of Shell's proposed activities, a series of IPFs have been identified. **Table 2** identifies the environmental resources that may be affected in the left column and identifies sources of impacts associated with the proposed project across the top. **Table 2** was adapted from Form BOEM-0142 and developed *a priori* to focus the impact analysis on those environmental resources that may be impacted as a result of one or more IPFs. The tabular matrix indicates which routine activities and accidental events could affect specific resources. An "X" indicates that an IPF could reasonably be expected to affect a certain resource, and a dash (--) indicates no impact or negligible impact. Where there may be an effect, an analysis is provided in **Section C**. Potential IPFs for the proposed activities are listed below and briefly discussed in the following sections.

- Vessel 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; dash (--) = no impact or negligible impact.

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

Numbers in parentheses refer to table footnotes on the following page.

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 of 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.*
      - Not applicable. The lease is not within the given ranges (buffer zone) of any marine sanctuary, topographic feature, or no-activity zone. There are no submarine banks in the lease block.

(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 BOEM as being in water depths 300 m or greater.*
   - No impacts on high-density deepwater benthic communities are anticipated. Geohazards assessments found that no features indicative of high-density chemosynthetic communities or coral communities were identified within 2,000 ft (610 m) of the proposed drilling, completion, well work, and associated subsea installation (BP America Inc, 2004; Fugro Geo-consulting Inc., 2010; C&C Technologies, 2011; Fugro Geo-consulting Inc., 2011a; b; Forum Energy Technologies, 2012).

(5) *Exploration or production activities where hydrogen sulfide (H_2S) concentrations greater than 500 ppm might be encountered.*
   - Development Operations Coordination Document (DOCD) **Section 4** contains WR 508 classified as an area absent of H_2S.

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

(7) *All activities that involve seafloor disturbances, including anchor emplacements, in any OCS block designated by the BOEM as having high-probability for the occurrence of shipwrecks or prehistoric sites, including such blocks that will be affected that are adjacent to the lease block in which your planned activity will occur. If the proposed activities are located a sufficient distance from a shipwreck or prehistoric site that no impact would occur, the EIA can note that in a sentence or two.*
   - No impacts on archaeological resources are expected from routine activities. The project area is not on BOEM's list of archaeology survey blocks (BOEM, 2011) and the water depths are well beyond the 197-ft (60-m) depth contour used by BOEM as the seaward extent for prehistoric archaeological site potential in the Gulf of Mexico. 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 drilling, completion, well work, and associated subsea installation (BP America Inc, 2004; Fugro Geo-consulting Inc., 2010; C&C Technologies, 2011; Fugro Geo-consulting Inc., 2011a; b; Forum Energy Technologies, 2012).

(8) *All activities that you determine might have an adverse effect on endangered or threatened marine mammals or sea turtles or their critical habitats.*
   - IPFs that may affect marine mammals or sea turtles include DP Mobile Drilling Unit (MODU) 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 Vessel Presence (including noise and lights)

Drilling, completion, well work, and completion of the four proposed wells and installation of associated subsea equipment will be accomplished with a DP MODU or installation vessels. DP MODUs and installation vessels are self-propelled and maintain position using a global positioning system, specific computer software, and sensors in conjunction with a series of thrusters. Potential impacts to marine resources from the installation of subsea equipment include the physical presence of the installation and support vessels in the ocean, increased light from working and safety lighting on the vessels, and noise audible above and below the water surface.

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

The DP MODU will maintain exterior lighting for working at night and navigational and aviation safety in accordance with federal regulations. Artificial lighting may attract and directly or indirectly impact natural resources, particularly birds, as discussed in **Section C.4**.

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

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

A.2 Physical Disturbance to the Seafloor

Drilling, completion, well works, and installation of subsea equipment will be accomplished with a DP MODU or installation vessels; no anchors will be used. 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, and where subsea equipment is placed on the substrate. Depending on the specific well configuration, the total disturbed area is estimated to be 0.62 ac (0.25 ha) per well (BOEM, 2012a).

BOEM (2012a) estimated an area of seafloor disturbance between 1.2 acres (ac) (0.5 hectares [ha]) and 2.5 ac (1.0 ha) per kilometer of flowline installation. Due to the water depth in the project area, it is anticipated that the subsea equipment will not be buried by trenching, but will instead be placed on the seafloor, decreasing the area of impact (**DOCD Section 6**).

A.3 Air Pollutant Emissions

Estimates of air pollutant emissions are provided in **DOCD Section 8**. Offshore air pollutant emissions will result from operations of the DP MODU and installation vessels as well as service vessels and helicopters. These emissions occur mainly from combustion of diesel and aviation fuel (Jet-A). Primary air pollutants typically associated with OCS activities are suspended particulate matter (PM), sulfur oxides (SO_x), nitrogen oxides (NO_x), volatile organic compounds (VOCs), and carbon monoxide (CO).

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 **DOCD Section 8**) prepared in accordance with BOEM requirements provided in 30 CFR 550 Subpart C. The AQR shows that the projected emissions associated with the proposed activities meet BOEM's exemption criteria. Based on calculated emissions and the location of the project area relative to shore, it can be concluded that project emissions will not significantly affect onshore air quality for any of the criteria pollutants. No further analysis or control measures are required.

A.4 Effluent Discharges

Effluent discharges from the DP MODUs are summarized in **DOCD Section 7**. Discharges from the DP MODUs are required to comply with the National Pollutant Discharge Elimination System (NPDES) General Permit for oil and gas activities (GMG290103). The support vessels' discharges are expected to be in accordance with USCG regulations.

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

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

Other effluent discharges from the DP MODU and support vessels are expected to include non-contact cooling water, treated sanitary and domestic wastes, deck drainage, desalination unit brine, blowout preventer fluid, well treatment and completion fluids, workover fluids, excess cement, water-based subsea production control fluid, hydrate inhibitor, treated seawater, uncontaminated fire water, bilge water, and ballast water. The DP MODU, and support vessel discharges are expected to be in accordance with NPDES permit and/or USCG regulations, as applicable, and are therefore not expected to cause significant impacts on water quality.

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 DP MODU (**DOCD 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 NPDES General Permit No. GMG290103 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 2 million gallons of water per day, of which at least 25% is used for cooling purposes.

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

A.6 Onshore Waste Disposal

Wastes generated during exploration activities are tabulated in **DOCD Section 7**. Used SBMs and additives will be transported to shore for recycling, reconditioning, or deep well injection at Halliburton Drilling Fluids, MiSwaco, Newpark Drilling Fluids, Ecoserv, or R360 Environmental Solutions, in Port Fourchon, Louisiana. Exploration and production wastes and cuttings wetted with SBMs will be transported to shore for deep well injection or landfarm at Ecoserv or R360 Environmental Solutions in Port Fourchon, Louisiana. Completion fluids will be transported to shore for recycling or deep well injection at Haliburton, Baker Hughes, Tetra, Superior, Ecoserv, or R360 Environmental Solutions in Port Fourchon, Louisiana. Salvage hydrocarbons will be transported to shore for recycling or deep well injection at PSC Industrial Outsourcing, Inc. in Jeanerette, Louisiana. Produced sand will be transported to shore for disposal or deep well injection at Ecoserv 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, Lamp Environmental in Hammond, Louisiana, or at a similarly permitted facility. Non-recyclable trash and debris will be transported to the Republic/BFI landfill in Sorrento, Louisiana; the parish landfill in Avondale, Louisiana; or to a similarly permitted facility. Used oil and glycol will be transported to Omega Waste Management in West Patterson, Louisiana. Non-hazardous waste will be transported to the Republic/BFI landfill in Sorrento, Louisiana; Lamp Environmental in Hammond, Louisiana; or to a similarly permitted facility. Non-hazardous oilfield waste will be transported to Ecoserv in Port Arthur, Texas. Universal waste items such as batteries, lamps, glass, and mercury contaminated waste will be sent to Lamp Environmental Services in Independence, Louisiana, for processing. Hazardous waste will be sent to Omega Waste Management in West Patterson, Louisiana; Lamp Environmental in Hammond, Louisiana; or to a similarly permitted facility. Wastes will be recycled or disposed according to applicable regulations at the respective onshore facilities.

A.7 Marine Debris

Trash and debris released into the marine environment can harm marine animals through entanglement and ingestion. Shell will adhere to the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) Annex V requirements, USEPA and USCG regulations, and BSEE regulations and NTLs regarding solid wastes. BSEE regulations at 30 CFR 250.300(a) and (b)(6) prohibit operators from deliberately discharging containers and other similar materials (e.g., trash and debris) into the marine environment, and 30 CFR 250.300(c) requires durable identification markings on equipment, tools and containers (especially drums), and other material. USCG and USEPA regulations require operators to become proactive in avoiding accidental loss of solid waste items by developing waste management plans, posting informational placards, manifesting trash sent to shore, and using special precautions such as covering outside trash bins to prevent accidental loss of solid waste. Shell complies 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 placards at prominent locations on offshore vessels and structures, and mandates a yearly marine trash and debris awareness training and certification process.

A.8 Support Vessel and Helicopter Traffic

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

The supply base at Port Fourchon 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 and installation activities. 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 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) overpopulated 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 300 ft (91 m) of marine mammals (BOEM, 2017a).

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

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 root-mean-square sound pressure levels (SPL_{rms})

underwater water of 109 dB re 1 µPa from a Bell 212 helicopter flying at an altitude of 500 ft (152 m). Penetration of aircraft noise below the sea surface is greatest directly below the aircraft; at angles greater than 13 degrees from vertical, much of the sound is reflected from the sea surface and so does not penetrate into the water (Richardson et al., 1995). The duration of underwater sound from passing aircraft is much shorter in water than air. For example, a helicopter passing at an altitude of 500 ft (152 m) that is audible in air for 4 minutes may be detectable under water for only 38 seconds at 10 ft (3 m) depth and for 11 seconds at 59 ft (18 m) depth (Richardson et al., 1995). Additionally, the sound amplitude is greatest as the aircraft approaches or leaves a location.

A.9 Accidents

A.9.1 Types of Accidents Evaluated

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 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 **DOCD 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**.

Recent EISs (BOEM, 2014a; 2015; 2016c; 2017a) analyzed five other types of accidents, including loss of well control, pipeline failures, vessel collisions, chemical and drilling fluid spills, and hydrogen sulfide (H_2S) release. These types of accidents are discussed briefly in **Section A.9.4**.

A.9.2 Small Fuel Spill

<u>Spill Size</u>. 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).

<u>Spill Fate</u>. 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. 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. Diesel oil is readily and completely degraded by naturally occurring microbes (NOAA, 2006).

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. 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 ADIOS 2 model results, coupled with spill trajectory information discussed in the next section for a large spill, indicate that a small fuel spill would not affect coastal or shoreline resources. The project area is 178 miles (286 km) from the nearest shoreline (Louisiana). Slicks from 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 of these potential spills on the OCS 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. **DOCD Section 9b** provides a detailed discussion of Shell's response to a spill.

A.9.3 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 **DOCD Section 2j**. Blowouts are rare events and most do not result in oil spills (Bureau of Ocean Energy Management, 2016a).

Spill Size. Shell has calculated the WCD for the DOCD using the requirements prescribed by NTL 2015-N01 as 47,144 barrels of oil per day (BOPD) for the initial release and 47,144 BOPD 30-day average. The detailed analysis of this calculation can be found in **DOCD Section 2j**. The WCD scenario for the DOCD has a low probability of being realized. Some of the factors that are likely to reduce rates and volumes, which 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.

Shell has a robust system in place to prevent blowouts. Included in **DOCD Sections 2j** and **9b** 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 also comply with NTL 2010-N10 and the Final Drilling Safety Rule, 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.

The results for Launch Area C048 (the launch area which includes the project area) are presented in **Table 3**. The model predicts <0.5% chance of shoreline contact within 10 days of a spill. Within 30 days of a spill, the model predicts low conditional probability of shoreline contact (1% to 2%) ranging 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 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, but 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 and will include equipment and services available to Shell through MWCC's development of near-term capability and other industry 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 Launch and Recovery System (LARS), which enables water sampling and monitoring to water depths of 3,000 m. The two 8 ft × 20 ft containers have been certified for offshore use by Det Norske Veritas and the American Bureau of Shipping (ABS). The LARS is a combined winch, A-frame, and 3,000-m 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 **DOCD Section 9b** for a detailed description of spill response measures.

A.9.4 Other Accidents Not Analyzed in Detail

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

Chemical Spill. 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).

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

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 DOCD is Shell's response to NTL 2015-N01, which includes descriptions of measures to prevent a blowout, reduce the likelihood of a blowout, and conduct effective and early intervention in the event of a blowout. Shell will comply with NTL 2010-N10, as extended under NTL 2015-N02, as well as the Final Drilling Safety Rule, which specify additional safety measures for OCS activities. See **DOCD Sections 2j** and **9b** for further information.

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

H_2S Release. WR 508 is classified as H_2S absent. Based on the H_2S absent classification, no further discussion on H_2S impacts is warranted.

B. Affected Environment

The project area is in the Central Planning Area in the Gulf of Mexico, 178 miles (286 km) from the nearest shoreline, 193 miles (311 km) from the onshore support base at Port Fourchon, Louisiana, and 214 miles (344 km) from the helicopter base at Houma, Louisiana. Water depth in the project area is approximately 9,554 ft (2,912 m).

The archaeological assessment identified one sonar contact within 2,000 ft (610 m) of the proposed drilling, completion, well works, and associated subsea installation. The sonar contact was identified as debris and not archaeologically significant (BP America Inc, 2004; Fugro Geo-consulting Inc., 2010; C&C Technologies, 2011; Fugro Geo-consulting Inc., 2011a; b; Forum Energy Technologies, 2012). No archaeological impacts are expected from routine activities in the project area.

A detailed description of the regional affected environment is provided by BOEM (2016c; 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 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 (2016c; 2017a).

C. Impact Analysis

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

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

C.1 Physical/Chemical Environment

C.1.1 Air Quality

Due to the distance from shore-based pollution sources, offshore air quality is expected to be good. The attainment status of federal OCS waters is unclassified because there is no provision in the Clean Air Act for classification of areas outside state waters (BOEM, 2012a).

In general, ambient air quality on coastal counties along the Gulf of Mexico is relatively good (BOEM, 2012a). As of May 2019, Mississippi, Alabama, and Florida Panhandle coastal counties are in attainment of the National Ambient Air Quality Standards (NAAQS) for all criteria pollutants (U.S. Environmental Protection Agency, 2019). St. Bernard Parish in Louisiana and Hillsborough County in Florida are nonattainment areas for sulfur dioxide based on the 2010 standard. One coastal metropolitan area in Texas (Houston-Galveston-Brazoria) is a nonattainment area for 8-hour ozone (2015 Standard). One coastal metropolitan area in Florida (Tampa) is was recently reclassified from a nonattainment area to an attainment area for lead based on the 2008 Standard to Maintenance status as current air quality values meet the 2008 Standard (U.S. Environmental Protection Agency, 2019).

Winds in the region are driven by the clockwise circulation around the Bermuda High (BOEM, 2017a). The Gulf of Mexico is located to the southwest of this center of circulation, resulting in a prevailing southeasterly to southerly flow, which is conducive to transporting emissions toward shore. However, circulation is also affected by tropical cyclones (hurricanes) during summer and fall and by extratropical cyclones (cold fronts) during winter.

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

Impacts of Air Pollutant Emissions

Air pollutant emissions are the only routine IPF anticipated to affect air quality. Offshore air pollutant emissions will result from the operation of the MODU and service vessels, and helicopters, as described in **Section A.3**. These emissions occur mainly from combustion or burning of diesel and Jet-A aircraft fuel. Additionally, exhaust emissions from tanker and barge loadings and transfers would be anticipated, though these would be relatively small (BOEM, 2012a). Primary air pollutants typically associated with OCS activities are suspended PM, SO_x, NO_x, VOCs, and CO.

Due to the distance from shore, routine operations in the project area are not expected to impact air quality along the coast. As noted in the lease sale EISs BOEM (BOEM, 2012a; 2013; 2014b; 2015; 2016c; 2017a), 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 550 Subpart C. The Air Quality Emissions Report (see **DOCD Section 8**) prepared in accordance with BOEM requirements shows that the projected emissions from emission sources associated with the proposed activities meet the BOEM exemption criteria. Therefore, the DOCD is exempt from further air quality review pursuant to 30 CFR 550.303(d).

The Breton Wilderness Area, which is part of the Breton National Wildlife Refuge (NWR), is designated under the Clean Air Act as a Prevention of Significant Deterioration Class I air quality area. The BOEM coordinates with the USFWS if emissions from proposed projects may affect the Breton Class I area. The project area is approximately 243 miles (391 km) from the Breton Wilderness Area. Shell will comply with emissions requirements as directed by the BOEM.

Greenhouse gas emissions contribute to climate change, with impacts on temperature, rainfall, frequency of severe weather, ocean acidification, and sea level rise (Intergovernmental Panel on

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

Impacts of a Small Fuel Spill

Potential impacts of a small spill on air quality are expected to be consistent with those analyzed and discussed by Bureau of Ocean Energy Management (2012a; 2015; 2016c; 2017a). The probability of a small spill would 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 impacts. **DOCD Section 9b** provides detail on spill response measures.

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.9.2**) 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 from a small spill would not be significant.

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

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 Bureau of Ocean Energy Management (2012a; 2015; 2016c; 2017a).

A large oil spill would likely affect air quality by introducing VOCs into the atmosphere through evaporation from the slick. 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 predictions (**Table 3**), no shoreline contact is expected within 10 days of a spill. Within 30 days of a spill, there is a 1% to 2% conditional probability of shoreline contact between Matagorda County, Texas and Plaquemines Parish, Louisiana. Galveston County, Texas, Cameron Parish, Louisiana, and Plaquemines Parish, Louisiana, have the highest probability of shoreline contact, with a 2% chance within 30 days 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 **DOCD Section 2j**. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. **DOCD Section 9b** provides detail on spill response measures. Therefore, no significant spill impacts on air quality are expected.

C.1.2 Water Quality

There are no site-specific baseline water quality data for the project area. Due to the lease location in deep, offshore waters, water quality is expected to be good, with low levels of contaminants. As noted by Bureau of Ocean Energy Management (2017a), deepwater areas in the northern Gulf of Mexico are relatively homogeneous with respect to temperature, salinity, and oxygen. Kennicutt (2000) noted that the deepwater region has little evidence of contaminants in the dissolved or particulate phases of the water column. IPFs that could potentially affect water quality are effluent discharges and two types of accidents (a small fuel spill and a large oil spill).

Impacts of Effluent Discharges

As described in **Section A.4**, NPDES General Permit GMG290103 establishes permit limits and monitoring requirements for effluent discharges from the DP MODU. NPDES permit limits and requirements will be met, and little or no impact on water quality is anticipated.

Water-based drilling muds and cuttings will be released at the seafloor during the initial well intervals before the marine riser is set, which allows their return to the surface vessel. Excess cement slurry and blowout preventer fluid will also be released at the seafloor. Impacts will be limited to the immediate discharge area with little to no impact to regional water quality.

Cuttings wetted with SBMs will be discharged overboard in accordance with the NPDES permit. After discharge, SBM retained on cuttings would be expected to adhere to the cuttings particles and, consequently, would not produce much turbidity as the cuttings sink through the water column (Neff et al., 2000). Recent EISs have concluded that the discharge of treated SBM cuttings will not cause persistent impacts on water quality in the project area (Bureau of Ocean Energy Management, 2012a; 2013). 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 DP 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 DP MODU will flow overboard without treatment. However, rainwater that falls on the DP MODU deck and other areas such as chemical storage areas and places where equipment is exposed will be collected and oil and water separated to meet NPDES permit requirements. Negligible impact on water quality is anticipated.

Other discharges from the DP MODU will be in accordance with the NPDES permit. Discharges include desalination unit brine and non-contact cooling water, blowout preventer fluid, well treatment and completion fluids, workover fluids, excess cement, water-based subsea production control fluid, hydrate inhibitor, treated seawater, fire water, bilge water, and ballast water and are expected to dilute rapidly and have little or no impact on water quality. The DP 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 Bureau of Ocean Energy Management (2012a; 2015; 2016c; 2017a). The probability of a small spill would 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 impacts. **DOCD 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, 2017). It is possible for diesel oil that is dispersed by wave action to form droplets that are small enough be kept in suspension and moved by the currents.

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

The extent and persistence of water quality impacts from a small diesel fuel spill would depend on the meteorological and oceanographic conditions at the time and the effectiveness of spill response measures. It is estimated that more than 90% of a small diesel spill would evaporate or disperse within 24 hours (see **Section A.9.2**). 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, 2006). 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 (see **Section A.9.2**).

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; 2016c; 2017a). 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). Analyses of the entire set of samples associated with the *Deepwater Horizon* incident have confirmed that the application of subsurface dispersants resulted in subsurface hydrocarbon plumes (Spier et al., 2013). A report by Kujawinski et al. (2011) indicates that chemical components of subsea dispersants used during the *Deepwater Horizon* incident persisted for up to 2 months and were detectable up to 186 miles (300 km) from the wellsite at water depths of 3,280 to 3,937 ft (1,000 to 1,200 m). Dispersants were detectable in <9% of the samples (i.e., 353 of the 4,114 total water samples), and concentrations in the samples were significantly below the chronic screening level for dispersants (BOEM, 2012b).

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

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

Due to the project area 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 predictions (**Table 3**), no shoreline contact is expected within 10 days of a spill. Within 30 days of a spill, there is a 1% to 2% conditional probability of shoreline contact between Matagorda County, Texas and Plaquemines Parish, Louisiana. Galveston County, Texas, Cameron Parish, Louisiana, and Plaquemines Parish, Louisiana, have the highest probability of shoreline contact, with a 2% chance within 30 days 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 detailed in **DOCD Section 2j**. In the event of a large spill, water quality could be temporarily affected, but no long-term significant impacts are expected. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. **DOCD Section 9b** provides detail on spill response measures. Therefore, no significant spill impacts on water quality are expected.

C.2 Seafloor Habitats and Biota

Water depth at the project area is approximately 9,554 ft (2,912 m). See **DOCD Section 6a** for further information.

According to Bureau of Ocean Energy Management (2012a; 2013; 2014b; 2015; 2016c; 2017a), existing information for the deepwater Gulf of Mexico indicates that the seafloor is composed primarily of soft sediments; hard bottom communities are rare. C&C Technologies (2011), BP America Inc (2004); Fugro Geo-consulting Inc. (2010; 2011a; 2011b), and Forum Energy Technologies (2012) conducted a shallow hazard assessment survey of WR 508. No features or areas that could support significant, high-density benthic communities were found within 2,000 ft (610 m) of the proposed drilling, completion, well work, and associated subsea infrastructure installation.

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., 2010b; Carvalho et al., 2013), which can be used to describe typical baseline benthic communities that occur at similar water depths elsewhere in the region. **Table 4** summarizes data from two nearby stations within the same faunal zone as the project area. Sediments at stations NB5 and GKF were predominantly clay (55% and 53%) and silt (41% and 45%), respectively (Rowe and Kennicutt, 2009).

Table 4. Baseline benthic community data from stations nearest to the project area in similar water depths sampled during the Northern Gulf of Mexico Continental Slope Habitats and Benthic Ecology Study (From: Wei, 2006, Rowe and Kennicutt, 2009).

Station	Location Relative to Lease Block	Water Depth (m)	Abundance		
			Meiofauna (individuals m^{-2})	Macroinfauna (individuals m^{-2})	Megafauna (individuals ha^{-1})
NB5	29 miles SW	2,063	117,263	706	1,600
GKF	47 miles NE	2,460	84,348	737	--

Meiofaunal and megafaunal abundance from Rowe and Kennicutt (2009); macroinfaunal abundance from Wei (2006).
-- = No data available.

Densities of meiofauna (animals that pass through a 0.5-mm sieve but are retained on a 0.062-mm sieve) in sediments collected at water depths representative of the project area typically range 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 macroinfauna is characterized by small mean individual sizes and low densities, both of which reflect the intrinsically low primary production in surface waters of the Gulf of Mexico surface waters (Wei, 2006). Densities decrease exponentially with water depth (Carvalho et al., 2013). Based on an equation presented by Wei (2006), macroinfaunal densities in the water depth of the project area is expected to be approximately 787 individuals m^{-2}; however, actual densities are unknown and often highly variable.

Polychaetes are typically the most abundant macroinfaunal group on the northern Gulf of Mexico continental slope, followed by amphipods, tanaids, bivalves, and isopods. 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 in Zone 3W consists of stations on the mid Texas-Louisiana Slope ranging in depth from 6,152 to 9,869 ft (1,875 to 3,008 m). The most abundant species in this zone were the polychaetes *Levinsenia uncinata*, *Paraonella monilaris*, and *Tachytrypane* spp.; the bivalve *Heterodonta* spp.; and the isopod *Macrostylis* sp. (Wei, 2006; Wei et al., 2010a).

Megafaunal density from a nearby station was 1,600 individuals ha^{-1} (**Table 4**). Common megafauna included motile groups such as decapods, ophiuroids, holothurians, and demersal fishes, as well as sessile groups such as sponges and anemones (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). For example, in deep sea sediments, Main et al. (2015) observed that microbial oxygen consumption rates increased and bacterial biomass decreased with hydrocarbon contamination. Bacterial biomass at the depth range of the project area typically is about 1 to 2 grams of carbon per square meter ($g\ C\ m^{-2}$) in the top 6 in. (15 cm) of sediments (Rowe and Kennicutt, 2009).

IPFs that could potentially affect benthic communities are physical disturbance, effluent discharges (drilling mud and cuttings), and a large oil spill resulting from a well blowout at the seafloor. A small fuel spill would not affect benthic communities because the diesel fuel would float and dissipate on the sea surface.

Impacts of Physical Disturbance to the Seafloor

In water depths such as those that are encountered in the project area, DP MODUs disturb the seafloor only around the wellbore (seafloor surface hole location) where the bottom template and blowout preventer are located. Due to the water depth in the project area, it is anticipated that the subsea equipment will not be buried by trenching, but will instead be placed on the seafloor, decreasing the area of impact (**DOCD Section 6**). Depending upon the specific well configuration, the seafloor disturbance is generally about 0.62 ac (0.25 ha) per well and between 1.2 ac (0.5 ha) and 2.5 ac (1.0 ha) per kilometer of flowline installation (BOEM, 2012a). Soft bottom benthic communities will also be disturbed in the area of installation of seafloor equipment and flowlines.

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

Impacts of Effluent Discharges

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

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

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

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

Impacts of a Large Oil Spill

Potential impacts of a large oil spill on the benthic community are expected to be consistent with those analyzed and discussed by BOEM (2012a; 2015; 2016c; 2017a). Impacts from a subsea blowout could include smothering and exposure to toxic hydrocarbons from oiled sediment settling to the seafloor. The most likely effects of a subsea blowout on benthic communities would be within a few hundred meters of the wellsites. BOEM (2012a) estimated that a severe subsurface blowout could suspend and disperse sediments within a 984 ft (300 m) radius. Although coarse sediments (sands) would probably settle at a rapid rate within 1,312 ft (400 m) from the blowout site, fine sediments (silts and clays) could be suspended for more than 30 days and dispersed over a much wider area. A previous study characterized surface sediments at the sampling stations in the vicinity of the proposed drilling, completion, well work, and subsea installation. A previous study characterized surface sediments at the sampling stations close to the project area. Stations NB5 and GKF were predominantly clay (55% and 53%) and silt (41% and 45%), respectively (Rowe and Kennicutt, 2009).

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

While the behavior and impacts of subsurface oil plumes are not well known, the Macondo findings indicate that benthic impacts likely extend beyond the immediate vicinity of the wellsite, depending on the extent, trajectory, and persistence of the plume. Baguley et al. (2015) noted that while nematode abundance increased with proximity to the Macondo wellhead, copepod abundance, relative species abundance, and diversity decreased in response to the *Deepwater Horizon* incident. Washburn et al. (2017) noted that richness, diversity, and evenness were affected within a radius of 1 km of the wellhead. Reuscher et al. (2017) found that meiofauna and macrofauna community diversity was significantly lower in areas that were impacted by Macondo oil. Demopoulos et al. (2016) reported abnormally high variability in meiofaunal and macrofaunal density in areas near the Macondo wellhead, which supports the Valentine et al. (2014b) supposition that hydrocarbon deposition and impacts in the vicinity of the Macondo wellhead were patchy. While there are some indications of partial recovery of benthic fauna, as of 2015, full recovery 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 **DOCD Section 2j**. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. **DOCD Section 9b** provides detail on spill response measures. Therefore, no significant spill impacts on soft bottom communities are expected.

C.2.2 High-Density Deepwater Benthic Communities

As defined in NTL 2009-G40, high-density deepwater benthic communities are features or areas that could support high-density chemosynthetic communities, high-density deepwater corals, or other associated high-density hard bottom communities. Chemosynthetic communities were discovered in the central Gulf of Mexico in 1984 and have been studied extensively (MacDonald, 2002). Deepwater coral communities are also known from numerous locations in the Gulf of Mexico (Cordes et al., 2008; Brooks et al., 2012; Demopoulos et al., 2017; Hourigan et al., 2017). These communities occur almost exclusively on exposed authigenic carbonate rock created by a biogeochemical (microbial) process, and on shipwrecks.

Monitoring programs on the Gulf of Mexico continental slope have shown that benthic impacts from drilling discharges typically are concentrated within approximately 1,640 ft (500 m) of the wellsite, although detectable deposits may extend beyond this distance (Continental Shelf Associates, 2004; Neff et al., 2005; Continental Shelf Associates, 2006). The nearest known high-density deepwater benthic communities include those in Green Canyon Block 287. The community in Green Canyon Block 287 is located approximately 81 miles (130 km) north from the project area (BOEM, nd).

High-resolution geophysical datasets and reprocessed exploration three dimensional seismic data, have been conducted in the project area as part of the assessment of archaeological resources and shallow hazards (BP America Inc, 2004; Fugro Geo-consulting Inc., 2010; C&C Technologies, 2011; Fugro Geo-consulting Inc., 2011a; b; Forum Energy Technologies, 2012). Based on these reports, features or areas that could support high-density chemosynthetic or other benthic communities are not anticipated in the project area.

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 disturbance and effluent discharge 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 on the sea surface.

Impacts of a Large Oil Spill

The geohazards assessment did not identify high-density deepwater benthic communities within 2,000 ft (610 m) of the proposed drilling, completion, well work, and associated subsea installation (BP America Inc, 2004; Fugro Geo-consulting Inc., 2010; C&C Technologies, 2011; Fugro Geo-consulting Inc., 2011a; b; Forum Energy Technologies, 2012).

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

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

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

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

Although no known deepwater coral communities are likely to be impacted by a subsurface plume, previously unidentified communities may be encountered if a large subsurface oil spill occurs. However, because of the scarcity of deepwater hard bottoms communities, their comparatively low surface area, and the distancing 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 **DOCD Section 2j**. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. **DOCD Section 9b** provides detail on spill response measures. Potential impacts on sensitive resources would be an integral part of the decision and approval process for the use of dispersants. Therefore, no significant spill impacts on deepwater benthic communities are expected.

C.2.3 Designated Topographic Features

The blocks are 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 Block 947, located 105 miles (169 km) north of the project area. There are no IPFs associated with either routine operations or accidents that could cause impacts to designated topographic features due to the distance from the 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 blocks are located about 234 miles (377 km) northeast of the project area in Main Pass Block 290.

There are no IPFs associated with either routine operations or accidents that could cause impacts to pinnacle trend area live bottoms due to the distance from the 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) northeast of the project area.

There are no IPFs associated with either routine operations or accidents that could cause impacts to eastern Gulf of Mexico live bottom areas due to the distance from the project area.

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

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

Endangered, Threatened, or species of concern that may occur in the project area and/or along the northern Gulf Coast are listed in **Table 5**. The table also indicates the location of designated critical habitat in the Gulf of Mexico. Critical habitat is defined as (1) specific areas within the geographical area occupied by the species at the time of listing, if they contain physical or biological features essential to conservation, and those features may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by the species if the agency determines that the area itself is essential for conservation. NMFS has jurisdiction over ESA-listed marine mammals (cetaceans) and fishes in the Gulf of Mexico, and USFWS has jurisdiction over ESA-listed birds and the West Indian manatee. These two agencies share federal jurisdiction over sea turtles, with NMFS having lead responsibility at sea and USFWS on nesting beaches.

Table 5. Listed endangered, threatened, and candidate species in the project area and along the U.S. Gulf Coast. dash (--) = not found in the area.

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

Table 5. (Continued).

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

Abbreviations: E = endangered; T = threatened; X = potentially present; -- = not present.

a 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.

Coastal Endangered or Threatened species that may occur along the U.S. Gulf Coast include the West Indian manatee, Piping Plover, Whooping Crane, Gulf sturgeon, and four subspecies of beach mouse. Critical habitat has been designated for all of these species as indicated in **Table 5** and discussed in individual sections. Two other coastal bird species (Bald Eagle and Brown Pelican) are no longer federally listed as Endangered or Threatened; these are discussed in **Section C.4.2**.

Five sea turtle species, the sperm whale, and the oceanic whitetip shark are the only Endangered or Threatened species likely to occur within the project area. The listed sea turtles include the leatherback turtle, Kemp's ridley turtle, hawksbill turtle, loggerhead turtle, and green turtle (Pritchard, 1997). Effective August 11, 2014, NMFS has designated certain marine areas as critical habitat for the northwest Atlantic distinct population segment (DPS) of the loggerhead sea turtle (**Section C.3.5**). No critical habitat has been designated in the Gulf of Mexico for the leatherback turtle, Kemp's ridley turtle, hawksbill turtle, or the green turtle. Listed marine mammal species include one odontocete (sperm whale) which is known to occur in the Gulf of Mexico (Würsig et al., 2000); no critical habitat has been designated for the sperm whale. The Bryde's whale exists in the Gulf of Mexico as a small, resident population. It is the only baleen whale known to be resident to the Gulf. The genetically distinct Northern Gulf of Mexico stock is severely restricted in range, being found only in the northeastern Gulf in the waters of the DeSoto Canyon (Waring et al., 2016) and are therefore not likely to occur within the project area.

The giant manta ray (*Manta birostris*) could occur in the project area but is most commonly observed in the Gulf of Mexico at the Flower Garden Banks. The Nassau grouper (*Epinephelus striatus*) has been observed in the Gulf of Mexico at the Flower Garden Banks but is most commonly observed in shallow tropical reefs of the Caribbean and is unlikely to occur in the project area.

Five endangered mysticete whales (blue whale, fin whale, humpback whale, North Atlantic right whale, and sei whale) have been reported from the Gulf of Mexico but are considered rare or extralimital (Würsig et al., 2000). These species are not included in the most recent NMFS stock assessment reports (Waring et al., 2015; Hayes et al., 2018) nor in the most recent BOEM multisale EIS (BOEM, 2017a); therefore, they are not considered further in the EIA.

Seven threatened coral species are known from the northern Gulf of Mexico: elkhorn coral (*Acropora palmata*), staghorn coral (*Acropora cervicronis*), lobed star coral (*Orbicella annularis*), mountainous star coral (*Orbicella faveolata*), boulder star coral (*Orbicella franksi*), pillar coral (*Dendrogyra cylindrus*), and rough cactus coral (*Mycetophyllia ferox*). None of these species are expected to be present in the project area (see **Section C.3.13**).

There are no other endangered animals or plants in the Gulf of Mexico that are reasonably likely to be affected by either routine or accidental events. Other species occurring at certain locations in the Gulf of Mexico, such as the endangered smalltooth sawfish (*Pristis pectinata*) and the endangered Florida salt marsh vole (*Microtus pennsylvanicus dukecampbelli*), are remote from the project area and highly unlikely to be affected.

C.3.1 Sperm Whale (Endangered)

The only Endangered marine mammal likely to be present at or near the project area is the sperm whale (*Physeter macrocephalus*). Resident populations of sperm whales occur within the Gulf of Mexico. 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 (2010b). Threats are defined as "any factor that could represent an impediment to recovery," and include fisheries interactions, anthropogenic noise, vessel interactions, contaminants and pollutants, disease, injury from marine debris, research, predation and natural mortality, direct harvest, competition for resources, loss of prey base due to climate change and ecosystem change, and cable laying. In the Gulf of Mexico, the impacts from many of these threats are identified as either low or unknown (BOEM, 2012a).

The distribution of sperm whales in the Gulf of Mexico is correlated with mesoscale physical features such as eddies associated with the Loop Current (Jochens et al., 2008). Sperm whale populations in the north-central Gulf of Mexico are present there throughout the year (Davis et al., 2000). Results of a multi-year tracking study show female sperm whales typically concentrated along the upper continental slope between the 656- and 3,280-foot (200- and 1,000-meter) depth contours (Jochens et al., 2008). Male sperm whales were more variable in their movements and were documented in water depths greater than 9,843 ft (3,000 m). Generally, groups of sperm whales sighted in the Gulf of Mexico during the MMS-funded Sperm Whale Seismic Study consisted of mixed-sex groups comprising adult females and juveniles, and groups of bachelor males. Typical group size for mixed groups was 10 individuals (Jochens et al., 2008). A review of sighting reports from seismic mitigation surveys in the Gulf of Mexico conducted over a 6-year period found a mean group size for sperm whales of 2.5 individuals (Barkaszi et al., 2012).

In these mitigation surveys, sperm whales were the most common cetacean encountered. Results of the Sperm Whale Seismic Study showed that sperm whales transit through the vicinity of the project area. Movements of satellite-tracked individuals suggest that this area of the Gulf of Mexico 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 vessel presence, noise, and lights; support vessel and helicopter traffic noise; support vessel strikes; 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. Compliance with BSEE NTL 2015-G03 will minimize the potential for marine debris-related impacts on sperm whales.

Impacts of Vessel Presence, Noise, and Lights

Some sounds produced by the DP 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 rig operations is relatively weak in intensity, and an individual animal's noise exposure would be transient. As discussed in **Section A.1**, source levels generated by an actively drilling MODU are maximum broadband (10 Hz to 10 kHz) energy of about 190 dB re 1 µPa m (Hildebrand, 2005).

NMFS (2018b) lists sperm whales in the same functional hearing group (i.e., mid frequency cetaceans) as most dolphins and other toothed whales, with an estimated hearing sensitivity from 150 Hz to 160 kHz. Therefore, vessel related noise is likely to be heard by sperm whales. Frequencies <150 Hz produced by the drilling operations are not likely to be perceived with any significance by mid-frequency cetaceans. The sperm whale may possess better low frequency hearing than some of the other odontocetes, although not as low as many baleen whale species that primarily produce sounds between 30 Hz and 5 kHz (Wartzok and Ketten, 1999). Generally, most of the acoustic energy produced by sperm whales is present at frequencies below 10 kHz, although diffuse energy up to and past 20 kHz is common, with source levels up to 236 dB re 1 µPa m (Møhl et al., 2003).

It is expected that due to the relatively stationary nature of the MODU operations, sperm whales would move away from the proposed operations area, and noise levels that could cause auditory injury would be avoided. Noise associated with proposed vessel operations may cause behavioral (disturbance) effects to sperm whales. Observations of sperm whales near offshore oil and gas operations suggest an inconsistent response to anthropogenic marine sound (Jochens et al., 2008). Most observations of behavioral responses of marine mammals to anthropogenic sounds, in general, have been limited to short-term behavioral responses, which included the cessation of feeding, resting, or social interactions (NMFS, 2009a). Animals can determine the direction from which a sound arrives based on cues, such as differences in arrival times, sound levels, and phases at the two ears. Thus, an animal's directional hearing capabilities have a bearing on its ability to avoid noise sources (National Research Council, 2003b).

NOAA Fisheries West Coast Region (2018b) presents criteria that are used in the interim to determine behavioral disturbance thresholds for marine mammals and are applied equally across all functional hearing groups. Received SPL_{rms} of 120 dB re 1 µPa from a non-impulsive source are considered high enough to elicit a behavioral reaction in some marine mammal species. The 120-dB isopleth may extend tens to hundreds of kilometers from the source depending on the propagation environment.

For mid frequency cetaceans exposed to a non-impulsive source (such as MODU operations), permanent threshold shifts are estimated to occur when the mammal has received a sound exposure level (SEL) of 198 dB re 1 μPa^2 s over a 24-hour period (NMFS, 2016a). Similarly, temporary threshold shifts are estimated to occur when the mammal has received an SEL of 178 dB re 1 μPa^2 s over a 24-hour period. Based on transmission loss calculations (see Urick, 1983), typical sources with DP thrusters are not expected to produce received SPL_{rms} greater than 160 dB re 1 µPa beyond 105 ft (32 m) from the source. Due to the short propagation distance of these SPL, 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 DP MODU will be located within a deepwater, open ocean environment. Sounds generated by drilling operations will be generally non-impulsive, with some variability in sound level. This analysis assumes that the continuous nature of sounds produced by the MODU will provide individual whales with cues relative to the direction and relative distance (sound intensity) of the sound source, and the fixed position of the MODU will allow for active avoidance of potential physical impacts. Drilling-related noise associated with this project will contribute to increases in the ambient noise environment of the Gulf of Mexico, but it is not expected to be in amplitudes sufficient enough to cause hearing effects to sperm whales.

DP MODU lighting and rig presence are not identified as IPFs for sperm whales (NMFS, 2007; Bureau of Ocean Energy Management, 2012a; 2013; 2014b; 2015; 2016c; 2017a).

Impacts of Support Vessel and Helicopter Traffic

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, 2010b). 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 300 ft (91 m) or greater whenever possible. Vessel operators are required to reduce vessel speed to 10 knots or less, when safety permits, when mother/calf pairs, pods, or large assemblages of cetaceans are observed near an underway vessel. Compliance with this NTL will minimize the likelihood of vessel strikes as well as reduce the chance for disturbing sperm whales.

NMFS (2007) analyzed the potential for vessel strikes and harassment of sperm whales in its Biological Opinion for the Five-Year Oil and Gas Leasing Program in the Central and Western Planning Areas of the Gulf of Mexico. With implementation of the mitigation measures in NTL BOEM-2016-G01, NMFS concluded that the likelihood of collisions between vessels and sperm whales would be reduced to insignificant levels. NMFS also concluded that the observed avoidance of passing vessels by sperm whales is an advantageous response to avoid a potential threat and is not expected to result in any significant effect on migration, breathing, nursing, breeding, feeding, or sheltering to individuals, or have any consequences at the level of the population. With implementation of the vessel strike avoidance measures, NMFS concluded that the potential for harassment of sperm whales would be reduced to discountable levels.

Helicopter traffic also has the potential to disturb sperm whales. Smultea et al. (2008) documented responses of sperm whales offshore Hawaii to fixed wing aircraft flying at an altitude of 804 ft (245 m). A reaction to the initial pass of the aircraft was observed during 3 (12%) of 24 sightings. All three reactions consisted of a hasty dive and occurred at less than 1,180 ft (360 m) lateral distance from the aircraft. Additional reactions were seen when aircraft circled certain whales to make further observations. Based on other studies of cetacean responses to sound, the authors concluded that the observed reactions to brief overflights by the aircraft were short-term and limited to behavioral disturbances (Smultea et al., 2008).

Helicopters maintain altitudes above 700 ft (213 m) during transit to and from the offshore working area. In the event that a whale is seen during transit, the helicopter will not approach or circle the animal(s). In addition, guidelines and regulations issued by NMFS under the authority of the MMPA specify that helicopters maintain an altitude of 1,000 ft (305 m) within 300 ft (91 m) of marine mammals (BOEM, 2016a; 2017a). Although whales may respond to helicopters (Smultea et al., 2008), NMFS (2007) concluded that this altitude would minimize the potential for disturbing sperm whales. Therefore, no significant impacts are expected.

Impacts of a Small Fuel Spill

Potential spill impacts on marine mammals including sperm whales are discussed by NMFS (2007) and BOEM (2012a; 2015; 2016c; 2017a). Oil impacts on marine mammals are discussed by Geraci and St. Aubin (1990) and by the Marine Mammal Commission (MMC) (2011). For the DOCD, 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. **DOCD 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.9.2** 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 (Marine Mammal Commission [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; 2016c; 2017a), and NMFS (2007). Oil impacts on marine mammals are discussed by Geraci and St. Aubin (1990) and by the MMC (2011). For the DOCD, there are no unique site-specific issues with respect to spill impacts on sperm whales.

Impacts of oil spills on sperm whales can include direct impacts from oil exposure as well as indirect impacts due to response activities and materials (e.g., vessel traffic, noise, and dispersants) (MMC, 2011). Direct physical and physiological effects can include skin irritation, inflammation, or necrosis; chemical burns of skin, eyes, and mucous membranes; inhalation of toxic fumes; ingestion of oil (and dispersants) directly or via contaminated prey; and stress from the activities and noise of response vessels and aircraft. The level of impact of oil exposure depends on the amount, frequency, and duration of exposure; route of exposure; and type or condition of petroleum compounds or chemical dispersants (Hayes et al., 2018). 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 **DOCD Section 2j**. In the event of oil from a large spill contacting sperm whales, it is expected that impacts resulting in the injury or death of individual sperm whales would be adverse but not likely significant at the population level. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. **DOCD Section 9b** provides detail on spill response measures. Therefore, no significant spill impacts on sperm whales are expected.

C.3.2 Bryde's Whale (Endangered)

The Bryde's whale (*Balaenoptera edeni*) is the only year-round resident baleen whale in the northern Gulf of Mexico. The Bryde's whale is sighted most frequently in the waters over Desoto Canyon between the 328 ft (100 m) and 3,280 ft (1,000 m) isobaths (Rosel et al., 2016; Hayes et al., 2018). Sightings have also been made off western Florida, although there have been some in the west-central portion of the northeastern Gulf of Mexico as well. Based on the available data, it is possible that Bryde's whales could occur in the project area.

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., 2018). On April 15, 2019, NMFS issued a final rule to list the Gulf of Mexico DPS of Bryde's whale as Endangered under the ESA. The listing became effective on May 15, 2019.

IPFs that could affect the Bryde's whales include vessel presence, noise, and lights; support vessel and helicopter traffic; and both types of spill accidents: a small fuel spill and a large oil spill. Effluent discharges are likely to have negligible impacts on Bryde's whales due to rapid dispersion, the small area of ocean affected, the intermittent nature of the discharges, and the mobility and low abundance of Bryde's whales in the Gulf of Mexico. Compliance with BSEE NTL 2015-G03 will minimize the potential for marine debris-related impacts on Bryde's whales.

Impacts of Vessel Presence, Noise, and Lights

Some sounds produced by the MODU may be emitted at levels that could potentially disturb individual whales or mask the sounds animals would normally produce or hear. Noise associated with drilling is relatively weak in intensity, and an individual animal's noise exposure would be transient. As discussed in **Section A.1**, frequencies generated by an actively drilling MODU are maximum broadband (10 Hz to 10 kHz) with a SPL_{rms} of approximately 177 to 190 dB re 1 µPa (Hildebrand, 2005).

NMFS (2018b) lists Bryde's whales in the functional hearing group of low frequency cetaceans (baleen whales), with an estimated hearing sensitivity from 7 Hz to 35 kHz. Therefore, vessel related noise is likely to be heard by Bryde's whales. Frequencies <150 Hz produced by the drilling operations is more likely to be perceived by low-frequency cetaceans.

It is expected that, due to the relatively stationary nature of the MODU operations, Bryde's whales would move away from the proposed operations area, and noise levels that could cause auditory injury would be avoided. Noise associated with proposed vessel operations may cause behavioral (disturbance) effects to individual Bryde's whales. NOAA Fisheries West Coast Region (2018b) presents criteria that are used in the interim to determine behavioral disturbance thresholds for marine mammals and are applied equally across all hearing groups. Received SPL_{rms} of 120 dB re 1 µPa from a non-impulsive source are considered high enough to elicit a behavioral reaction in some marine mammal species. The 120-dB isopleth may extend tens to hundreds of kilometers from the source depending on the propagation environment. However, exposure to a SPL_{rms} of 120 dB re 1 µPa does not equate to a behavioral response or a biological consequence; rather it represents the level at which onset of a behavioral response may occur.

For low frequency cetaceans, specifically the Bryde's whale, permanent and temporary threshold shift onset is estimated to occur at cumulative SELs of 199 dB re 1 μPa^2 s and 179 re 1 μPa^2 s, repectively. MODU operatorions and DP thrusters are not expected to reach permanent or temporary theshold hold shift values, and based on open water transmission loss calculations (Urick, 1983), noise produced by typical sources with DP thrusters in use during drilling, are not expected to propagate SPL_{rms} greater than 120 dB re 1 µPa beyond 2,297 ft (700 m) from the source.

The MODU will be located within a deepwater, open ocean environment. Sounds generated by drilling operations will be generally non-impulsive, with some variability in sound level and frequency. This analysis assumes that the continuous nature of sounds produced by the MODU will provide individual whales with cues relative to the direction and relative distance (sound intensity) of the sound source, and the fixed position of the MODU will allow for active avoidance of potential physical impacts. Drilling-related noise associated with this project will contribute to increases in the ambient noise environment of the Gulf of Mexico, but it is not expected to be in amplitudes sufficient enough to cause hearing effects to Bryde's whales and due to the low density of Bryde's whales in the Gulf of Mexico, no significant impacts are expected.

Impacts of Support Vessel and Helicopter Traffic

Support vessel traffic has the potential to disturb Bryde's whales and creates a risk of vessel strikes. To reduce the potential for vessel strikes, BOEM has issued NTL BOEM-2016-G01, which recommends protected species identification training and that vessel operators and crews maintain a vigilant watch for marine mammals and slow down or stop their vessel to avoid striking protected species and requires operators to report sightings of any injured or dead protected species. When whales are sighted, vessel operators and crews are required to attempt to maintain a distance of 300 ft (91 m) or greater whenever possible. Vessel operators are required to reduce vessel speed to 10 knots or less, when safety permits, when mother/calf pairs, pods, or large assemblages of cetaceans are observed near an underway vessel. Compliance with this NTL will minimize the likelihood of vessel strikes as well as reduce the chance for disturbing Bryde's whales.

Helicopter traffic also has the potential to disturb Bryde's whales. Based on studies of cetacean responses to sound, the observed reactions to brief overflights by aircraft were short-term and limited to behavioral disturbances (Smultea et al., 2008). Helicopters maintain altitudes above 700 ft (213 m) during transit to and from the offshore working area. In the event that a whale is seen during transit, the helicopter will not approach or circle the animal(s). In addition, guidelines and regulations issued by NMFS under the authority of the MMPA specify that helicopters maintain an altitude of 1,000 ft (305 m) within 300 ft (91 m) of marine mammals (BOEM, 2016a; 2017a). Due to the brief potential for disturbance the low density of Bryde's whales thought to reside in the Gulf of Mexico, no significant impacts are expected.

Impacts of a Small Fuel Spill

Potential spill impacts on marine mammals are discussed by NMFS (2007) and BOEM (2012a; 2015; 2016c; 2017a). Oil impacts on marine mammals are discussed by Geraci and St. Aubin (1990) and by the MMC (2011). The probability of a fuel spill will be minimized by Shell's preventative measures during routine operations, including fuel transfer. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the potential for impacts on Bryde's whales. **DOCD Section 9b** provides detail on spill response measures. Given the open ocean location of the project area and the duration of a small spill, the opportunity for impacts to occur would be very brief.

A small fuel spill in offshore waters would produce a thin slick on the water surface and introduce concentrations of petroleum hydrocarbons and their degradation products. The extent and persistence of impacts would depend on the meteorological and oceanographic conditions at the time of the spill as well as the effectiveness of spill response measures. **Section A.9.1** discusses the likely fate of a small fuel spill and indicates that more than 90% would evaporate or disperse naturally within 24 hours. The area of diesel fuel on the sea surface would range from 1.2 to 12 ac (0.5 to 5 ha), depending on sea state and weather conditions.

Direct physical and physiological effects of exposure to diesel fuel could include skin irritation, inflammation, or necrosis; chemical burns of skin, eyes, and mucous membranes; inhalation of toxic fumes; ingestion of oil directly or via contaminated prey; and stress from the activities and noise of response vessels and aircraft (MMC, 2011). However, due to the limited areal extent and short duration of water quality impacts from a small fuel spill, as well as the mobility of Bryde's whales and the unlikelihood of Bryde's whales in the project area, no significant impacts are expected.

Impacts of a Large Oil Spill

Potential spill impacts on marine mammals are discussed by BOEM (2012a; 2015; 2016c; 2017a), and NMFS (2007). Oil impacts on marine mammals are discussed by Geraci and St. Aubin (1990) and by the MMC (2011).

Potential impacts of a large oil spill on Bryde's whales could include direct impacts from oil exposure as well as indirect impacts due to response activities and materials (e.g., vessel traffic, noise, and dispersants) (MMC, 2011). Direct physical and physiological effects could include skin irritation, inflammation, or necrosis; chemical burns of skin, eyes, and mucous membranes;

inhalation of toxic fumes; ingestion of oil (and dispersants) directly or via contaminated prey; and stress from the activities and noise of response vessels and aircraft. The level of impact of oil exposure depends on the amount, frequency, and duration of exposure; route of exposure; and type or condition of petroleum compounds or chemical dispersants (Hayes et al., 2018). Complications of the above may lead to dysfunction of immune and reproductive systems, physiological stress, declining physical condition, and death. Behavioral responses can include displacement of animals from prime habitat, disruption of social structure, changing prey availability and foraging distribution and/or patterns, changing reproductive behavior/productivity, and changing movement patterns or migration (MMC, 2011).

In the event of a large spill, the level of vessel and aircraft activity associated with spill response could disturb Bryde's whales and potentially result in vessel strikes, entanglement, or other injury or stress. Response vessels would operate in accordance with NTL BOEM-2016-G01 (see **Table 1**) to reduce the potential for striking or disturbing these animals.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in **DOCD Section 2j**. In the event of oil from a large spill contacting Bryde's whales, it is expected that impacts resulting in the injury or death of individual Bryde's whales would be adverse but not likely significant at the population level. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. **DOCD Section 9b** provides detail on spill response measures.

C.3.3 West Indian Manatee (Endangered)

Most of the Gulf of Mexico West Indian manatee (*Trichechus manatus*) population is located in peninsular Florida (USFWS, 2001). 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; Hieb et al., 2017) into Alabama and Louisiana coastal habitats, with some individuals traveling as far west as Texas (Fertl et al., 2005). There have been three verified reports of Florida manatee sightings on the OCS during seismic mitigation surveys in mean water depths of over 1,969 ft (600 m) (Barkaszi and Kelly, 2018). One of these sightings resulted in a shutdown of airgun operations. A species description is presented in the recovery plan for this species (USFWS, 2001).

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.9.2**, a small fuel spill would not be expected to make landfall or reach coastal waters prior to breaking up. Compliance with NTL BSEE 2015-G013 will minimize the potential for marine debris-related impacts on manatees. Consistent with the analysis by Bureau of Ocean Energy Management (2016a), impacts of routine project-related activities on the manatee would be negligible.

Impacts of Support Vessel and Helicopter Traffic

Support vessel traffic associated with routine MODU operations has the potential to disturb manatees, and there is also a risk of vessel strikes, which are identified as a threat in the recovery plan for this species (USFWS, 2001). 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. Compliance with NTL BOEM-2016-G01 will minimize the likelihood of vessel strikes, and no significant impacts on manatees are expected.

Depending on flight altitude, helicopter traffic also has the potential to disturb manatees. Rathbun (1988) reported that manatees were disturbed more by helicopters than by fixed-wing aircraft; however, the helicopter was flown at relatively low altitudes of 66 to 525 ft (20 to 160 m). Helicopters used in support operations maintain a minimum altitude of 700 ft (213 m) while in transit offshore, 1,000 ft (305 m) over unpopulated areas or across coastlines, and 2,000 ft (610 m) overpopulated 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 300 ft (91 m) of marine mammals (BOEM, 2012a; b). This mitigation measure will minimize the potential for disturbing manatees, and no significant impacts are expected.

Impacts of a Large Oil Spill

The 30-day OSRA modeling results summarized in **Table 3** no shoreline contact is predicted within 10 days of a spill. Within 30 days, four Texas counties and four Louisiana parishes have a 1% to 2% probability of being contacted. There is no manatee critical habitat designated in these areas, and the number of manatees potentially present is a small fraction of the population in peninsular Florida.

In the event that manatees were exposed to oil, effects could include direct impacts from oil exposure, as well as indirect impacts due to response activities and materials (e.g., vessel traffic, noise, and dispersants) (MMC, 2011). Direct physical and physiological effects can include asphyxiation, acute poisoning, lowering of tolerance to other stress, nutritional stress, and inflammation infection (BOEM, 2017a). Indirect impacts include stress from the activities and noise of response vessels and aircraft (BOEM, 2017a). Complications of the above may lead to dysfunction of immune and reproductive systems, physiological stress, declining physical condition, and death. Behavioral responses can include displacement of animals from prime habitat, disruption of social structure, changing prey availability and foraging distribution and/or patterns, changing reproductive behavior/productivity, and changing movement patterns or migration (MMC, 2011).

In the event that a large spill reached coastal waters where manatees were present, the level of vessel and aircraft activity associated with spill response could disturb manatees and potentially result in vessel strikes, entanglement, or other injury or stress. Response vessels would operate in accordance with NTL BOEM-2016-G01 (see **Table 1**) to reduce the potential for striking or disturbing these animals.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in **DOCD Section 2j**. In the event of oil from a large spill entering areas inhabited by manatees, it is expected that impacts resulting in the injury or death of individual manatees could be significant at the population level. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. **DOCD Section 9b** provides detail on spill response measures. Therefore, no significant spill impacts on manatees are expected.

C.3.4 Non-Endangered Marine Mammals

All marine mammal species are protected under the MMPA. In addition to the three endangered species of marine mammals that were cited in **Sections C.3.1** to **C.3.3**, 20 additional species of marine mammals may be found in the Gulf of Mexico. These include the dwarf and pygmy sperm whales, four species of beaked whales, and 14 species of delphinid whales and dolphins (see **DOCD Section 6h**). The minke whale (*Balaenoptera acutorostrata*) is considered rare in the Gulf of Mexico, and is therefore not considered further in the EIA (BOEM, 2012a). The most common non-endangered cetaceans in the deepwater environment are odontocetes (toothed whales and dolphins) such as the pantropical spotted dolphin, spinner dolphin, and Clymene dolphin. A brief summary is presented in this section, and additional information on these groups is presented by BOEM (2017a).

Dwarf and pygmy sperm whales. At sea, it is difficult to differentiate dwarf sperm whales (*Kogia sima*) from pygmy sperm whales (*Kogia breviceps*), and sightings are often grouped together as *Kogia* spp. Both species have a worldwide distribution in temperate to tropical waters. In the Gulf of Mexico, both species occur primarily along the continental shelf edge and in deeper waters off the continental shelf (Mullin et al., 1991; Mullin, 2007; Waring et al., 2015). Either species could occur in the project area.

Beaked whales. Four species of beaked whales are known from the Gulf of Mexico. They are Blainville's beaked whale (*Mesoplodon densirostris*), Sowerby's beaked whale (*Mesoplodon bidens*), Gervais' beaked whale (*Mesoplodon europaeus*), and Cuvier's beaked whale (*Ziphius cavirostris*). Stranding records (Würsig et al., 2000), as well as passive acoustic monitoring in the Gulf of Mexico (Hildebrand et al., 2015), suggest that Gervais' beaked whale and Cuvier's beaked whale are the most common species in the region. The Sowerby's beaked whale is considered extralimital, with only one documented stranding in the Gulf of Mexico (Bonde and O'Shea, 1989). Blainville's beaked whales are rare, with only four documented strandings in the northern Gulf of Mexico (Würsig et al., 2000).

Due to the difficulties of at-sea identification, beaked whales in the Gulf of Mexico are identified either as Cuvier's beaked whales (*Ziphius* spp.) or grouped into an undifferentiated species complex (*Mesoplodon* spp.). In the northern Gulf of Mexico, they are broadly distributed in waters greater than 3,281 ft (1,000 m) over lower slope and abyssal landscapes (Davis et al., 2000). Any of these species could occur in the project area (Waring et al., 2015; Hayes et al., 2018).

Delphinids. Fourteen species of delphinids are known to occur in the Gulf of Mexico: Atlantic spotted dolphin (*Stenella frontalis*), bottlenose dolphin (*Tursiops truncatus*), Clymene dolphin (*Stenella clymene*), killer whale (*Orcinus orca*), false killer whale (*Pseudorca crassidens*), Fraser's dolphin (*Lagenodelphis hosei*), melon-headed whale (*Peponocephala electra*), pantropical spotted dolphin (*Stenella attenuata*), pygmy killer whale (*Feresa attenuata*), short-finned pilot whale (*Globicephala macrorhynchus*), Risso's dolphin (*Grampus griseus*), rough-toothed dolphin (*Steno bredanensis*), spinner dolphin (*Stenella longirostris*), and striped dolphin (*Stenella coeruleoalba*). The most common non-endangered cetaceans in the deepwater environment of the northern Gulf of Mexico are the pantropical spotted dolphin, spinner dolphin, and rough-toothed dolphin. However, any of these species could occur in the project area (Waring et al. 2016; Hayes et al., 2018).

Bottlenose dolphins. The bottlenose dolphin (*Tursiops truncatus*) is a common inhabitant of the northern Gulf of Mexico, particularly within continental shelf waters. There are two ecotypes of bottlenose dolphins, a coastal form and an offshore form, which are genetically isolated from each other (Waring et al. 2016). The offshore form of the bottlenose dolphin inhabits waters seaward from the 200-meter isobath and may occur within the project area. Inshore populations of coastal bottlenose dolphins in the northern Gulf of Mexico are separated by the NMFS into 31 geographically distinct population units, or stocks, for management purposes (Hayes et al., 2018).

Bottlenose dolphins in the Northern Gulf of Mexico are categorized into three stocks by NMFS (2016b): Bay, Sound, and Estuary; Continental Shelf; and Coastal and Oceanic. The Bay, Sound, and Estuary Stocks are considered to be strategic stocks. The strategic stock designation in this case was based primarily on the occurrence of an "unusual mortality event" of unprecedented size and duration (from April 2010 through July 2014) (NOAA, 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 vessel 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 will minimize the potential for marine debris-related impacts on marine mammals.

Impacts of Vessel Presence, Noise, and Lights

Noise from routine drilling activities has the potential to disturb marine mammals. Most odontocetes use higher frequency sounds than those produced by OCS drilling activities (Richardson et al., 1995). Three functional hearing groups are represented in the 20 non-endangered cetaceans found in the Gulf of Mexico (NMFS, 2018b). Eighteen of the 19 odontocete species are considered to be in the mid-frequency functional hearing group and two species (dwarf and pygmy sperm whales) are in the high frequency functional hearing group (NMFS, 2018b). Thruster and installation noise will affect each group differently depending on the frequency bandwiths produced by operations.

For mid frequency cetaceans exposed to a non-impulsive source (like drilling operations), permanent threshold shifts are estimated to occur when the mammal has received an SEL of 198 dB re 1 μPa^2 s over a 24-hour period. Simlarly, temporary threshold shifts are estimated to occur when the mammal has received an SEL of 178 dB re 1 μPa^2 s over a 24-hour period. Based on transmission loss calculations (Urick, 1983), open water propagation of noise produced by typical sources with intermittent use of DP thrusters during offshore operations, are not expected to produce received SPL_{rms} greater than 160 dB re 1 µPa beyond 105 ft (32 m) from the source. Due to the short propagation distance of these SPL_{rms}, the transient nature of marine mammals and the stationary nature of the proposed activites, it is not expected that any marine mammals will receive exposure levels necessary for the onset of auditory threshold shifts. NOAA Fisheries West Coast Region (2018a) presents criteria that are used in the interim to determine behavioral disturbance thresholds for marine mammals and are applied equally across all functional hearing groups. Received SPL_{rms} of 120 dB re 1 μPa from a non-impulsive source are considered high enough to elicit a behavioral reaction in some marine mammal species. The 120-dB isopleth may extend tens to hundreds of kilometers from the source depending on the propagation environment.

Some odontocetes have shown increased feeding activity around lighted platforms at night (Todd et al., 2009). Even temporary drilling rigs 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 exposes 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 the drilling and installation 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.

DP MODU lighting and presence are not identified as IPFs for marine mammals by Bureau of Ocean Energy Management (2012a; 2013; 2014b; 2015; 2016c; 2017a). DP MODU characteristics are expected to be similar to a drilling rig in terms of lighting and presence. Therefore, no significant impacts are expected.

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 when whales are sighted and 150 ft (45 m) when small cetaceans are sighted. When cetaceans are sighted while a vessel is underway, vessels must attempt to remain parallel to the animal's course and avoid excessive speed or abrupt changes in direction until the cetacean has left the area. Vessel operators are required to reduce vessel speed to 10 knots or less when mother/calf pairs, pods, or large assemblages of cetaceans are observed near an underway vessel, when safety permits. Compliance with this NTL will minimize the likelihood of vessel strikes as well as reduce the chance for disturbing marine mammals, and therefore no significant impacts are expected.

Helicopter traffic also has the potential to disturb marine mammals (Würsig et al., 1998). However, while flying offshore, helicopters maintain altitudes above 700 ft (213 m) during transit to and from the working area. In addition, guidelines and regulations issued by NMFS under the authority of the MMPA specify that helicopters maintain an altitude of 1,000 ft (305 m) within 300 ft (91 m) of marine mammals (BOEM, 2017a). 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 (2016c; 2017a), and oil impacts on marine mammals in general are discussed by Geraci and St. Aubin (1990). For the DOCD, 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. **DOCD 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 and the effectiveness of spill response measures. **Section A.9.2** 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 (2016c; 2017a), and Geraci and St. Aubin (1990). For the DOCD, there are no unique site-specific issues.

Impacts of oil spills on marine mammals can include direct impacts from oil exposure as well as indirect impacts due to response activities and materials (e.g., vessel traffic, noise, and dispersants) (MMC, 2011). Direct physical and physiological effects can include skin irritation, inflammation, or necrosis; chemical burns of skin, eyes, and mucous membranes; inhalation of toxic fumes; ingestion of oil (and dispersants) directly or via contaminated prey; and stress from the activities and noise of response vessels and aircraft. Complications of the above may lead to dysfunction of immune and reproductive systems (DeGuise et al., 2017), physiological stress, declining physical condition, and death. Kellar et al. (2017) estimated reproductive success rates for two northern Gulf of Mexico stocks affected by oil were less than a third (19.4%) of those previously reported in other areas (64.7%) not impacted. Behavioral responses can include displacement of animals from prime habitat (McDonald et al., 2017a); disruption of social structure; changing prey availability and foraging distribution and/or patterns; changing reproductive behavior/productivity; and changing movement patterns or migration (MMC, 2011).

Data from the *Deepwater Horizon* incident, as analyzed and summarized by NOAA (2016b) indicate the scope of potential impacts from a large spill. Tens of thousands of marine mammals were exposed to oil, where they likely inhaled, aspirated, ingested, physically contacted, and absorbed oil components (NOAA, 2016b; Takeshita et al., 2017). Nearly all of the marine mammal stocks in the northern Gulf of Mexico were affected. The oil's physical, chemical, and toxic effects damaged tissues and organs, leading to a constellation of adverse health effects, including reproductive failure, adrenal disease, lung disease, and poor body condition (NOAA, 2016b). According to the National Wildlife Federation (2016a), nearly all of the 20 species of dolphins and whales that live in the northern Gulf of Mexico had demonstrable, quantifiable injuries. NMFS (2014a) documented 13 dolphins and whales live-stranded, and over 150 dolphins and whales dead during the oil spill response. Because of known low detection rates of carcasses (Williams et al., 2011), it is possible that the number of marine mammal deaths is underestimated. Also, necropsies to confirm the cause of death could not be conducted for many of these marine mammals, therefore some cause of deaths reported as unknown are likely attributable to oil interaction. Schwacke et al. (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 **DOCD Section 2j**. In the event of oil from a large spill, it is expected that impacts resulting in the injury or death of individual marine mammals could be significant at the population level depending on the level of oiling and the species affected. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. **DOCD Section 9b** provides detail on spill response measures. Therefore, no significant spill impacts on marine mammals are expected.

C.3.5 Sea Turtles (Endangered/Threatened)

As listed in **DOCD Section 6h**, five species of Endangered or Threatened sea turtles may be found near the project area. Endangered species are the leatherback (*Dermochelys coriacea*), Kemp's ridley (*Lepidochelys kempii*), and hawksbill (*Eretmochelys imbricata*) turtles. As of May 6, 2016, the entire North Atlantic DPS of the green turtle (*Chelonia mydas*) is listed as threatened (81 *Federal Register* [FR] 20057). The DPS of loggerhead turtle (*Caretta caretta*) that occurs in the Gulf of Mexico is listed as Threatened, although other DPSs are Endangered. Of the sea turtle species that may be found in the project area, only the Kemp's ridley relies on the Gulf of Mexico as its sole breeding ground. Species descriptions are presented by (BOEM, 2017a).

Critical habitat has been designated for the loggerhead turtle in the Gulf of Mexico as shown in **Figure 1**. Critical habitat in the northern Gulf of Mexico includes nesting beaches in Mississippi, Alabama, and the Florida Panhandle; nearshore reproductive habitat seaward from these beaches; and a large area of *Sargassum* habitat. The nearest designated nearshore reproductive critical habitat for loggerhead sea turtles is approximately 285 miles (459 km) from the project area.

Loggerhead turtles in the Gulf of Mexico are part of the Northwest Atlantic Ocean DPS (NMFS, 2014b). In July 2014, NMFS and the USFWS designated critical habitat for this DPS. The USFWS designation (79 FR 39756) includes nesting beaches in Jackson County, Mississippi; Baldwin County, Alabama; and Bay, Gulf, and Franklin Counties in the Florida Panhandle as well as several counties in southwest Florida and the Florida Keys (and other areas along the Atlantic coast). The NMFS designation (79 FR 39856) includes nearshore reproductive habitat within 1 mile (1.6 km) seaward of the mean high water line along these same nesting beaches. NMFS also designated a large area of shelf and oceanic waters, termed *Sargassum* habitat, in the Gulf of Mexico (and Atlantic Ocean) as critical habitat. *Sargassum* is a genus of brown alga (Class Phaeophyceae) that has a pelagic existence. Rafts of *Sargassum* spp. serve as important foraging and developmental habitat for numerous fishes, and young sea turtles, including loggerhead turtles. NMFS also designated three other categories of critical habitat: of these, two (migratory habitat and overwintering habitat) are along the Atlantic coast, and the third (breeding habitat) is found in the Florida Keys and along the Florida east coast (NMFS, 2014b).

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. Hatchlings or juveniles of any of the sea turtles may be present in deepwater areas, including the project area, where they may be associated with *Sargassum* 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.

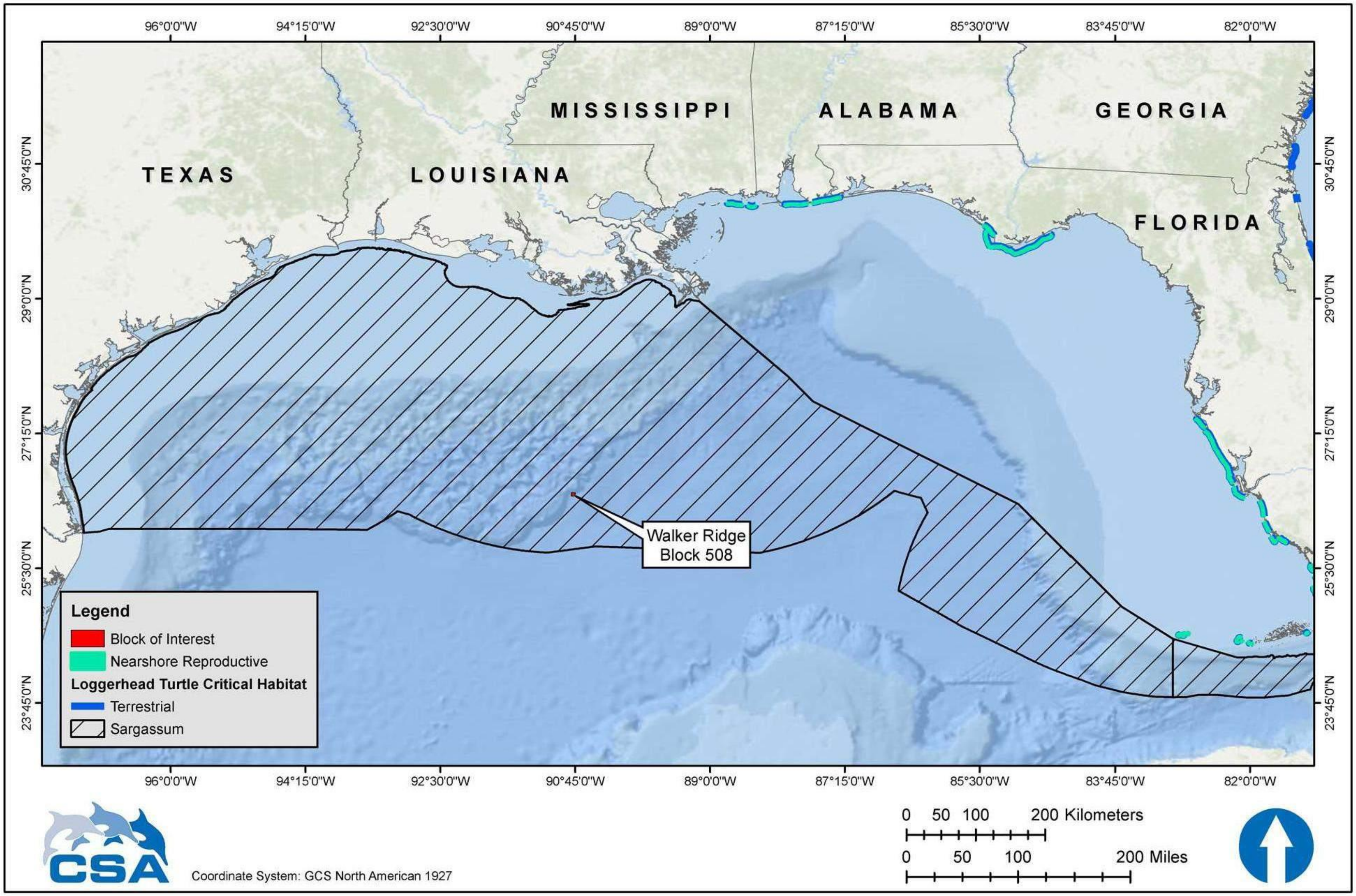

Figure 1. Location of loggerhead turtle designated critical habitat in relation to the project area.

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, n.d.-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, n.d.-b; c);
- Kemp's ridley turtles—The main nesting site is Rancho Nuevo beach in Tamaulipas, Mexico (NMFS et al., 2011). As of June 2019, a total of 185 Kemp's ridley turtle nests were counted on Texas beaches during the 2019 nesting season and a total of 250 Kemp's ridley turtle nests were counted during the 2018 nesting season. In 2017, 353 Kemp's ridley turtle nests were counted, an increase from the 185 counted in 2016; 159 counted in 2015; and 118 counted in 2014 (Turtle Island Restoration Network, 2019). Padre Island National Seashore, along the coast of Willacy, Kenedy, and Kleberg Counties in southern Texas, is the most important nesting location for this species in the U.S.; and
- Hawksbill turtles—Hawksbill turtles typically do not nest anywhere near the project area, with most nesting in the region located in the Caribbean Sea and on beaches of the Yucatan Peninsula (U.S. Fish and Wildlife Service, 2016).

IPFs that could potentially affect sea turtles include vessel 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. Compliance with NTL BSEE 2015-G013 will minimize the potential for marine debris-related impacts on sea turtles.

Impacts of Vessel Presence, Noise, and Lights

Offshore drilling activities produce broadband sounds at frequencies and intensities that may be detected by sea turtles (Samuel et al., 2005; Popper et al., 2014). Potential impacts could include behavioral disruption and displacement from the area near the sound source. There is scarce information regarding hearing and acoustic thresholds for marine turtles. Sea turtles can hear low to mid-frequency sounds and they appear to hear best between 200 and 750 Hz and do not respond well to sounds above 1,000 Hz (Ketten and Bartol, 2005). The currently accepted hearing and response estimates are derived from fish hearing data rather than from marine mammal hearing data in combination with the limited experimental data available (Popper et al., 2014). NMFS Biological Opinion (NMFS, 2015) lists the sea turtle underwater SPL_{rms} injury threshold as 207 dB re 1 µPa; Blackstock et al. (2018) identified the sea turtle underwater acoustic SPL_{rms} behavioral threshold as 175 dB re 1 µPa. No distinction is made between impulsive and non-impulsive sources for these thresholds. Based on transmission loss calculations (Urick, 1983), open water propagation of noise produced by typical sources with DP thrusters in use during drilling, are not expected to produce SPL_{rms} greater than 160 dB re 1 µPa beyond 105 ft (32 m) from the source. Certain sea turtles, especially loggerheads, may be attracted to offshore structures (Lohoefener et al., 1990; Gitschlag et al., 1997) and thus, may be more susceptible to impacts from sounds produced during routine drilling and completion activities. Helicopters and support vessels may also affect sea turtles because of machinery noise or visual disturbances. Any impacts would likely be short-term behavioral changes such as diving and evasive swimming, disruption of activities, or departure from the area. Because of the limited scope and short duration of drilling activities, these short-term impacts are not expected to be biologically significant to sea turtle populations.

Artificial lighting can disrupt the nocturnal orientation of sea turtle hatchlings (Witherington, 1997; Tuxbury and Salmon, 2005). However, hatchlings may rely less on light cues when they are offshore than when they are emerging on the beach (Salmon and Wyneken, 1990). NMFS (2007) concluded that the effects of lighting from offshore structures on sea turtles are insignificant. 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). 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 150 ft (45 m) or greater whenever possible. Compliance with this NTL will minimize the likelihood of vessel strikes as well as reduce the chance for disturbing sea turtles (NMFS, 2007). 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, 2007; BOEM, 2012b).

Impacts of a Small Fuel Spill

Potential spill impacts on sea turtles are discussed by NMFS (2007) and BOEM (2017a; b). For the DOCD, there are no unique site-specific issues with respect to spill impacts on sea turtles.

The probability of a 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 sea turtles. **DOCD 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 of the spill, as well as the effectiveness of spill response measures. **Section A.9.2** 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 (NMFS, 2014a). However, due to the limited areal extent and short duration of water quality impacts from a small fuel spill, no significant impacts would be expected.

Effects of a small spill on *Sargassum* critical habitat for loggerhead turtles 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 approximately 100,480,000 ac (40,662,810 ha) designated *Sargassum* critical habitat for loggerhead turtles in the northern Gulf of Mexico.

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) and 285 miles (459 km) from the nearest designated loggerhead nearshore reproductive critical habitat As explained in **Section A.9.2**, a small fuel spill would not be expected to make landfall or reach coastal waters prior to breaking up.

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, and beach cleanup activities). 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, changing food availability and foraging distribution and/or patterns, changing reproductive behavior/productivity, and changing movement patterns or migration (MMC, 2011; NMFS, 2014b). In the unlikely event of a spill, implementation of Shell's OSRP is expected to mitigate and reduce the potential for these types of impacts on sea turtles. **DOCD 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, 2007).

Results of the *Deepwater Horizon* incident 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). Estimates 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 could be significant to local populations.

The 30-day OSRA modeling results summarized in **Table 3** predict <0.5% probability of contact to any terrestrial or nearshore reproductive critical habitat for the loggerhead sea turtle, or to Padre Island National Seashore within 30 days of a spill. Oil could reach areas that support small numbers of loggerhead nests in Louisiana; portions of the Breton NWR in Plaquemines Parish, Louisiana, have a 1% to 2% probability of being contacted within 30 days. Spilled oil reaching sea turtle nesting beaches could have effects on nesting sea turtles and egg development (NMFS, 2007). 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 are subject to the same types of oil spill exposure hazards as adults. Hatchlings that contact oil residues while crossing a beach can exhibit a range of effects, from acute toxicity to impaired movement and normal bodily functions (NMFS, 2007).

The project area is within the loggerhead turtle critical habitat designated as *Sargassum* habitat (**Figure 1**), which includes most of the Western and Central Planning Areas in the Gulf of Mexico and parts of the southern portion of the Eastern Planning Area (NMFS, 2014b). In the event of a large spill, parts of the *Sargassum* habitat would likely come into contact with spilled oil. Because *Sargassum* is a floating and pelagic species, it would only be affected by impacts that occur near the surface.

Due to the large area covered by the designated *Sargassum* habitat for loggerhead turtles, a large spill could result in the oiling of a substantial part of the *Sargassum* habitat in the northern Gulf of Mexico. However, the Deepwater Horizon incident affected approximately one-third of the *Sargassum* habitat in the northern Gulf of Mexico (BOEM, 2016c). It is unlikely that the entire *Sargassum* critical habitat would be affected by a large spill. Because *Sargassum* is a floating and pelagic species, it would only be affected by impacts that occur near the surface.

The effects of oiling on *Sargassum* vary with severity, but moderate to heavy oiling that could occur during a large spill could cause complete mortality to *Sargassum* and its associated communities (BOEM, 2017a). *Sargassum* 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*. The *Sargassum* 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, 2016c). *Sargassum* has a yearly seasonal cycle of growth and a yearly cycle of migration 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* community would be expected to occur within a short time period (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 **DOCD 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. **DOCD Section 9b** provides detail on spill response measures.

C.3.6 Piping Plover (Threatened)

The Piping Plover (*Charadrius melodus*) is a migratory shorebird that overwinters along the southeastern U.S. and Gulf of Mexico coasts. This Threatened species is in decline as a result of hunting, habitat loss and modification, predation, and disease (USFWS, 2003). Critical overwintering habitat has been designated, including beaches in Texas, Louisiana, Mississippi, Alabama, and Florida (**Figure 2**). Piping Plovers inhabit coastal sandy beaches and mudflats, feeding by probing for invertebrates at or just below the surface. They use beaches adjacent to foraging areas for roosting and preening (USFWS, 2010). A species description is presented by (BOEM, 2017a).

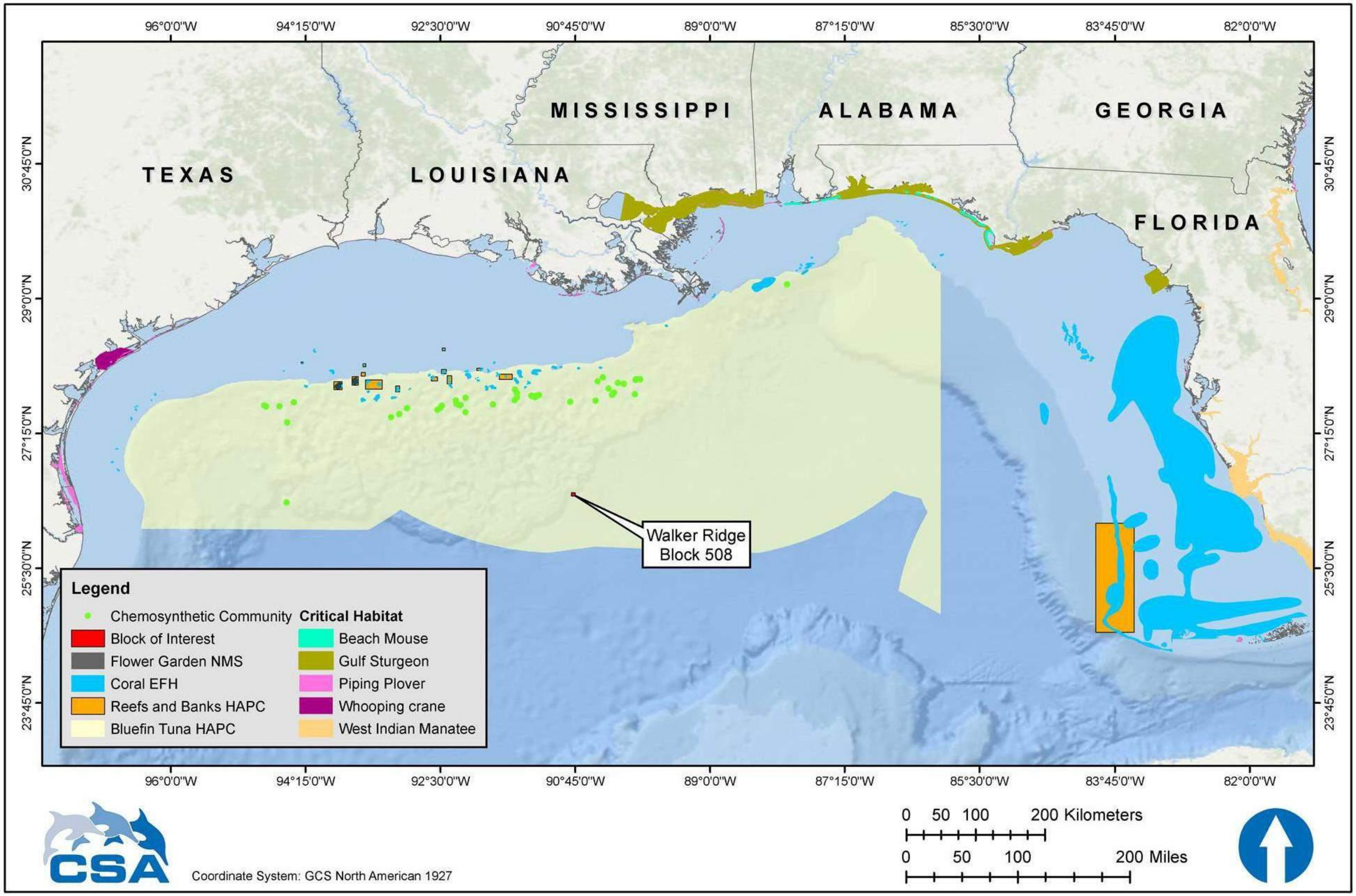

Figure 2. Location of selected environmental features in relation to the project area. (EFH = Essential Fish Habitat; HAPC = Habitat Area of Particular Concern.)

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

Impacts of a Large Oil Spill

The project area is 176 miles (283 km) from the nearest shoreline designated as Piping Plover critical habitat. Based on the 30-day OSRA results summarized in **Table 3,** no shoreline contact is predicted within 10 days of a spill. Within 30 days, four Texas counties and four Louisiana parishes, some of which contain piping plover critical habitat, have a 1% to 2% probability of being contacted.

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 **DOCD 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. **DOCD Section 9b** provides detail on spill response measures. Therefore, no significant spill impacts on Piping Plovers are expected.

C.3.7 Whooping Crane (Endangered)

The Whooping Crane (*Grus americana*) is a large omnivorous wading bird and a listed Endangered species. Three wild populations live in North America (National Wildlife Federation, 2016b). One of these populations winters along the Texas coast at Aransas NWR and summers at Wood Buffalo National Park in Canada. This population represents the majority of the world's population of free-ranging Whooping Cranes, reaching an estimated population of 505 at Aransas NWR during the 2017 to 2018 winter (USFWS, 2018). A non-migratory population was reintroduced in central Florida and another reintroduced population summers in Wisconsin and migrates to the southeastern U.S. for the winter (USFWS, 2015a). Whooping Cranes breed, migrate, winter, and forage in a variety of habitats, including coastal marshes and estuaries, inland marshes, lakes, ponds, wet meadows and rivers, and agricultural fields (USFWS, 2007). About 22,240 ac (9,000 ha) of salt flats in Aransas NWR and adjacent islands comprise the principal wintering grounds of the Whooping Crane. Aransas NWR is designated as critical habitat for the species (**Figure 2**). A species description is presented by (BOEM, 2012a).

A large oil spill is the only IPF that could potentially affect Whooping Cranes due to the distance of the project area from Aransas NWR.

Impacts of a Large Oil Spill

The 30-day OSRA results summarized in **Table 3** predict that a large oil spill has a <0.5% probability of reaching Whooping Crane critical habitat in the Aransas NWR located in Aransas and Calhoun Counties in 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 a species level.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in **DOCD Section 2j**. In the event of oil from a large spill contacting Whooping Crane habitat, it is expected that impacts resulting in the injury or death of individual Whooping Cranes could be significant at the population level. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. **DOCD Section 9b** provides detail on spill response measures.

C.3.8 Oceanic Whitetip Shark (Threatened)

The oceanic whitetip shark (*Carcharhinus longimanus*) was listed as Threatened under the ESA in 2018 by NMFS (83 FR 4153). Oceanic whitetip sharks are found worldwide in offshore waters between approximately 30° N and 35° S latitude, and historically were one of the most widespread and abundant species of shark (Baum et al., 2015). However, based on reported oceanic whitetip shark catches in several major long-line fisheries, the global population appears to have suffered substantial declines (Camhi et al., 2008) and the species is now only occasionally reported in the Gulf of Mexico (Baum et al., 2015).

A comparison of historical shark catch rates in the Gulf of Mexico by Baum and Myers (2004) noted that most recent papers dismissed the oceanic whitetip shark as rare or absent. NMFS (2018a) noted that there has been an 88% decline in abundance of the species in the Gulf of Mexico since the mid-1990s due to commercial fishing pressure.

IPFs that could affect the oceanic whitetip shark include vessel presence, noise, and lights, and a large oil spill. A small diesel fuel spill in the project area 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.

Impacts of Vessel Presence, Noise, and Lights

Offshore drilling activities produce a broad array of sounds at frequencies and intensities that may be detected by elasmobranchs including the threatened oceanic whitetip shark. The general frequency range for elasmobranch hearing is approximately between 20 Hz and 1 kHz (Ladich and Fay, 2013), which includes frequencies exhibited by individual species such as the nurse shark (*Ginglymostoma cirratum*; 300 and 600 Hz) and the lemon shark (*Negaprion brevirostris*; 20 Hz to 1 kHz) (Casper and Mann, 2006). These frequencies overlap with SPLs associated with drilling activities (typically 10 Hz to 10 kHz) (Hildebrand, 2005). Impacts from offshore drilling activities (i.e., non-impulsive sound) could include masking or behavioral change (Popper et al., 2014). However, because of the limited propagation distances of SPLs from the drilling rig, impacts would be limited in geographic scope and no population level impacts on oceanic whitetip sharks are expected.

Impacts of a Large Oil Spill

Information regarding the direct effects of oil on elasmobranchs, including the oceanic whitetip shark are largely unknown. However, in the event of a large oil spill, oceanic whitetip sharks could be affected by direct ingestion, ingestion of oiled prey, or the absorption of dissolved petroleum products through the gills. Because oceanic whitetip sharks may be found in surface waters, they could be more likely to be impacted by floating oil than other species which only reside at depth.

It is possible that a large oil spill could affect individual oceanic whitetip sharks and result in injuries or deaths. However, due to the low density of oceanic whitetip sharks thought to exist in the Gulf of Mexico, it is unlikely that a large spill would result in population-level effects.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in **DOCD Section 2j**. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. **DOCD Section 9b** provides detail on spill response measures.

C.3.9 Giant Manta Ray (Threatened)

The giant manta ray (*Manta birostris*) was listed as Threatened under the ESA in 2018 by NMFS (83 FR 2916). The species is a slow-growing, migratory, and planktivorous, inhabiting tropical, subtropical, and temperate bodies of water worldwide (NOAA, 2018a).

Commercial fishing is the primary threat to giant manta rays (NOAA, 2018a). The species is targeted and caught as bycatch in several global fisheries throughout its range. Although protected in U.S. waters, protection of populations is difficult as they are highly migratory with sparsely distributed and fragmented populations throughout the world. Some estimated regional population sizes are small (between 100 to 1,500 individuals) (Marshall et al., 2018; NOAA, 2018a). Stewart et al. (2018) recently reported evidence that the Flower Garden Banks serves as nursery habitat for aggregations of juvenile manta rays. At least 74 unique individuals have been positively identified at the Flower Garden Banks based on unique underbelly coloration (Flower Garden Banks National Marine Sanctuary, 2018). Genetic and photographic evidence in the Flower Garden Banks over 25 years of monitoring showed that 95% of identified giant manta ray male individuals were smaller than mature size (Stewart et al., 2018).

IPFs that may affect giant manta rays include vessel presence, noise, and lights, and a large oil spill. A small diesel fuel spill in the project area 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.

Impacts of Vessel Presence, Noise, and Lights

Offshore drilling activities produce a broad array of sounds at frequencies and intensities that may be detected by elasmobranchs including the giant manta ray. The general frequency range for elasmobranch hearing is approximately between 20 Hz and 1 kHz (Ladich and Fay, 2013). Studies indicate that the most sensitive hearing ranges for individual species were 300 and 600 Hz (yellow stingray [*Urobatis jamaicensis*]) and 100 to 300 Hz (little skate [*Erinacea raja*]) (Casper et al., 2003; Casper and Mann, 2006). These frequencies overlap with SPLs associated with drilling activities (typically 10 Hz to 10 kHz) (Hildebrand, 2005). Impacts from offshore drilling activities (i.e., continuous sound) could include masking or behavioral change (Popper et al., 2014). However, because of the limited propagation distances of SPLs from the drilling rig, impacts would be limited in geographic scope and no population level impacts on giant manta rays are expected.

Impacts of a Large Oil Spill

A large oil spill in the project area could reach coral reefs at the Flower Garden Banks which is the only known location of giant manta ray aggregations in the Gulf of Mexico. Individuals may occur anywhere in the Gulf of Mexico. In the unlikely event of a large oil spill impacting areas with giant manta rays, individual rays could be affected by direct ingestion of oil which could cover their gill filaments or gill rakers, or by ingestion of oiled plankton. Giant manta rays typically feed in shallow waters of less than 33 ft (10 m) depth (NOAA, 2018b). 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 199 miles [320 km]), it is unlikely that oil would impact the threatened giant manta ray nursery habitat. It is possible that a large oil spill could contact individual giant manta rays, but due to the low density of individuals thought to occur in the Gulf of Mexico, there would not likely be any population-level effects.

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in **DOCD Section 2j**. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. **DOCD Section 9b** provides detail on spill response measures.

C.3.10 Gulf Sturgeon (Threatened)

The Gulf sturgeon (*Acipenser oxyrinchus desotoi*) is a Threatened fish species that inhabits major rivers and inner shelf waters from the Mississippi River to the Suwannee River, Florida (Barkuloo, 1988; Wakeford, 2001). 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, 2018c). Populations have been depleted or even extirpated throughout the species' historical range by fishing, shoreline development, dam construction, water quality changes, and other factors (Barkuloo, 1988; Wakeford, 2001). These declines prompted the listing of the Gulf sturgeon as a threatened species in 1991. The best-known populations occur in the Apalachicola and Suwannee Rivers in Florida (Carr, 1996; Sulak and Clugston, 1998), the Choctawhatchee River in Alabama (Fox et al., 2000), and the Pearl River in Mississippi/Louisiana (Morrow et al., 1998). Rudd et al. (2014) reconfirmed the spatial distribution and movement patterns of Gulf Sturgeon by surgically implanting acoustic telemetry tags. Critical habitat in the Gulf extends from Lake Borgne, Louisiana (St. Bernard Parish), to Suwannee Sound, Florida (Levy County) (NMFS, 2014c) (**Figure 2**). Species descriptions are presented by (BOEM, 2012a) and in the recovery plan for this species (USFWS et al., 1995).

A large oil spill is the only IPF that could potentially affect Gulf sturgeon. There are no IPFs associated with routine project activities that could affect this species. A small fuel spill in the project area would be unlikely to affect Gulf sturgeon, because a small fuel spill would not be expected to make landfall or reach coastal waters prior to breaking up (see explanation in **Section A.9.2**).

Impacts of a Large Oil Spill

Potential spill impacts on Gulf sturgeon are discussed by BOEM (2016c; 2017a), and NMFS (2007). For the DOCD, 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 results (**Table 3**) predicts that a spill in the project area would have a <0.5% conditional probability of contacting Gulf sturgeon critical habitat within 30 days of a spill.

In the event of oil reaching Gulf sturgeon habitat, the fish could be affected by direct ingestion, ingestion of oiled prey, or the absorption of dissolved petroleum products through the gills. Based on the life history of this species, subadult and adult Gulf sturgeon would be most vulnerable to a marine oil spill, and would be vulnerable only during winter months (from September 1 through April 30) when this species is foraging in estuarine and marine habitats (NMFS, 2007).

NOAA (2016b) estimated that 1,100 to 3,600 Gulf sturgeon were exposed to oil from the Macondo spill. 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 **DOCD 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. **DOCD Section 9b** provides detail on spill response measures. Therefore, no significant spill impacts on Gulf sturgeon are expected.

C.3.11 Nassau Grouper (Threatened)

The Nassau grouper (*Epinephelus striatus*) 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, the Florida Keys, Bermuda, the Yucatan Peninsula, and the Caribbean south to Brazil, as well as in 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 Florida Keys. A large oil spill is the only relevant IPF.

Impacts of a Large Oil Spill

Based on the 30-day OSRA modeling results (**Table 3**), a large oil spill would be unlikely (<0.5% probability) to reach Nassau grouper habitat in the Florida Keys (Monroe County, Florida). A spill would be unlikely to contact the Flower Garden Banks based on the distance between the project area and the Flower Garden Banks (approximately 199 miles [320 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 199 miles [320 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. (2014a) 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. It is possible that a large oil spill could contact individual Nassau grouper fish, but due to the low density of individuals thought to occur in the Gulf of Mexico, there would not likely be any population-level effects.

In the unlikely event that an oil slick contacts Nassau grouper habitat, oil droplets or oiled sediment particles could come into contact with Nassau grouper present on the reefs. Individual fish could be affected by direct ingestion of oil which could cover their gill filaments or gill rakers, result in ingestion of oiled prey, or the absorption of dissolved petroleum products through the gills.

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 **DOCD Section 2j**. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. **DOCD Section 9b** provides detail on spill response measures.

C.3.12 Beach Mice (Endangered)

Four subspecies of Endangered beach mouse (*Peromyscus polionotus*) occur on the barrier islands of Alabama and the Florida Panhandle: the Alabama, Choctawhatchee, Perdido Key, and St. Andrew beach mouse. Critical habitat has been designated for all four subspecies and is shown combined in **Figure 2**. 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 beach mice are discussed by BOEM (2016c; 2017a). For the DOCD, there are no unique site-specific issues with respect to these species.

The project area is approximately 325 miles (523 km) from the nearest beach mouse critical habitat. The 30-day OSRA results summarized in **Table 3** predict a <0.5% conditional probability that a spill in the project area would contact 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 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 (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 **DOCD Section 2j**. In the event of oil from a large spill contacting beach mice habitat, it is expected that impacts resulting in the death of individual beach mice would be adverse and potentially significant at the population level. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. **DOCD Section 9b** provides detail on spill response measures.

C.3.13 Threatened Coral Species

Seven Threatened coral species are known from the northern Gulf of Mexico: elkhorn coral (*Acropora palmata*), staghorn coral (*Acropora cervicronis*), lobed star coral (*Orbicella annularis*), mountainous star coral (*Orbicella faveolata*), boulder star coral (*Orbicella franksi*), pillar coral (*Dendrogyra cylindrus*), and rough cactus coral (*Mycetophyllia ferox*). Elkhorn coral, lobed star coral, mountainous star coral, and boulder star coral have been reported from the coral cap region of the Flower Garden Banks (NOAA, 2014), but are unlikely to be present as regular residents in the northern Gulf of Mexico because they typically inhabit coral reefs in shallow, clear tropical, or subtropical waters. Staghorn coral, pillar coral, and rough cactus coral are only known from the Florida Keys and Dry Tortugas (Florida Fish and Wildlife Conservation Commission, n.d.-d). Other Caribbean coral species evaluated by NMFS in 2014 (79 FR 53852) either do not meet the criteria for ESA listing or are not known from the Flower Garden Banks, Florida Keys, or Dry Tortugas. Critical habitat has been designated for elkhorn coral and staghorn coral in the Florida Keys (Monroe County, Florida) and Dry Tortugas, but none has been designated for the other Threatened coral species included here.

There are no IPFs associated with routine project activities that could affect Threatened corals in the northern Gulf of Mexico. A small fuel spill would not affect Threatened coral species because the oil would float and dissipate on the sea surface. A large oil spill is the only relevant IPF.

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). The 30-day OSRA modeling (**Table 3**) predicts the conditional probability of oil contacting the Florida Keys is <0.5%. The nearest coral HAPC is approximately 100 miles (161 km) northwest of the lease block. 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 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. (2014b) observed the spatial distribution of excess hopane, a crude oil tracer from *Deepwater Horizon* incident sediment core samples, to be in the deeper waters and not transported up the shelf, thus confirming near-bottom currents flow along the isobaths.

In the unlikely event that an oil slick reached reefs at the Flower Garden Banks or other Gulf of Mexico reefs, oil droplets or oiled sediment particles could come into contact with reef organisms or corals. As discussed by BOEM (2017a) impacts could include loss of habitat, biodiversity, and live coral coverage; destruction of hard substrate; change in sediment characteristics; and reduction or loss of one or more commercial and recreational fishery habitats. Sublethal effects could be long-lasting and affect the resilience of coral colonies to natural disturbances (e.g., elevated water temperature and diseases) (BOEM, 2017a).

Due to the distance between the project area and coral habitats, there is a low chance of oil contacting Threatened coral habitat in the event of a spill and no significant impacts on Threatened coral species are expected.

C.4 Coastal and Marine Birds

C.4.1 Marine and Pelagic Birds

Marine birds include seabirds and other species that may occur in the pelagic environment of the project area (Clapp et al., 1982a,b; Clapp et al., 1983; Peake, 1996; Hess and Ribic, 2000). Seabirds spend much of their lives offshore over the open ocean, except during breeding season when they nest on islands and along the coast. Other waterbirds, such as waterfowl, marsh birds, and shorebirds may occasionally be present over open ocean areas. No Endangered or Threatened bird species are likely to occur at the project area. For a discussion of coastal birds, see **Section C.4.2**.

Seabirds of the northern Gulf of Mexico were surveyed from ships during the GulfCet II program (Davis et al., 2000). Davis et al. (2000) reported that terns, storm-petrels, shearwaters, and jaegers were the most frequently sighted seabirds in the deepwater area. From these surveys, four ecological categories of seabirds were documented in the deepwater areas of the Gulf: summer migrants (shearwaters, storm-petrels, boobies); summer residents that breed along the Gulf coast (Sooty Tern, Least Tern, Sandwich Tern, Magnificent Frigatebird); winter residents (gannets, gulls, jaegers); and permanent resident species (Laughing Gulls, Royal Terns, Bridled Terns) (Davis et al., 2000). The GulfCet II study did not estimate bird densities; however, seabird densities over the open ocean have been estimated to be 1.6 birds km^{-2} (Haney et al., 2014).

The distributions and relative densities of seabirds within the deepwater areas of the Gulf of Mexico, including the project area, vary temporally (i.e., seasonally) and spatially. In GulfCet II studies (Davis et al., 2000), species diversity and density varied by hydrographic environment and by the presence and relative location of mesoscale features such as Loop Current eddies that may enhance nutrient levels and productivity of surface waters where these seabird species forage (Davis et al., 2000).

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

IPFs that could potentially affect marine and pelagic birds include vessel 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 NTL BSEE 2015-G013 will minimize the potential for marine debris-related impacts on birds.

Impacts of Vessel Presence, Noise, and Lights

Birds migrating over water have been known to strike offshore structures, resulting in death or injury (Wiese et al., 2001; Russell, 2005). Mortality of migrant birds at tall towers and other land-based structures has been reviewed extensively, and the mechanisms involved in platform collisions appear to be similar. In some cases, migrants simply do not see a part of the platform until it is too late to avoid it. In other cases, navigation may be disrupted by noise or lighting (Russell, 2005; Ronconi et al., 2015). However, offshore structures may in some cases serve as suitable stopover habitats for trans-Gulf migrant species, particularly in spring (Russell, 2005; Ronconi et al., 2015).

Overall, potential negative impacts to birds from DP MODU lighting, potential collisions, or other adverse effects are highly localized, relatively short term and temporary in nature, and may be expected to affect only individual birds during migration periods. Therefore, these potential impacts may be adverse, but are not expected to affect birds at the population or species level and are not significant (BOEM, 2012a).

Impacts of Support Vessel and Helicopter Traffic

Support vessels and helicopters are unlikely to significantly disturb pelagic 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 (2016c; 2017a). For the DOCD, there are no unique site-specific issues with respect to spill impacts on marine and pelagic birds.

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 marine and pelagic birds. **DOCD 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.9.2** discusses the likely fate of a small fuel spill and indicates that more than 90% would evaporate or disperse naturally within 24 hours. The area of diesel fuel on the sea surface would range from 1.2 to 12 ac (0.5 to 5 ha), depending on sea state and weather conditions.

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

Impacts of a Large Oil Spill

Potential spill impacts on marine birds are discussed by BOEM (2016c; 2017a). For the DOCD, 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 water depth). 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 were treated for oiling include several pelagic species such as the Northern Gannet, Magnificent Frigatebird, and Masked Booby (USFWS, 2011). The Northern Gannet was among the species with the largest numbers of individuals affected by the spill. NOAA reported that at least 93 resident and migratory bird species across all five Gulf Coast states were exposed to oil from the *Deepwater Horizon* incident in multiple habitats, including offshore/open waters, island waterbird colonies, barrier islands, beaches, bays, and marshes (NOAA, 2016b). Exposure of marine birds to oil can result in adverse health with severity, depending on the level of oiling. Effects can range from plumage damage and loss of buoyancy for external oiling to more severe effects such as organ damage, immune suppression, endocrine imbalance, reduced aerobic capacity and death as a result of oil inhalation or ingestion (NOAA, 2016b).

However, a blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in **DOCD 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. **DOCD Section 9b** provides detail on spill response measures. Therefore, no significant spill impacts on marine and pelagic birds are expected.

C.4.2 Coastal Birds

Threatened and endangered bird species (Piping Plover and Whooping Crane) are discussed in **Section C.3**. Various species of non-endangered birds are also found along the northern Gulf Coast, including diving birds, shorebirds, marsh birds, wading birds, and waterfowl. Gulf Coast marshes and beaches also provide important feeding grounds and nesting habitats. Species that nest on beaches, flats, dunes, bars, barrier islands, and similar coastal and nearshore habitats include the Sandwich Tern, Wilson's Plover, Black Skimmer, Forster's Tern, Gull-Billed Tern, Laughing Gull, Least Tern, and Royal Tern (USFWS, 2010). Additional information is presented by Bureau of Ocean Energy Management (2012a; 2017a).

The Brown Pelican (*Pelecanus occidentalis*) was delisted from federal Endangered status in 2009 (USFWS, 2016) and was delisted from state species of special concern status by the State of Florida in 2017 (Florida Fish and Wildlife Conservation Commission, 2018). However, this species remains listed as endangered by both Louisiana and Mississippi (Mississippi Natural Heritage Program, 2018). Brown Pelicans inhabit coastal habitats and forage within both coastal waters and waters of the inner continental shelf. Aerial and shipboard surveys, including GulfCet and GulfCet II (Davis et al., 2000) indicate that Brown Pelicans do not occur over deep offshore waters (Fritts and Reynolds, 1981; Peake, 1996). Nearly half the southeastern population of Brown Pelicans lives in the northern Gulf Coast, generally nesting on protected islands (USFWS, 2010).

The Bald Eagle (*Haliaeetus leucocephalus*) was delisted from its federal Threatened status in 2007. However, this species is listed as endangered in Louisiana (Louisiana Department of Wildlife and Fisheries, 2017) and Mississippi (Mississippi Natural Heritage Program, 2018). The Bald Eagle is also listed as threatened in Texas (Texas Parks and Wildlife Department, nd) and still receives federal protection under the Migratory Bird Treaty Act of 1918 and the Bald and Golden Eagle Protection Act of 1940 (USFWS, 2015b). The Bald Eagle is a terrestrial raptor widely distributed across the southern U.S., including coastal habitats along the Gulf of Mexico. The Gulf Coast is inhabited by both wintering migrant and resident Bald Eagles (Buehler, 2000).

IPFs that could potentially affect coastal birds include support vessel and helicopter traffic and a large oil spill. As explained in **Section A.9.2**, a small fuel spill would not be expected to make landfall or reach coastal waters prior to breaking up. Compliance with NTL BSEE 2015-G013 will minimize the potential for marine debris-related impacts on shorebirds.

Impacts of Support Vessel and Helicopter Traffic

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

Vessel traffic may disturb some foraging and resting birds. Flushing distances vary among species and individuals (Rodgers and Schwikert, 2002; Schwemmer et al., 2011). The disturbances will be limited to flushing birds away from vessel pathways; known distances are from 65 to 160 ft (20 to 49 m) for personal watercraft and 75 to 190 ft (23 to 58 m) for outboard-powered boats (Rodgers and Schwikert, 2002). Flushing distances may be similar or less for the support vessels to be used for this project, and some species such as gulls are attracted to boats. Support vessels will not approach nesting or breeding areas on the shoreline, so nesting birds, eggs, and chicks will not be disturbed. Vessel operators will use designated navigation channels and comply with posted speed and wake restrictions while transiting sensitive inland waterways. Due to the limited scope, duration, and geographic extent of installation activities, any short-term impacts are not expected to be significant to coastal bird populations.

Helicopter traffic can cause some disturbance to birds onshore and offshore. Responses are highly dependent on the type of aircraft, bird species, activities that animals were previously engaged in, and previous exposures to overflights (Efroymson et al., 2001). Helicopters seem to cause the most intense responses over other human disturbances for some species (Bélanger and Bédard, 1989). However, Federal Aviation Administration Advisory Circular No. 91-36D recommends that pilots maintain a minimum altitude of 2,000 ft (610 m) when flying over noise-sensitive areas such as wildlife refuges, parks, and areas with wilderness characteristics. This is greater than the distance (slant range) at which aircraft overflights have been reported to cause behavioral effects on most species of birds studied in Efroymson et al. (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 or species in the project area.

Impacts of Large Oil Spill

Coastal birds can be exposed to oil as they float on the water surface, dive during foraging, or wade in oiled coastal waters. The Brown Pelican and Bald Eagle could be impacted by the ingestion of contaminated fish or birds (BOEM, 2012a; 2016c). In the event of a large oil spill reaching coastal habitats, cleanup personnel and equipment could create short-term disturbances to coastal birds. Indirect effects could occur from restoration efforts, resulting in habitat loss, alteration, or fragmentation (BOEM, 2017a). Based on the 30-day OSRA results summarized in **Table 3,** no shoreline contact is expected within 10 days of a spill. Within 30 days of a spill, there is a 1% to 2% conditional probability of shoreline contact between Matagorda County, Texas and Plaquemines Parish, Louisiana. Galveston County, Texas, Cameron Parish, Louisiana, and Plaquemines Parish, Louisiana, have the highest probability of shoreline contact, with a 2% chance within 30 days of a spill.

Studies concerning the *Deepwater Horizon* incident provide additional information regarding impacts on shorebirds and coastal nesting birds that may be affected in the event that a large oil spill reaches coastal habitats. According to NOAA (2016b), an estimated 51,600 to 84,500 birds were killed by the spill, and the reproductive output lost as a result of breeding adult bird mortality was estimated to range from 4,600 to 17,900 fledglings that would have been produced in the absence of premature deaths of adult birds (NOAA, 2016b). Species with the largest numbers of estimated mortalities were American White Pelican, Black Skimmer, Black Tern, Brown Pelican, Laughing Gull, Least Tern, Northern Gannet, and Royal Tern (NOAA, 2016b). A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in **DOCD 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. **DOCD Section 9b** provides detail on spill response measures. Therefore, no significant spill impacts on shorebirds and coastal nesting birds are expected.

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 numerical abundance was dominated by relatively few families and species.

IPFs that could potentially affect pelagic communities and ichthyoplankton include vessel presence, noise, and lights; effluent discharges; water intakes; and two types of accidents (a small fuel spill and a large oil spill).

Impacts of Vessel Presence, Noise, and Lights

The DP MODU, as a floating structure in the deepwater environment, will act as a fish-attracting device (FAD). In oceanic waters, the FAD effect would be most pronounced for epipelagic fishes such as tunas, dolphin, billfishes, and jacks, which are commonly attracted to fixed and drifting surface structures (Holland, 1990; Higashi, 1994; Relini et al., 1994). Positive fish associations with offshore rigs and platforms in the Gulf of Mexico are well documented (Gallaway and Lewbel, 1982; Wilson et al., 2003; Wilson et al., 2006). The FAD effect could possibly enhance the feeding of epipelagic predators by attracting and concentrating smaller fish species. MODU noise could potentially cause acoustic masking in fishes, thereby reducing their ability to hear biologically relevant sounds (Radford et al., 2014). The only defined acoustic threshold levels for continuous noise are given by Popper et al. (2014) and apply only to species of fish with swim bladders that provide some hearing (pressure detection) function. Popper et al. (2014) estimated SEL thresholds of 170 dB re 1 μPa^2 s accumulated over a 48-hour period for onset of recoverable injury, and 158 dB re 1 μPa^2 s 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 DP MODU are a single, temporary structure, impacts on fish populations, whether beneficial or adverse, are considered minor.

Few data exist regarding the impacts of noise on pelagic larvae and eggs. Generally, it is believed that larval fish will have similar hearing sensitivities as adults, but may be more susceptible to barotrauma injuries associated with impulsive noise (Popper et al., 2014). Larval fish were experimentally exposed to simulated impulsive sounds by Bolle et al. (2012). The controlled playbacks produced cumulative SEL of 206 dB re 1 μPa^2 s but resulted in no increased mortality between the exposure and control groups. Non-impulsive noise sources (such as MODU operations) are expected to be far less injurious than impulsive noise. Based on transmission loss calculations, open water propagation of noise produced by typical sources with DP thrusters in use during drilling, are not expected to produce received SPL_{rms} greater than 160 dB re 1 µPa beyond 105 ft (32 m) from the source. Because of the limited propagation distances of SPLs and the periodic and transient nature of ichthyoplankton, no impacts to these life stages are expected.

Impacts of Effluent Discharges

Discharges of treated 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). Effluents discharged during the course of normal subsea equipment installation activities are not expected to have a significant impact on water column biota. NPDES permit limits regulate the discharges.

Water-based drilling muds and cuttings will be released at the seafloor during the initial well intervals before the marine riser is set, which allows their return to the surface vessel. Excess cement slurry and blowout preventer fluid will also be released at the seafloor. Impacts will be limited to the immediate area of the discharge, with little to no impact to fisheries resources.

Treated sanitary and domestic wastes may have a slight 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 will dilute rapidly to undetectable levels within tens to hundreds of meters from the source. Minimal impacts on water quality, plankton, and nekton are anticipated.

Deck drainage may have a slight effect on the pelagic environment in the immediate vicinity of these discharges. Deck drainage from contaminated areas will be passed through an oil and water separator prior to release, and discharges will be monitored for visible sheen. The discharges may have slightly elevated levels of hydrocarbons but will 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 discharges in accordance with the NPDES permit, such as desalination unit brine and non-contact cooling water, blowout preventer fluid, well treatment and completion fluids, workover fluids, excess cement, water-based subsea production control fluid, hydrate inhibitor, treated seawater, fire water, bilge water, and ballast water, are expected to dilute rapidly and have little or no impact on water column biota. The DP MODU, and support vessel discharges are expected to be in accordance with NPDES permit and USCG regulations, as applicable, and therefore are not expected to cause significant impacts on water quality.

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 DP MODU (**DOCD Table 7a**). Section 316(b) of the Clean Water Act requires NPDES permits to ensure that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available to minimize adverse environmental impact from impingement and entrainment of aquatic organisms. The current general NPDES Permit No. GMG290103 specifies requirements for new facilities for which construction commenced after 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.

If the DP MODU selected for this project meets the described applicability for new facilities, the vessels' 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 of drilling activities, any short-term impacts of entrainment are not expected to be biologically significant to plankton or ichthyoplankton populations (BOEM, 2017a).

Impacts of a Small Fuel Spill

Potential spill impacts on fisheries resources are discussed by BOEM (2016c; 2017a). For the DOCD, there are no unique site-specific issues with respect to spill impacts.

The probability of a 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. **DOCD 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.9.2** 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 (2016c; 2017a). For the DOCD, 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, 2014b; 2015; 2016c).

Oil spill impacts to phytoplankton include changes in community structure and increases in biomass, which have been attributed to the effects of oil contamination and of decreased predation due to zooplankton mortality (Abbriano et al., 2011; Ozhan et al., 2014). Ozhan et al. (2014) reported that the formation of oil films on the water surface can limit gas exchange through the air-sea interface and can reduce light penetration into the water column which will limit phytoplankton photosynthesis. Determining the impact of a diesel spill on phytoplankton is a complex issue as some phytoplankton species are more tolerant of oil exposure than others (Ozhan et al., 2014). Phytoplankton populations can change quickly on small temporal and spatial scales, making it difficult to predict how a phytoplankton community as a whole will respond to an oil spill.

Mortality of zooplankton has been shown to be positively correlated with oil concentrations (Lennuk et al., 2015). Spills that are not immediately lethal can have short- or long-term impacts on biomass and community composition, behavior, reproduction, feeding, growth and development, immune response and respiration (Harvell et al., 1999; Wootton et al., 2003; Auffret et al., 2004; Hannam et al., 2010; Bellas et al., 2013; Blackburn et al., 2014). Zooplankton are especially vulnerable to acute oil pollution, showing increased mortality and sublethal changes in physiological activities (e.g., egg production; Moore and Dwyer, 1974; Linden, 1976; Lee et al., 1978; Suchanek, 1993). Zooplankton may also accumulate PAHs through diffusion from surrounding waters, direct ingestion of micro-droplets (e.g., Berrojalbiz et al., 2009; Lee et al., 2012; Lee, 2013), and by ingestion of droplets that are attached to phytoplankton (Almeda et al., 2013). Bioaccumulation of hydrocarbons can lead to additional impacts among those higher trophic level consumers that rely on zooplankton as a food source (Almeda et al., 2013; Blackburn et al., 2014).

Planktonic communities have a high capacity for recovery from the effects of oil spill pollution due to their short life cycle and high reproductive capacity (Abbriano et al., 2011). Planktonic communities drift with water currents and recolonize from adjacent areas. Because of these attributes, plankton usually recover relatively rapidly to normal population levels following hydrocarbon spill events. Research in the aftermath of the *Deepwater Horizon* incident found that phytoplankton population recovered within weeks to months and zooplankton populations may have only been minimally affected (Abbriano et al., 2011).

A blowout resulting in a large oil spill is a rare event, and the probability of such an event will be minimized by Shell's well control and blowout prevention measures as detailed in **DOCD 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. **DOCD Section 9b** provides detail on spill response measures. Therefore, no significant spill impacts on pelagic communities and ichthyoplankton are expected.

C.5.2 Essential Fish Habitat

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

The Gulf of Mexico Fishery Management Council (GMFMC) has prepared Fishery Management Plans for corals and coral reefs, shrimps, spiny lobster, reef fishes, coastal migratory pelagic fishes, and red drum. In 2005, the EFH for these managed species was redefined in Generic Amendment No. 3 to the various Fishery Management Plans (Gulf of Mexico Fishery Management Council, 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 on the Texas-Louisiana OCS, the nearest of which is located 100 miles (161 km) northwest of 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 at or near the project area include the following (NMFS, 2009b):

- Albacore tuna (adults)
- Bigeye tuna (adults)
- Blue marlin (juveniles, adults)
- Bluefin tuna (spawning, eggs, larvae, adults)
- Common Thresher shark (all)
- Longbill spearfish (juveniles, adults)
- Longfin mako shark (all)Oceanic whitetip shark (all)
- Skipjack tuna (spawning, adults)
- Swordfish (larvae, juveniles, adults)
- White marlin (juveniles, adults)
- Yellowfin tuna (spawning, juveniles, adults)

Research indicates the central and western Gulf of Mexico may be important spawning habitat for Atlantic bluefin tuna (*Thunnus thynnus*) (Theo and Block, 2010), and NMFS (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 2**). The areal extent of the HAPC is approximately 115,830 miles^2 (300,000 km^2). The prevailing assumption is that Atlantic bluefin tuna follow an annual cycle of foraging in June through March off the eastern U.S. and Canadian coasts, followed by migration to the Gulf of Mexico to spawn in April, May, and June (NMFS, 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, 2016b).

Other HAPCs have been identified in the Gulf of Mexico by the Gulf of Mexico Fishery Management Council (2005), including the Florida Middle Grounds, Madison-Swanson Marine Reserve, Tortugas North and South Ecological Reserves, Pulley Ridge, and several individual reefs and banks of the northwestern Gulf of Mexico (**Figure 2**). The GMFMC is currently considering options on protecting deep-sea corals to add to the HAPCs previously identified (Fisheries Leadership and Sustainability Forum, 2015). The nearest of these is Jakkula Bank, located 112 miles (180 km) northwest of the project area.

Routine IPFs that could potentially affect EFH and fisheries resources include vessel 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 Vessel Presence, Noise, and Lights

The DP MODU, as a floating structure in the deepwater environment, will act as an FAD. In oceanic waters, the FAD effect would be most pronounced for epipelagic fishes such as tunas, dolphin, billfishes, and jacks that are commonly attracted to fixed and drifting surface structures (Holland, 1990; Higashi, 1994; Relini et al., 1994). This FAD effect would possibly enhance feeding of epipelagic predators by attracting and concentrating smaller fish species. MODU noise could potentially cause masking in 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). Any impacts on EFH for highly migratory pelagic fishes are not expected to be significant.

Impacts of Effluent Discharges

Other 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, blowout preventer fluid, well treatment and completion fluids, workover fluids, excess cement, water-based subsea production control fluid, hydrate inhibitor, treated seawater, 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 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 the drilling and installation activities, any short-term impacts on EFH for highly migratory pelagic fishes are not expected to be biologically significant.

Impacts of a Small Fuel Spill

Potential spill impacts on EFH are discussed by BOEM (2016c; 2017a). For the DOCD, there are no unique site-specific issues with respect to spill impacts.

The probability of a 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. **DOCD 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.9.2** discusses the likely fate of a small fuel spill and indicates that more than 90% would evaporate or disperse naturally within 24 hours. The area of diesel fuel on the sea surface would range from 1.2 to 12 ac (0.5 to 5 ha), depending on sea state and weather conditions.

A small fuel spill could have localized impacts on EFH for highly migratory pelagic fishes, including tunas, swordfishes, billfishes, and sharks. These species occur as transients in the project area. A spill would also produce short-term impact on surface and near-surface water quality in the HAPC for spawning Atlantic bluefin tuna, which covers much of the deepwater Gulf of Mexico. The affected area would represent a negligible portion of the HAPC, which covers approximately 115,830 miles^2 (300,000 km^2) of the Gulf of Mexico. Therefore, no significant spill impacts on EFH for highly migratory pelagic fishes are expected.

A small fuel spill would not affect EFH for corals and coral reefs; the nearest coral EFH is located 100 miles (161 km) northwest of the project area. A small fuel spill would float and dissipate on the sea surface and would not contact these 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 (2016c; 2017a). For the DOCD, 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 (Gulf of Mexico Fishery Management Council, 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 Atlantic 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 and their offspring. 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) northwest of the project area. An accidental spill would be unlikely to reach or affect this feature. Near-bottom currents in the region are expected to flow along the isobaths (Nowlin et al., 2001; Valentine et al., 2014b) 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 **DOCD Section 2j**. In the event of oil from a large spill contacting EFH for managed species, it is expected that impacts could be significant but would likely be temporary and short-term. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. **DOCD Section 9b** provides detail on spill response measures.

C.6 Archaeological Resources

C.6.1 Shipwreck Sites

In Bureau of Ocean Energy Management (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 project area is not on the list of archaeological survey blocks determined to have a high potential for containing archaeological properties (BOEM, 2011). The archaeological assessment identified one sonar contact within 2,000 ft (610 m) of the proposed drilling, completion, well work, and associated subsea installation (BP America Inc, 2004; Fugro Geo-consulting Inc., 2010; C&C Technologies, 2011; Fugro Geo-consulting Inc., 2011a; b; Forum Energy Technologies, 2012). The sonar contact was not identified as archaeologically significant. No archaeological impacts are expected from routine activities in the project area.

Because no historic shipwreck sites are present in the project area (see **DOCD 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

Bureau of Ocean Energy Management (2012a) estimated that a severe subsurface blowout could resuspend and disperse sediments within a 984 ft (300 m) radius. Because there are no historic shipwrecks in the project area, this impact would not be relevant.

Beyond the seafloor blowout radius, there is the potential for impacts from oil, dispersants, and depleted oxygen levels (BOEM, 2017a). These impacts could include chemical contamination, alteration of the rates of microbial activity (BOEM, 2017a), and reduced biodiversity as shipwreck-associated sediment microbiomes (Hamdan et al., 2018). During the *Deepwater Horizon* incident, subsurface plumes were reported at a water depth of approximately 3,600 ft (1,100 m), extending at least 22 miles (35 km) from the wellsite and persisting for more than a month (Camilli et al., 2010). The subsurface plumes apparently resulted from the use of dispersants at the wellhead (NOAA, 2011b). While the behavior and impacts of subsurface plumes are not well known, a subsurface plume could contact shipwreck sites beyond the 984-foot (300-meter) radius estimated by BOEM (2012a), depending on its extent, trajectory, and persistence (Spier et al., 2013). If oil from a subsea spill should contact wooden shipwrecks on the seafloor, it could adversely affect their condition or preservation.

Although there are no known historic shipwrecks in the project area, an archaeological review did identify one sonar contact within 2,000 ft (610 m) of the proposed drilling, completion, well work, and associated subsea installation (BP America Inc, 2004; Fugro Geo-consulting Inc., 2010; C&C Technologies, 2011; Fugro Geo-consulting Inc., 2011a; b; Forum Energy Technologies, 2012). The sonar contact was not identified as archaeologically significant. No archaeological impacts are expected from routine activities in the project area.

A spill entering shallow coastal waters could conceivably contaminate undiscovered or known historic shipwreck sites. The 30-day OSRA modeling results summarized in **Table 3** predicts that no shoreline contact is expected within 10 days of a spill. Within 30 days of a spill, there is a 1% to 2% conditional probability of shoreline contact between Matagorda County, Texas and Plaquemines Parish, Louisiana. Galveston County, Texas, Cameron Parish, Louisiana, and Plaquemines Parish, Louisiana, have the highest probability of shoreline contact, with a 2% chance within 30 days of a spill. 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 **DOCD Section 2j**. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. **DOCD Section 9b** provides detail on spill response measures. Therefore, no significant spill impacts on historic shipwrecks are expected.

C.6.2 Prehistoric Archaeological Sites

With a water depth of approximately 9,554 ft (2,912 m), the project area is well beyond the 197 ft (60 m) depth contour used by the BOEM as the seaward extent for prehistoric archaeological site potential in the Gulf of Mexico. Because prehistoric archaeological sites are not found in the project area, the only relevant IPF is a large oil spill that would reach coastal waters within the 197 ft (60 m) depth contour.

Impacts of a Large Oil Spill

Because prehistoric archaeological sites are not found in the project area, it is highly unlikely that any such resources would be affected by the physical effects of a subsea blowout. Bureau of Ocean Energy Management (2012a) estimates that a severe subsurface blowout could resuspend and disperse sediments within a 984-ft (300-m) radius.

Along the northern Gulf Coast, prehistoric sites occur frequently along the barrier islands and mainland coast and along the margins of bays and bayous Bureau of Ocean Energy Management (2012a). The 30-day OSRA modeling summarized in **Table 3** predicts that no shoreline contact is expected within 10 days of a spill. Within 30 days of a spill, there is a 1% to 2% conditional probability of shoreline contact between Matagorda County, Texas and Plaquemines Parish, Louisiana. Galveston County, Texas, Cameron Parish, Louisiana, and Plaquemines Parish, Louisiana, have the highest probability of shoreline contact, with a 2% chance within 30 days of a spill. A spill reaching a prehistoric site along these shorelines could coat fragile artifacts or site features and compromise the potential for radiocarbon dating organic materials in a site (although other dating methods are available and it is possible to decontaminate an oiled sample for radiocarbon dating). Coastal prehistoric sites could also be damaged by spill cleanup operations (e.g., by destroying fragile artifacts and disturbing the provenance of artifacts and site features). Bureau of Ocean Energy Management (2017a) notes that some unavoidable direct and indirect impacts on coastal historic resources could occur, resulting in the loss of information.

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

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; 2014b; 2015; 2016c; 2017a) and in a literature review by Collard and Way (1997). Sensitive coastal habitats are also tabulated in the OSRP. Coastal habitats inshore of the project area include coastal and barrier island beaches and dunes, wetlands, oyster reefs, and submerged seagrass beds. Generally, most of the northern Gulf of Mexico is fringed by coastal and barrier island beaches, with wetlands and/or submerged seagrass beds occurring in sheltered areas behind the barrier islands and in estuaries.

Due to the distance from shore, there are no IPFs associated with routine activities occurring in the project area that are likely to affect beaches and dunes, wetlands, seagrass beds, coastal wildlife refuges, wilderness areas, or any other managed or protected coastal area. The support bases are not located in a wildlife refuge or a wilderness area. Potential impacts of support vessel traffic are briefly addressed in this section.

A large oil spill is the only accidental impact analyzed. A small fuel spill in the project area would be unlikely to affect coastal habitats due to the project area's distance from the nearest shoreline. As explained in **Section A.9.2**, a small fuel spill in the project area would be unlikely to affect coastal habitats, because it would not be expected to make landfall or reach coastal waters prior to natural dispersion.

Impacts of Support Vessel Traffic

For OCS activities in general, support operations, including the crew boat and supply boats, may have a minor incremental impact on coastal habitats. Over time, a large number of vessel trips and vessel wakes can erode shorelines along inlets, channels, and harbors. Support operations, including the crew boat and supply boats as detailed in **DOCD Section 14**, may have a minor incremental impact on coastal habitats, seagrass beds, wetlands, or protected areas. 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; b).

Impacts of a Large Oil Spill

Potential spill impacts on coastal habitats are discussed by BOEM (2016c; 2017a). Coastal habitats inshore of the project area include coastal and barrier island beaches, wetlands, oyster reefs, and submerged seagrass beds. For the DOCD, there are no unique site-specific issues with respect to coastal habitats.

The 30-day OSRA modeling results summarized in **Table 3** predict that no shoreline contact is expected within 10 days of a spill. Within 30 days of a spill, there is a 1% to 2% conditional probability of shoreline contact between Matagorda County, Texas and Plaquemines Parish, Louisiana. Galveston County, Texas, Cameron Parish, Louisiana, and Plaquemines Parish, Louisiana, have the highest probability of shoreline contact, with a 2% chance within 30 days of a spill.

NWRs and other protected areas such as Wildlife Management Areas (WMAs) along the coast are discussed in the lease sale EIS (BOEM, 2017a) and Shell's OSRP. Coastal wildlife refuges, wilderness areas, and state and national parks within the geographic range of the potential shoreline contacts within 30 days of a large oil spill are listed in **Table 6**.

Table 6. Wildlife refuges, wilderness areas, and state and national parks within the geographic range of potential shoreline contacts within 30 days of a large oil spill based on OSRA modeling.

County or Parish, State	Wildlife Refuge, Wilderness Area, or State/National Park
Matagorda County, Texas	Big Boggy National Wildlife Refuge
	Matagorda Bay Nature 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	Sabine National Wildlife Refuge
	Rockefeller State Wildlife Refuge and Game Preserve
	Peveto Woods Sanctuary
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

The 30-day OSRA modeling results in **Table 3** include only shoreline segments with contact probabilities greater than 0.5% within 30 days; other coastal areas could be affected at lower contact probabilities within 30 days, or beyond 30 days from the spill. Additional NWRs and managed wildlife areas occur along the Gulf Coast. These areas include habitats such as barrier beach and dune systems, wetlands, and submerged seagrass beds that support diverse wildlife, including endangered or threatened species.

The level of impacts from oil spills on coastal habitats depends on many factors, including the oil characteristics, the geographic location of the landfall, and the weather and oceanographic conditions at the time of the spill (BOEM, 2017a). Oil that makes it to beaches may be liquid, weathered oil, an oil-and-water mousse, or tarballs. Oil is generally deposited on beaches in lines defined by wave action at the time of landfall. Oil that remains on the beach will thicken as its volatile components are lost. Thickened oil may form tarballs or aggregations that incorporate sand, shell, and other materials into its mass. Tar may be buried to varying depths under the sand. On warm days, both exposed and buried tarballs may liquefy and ooze. Oozing may also serve to expand the size of a mass as it incorporates beach materials. Oil on beaches may be cleaned up manually, mechanically, or both. Some oil can remain on the beach at varying depths and may persist for several years as it slowly biodegrades and volatilizes (BOEM, 2017a). Impacts associated with an extensive oiling of coastal and barrier island beaches from a large oil spill are expected to be adverse.

Coastal wetlands are highly sensitive to oiling and can be significantly impacted because of the inherent toxicity of hydrocarbon and non-hydrocarbon components of the spilled substances (Mendelssohn et al., 2012; Lin et al., 2016). Numerous variables such as oil concentration and chemical composition, vegetation type and density, season or weather, preexisting stress levels, soil types, and water levels may influence the impacts of oil exposure on wetlands. Light oiling could cause plant die-back, followed by recovery in a fairly short time. Vegetation exposed to oil that persists in wetlands could take years to recover (BOEM, 2017a). However, in a study in Barataria Bay, Louisiana, after the *Deepwater Horizon* spill, Silliman et al. (2012) reported that previously healthy marshes largely recovered to a pre-oiling state within 18 months. At 103 salt marsh locations that spanned 267 miles (430 km) of shoreline in Louisiana, Mississippi, and Alabama, Silliman et al. (2016) determined a threshold for oil impacts on marsh edge erosion with higher erosion rates occurring for approximately 1 to 2 years after the *Deepwater Horizon* spill at sites with the highest amounts of plant stem oiling (90% to 100%) indicating a large-scale ecosystem loss. In addition to the direct impacts of oil, cleanup activities in marshes may accelerate rates of erosion and retard recovery rates (BOEM, 2017a). Impacts associated with an extensive oiling of coastal wetland habitat are expected to be significant.

In addition to the direct impacts of oil, cleanup activities in marshes may accelerate rates of erosion and retard recovery rates (BOEM, 2017a). A recent review of the literature and new studies indicated that oil spill impacts to seagrass beds are often limited and may be limited to when oil is in direct contact with these plants (Fonseca et al., 2017). Impacts associated with an extensive oiling of coastal wetland habitat are expected to be significant.

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

C.8 Socioeconomic and Other Resources

C.8.1 Recreational and Commercial Fishing

Potential impacts to recreational and commercial fishing are analyzed by BOEM (2017a). The major species sought by commercial fishermen in federal waters of the Gulf of Mexico include shrimp, menhaden, red snapper, tunas, and groupers (BOEM, 2017a). However, most of the fishing effort for these species is on the continental shelf in shallow waters. The main commercial fishing activity in deep waters of the northern Gulf of Mexico is pelagic longlining for tunas, swordfishes, and other billfishes (Continental Shelf Associates, 2002; Beerkircher et al., 2009). Pelagic longlining has occurred historically in the project area, primarily during spring and summer.

It is unlikely that any commercial fishing activity other than longlining will occur at or near the project area due to the water depth. 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 would be petroleum platforms in offshore waters of Texas and Louisiana. Due to 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 vessel 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 Vessel Presence, Noise, and Lights

There is a slight possibility of pelagic longlines becoming entangled in the DP 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 adverse impacts on fishing activities are anticipated. Other factors such as effluent discharges are likely to have negligible impacts on commercial or recreational fisheries due to rapid dispersion, the small area of ocean affected, and the intermittent nature of the discharges.

Impacts of a 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. **DOCD 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.

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

Impacts of a Large Oil Spill

Potential spill impacts on fishing activities are discussed by BOEM (2016c; 2017a). For the DOCD, 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, 2010a). At its peak on 12 July 2010, closures encompassed 84,101 miles^2 (217,821 km^2), or 34.8% of the U.S. Gulf of Mexico 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; b). 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 **DOCD Section 2j**. In the event of a large spill, impacts to recreational and commercial fishing are expected to be adverse, but likely temporary. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. **DOCD Section 9b** provides detail on spill response measures. Therefore, no significant spill impacts on fishing activities are expected.

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. 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 DP MODU maintains a Shipboard Oil Pollution Emergency Plan as required under MARPOL 73/78.

Depending on the spill rate and duration, the physical/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 **DOCD Section 2j**. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. **DOCD Section 9b** provides detail on spill response measures. Therefore, 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 installation activities 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, 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 (2016c; 2017a). For the DOCD, 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.

Non-market 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. Based on the 30-day OSRA modeling predictions (**Table 3**), no shoreline contact is expected within 10 days of a spill. Within 30 days of a spill, there is a 1% to 2% conditional probability of shoreline contact between Matagorda County, Texas and Plaquemines Parish, Louisiana. Galveston County, Texas, Cameron Parish, Louisiana, and Plaquemines Parish, Louisiana, have the highest probability of shoreline contact, with a 2% chance within 30 days 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 **DOCD Section 2j**. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. **DOCD Section 9b** provides detail on spill response measures. Therefore, no significant spill impacts on employment and infrastructure are expected.

C.8.4 Recreation and Tourism

For the DOCD, there are no unique site-specific issues with respect to this activity. There are no known recreational uses of 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 DP MODU and subsequently washing up on beaches. There are no known recreational or tourism activities occurring in the project area, and as explained in **Section A.9.2**, a small fuel spill would not be expected to make landfall or reach coastal waters prior to breaking up. Therefore, a small fuel spill in the project area would be unlikely to affect recreation and tourism. A large oil spill is the only IPF that has the potential to affect recreation and tourism.

Impacts of a Large Oil Spill

Potential impacts of an oil spill on recreation and tourism are discussed by Bureau of Ocean Energy Management (2017a). For the DOCD, there are no unique site-specific issues with respect to these impacts.

Impacts on recreation and tourism would vary depending on the duration of the spill and its fate including the effectiveness of response measures. A large spill that reached coastal waters and shorelines could adversely affect recreation and tourism by contaminating beaches and wetlands, resulting in negative publicity that encourages people to stay away. Loss of tourist confidence and public health concerns can then lead to the potential for economic loss. Media coverage of oil contamination, or word-of-mouth, can have implications on public perception of the incident.

However, quantifying financial loss due to loss in confidence can be difficult, because it depends on implementation of an effective response plan as well as a strategy to restore any loss of appeal to tourists that the area may have suffered.

Based on the 30-day OSRA modeling results summarized in **Table 3** predict that no shoreline contact is expected within 10 days of a spill. Within 30 days of a spill, there is a 1% to 2% conditional probability of shoreline contact between Matagorda County, Texas and Plaquemines Parish, Louisiana. Galveston County, Texas, Cameron Parish, Louisiana, and Plaquemines Parish, Louisiana, have the highest probability of shoreline contact, with a 2% chance within 30 days of a spill.

According to BOEM (2017a), should an oil spill occur and contact a beach area or other recreational resource, it would cause some disruption during the impact and cleanup phases of the spill. However, these effects are also likely to be small in scale and of short duration, in part because the probability of an offshore spill contacting most beaches is small. In the unlikely event that a spill occurs that is sufficiently large to affect large to affect areas of the coast and, through public perception, have effects that reach beyond the damaged area, effects to recreation and tourism could be significant (BOEM, 2017a).

Impacts of the *Deepwater Horizon* incident on recreation and tourism provide some insight into the potential effects of a large spill. NOAA (2016b) estimated that the public lost 16,857,116 user-days of fishing, boating, and beach-going experiences as a result of the spill. The U.S. Travel Association has estimated the economic impact of the *Deepwater Horizon* incident on tourism across the Gulf Coast over a 3-year period at $22.7 billion (Oxford Economics, 2010). Hotels and restaurants were the most affected tourism businesses, but charter fishing, marinas, and boat dealers and sellers were among the others affected (Eastern Research Group, 2014).

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 **DOCD Section 2j**. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. **DOCD Section 9b** provides detail on spill response measures. Therefore, no significant spill impacts on recreation and tourism are expected.

C.8.5 Land Use

Land use along the northern Gulf coast is discussed by BOEM (2016c; 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 accident 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, (2016c) 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 **DOCD Section 2j**. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. **DOCD Section 9b** provides detail on spill response measures. Therefore, 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 or 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 aircraft.

The shallow hazard assessment identified previously approved and drilled wells, sleds, umbilicals, and other subsea equipment within 500 ft (152 m) of the proposed drilling, completion, well works and associated subsea installation (BP America Inc, 2004; Fugro Geo-consulting Inc., 2010; C&C Technologies, 2011; Fugro Geo-consulting Inc., 2011a; b; Forum Energy Technologies, 2012). There are 10 transponder frames and four pipelines within 2,000 ft (610 m).

The archaeological assessment detected one sonar contact within 2,000 ft (610 m) of the proposed drilling, completion, well work, and associated subsea installation location (BP America Inc, 2004; Fugro Geo-consulting Inc., 2010; C&C Technologies, 2011; Fugro Geo-consulting Inc., 2011a; b; Forum Energy Technologies, 2012). The sonar contact was not identified as archaeologically significant but as potential debris.

A large oil spill is the only relevant IPF. A small fuel spill would not have impacts on other marine uses because the spill and response activities would be mainly within the project area, and the duration would be brief.

Impacts of a Large Oil Spill

An accidental spill would be unlikely to significantly affect shipping or other marine uses. The lease block is not located within any USCG-designated fairway, shipping lane, or Military Warning Area. In the event of a large spill requiring numerous response vessels, coordination would be required to manage the vessel traffic for safe operations. Shell will comply with BOEM requirements and lease stipulations to avoid impacts on uses of the area by military vessels and aircraft.

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 **DOCD Section 2j**. In the unlikely event of a spill, implementation of Shell's OSRP will mitigate and reduce the impacts. **DOCD Section 9b** provides detail on spill response measures. Therefore, no significant spill impacts on other marine uses are expected.

C.9 Cumulative Impacts

For purposes of NEPA, cumulative impact is defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR 1508.7). Any single activity or action may have a negligible impact(s) by itself, but when combined with impacts from other activities in the same area and/or time period, substantial impacts may result.

Prior Studies. Prior to the lease sales, BOEM and its predecessors prepared multisale EISs to analyze the environmental impact of activities that might occur in the multisale area. BOEM and its predecessors also analyzed the cumulative impacts of OCS exploration activities similar to those planned in the DOCD in several documents. The level and types of activities planned in Shell's DOCD are within the range of activities described and evaluated by BOEM (2012a; b; 2013; 2014b; 2015; 2016a; c; 2017a). Past, present, and reasonably foreseeable activities were identified in the cumulative effects scenario of these documents, which are incorporated by reference. The proposed action will not result in any additional impacts beyond those evaluated in the multisale and Final EISs.

Description of Activities Reasonably Expected to Occur in the Vicinity of Project Area. Shell does not anticipate other projects in the vicinity of the project area beyond the types of projects analyzed in the lease sale and Supplemental EISs (BOEM, 2012a; 2013; 2014b; 2015; 2016c; 2017a).

Cumulative Impacts of Activities in the DOCD. The Bureau of Ocean Energy Management (2017a) Final EIS included a lengthy discussion of cumulative impacts, which analyzed the environmental and socioeconomic impacts from the incremental impact of the 10 proposed lease sales, in addition to all activities (including non-OCS activities) projected to occur from past, proposed, and future lease sales. The EISs considered exploration, delineation, and development wells; platform installation; service vessel trips; and oil spills. The EISs examined the potential cumulative effects on each specific resource for the entire Gulf of Mexico.

The level and type of activity proposed in Shell's DOCD are within the range of activities described and evaluated in the recent lease sale EISs. The EIA incorporates and builds on these analyses by examining the potential impacts on physical, biological, and socioeconomic resources from the work planned in the DOCD, in conjunction with the other reasonably foreseeable activities expected to occur in the Gulf of Mexico. Thus, for all impacts, the incremental contribution of Shell's proposed actions to the cumulative impacts analysis in these prior analyses is not significant.

C.9.1 Cumulative Impacts to Physical/Chemical Resources

The work planned in the DOCD is limited in geographic scope and duration, and the impacts on the physical/chemical environment will be correspondingly limited.

Air Quality. Emissions from pollutants into the atmosphere from activities are not projected to have significant effects on onshore air quality because of the distance from shore, the prevailing atmospheric conditions, emission rates and heights, and resulting pollutant concentrations. As BOEM found in the multisale EISs, the incremental contribution of activities similar to Shell's proposed activities to the cumulative impacts is not significant and will not cause or contribute to a violation of NAAQS (BOEM, 2012a; 2013; 2014b; 2015; 2016c; 2017a). In addition, the cumulative contribution to visibility impairment is also very small. As mentioned in previous sections, projected emissions meet the BOEM exemption criteria and would not significantly contribute to cumulative impacts on air quality.

Climate Change. CO_2 and CH_4 emissions from the project would constitute a negligible contribution to greenhouse gas emissions from all OCS activities. According to Bureau of Ocean Energy Management (2013), greenhouse gas emissions from all OCS oil and gas activities make up a very small portion of national CO_2 emissions and BOEM does not believe that emissions directly attributable to OCS activities are a significant contributor to global greenhouse gas levels. Greenhouse gas emissions identified in the DOCD represent a negligible contribution to the total greenhouse gas emissions from reasonably foreseeable activities in the Gulf of Mexico area and would not significantly alter any of the climate change impacts evaluated in the previous EISs.

Water Quality. Shell's project may result in some minor water quality impacts due to the NPDES-permitted discharge of water based drilling fluids and associated cuttings, cuttings wetted with SBM, treated sanitary and domestic wastes, non-contact cooling water, deck drainage, desalination unit brine, blowout preventer fluid, well treatment and completion fluids, workover fluids, excess cement, water-based subsea production control fluid, hydrate inhibitor, treated seawater, 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 DP MODU), and temporary (lasting only hours longer than the disturbance or discharge). Any cumulative effects to water quality are expected to be negligible.

Archaeological Resources. The lease block is not on the list of archaeology survey blocks (Bureau of Ocean Energy Management, 2011). The archaeological assessments did not identify any known shipwrecks or other archaeological artifacts on this lease block (BP America Inc, 2004; Fugro Geo-consulting Inc., 2010; C&C Technologies, 2011; Fugro Geo-consulting Inc., 2011a; b; Forum Energy Technologies, 2012). The project area is well beyond the 197-ft (60-m) depth contour used by the BOEM as the seaward extent for prehistoric archaeological site potential in the Gulf of Mexico. Therefore, Shell's operations will have no cumulative impacts on historic shipwrecks or prehistoric archaeological resources.

New Information. New information included in the most recent Programmatic, Supplemental, and Final EISs (BOEM, 2012a; 2013; 2014b; 2015; 2016a; 2016c; 2017a) has been incorporated into the EIA, where applicable.

C.9.2 Cumulative Impacts to Biological Resources

The work planned in the DOCD is limited in geographic scope, 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 and bottom disturbance associated with drilling, completion, well works, and installation activities are expected to be minor and limited to a small area. As described previously, the geophysical surveys did not identify any features that could support high-density deepwater benthic communities in the project area (BP America Inc, 2004; Fugro Geo-consulting Inc., 2010; C&C Technologies, 2011; Fugro Geo-consulting Inc., 2011a; b; 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 cumulative impacts is not determined to be significant (BOEM, 2012a; b; 2013; 2014b; 2015; 2016c; 2017a).

Threatened, Endangered, and Protected Species. Threatened, Endangered, and protected species which could occur in the project area include two species of marine mammal, one species of shark, two species of fish, and five species of sea turtles. Potential impact sources include vessel presence including noise and lights, marine debris, and support vessel and aircraft traffic. Potential effects for these species would be limited and temporary, and would be reduced by Shell's compliance with BOEM-required mitigation measures, including NTLs BSEE-2015-G013. No significant cumulative impacts are expected.

Coastal and Marine Birds. Birds may be exposed to contaminants, including air pollutants and routine discharges, but significant impacts are unlikely due to rapid dispersion. Shell's compliance with NTL BSEE-2015-G013 will minimize the likelihood of debris-related impacts on birds. Support vessel and helicopter traffic may disturb some foraging and resting birds; however, it is likely that individual birds would experience, at most, only short-term behavioral disruption.

Due to the limited scope, timing, and geographic extent of installation activities, collisions or other adverse effects are unlikely, and no significant cumulative impacts are expected.

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

Coastal Habitats. Due to the distance 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 at Port Fourchon and Houma, Louisiana, are not in wildlife refuge 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; 2014b; 2015; 2016a; 2016c; 2017a) has been incorporated into the EIA, where applicable.

C.9.3 Cumulative Impacts to Socioeconomic Resources

The work planned in the DOCD is limited in geographic scope and the impacts on socioeconomic resources will be correspondingly limited.

The multisale and Supplemental and Final EISs analyzed the cumulative impacts of oil and gas exploration and development in the project area, in combination with other impact-producing activities, on commercial fishing, recreational fishing, recreational resources, historical and archaeological resources, land use and coastal infrastructure, demographics, and environmental justice (BOEM, 2012a; 2013; 2014b; 2015; 2016c; 2017a). BOEM also analyzed the economic impact of oil and gas activities on the Gulf States, finding only minor impacts in most of Texas, Mississippi, Alabama, and Florida, more significant impacts in parts of Texas, and substantial impacts on Louisiana.

Shell's proposed activities will have negligible cumulative impacts on socioeconomic resources. There are no IPFs associated with routine operations that are expected to affect public health and safety, employment and infrastructure, recreation and tourism, land use, or other marine uses. Due to the distance from shore, it is unlikely that any recreational fishing activity is occurring in the project area, and it is unlikely that any commercial fishing activity other than longlining occurs at or near the project area. The project will have negligible impacts on fishing activities.

New Information. New information included in the most recent Programmatic, Supplemental, and Final EISs (BOEM, 2012a; b; 2013; 2014b; 2015; 2016a; 2016c; 2017a) has been incorporated into the EIA, where applicable.

D. Environmental Hazards

D.1 Geologic Hazards

Based on the results of high-resolution geophysical datasets and reprocessed exploration three dimensional seismic data, the proposed drilling, completion, well work, and associated subsea equipment installation appear suitable for the planned activities (BP America Inc, 2004; Fugro Geo-consulting Inc., 2010; C&C Technologies, 2011; Fugro Geo-consulting Inc., 2011a; b; Forum Energy Technologies, 2012).

See **DOCD 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 DP 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 DP 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 rig. Metocean conditions such as sea states, 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 DP 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 DP MODU for safety reasons until the storm or weather event passes.

E. Alternatives

No formal alternatives were evaluated in the DOCD. However, various technical and operational options, including the location of the 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 **DOCD Section 2f**.

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

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 2 – Production data table
Section 5 – Reservoir development

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