UNITED STATES GOVERNMENT MEMORANDUM

August 16, 2019

To: Public Information (MS 5030)

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

Subject: Public Information copy of plan

Control # - N-10073

Type - Initial Exploration Plan

Lease(s) - OCS-G36181 Block - 881 Walker Ridge Area
OCS-G36475 Block - 925 Walker Ridge Area

Operator - Anadarko Petroleum Corporation

Description - Wells WR 881 A, WR 881 AA, WR 881 B, WR 881 D, WR 881 F, WR 881 FF, WR 925 A Atl, WR 925 AA Atl, WR 925 AAA Atl, WR 925

Rig Type - DP Semisubmersible and Drillship

Attached is a copy of the subject plan.

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

Chiquita Hill
Plan Coordinator

Site Type/Name	**Botm Lse/Area/Blk**	**Surface Location**	**Surf Lse/Area/Blk**
WELL/WR 881 A	G36181/WR/881	1034 FSL, 3428 FWL	G36181/WR/881
WELL/WR 881 B	G36181/WR/881	5644 FSL, 2264 FWL	G36181/WR/881
WELL/WR 881 D	G36181/WR/881	3128 FSL, 3274 FEL	G36181/WR/881
WELL/WR 881 F	G36181/WR/881	4199 FSL, 4982 FWL	G36181/WR/881
WELL/WR 881AA	G36181/WR/881	1119 FSL, 3506 FWL	G36181/WR/881
WELL/WR 881FF	G36181/WR/881	4124 FSL, 4945 FWL	G36181/WR/881
WELL/WR 925 A	G36475/WR/925	1008 FSL, 2452 FWL	G36181/WR/881
WELL/WR 925 E	G36475/WR/925	471 FNL, 5763 FWL	G36475/WR/925
WELL/WR 925AA	G36475/WR/925	888 FSL, 2631 FWL	G36181/WR/881
WELL/WR 925EE	G36475/WR/925	371 FNL, 5863 FWL	G36475/WR/925
WELL/WR925AAA	G36475/WR/925	999 FSL, 2231 FWL	G36181/WR/881

INITIAL SUPPLEMENTAL EXPLORATION PLAN (N-10073)

ANADARKO PETROLEUM CORPORATION

WALKER RIDGE BLOCK 881/925
OCS-G36181/OCS-G36475

PUBLIC COPY

RECORD OF CHANGE LOG

Submission Type	Date Sent to BOEM	Summary of Submission	Page Numbers
Initial	6/13/2019 (BOEM (received 6/17/2019)	Initial EP submission	All
Amendment	6/26/2019	Provided further clarification for disposal location and method for Section F. (Already denoted in Section K, L for waste transportation.)	218-219, 259, 263
Amendment	7/8/19	Submitted reference information for sand not anticipated to impact the worst-case discharge volume. (Confidential data, not included.)	N/A
Final Copy of Plan	7/31/19	Complete EP Submittal.	All
Add Record of Change Log	7/31/19	Add Record of Change Log	1

PUBLIC

INITIAL SUPPLEMENTAL EXPLORATION PLAN

WALKER RIDGE BLOCK 881/925
OCS-G36181/OCS-G36475

OFFSHORE, LOUISIANA

Anadarko Petroleum Corporation
1201 Lake Robbins Drive
The Woodlands, Texas 77380
Contact: Bridget O'Farrell
Bridget.OFarrell-Villarreal@anadarko.com
(832) 636-1694

1 – Hard Copy Confidential
1 – CD Confidential
1 – Hard Copy Public Information
1 – CD Public Information

June 2019

INITIAL SUPPLEMENTAL EXPLORATION PLAN
LEASE OCS-G36181/OCS-G36475
Walker Ridge Block 881/925

SECTION A
PLAN CONTENTS

(a) Plan Information Form

Under this Initial Supplemental Exploration Plan (EP), Anadarko Petroleum Corporation (Anadarko) proposes to drill and complete 11 wells total in Walker Ridge 881/925.

- Walker Ridge 881: Location A, AA, B, D, F, FF
- Walker Ridge 925: Location A Alt., AA Alt., AAA Alt., E, EE

The wells will be drilled using a dynamically positioned (DP) drillship or DP semi-submersible drilling rig. Drilling and completion operations for all well locations will utilize a subsea BOP stack. OCS Plan Information Form BOEM-137 is enclosed as **Attachment A-1.**

(b) Location

Enclosed as **Attachment A-2** is a well location plat at a scale of 1 inch = 2,000 feet that depicts the surface locations and water depth of the proposed wells.

(c) Safety and Pollution Prevention Features

Safety features on the drilling rig will include well control, pollution prevention, safe welding procedures, and blowout prevention equipment as described in Title 30 CFR Part 250, Subparts C, D, E, G and O; and as further clarified by BOEM/BSEE Notices to Lessees, and applicable regulations of the Environmental Protection Agency and the U.S. Coast Guard. The appropriate life rafts, life jackets, ring buoys, etc., as prescribed by the U.S. Coast Guard, will be maintained on the facility at all times.

(d) Storage Tanks and Production Vessels

The proposed wells will be drilled with a DP drillship or DP semi-submersible drilling rig. The storage tanks represented below reflect the largest tank capacities from MODU's under contract. Another MODU or vessel may be utilized during operations, but will have a total storage tank capacity equal to or less than the following:

Type of Facility	Type Of Storage Tank	Tank Capacity	Number Of Tanks	Total Capacity	Fluid Gravity (Api)	Total Capacity of all Tanks for Rig Type
Drillship	Hydrocarbons/Fuel Oil Storage Tank	5,514 bbls	2	11,028 bbls	No. 2 Diesel/ varies	**12 tanks total= 62,874 bbls**
	Hydrocarbons/Fuel Oil Storage Tank	12,458 bbls	2	24,916 bbls	No. 2 Diesel/ varies	
	Hydrocarbons/Fuel Oil Storage Tank	12,065 bbls	2	24,130 bbls	No. 2 Diesel/ varies	
	Fuel Oil Settling Tanks	640 bbls	2	1,280 bbls	No. 2 Diesel	
	Fuel Oil Service Tanks	480 bbls	3	1,440 bbls	No. 2 Diesel	
	Fuel Oil Emergency Generator Tank	80 bbls	1	80 bbls	No. 2 Diesel	
DP Semi	Hydrocarbon/Fuel Oil Hull Tanks	4,541 bbls	2	9,082 bbls	No. 2 Diesel/ varies	**7 tanks total= 16,689 bbls**
	Hydrocarbon/Fuel Oil Hull Tanks	3,392 bbls	2	6,784 bbls	No. 2 Diesel/ varies	
	Fuel Oil Deck Day Tank	629 bbls	1	629 bbls	No. 2 Diesel	
	Fuel Oil Deck Settling Tank	164 bbls	1	164 bbls	No. 2 Diesel	
	Fuel Oil Emergency Generator	30 bbls	1	30 bbls	No. 2 Diesel	

(e) Pollution Prevention Measures

The drilling rig utilized for these operations will comply with all applicable regulations regarding pollution prevention and control. The rig has a Shipboard Oil Pollution Emergency Plan (SOPEP), which is reviewed and approved annually by the American Bureau of Shipping (ABS). The SOPEP is provided to assist employees in dealing with an unexpected discharge of oil. Its primary purpose is to set in motion the necessary actions to stop or minimize the discharge of oil and to mitigate its effects. Effective planning ensures that the necessary actions are taken in a structured, logical and timely manner.

Pollution prevention measures include installation of curbs, gutters, drip pans, and drains on deck areas to collect all contaminants and debris. Most deck drains and some of the joints at the edge of the rig floor go overboard or into the moonpool, respectively. To prevent ocean discharge from the drains there is a dedicated drip pan under the rotary table. The pipe racks, mud pump room, sack store, and drill floor drains go to a holding tank, which is served by a dedicated oily water separator. The well test area, engine room, and other major machinery spaces drains all go to slops tanks, which are served by a large general-service, oily water separator. The containment devices are temporary. They are not meant for permanent storage of waste. On the rare occasion that they contain wastes, they are pumped, mopped, or cleaned within a short period of time. The chances of damage to a containment structure during such time as it contains wastes are exceedingly small.

(f) Additional Pollution Prevention Measures

No additional measures are proposed under this plan. The activities proposed in this plan are not located offshore Florida.

(g) Description of Previously Approved Lease Activities

Anadarko has no previously approved well locations in Walker Ridge 881/925. Anadarko will not be revising or utilizing Equinor Gulf of Mexico LLC's (formerly Statoil Gulf of Mexico LLC) well location approved under the Initial Exploration Plan (EP) or Revised EP, Plan Control No.: N-9373 or R-5112 for Walker Ridge 925.

Control #	Plan Type/Approval	Well Location(s)	Status of Well Location
N-9373	Initial EP, Approved 6/25/09	WR 925, Location C	Location cancelled 12/2/10
R-5112	Revised EP, Approved 6/24/11	WR 925, Location C	Location cancelled 2/25/14

Attachment A-1

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

OMB Control Number: 1010-0151
OMB Approval Expires: 6/30/2021

OCS PLAN INFORMATION FORM

General Information

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

Company Name: Anadarko Petroleum Corporation	BOEM Operator Number: 00981
Address:	Contact Person: Bridget O'Farrell
1201 Lake Robbins Drive	Phone Number: 832-636-1694
The Woodlands, TX 77380	E-Mail Address: Bridget.OFarrell-Villarreal@anadarko.com

If a service fee is required under 30 CFR 550.125(a), provide the	Amount paid	$22,038.00	Receipt No.	Pay.gov ID: 26I3JI3D, Agency ID: 75769813836

Project and Worst Case Discharge (WCD) Information

Lease(s): G36181/G36475	Area: WR	Block: 881/925	Project Name (If Applicable): Magnus

Objective(s)	X	Oil	X	Gas		Sulphur		Salt	Onshore Support Base(s): Fourchon, LA* / Houma,LA Alt. Galveston,TX; Cameron,LA;Lake Charles,LA; Pascagoula,MS

Platform/Well Name: WR 925 A Alt.	Total Volume of WCD: 250,000 bopd	API Gravity: 30
Distance to Closest Land (Miles): 211	Volume from uncontrolled blowout: 20,250,000 bbls	

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

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

Proposed Activity	Start Date	End Date	No. of Days
Drill, complete, conduct flowtest-WR 881 Location A	11/16/2019	2/24/2020	100 (2019=60, 2020=40)
Drill, complete, conduct flowtest-WR 925 Location A Alt.	2/25/2020	6/4/2020	100 (2020)
Drill, complete, conduct flowtest-WR 925 Location E	6/05/2020	9/13/2020	100 (2020)
Drill, complete, conduct flowtest-WR 925 Location AA Alt.	3/01/2021	6/09/2021	100 (2021)
Drill, complete, conduct flowtest-WR 925 Location EE	9/01/2021	12/10/2021	100 (2021)
Drill, complete, conduct flowtest-WR 881 Location F	5/01/2022	8/09/2022	100 (2022)
Drill, complete, conduct flowtest-WR 881 Location B	9/15/2022	12/24/2022	100 (2022)
Drill, complete, conduct flowtest-WR 881 Location AA	3/01/2023	6/09/2023	100 (2023)
Drill, complete, conduct flowtest-WR 881 Location D	5/1/2024	8/09/2024	100 (2024)
Drill, complete, conduct flowtest-WR 925 Location AAA Alt.	1/1/2025	4/11/2025	100 (2025)

Description of Drilling Rig

	Jackup	X	Drillship
	Gorilla Jackup		Platform rig
	Semisubmersible		Submersible
X	DP Semisubmersible		Other (Attach Description)
Drilling Rig Name (If Known):			

Description of Structure

	Caisson		Tension leg platform
	Fixed platform		Compliant tower
	Spar		Guyed tower
	Floating production system		Other (Attach Description)

Description of Lease Term Pipelines

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

PROPOSED ACTIVITY CONTINUED ON NEXT PAGE

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

OMB Control Number: 1010-0151
OMB Approval Expires: 6/30/2021

OCS PLAN INFORMATION FORM

General Information

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

Company Name: Anadarko Petroleum Corporation	BOEM Operator Number: 00981
Address:	Contact Person: Bridget O'Farrell
1201 Lake Robbins Drive	Phone Number: 832-636-1694
The Woodlands, TX 77380	E-Mail Address: Bridget.OFarrell-Villarreal@anadarko.com

If a service fee is required under 30 CFR 550.125(a), provide the	Amount paid	$22,038.00	Receipt No.	Pay.gov ID: 26I3JI3D, Agency ID: 75769813836

Project and Worst Case Discharge (WCD) Information

Lease(s): G36181/G36475	Area: WR	Block: 881/925	Project Name (If Applicable): Magnus

Objective(s)	X	Oil	X	Gas		Sulphur		Salt	Onshore Support Base(s): Fourchon, LA* / Houma,LA Alt. Galveston,TX; Cameron,LA;Lake Charles,LA; Pascagoula,MS

Platform/Well Name: WR 925 A Alt.	Total Volume of WCD: 250,000 bopd	API Gravity: 30
Distance to Closest Land (Miles): 211	Volume from uncontrolled blowout: 20,250,000 bbls	

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

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

Proposed Activity	Start Date	End Date	No. of Days
Drill, complete, conduct flowtest-WR 881 Location FF	1/01/2026	4/11/2026	100 (2026)
.			

Description of Drilling Rig

	Jackup	X	Drillship
	Gorilla Jackup		Platform rig
	Semisubmersible		Submersible
X	DP Semisubmersible		Other (Attach Description)
Drilling Rig Name (If Known):			

Description of Structure

	Caisson		Tension leg platform
	Fixed platform		Compliant tower
	Spar		Guyed tower
	Floating production system		Other (Attach Description)

Description of Lease Term Pipelines

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

OCS PLAN INFORMATION FORM (CONTINUED)

Include one copy of this page for each proposed well/structure

Proposed Well/Structure Location						
Well or Structure Name/Number (If renaming well or structure, reference previous name): WR 881 A			Previously reviewed under an approved EP or DOCD?		Yes	X No
Is this an existing well or structure?	Yes	No X	If this is an existing well or structure, list the Complex ID or API No.			
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 blowout (Bbls/day): 240,441		For structures, volume of all storage and pipelines (Bbls):		API Gravity of fluid	30
	Surface Location		**Bottom-Hole Location (For Wells)**		**Completion (For multiple completions, enter separate lines)**	
Lease No.	OCS G36181		OCS		OCS OCS	
Area Name	Walker Ridge					
Block No.	881					
Blockline Departures (in feet)	N/S Departure: F__L 1,034 FSL		N/S Departure: F__L		N/S Departure: F__L N/S Departure: F__L N/S Departure: F__L	
	E/W Departure: F__L 3,428 FWL		E/W Departure: F__L		E/W Departure: F__L E/W Departure: F__L E/W Departure: F__L	
Lambert X-Y coordinates	X: 1,999,267.53		X:		X: X: X:	
	Y: 9,457,513.85		Y:		Y: Y: Y:	
Latitude/ Longitude	Latitude 26.0602877		Latitude		Latitude Latitude Latitude	
	Longitude -91.90657128		Longitude		Longitude Longitude Longitude	
Water Depth (Feet): 7,781			MD (Feet):	TVD (Feet):	MD (Feet): MD (Feet): MD (Feet):	TVD (Feet): TVD (Feet): TVD (Feet):
Anchor Radius (if applicable) in feet:			N/A			

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

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

OCS PLAN INFORMATION FORM (CONTINUED)

Include one copy of this page for each proposed well/structure

<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): WR 881 AA</td><td colspan="2">Previously reviewed under an approved EP or DOCD?</td><td>Yes</td><td>X No</td></tr>
<tr><td colspan="2">Is this an existing well or structure? Yes / No X</td><td colspan="2">If this is an existing well or structure, list the Complex ID or API No.</td><td colspan="2"></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 blowout (Bbls/day):</td><td colspan="2">For structures, volume of all storage and pipelines (Bbls):</td><td>API Gravity of fluid</td><td></td></tr>
<tr><td></td><td>Surface Location</td><td colspan="2">Bottom-Hole Location (For Wells)</td><td colspan="2">Completion (For multiple completions, enter separate lines)</td></tr>
<tr><td>Lease No.</td><td>OCS G36181</td><td colspan="2">OCS</td><td colspan="2">OCS
OCS</td></tr>
<tr><td>Area Name</td><td>Walker Ridge</td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>Block No.</td><td>881</td><td colspan="2"></td><td colspan="2"></td></tr>
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N/S Departure: F___L</td></tr>
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Y:</td></tr>
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Latitude</td></tr>
<tr><td>Longitude
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Longitude</td></tr>
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MD (Feet):
MD (Feet):</td><td rowspan="2">TVD (Feet):
TVD (Feet):
TVD (Feet):</td></tr>
<tr><td colspan="4">Anchor Radius (if applicable) in feet: N/A</td></tr>
</table>

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

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

OCS PLAN INFORMATION FORM (CONTINUED)
Include one copy of this page for each proposed well/structure

Proposed Well/Structure Location						
Well or Structure Name/Number (If renaming well or structure, reference previous name): WR 881 B		Previously reviewed under an approved EP or DOCD?		Yes	X	No
Is this an existing well or structure?	Yes	No X	If this is an existing well or structure, list the Complex ID or API No.			
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 blowout (Bbls/day):		For structures, volume of all storage and pipelines (Bbls):		API Gravity of fluid	

	Surface Location	Bottom-Hole Location (For Wells)	Completion (For multiple completions, enter separate lines)
Lease No.	OCS G36181	OCS	OCS OCS
Area Name	Walker Ridge		
Block No.	881		
Blockline Departures (in feet)	N/S Departure: F___L 5,644 FSL	N/S Departure: F___L	N/S Departure: F___L N/S Departure: F___L N/S Departure: F___L
	E/W Departure: F___L 2,264 FWL	E/W Departure: F___L	E/W Departure: F___L E/W Departure: F___L E/W Departure: F___L
Lambert X-Y coordinates	X: 1,998,103.56	X:	X: X: X:
	Y: 9,462,123.57	Y:	Y: Y: Y:
Latitude/ Longitude	Latitude 26.07299999	Latitude	Latitude Latitude Latitude
	Longitude -91.91	Longitude	Longitude Longitude Longitude
Water Depth (Feet): 7,633		MD (Feet): TVD (Feet):	MD (Feet): TVD (Feet): MD (Feet): TVD (Feet): MD (Feet): TVD (Feet):
Anchor Radius (if applicable) in feet:		N/A	

Anchor Locations for Drilling Rig or Construction Barge (If anchor radius supplied above, not necessary)					
Anchor Name or No.	Area	Block	X Coordinate	Y Coordinate	Length of Anchor Chain on Seafloor
			X =	Y =	
			X =	Y =	
			X =	Y =	
			X =	Y =	
			X =	Y =	
			X =	Y =	
			X =	Y =	
			X =	Y =	

OCS PLAN INFORMATION FORM (CONTINUED)
Include one copy of this page for each proposed well/structure

Proposed Well/Structure Location					
Well or Structure Name/Number (If renaming well or structure, reference previous name): WR 881 D	Previously reviewed under an approved EP or DOCD?		Yes	X	No
Is this an existing well or structure?		Yes	No X	If this is an existing well or structure, list the Complex ID or API No.	
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 blowout (Bbls/day):	For structures, volume of all storage and pipelines (Bbls):	API Gravity of fluid	
	Surface Location	**Bottom-Hole Location (For Wells)**	**Completion (For multiple completions, enter separate lines)**	
Lease No.	OCS G36181	OCS	OCS OCS	
Area Name	Walker Ridge			
Block No.	881			
Blockline Departures (in feet)	N/S Departure: F___L 3,128 FSL	N/S Departure: F___L	N/S Departure: F___L N/S Departure: F___L N/S Departure: F___L	
	E/W Departure: F___L 3,274 FEL	E/W Departure: F___L	E/W Departure: F___L E/W Departure: F___L E/W Departure: F___L	
Lambert X-Y coordinates	X: 2,008,405.91	X:	X: X: X:	
	Y: 9,459,607.75	Y:	Y: Y: Y:	
Latitude/ Longitude	Latitude 26.0658363	Latitude	Latitude Latitude Latitude	
	Longitude -91.87867572	Longitude	Longitude Longitude Longitude	
Water Depth (Feet): 7,560		MD (Feet): / TVD (Feet):	MD (Feet): MD (Feet): MD (Feet):	TVD (Feet): TVD (Feet): TVD (Feet):
Anchor Radius (if applicable) in feet:		N/A		

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

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

OCS PLAN INFORMATION FORM (CONTINUED)
Include one copy of this page for each proposed well/structure

Proposed Well/Structure Location						
Well or Structure Name/Number (If renaming well or structure, reference previous name): WR 881 F		Previously reviewed under an approved EP or DOCD?		Yes	X	No
Is this an existing well or structure?	Yes	No X	If this is an existing well or structure, list the Complex ID or API No.			
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 blowout (Bbls/day):	For structures, volume of all storage and pipelines (Bbls):		API Gravity of fluid		

	Surface Location	Bottom-Hole Location (For Wells)	Completion (For multiple completions, enter separate lines)
Lease No.	OCS G36181	OCS	OCS OCS
Area Name	Walker Ridge		
Block No.	881		
Blockline Departures (in feet)	N/S Departure: F___L 4,199 FSL	N/S Departure: F___L	N/S Departure: F___L N/S Departure: F___L N/S Departure: F___L
	E/W Departure: F___L 4,982 FWL	E/W Departure: F___L	E/W Departure: F___L E/W Departure: F___L E/W Departure: F___L
Lambert X-Y coordinates	X: 2,000,822.48	X:	X: X: X:
	Y: 9,460,678.7	Y:	Y: Y: Y:
Latitude/ Longitude	Latitude 26.06896106	Latitude	Latitude Latitude Latitude
	Longitude -91.90175277	Longitude	Longitude Longitude Longitude

Water Depth (Feet): 7,722	MD (Feet):	TVD (Feet):	MD (Feet): MD (Feet): MD (Feet):	TVD (Feet): TVD (Feet): TVD (Feet):
Anchor Radius (if applicable) in feet:	N/A			

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

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

OCS PLAN INFORMATION FORM (CONTINUED)
Include one copy of this page for each proposed well/structure

Proposed Well/Structure Location							
Well or Structure Name/Number (If renaming well or structure, reference previous name): WR 881 FF			Previously reviewed under an approved EP or DOCD?		Yes	X	No
Is this an existing well or structure?	Yes	No X	If this is an existing well or structure, list the Complex ID or API No.				
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 blowout (Bbls/day):		For structures, volume of all storage and pipelines (Bbls):	API Gravity of fluid			
	Surface Location		**Bottom-Hole Location (For Wells)**	**Completion (For multiple completions, enter separate lines)**			
Lease No.	OCS G36181		OCS	OCS OCS			
Area Name	Walker Ridge						
Block No.	881						
Blockline Departures (in feet)	N/S Departure: F___L 4,124 FSL		N/S Departure: F___L	N/S Departure: F___L N/S Departure: F___L N/S Departure: F___L			
	E/W Departure: F___L 4,945 FWL		E/W Departure: F___L	E/W Departure: F___L E/W Departure: F___L E/W Departure: F___L			
Lambert X-Y coordinates	X: 2,000,785.18		X:	X: X: X:			
	Y: 9,460,604.32		Y:	Y: Y: Y:			
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	Longitude -91.90186834		Longitude	Longitude Longitude Longitude			
Water Depth (Feet): 7,725			MD (Feet):	TVD (Feet):	MD (Feet): MD (Feet):		TVD (Feet): TVD (Feet):
Anchor Radius (if applicable) in feet:			N/A		MD (Feet):		TVD (Feet):

Anchor Locations for Drilling Rig or Construction Barge (If anchor radius supplied above, not necessary)					
Anchor Name or No.	**Area**	**Block**	**X Coordinate**	**Y Coordinate**	**Length of Anchor Chain on Seafloor**
			X =	Y =	
			X =	Y =	
			X =	Y =	
			X =	Y =	
			X =	Y =	
			X =	Y =	
			X =	Y =	
			X =	Y =	

OCS PLAN INFORMATION FORM (CONTINUED)

Include one copy of this page for each proposed well/structure

Proposed Well/Structure Location					
Well or Structure Name/Number (If renaming well or structure, reference previous name): WR 925 A Alt.	Previously reviewed under an approved EP or DOCD?		Yes	X	No

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

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 blowout (Bbls/day): 250,000	For structures, volume of all storage and pipelines (Bbls):	API Gravity of fluid	30

	Surface Location	Bottom-Hole Location (For Wells)	Completion (For multiple completions, enter separate lines)
Lease No.	OCS G36181	OCS	OCS OCS
Area Name	Walker Ridge		
Block No.	881		
Blockline Departures (in feet)	N/S Departure: F___L 1,008 FSL	N/S Departure: F___L	N/S Departure: F___L N/S Departure: F___L N/S Departure: F___L
	E/W Departure: F___L 2,452 FWL	E/W Departure: F___L	E/W Departure: F___L E/W Departure: F___L E/W Departure: F___L
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	Y: 9,457,488	Y:	Y: Y: Y:
Latitude/ Longitude	Latitude 26.06023905	Latitude	Latitude Latitude Latitude
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Water Depth (Feet): 7,797	MD (Feet):	TVD (Feet):	MD (Feet): MD (Feet): MD (Feet):	TVD (Feet): TVD (Feet): TVD (Feet):
Anchor Radius (if applicable) in feet:	N/A			

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

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

OCS PLAN INFORMATION FORM (CONTINUED)

Include one copy of this page for each proposed well/structure

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<tr><td colspan="2">Is this an existing well or structure? Yes | No X</td><td colspan="2">If this is an existing well or structure, list the Complex ID or API No.</td><td colspan="2"></td></tr>
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<tr><td></td><td>Surface Location</td><td colspan="2">Bottom-Hole Location (For Wells)</td><td colspan="2">Completion (For multiple completions, enter separate lines)</td></tr>
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TVD (Feet):
TVD (Feet):</td></tr>
<tr><td colspan="4">Anchor Radius (if applicable) in feet: N/A</td></tr>
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Anchor Locations for Drilling Rig or Construction Barge (If anchor radius supplied above, not necessary)

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

OCS PLAN INFORMATION FORM (CONTINUED)
Include one copy of this page for each proposed well/structure

Proposed Well/Structure Location

Well or Structure Name/Number (If renaming well or structure, reference previous name): WR 925 AAA Alt.	Previously reviewed under an approved EP or DOCD?		Yes	X	No
Is this an existing well or structure?		Yes		No X	If this is an existing well or structure, list the Complex ID or API No.
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 blowout (Bbls/day):	For structures, volume of all storage and pipelines (Bbls):	API Gravity of fluid
	Surface Location	**Bottom-Hole Location (For Wells)**	**Completion (For multiple completions, enter separate lines)**
Lease No.	OCS G36181	OCS	OCS OCS
Area Name	Walker Ridge		
Block No.	881		
Blockline Departures (in feet)	N/S Departure: F___L 999 FSL	N/S Departure: F___L	N/S Departure: F___L N/S Departure: F___L N/S Departure: F___L
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	Y: 9,457,479.32	Y:	Y: Y: Y:
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Water Depth (Feet): 7,798	MD (Feet):	TVD (Feet):	MD (Feet): MD (Feet): MD (Feet):	TVD (Feet): TVD (Feet): TVD (Feet):
Anchor Radius (if applicable) in feet:	N/A			

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

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

OCS PLAN INFORMATION FORM (CONTINUED)
Include one copy of this page for each proposed well/structure

Proposed Well/Structure Location

Well or Structure Name/Number (If renaming well or structure, reference previous name): WR 925 E	Previously reviewed under an approved EP or DOCD?		Yes	X	No
Is this an existing well or structure?		Yes	No X	If this is an existing well or structure, list the Complex ID or API No.	
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 blowout (Bbls/day):	For structures, volume of all storage and pipelines (Bbls):	API Gravity of fluid	

	Surface Location	**Bottom-Hole Location (For Wells)**	**Completion (For multiple completions, enter separate lines)**
Lease No.	OCS 36475	OCS	OCS OCS
Area Name	Walker Ridge		
Block No.	925		
Blockline Departures (in feet)	N/S Departure: F___L 471 FNL	N/S Departure: F___L	N/S Departure: F___L N/S Departure: F___L N/S Departure: F___L
	E/W Departure: F___L 5,763 FWL	E/W Departure: F___L	E/W Departure: F___L E/W Departure: F___L E/W Departure: F___L
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	Y: 9,456,008.73	Y:	Y: Y: Y:
Latitude/ Longitude	Latitude 26.05609171	Latitude	Latitude Latitude Latitude
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Water Depth (Feet): 7,814	MD (Feet):	TVD (Feet):	MD (Feet): MD (Feet): MD (Feet):	TVD (Feet): TVD (Feet): TVD (Feet):
Anchor Radius (if applicable) in feet:	N/A			

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

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

OCS PLAN INFORMATION FORM (CONTINUED)

Include one copy of this page for each proposed well/structure

<table>
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<tr><td colspan="2">Is this an existing well or structure?   Yes: No: X</td><td colspan="2">If this is an existing well or structure, list the Complex ID or API No.</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?   X Yes   No</td></tr>
<tr><td>WCD info</td><td>For wells, volume of uncontrolled blowout (Bbls/day):</td><td>For structures, volume of all storage and pipelines (Bbls):</td><td>API Gravity of fluid</td></tr>
<tr><td></td><td>Surface Location</td><td>Bottom-Hole Location (For Wells)</td><td>Completion (For multiple completions, enter separate lines)</td></tr>
<tr><td>Lease No.</td><td>OCS
36475</td><td>OCS</td><td>OCS
OCS</td></tr>
<tr><td>Area Name</td><td>Walker Ridge</td><td></td><td></td></tr>
<tr><td>Block No.</td><td>925</td><td></td><td></td></tr>
<tr><td rowspan="2">Blockline Departures (in feet)</td><td>N/S Departure: F___L
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N/S Departure: F___L</td></tr>
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X:</td></tr>
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Y:
Y:</td></tr>
<tr><td rowspan="2">Latitude/ Longitude</td><td>Latitude
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<tr><td>Longitude
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Longitude</td></tr>
<tr><td colspan="2">Water Depth (Feet):
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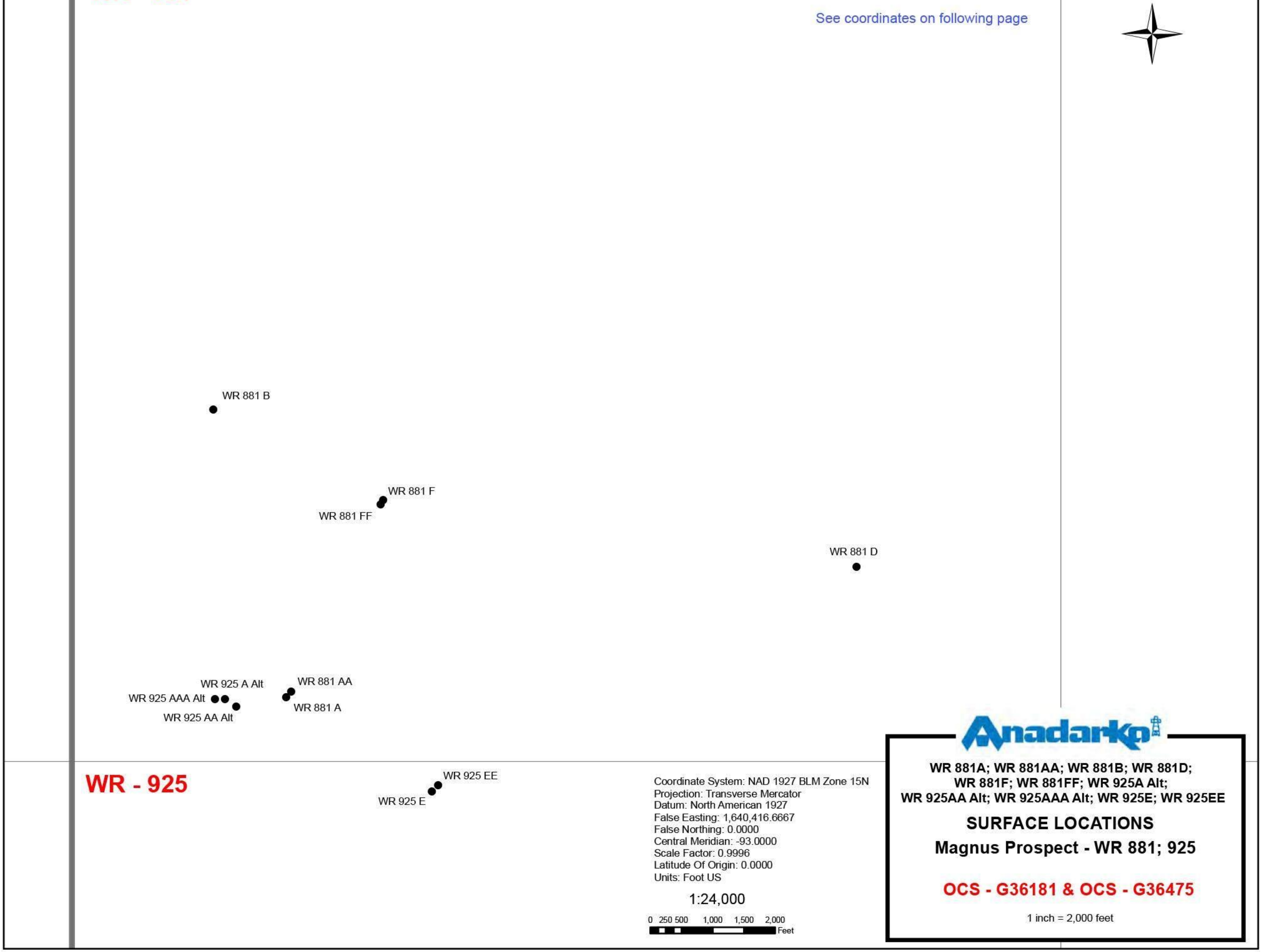
MD (Feet): TVD (Feet):
MD (Feet): TVD (Feet):</td></tr>
<tr><td colspan="3">Anchor Radius (if applicable) in feet: N/A</td></tr>
</table>

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

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

Attachment A-2



Well Name	SHL Easting	SHL Northing	SHL Lat	SHL Long	SHL N/S Departure	SHL E/W Departure	WD
WR 925 A Alt	1998291.5	9457488	26.06023905	-91.9095455	1008 FSL	2452 FWL	7797
WR 925 AA Alt	1998470.69	9457368.22	26.05990531	-91.90900264	888 FSL	2631 FWL	7793
WR 925 AAA Alt	1998131.03	9457479.32	26.06021886	-91.91003461	999 FSL	2231 FWL	7798
WR 881 A	1999267.53	9457513.85	26.0602877	-91.90657128	1034 FSL	3428 FWL	7781
WR 881 AA	1999346.05	9457599.45	26.06052145	-91.90632988	1119 FSL	3506 FWL	7780
WR 881 B	1998103.56	9462123.57	26.07299999	-91.91	5644 FSL	2264 FWL	7633
WR 881 D	2008405.91	9459607.75	26.0658363	-91.87867572	3128 FSL	3274 FEL	7560
WR 925 E	2001603.18	9456008.73	26.05609171	-91.89949423	471 FNL	5763 FWL	7814
WR 925 EE	2001702.77	9456109.02	26.05636537	-91.89918826	371 FNL	5863 FWL	7815
WR 881 F	2000822.48	9460678.7	26.06896106	-91.90175277	4199 FSL	4982 FWL	7722
WR 881 FF	2000785.18	9460604.32	26.06875725	-91.90186834	4124 FSL	4945 FWL	7725

SECTION B
GENERAL INFORMATION

(a) Applications and Permits

Prior to beginning exploration operations the following application(s) will be submitted for approval:

Application/Permit	Issuing Agency	Status
Permit to Drill	Bureau of Safety and Environmental Enforcement (BSEE)	To be submitted

(b) Drilling Fluids

Type of Drilling Fluid	Estimated Volume Per Well
Water-based (NaCl saturated, seawater, freshwater, barite) for Pump and Dump	35,000 bbls*
Synthetic-based (internal olefin, ester)	16,000 bbls
Oil-based	N/A

**The actual volume ordered out will be an estimated 35,000 bbls/well of mud. Once on location this volume will be cut back and mixed with seawater to different desired mud weights which will increase the volume that is discharged at the seafloor. The estimated volume that will be discharged at the seafloor will be approximately 80,000 bbls/well.*

(c) Oils Characteristics

Oil will not be produced under this Initial Supplemental EP. Therefore the oils characteristics information is not required per NTL 2008-G04 2(d), extended by NTL 2015-N02.

(d) New or Unusual Technology

Anadarko does not propose to use any new or unusual technology to drill the wells proposed in this plan.

(e) Bonding Statement

The bond requirements for the activities and facilities proposed in this EP are satisfied by an area-wide bond furnished and maintained according to 30 CFR Part 556, Subpart I; NTL 2015-N04, "General Financial Assurance," and BOEM NTL 2016-N01, "Requiring Additional Security".

(f) Oil Spill Financial Responsibility (OSFR)

Anadarko Petroleum Corporation (Company Number 00981) has demonstrated oil spill financial responsibility for the facilities proposed in this EP according to 30 CFR Part 553, and NTL 2008-N05, "Guidelines for Oil Spill Financial Responsibility for Covered Facilities".

(g) Deepwater Well Control Statement

Anadarko Petroleum Corporation (Company Number 00981) has the financial capability to drill a relief well and conduct other emergency well control operations if required.

(h) Blowout Scenario

Anadarko prepared the following blowout scenarios pursuant to guidance provided in NTL No. 2015-N01.

Anadarko prepared this blowout scenario pursuant to guidance provided in NTL No. 2015-N01. **Walker Ridge 925, Location A Alt. is addressed in this blowout scenario since it is the location with the highest potential worse case discharge (WCD) rate covered in this EP.** A similar approach would be taken in the event of a blowout for Walker Ridge 881, Location A and the other wells covered under this plan. **Based on NTL No. 2015-N01 guidance, the maximum hydrocarbon discharge for Walker Ridge 925 is calculated to be 250,000 bopd.** (Walker Ridge 881 is calculated to be 240,441 bopd.)

Purpose

This overview provides a generic blowout scenario, additional information regarding any potential oil spill, and the measures Anadarko will take to prevent a blowout and if necessary promptly respond to manage a blowout scenario if one occurs. The following attachment is pursuant with 30 CFR 550.213(g), 30 CFR 550.219 and NTL 2015-N01.

Background

This information has been developed to document the additional information requirements for Exploration Plans as requested by NTL No. 2015-N01 guidance.

Information Requirements

The scenario that could result in the highest blowout discharge rate among the activities described above would occur when drilling with a dynamically positioned MODU (drill ship or semi-submersible).

The scenario assumes a hydrocarbon influx occurs from all of the hydrocarbon sands, followed by a well control event. The subsea BOP and marine riser fails, and a blowout occurs at the seabed.

Estimated flow rate of the potential blowout:

Category	Initial
Type of Activity	Drilling
Facility Location (area/block)	WR 925 A Alt.
Facility Designation	*DP MODU*
Distance to Nearest Shoreline (miles)	211
Uncontrolled blowout (volume per day)	250,000 bopd*
Type of Fluid(s)	Crude oil (~30 API)

** Rounded up from 249,593 bopd.*

a) Potential for the well to bridge over

Mechanical collapse of the reservoirs in the open-hole section of the wellbore was not considered.

b) Likelihood and measures taken for surface and/or sub-sea intervention to stop the blowout

The likelihood of surface intervention to stop a blowout is high and is based on the following equipment specific to the MODU that has been contracted to do this drilling program:

- ROV Secondary BOP Control System: The BOP is confirmed to have a ROV Intervention Panel and circuits that have the following attributes:
    - Hot stab is capable of closing one set of:
    - ▪ Blind-Shear Rams – One Set
    - ▪ Pipe Rams – One Set
    - ▪ Unlatch the Lower Marine Riser Package
    - ROV hot stab to be function tested in conjunction with the Stump test and were tested at the same rate and pressure as the pump installed on the ROV used by the rig.

  The panels may also be operated by an ROV from an independent supply boat in the event of a loss of rig scenario.
- Deadman / Autoshear function: The rig is equipped with an automated sequence that closes the blind shear rams in the event of any of the following scenarios:
    - Inadvertent disconnect of the LMRP
    - Loss of both hydraulic pressure and electrical supply from the surface BOP control system

  No human interface is required once these systems are armed.

c) **Availability of a rig to drill a relief well**
Anadarko has entered into a Mutual Aid agreement with other E&P Operators in the Gulf of Mexico. Under this agreement, Anadarko will be able to select from the best rig option available in the Gulf of Mexico fleet if and when it is required for relief well work. As of June 6, 2019, there were approximately 18 MODU rigs capable of drilling a relief well on this lease in the Gulf of Mexico. A rig which could be used to drill a relief well is the *Transocean Deepwater Conqueror* which is a drillship capable of drilling in 10,000' of water without any constraints. There are no nearby platforms from which to drill a relief well and it is not feasible to drill a relief well from land.

d) **Rig constraints**
A rig capable of drilling in 7,800' of water with a 15k stack is required for any relief well operations. The *Transocean Deepwater Conqueror* is among the DP MODUs that meet these requirements.

e) **Time taken to mobilize a rig and drill a relief well**
An estimate of 7-21 days would be required to suspend operations on a deepwater GOM well and begin drilling the relief well. This assumes 0-14 days to suspend current operations on an existing well and 7 days to mobilize and be ready to spud the relief well. The estimated time to drill the relief well to a blowout is 55-60 days for an estimated total of 62-81 days from time of blowout to completion of a relief well.

The maximum total volume during a blowout could potentially be **20,250,000 bbls** assuming 81 days for the maximum duration of a blowout, multiplied by the worst case daily uncontrolled blowout volume of 250,000 bopd.

f) **Assumptions and calculations used in approved or proposed Oil Spill Response Plan and EP**

- Anadarko submitted a revision to its Regional OSRP updating the exploratory WCD to Green Canyon 683 (Plan Control No. S-7623) since Anadarko no longer owns Walker Ridge 51. This was a non-regulatory required update since the volume was lower than what was previously approved in the OSRP. The update was submitted on June 19, 2018. BSEE acknowledged the updates as in compliance on July 18, 2018.
- The exploratory WCD in the Regional OSRP is 403,608 bopd (API 28.9°).
- Walker Ridge 925, Location A Alt. is the location with the highest potential worse case discharge (WCD) rate covered in this EP. The maximum hydrocarbon discharge for Walker Ridge 925 is calculated to be 250,000 bopd (API 30°).

g) Measures taken to enhance ability to prevent a blowout

- Anadarko utilizes a systematic well design process for the planning and construction of a well operation. This process taps into the depth of experience Anadarko possesses in the deepwater arena and involves a multi-team peer review of the well design, shallow hazards, and formation pressure hazards expected during drilling. This process minimizes the potential for an unplanned well control event that could lead to a blowout. This process will also include a Professional Engineer review and approval of the final casing design and cementing program.

  A detailed pre-drill assessment of formation pressure provided by Anadarko's Geologic/Geophysics team along with pore pressure specialists allows for a mud program that provides an overbalanced mud weight for the safe drilling of the well. The formation pressures may be measured during the well construction process to allow development of alternate plans during the well construction process if needed.

  The well construction process also requires a systematic review and management acceptance of the start-up preparation work for the rig and crews and the third party technical audit work on the rig and the rig's well control equipment. This measures the rig's ability to handle an unplanned well control event and provide assurance that the rig can successfully mitigate a loss of well control event and prevent it from becoming a blowout scenario.

- **Barrier Philosophy:** For all well designs, Anadarko requires and uses a redundant barrier philosophy, that being two independent barriers for both internal and external flow paths in the final wellbore. It is also standard practice to conduct pressure testing, in accordance with applicable regulations, to confirm integrity on all relevant barriers. In addition, all intermediate and production casings returned to the subsea wellhead will be locked down before subsequent drilling continues.

- **BOP and well control equipment:** The rig will have an 18-3/4" 15k psi BOP with primary and secondary BOP control systems. The BOP will have been completely recertified compliant to OEM specifications, by a qualified 3rd Party. Prior to commencement of operations, an independent third party verification will be obtained that the BOP is designed for use with the specific equipment on the rig and this specific well design as required by 30 CFR §250.731(c) and §250.731(d).

- **BOP and well control equipment testing**: To ensure effectiveness of the BOP and well control equipment, a testing program will be conducted prior to installing the BOP and during the well operations. This testing program will provide compliance with current federal regulations for pressure and function testing and will also provide periodic assurance on the performance of both primary and secondary BOP control systems including actual interface operations with the ROV and the ROV panel.

- **Well control training and drills:** Anadarko requires that key nominated onshore and offshore positions including rig contractor personnel hold a WellCAP or equivalent well control training certificate, renewed every two years. Anadarko also monitors compliance of its personnel with applicable federal regulations, including 30 CFR Part 250, Sub-Part O (well control training).

A comprehensive program of well control drills will be conducted offshore to ensure readiness to identify and then manage a well control situation and thereby minimize the potential for a well control event to lead to a blowout scenario.

h) Arrangements for drilling a relief well

- Anadarko maintains a master agreement with Wild Well Control for advice, management, engineering, well kick pre-and-post modeling and resource support for an unplanned loss of well control event. If a well control event occurs, Wild Well Control would be contacted and mobilized if required to support Anadarko's operational team both in the onshore and offshore locations.

- The conceptual relief well design is similar to the design of the Walker Ridge 925 #001 (Location A Alt.). This plan would allow multiple strings to be set as needed prior to intercept with the blowout well. A block wide shallow hazard assessment has been completed for Walker Ridge 881/925. Site Clearance letters for multiple surface locations in Walker Ridge 881/925 been completed and deemed acceptable for drilling. Furthermore, the potential for high density chemo-synthetic communities in the study area are negligible. Depending on the nature of the blowout scenario, well geometry, and total depth required to intersect the blowout, previously submitted surface locations and/or additional surface locations would be submitted and all reviewed to determine the most suitable location of the relief well. The conceptual well design is not anticipated to take over 2 days to finalize upon initialization.

- Anadarko's policy is to carry adequate inventory in stock to drill a complete well(s) from surface to TD. Back-up long lead equipment equivalent to the original well design will be carried in stock to allow a rapid response. This includes a spare deepwater subsea wellhead system and the large OD casing and connectors required for the first part of the well. Smaller OD casing is considered widely available on the ground in the GOM and would be resourced out of existing inventory or from suppliers as required.

- Existing service agreements are in place for support services including drilling fluids, casing running, cementing, ROV's, solids control, mud logging, directional drilling, LWD/MWD, logging, boats and helicopters.

- Specialist services for range finding to drill the relief well in close proximity to the original wellbore at the reservoir depth will be provided through Vector Magnetics LLC. Sperry Drilling and Anadrill have in-house personnel to supplement Vector Magnetics under our existing directional drilling agreements should such support become necessary.

SECTION C
GEOLOGICAL AND GEOPHYSICAL INFORMATION

(a) Geological Description

Discussions regarding geologic information are considered proprietary and have been omitted from this public copy of the EP, along with the attachments.

(b) Structure Contour Maps

Current structure maps drawn to the top of each productive hydrocarbon sand showing the entire lease block, the surface locations of each well and locations of geological cross-sections, are enclosed as **Attachment C-1. (Omitted, proprietary.)**

(c) Interpreted 2-D and/or 3-D Seismic Lines

Interpreted seismic lines are enclosed as **Attachment C-2. (Omitted, proprietary.)**

(d) Geological Structure Cross-Sections

Interpreted geological structure cross-sections showing the location and depth of each proposed well are enclosed as **Attachment C-3. (Omitted, proprietary.)**

(e) Shallow Hazards Report

A Shallow Hazards Report prepared by Fugro covering Keathley Canyon 920/921/965 and Walker Ridge 881/925 has been included with this submittal for each of the locations proposed under the EP. (Document No. 02.18031334-Magnus)

(f) Shallow Hazards Assessment

Site clearance letters for the proposed wellsites are included with this EP submittal and enclosed as **Attachment C-4.**

- The site clearance letter for Walker Ridge 881, Location A also covers Locations AA
- The site clearance letter for Walker Ridge 881, Location F also covers Locations FF
- The site clearance letter for Walker Ridge 925, Location A Alt. also covers Locations AA Alt. and AAA Alt.
- The site clearance letter for Walker Ridge 925, Location E also covers Location EE

(g) High-resolution Seismic Lines

High resolution seismic lines are enclosed as **Attachment C-5. (Omitted, proprietary.)**

(h) Stratigraphic Column

A generalized stratigraphic column depicting the wells from the seafloor to total depth is included as **Attachment C-6. (Omitted, proprietary.)**

(i) Time Vs. Depth Tables

The proposed activities under this EP are not considered to be in areas where there is no well control. Therefore, a seismic travel time versus depth table is not required per NTL 2008-G04, extended by NTL 2015-N02.

Attachment C-4

Some pages omitted due to proprietary data

Well Clearance Letter for **Anadarko Petroleum Corporation**

Project:
Proposed WR881-A Location
Walker Ridge Block WR881, Offshore Gulf of Mexico

Description:
3D Geohazard Assessment

Project Number:
2019-112

Report Status:
Final

Ocean Geo Solutions

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www.oceangeosolutions.com

REPORT AUTHORISATION AND DISTRIBUTION

Compilation	Geophysics	L Fuentes
Authorization	Geophysics	A.R.H. .... A Haigh
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Revision	**Date**	**Title**
0	February 15, 2019	Draft
1	March 25, 2019	Final

Distribution

4 copies

Anadarko Petroleum Corporation
1201 Lake Robbins Drive
The Woodlands, TX 77380

For the attention of:
Trey Kramer

SERVICE WARRANTY

USE OF THIS REPORT

This report has been prepared with due care, diligence and with the skill reasonably expected of a reputable contractor experienced in the types of work, carried out under the contract. As such, the findings in this report are based on an interpretation of data which is a matter of opinion on which professionals may differ and, unless clearly stated, is not a recommendation of any course of action.

Ocean Geo Solutions, Inc. has prepared this report for the client identified on the front cover in fulfillment of its contractual obligations under the referenced contract, and the only liabilities Ocean Geo Solutions, Inc. will accept are those contained therein.

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OCEAN GEO SOLUTIONS, INC
8399 Westview Dr, Suite 200, Houston, Texas 77055, USA
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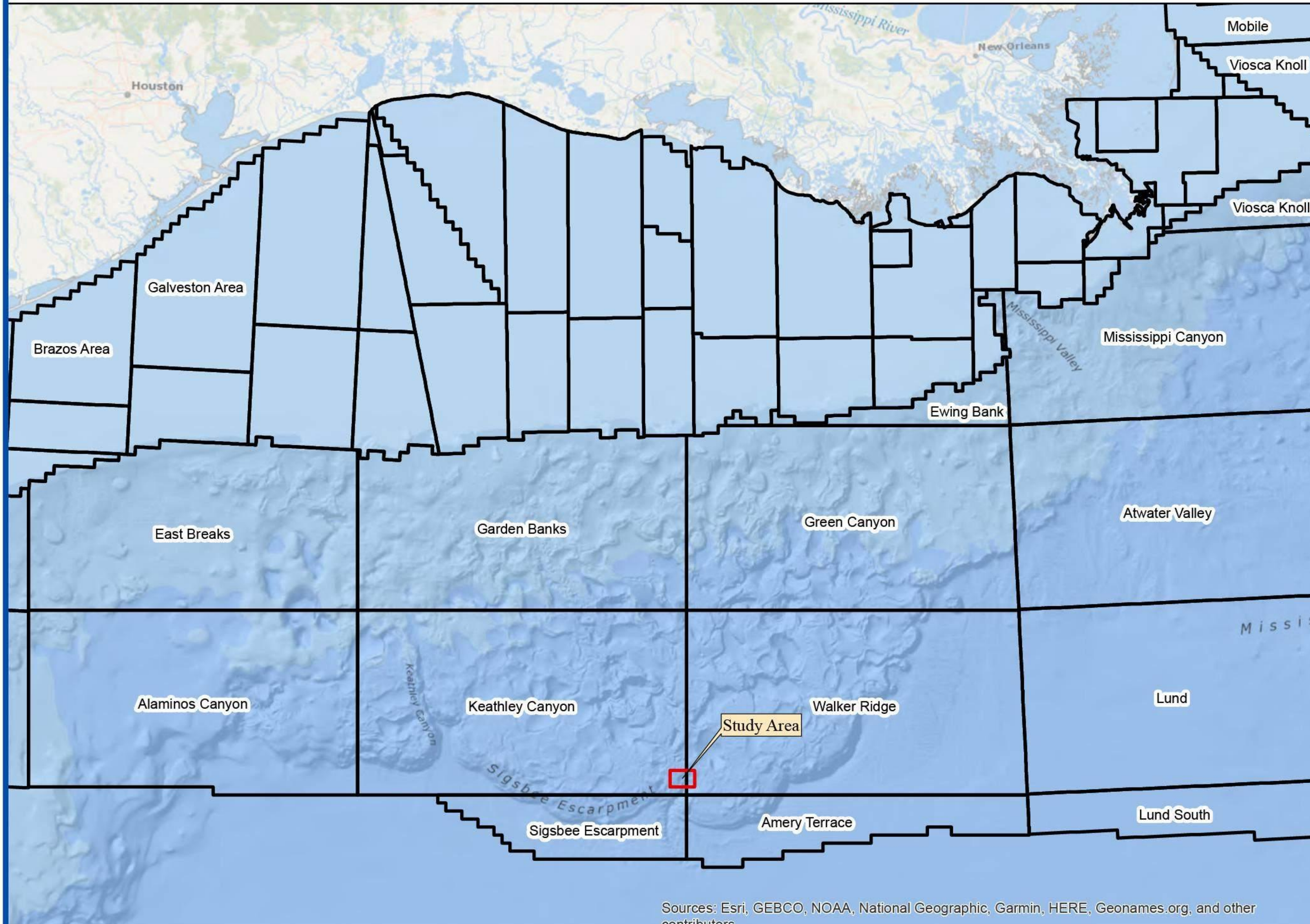
Location Map



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LIST OF FIGURES

WELL CLEARANCE LETTER – PROPOSED WR881-A WELL LOCATION

March 25, 2019
Anadarko Petroleum Corporation
1201 Lake Robbins Drive,
The Woodlands
Texas, 77380

Attention: **Trey Kramer**

Well Clearance Letter
Proposed WR881-A Well Location
Walker Ridge Block WR881
Offshore Gulf of Mexico

Ocean Geo Solutions Inc. was contracted by Anadarko Petroleum Corporation to prepare a Well Clearance Letter for the proposed WR881-A Well Location in Block 881, Walker Ridge Area (OCS-G- 36181). This assessment addresses seafloor and shallow geologic conditions that may impact drilling operations within 2,000ft of the proposed well site. The depth limit of this geohazard assessment is Horizon H40 at -12,025ft below sea surface (4,244ft below seabed). We understand that Anadarko Petroleum Corporation plans to drill the proposed development well from a dynamically positioned drillship; therefore, an anchoring assessment was not requested. Relevant letter-size chart extracts, data examples, and a Top Hole Prognosis are presented with this Well Clearance Letter.

This well site assessment incorporates 3D seismic data and high –resolution autonomous underwater vehicle (AUV)-acquired multibeam, side scan sonar, and sub-bottom profiler data. The regional 3D seismic data was interpreted by Fugro and the multibeam, side scan sonar, and sub-bottom profiler data was acquired by Fugro.

3D Geophysical Survey. Anadarko Petroleum Corporation provided the 3D dataset to Ocean Geo Solutions Inc. on tape media in SEG-Y format for loading onto a Seismic Micro-Technology (SMT) workstation. The 3D data cube contains a survey with 10 feet sample rate data to a record length of 15,000ft below the sea surface. Inlines are oriented northeast to southwest have a numerical increment of one, and exhibit a line spacing of 98.4213ft. Crosslines are oriented northwest to southeast, have a numerical increment of four, and exhibit a line spacing of 82.0212ft.

- Acquired by CGG, March 2018.
- Lucius DCS WAZ TTI PSDM Re-Imaged, 55Hz Kirchoff Stack
- Processing Flow:
- Anti-aliasing
- Resample to 6ms
- Sailline Denoise
- Debubble
- 3D FP Deghost
- Designautre and Datum correction
- SRME Q correction

- DC WAZ Data Regularize 55Hz Kirchhoff Migration
- Diverge Z power 1.

The data was spectrally whitened with IHS Kingdom for the purpose of frequency enhancement. Data exhibits a good frequency response across the upper second below the seabed, with an effective frequency range of 18 - 56Hz at 50% power (Figure 11). The data exhibits a dominant frequency in the upper second of approximately 41Hz, resulting in a mean vertical resolvability of typically 34ft and a layer detectability of 6ft. The data is considered good to excellent quality.

In summary and with reference to NTL No. 2008-G04:

a) The data provides imaging of sufficient resolution of the shallow section allowing a clear analysis of the shallow conditions.
b) The data can be loaded to a workstation at 16-bit resolution or greater and is unscaled.
c) There is no trace or sample decimation.
d) The sample interval and bin size are maintained throughout the assessment area.
e) The data possess a frequency content of 50Hz or higher at 50% power in the first second below the seabed.
f) Seabed reflection is free of gaps and is defined by a wavelet of stable shape and phase, allowing auto-tracking of the seabed event with minimum user intervention and guidance.
g) There are no significant acquisition artifacts throughout the dataset.
h) Merge points in the data are marked by no time shifts and very minimal amplitude changes, and are not a detriment to interpretation.
i) Processed bin sizes are 98.4213ft x 82.0212ft
j) The sample rate of the data is 10 feet sample rate data.
k) An accurate velocity model has been utilized in the shallow section allowing optimum structural and stratigraphy resolution with no evidence of under- or over-migration.
l) There is no significant multiple energy.

The proposed activities are not within an area defined by BOEM as having high archaeological potential (see NTL No. 2011-JOINT-G-01). An archeological assessment within the Magnus Prospect Blocks KC920, 921, and 965 of the Keathley Canyon Area and Blocks 881 and 925 of the Walker Ridge Area, Gulf of Mexico was performed by Fugro USA Marine, Inc. in February 2018.

1. LOCATION COORDINATES

1.1 Proposed WR881-A Well Location

Proposed WR881-A Well Location (Surface)							
Location Coordinates							
NAD 27 Datum - Clarke 1866 Ellipsoid					UTM Zone 15 - CM 93° West		
Latitude	26°	03'	37.035"	North	Easting	1,999,268	US ft. E
Longitude	91°	54'	23.667	West	Northing	9,457,514	US ft. N
FWL Walker Ridge 881	3,428ft	US ft.	Inline	6225			
FSL Walker Ridge 881	1,034ft	US ft.	Crossline	18585			
Water Depth: -7,781ft.	Slope: 2.3° SE						
Nearest Shoreline	188 Nautical Miles @ 17.50°						
Port of Operation Fourchon	203 Nautical Miles @ 26.12°						
Nearest Manned Platform	A-Structure A (Lucius) KC875	9.0 Nautical Miles @ 299°					

Proposed WR881-AA Well Location (Surface)							
Location Coordinates							
NAD 27 Datum - Clarke 1866 Ellipsoid					UTM Zone 15 - CM 93° West		
Latitude	26°	03'	37.877"	North	Easting	1,999,346	US ft. E
Longitude	91°	54'	22.787	West	Northing	9,457,599	US ft. N
FWL Walker Ridge 881	3,506ft	US ft.	Inline	6225			
FSL Walker Ridge 881	1,119ft	US ft.	Crossline	18589			
Water Depth: -7,780ft.	Slope: 2.6° SE						
Nearest Shoreline	188 Nautical Miles @ 17.50°						
Port of Operation Fourchon	203 Nautical Miles @ 26.12°						
Nearest Manned Platform	A-Structure (Lucius) KC875	9.0 Nautical Miles @ 297°					

Location WR881-AA is 116ft from WR881-A on a bearing of 43°. Contact 20 explained in more detailed in the following section is located 1,845ft to the SSE. Geological conditions at seabed and sub-seabed will be similar to those encountered at the proposed WR881-A.

2. VELOCITY DATA

2.1 Seabed Depth

3D Seismic Data was provided in-depth, therefore no depth conversion was required. Additionally, AUV-multibeam depth was acquired by Fugro.

2.1 Sub-seabed Depth

3D Seismic Data was provided in-depth, therefore no depth conversion was required to convert mapped horizons.

3. SEABED CONDITIONS

3.1 Seabed Depth

Seabed depth at the proposed well location is -7,781ft below the sea surface (Figure 1). The seafloor gradient at the proposed well is 2.3° to the southeast.

3.2 Seafloor Morphology and Man-Made Features

The proposed WR881-A well location is in the southwest of Block WR881. At the proposed well location, the seabed is smooth (Figure 2). Soft clays and silts are predicted at the seabed. The lithology, below the surficial sediments, is interpreted to consist of clays, silts, and several slightly coarser-grained interbeds. Sediments appear conducive for jetting of seabed casing with no hard layers predicted.

The proposed well is located within a mini basin occurring approximately 6,647ft to the east of Bryant Canyon. The proposed well is located on the eastern edge of a north to south trending elongated low-relief ridge. These ridges are due to underlying salt movement. No seabed surficial failures are expected at the proposed well.

There are no anomalous seabed amplitudes indicative of hydrocarbon macroseep observed within a 2,000ft radius of the proposed location (Figure 3). Backscatter data shows relatively uniform amplitudes associated with clays and silt drape. No seabed fluid venting areas were identified within 2,000ft of the proposed well and no sites were identified in the study area.

No existing seabed infrastructure occurs within 2,000ft of the proposed well.

The archeological assessment identified a seabed contact within 2,000ft of the proposed well. The sonar contact (Contact 20) is located 1,748ft to the SSE. According to the archaeological report produced by Fugro, Contact 20 is described as possible modern debris with dimensions of 18.8ft x 6.3ft and less than 1.0ft in height.

No other features are observed within a 2,000ft radius that could affect well emplacement or jetting of a casing.

4. SUB-SEABED CONDITIONS

4.1 Ocean Geo Solutions Hazard Classification Scheme

4.1.1 Shallow Gas Classification

Shallow gas detection is normally made in the first instance by recognition of anomalously high amplitude ('bright' spots). This parameter allied to a number of other characteristics, such as acoustic masking, underlying velocity pulldown, structural closure, edge effects, frequency reduction, and basal 'flat' spots are indicative of shallow gas accumulations. High amplitude polarity-reversed reflectors are particularly relevant to shallow gasified sands, particularly within the topmost kilometer of sediments below the seabed. The quantitative degree of these gas risks is further detailed as:

High Risk of Gas –Anomalously high amplitudes coupled with multiple other well-defined subsidiary indicators, such as acoustic masking, velocity pulldown, structural closure, phase reversal, frequency reduction, etc. Predicted Gas Risk considered *probable*.

Moderate Risk of Gas –Anomalously high amplitudes coupled with two other well-defined subsidiary indicators, such as acoustic masking, velocity pulldown, structural closure, phase reversal, frequency reduction, etc. Predicted Gas Risk considered *likely*.

Slight Risk of Gas –Anomalously high amplitudes coupled with one to two other well-defined subsidiary indicators, or very high amplitude alone. Predicted Gas Risk considered *possible*.

4.1.2 Shallow Water Flow Classification

High Shallow Water Flow Risk –Potential sand-prone interval, overlain by a well-defined seal with significant rapidly-deposited overburden, together with a tie to a known Shallow Water Flow zone in a nearby well. Shallow Water Flow considered *probable*.

Moderate Shallow Water Flow Risk–A potential sand-prone interval, overlain by a well-defined clay seal with significant rapidly deposited overburden. Shallow Water Flow considered *likely*.

Slight Shallow Water Flow Risk –Possible sand-prone interval, overlain by a poor or breached seal, or slowly deposited overburden. Or a moderate or high-risk type deposit, where a nearby well has disproved the flow zone. Shallow Water Flow considered unlikely but still *possible*.

4.2 Geology and Lithology

The sub-seabed geology has been divided into four units, Units 1, 2, 3, and 4. These are separated by Horizons H10, H20, H30, and H40 (Figures 5 through 9).

4.3 Unit 1

The lithology within the upper part of Unit 1 from the seabed to approximately 50ft below seabed of sediments are interpreted as probably soft clays and silts as shown on the Seismic Profiler Data Example (Figure 6). From -7,831ft to -7,963ft below sea surface (50ft to 182ft below seabed) is characterized by well-layered and low and slightly moderate-amplitude reflectors interpreted as clays, silts, with occasional minor slightly coarser-grained interbeds.

From -7,963ft to -8,427ft below sea surface (182ft to 646ft below seabed) presents as slightly chaotic and well-layered, low-amplitude reflectors interpreted as clays and silts.

No gas hazards or shallow water flow risks are interpreted within Unit 1 at the wellbore or within 2,000ft.

Horizon H10 marks the base of this unit at -8,427ft below sea surface (646ft below seabed). Horizon H10 presents some character indicative of a minor thin sand interbed. Minor wellbore and drilling fluid circulation problems may occur at the level of Horizon H10.

4.4 Unit 2

The upper part of Unit 2 from -8,427ft to -8,700ft below sea surface (646ft to 919ft below seabed) consists of slightly-chaotic, low and moderate-amplitude reflectors interpreted as clays and silts with several sand interbeds. A better defined <30ft thick sand interbed occurs at -8,582ft below sea surface (801ft below seabed). The well-path will not traverse any clearly identified risk of gas hazards within this interval, however, this <30ft thick sheet sand presents significantly increased amplitudes, but no other indication of shallow gas. Given this character, a **Slight Risk of Gas** and a **Slight Shallow Water Flow Risk** is assigned. Additionally, due to the increased potential for poorly consolidated material in this interval minor wellbore and drilling fluid circulation problems may occur.

From -8,700ft to -9,279ft below sea surface (919ft to 1,498ft below seabed) is interpreted to consist of low-amplitude, of well-layered clays, silts, and occasional minor sands.

The well-path will not intersect any major faults within Unit 2.

Horizon H20 marks the base of this unit at –9,279ft below sea surface (1,498ft below seabed). A <30ft thick sand interbed is interpreted at the level of Horizon H20. Minor wellbore and drilling fluid circulation problems may occur at the level of this horizon.

4.5 Unit 3

The upper part of Unit 3 from -9,279ft to -9,374ft below sea surface (1,498ft to 1,593ft below seabed) presents as slightly-chaotic, low-amplitude reflectors interpreted as channel infill clays and silts.

From -9,374ft to -10,032ft below sea surface (1,593ft to 2,251ft below seabed) is characterized by tilted, well-layered low-amplitude reflectors interpreted as clays and silts with occasional sands.

The lower interval in Unit 3 from -10,032ft to -10,855ft below sea surface (2,251ft to 3,074ft below seabed) presents as well-layered and slightly-chaotic, low and moderate-amplitude reflectors interpreted as clays, silts, and several sands/ marl interbeds. The interbeds within this interval have been uplifted and tilted, with the potential for any fluid within the deeper parts of the mini-basin possibly migrating upslope. Given this setting where there is the potential for deeper mini basin pressures to be transmitted into this shallower section (if pore connectivity exists) a **Slight Shallow Water Flow Risk** is assigned.

No anomalies indicative of shallow gas are present within the deeper part of this interval. The nearest risk of gas at these depths is located 1,209ft to the east upslope from the well-path.

The well-path will intersect a possible minor fault at -9,692ft below sea surface (1,911ft below seabed). Minor wellbore stability and drilling fluid circulation problems may occur at the level of the fault.

Horizon H30 marks the base of this unit at –10,855ft below sea surface (3,074ft below seabed).

4.6 Unit 4

The upper part of Unit 4 from -10,855ft to -11,297ft below sea surface (3,074ft to 3,516ft below seabed presents as well-layered, low and moderate-amplitude reflectors interpreted as clays and silts with several sands. Minor wellbore stability and drilling fluid circulation problems are considered possible.

The lower interval from -11,297ft to -12,025ft below sea surface (3,516ft to 4,244ft below seabed) is characterized by well-layered, low-amplitude reflectors interpreted as clays and silts.

The well-path will not intersect any faults within Unit 4.

Horizon H40 marks the base of this unit and the base of this interpretation at –12,025ft below sea surface (4,244ft below seabed).

4.7 Shallow Gas Assessment

Within Unit 2 a **Slight Risk of Gas** is assigned at the level of a <30ft sand interbed at -8,582ft below sea surface (801ft below seabed).

4.8 Shallow Water Flow Assessment

Within Unit 2 a **Slight Shallow Water Flow Risk** is assigned at the level of a <30ft sand interbed at -8,582ft below sea surface (801ft below seabed).

Within Unit 3 a **Slight Shallow Water Flow Risk** is assigned from -10,032ft to -10,855ft below sea surface (2,251ft to 3,074ft below seabed).

5. CONCLUSIONS AND RECOMMENDATIONS

- Seabed

  No major drilling hazards or problems are interpreted.

- Unit 1

  Minor wellbore stability and drilling fluid circulation problems are possible at the level of Horizon H10 at -8,427ft below sea surface (646ft below seabed).

- Unit 2

  Within Unit 2 a **Slight Risk of Gas** and a **Slight Shallow Water Flow Risk** is assigned at the level of a <30ft sand interbed at -8,582ft below sea surface (801ft below seabed). Drilling Caution is advised, and appropriate drilling methodology is recommended to deal with a possible short-lived non-persistent water flow event.

- Unit 3

  Minor wellbore stability and drilling fluid circulation problems are possible at the level of Horizon H20 at -9,279ft below sea surface (1,498ft below seabed).

  Within Unit 3 a **Slight Shallow Water Flow Risk** is assigned from -10,032ft to -10,855ft below sea surface (2,251ft to 3,074ft below seabed). Appropriate drilling methodology is recommended to deal with a possible short-lived non-persistent water flow event.

  The well-path will intersect a fault at -9,692ft below sea surface (1,911ft below seabed). Minor wellbore and drilling fluid circulation problems may occur at the level of the fault. Casing seats should avoid all fault intersections as formation integrity could be compromised.

- Unit 4

  Minor wellbore stability and drilling fluid circulation problems are possible within the interval from -10,855ft to -11,297ft below sea surface (3,074ft to 3,516ft below seabed).

We appreciate the opportunity to work with you on this project and look forward to continuing as your geohazards consultants. Please contact us if you have any questions or if we can be of further assistance.

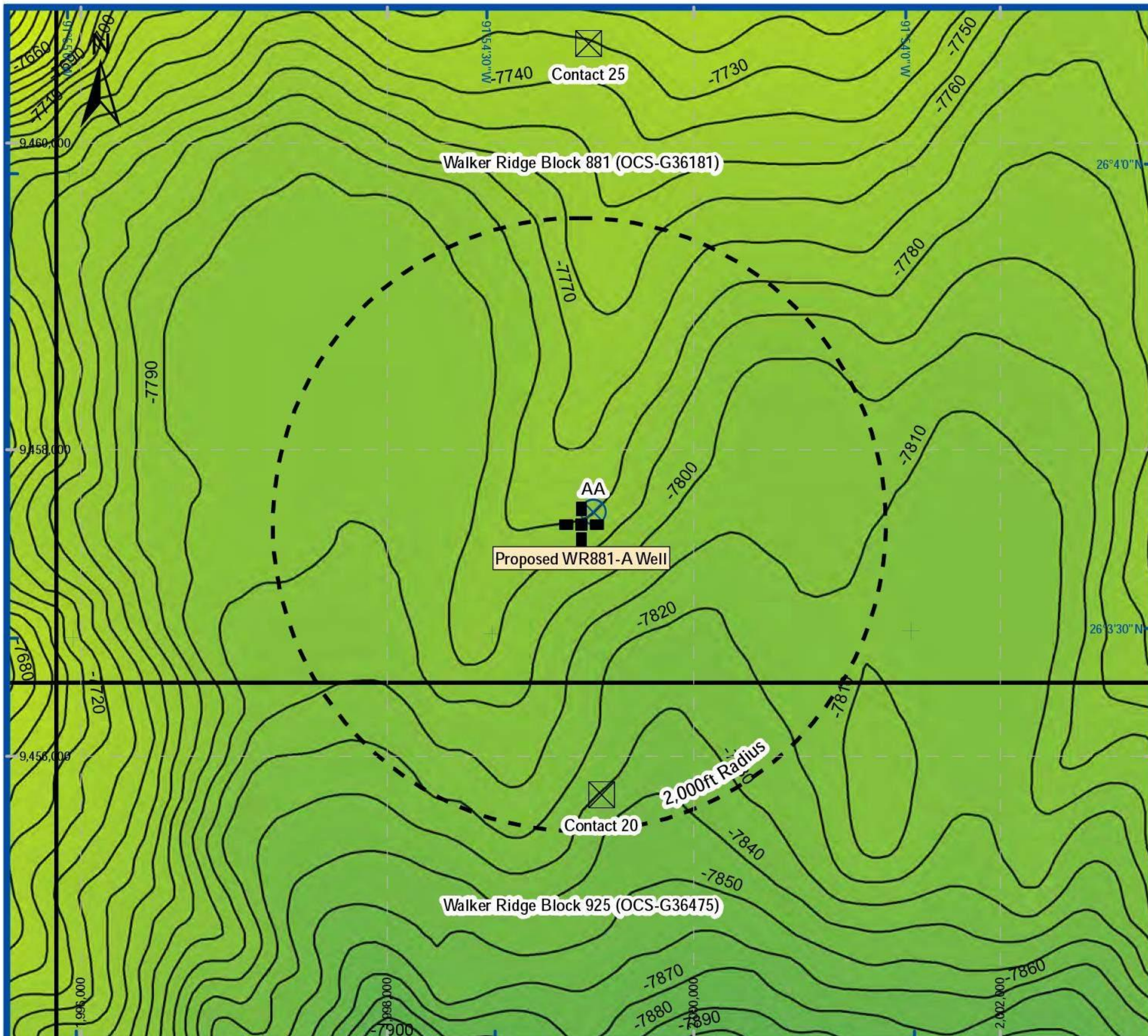
Sincerely,
Ocean Geo Solutions Inc.

Andrew Haigh
Geophysical Manager

Denise Haigh
Quality Assurance

Copies Submitted: 4 copies to Trey Kramer at Anadarko Petroleum Corporation

Attachments:
Proposed WR881-A Well Location
Seabed Depth Extract
Seabed Morphology Extract
Seabed Amplitude Extract
Geohazard Summary Extract
Side Scan Sonar Data Example
Seismic Profiler Data Example
Inline Data Example
Crossline Data Example
Top Hole Prognosis
ROV Plat
Power Spectrum
Bathymetry Plat
Public Information Plat
Proprietary Information Plat
Vicinity Plat
10-Mile Radius Plat



Seabed Depth Extract

Proposed WR881-A Well Location (1,999,268ft E / 9,457,514ft N)

Proposed AA Well Location

Side scan sonar contact

Block boundaries

-7781 Depth in feet below sea surface to seabed, contoured at 10ft intervals

Chart Scale 1" = 1,000'

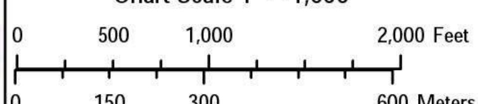
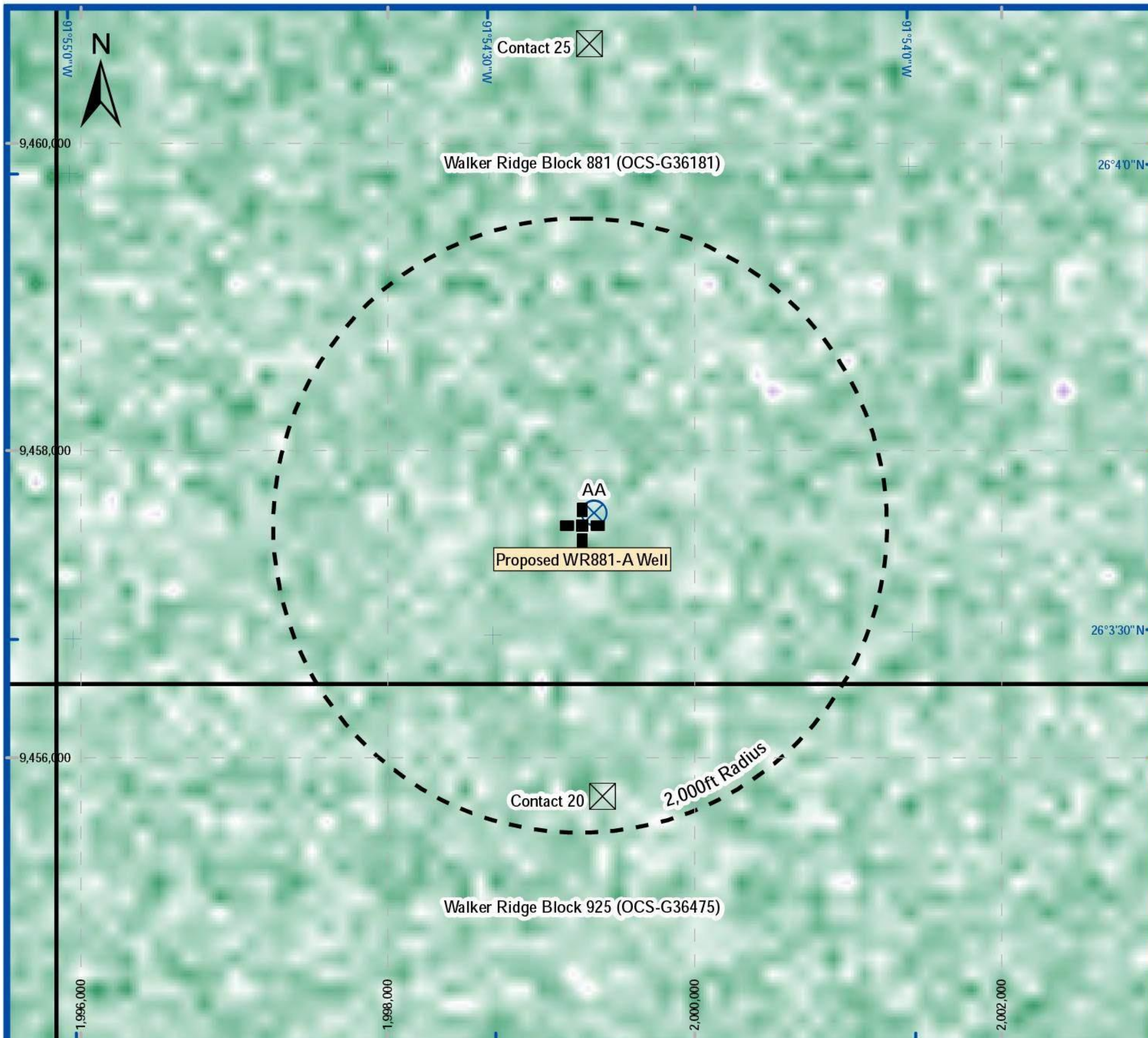


Figure 1
(WR881-A)



Seabed Backscatter Amplitude Extract

- Proposed WR881-A Well Location (1,999,268ft E / 9,457,514ft N)
- Proposed AA Well Location
- Side scan sonar contact
- Block boundaries

-45 -43 -41 -39 -37 -35 -33 -31 -29 -27 -25 -23 -21

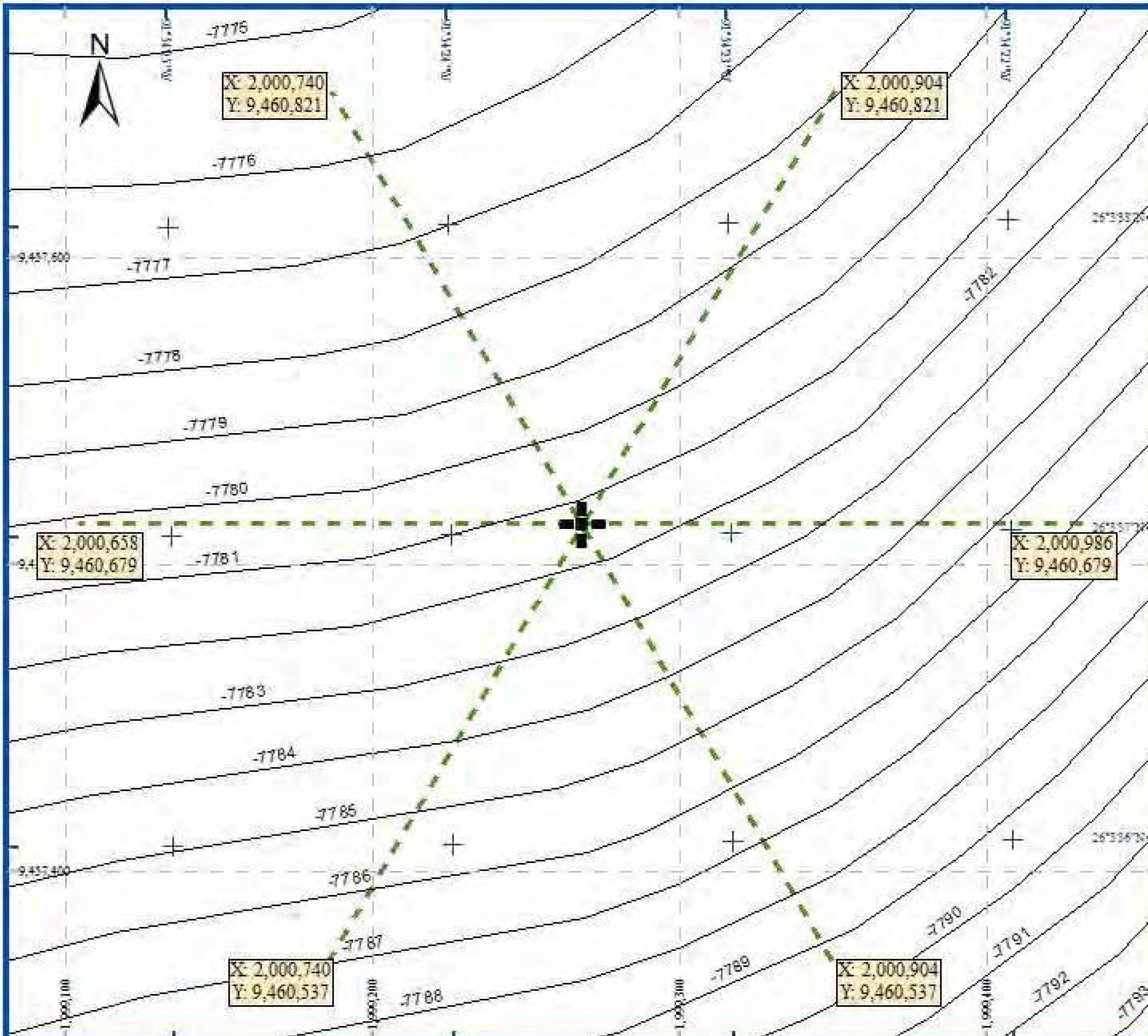
Relative Seabed Backscattered Amplitude

Chart Scale 1" = 1,000'

0 500 1,000 2,000 Feet

0 150 300 600 Meters

Figure 3
(WR881-A)



ROV Plat (WR881-A)

Proposed WR881-A Well Location
(1,999,268ft E / 9,457,513ft N)

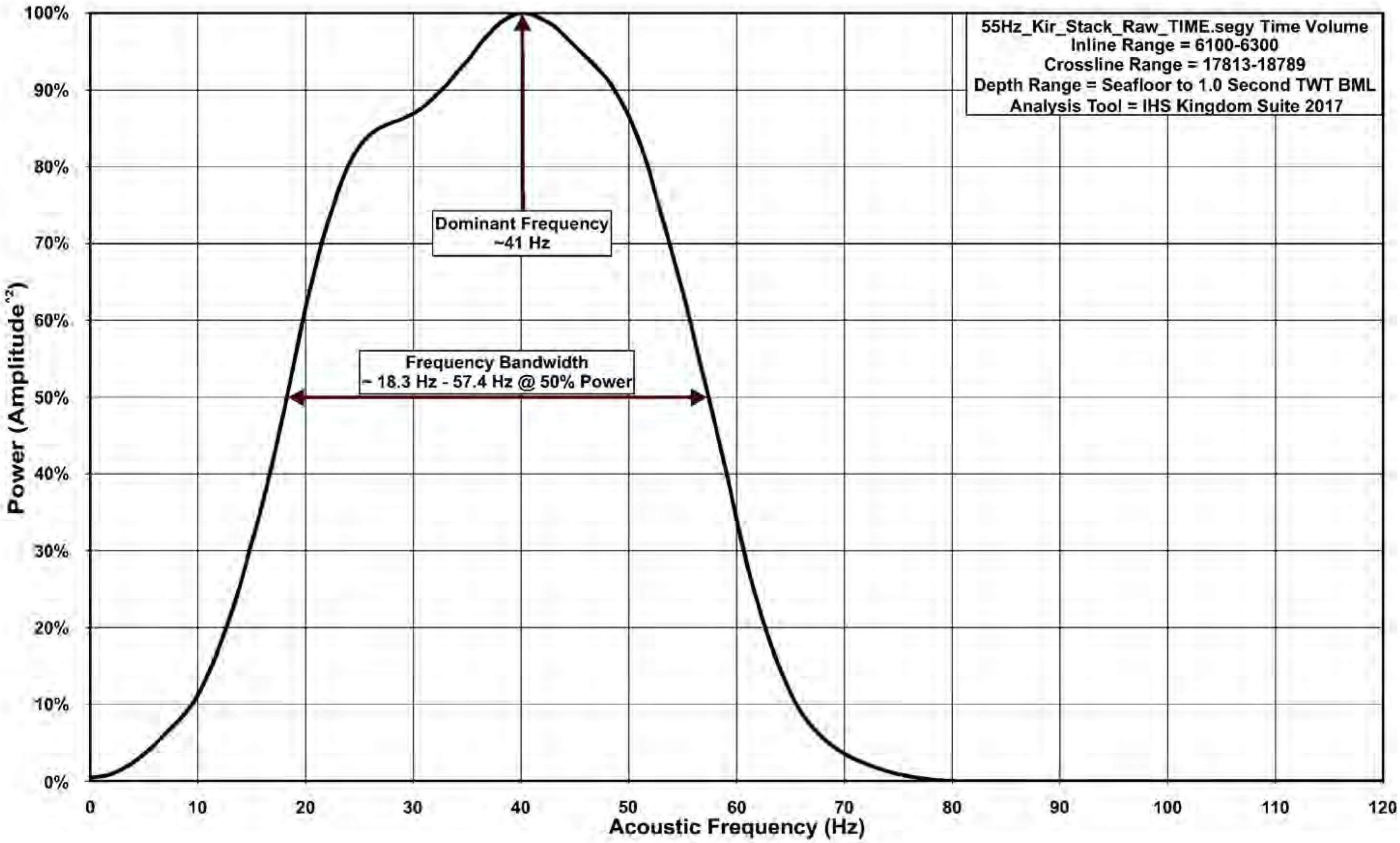
-7781 Depth in feet below sea surface to seabed, contoured at 1ft intervals

Chart Scale 1" = 50'

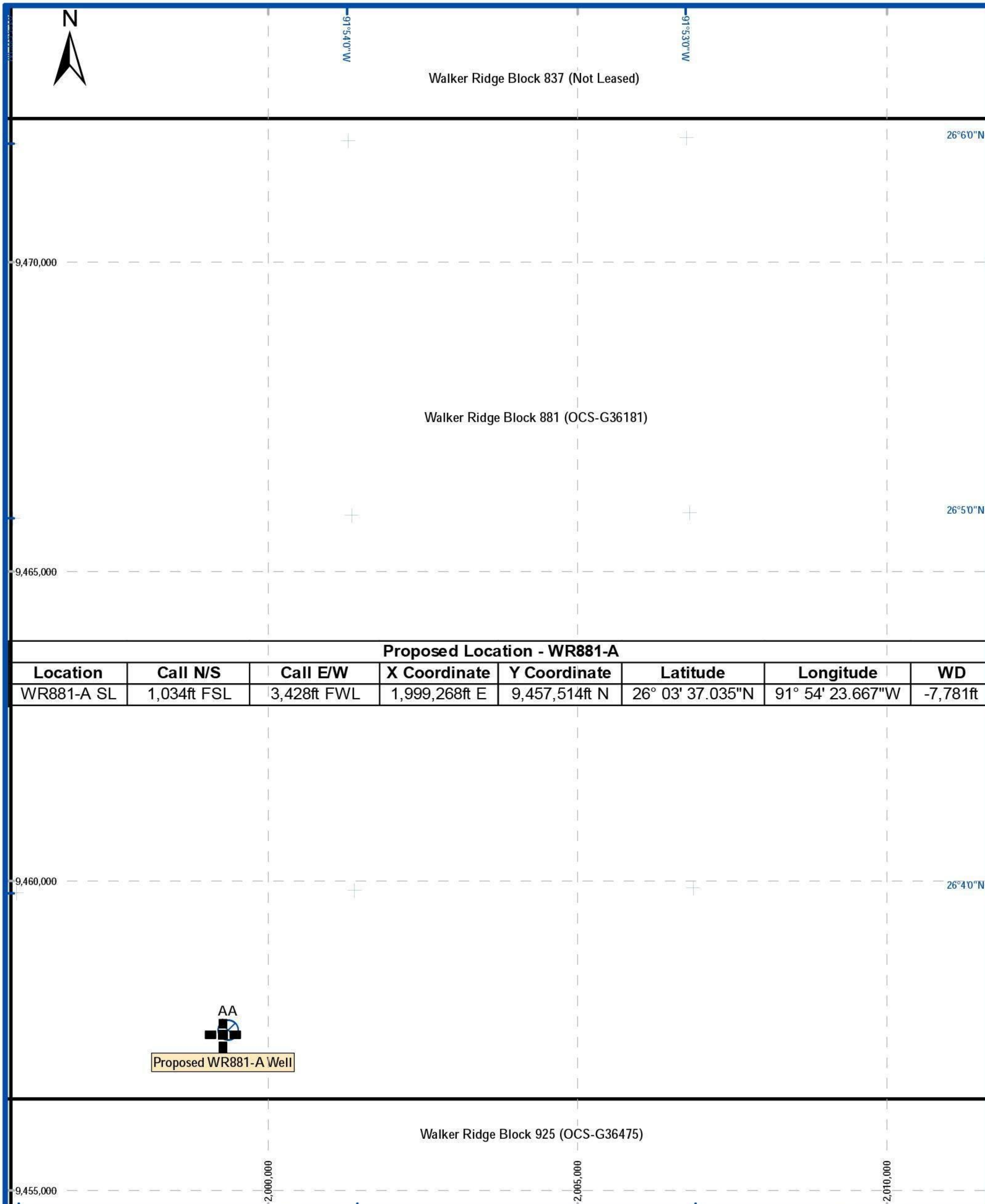
0 50 100 200 Feet

0 12.5 25 50 Meters

Figure 10
(WR881-A)



WR881-A	Power Spectrum	Figure 11



Proposed Location - WR881-A

Location	Call N/S	Call E/W	X Coordinate	Y Coordinate	Latitude	Longitude	WD
WR881-A SL	1,034ft FSL	3,428ft FWL	1,999,268ft E	9,457,514ft N	26° 03' 37.035"N	91° 54' 23.667"W	-7,781ft

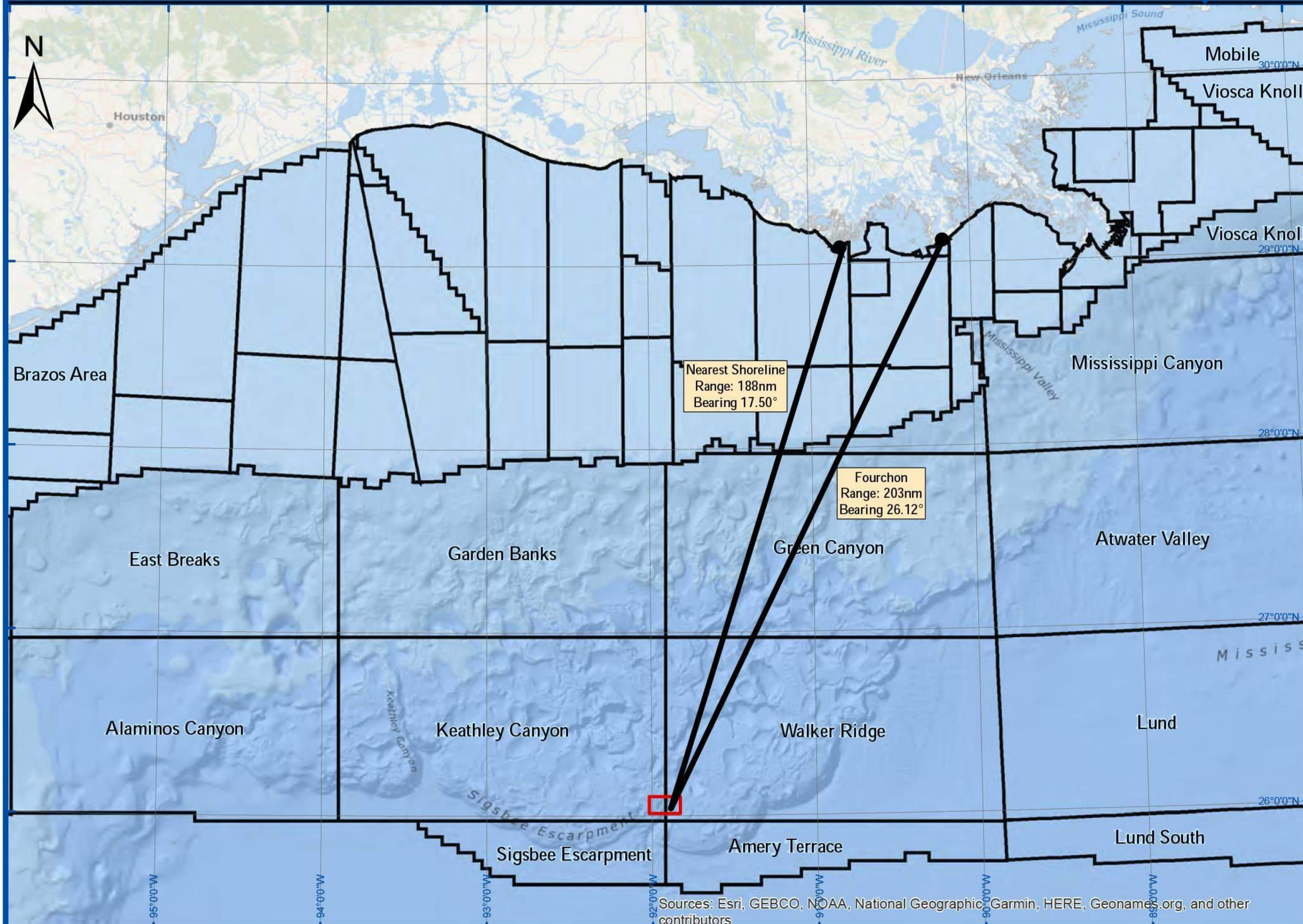
Chart scale 1" = 2,000'
0 500 1,000 2,000 Feet
0 125 250 500 Meters

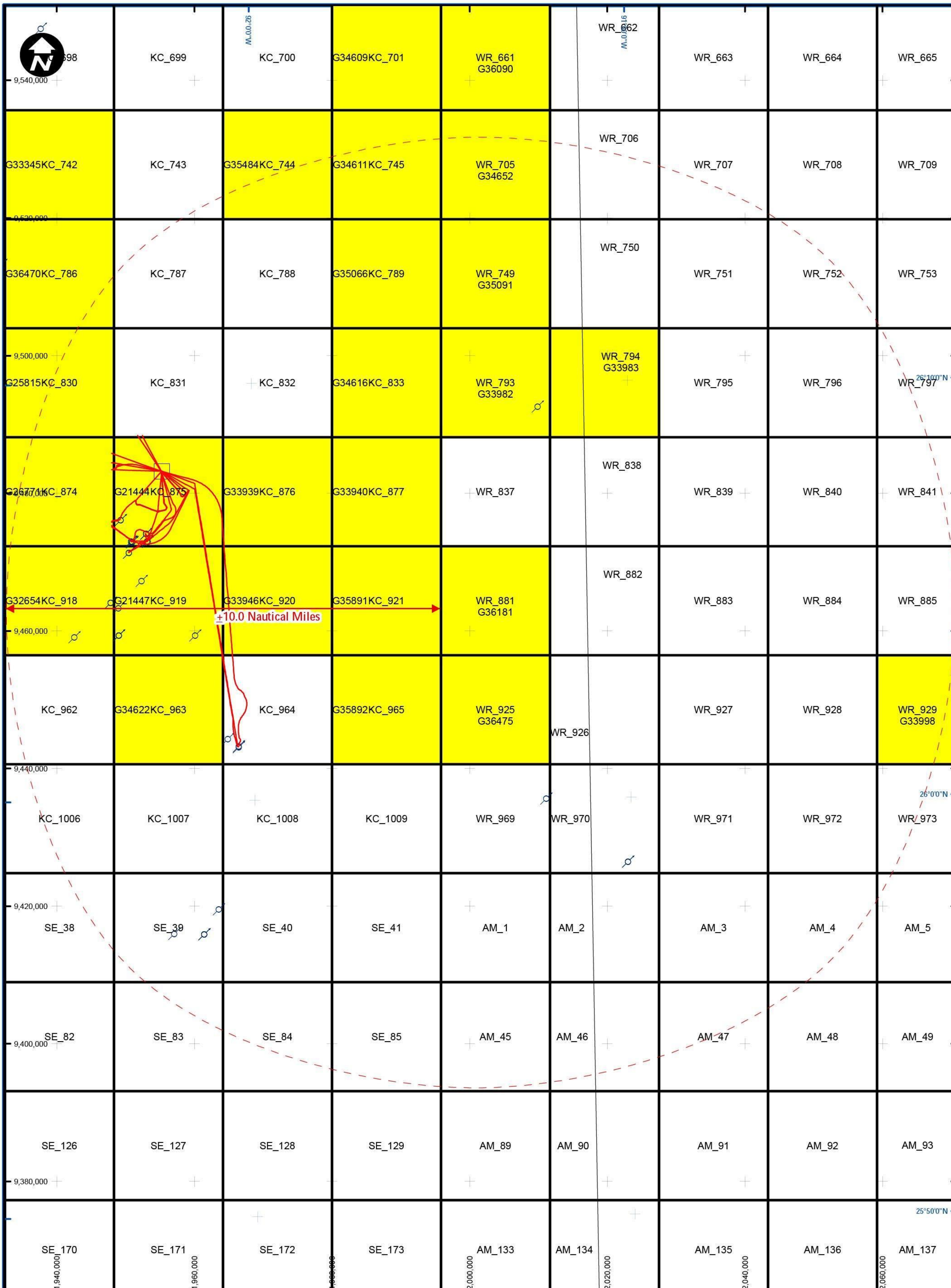
Well Location Plat - Public Information

Figure 13

Vicinity Map - Walker Ridge Block 881

Figure 15





Legend

- Seabed Well
- Platform
- Not Leased
- Leased
- Pipeline

10 MILE RADIUS SEABED INFRASTRUCTURE
WALKER RIDGE - BLOCK 881

0 5 10 Miles

1 inch = 2.5 miles

Ocean Geo Solutions

Anadarko Petroleum Corporation

March 25, 2019

Figure 16

APPENDIX A – PUBLIC SHALLOW HAZARDS STATEMENTS

Public Shallow Hazards Statement – Proposed WR881-A Location

March 25, 2019

US Department of the Interior
Bureau of Ocean Energy Management
1201 Elmwood Park Blvd.
New Orleans, LA 70213-2394

Reference: Shallow Hazards Analysis
Walker Ridge Block 881
(OCS-G 36181)

Ladies/Gentlemen:

Anadarko Petroleum Corporation contracted Ocean Geo Solutions Inc. to prepare a Well Clearance Letter for the Proposed WR881-A well location in Block 881, Walker Ridge Area (OCS-G-36181). This letter addresses seabed and shallow geologic conditions that may impact exploratory drilling operations within 2,000ft of the proposed well site. The depth limit of this site clearance assessment is Horizon H40 at -12,025ft below sea surface (4,244ft below seabed)

Seabed Hazards. The proposed location exhibits a smooth seabed. Soft clays and silts are predicted at the seabed. The lithology, below the surficial sediments, is interpreted to consist of clays, silts, and occasional slightly coarser-grained interbeds. Sediments appear conducive for jetting of seabed casing with no hard layers predicted.

The proposed well is located within a mini basin occurring approximately 6,647ft to the east of Bryant Canyon. The seabed morphology at the edges of Bryant Canyon is rugose with high-gradients and numerous surficial failures. The proposed well is located on the eastern edge of a north to south trending elongated low-relief ridge. These ridges are due to salt movement and the proximity of Bryant Canyon. No seabed surficial failures are expected at the proposed well.

There are no anomalous seabed amplitudes indicative of hydrocarbon macroseep observed within a 2,000ft radius of the proposed location. Backscatter data shows relatively uniform amplitudes associated with clays and silt drape. No seabed fluid venting areas were identified within 2,000ft of the proposed well and no sites were identified in the study area. Several areas exhibiting over consolidated seabed were identified. The nearest area with over consolidated seabed is located 6,867ft to the west of the proposed well.

No existing seabed infrastructure occurs within 2,000ft of the proposed well.

The archeological assessment identified a seabed contact within 2,000ft of the proposed well. The sonar contact (Contact 20) is located 1,748ft to the SSE. According to the archaeological report produced by Fugro, Contact 20 is described as possible modern debris with a width of 6.3ft, <1.0ft in height, and 18.8ft in length

Sub-Seabed Hazards. No identified amplitude anomalies indicative of shallow gas occur at the well-path. Several anomalies occur within the 2,000ft radius of the proposed well location within Units 2 and 3. A <30ft thick sand interbeds within Unit 2 has been assigned a **Slight Risk of Gas**.

A **Slight Shallow Water Flow Risk** is assigned to an interpreted sand interbed in Unit 2 and also within an interval in Unit 3 due to the presence of slightly tilted interbeds and the possibility that fluid may migrate upslope along these tilted interbeds to the borehole. Some intervals with the potential to contain sands may induce minor wellbore and drilling fluid circulation problems.

The well-path will traverse a possible minor fault in Unit 3.

Proposed WR881-A Well Location (Surface)							
Location Coordinates							
NAD 27 Datum - Clarke 1866 Ellipsoid					UTM Zone 15 - CM 93° West		
Latitude	26°	03'	37.035"	North	Easting	1,999,268	US ft. E
Longitude	91°	54'	23.667	West	Northing	9,457,514	US ft. N
FWL Walker Ridge 881		3,428ft		US ft.	Inline	6225	
FSL Walker Ridge 881		1,034ft		US ft.	Crossline	18585	
Water Depth: -7,781ft.		Slope: 2.3° SE					
Nearest Shoreline		188 Nautical Miles @ 17.50°					
Port of Operation Fourchon		203 Nautical Miles @ 26.12°					
Nearest Manned Platform		A-Structure A (Lucius) KC875			9.0 Nautical Miles @ 299°		

Proposed WR881-AA Well Location (Surface)							
Location Coordinates							
NAD 27 Datum - Clarke 1866 Ellipsoid					UTM Zone 15 - CM 93° West		
Latitude	26°	03'	37.877"	North	Easting	1,999,346	US ft. E
Longitude	91°	54'	22.787	West	Northing	9,457,599	US ft. N
FWL Walker Ridge 881		3,506ft		US ft.	Inline	6225	
FSL Walker Ridge 881		1,119ft		US ft.	Crossline	18589	
Water Depth: -7,780ft.		Slope: 2.6° SE					
Nearest Shoreline		188 Nautical Miles @ 17.50°					
Port of Operation Fourchon		203 Nautical Miles @ 26.12°					
Nearest Manned Platform		A-Structure (Lucius) KC875			9.0 Nautical Miles @ 297°		

Conclusions and Recommendations. No major problems are anticipated at the seabed. No existing seabed infrastructure occurs within 2,000ft of the proposed well. The nearest sonar contact (Contact 20) is located 1,748ft to the SSE. According to the archaeological report produced by Fugro, Contact 20 is described as possible modern debris with a width of 6.3ft, <1.0ft in height, and 18.8ft in length.

A **Slight Risk of Gas** is interpreted within an interpreted sand interbed in Unit 2. A **Slight Shallow Water Flow Risk** is assigned to the same sand interbed in Unit 2 and also within an interval in Unit 3.

The well-path will traverse a minor fault in Unit 3.

Sincerely,
Anadarko Petroleum Corporation

APPENDIX B – Sensitive Sessile Benthic Community Statement

Sensitive Sessile Benthic Communities Statement – Proposed WR881-A Well Location

Anadarko Petroleum Corporation.
March 25, 2019

US Department of the Interior
Bureau of Ocean Energy Management
1201 Elmwood Park Blvd.
New Orleans, LA 70213

Reference: Sensitive Sessile Benthic Community Summary
Proposed WR881-A Well Location in Walker Ridge WR881 (OCS-G 36181)

Ladies/Gentlemen:
Anadarko Petroleum Corporation contracted Ocean Geo Solutions Inc. to prepare a Well Clearance Letter for the Proposed WR881-A well location in Block 881, Walker Ridge Area (OCS-G-36181). This letter addresses location proximity to potential sensitive sessile benthic community sites. This well will be drilled from a dynamically-positioned drilling module; therefore, an anchoring assessment is not required.

This sensitive sessile benthic community summary letter is issued as a supplement to the Well Clearance Letter for this proposed well. A Biological, Physical and Socio-economic Map is included illustrating the areas of potential seabed impact.

Potential Sensitive Sessile Benthic Communities
Features or areas that could support high-density sensitive sessile benthic communities are *not* located within 2,000 feet of any proposed mud and cuttings discharge location. No areas with the potential to host benthic communities were identified within the study area.

Backscatter data shows relatively uniform amplitudes associated with clays and silt drape. No seabed fluid venting areas were identified within 2,000ft of the proposed well and no sites were identified in the study area. Several areas exhibiting over consolidated seabed were identified. The nearest area with over consolidated seabed is located 6,867ft to the west of the proposed well.

The archeological assessment identified a seabed contact within 2,000ft of the proposed well. The sonar contact (Contact 20) is located 1,748ft to the SSE. According to the archaeological report produced by Fugro, Contact 20 is described as possible modern debris with a width of 6.3ft, <1.0ft in height, and 18.8ft in length
.

Proposed WR881-A Well Location (Surface)								
Location Coordinates								
NAD 27 Datum - Clarke 1866 Ellipsoid					UTM Zone 15 - CM 93° West			
Latitude	26°	03'	37.035"	North	Easting	1,999,268		US ft. E
Longitude	91°	54'	23.667	West	Northing	9,457,514		US ft. N
FWL Walker Ridge 881			3,428ft		US ft.	Inline	6225	
FSL Walker Ridge 881			1,034ft		US ft.	Crossline	18585	
Water Depth: -7,781ft.			Slope: 2.3° SE					
Nearest Shoreline			188 Nautical Miles @ 17.50°					
Port of Operation Fourchon			203 Nautical Miles @ 26.12°					
Nearest Manned Platform			A-Structure A (Lucius) KC875			9.0 Nautical Miles @ 299°		

Proposed WR881-AA Well Location (Surface)								
Location Coordinates								
NAD 27 Datum - Clarke 1866 Ellipsoid					UTM Zone 15 - CM 93° West			
Latitude	26°	03'	37.877"	North	Easting	1,999,346		US ft. E
Longitude	91°	54'	22.787	West	Northing	9,457,599		US ft. N
FWL Walker Ridge 881			3,506ft		US ft.	Inline	6225	
FSL Walker Ridge 881			1,119ft		US ft.	Crossline	18589	
Water Depth: -7,780ft.			Slope: 2.6° SE					
Nearest Shoreline			188 Nautical Miles @ 17.50°					
Port of Operation Fourchon			203 Nautical Miles @ 26.12°					
Nearest Manned Platform			A-Structure (Lucius) KC875			9.0 Nautical Miles @ 297°		

There are no areas with the potential to host a Sensitive Sessile Benthic Community within 2,000ft of the proposed location.

Conclusions and Recommendations: The Proposed WR881-A and WR881-AA Well Locations in WR881 will not impact any sites favorable for the development of sensitive sessile benthic communities.

Sincerely,
Anadarko Petroleum Corporation

Attachment C-4

Some pages omitted due to proprietary data

Well Clearance Letter for **Anadarko Petroleum Corporation**

Project:
Proposed WR881-B Location
Walker Ridge Block WR881, Offshore Gulf of Mexico

Description:
3D Geohazard Assessment

Project Number:
2019-113

Report Status:
Final

Ocean Geo Solutions

8399 Westview Drive, Suite 200, Houston, 77055, USA
www.oceangeosolutions.com

REPORT AUTHORISATION AND DISTRIBUTION

Compilation	Geophysics	L Fuentes
Authorization	Geophysics	A.R.H .... A Haigh
	Quality Assurance	D Haigh .... D Haigh

Revision	**Date**	**Title**
0	March 01, 2019	Draft
1	March 25, 2019	Final

Distribution

4 copies

Anadarko Petroleum Corporation
1201 Lake Robbins Drive
The Woodlands, TX 77380

For the attention of:
Trey Kramer

SERVICE WARRANTY

USE OF THIS REPORT

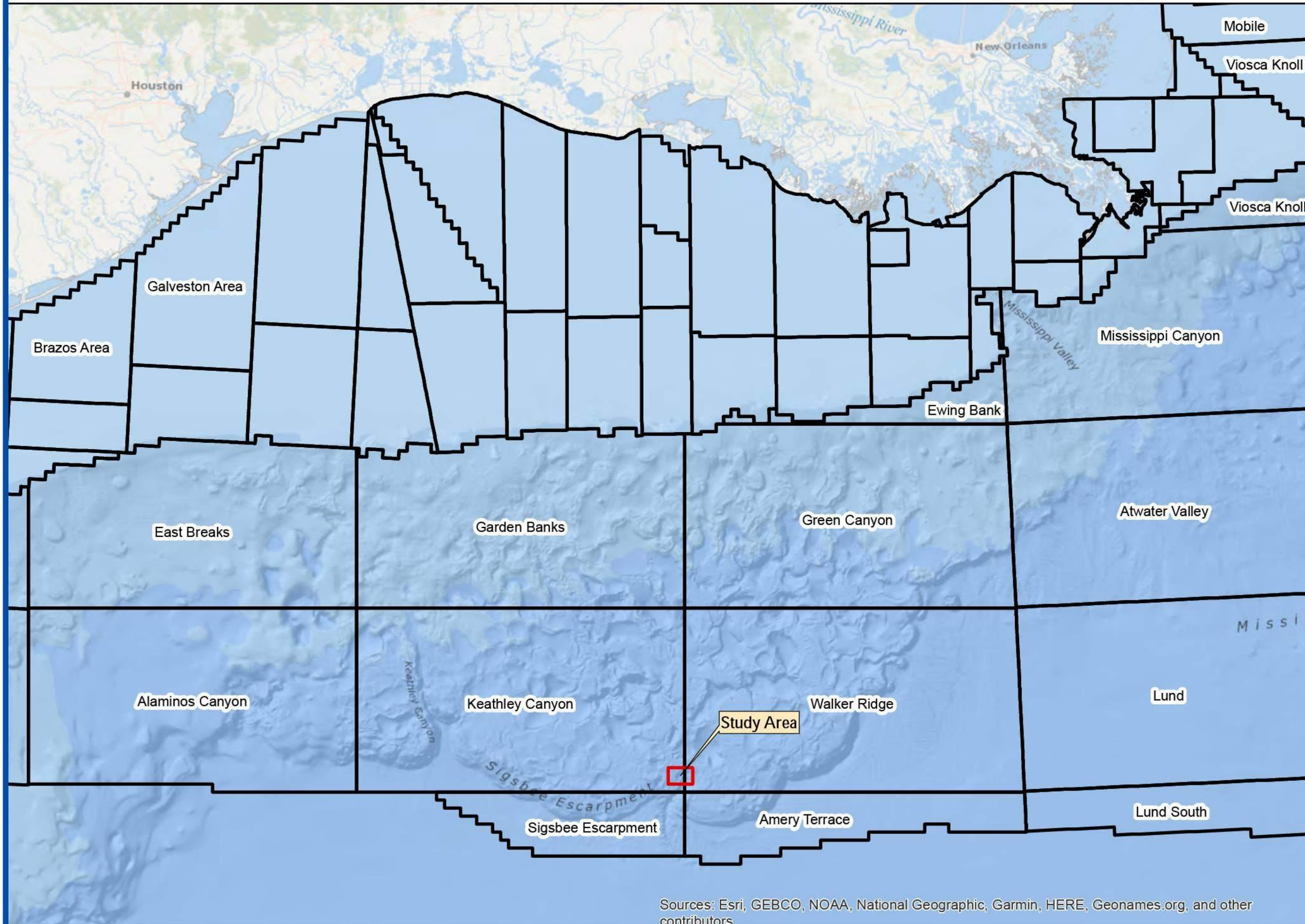
This report has been prepared with due care, diligence and with the skill reasonably expected of a reputable contractor experienced in the types of work, carried out under the contract. As such, the findings in this report are based on an interpretation of data which is a matter of opinion on which professionals may differ and, unless clearly stated, is not a recommendation of any course of action.

Ocean Geo Solutions, Inc. has prepared this report for the client identified on the front cover in fulfillment of its contractual obligations under the referenced contract, and the only liabilities Ocean Geo Solutions, Inc. will accept are those contained therein.

Please be aware that further distribution of this report, in whole or part, or the use of the data for a purpose not expressly stated within the contractual work scope is at the client's sole risk, and Ocean Geo Solutions, Inc recommends that this disclaimer is included in any such distribution.

OCEAN GEO SOLUTIONS, INC
8399 Westview Dr, Suite 200, Houston, Texas 77055, USA
Telephone 713 481 4630 Fax 713 464 8275
www.oceangeosolutions.com

Location Map



Sources: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributors

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Ocean Geo Solutions

WELL CLEARANCE LETTER – PROPOSED WR881-B WELL LOCATION

March 25, 2019
Anadarko Petroleum Corporation
1201 Lake Robbins Drive,
The Woodlands
Texas, 77380

Attention: **Trey Kramer**

Well Clearance Letter
Proposed WR881-B Well Location
Walker Ridge Block WR881
Offshore Gulf of Mexico

Ocean Geo Solutions Inc. was contracted by Anadarko Petroleum Corporation to prepare a Well Clearance Letter for the proposed WR881-B Well Location in Block 881, Walker Ridge Area (OCS-G- 36181). This assessment addresses seafloor and shallow geologic conditions that may impact drilling operations within 2,000ft of the proposed well site. The depth limit of this geohazard assessment is Horizon H40 at -12,556ft below sea surface (4,923ft below seabed). We understand that Anadarko Petroleum Corporation plans to drill the proposed development well from a dynamically positioned drillship; therefore, an anchoring assessment was not requested. Relevant letter-size chart extracts, data examples, and a Top Hole Prognosis are presented with this Well Clearance Letter.

This well site assessment incorporates 3D seismic data and high –resolution autonomous underwater vehicle (AUV)-acquired multibeam, side scan sonar, and sub-bottom profiler data. The regional 3D seismic data was interpreted by Fugro and the multibeam, side scan sonar, and sub-bottom profiler data was acquired by Fugro.

3D Geophysical Survey. Anadarko Petroleum Corporation provided the 3D dataset to Ocean Geo Solutions Inc. on tape media in SEG-Y format for loading onto a Seismic Micro-Technology (SMT) workstation. The 3D data cube contains a survey with 10 feet sample rate data to a record length of 15,000ft below the sea surface. Inlines are oriented northeast to southwest have a numerical increment of one, and exhibit a line spacing of 98.4213ft. Crosslines are oriented northwest to southeast, have a numerical increment of four, and exhibit a line spacing of 82.0212ft.

- Acquired by CGG, March 2018.
- Lucius DCS WAZ TTI PSDM Re-Imaged, 55Hz Kirchoff Stack
- Processing Flow:
- Anti-aliasing
- Resample to 6ms
- Sailline Denoise
- Debubble
- 3D FP Deghost
- Designautre and Datum correction
- SRME Q correction

- DC WAZ Data Regularize 55Hz Kirchhoff Migration
- Diverge Z power 1.

The data was spectrally whitened with IHS Kingdom for the purpose of frequency enhancement. Data exhibits a good frequency response across the upper second below the seabed, with an effective frequency range of 18 - 56Hz at 50% power (Figure 11). The data exhibits a dominant frequency in the upper second of approximately 41Hz, resulting in a mean vertical resolvability of typically 34ft and a layer detectability of 6ft. The data is considered good to excellent quality.

In summary and with reference to NTL No. 2008-G04:

a) The data provides imaging of sufficient resolution of the shallow section allowing a clear analysis of the shallow conditions.
b) The data can be loaded to a workstation at 16-bit resolution or greater and is unscaled.
c) There is no trace or sample decimation.
d) The sample interval and bin size are maintained throughout the assessment area.
e) The data possess a frequency content of 50Hz or higher at 50% power in the first second below the seabed.
f) Seabed reflection is free of gaps and is defined by a wavelet of stable shape and phase, allowing auto-tracking of the seabed event with minimum user intervention and guidance.
g) There are no significant acquisition artifacts throughout the dataset.
h) Merge points in the data are marked by no time shifts and very minimal amplitude changes, and are not a detriment to interpretation.
i) Processed bin sizes are 98.4213ft x 82.0212ft
j) The sample rate of the data is 10 feet sample rate data.
k) An accurate velocity model has been utilized in the shallow section allowing optimum structural and stratigraphy resolution with no evidence of under- or over-migration.
l) There is no significant multiple energy.

The proposed activities are not within an area defined by BOEM as having high archaeological potential (see NTL No. 2011-JOINT-G-01). An archeological assessment within the Magnus Prospect Blocks KC920, 921, and 965 of the Keathley Canyon Area and Blocks 881 and 925 of the Walker Ridge Area, Gulf of Mexico was performed by Fugro USA Marine, Inc. in February 2018.

1. LOCATION COORDINATES

1.1 Proposed WR881-B Well Location

Proposed WR881-B Well Location (Surface)							
Location Coordinates							
NAD 27 Datum - Clarke 1866 Ellipsoid					UTM Zone 15 - CM 93° West		
Latitude	26°	04’	22.800”	North	Easting	1,998,104	US ft. E
Longitude	91°	54’	36.000	West	Northing	9,462,124	US ft. N

FWL Walker Ridge 881	2,264ft	US ft.	Inline	6184
FSL Walker Ridge 881	5,644ft	US ft.	Crossline	18705
Water Depth: -7,633ft.	Slope: 4.3° SE			
Nearest Shoreline	188 Nautical Miles @ 17.50°			
Port of Operation Fourchon	203 Nautical Miles @ 26.12°			
Nearest Manned Platform	A-Structure A (Lucius) KC875	8.4 Nautical Miles @ 297°		

2. VELOCITY DATA

2.1 Seabed Depth

3D Seismic Data was provided in depth; therefore, no depth conversion was required. Additionally, AUV-multibeam depth was acquired by Fugro.

2.1 Sub-seabed Depth

3D Seismic Data was provided in depth; therefore, no depth conversion was required to convert mapped horizons.

3. SEABED CONDITIONS

3.1 Seabed Depth

Seabed depth at the proposed well location is -7,633ft below the sea surface (Figure 1). The seafloor gradient at the proposed well is 4.3° to the southeast.

3.2 Seafloor Morphology and Man-Made Features

The proposed WR881-B well location is in the west-central part of Block WR881. At the proposed well location, the seabed is slightly undulating (Figure 2). Soft clays and silts are predicted at the seabed.

The proposed well is located on the western part of a mini basin on a slump lobe deposit area approximately 1,169ft to the southeast of the slump scarp. The headwall scarp of the failure and associated numerous fault intersections are present in the northwestern two-thirds of the 2,000ft radius. No problems are anticipated for a short-term exploration well, however, further soil stability studies are recommended for any long-term infrastructure due to the proximity of the surficial failures.

There are no anomalous seabed amplitudes indicative of hydrocarbon macroseep observed within a 2,000ft radius of the proposed location (Figure 3). Backscatter data shows relatively uniform amplitudes associated with clays and silt drape. No seabed fluid venting areas were identified within 2,000ft of the proposed well and no sites were identified in the study area.

No existing seabed infrastructure occurs within 2,000ft of the proposed well.

The archeological assessment did identify a seabed contact within 2,000ft of the proposed well. The sonar contact (Contact 25) is located 1,910ft to the southeast. According to the archaeological report produced by Fugro, Contact 25 is described as possible modern debris with a width of 4.3ft, <1.0ft in height, and 8.4ft in length.

No other features are observed within a 2,000ft radius that could affect well emplacement or jetting of a casing.

4. SUB-SEABED CONDITIONS

4.1 Ocean Geo Solutions Hazard Classification Scheme

4.1.1 Shallow Gas Classification

Shallow gas detection is normally made in the first instance by recognition of anomalously high amplitude ('bright' spots). This parameter allied to a number of other characteristics, such as acoustic masking, underlying velocity pulldown, structural closure, edge effects, frequency reduction, and basal 'flat' spots is indicative of shallow gas accumulations. High amplitude polarity-reversed reflectors are particularly relevant to shallow gasified sands, particularly within the topmost kilometer of sediments below the seabed. The quantitative degree of these gas risks is further detailed as:

High Risk of Gas –Anomalously high amplitudes coupled with multiple other well-defined subsidiary indicators, such as acoustic masking, velocity pulldown, structural closure, phase reversal, frequency reduction, etc. Predicted Gas Risk considered *probable*.

Moderate Risk of Gas –Anomalously high amplitudes coupled with two other well-defined subsidiary indicators, such as acoustic masking, velocity pulldown, structural closure, phase reversal, frequency reduction, etc. Predicted Gas Risk considered *likely*.

Slight Risk of Gas –Anomalously high amplitudes coupled with one to two other well-defined subsidiary indicators, or very high amplitude alone. Predicted Gas Risk considered *possible*.

4.1.2 Shallow Water Flow Classification

High Shallow Water Flow Risk –Potential sand-prone interval, overlain by a well-defined seal with significant rapidly-deposited overburden, together with a tie to a known Shallow Water Flow zone in a nearby well. Shallow Water Flow considered *probable*.

Moderate Shallow Water Flow Risk–A potential sand-prone interval, overlain by a well-defined clay seal with significant rapidly deposited overburden. Shallow Water Flow considered *likely*.

Slight Shallow Water Flow Risk –Possible sand-prone interval, overlain by a poor or breached seal, or slowly deposited overburden. Or a moderate or high-risk type deposit, where a nearby well has disproved the flow zone. Shallow Water Flow considered unlikely but still *possible*.

4.2 Geology and Lithology

The sub-seabed geology has been divided into four units, Units 1, 2, 3, and 4. These are separated by Horizons H10, H20, H30, and H40 (Figures 5 through 9).

4.3 Unit 1

The lithology within the upper part of Unit 1 from the seabed to approximately 50ft below seabed of sediments are interpreted as probably soft clays and silts as shown on the Seismic Profiler Data Example (Figure 6). From -7,683ft to -8,313ft below sea surface (50ft to 680ft below seabed) is characterized by well-layered, low-amplitude reflectors interpreted as clays and silts with occasional sands.

No gas hazards or shallow water flow risks are interpreted within Unit 1 at the wellbore or within 2,000ft.

Horizon H10 marks the base of this unit at -8,313ft below sea surface (680ft below seabed). Horizon H10 presents some character indicative of a minor thin sand interbed.

4.4 Unit 2

The upper part of Unit 2 from -8,313ft to -8,929ft below sea surface (680ft to 1,296ft below seabed) consists of slightly-chaotic, low amplitude reflectors interpreted as clays and silts with several sand interbeds. A well-defined <30ft thick interpreted sand interbed occurs at -8,431ft below sea surface (798ft below seabed). The well-path will not traverse any clearly identified risk of gas hazards within this interval, however, at the sand interbed significantly increased amplitudes are observed, and the sandy package increases in thickness to the east. No other indication of shallow gas was observed. Given this character, a **Slight Risk of Gas** and a **Slight Shallow Water Flow Risk** is assigned at the sand interbed. Minor wellbore stability and drilling fluid circulation problems are possible through the remainder of this upper interval.

The lower interval from -8,929ft to -9,076ft below sea surface (1,296ft to 1,443ft below seabed) is characterized by well-layered, low-amplitude and slightly-moderate amplitudes reflectors character expected to comprise clays, silts, and occasional minor sands.

The well-path will intersect a possible minor fault within Unit 2 at 8,677ft below sea surface (1,044ft below seabed). Minor wellbore stability and drilling fluid circulation problems may occur at the level of the fault.

Horizon H20 marks the base of this unit at –9,076ft below sea surface (1,443ft below seabed). Horizon H20 is interpreted as possible sand interbed and may induce minor drilling fluid circulation and wellbore stability problems.

4.5 Unit 3

The upper part of Unit 3 from -9,076ft to -10,542ft below sea surface (1,443ft to 2,909ft below seabed) presents as slightly-chaotic, low-amplitude reflectors interpreted to consist of slightly-channelized deposits comprising clays and silts with occasional minor coarser interbeds.

A better defined <30ft thick interpreted sand interbed occurs at -9,556ft below sea surface (1,923ft below seabed). Minor wellbore stability and drilling fluid circulation problems may occur at the level of this interpreted sand interbed.

From -10,542ft to -11,639ft below sea surface (2,909ft to 4,006ft below seabed) presents as well-layered, low and moderate-amplitude reflectors interpreted as clays, silts, and several sands/marl interbeds. The interbeds within this interval have been tilted, with the potential for any fluid if present within the deeper parts of the mini-basin may migrate upslope along these underlying interbeds and become ponded in this interval of Unit 3. The tilted interbeds have the potential to transmit deeper mini basin pressures into this section (if pore connectivity exists) and a **Slight Shallow Water Flow Risk** is assigned.

No anomalies indicative of shallow gas are present within Unit 3 at the proposed well location. A risk of gas anomaly occurs approximately 1,813ft to the northwest. This anomaly occurs in the upper part of Unit 3.

The well-path will intersect three possible minor faults at -9,945ft below sea surface (2,312ft below seabed), at -10,639ft below sea surface (3,006ft below seabed) and at -11,362ft below sea surface (3,729ft below seabed). Minor wellbore stability and drilling fluid circulation problems may occur at the level of the faults.

Horizon H30 marks the base of this unit at –11,639ft below sea surface (4,006ft below seabed).

4.6 Unit 4

The upper part of Unit 4 from -11,639ft to -11,973ft below sea surface (4,006ft to 4,340ft below seabed presents as well-layered, low and moderate-amplitude reflectors interpreted to contain clays and silts with several sands. Minor wellbore stability and drilling fluid circulation problems are considered possible.

The lower interval from -11,973ft to -12,556ft below sea surface (4,340ft to 4,923ft below seabed) is characterized by well-layered, low-amplitude reflectors interpreted as clays and silts.

The well-path will not intersect any faults within Unit 4.

Horizon H40 marks the base of this unit and the base of this interpretation at –12,556ft below sea surface (4,923ft below seabed).

4.7 Shallow Gas Assessment

Within Unit 2 a **Slight Risk of Gas** is assigned at the level of a <30ft thick interpreted sand interbed at -8,431ft below sea surface (798ft below seabed).

4.8 Shallow Water Flow Assessment

Within Unit 2 a **Slight Shallow Water Flow Risk** is assigned at the level of a <30ft thick interpreted sand interbed at -8,431ft below sea surface (798ft below seabed)

Within Unit 3 a **Slight Shallow Water Flow Risk** is assigned from -10,542ft to -11,639ft below sea surface (2,909ft to 3,006ft below seabed).

5. CONCLUSIONS AND RECOMMENDATIONS

- Seabed

  Gradients are slightly elevated at 4.3° to the southeast. The proposed well is located within a slump lobe deposit and is located to close proximity to a headwall failure scarp. No problems are anticipated for a short-term exploration well, however further soil stability studies are recommended for any longer-term infrastructure.

- Unit 1

  No major drilling hazards or problems are interpreted.

- Unit 2

  Within Unit 2 a **Slight Risk of Gas** and a **Slight Shallow Water Flow Risk** is assigned at the level of a <30ft thick sand interbed at -8,431ft below sea surface (798ft below seabed). Drilling Caution is advised, and appropriate drilling methodology is recommended to deal with a possible short-lived non-persistent water flow event.

  Minor wellbore stability and drilling fluid circulation problems are possible within the interval from -8,313ft to -8,929ft below sea surface (680ft to 1,296ft below seabed).

  The well-path will intersect a fault at -8,677ft below sea surface (1,044ft below seabed). Minor wellbore and drilling fluid circulation problems may occur at the level of the fault. Casing seats should avoid all fault intersections as formation integrity could be compromised.

- Unit 3

  Within Unit 3 a **Slight Shallow Water Flow Risk** is assigned from -10,542ft to -11,639ft below sea surface (2,909ft to 4,006ft below seabed). Appropriate drilling methodology is recommended to deal with a possible short-lived non-persistent water flow event.

  Minor wellbore stability and drilling fluid circulation problems are possible at the level of Horizon H20 at -9,076ft below sea surface (1,443ft below seabed) and at the level of a <30ft thick interpreted sand interbed at -9,556ft below sea surface (1,923ft below seabed).

  The well-path will intersect three faults at -9,945ft below sea surface (2,312ft below seabed), at -10,639ft below sea surface (3,006ft below seabed) and at -11,362ft below sea surface (3,729ft below seabed). Minor wellbore stability and drilling fluid circulation problems may occur at the level of the faults. Casing seats should avoid all fault intersections as formation integrity could be compromised.

- Unit 4

  Minor wellbore stability and drilling fluid circulation problems are possible within the interval from -11,639ft to -11,973ft below sea surface (4,006ft to 4,340ft below seabed).

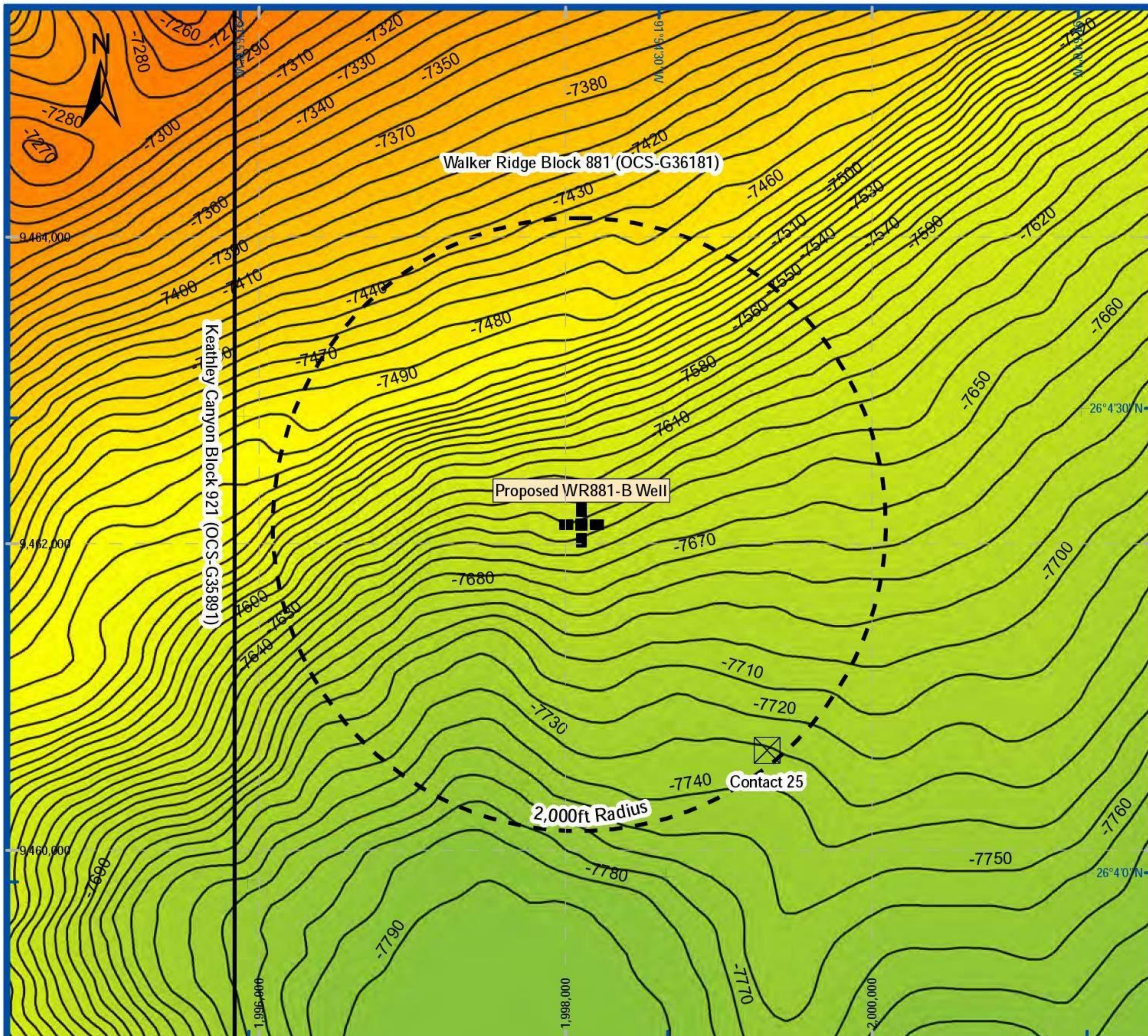
We appreciate the opportunity to work with you on this project and look forward to continuing as your geohazards consultants. Please contact us if you have any questions or if we can be of further assistance.

Sincerely,
Ocean Geo Solutions Inc.

Andrew Haigh	Denise Haigh
Geophysical Manager	Quality Assurance

Copies Submitted: 4 copies to Trey Kramer at Anadarko Petroleum Corporation

Attachments:
Proposed WR881-B Well Location
Seabed Depth Extract
Seabed Morphology Extract
Seabed Amplitude Extract
Geohazard Summary Extract
Side Scan Sonar Data Example
Seismic Profiler Data Example
Inline Data Example
Crossline Data Example
Top Hole Prognosis
ROV Plat
Power Spectrum
Bathymetry Plat
Public Information Plat
Proprietary Information Plat
Vicinity Plat
10-Mile Radius Plat



Seabed Depth Extract

Proposed WR881-B Well Location (1,998,104ft E / 9,462,124ft N)

Side scan sonar contact

Block boundaries

-7,633 Depth in feet below sea surface to seabed, contoured at 10ft intervals

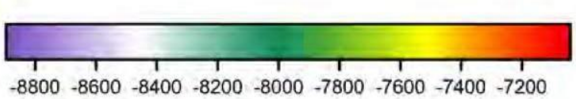


Chart Scale 1" = 1,000'

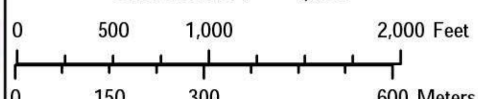
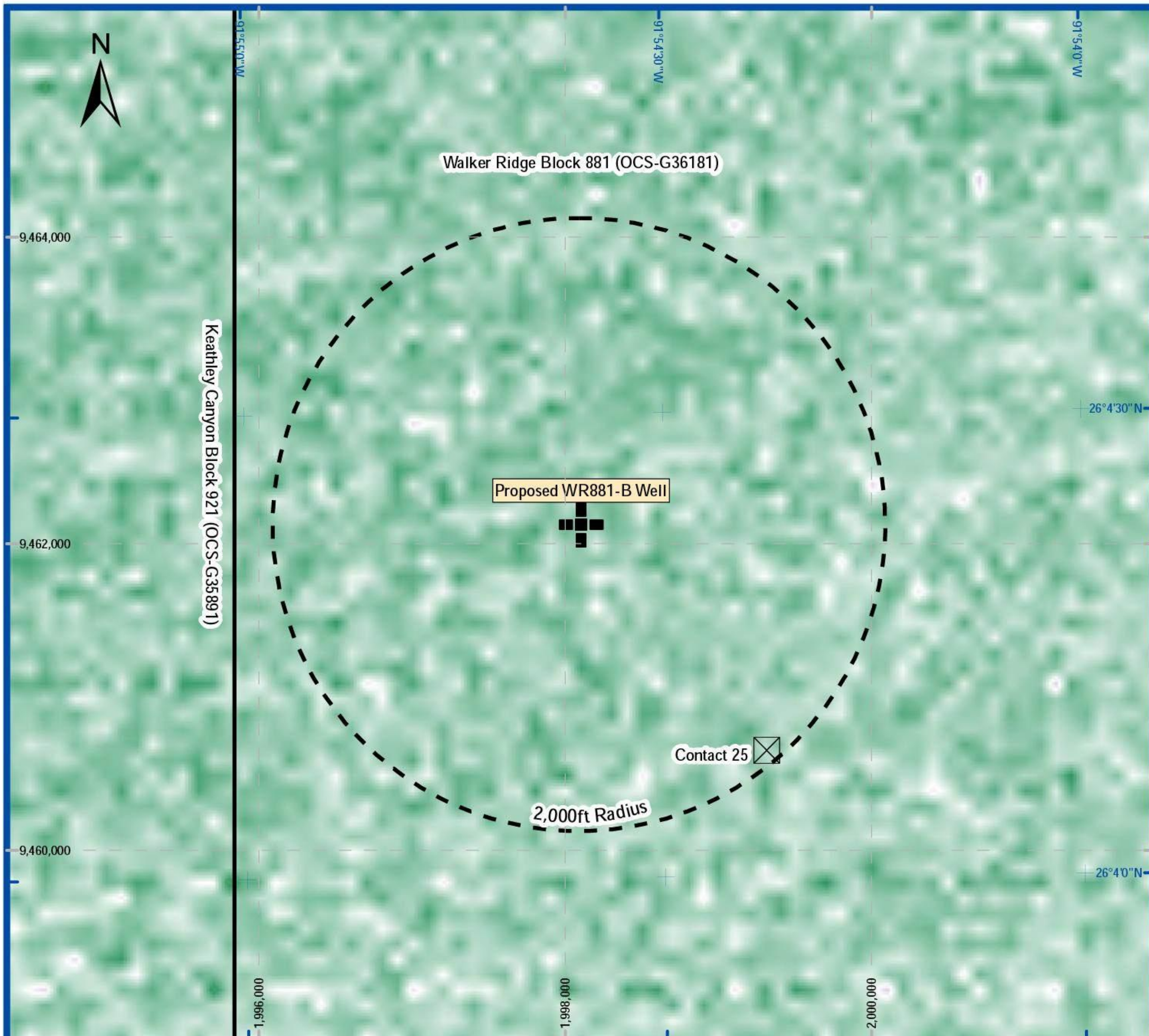


Figure 1 (WR881-B)



Seabed Backscatter Amplitude Extract

Proposed WR881-B Well Location (1,998,104ft E / 9,462,124ft N)

Side scan sonar contact

Block boundaries

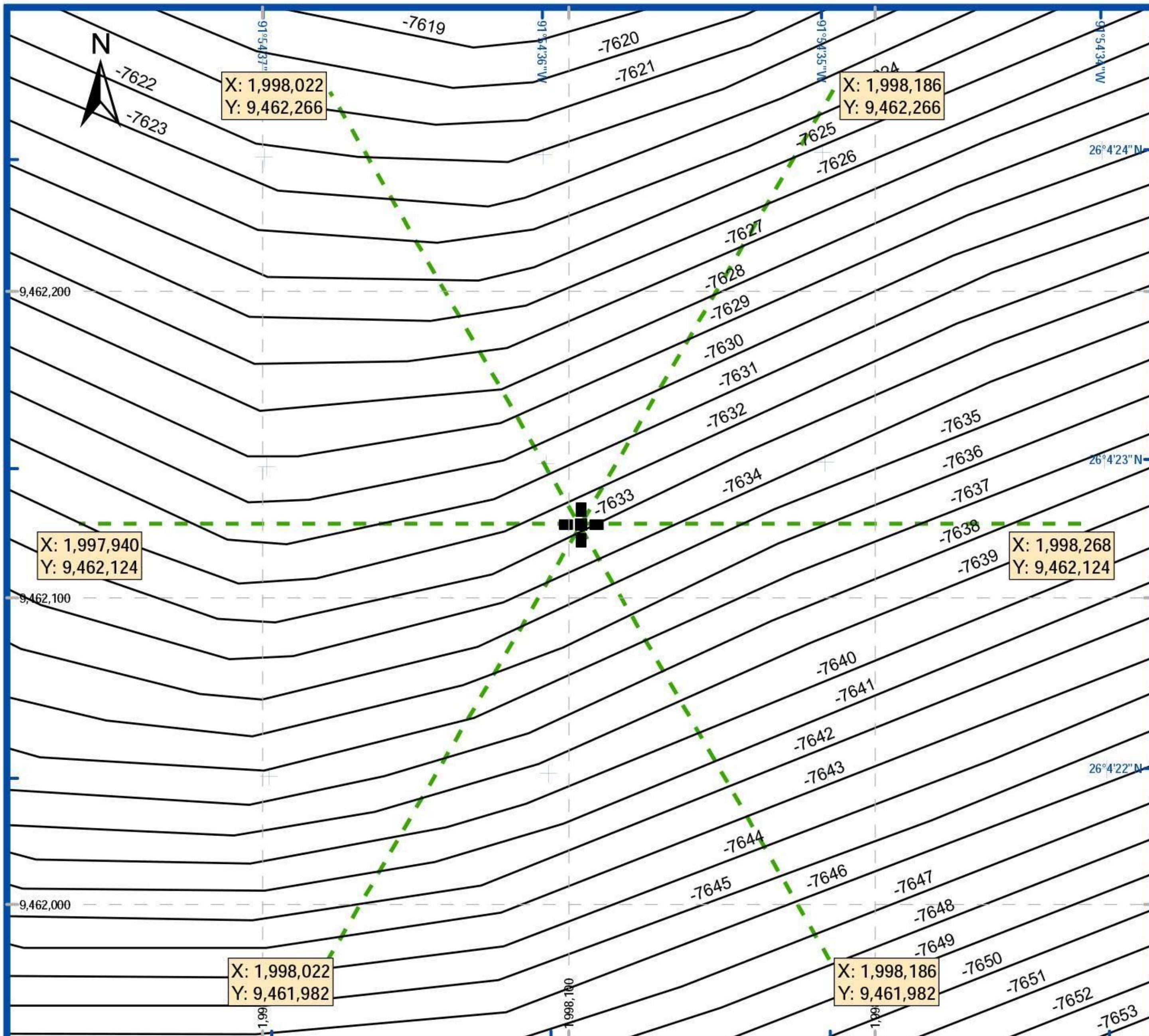
Relative Seabed Backscatter Amplitude

Chart Scale 1" = 1,000'

0 500 1,000 2,000 Feet

0 150 300 600 Meters

Figure 3
(WR881-B)



ROV Plat (WR881-B)

Proposed WR881-B Well Location
(1,998,104ft E / 9,462,124ft N)

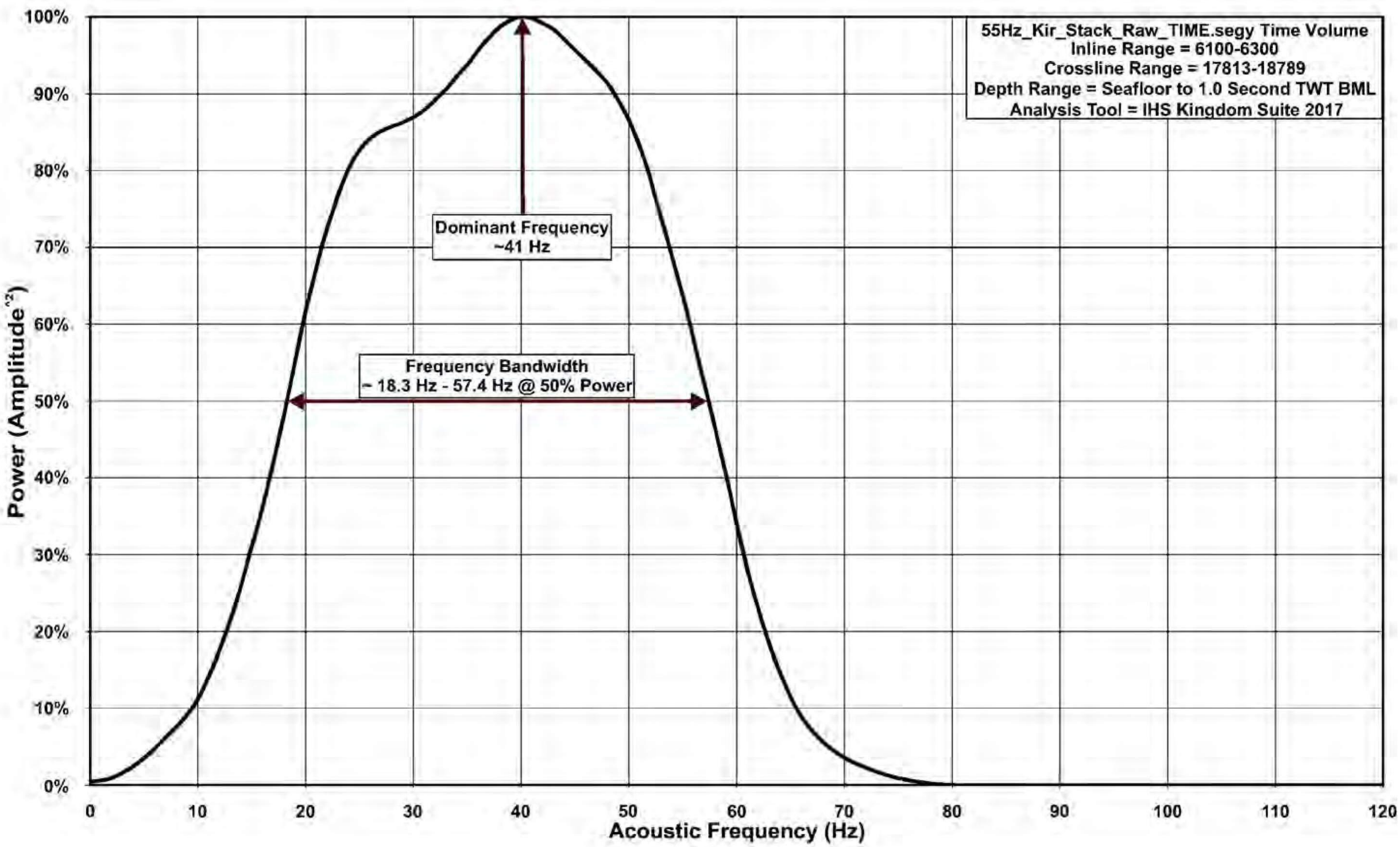
-7633 Depth in feet below sea surface to seabed, contoured at 1ft intervals

Chart Scale 1" = 50'

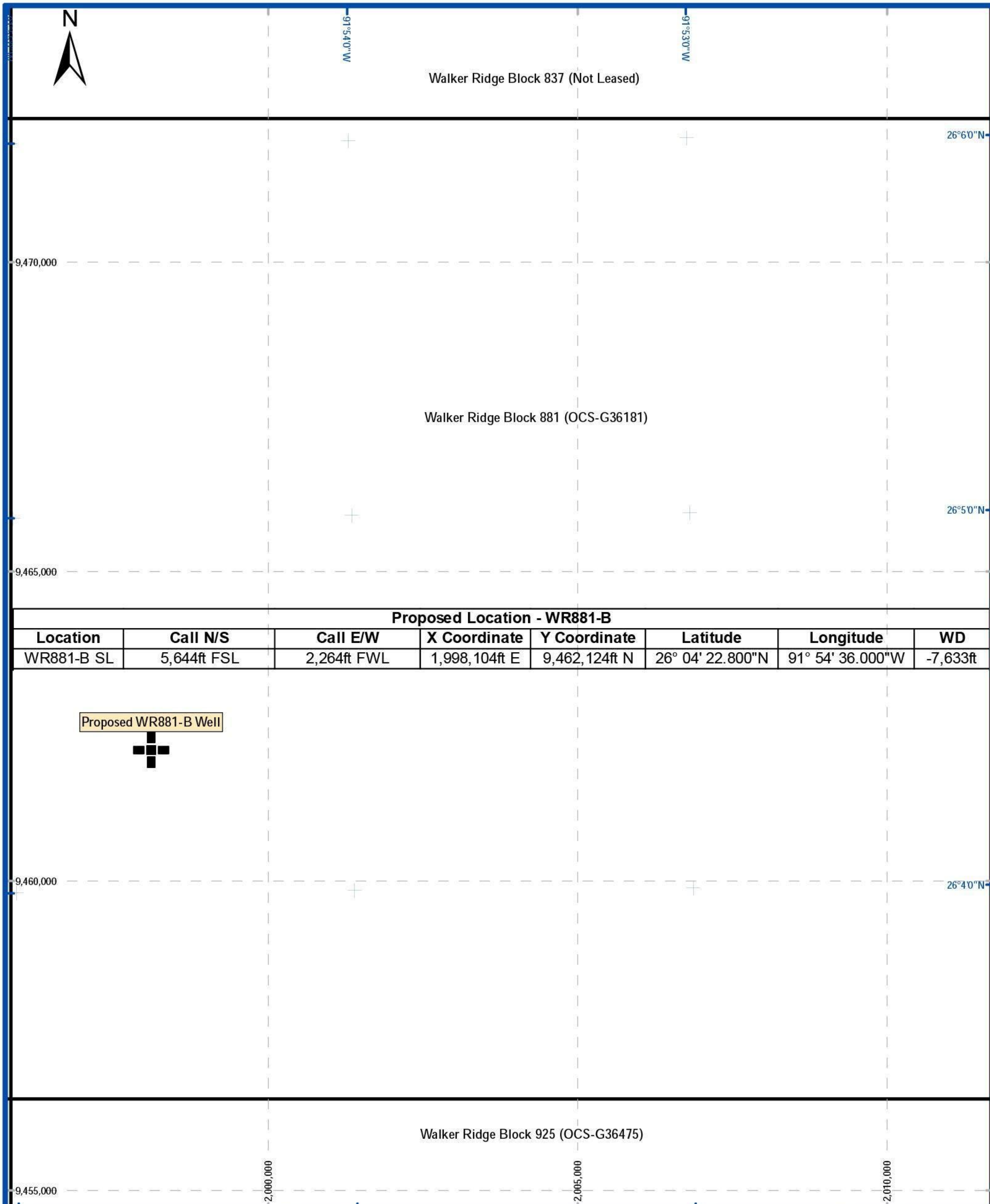
0 50 100 200 Feet

0 12.5 25 50 Meters

Figure 10
(WR881-B)



WR881-B	Power Spectrum	Figure 11



Proposed Location - WR881-B							
Location	**Call N/S**	**Call E/W**	**X Coordinate**	**Y Coordinate**	**Latitude**	**Longitude**	**WD**
WR881-B SL	5,644ft FSL	2,264ft FWL	1,998,104ft E	9,462,124ft N	26° 04' 22.800"N	91° 54' 36.000"W	-7,633ft

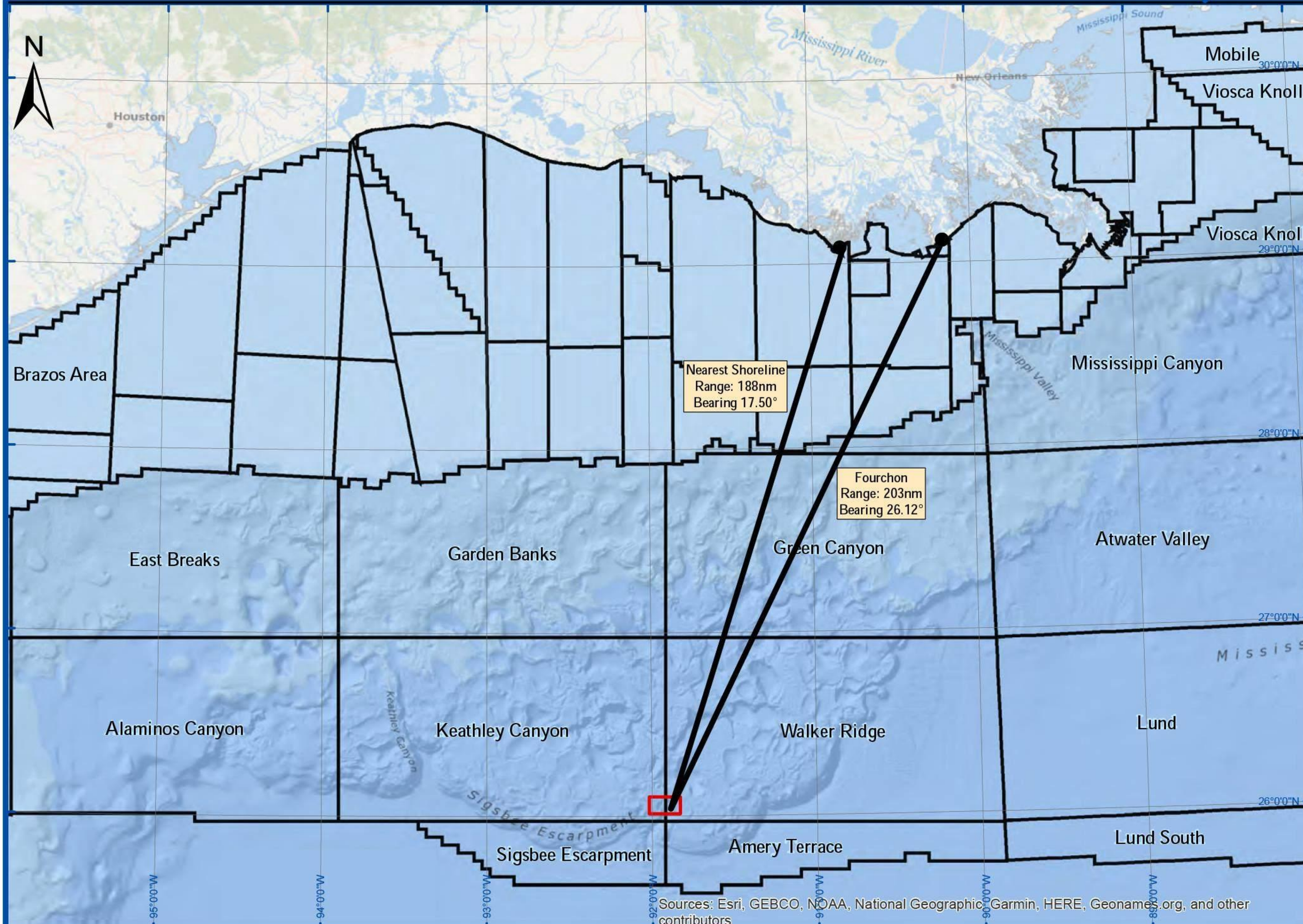
Chart scale 1" = 2,000'
0 500 1,000 2,000 Feet
0 125 250 500 Meters

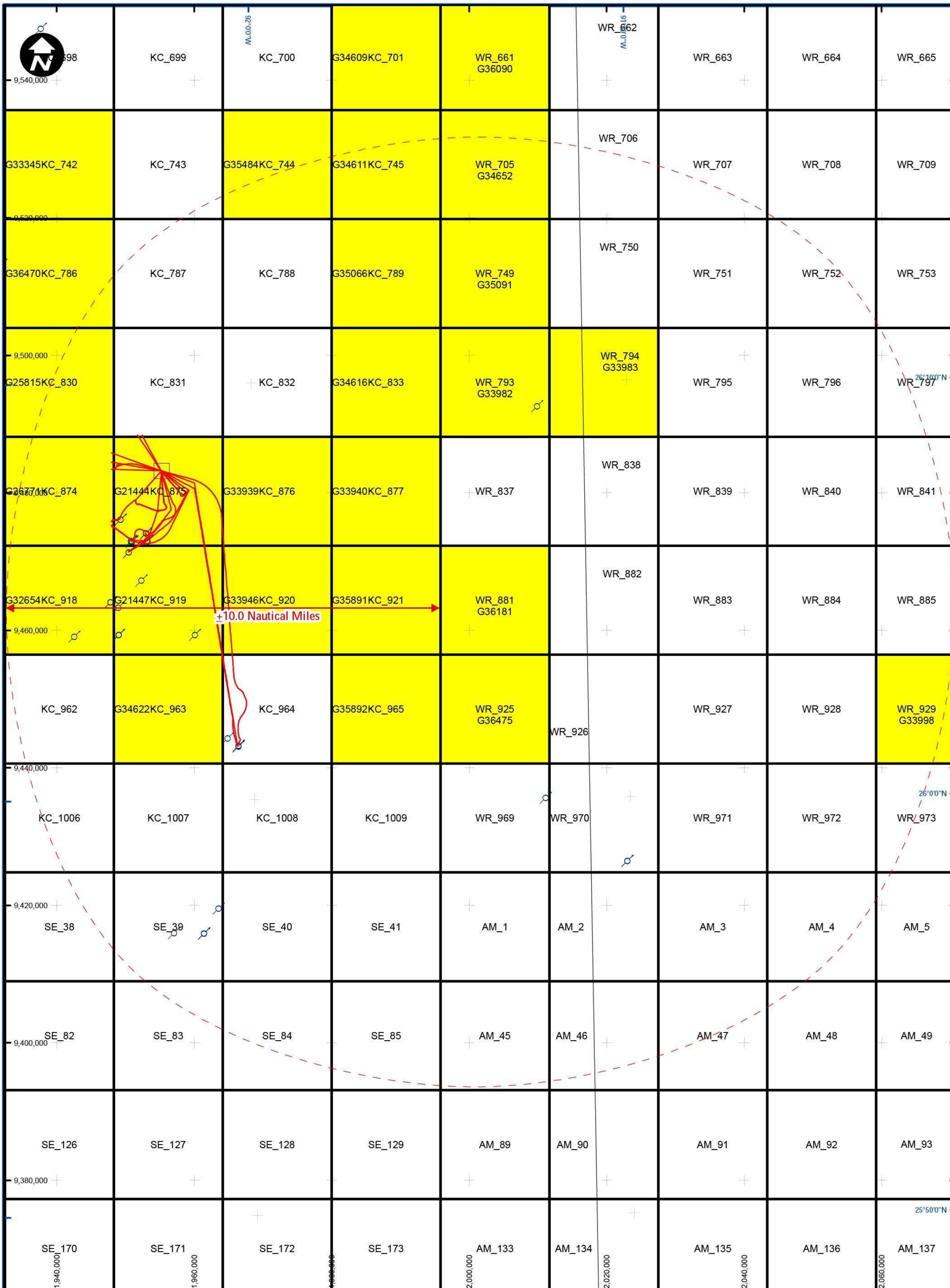
Well Location Plat - Public Information

Figure 13

Vicinity Map - Walker Ridge Block 881

Figure 15





Legend

- Seabed Well
- Platform
- Not Leased
- Leased
- Pipeline

10 MILE RADIUS SEABED INFRASTRUCTURE
WALKER RIDGE - BLOCK 881

0 5 10 Miles

1 inch = 2.5 miles

Ocean Geo Solutions

Anadarko Petroleum Corporation

March 25, 2019

Figure 16

APPENDIX A – PUBLIC SHALLOW HAZARDS STATEMENTS

Ocean Geo Solutions

Public Shallow Hazards Statement – Proposed WR881-B Location

March 25, 2019

US Department of the Interior
Bureau of Ocean Energy Management
1201 Elmwood Park Blvd.
New Orleans, LA 70213-2394

Reference: Shallow Hazards Analysis
Walker Ridge Block 881
(OCS-G 36181)

Ladies/Gentlemen:

Anadarko Petroleum Corporation contracted Ocean Geo Solutions Inc. to prepare a Well Clearance Letter for the Proposed WR881-B well location in Block 881, Walker Ridge Area (OCS-G-36181). This letter addresses seabed and shallow geologic conditions that may impact exploratory drilling operations within 2,000ft of the proposed well site. The depth limit of this site clearance assessment is Horizon H40 at -12,556ft below sea surface (4,923ft below seabed)

Seabed Hazards. The proposed well is located on a depositional slump lobe. The slump deposits derived from a headwall scarp/ridge approximately 1,179ft to the northwest. No problems are anticipated for a short-term exploration well, however, further soil instability studies are recommended for any long-term infrastructure.

There are no anomalous seabed amplitudes indicative of hydrocarbon macroseep observed within a 2,000ft radius of the proposed location (Figure 3). Backscatter data shows relatively uniform amplitudes associated with clays and silt drape. No seabed fluid venting areas were identified within 2,000ft of the proposed well and no sites were identified in the study area.

No existing seabed infrastructure occurs within 2,000ft of the proposed well.

The archeological assessment did identify a seabed contact within 2,000ft of the proposed well. The sonar contact (Contact 25) is located 1,910ft to the southeast. According to the archaeological report produced by Fugro, Contact 25 is described as possible modern debris with a width of 4.3ft, <1.0ft in height, and 8.4ft in length.

No other features are observed within a 2,000ft radius that could affect well emplacement or jetting of a casing.

Sub-Seabed Hazards. A <30ft thick interpreted sand interbed within Unit 2 has been assigned a **Slight Risk of Gas** and a **Slight Shallow Water Flow Risk**. An interval in Unit 3 due to the presence of slightly tilted interbeds and the possibility that fluid may migrate upslope along these tilted interbeds to the borehole is interpreted as a **Slight Shallow Water Flow Risk**. Some intervals with the potential to contain sands may induce minor wellbore and drilling fluid circulation problems.

The well-path will traverse a minor fault in the lower section of Unit 2 and three minor faults within Unit 3.

Proposed WR881-B Well Location (Surface)							
Location Coordinates							
NAD 27 Datum - Clarke 1866 Ellipsoid					UTM Zone 15 - CM 93° West		
Latitude	26°	04'	22.800"	North	Easting	1,998,104	US ft. E
Longitude	91°	54'	36.000	West	Northing	9,462,124	US ft. N
FWL Walker Ridge 881		2,264ft		US ft.		Inline	6184
FSL Walker Ridge 881		5,644ft		US ft.		Crossline	18705
Water Depth: -7,633ft.		Slope: 4.3° SE					
Nearest Shoreline		188 Nautical Miles @ 17.50°					
Port of Operation Fourchon		203 Nautical Miles @ 26.12°					
Nearest Manned Platform		A-Structure A (Lucius) KC875			8.4 Nautical Miles @ 297°		

Conclusions and Recommendations. Slightly higher gradients occur at the seabed. The proposed well is located within a slump deposition lobe. No problems are anticipated for a short-term exploration well, however further soil stability studies are recommended for any long-term infrastructure. No existing seabed infrastructure occurs within 2,000ft of the proposed well. The sonar contact (Contact 25) is located 1,910ft to the southeast. According to the archaeological report produced by Fugro, Contact 25 is described as possible modern debris with a width of 4.3ft, <1.0ft in height, and 8.4ft in length.

A **Slight Risk of Gas** is interpreted at the level of a <30ft thick sand interbed in Unit 2. A **Slight Shallow Water Flow Risk** is assigned to the same interbed in Unit 2 and an interval in Unit 3.

The well-path will traverse a minor fault in Unit 2 and three minor faults within Unit 3.

Sincerely,
Anadarko Petroleum Corporation

APPENDIX B – Sensitive Sessile Benthic Community Statement

Sensitive Sessile Benthic Communities Statement – Proposed WR881-B Well Location

Anadarko Petroleum Corporation.

March 25, 2019

US Department of the Interior
Bureau of Ocean Energy Management
1201 Elmwood Park Blvd.
New Orleans, LA 70213

Reference: Sensitive Sessile Benthic Community Summary
Proposed WR881-F Well Location in Walker Ridge WR881 (OCS-G 36181)

Ladies/Gentlemen:
Anadarko Petroleum Corporation contracted Ocean Geo Solutions Inc. to prepare a Well Clearance Letter for the Proposed WR881-B well location in Block 881, Walker Ridge Area (OCS-G-36181). This letter addresses location proximity to potential sensitive sessile benthic community sites. This well will be drilled from a dynamically-positioned drilling module; therefore, an anchoring assessment is not required.

This sensitive sessile benthic community summary letter is issued as a supplement to the Well Clearance Letter for this proposed well. A Biological, Physical and Socio-economic Map is included illustrating the areas of potential seabed impact.

Potential Sensitive Sessile Benthic Communities
Features or areas that could support high-density sensitive sessile benthic communities are *not* located within 2,000 feet of any proposed mud and cuttings discharge location. No areas with the potential to host benthic communities were identified within the study area.

Backscatter data shows relatively uniform amplitudes associated with clays and silt drape. No seabed fluid venting areas were identified within 2,000ft of the proposed well and no sites were identified in the study area. Several areas exhibiting over consolidated seabed were identified. The nearest area with over consolidated seabed is located 5,925ft to the northwest of the proposed well.

The archeological assessment did identify a seabed contact within 2,000ft of the proposed well. The sonar contact (Contact 25) is located 1,910ft to the southeast. According to the archaeological report produced by Fugro, Contact 25 is described as possible modern debris with a width of 4.3ft, <1.0ft in height, and 8.4ft in length.

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Proposed WR881-B Well Location (Surface)							
Location Coordinates							
NAD 27 Datum - Clarke 1866 Ellipsoid					UTM Zone 15 - CM 93° West		
Latitude	26°	04'	22.800"	North	Easting	1,998,104	US ft. E
Longitude	91°	54'	36.000	West	Northing	9,462,124	US ft. N
FWL Walker Ridge 881		2,264ft	US ft.	Inline	6184		
FSL Walker Ridge 881		5,644ft	US ft.	Crossline	18705		
Water Depth: -7,633ft.		Slope: 4.3° SE					
Nearest Shoreline		188 Nautical Miles @ 17.50°					
Port of Operation Fourchon		203 Nautical Miles @ 26.12°					
Nearest Manned Platform		A-Structure A (Lucius) KC875		8.4 Nautical Miles @ 297°			

There are no areas with the potential to host a Sensitive Sessile Benthic Community within 2,000ft of the proposed location.

Conclusions and Recommendations: The Proposed WR881-B Well Locations in WR881 will not impact any sites favorable for the development of sensitive sessile benthic communities.

Sincerely,
Anadarko Petroleum Corporation

Attachment C-4

Some pages omitted due to proprietary data

Well Clearance Letter for **Anadarko Petroleum Corporation**

Project:
Proposed WR881-D Location
Walker Ridge Block WR881, Offshore Gulf of Mexico

Description:
3D Geohazard Assessment

Project Number:
2019-114

Report Status:
Final

Ocean Geo Solutions
8399 Westview Drive, Suite 200, Houston, 77055, USA
www.oceangeosolutions.com

REPORT AUTHORISATION AND DISTRIBUTION

Compilation	Geophysics	L Fuentes
Authorization	Geophysics	A Haigh
	Quality Assurance	D Haigh

Revision	Date	Title
0	March 04, 2019	Draft
1	March 25, 2019	Final

Distribution

4 copies

Anadarko Petroleum Corporation
1201 Lake Robbins Drive
The Woodlands, TX 77380

For the attention of:
Trey Kramer

SERVICE WARRANTY

USE OF THIS REPORT

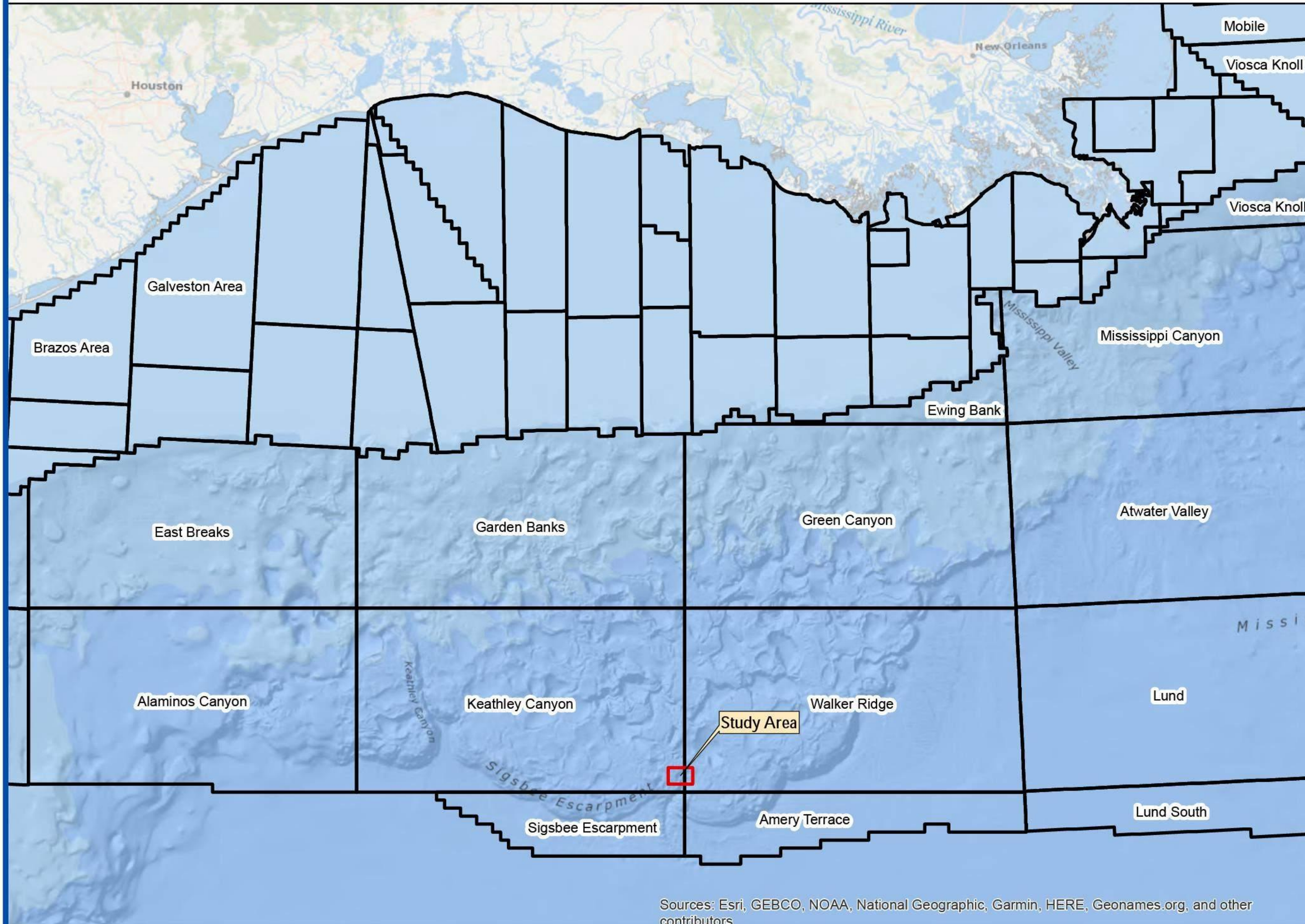
This report has been prepared with due care, diligence and with the skill reasonably expected of a reputable contractor experienced in the types of work, carried out under the contract. As such, the findings in this report are based on an interpretation of data which is a matter of opinion on which professionals may differ and, unless clearly stated, is not a recommendation of any course of action.

Ocean Geo Solutions, Inc. has prepared this report for the client identified on the front cover in fulfillment of its contractual obligations under the referenced contract, and the only liabilities Ocean Geo Solutions, Inc. will accept are those contained therein.

Please be aware that further distribution of this report, in whole or part, or the use of the data for a purpose not expressly stated within the contractual work scope is at the client’s sole risk, and Ocean Geo Solutions, Inc. recommends that this disclaimer is included in any such distribution.

OCEAN GEO SOLUTIONS, INC
8399 Westview Dr, Suite 200, Houston, Texas 77055, USA
Telephone 713 481 4630 Fax 713 464 8275
www.oceangeosolutions.com

Location Map



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LIST OF FIGURES

WELL CLEARANCE LETTER – PROPOSED WR881-D WELL LOCATION

March 25, 2019
Anadarko Petroleum Corporation
1201 Lake Robbins Drive,
The Woodlands
Texas, 77380

Attention: **Trey Kramer**

Well Clearance Letter
Proposed WR881-D Well Location
Walker Ridge Block WR881
Offshore Gulf of Mexico

Ocean Geo Solutions Inc. was contracted by Anadarko Petroleum Corporation to prepare a Well Clearance Letter for the proposed WR881-D Well Location in Block 881, Walker Ridge Area (OCS-G- 36181). This assessment addresses seafloor and shallow geologic conditions that may impact drilling operations within 2,000ft of the proposed well site. The depth limit of this geohazard assessment is Top of salt at -10,833ft below sea surface (3,273ft below seabed). We understand that Anadarko Petroleum Corporation plans to drill the proposed development well from a dynamically positioned drillship; therefore, an anchoring assessment was not requested. Relevant letter-size chart extracts, data examples, and a Top Hole Prognosis are presented with this Well Clearance Letter.

This well site assessment incorporates 3D seismic data and high –resolution autonomous underwater vehicle (AUV)-acquired multibeam, side scan sonar, and sub-bottom profiler data. The regional 3D seismic data was interpreted by Fugro and the multibeam, side scan sonar, and sub-bottom profiler data was acquired by Fugro.

3D Geophysical Survey. Anadarko Petroleum Corporation provided the 3D dataset to Ocean Geo Solutions Inc. on tape media in SEG-Y format for loading onto a Seismic Micro-Technology (SMT) workstation. The 3D data cube contains a survey with 10 feet sample rate data to a record length of 15,000ft below the sea surface. Inlines are oriented northeast to southwest have a numerical increment of one, and exhibit a line spacing of 98.4213ft. Crosslines are oriented northwest to southeast, have a numerical increment of four, and exhibit a line spacing of 82.0212ft.

- Acquired by CGG, March 2018.
- Lucius DCS WAZ TTI PSDM Re-Imaged, 55Hz Kirchoff Stack
- Processing Flow:
- Anti-aliasing
- Resample to 6ms
- Sailline Denoise
- Debubble
- 3D FP Deghost
- Designautre and Datum correction
- SRME Q correction

- DC WAZ Data Regularize 55Hz Kirchhoff Migration
- Diverge Z power 1.

The data was spectrally whitened with IHS Kingdom for the purpose of frequency enhancement. Data exhibits a good frequency response across the upper second below the seabed, with an effective frequency range of 18 - 56Hz at 50% power (Figure 11). The data exhibits a dominant frequency in the upper second of approximately 41Hz, resulting in a mean vertical resolvability of typically 34ft and a layer detectability of 6ft. The data is considered good to excellent quality.

In summary and with reference to NTL No. 2008-G04:

a) The data provides imaging of sufficient resolution of the shallow section allowing a clear analysis of the shallow conditions.
b) The data can be loaded to a workstation at 16-bit resolution or greater and is unscaled.
c) There is no trace or sample decimation.
d) The sample interval and bin size are maintained throughout the assessment area.
e) The data possess a frequency content of 50Hz or higher at 50% power in the first second below the seabed.
f) Seabed reflection is free of gaps and is defined by a wavelet of stable shape and phase, allowing auto-tracking of the seabed event with minimum user intervention and guidance.
g) There are no significant acquisition artifacts throughout the dataset.
h) Merge points in the data are marked by no time shifts and very minimal amplitude changes, and are not a detriment to interpretation.
i) Processed bin sizes are 98.4213ft x 82.0212ft
j) The sample rate of the data is 10 feet sample rate data.
k) An accurate velocity model has been utilized in the shallow section allowing optimum structural and stratigraphy resolution with no evidence of under- or over-migration.
l) There is no significant multiple energy.

The proposed activities are not within an area defined by BOEM as having high archaeological potential (see NTL No. 2011-JOINT-G-01). An archeological assessment within the Magnus Prospect Blocks KC920, 921, and 965 of the Keathley Canyon Area and Blocks 881 and 925 of the Walker Ridge Area, Gulf of Mexico was performed by Fugro USA Marine, Inc. in February 2018.

1. LOCATION COORDINATES

1.1 Proposed WR881-D Well Location

Proposed WR881-D Well Location (Surface)							
Location Coordinates							
NAD 27 Datum - Clarke 1866 Ellipsoid					UTM Zone 15 - CM 93° West		
Latitude	26°	03'	57.010"	North	Easting	2,008,406	US ft. E
Longitude	91°	52'	43.232	West	Northing	9,459,608	US ft. N
FEL Walker Ridge 881	3,274ft	US ft.	Inline	6276			
FSL Walker Ridge 881	3,128ft	US ft.	Crossline	18973			
Water Depth: -7,560ft.	Slope: 2.6° WNW						
Nearest Shoreline	188 Nautical Miles @ 17.50°						
Port of Operation Fourchon	203 Nautical Miles @ 26.12°						
Nearest Manned Platform	A-Structure A (Lucius) KC875	10.4 Nautical Miles @ 294°					

2. VELOCITY DATA

2.1 Seabed Depth

3D Seismic Data was provided in-depth, therefore no depth conversion was required. Additionally, AUV-multibeam depth was acquired by Fugro.

2.1 Sub-seabed Depth

3D Seismic Data was provided in-depth, therefore no depth conversion was required to convert mapped horizons.

3. SEABED CONDITIONS

3.1 Seabed Depth

Seabed depth at the proposed well location is -7,560ft below the sea surface (Figure 1). The seafloor gradient at the proposed well is 2.6° to the WNW.

3.2 Seafloor Morphology and Man-Made Features

The proposed WR881-D well location is in the southeast of Block WR881. At the proposed well location, the seabed is smooth (Figure 2). Soft clays and silts are predicted at the seabed. Sediments appear conducive for jetting of seabed casing with no hard layers predicted.

The proposed well is located within a mini basin occurring approximately 15,684ft to the northeast of Bryant Canyon. The proposed well is located to the north of an area with rugose seabed. The rugosity at the seabed is due to an underlying salt movement that results in numerous small scale buried faults. No seabed surficial failures are expected at the proposed well.

There are no anomalous seabed amplitudes indicative of hydrocarbon macroseep observed within a 2,000ft radius of the proposed location (Figure 3). Backscatter data shows relatively uniform amplitudes associated with clays and silt drape. No seabed fluid venting areas were identified within 2,000ft of the proposed well and no sites were identified in the study area.

No existing seabed infrastructure occurs within 2,000ft of the proposed well.

The archeological assessment did identify a seabed contact within 2,000ft of the proposed well. The sonar contact (Contact 24) is located 1,178ft to the northeast. According to the archaeological report produced by Fugro, Contact 24 is described as possible modern debris with dimensions of 16.7ft x 4.2ft and less than <1.0ft in height.

No other features are observed within a 2,000ft radius that could affect well emplacement or jetting of a casing.

4. SUB-SEABED CONDITIONS

4.1 Ocean Geo Solutions Hazard Classification Scheme

4.1.1 Shallow Gas Classification

Shallow gas detection is normally made in the first instance by recognition of anomalously high amplitude ('bright' spots). This parameter allied to a number of other characteristics, such as acoustic masking, underlying velocity pulldown, structural closure, edge effects, frequency reduction, and basal 'flat' spots are indicative of shallow gas accumulations. High amplitude polarity-reversed reflectors are particularly relevant to shallow gasified sands, particularly within the topmost kilometer of sediments below the seabed. The quantitative degree of these gas risks is further detailed as:

High Risk of Gas –Anomalously high amplitudes coupled with multiple other well-defined subsidiary indicators, such as acoustic masking, velocity pulldown, structural closure, phase reversal, frequency reduction, etc. Predicted Gas Risk considered *probable*.

Moderate Risk of Gas –Anomalously high amplitudes coupled with two other well-defined subsidiary indicators, such as acoustic masking, velocity pulldown, structural closure, phase reversal, frequency reduction, etc. Predicted Gas Risk considered *likely*.

Slight Risk of Gas –Anomalously high amplitudes coupled with one to two other well-defined subsidiary indicators, or very high amplitude alone. Predicted Gas Risk considered *possible*.

4.1.2 Shallow Water Flow Classification

High Shallow Water Flow Risk –Potential sand-prone interval, overlain by a well-defined seal with significant rapidly-deposited overburden, together with a tie to a known Shallow Water Flow zone in a nearby well. Shallow Water Flow considered *probable*.

Moderate Shallow Water Flow Risk–A potential sand-prone interval, overlain by a well-defined clay seal with significant rapidly deposited overburden. Shallow Water Flow considered *likely*.

Slight Shallow Water Flow Risk –Possible sand-prone interval, overlain by a poor or breached seal, or slowly deposited overburden. Or a moderate or high-risk type deposit, where a nearby well has disproved the flow zone. Shallow Water Flow considered unlikely but still *possible*.

4.2 Geology and Lithology

The sub-seabed geology has been divided into four units, Units 1, 2, 4, and 5 (Unit 3 is absent at this proposed location). These are separated by Horizons H10, H20, H40, and Top of Salt (Figures 5 through 9).

4.3 Unit 1

The lithology within the upper part of Unit 1 from the seabed to approximately 50ft below seabed of sediments are interpreted as probably soft clays and silts as shown on the Seismic Profiler Data Example (Figure 6). From -7,610ft to -7,710ft below sea surface (50ft to 150ft below seabed) is characterized by well-layered and low and slightly moderate-amplitude reflectors interpreted as clays, silts, with occasional minor slightly coarser-grained interbeds.

From -7,710ft to -8,199ft below sea surface (150ft to 639ft below seabed) presents as slightly chaotic, low-amplitude reflectors interpreted as clays and silts.

No gas hazards or shallow water flow risks are interpreted within Unit 1 at the wellbore or within 2,000ft.

Horizon H10 marks the base of this unit at -8,199ft below sea surface (639ft below seabed). Horizon H10 presents some character indicative of a minor thin sand interbed. Minor wellbore and drilling fluid circulation problems may occur at the level of Horizon H10.

4.4 Unit 2

The upper part of Unit 2 from -8,199ft to -8,349ft below sea surface (639ft to 789ft below seabed) consists of well-layered and slightly-chaotic, low and moderate-amplitude reflectors interpreted as clays and silts with occasional sand interbeds.

Unit 2 from -8,349ft to -8,716ft below sea surface (789ft to 1,156ft below seabed) presents as slightly-chaotic, low and moderate-amplitude reflectors interpreted as clays and silts with several sand interbeds deposited as a mass-transport and slightly channelized intervals. A better defined <30ft thick sand interbed occurs at the base of the unit at -8,641ft below sea surface (1,081ft below seabed). The well-path will not traverse any clearly identified risk of gas hazards within this interval. An amplitude anomaly with a potential to contain shallow gas is located approximately 1,530ft to the south and southeast. Given the character of this unit exhibiting possible rapid deposition and inadequate dewatering, a **Slight Shallow Water Flow Risk** is assigned.

From -8,716ft to -9,281ft below sea surface (1,156ft to 1,721ft below seabed) is interpreted to consist of low-amplitude, of well-layered clays, silts, and occasional minor sands.

The lower interval from -8,716ft to -9,281ft below sea surface (1,156ft to 1,721ft below seabed) is interpreted to consist of slightly chaotic and slightly channelized low and occasional moderate-amplitude reflectors with clays, silts, and occasional sands.

The well-path will not intersect any major faults within Unit 2.

Horizon H20 marks the base of this unit at –9,281ft below sea surface (1,721ft below seabed).

4.5 Unit 3

The well-path will not traverse Unit 3 due to salt uplift.

4.6 Unit 4

Unit 4 presents as slightly-chaotic, low and moderate-amplitude reflectors interpreted as slightly channelized deposits with clays, silts, and several sands. No anomalies indicative of shallow gas are observed at the proposed well location, with the closest anomaly located 1,081ft to the north. Due to the possibility for minor sands in this interval, minor drilling fluid circulation and wellbore stability problems may occur.

The well-path will not intersect any faults within Unit 4.

Horizon H40 marks the base of this unit at –9,411ft below sea surface (1,851ft below seabed).

4.7 Unit 5

The upper part of Unit 5 from -9,411ft to -9,772ft below sea surface (1,851ft to 2,212ft below seabed presents as well-layered, moderate-amplitude reflectors interpreted as clays and silts with several sands. The interbeds within this interval have been uplifted and tilted, with the potential for any fluid within the deeper parts of the mini-basin possibly migrating upslope. Given this setting where there is the potential for deeper mini basin pressures to be transmitted into this shallower section (if pore connectivity exists) a **Slight Shallow Water Flow Risk** is assigned. Minor wellbore stability and drilling fluid circulation problems are considered possible.

From -9,772ft to -10,292ft below sea surface (2,212ft to 2,732ft below seabed) is characterized by slightly channelized, low and occasional moderate-amplitude reflectors interpreted as clays, silts, and occasional sand interbeds.

The lower interval from -10,292ft to -10,833ft below sea surface (2,732ft to 3,273ft below seabed) is characterized by well-layered, low-amplitude reflectors interpreted as clays and silts with several sands intersected by numerous micro-faults. Minor wellbore stability and drilling fluid circulation problems are considered possible.

The well-path will intersect two better-defined faults within Unit 5 at -9,592ft below sea surface (2,032ft below seabed) and at -9,772ft below sea surface (2,212ft below seabed). Minor wellbore stability and drilling fluid circulation problems are considered possible at the level of the faults.

Top of Salt marks the base of this unit and the base of this interpretation at –10,833ft below sea surface (3,273ft below seabed).

4.8 Shallow Gas Assessment

No risk of shallow gas is interpreted at the proposed well location.

4.9 Shallow Water Flow Assessment

Within Unit 2 a **Slight Shallow Water Flow Risk** is assigned from -8,349ft to -8,716ft below sea surface (789ft to 1,156ft below seabed).

Within Unit 5 a **Slight Shallow Water Flow Risk** is assigned within the interval from -9,411ft to -9,772ft below sea surface (1,851ft to 2,212ft below seabed).

5. CONCLUSIONS AND RECOMMENDATIONS

- Seabed

  No major drilling hazards or problems are interpreted.

- Unit 1

  No major drilling hazards or problems are interpreted.

- Unit 2

  Within Unit 2 a **Slight Shallow Water Flow Risk** is interpreted from -8,349ft to -8,716ft below sea surface (789ft to 1,156ft below seabed). Appropriate drilling methodology is recommended to deal with a possible short-lived non-persistent water flow event.

  Minor wellbore stability and drilling fluid circulation problems are possible at the level of Horizon H10 at -8,199ft below sea surface (639ft below seabed) and within the interval from -8,349ft to -8,716ft below sea surface (789ft to 1,156ft below seabed).

- Unit 4

  No major drilling hazards or problems are interpreted.

- Unit 5

  Within Unit 5 a **Slight Shallow Water Flow Risk** is assigned within the interval from -9,411ft to -9,772ft below sea surface (1,851ft to 2,212ft below seabed). Appropriate drilling methodology is recommended to deal with a possible short-lived non-persistent water flow event.

  Minor wellbore stability and drilling fluid circulation problems are possible within the interval from -10,292ft to -10,833ft below sea surface (2,732ft to 3,273ft below seabed) due to the possibility of several sands and the possibility of numerous micro faults.

  The well-path will intersect two faults within Unit 5 at -9,592ft below sea surface (2,032ft below seabed) and at -9,772ft below sea surface (2,212ft below seabed). Minor wellbore stability and drilling fluid circulation problems are considered possible at the level of the faults. Casing seats should avoid all fault intersections.

We appreciate the opportunity to work with you on this project and look forward to continuing as your geohazards consultants. Please contact us if you have any questions or if we can be of further assistance.

Sincerely,
Ocean Geo Solutions Inc.

Andrew Haigh	Denise Haigh
Geophysical Manager	Quality Assurance

Copies Submitted: 1 copy to Trey Kramer at Anadarko Petroleum Corporation

Attachments:

Proposed WR881-D Well Location

Seabed Depth Extract

Seabed Morphology Extract

Seabed Amplitude Extract

Geohazard Summary Extract

Side Scan Sonar Data Example

Seismic Profiler Data Example

Inline Data Example

Crossline Data Example

Top Hole Prognosis

ROV Plat

Power Spectrum

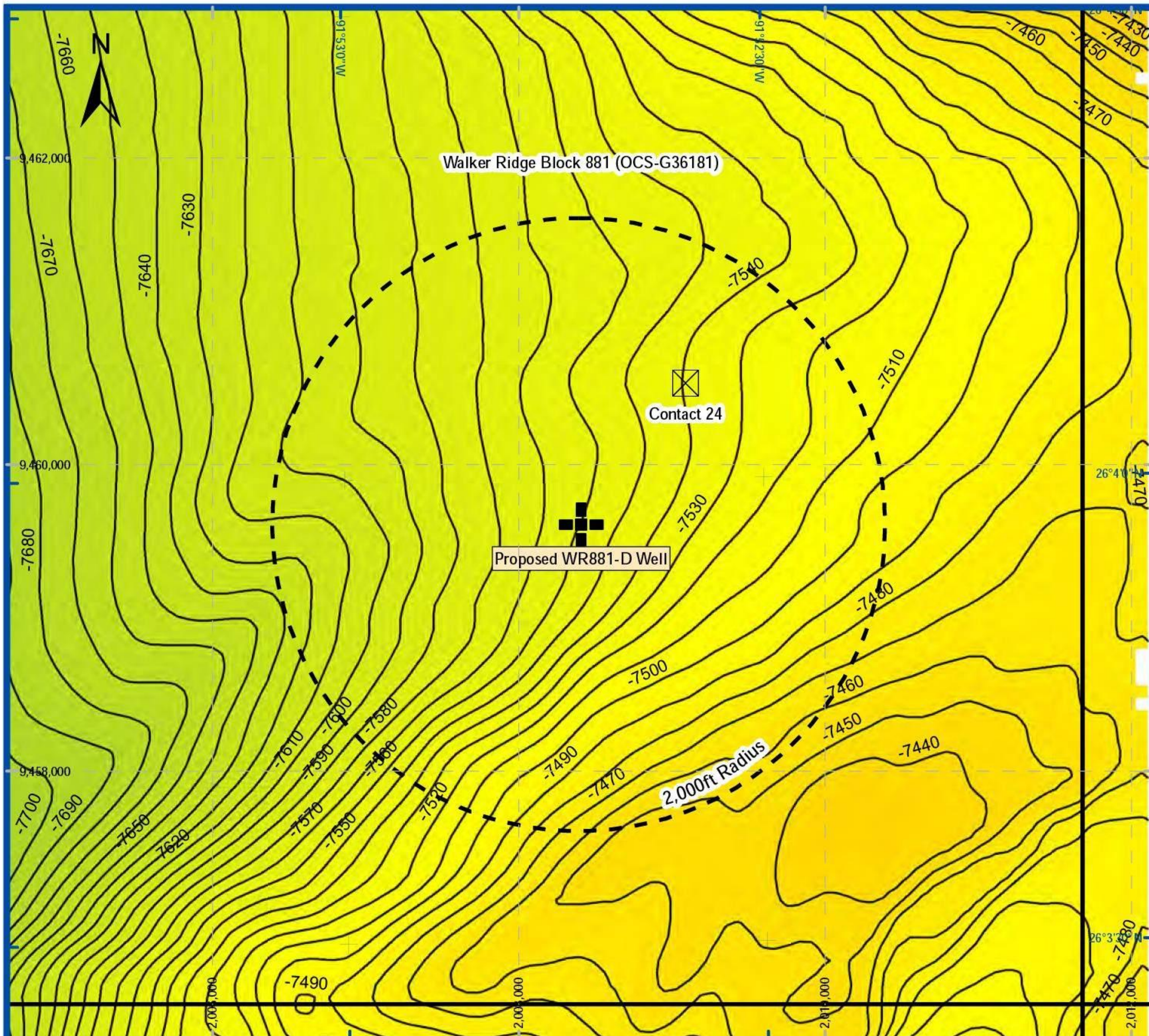
Bathymetry Plat

Public Information Plat

Proprietary Information Plat

Vicinity Plat

10-Mile Radius Plat



Seabed Depth Extract

Proposed WR881-D Well Location (2,008,406ft E / 9,459,608ft N)

Side scan sonar contact

Block boundaries

-7560 Depth in feet below sea surface to seabed, contoured at 10ft intervals

Seabed Depth (Feet)

Chart Scale 1" = 1,000'

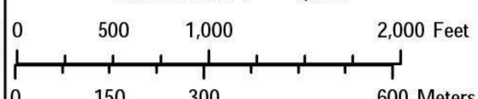
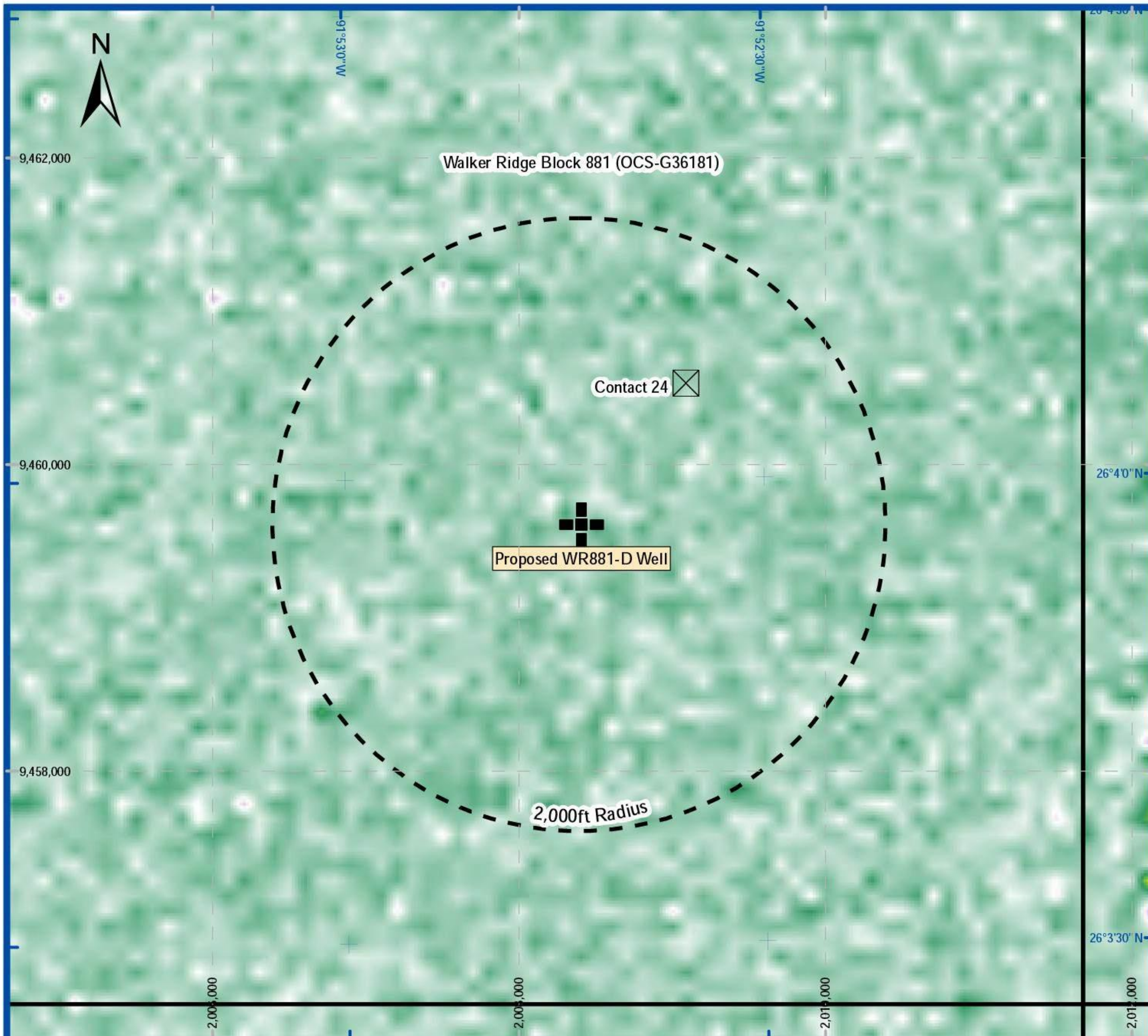


Figure 1 (WR881-D)

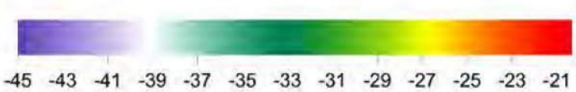


Seabed Backscatter Amplitude Extract

Proposed WR881-D Well Location
(2,008,406ft E / 9,459,608ft N)

Side scan sonar contact

Block boundaries



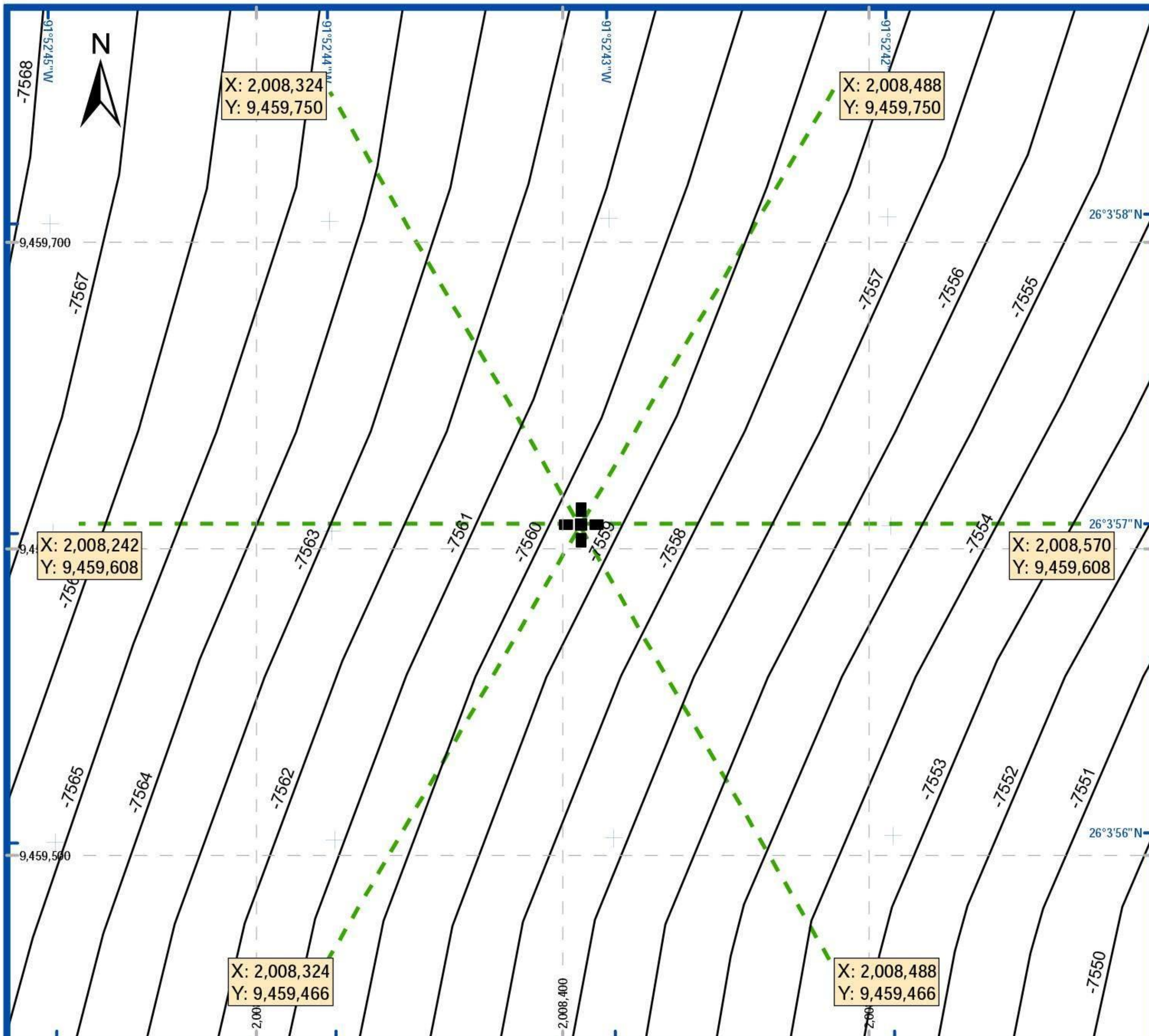
Relative Seabed Backscatter Amplitude

Chart Scale 1" = 1,000'

0 500 1,000 2,000 Feet

0 150 300 600 Meters

Figure 3
(WR881-D)



ROV Plat (WR881-D)

Proposed WR881-D Well Location
(2,008,406ft E / 9,459,608ft N)

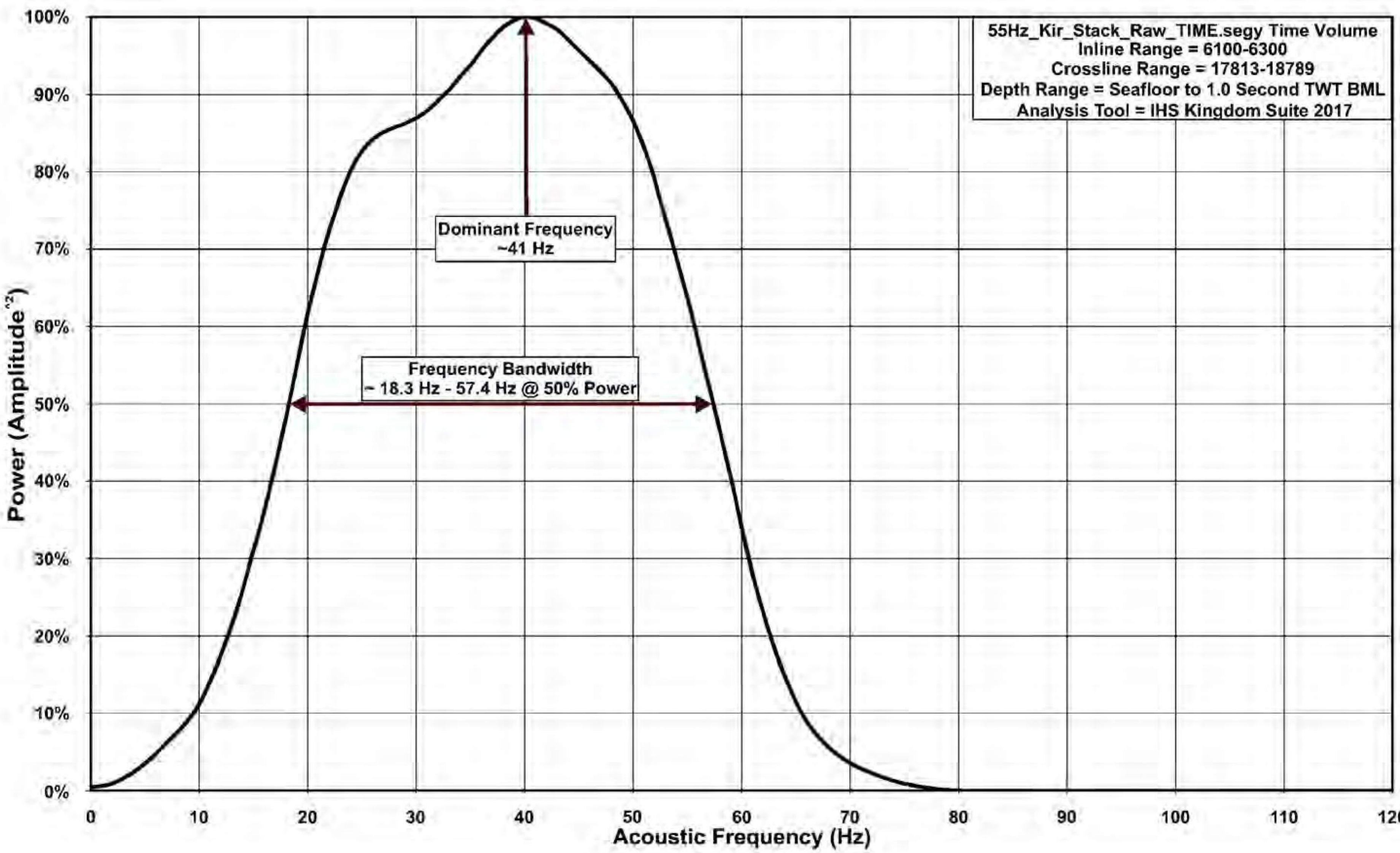
-7633 Depth in feet below sea surface to seabed, contoured at 1ft intervals

Chart Scale 1" = 50'

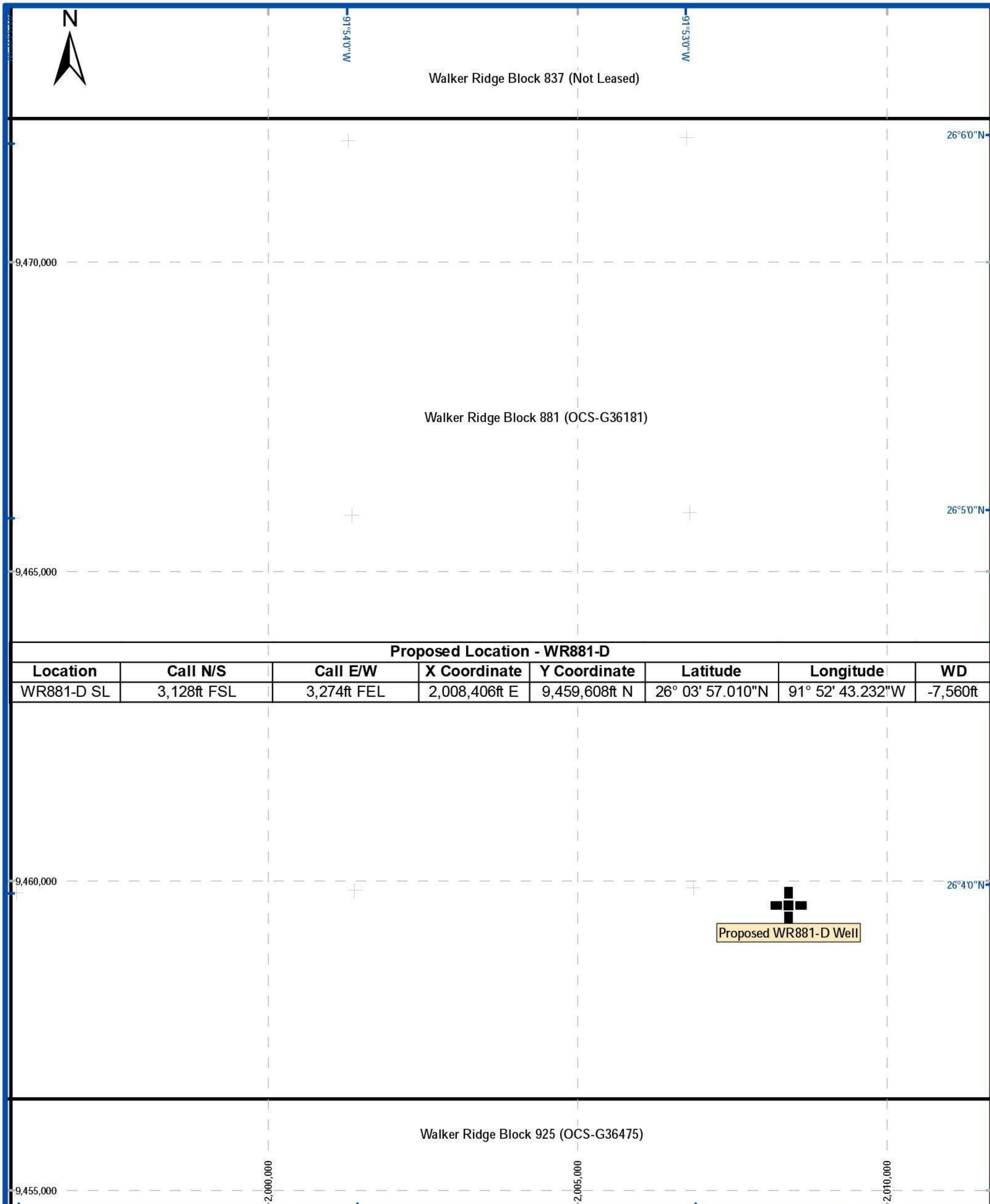
0 50 100 200 Feet

0 12.5 25 50 Meters

Figure 10
(WR881-D)



WR881-B	Power Spectrum	Figure 11



Proposed Location - WR881-D							
Location	**Call N/S**	**Call E/W**	**X Coordinate**	**Y Coordinate**	**Latitude**	**Longitude**	**WD**
WR881-D SL	3,128ft FSL	3,274ft FEL	2,008,406ft E	9,459,608ft N	26° 03' 57.010"N	91° 52' 43.232"W	-7,560ft

Chart scale 1" = 2,000'

0 500 1,000 2,000 Feet

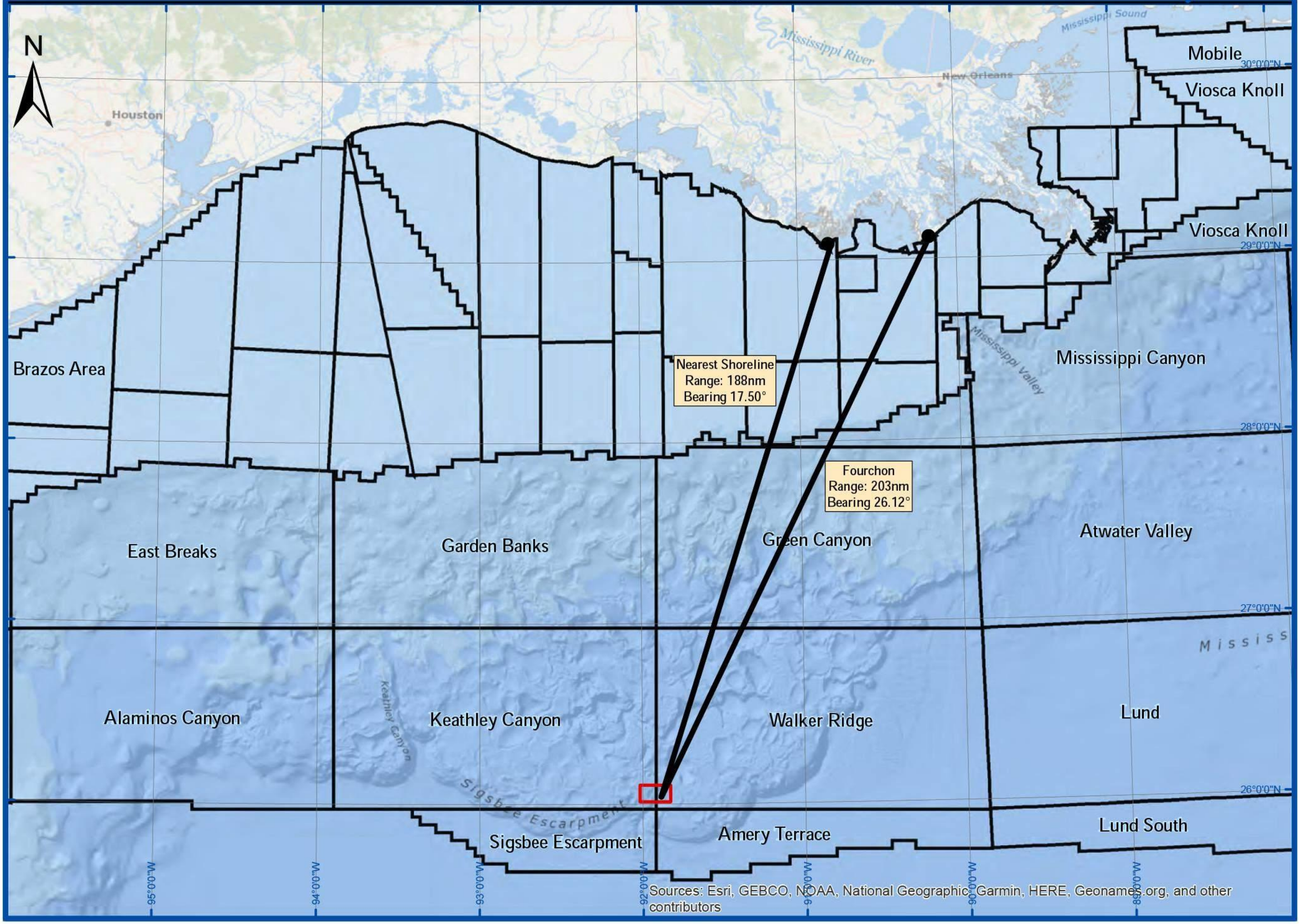
0 125 250 500 Meters

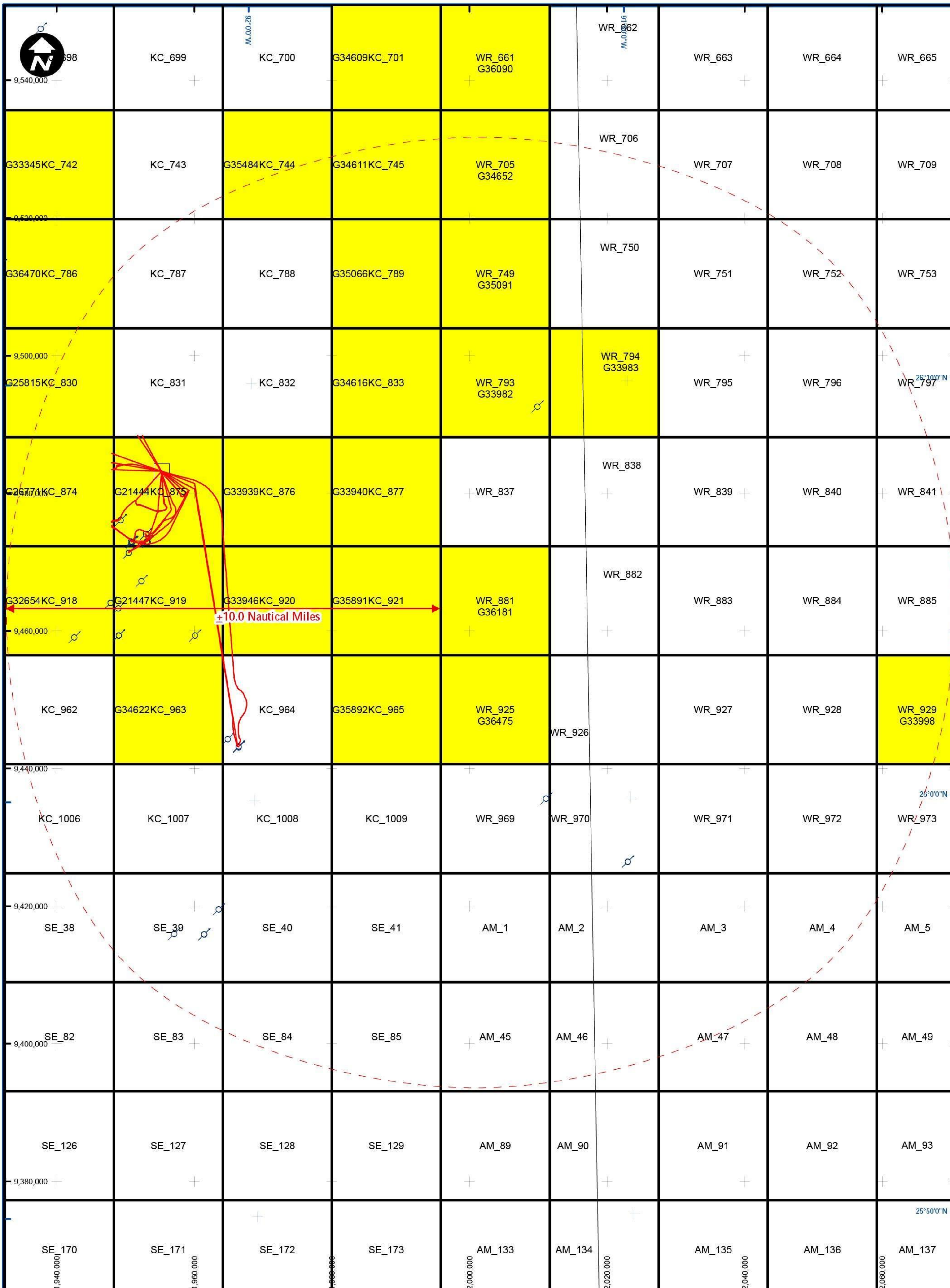
Well Location Plat - Public Information

Figure 13

Vicinity Map - Walker Ridge Block 881

Figure 15





Legend

- Seabed Well
- Platform
- Not Leased
- Leased
- Pipeline

10 MILE RADIUS SEABED INFRASTRUCTURE
WALKER RIDGE - BLOCK 881

0 5 10 Miles

1 inch = 2.5 miles

Ocean Geo Solutions

Anadarko Petroleum Corporation

March 25, 2019

Figure 16

APPENDIX A – PUBLIC SHALLOW HAZARDS STATEMENTS

Public Shallow Hazards Statement – Proposed WR881-D Location

March 25, 2019

US Department of the Interior
Bureau of Ocean Energy Management
1201 Elmwood Park Blvd.
New Orleans, LA 70213-2394

Reference: Shallow Hazards Analysis
Walker Ridge Block 881
(OCS-G 36181)

Ladies/Gentlemen:

Anadarko Petroleum Corporation contracted Ocean Geo Solutions Inc. to prepare a Well Clearance Letter for the Proposed WR881-D well location in Block 881, Walker Ridge Area (OCS-G-36181). This letter addresses seabed and shallow geologic conditions that may impact exploratory drilling operations within 2,000ft of the proposed well site. The depth limit of this site clearance assessment is Top of Salt at -10,833ft below sea surface (3,273ft below seabed).

Seabed Hazards. The proposed location exhibits a smooth seabed. Soft clays and silts are predicted at the seabed. The lithology, below the surficial sediments, is interpreted to consist of clays, silts, and occasional slightly coarser-grained interbeds. Sediments appear conducive for jetting of seabed casing with no hard layers predicted.

The proposed well is located within a mini basin occurring approximately 15,684ft to the northeast of Bryant Canyon. The proposed well is located to the north of an area with rugose seabed. The rugosity at the seabed is due to underlying salt movement. No seabed surficial failures are expected at the proposed well.

There are no anomalous seabed amplitudes indicative of hydrocarbon macroseep observed within a 2,000ft radius of the proposed location (Figure 3). Backscatter data shows relatively uniform amplitudes associated with clays and silt drape.

No seabed fluid venting areas were identified within 2,000ft of the proposed well and no sites were identified in the study area and no areas with the potential to host benthic communities occur at or within 2,000ft of the proposed well.

No existing seabed infrastructure occurs within 2,000ft of the proposed well.

The archeological assessment did identify a seabed contact within 2,000ft of the proposed well. The sonar contact (Contact 24) is located 1,178ft to the northeast. According to the archaeological report produced by Fugro, Contact 24 is described as possible modern debris with dimensions of 16.7ft x 4.2ft and less than <1.0ft in height.

No other features are observed within a 2,000ft radius that could affect well emplacement or jetting of a casing

Sub-Seabed Hazards. No identified amplitude anomalies indicative of shallow gas occur at the well-path. Several anomalies occur within the 2,000ft radius of the proposed well location within Units 2 and 4.

A **Slight Shallow Water Flow Risk** is assigned to an interval in Unit 2 and Unit 5. Some intervals with the potential to contain sands may induce minor wellbore and drilling fluid circulation problems.

The well-path will traverse two minor faults in Unit 5.

Proposed WR881-D Well Location (Surface)							
Location Coordinates							
NAD 27 Datum - Clarke 1866 Ellipsoid					UTM Zone 15 - CM 93° West		
Latitude	26°	03'	57.010"	North	Easting	2,008,406	US ft. E
Longitude	91°	52'	43.232	West	Northing	9,459,608	US ft. N
FEL Walker Ridge 881			3,274ft	US ft.	Inline	6276	
FSL Walker Ridge 881			3,128ft	US ft.	Crossline	18973	
Water Depth: -7,560ft.			Slope: 2.6° WNW				
Nearest Shoreline			188 Nautical Miles @ 17.50°				
Port of Operation Fourchon			203 Nautical Miles @ 26.12°				
Nearest Manned Platform			A-Structure A (Lucius) KC875		10.4 Nautical Miles @ 294°		

Conclusions and Recommendations. No major problems are anticipated at the seabed. No existing seabed infrastructure occurs within 2,000ft of the proposed well. Sonar contact (Contact 24) is located 1,178ft to the northeast. According to the archaeological report produced by Fugro, Contact 24 is described as possible modern debris with dimensions of 16.7ft x 4.2ft and less than <1.0ft in height.

A **Slight Shallow Water Flow Risk** is assigned within Unit 2 and also within Unit 5.

The well-path will traverse two minor faults in Unit 5.

Sincerely,
Anadarko Petroleum Corporation

APPENDIX B – Sensitive Sessile Benthic Community Statement

Sensitive Sessile Benthic Communities Statement – Proposed WR881-D Well Location

Anadarko Petroleum Corporation.

March 25, 2019

US Department of the Interior
Bureau of Ocean Energy Management
1201 Elmwood Park Blvd.
New Orleans, LA 70213

Reference: Sensitive Sessile Benthic Community Summary
Proposed WR881-D Well Location in Walker Ridge WR881 (OCS-G 36181)

Ladies/Gentlemen:

Anadarko Petroleum Corporation contracted Ocean Geo Solutions Inc. to prepare a Well Clearance Letter for the Proposed WR881-D well location in Block 881, Walker Ridge Area (OCS-G-36181). This letter addresses location proximity to potential sensitive sessile benthic community sites. This well will be drilled from a dynamically-positioned drilling module; therefore, an anchoring assessment is not required.

This sensitive sessile benthic community summary letter is issued as a supplement to the Well Clearance Letter for this proposed well. A Biological, Physical and Socio-economic Map is included illustrating the areas of potential seabed impact.

Potential Sensitive Sessile Benthic Communities

Features or areas that could support high-density sensitive sessile benthic communities are *not* located within 2,000 feet of any proposed mud and cuttings discharge location. No areas with the potential to host benthic communities were identified within the study area.

Backscatter data shows relatively uniform amplitudes associated with clays and silt drape.

The archeological assessment did identify a seabed contact within 2,000ft of the proposed well. The sonar contact (Contact 24) is located 1,178ft to the northeast. According to the archaeological report produced by Fugro, Contact 24 is described as possible modern debris with dimensions of 16.7ft x 4.2ft and less than <1.0ft in height.

Proposed WR881-D Well Location (Surface)							
Location Coordinates							
NAD 27 Datum - Clarke 1866 Ellipsoid					UTM Zone 15 - CM 93° West		
Latitude	26°	03’	57.010”	North	Easting	2,008,406	US ft. E
Longitude	91°	52’	43.232	West	Northing	9,459,608	US ft. N
FEL Walker Ridge 881	3,274ft	US ft.	Inline	6276			
FSL Walker Ridge 881	3,128ft	US ft.	Crossline	18973			
Water Depth: -7,560ft.	Slope: 2.6° WNW						
Nearest Shoreline	188 Nautical Miles @ 17.50°						
Port of Operation Fourchon	203 Nautical Miles @ 26.12°						
Nearest Manned Platform	A-Structure A (Lucius) KC875	10.4 Nautical Miles @ 294°					

There are no areas with the potential to host a Sensitive Sessile Benthic Community within 2,000ft of the proposed location.

Conclusions and Recommendations: The Proposed WR881-D Well Locations in WR881 will not impact any sites favorable for the development of sensitive sessile benthic communities.

Sincerely,
Anadarko Petroleum Corporation

Attachment C-4

Some pages omitted due to proprietary data

Well Clearance Letter for
Anadarko Petroleum Corporation

Project:
Proposed WR881-F Location
Walker Ridge Block WR881, Offshore Gulf of Mexico

Description:
3D Geohazard Assessment

Project Number:
2019-116

Report Status:
Final

Ocean Geo Solutions
8399 Westview Drive, Suite 200, Houston, 77055, USA
www.oceangeosolutions.com

REPORT AUTHORISATION AND DISTRIBUTION

Compilation	Geophysics	L Fuentes
Authorization	Geophysics	A.R.K …………………… A Haigh
	Quality Assurance	D Haigh …………………… D Haigh

Revision	**Date**	**Title**
0	February 7, 2019	Draft
1	February 11, 2019	2nd Draft
2	March 25, 2019	Final

Distribution

4 copies

Anadarko Petroleum Corporation
1201 Lake Robbins Drive
The Woodlands, TX 77380

For the attention of:
Trey Kramer

SERVICE WARRANTY

USE OF THIS REPORT

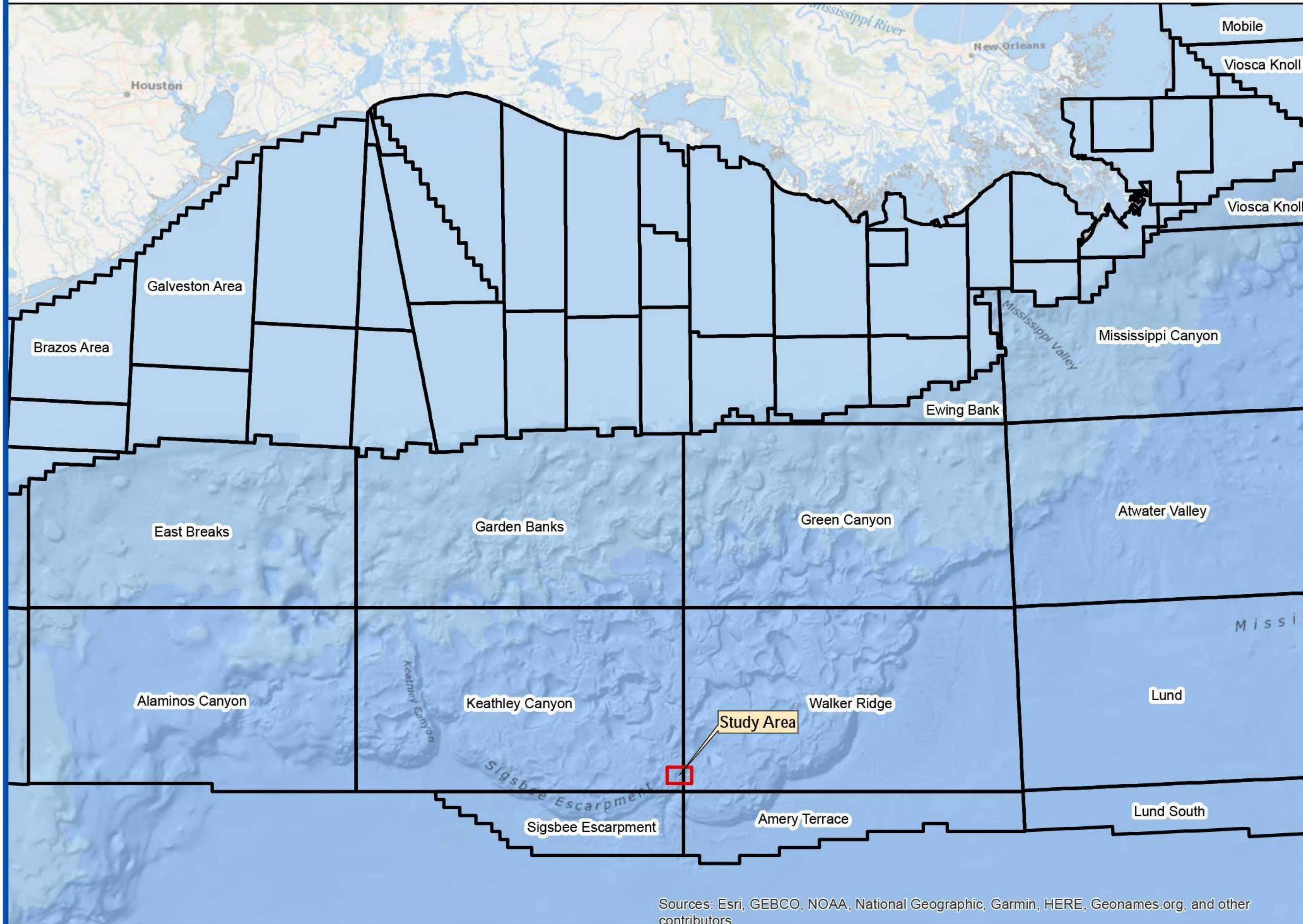
This report has been prepared with due care, diligence and with the skill reasonably expected of a reputable contractor experienced in the types of work, carried out under the contract. As such, the findings in this report are based on an interpretation of data which is a matter of opinion on which professionals may differ and, unless clearly stated, is not a recommendation of any course of action.

Ocean Geo Solutions, Inc. has prepared this report for the client identified on the front cover in fulfillment of its contractual obligations under the referenced contract, and the only liabilities Ocean Geo Solutions, Inc. will accept are those contained therein.

Please be aware that further distribution of this report, in whole or part, or the use of the data for a purpose not expressly stated within the contractual work scope is at the client's sole risk, and Ocean Geo Solutions, Inc recommends that this disclaimer is included in any such distribution.

OCEAN GEO SOLUTIONS, INC
8399 Westview Dr, Suite 200, Houston, Texas 77055, USA
Telephone 713 481 4630 Fax 713 464 8275
www.oceangeosolutions.com

Location Map



Sources: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributors

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LIST OF FIGURES

WELL CLEARANCE LETTER – PROPOSED WR881-F WELL LOCATION

March 25, 2019
Anadarko Petroleum Corporation
1201 Lake Robbins Drive,
The Woodlands
Texas, 77380

Attention: **Trey Kramer**

Well Clearance Letter
Proposed WR881-F Well Location
Walker Ridge Block WR881
Offshore Gulf of Mexico

Ocean Geo Solutions Inc. was contracted by Anadarko Petroleum Corporation to prepare a Well Clearance Letter for the proposed WR881-F Well Location in Block 881, Walker Ridge Area (OCS-G- 36181). This assessment addresses seafloor and shallow geologic conditions that may impact drilling operations within 2,000ft of the proposed well site. The depth limit of this geohazard assessment is Horizon H40 at -12,451ft below sea surface (4,729ft below seabed). We understand that Anadarko Petroleum Corporation plans to drill the proposed development well from a dynamically positioned drillship; therefore, an anchoring assessment was not requested. Relevant letter-size chart extracts, data examples, and a Top Hole Prognosis are presented with this Well Clearance Letter.

This well site assessment incorporates 3D seismic data and high –resolution autonomous underwater vehicle (AUV)-acquired multibeam, side scan sonar, and sub-bottom profiler data. The regional 3D seismic data was interpreted by Fugro and the multibeam, side scan sonar, and sub-bottom profiler data was acquired by Fugro.

3D Geophysical Survey. Anadarko Petroleum Corporation provided the 3D dataset to Ocean Geo Solutions Inc. on tape media in SEG-Y format for loading onto a Seismic Micro-Technology (SMT) workstation. The 3D data cube contains a survey with 10 feet sample rate data to a record length of 15,000ft below the sea surface. Inlines are oriented northeast to southwest have a numerical increment of one, and exhibit a line spacing of 98.4213ft. Crosslines are oriented northwest to southeast, have a numerical increment of four, and exhibit a line spacing of 82.0212ft.

- Acquired by CGG, March 2018.
- Lucius DCS WAZ TTI PSDM Re-Imaged, 55Hz Kirchoff Stack
- Processing Flow:
- Anti-aliasing
- Resample to 6ms
- Sailline Denoise
- Debubble
- 3D FP Deghost
- Designautre and Datum correction
- SRME Q correction

- DC WAZ Data Regularize 55Hz Kirchhoff Migration
- Diverge Z power 1.

The data was spectrally whitened with IHS Kingdom for the purpose of frequency enhancement. Data exhibits a good frequency response across the upper second below the seabed, with an effective frequency range of 18 - 56Hz at 50% power (Figure 11). The data exhibits a dominant frequency in the upper second of approximately 41Hz, resulting in a mean vertical resolvability of typically 34ft and a layer detectability of 6ft. The data is considered good to excellent quality.

In summary and with reference to NTL No. 2008-G04:

a) The data provides imaging of sufficient resolution of the shallow section allowing a clear analysis of the shallow conditions.
b) The data can be loaded to a workstation at 16-bit resolution or greater and is unscaled.
c) There is no trace or sample decimation.
d) The sample interval and bin size are maintained throughout the assessment area.
e) The data possess a frequency content of 50Hz or higher at 50% power in the first second below the seabed.
f) Seabed reflection is free of gaps and is defined by a wavelet of stable shape and phase, allowing auto-tracking of the seabed event with minimum user intervention and guidance.
g) There are no significant acquisition artifacts throughout the dataset.
h) Merge points in the data are marked by no time shifts and very minimal amplitude changes, and are not a detriment to interpretation.
i) Processed bin sizes are 98.4213ft x 82.0212ft
j) The sample rate of the data is 10 feet sample rate data.
k) An accurate velocity model has been utilized in the shallow section allowing optimum structural and stratigraphy resolution with no evidence of under- or over-migration.
l) There is no significant multiple energy.

The proposed activities are not within an area defined by BOEM as having high archaeological potential (see NTL No. 2011-JOINT-G-01). An archeological assessment within the Magnus Prospect Blocks KC920, 921, and 965 of the Keathley Canyon Area and Blocks 881 and 925 of the Walker Ridge Area, Gulf of Mexico was performed by Fugro USA Marine, Inc. in February 2018.

1. LOCATION COORDINATES

1.1 Proposed WR881-F Well Location

Proposed WR881-F Well Location (Surface)							
Location Coordinates							
NAD 27 Datum - Clarke 1866 Ellipsoid					UTM Zone 15 - CM 93° West		
Latitude	26°	04'	08.259"	North	Easting	2,000,822	US ft. E
Longitude	91°	54'	06.310	West	Northing	9,460,679	US ft. N
FWL Walker Ridge 881	4,982ft	US ft.	Inline	6213			
FSL Walker Ridge 881	4,199ft	US ft.	Crossline	18749			
Water Depth: -7,722ft.	Slope: 1.9° South						
Nearest Shoreline	188 Nautical Miles @ 17.50°						
Port of Operation Fourchon	203 Nautical Miles @ 26.12°						
Nearest Manned Platform	A-Structure (Lucius) KC875	9.0 Nautical Miles @ 297°					

Proposed WR881-FF Well Location (Surface)							
Location Coordinates							
NAD 27 Datum - Clarke 1866 Ellipsoid					UTM Zone 15 - CM 93° West		
Latitude	26°	04'	07.526"	North	Easting	2,000,785	US ft. E
Longitude	91°	54'	06.726	West	Northing	9,460,604	US ft. N
FWL Walker Ridge 881	4,945ft	US ft.	Inline	6214			
FSL Walker Ridge 881	4,124ft	US ft.	Crossline	18745			
Water Depth: -7,725ft.	Slope: 2.3° SE						
Nearest Shoreline	188 Nautical Miles @ 17.50°						
Port of Operation Fourchon	203 Nautical Miles @ 26.12°						
Nearest Manned Platform	A-Structure (Lucius) KC875	9.0 Nautical Miles @ 297°					

Location WR881-FF is 82ft from WR881-F on a bearing of 27°. Contact 25 explained in more detailed in the following section is located 1,465ft to the west. Geological conditions at seabed and sub-seabed will be similar to those encountered at the proposed WR881-F. Two intervals one within Unit 2 and another one within Unit 3 have the possibility for a **Slight Risk of Gas**. Three intervals within Unit 2, Unit 3, and Unit 4 have the possibility to encounter a **Slight Shallow Water Flow Risk**. Several intervals may have several sand interbeds and may cause minor wellbore and drilling fluid circulation problems.

2. VELOCITY DATA

2.1 Seabed Depth

3D Seismic Data was provided in depth; therefore no depth conversion was required. Additionally, AUV-multibeam depth was acquired by Fugro.

2.1 Sub-seabed Depth

3D Seismic Data was provided in depth; therefore no depth conversion was required to convert mapped horizons.

3. SEABED CONDITIONS

3.1 Seabed Depth

Seabed depth at the proposed well location is -7,722ft below the sea surface (Figure 1). The seafloor gradient at the proposed well is 1.9° to the south.

3.2 Seafloor Morphology and Man-Made Features

The proposed WR881-F well location is in the southwest of Block WR881. At the proposed well location, the seabed is smooth (Figure 2). Soft clays and silts are predicted at the seabed. The lithology, below the surficial sediments, is interpreted to consist of clays, silts, and several slightly coarser-grained interbeds. Sediments appear conducive for jetting of seabed casing with no hard layers predicted.

The proposed well is located within a mini basin occurring approximately 7,750ft to the east of Bryant Canyon. The seabed morphology at the edges of Bryant Canyon is rugose with high-gradients and numerous surficial failures. The proposed well is located in the outer limits of surficial stability on the flanks of the Bryant Canyon. The failures are present approximately 3,783ft to the northwest and the northwest part of the 2.000ft radius presents some indications of early stage instability. However, it is considered that the proposed location is far enough from this area not to be affected by any immediate instability.

There are no anomalous seabed amplitudes indicative of hydrocarbon macroseep observed within a 2,000ft radius of the proposed location (Figure 3). Backscatter data shows relatively uniform amplitudes associated with clays and silt drape. No seabed fluid venting areas were identified within 2,000ft of the proposed well and no sites were identified in the study area. Several areas exhibiting over consolidated seabed were identified. The nearest area with over consolidated seabed is located 8,647ft to the northwest of the proposed well.

No existing seabed infrastructure occurs within 2,000ft of the proposed well.

The archeological assessment did not identify any seabed contacts within 2,000ft of the proposed well. The nearest sonar contact (Contact 25) is located 3,149ft to the SSE. According to the archaeological report produced by Fugro, Contact 25 is described as possible modern debris with a width of 4.3ft, <1.0ft in height, and 8.4ft in length. Contact 26 is located 3,167ft to the east. This contact is also described as possible modern debris with a width of 4.3ft, <1.0ft in height, and 12.5ft in length.

No other features are observed within a 2,000ft radius that could affect well emplacement or jetting of a casing.

4. SUB-SEABED CONDITIONS

4.1 Ocean Geo Solutions Hazard Classification Scheme

4.1.1 Shallow Gas Classification

Shallow gas detection is normally made in the first instance by recognition of anomalously high amplitude ('bright' spots). This parameter allied to a number of other characteristics, such as acoustic masking, underlying velocity pulldown, structural closure, edge effects, frequency reduction, and basal 'flat' spots are indicative of shallow gas accumulations. High amplitude polarity-reversed reflectors are particularly relevant to shallow gasified sands, particularly within the topmost kilometer of sediments below the seabed. The quantitative degree of these gas risks is further detailed as:

High Risk of Gas –Anomalously high amplitudes coupled with multiple other well-defined subsidiary indicators, such as acoustic masking, velocity pulldown, structural closure, phase reversal, frequency reduction, etc. Predicted Gas Risk considered *probable*.

Moderate Risk of Gas –Anomalously high amplitudes coupled with two other well-defined subsidiary indicators, such as acoustic masking, velocity pulldown, structural closure, phase reversal, frequency reduction, etc. Predicted Gas Risk considered *likely*.

Slight Risk of Gas –Anomalously high amplitudes coupled with one to two other well-defined subsidiary indicators, or very high amplitude alone. Predicted Gas Risk considered *possible*.

4.1.2 Shallow Water Flow Classification

High Shallow Water Flow Risk –Potential sand-prone interval, overlain by a well-defined seal with significant rapidly-deposited overburden, together with a tie to a known Shallow Water Flow zone in a nearby well. Shallow Water Flow considered *probable*.

Moderate Shallow Water Flow Risk–A potential sand-prone interval, overlain by a well-defined clay seal with significant rapidly deposited overburden. Shallow Water Flow considered *likely*.

Slight Shallow Water Flow Risk –Possible sand-prone interval, overlain by a poor or breached seal, or slowly deposited overburden. Or a moderate or high-risk type deposit, where a nearby well has disproved the flow zone. Shallow Water Flow considered unlikely but still *possible*.

4.2 Geology and Lithology

The sub-seabed geology has been divided into four units, Units 1, 2, 3, and 4. These are separated by Horizons H10, H20, H30, and H40 (Figures 5 through 9).

4.3 Unit 1

The lithology within the upper part of Unit 1 from the seabed to approximately 50ft below seabed of sediments are interpreted as probably soft clays and silts as shown on the Seismic Profiler Data Example (Figure 6). From -7,772ft to -7,884ft below sea surface (50ft to 162ft below seabed) is characterized by well-layered and low and slightly moderate-amplitude reflectors interpreted as clays, silts, with occasional minor slightly coarser-grained interbeds.

From -7,884ft to -8,054ft below sea surface (162ft to 332ft below seabed) presents as slightly chaotic and well-layered, low-amplitude reflectors interpreted as low energy channel infill or mass-transport deposits of clays and silts.

The lower part of Unit A from -8,054ft to -8,455ft below sea surface (332ft to 733ft below seabed) is characterized by well-layered, low-amplitude reflectors interpreted as clays and silts.

No gas hazards or shallow water flow risks are interpreted within Unit 1 at the wellbore or within 2,000ft. The nearest risk of gas anomaly is located 4,623ft to the northwest.

Horizon H10 marks the base of this unit at -8,455ft below sea surface (733ft below seabed). Horizon H10 presents some character indicative of a minor thin sand interbed.

4.4 Unit 2

The upper part of Unit 2 from -8,455ft to -8,560ft below sea surface (733ft to 838ft below seabed) consists of slightly-chaotic, low amplitude reflectors interpreted as clays and silts with occasional sand interbeds.

From -8,560ft to -8,685ft below sea surface (838ft to 963ft below seabed) is characterized by moderate-amplitude reflectors interpreted as clays, silts, and several sands. The well-path will not traverse any clearly identified risk of gas hazards within this interval, however, at the base of the interval a sheet sand is interpreted that presents significantly increased amplitudes, but no other indication of shallow gas. Given this character, a **Slight Risk of Gas** and a **Slight Shallow Water Flow Risk** is assigned.

From -8,685ft to -8,980ft below sea surface (963ft to 1,258ft below seabed) slightly-chaotic, low amplitude reflectors interpreted as clays and silts with occasional sands.

From -8,980ft to -9,183ft below sea surface (1,258ft to 1,461ft below seabed) a slightly higher energy section with low to moderate amplitude reflectors are observed and these are interpreted to consist of well-layered clays, silts, and several sands. Due to the slight possibility of minor coarser poorly consolidated interbeds some minor wellbore stability and drilling fluid circulation problems may occur within this interval.

The lower interval from -9,183ft to -9,470ft below sea surface (1,461ft to 1,748ft below seabed) is characterized by well-layered, low-amplitude and slightly-moderate amplitudes reflectors character expected to comprise clays, silts, and occasional minor sands.

The well-path will not intersect any major faults within Unit 2.

Horizon H20 marks the base of this unit at –9,470ft below sea surface (1,748ft below seabed).

4.5 Unit 3

The upper part of Unit 3 from -9,470ft to -9,591ft below sea surface (1,748ft to 1,869ft below seabed) presents as slightly-chaotic, low and -moderate-amplitude reflectors interpreted to consist of slightly-channelized deposits with clays, silts, and several sands. Due to the possibility of encountering possibly poorly consolidated sands within this upper interval, minor wellbore stability and drilling fluid circulation problems are considered possible.

From -9,591ft to -9,842ft below sea surface (1,869ft to 2,120ft below seabed) presents as well-layered and slightly-chaotic, low and moderate-amplitude reflectors interpreted as clays, silts, and several sands. The interbeds within this interval have been tilted, with the potential for any fluid if present within the deeper parts of the mini-basin may migrate upslope along these underlying interbeds and become ponded in this interval of Unit 3. Minor sand interbeds are interpreted at the top and base of this interval and if fluid is migrating up the underlying tilted interbeds it could have become ponded in these interbeds. Given this setting and the slightly elevated amplitude response of the possible sands at the top and base of the interval, a **Slight Risk of Gas** is interpreted. Additionally, due to the underlying tilted interbeds with the potential to transmit deeper mini basin pressures into this section (if pore connectivity exists) a **Slight Shallow Water Flow Risk** is assigned.

The stratigraphy from -9,842ft to -10,546ft below sea surface (2,120ft to 2,824ft below seabed) is characterized by tilted, well-layered low-amplitude reflectors interpreted as clays and silts.

From -10,546ft to -10,971ft below sea surface (2,824ft to 3,249ft below seabed) the stratigraphy presents as well-layered, low and moderate-amplitude reflectors interpreted to comprise clays, silts, and several sands. Minor wellbore stability and drilling fluid circulation problems may occur within this interval.

The lower interval from -10,971ft to -11,327ft below sea surface (3,249ft to 3,605ft below seabed) the stratigraphy is interpreted to consist of well-layered, low and moderate-amplitude reflectors, highly faulted, with clays, silts, and several sands. The interbeds in the deeper parts of the mini-basin show an increase in amplitude with the potential to contain small amounts of fluid. Given that these interbeds are tilted and the well-path will traverse these interbeds up-dip with possible pore pressure connectivity to the deeper part of the mini-basin there is the possibility that fluid may migrate upslope to the well-path location and a **Slight Shallow Water Flow Risk** is assigned. Due to the possibility for more porous sandy sediments in this interval, minor drilling fluid circulation and wellbore stability problems may occur.

No anomalies indicative of shallow gas are present within the deeper part of this interval. The nearest risk of gas at these depths is located 371ft to the southeast. This is a sand lens with the potential of shallow gas, however, this anomaly occurs upslope from the well-path and is not connected.

The well-path will intersect a fault at -11,055ft below sea surface (3,333ft below seabed). Minor wellbore stability and drilling fluid circulation problems may occur at the level of the fault.

Horizon H30 marks the base of this unit at –11,327ft below sea surface (3,605ft below seabed).

4.6 Unit 4

The upper part of Unit 4 from -11,327ft to -11,786ft below sea surface (3,605ft to 4,064ft below seabed presents as well-layered, low and moderate-amplitude reflectors interpreted to contain clays and silts with several sands. Minor wellbore stability and drilling fluid circulation problems are considered possible.

The lower interval from -11,786ft to -12,451ft below sea surface (4,064ft to 4,729ft below seabed) is characterized by well-layered, low-amplitude reflectors interpreted as clays and silts.

The well-path will not intersect any faults within Unit 4.

Horizon H40 marks the base of this unit and the base of this interpretation at –12,451ft below sea surface (4,729ft below seabed).

4.7 Shallow Gas Assessment

Within Unit 2 a **Slight Risk of Gas** is assigned from -8,560ft to -8,685ft below sea surface (838ft to 963ft below seabed).

Within Unit 3 a **Slight Risk of Gas** is assigned from -9,591ft to -9,842ft below sea surface (1,869ft to 2,120ft below seabed).

4.8 Shallow Water Flow Assessment

Within Unit 2 a **Slight Shallow Water Flow Risk** is assigned from -8,560ft to -8,685ft below sea surface (838ft to 963ft below seabed).

Within Unit 3 a **Slight Shallow Water Flow Risk** is assigned from -9,591ft to -9,842ft below sea surface (1,869ft to 2,120ft below seabed) and from -10,971ft to -11,327ft below sea surface (3,249ft to 3,605ft below seabed).

5. CONCLUSIONS AND RECOMMENDATIONS

- Seabed

No major drilling hazards or problems are interpreted.

- Unit 1

No major drilling hazards or problems are interpreted.

- Unit 2

Within Unit 2 a **Slight Risk of Gas** and a **Slight Shallow Water Flow Risk** is assigned from -8,560ft to -8,685ft below sea surface (838ft to 963ft below seabed). Drilling Caution is advised, and appropriate drilling methodology is recommended to deal with a possible short-lived non-persistent water flow event.

Minor wellbore stability and drilling fluid circulation problems are possible within the interval from -8,560ft to -8,685ft below sea surface (840ft to 963ft below seabed) and from -8,980ft to -9,183ft below sea surface (1,258ft to 1,461ft below seabed).

- Unit 3

Within Unit 3 a **Slight Risk of Gas** and a **Slight Shallow Water Flow Risk** is assigned from -9,591ft to -9,842ft below sea surface (1,869ft to 2,120ft below seabed). Drilling Caution is advised, and appropriate drilling methodology is recommended to deal with a possible short-lived non-persistent water flow event.

Within Unit 3 a **Slight Shallow Water Flow Risk** is assigned from -10,971ft to -11,327ft below sea surface (3,249ft to 3,605ft below seabed). Appropriate drilling methodology is recommended to deal with a possible short-lived non-persistent water flow event.

Minor wellbore stability and drilling fluid circulation problems are possible within the interval from -9,470ft to -9,842ft below sea surface (1,748ft to 2,120ft below seabed) and from -10,546ft to -11,327ft below sea surface (2,824ft to 3,605ft below seabed).

The well-path will intersect a fault at -11,055ft below sea surface (3,333ft below seabed). Minor wellbore and drilling fluid circulation problems may occur at the level of the fault. Casing seats should avoid all fault intersections.

- Unit 4

Minor wellbore stability and drilling fluid circulation problems are possible within the interval from -11,327ft to -11,786ft below sea surface (3,605ft to 4,064ft below seabed).

We appreciate the opportunity to work with you on this project and look forward to continuing as your geohazards consultants. Please contact us if you have any questions or if we can be of further assistance.

Sincerely,
Ocean Geo Solutions Inc.

Andrew Haigh	Denise Haigh
Geophysical Manager	Quality Assurance

Copies Submitted: 4 copies to Trey Kramer at Anadarko Petroleum Corporation

Attachments:

Proposed WR881-F Well Location

Seabed Depth Extract

Seabed Morphology Extract

Seabed Amplitude Extract

Geohazard Summary Extract

Side Scan Sonar Data Example

Seismic Profiler Data Example

Inline Data Example

Crossline Data Example

Top Hole Prognosis

ROV Plat

Power Spectrum

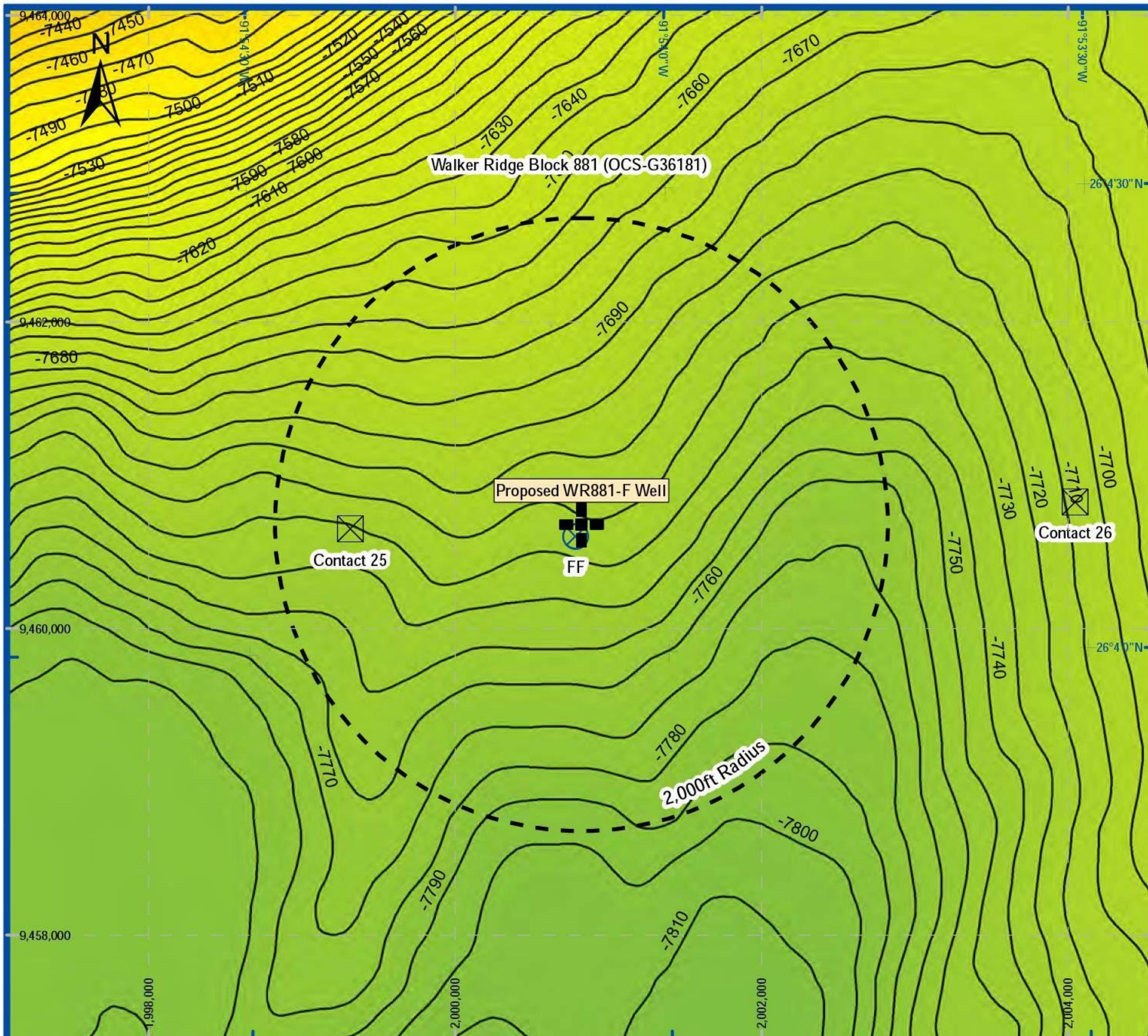
Bathymetry Plat

Public Information Plat

Proprietary Information Plat

Vicinity Plat

10-Mile Radius Plat



Seabed Depth Extract

Proposed WR881-F Well Location
(2,000,822ft E / 9,460,679ft N)

Proposed FF Well Location

Side scan sonar contact

-7722 Depth in feet below sea surface to seabed, contoured at 10ft intervals

-8800 -8600 -8400 -8200 -8000 -7800 -7600 -7400 -7200

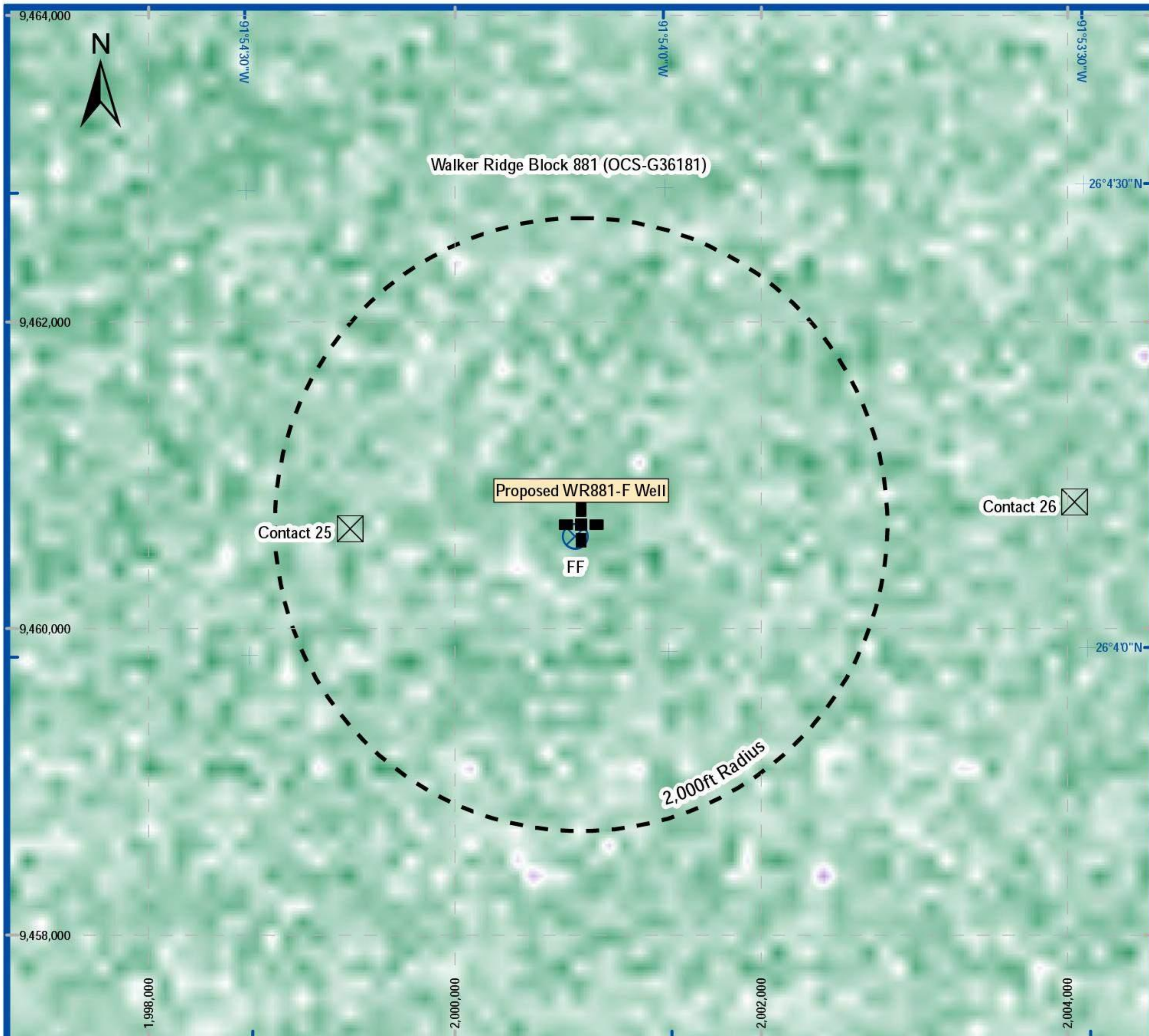
Seabed Depth (Feet)

Chart Scale 1" = 1,000'

0 500 1,000 2,000 Feet

0 150 300 600 Meters

Figure 1
(WR881-F)



Seabed Backscatter Amplitude Extract

Proposed WR881-F Well Location (2,000,822ft E / 9,460,679ft N)

Proposed FF Well Location

Side scan sonar contact

-45 -43 -41 -39 -37 -35 -33 -31 -29 -27 -25 -23 -21

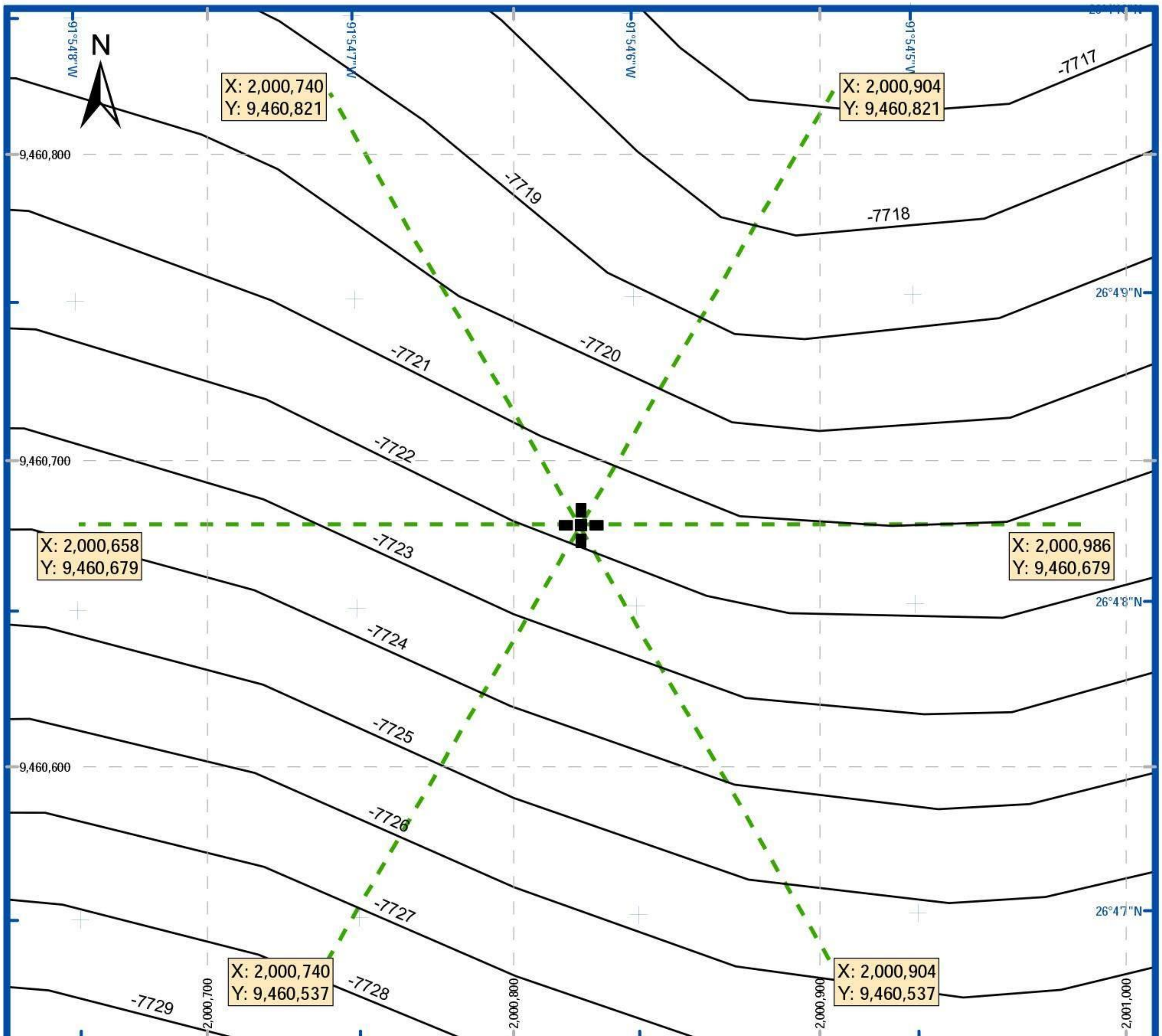
Relative Seabed Backscattered Amplitude

Chart Scale 1" = 1,000'

0 500 1,000 2,000 Feet

0 150 300 600 Meters

Figure 3 (WR881-F)



ROV Plat (WR881-F)

Proposed WR881-F Well Location
(2,000,822ft E / 9,460,679ft N)

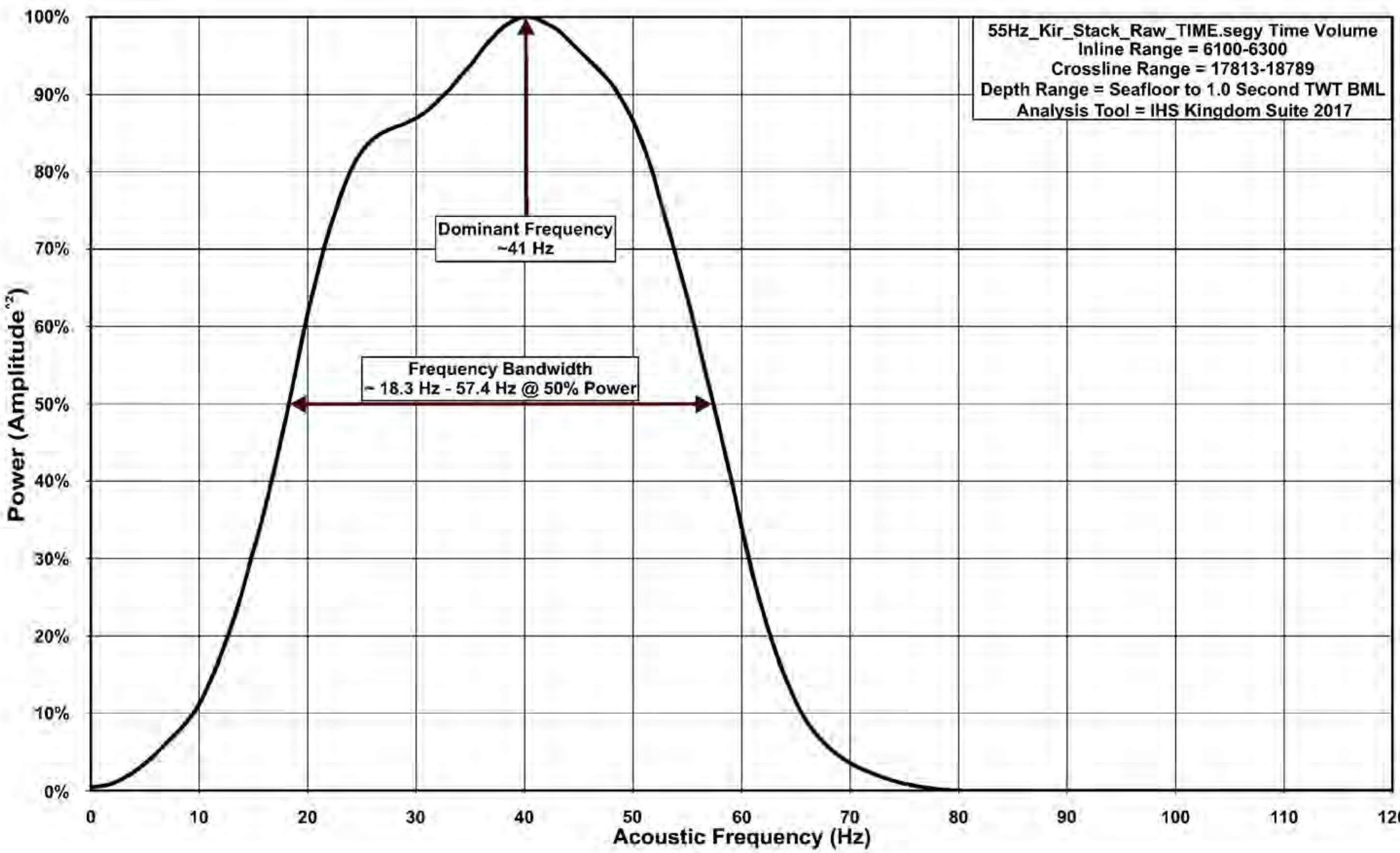
-7722 Depth in feet below sea surface to seabed, contoured at 1ft intervals

Chart Scale 1" = 50'

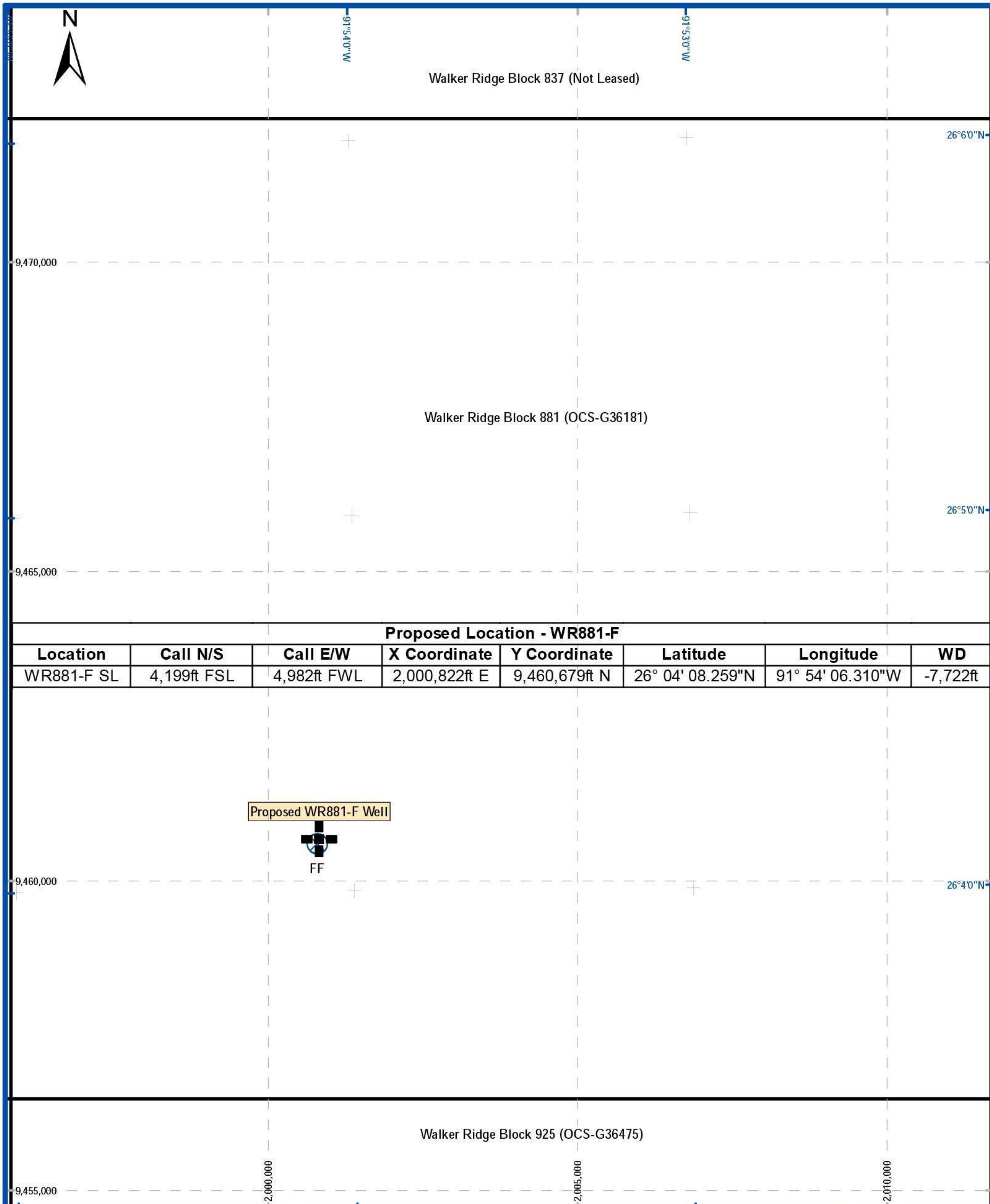
0 50 100 200 Feet

0 12.5 25 50 Meters

Figure 10
(WR881-F)



WR881-F	Power Spectrum	Figure 11



Proposed Location - WR881-F

Location	Call N/S	Call E/W	X Coordinate	Y Coordinate	Latitude	Longitude	WD
WR881-F SL	4,199ft FSL	4,982ft FWL	2,000,822ft E	9,460,679ft N	26° 04' 08.259"N	91° 54' 06.310"W	-7,722ft

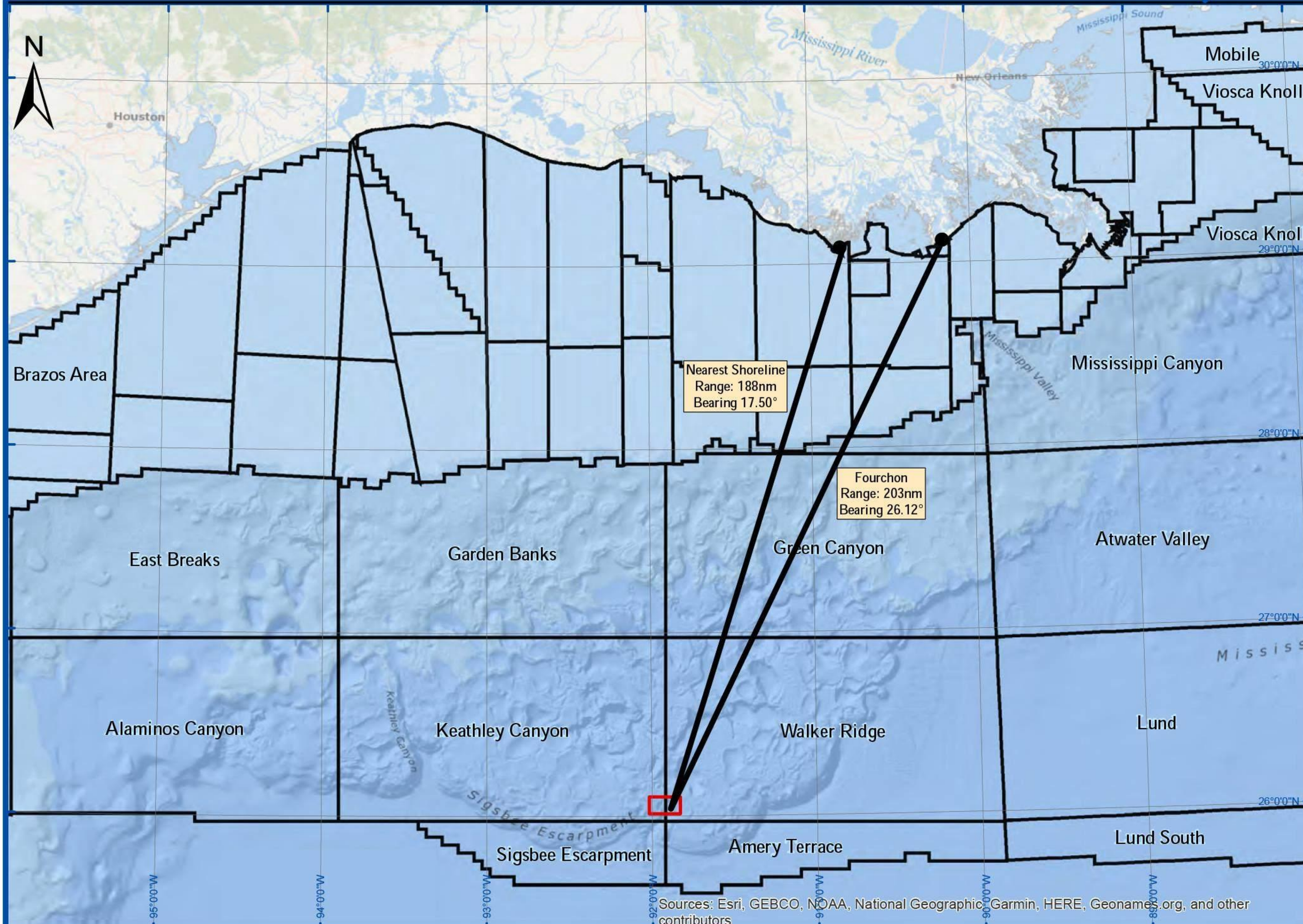
Chart scale 1" = 2,000'
0 500 1,000 2,000 Feet
0 125 250 500 Meters

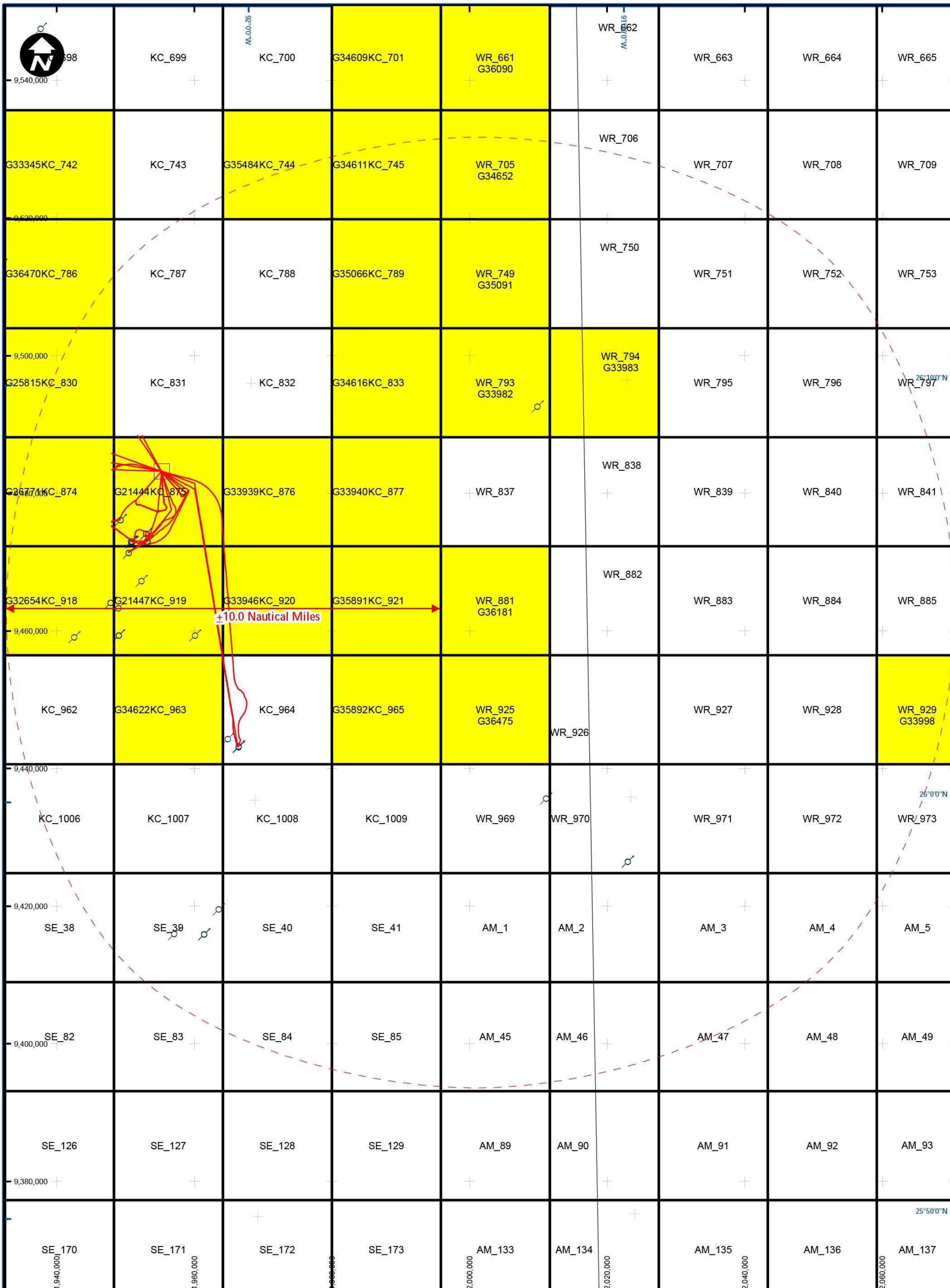
Well Location Plat - Public Information

Figure 13

Vicinity Map - Walker Ridge Block 881

Figure 15





Legend

- Seabed Well
- Platform
- Not Leased
- Leased
- Pipeline

10 MILE RADIUS SEABED INFRASTRUCTURE
WALKER RIDGE - BLOCK 881

0 5 10 Miles

1 inch = 2.5 miles

Ocean Geo Solutions

Anadarko Petroleum Corporation

March 25, 2019

Figure 16

APPENDIX A – PUBLIC SHALLOW HAZARDS STATEMENTS

Ocean Geo Solutions

Public Shallow Hazards Statement – Proposed WR881-F Location

March 25, 2019

US Department of the Interior
Bureau of Ocean Energy Management
1201 Elmwood Park Blvd.
New Orleans, LA 70213-2394

Reference: Shallow Hazards Analysis
Walker Ridge Block 881
(OCS-G 36181)

Ladies/Gentlemen:

Anadarko Petroleum Corporation contracted Ocean Geo Solutions Inc. to prepare a Well Clearance Letter for the Proposed WR881-F well location in Block 881, Walker Ridge Area (OCS-G-36181). This letter addresses seabed and shallow geologic conditions that may impact exploratory drilling operations within 2,000ft of the proposed well site. The depth limit of this site clearance assessment is Horizon H40 at -12,451ft below sea surface (4,729ft below seabed)

Seabed Hazards. The proposed location exhibits a smooth seabed. The proposed well is in the southern edge of a slump lobe. The slump deposits derived from a ridge approximately 3,783ft to the northwest and the slump deposits at the seabed occupy approximately 2.2 square miles. The northwest part of the 2.000ft radius is located in the deposited slump deposits. We do not expect any problems associated with this feature as the proposed well is in the outermost limits of the slump lobe deposits area.

There are no anomalous seabed amplitudes indicative of hydrocarbon macroseep observed within a 2,000ft radius of the proposed location. Backscatter data shows relatively uniform amplitudes associated with clays and silt drape. No seabed fluid venting areas were identified within 2,000ft of the proposed well and no sites were identified in the study area. Several areas exhibiting over consolidated seabed were identified. The nearest area with over consolidated seabed is located 8,647ft to the northwest of the proposed well.

No existing seabed infrastructure occurs within 2,000ft of the proposed well.

The archeological assessment did not identify any seabed contacts within 2,000ft of the proposed well. The nearest sonar contact (Contact 25) is located 3,149ft to the SSE. According to the Archaeological report produced by Fugro, Contact 25 is described as possible modern debris with a width of 4.3ft, <1.0ft in height, and 8.4ft in length. Contact 26 is located 3,167ft to the east. This contact is also described as possible modern debris with a width of 4.3ft, <1.0ft in height, and 12.5ft in length.

Sub-Seabed Hazards. No identified amplitude anomalies indicative of shallow gas occur at the well-path. Several anomalies occur within the 2,000ft radius of the proposed well location within Units 2 and 3. An interval within Unit 2 has been assigned a **Slight Risk of Gas**. Another interval in Unit 3 has been assigned a **Slight Risk of Gas**.

A **Slight Shallow Water Flow Risk** is assigned to an interval Unit 2 and two intervals in Unit 3 due to the presence of slightly tilted interbeds and the possibility that fluid may migrate upslope along these tilted interbeds to the borehole. Some intervals with the potential to contain sands may induce minor wellbore and drilling fluid circulation problems.

The well-path will traverse a fault in the lower section of Unit 3.

Proposed WR881-F Well Location (Surface)							
Location Coordinates							
NAD 27 Datum - Clarke 1866 Ellipsoid				UTM Zone 15 - CM 93° West			
Latitude	26°	04’	08.259”	North	Easting	2,000,822	US ft. E
Longitude	91°	54’	06.310	West	Northing	9,460,679	US ft. N
FWL Walker Ridge 881	4,982ft	US ft.	Inline	6213			
FSL Walker Ridge 881	4,199ft	US ft.	Crossline	18749			
Water Depth: -7,722ft.	Slope: 1.9° South						
Nearest Shoreline	188 Nautical Miles @ 17.50°						
Port of Operation Fourchon	203 Nautical Miles @ 26.12°						
Nearest Manned Platform	A-Structure (Lucius) KC875	9.0 Nautical Miles @ 297°					

Proposed WR881-FF Well Location (Surface)							
Location Coordinates							
NAD 27 Datum - Clarke 1866 Ellipsoid				UTM Zone 15 - CM 93° West			
Latitude	26°	04’	07.526”	North	Easting	2,000,785	US ft. E
Longitude	91°	54’	06.726	West	Northing	9,460,604	US ft. N
FWL Walker Ridge 881	4,945ft	US ft.	Inline	6214			
FSL Walker Ridge 881	4,124ft	US ft.	Crossline	18745			
Water Depth: -7,725ft.	Slope: 2.3° SE						
Nearest Shoreline	188 Nautical Miles @ 17.50°						
Port of Operation Fourchon	203 Nautical Miles @ 26.12°						
Nearest Manned Platform	A-Structure (Lucius) KC875	9.0 Nautical Miles @ 297°					

Conclusions and Recommendations. No major problems are anticipated at the seabed. No existing seabed infrastructure occurs within 2,000ft of the proposed well. The nearest sonar contact (Contact 25) is located 3,149ft to the SSE. According to the Archaeological report produced by Fugro, Contact 25 is described as possible modern debris with a width of 4.3ft, <1.0ft in height, and 8.4ft in length.

A **Slight Risk of Gas** is interpreted within an interval in Unit 2 and an interval in Unit 3. A **Slight Shallow Water Flow Risk** is assigned to an interval in Unit 2 and two intervals in Unit 3.

The well-path will traverse a fault in Unit 3.

Sincerely,
Anadarko Petroleum Corporation

APPENDIX B – Sensitive Sessile Benthic Community Statement

Sensitive Sessile Benthic Communities Statement – Proposed WR881-F Well Location

Anadarko Petroleum Corporation.

March 25, 2019

US Department of the Interior
Bureau of Ocean Energy Management
1201 Elmwood Park Blvd.
New Orleans, LA 70213

Reference: Sensitive Sessile Benthic Community Summary
Proposed WR881-F Well Location in Walker Ridge WR881 (OCS-G 36181)

Ladies/Gentlemen:
Anadarko Petroleum Corporation contracted Ocean Geo Solutions Inc. to prepare a Well Clearance Letter for the Proposed WR881-F well location in Block 881, Walker Ridge Area (OCS-G-36181). This letter addresses location proximity to potential sensitive sessile benthic community sites. This well will be drilled from a dynamically-positioned drilling module; therefore, an anchoring assessment is not required.

This sensitive sessile benthic community summary letter is issued as a supplement to the Well Clearance Letter for this proposed well. A Biological, Physical and Socio-economic Map is included illustrating the areas of potential seabed impact.

Potential Sensitive Sessile Benthic Communities
Features or areas that could support high-density sensitive sessile benthic communities are *not* located within 2,000 feet of any proposed mud and cuttings discharge location. No areas with the potential to host benthic communities were identified within the study area.

Backscattered data shows relatively uniform amplitudes associated with clays and silt drape. No seabed fluid venting areas were identified within 2,000ft of the proposed well and no sites were identified in the study area. Several areas exhibiting over consolidated seabed were identified. The nearest area with over consolidated seabed is located 8,647ft to the northwest of the proposed well. *These areas do not have any fluid venting at the seabed.*

The archeological assessment did not identify any seabed contacts within 2,000ft of the proposed well. The nearest sonar contact (Contact 25) is located 3,149ft to the SSE. According to the Archaeological report produced by Fugro, Contact 25 is described as possible modern debris with a width of 4.3ft, <1.0ft in height, and 8.4ft in length. Contact 26 is located 3,167ft to the east. This contact is also described as possible modern debris with a width of 4.3ft, <1.0ft in height, and 12.5ft in length.

Proposed WR881-F Well Location (Surface)							
Location Coordinates							
NAD 27 Datum - Clarke 1866 Ellipsoid					UTM Zone 15 - CM 93° West		
Latitude	26°	04’	08.259”	North	Easting	2,000,822	US ft. E
Longitude	91°	54’	06.310	West	Northing	9,460,679	US ft. N
FWL Walker Ridge 881		4,982ft		US ft.	Inline	6213	
FSL Walker Ridge 881		4,199ft		US ft.	Crossline	18749	
Water Depth: -7,722ft.		Slope: 1.9° South					
Nearest Shoreline		188 Nautical Miles @ 17.50°					
Port of Operation Fourchon		203 Nautical Miles @ 26.12°					
Nearest Manned Platform		A-Structure (Lucius) KC875			9.0 Nautical Miles @ 297°		

Proposed WR881-FF Well Location (Surface)							
Location Coordinates							
NAD 27 Datum - Clarke 1866 Ellipsoid					UTM Zone 15 - CM 93° West		
Latitude	26°	04’	07.526”	North	Easting	2,000,785	US ft. E
Longitude	91°	54’	06.726	West	Northing	9,460,604	US ft. N
FWL Walker Ridge 881		4,945ft		US ft.	Inline	6214	
FSL Walker Ridge 881		4,124ft		US ft.	Crossline	18745	
Water Depth: -7,725ft.		Slope: 2.3° SE					
Nearest Shoreline		188 Nautical Miles @ 17.50°					
Port of Operation Fourchon		203 Nautical Miles @ 26.12°					
Nearest Manned Platform		A-Structure (Lucius) KC875			9.0 Nautical Miles @ 297°		

There are no areas with the potential to host a Sensitive Sessile Benthic Community within 2,000ft of the proposed location.

Conclusions and Recommendations: The Proposed WR881-F and WR881-FF Well Locations in WR881 will not impact any sites favorable for the development of sensitive sessile benthic communities.

Sincerely,
Anadarko Petroleum Corporation

Attachment C-4

Some pages omitted due to proprietary data

Well Clearance Letter for **Anadarko Petroleum Corporation**

Project:
Proposed WR925-A Alt Location
Walker Ridge Block WR925, Offshore Gulf of Mexico

Description:
3D Geohazard Assessment

Project Number:
2019-142

Report Status:
Final

Ocean Geo Solutions
8399 Westview Drive, Suite 200, Houston, 77055, USA
www.oceangeosolutions.com

REPORT AUTHORISATION AND DISTRIBUTION

Compilation	Geophysics	L Fuentes
Authorization	Geophysics	A Haigh
	Quality Assurance	D Haigh

Revision	**Date**	**Title**
0	April 30, 2019	Draft
1	May 07, 2019	Final

Distribution

4 copies

Anadarko Petroleum Corporation
1201 Lake Robbins Drive
The Woodlands, TX 77380

For the attention of:
Trey Kramer

SERVICE WARRANTY

USE OF THIS REPORT

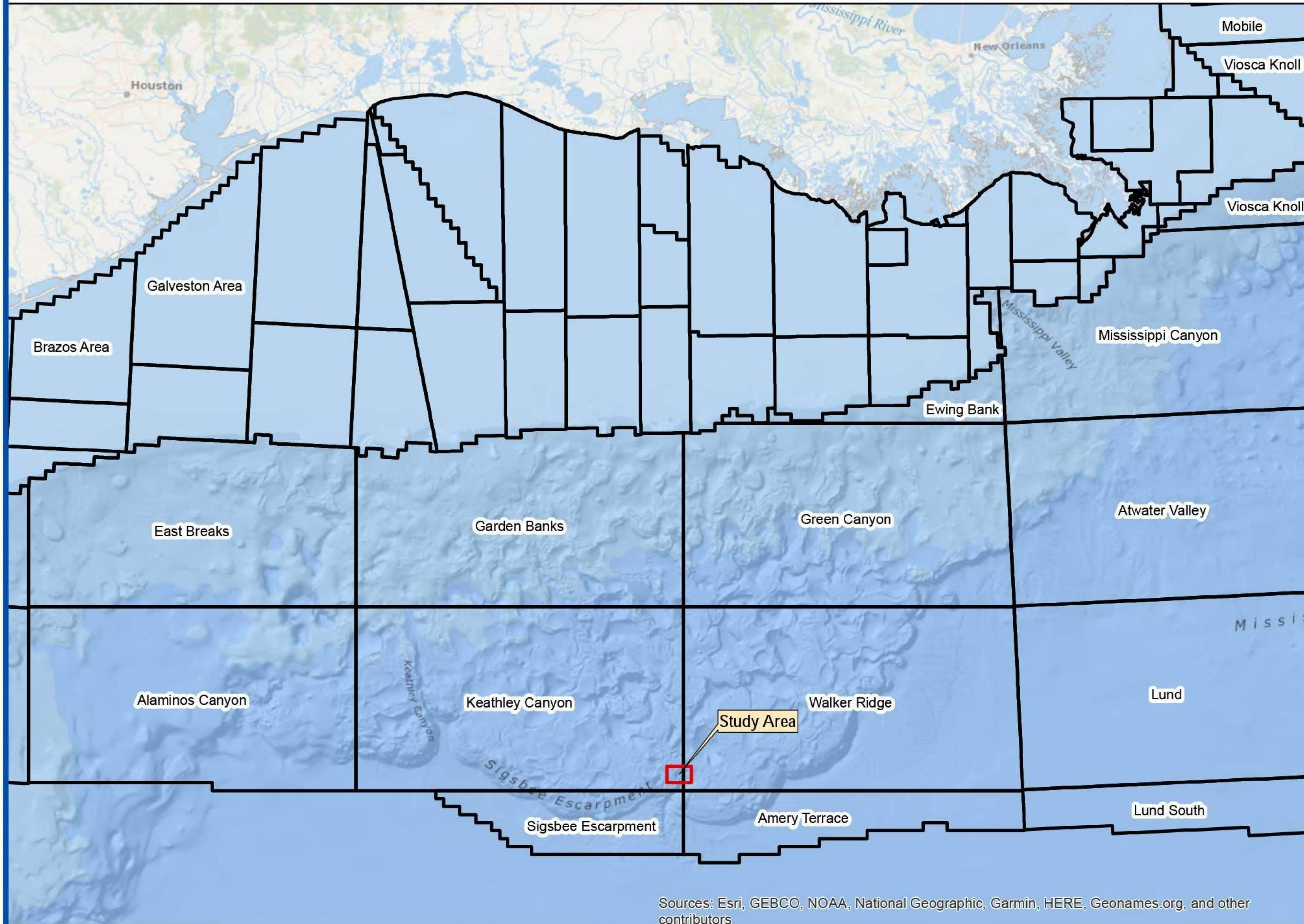
This report has been prepared with due care, diligence and with the skill reasonably expected of a reputable contractor experienced in the types of work, carried out under the contract. As such, the findings in this report are based on an interpretation of data which is a matter of opinion on which professionals may differ and, unless clearly stated, is not a recommendation of any course of action.

Ocean Geo Solutions, Inc. has prepared this report for the client identified on the front cover in fulfillment of its contractual obligations under the referenced contract, and the only liabilities Ocean Geo Solutions, Inc. will accept are those contained therein.

Please be aware that further distribution of this report, in whole or part, or the use of the data for a purpose not expressly stated within the contractual work scope is at the client's sole risk, and Ocean Geo Solutions, Inc. recommends that this disclaimer is included in any such distribution.

OCEAN GEO SOLUTIONS, INC
8399 Westview Dr, Suite 200, Houston, Texas 77055, USA
Telephone 713 481 4630 Fax 713 464 8275
www.oceangeosolutions.com

Location Map



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WELL CLEARANCE LETTER – PROPOSED WR25-A ALT WELL LOCATION

May 07, 2019
Anadarko Petroleum Corporation
1201 Lake Robbins Drive,
The Woodlands
Texas, 77380

Attention: **Trey Kramer**

Well Clearance Letter
Proposed WR925-A Alt Well Location
Walker Ridge Block WR925
Offshore Gulf of Mexico

Ocean Geo Solutions Inc. was contracted by Anadarko Petroleum Corporation to prepare a Well Clearance Letter for the proposed WR925-A Alt Well Location (With surface location in WR881), Walker Ridge Area (OCS-G- 36181). This assessment addresses seafloor and shallow geologic conditions that may impact drilling operations within 2,000ft of the proposed well site. The depth limit of this geohazard assessment is Horizon H40 at -12,165ft below sea surface (4,368ft below seabed). We understand that Anadarko Petroleum Corporation plans to drill the proposed development well from a dynamically positioned drillship; therefore, an anchoring assessment was not requested. Relevant letter-size chart extracts, data examples, and a Top Hole Prognosis are presented with this Well Clearance Letter.

This well site assessment incorporates 3D seismic data and high –resolution autonomous underwater vehicle (AUV)-acquired multibeam, side scan sonar, and sub-bottom profiler data. The regional 3D seismic data was interpreted by Fugro and the multibeam, side scan sonar, and sub-bottom profiler data was acquired by Fugro.

3D Geophysical Survey. Anadarko Petroleum Corporation provided the 3D dataset to Ocean Geo Solutions Inc. on tape media in SEG-Y format for loading onto a Seismic Micro-Technology (SMT) workstation. The 3D data cube contains a survey with 10 feet sample rate data to a record length of 15,000ft below the sea surface. Inlines are oriented northeast to southwest have a numerical increment of one, and exhibit a line spacing of 98.4213ft. Crosslines are oriented northwest to southeast, have a numerical increment of four, and exhibit a line spacing of 82.0212ft.

- Acquired by CGG, March 2018.
- Lucius DCS WAZ TTI PSDM Re-Imaged, 55Hz Kirchoff Stack
- Processing Flow:
- Anti-aliasing
- Resample to 6ms
- Sailline Denoise
- Debubble
- 3D FP Deghost
- Designautre and Datum correction
- SRME Q correction

- DC WAZ Data Regularize 55Hz Kirchhoff Migration
- Diverge Z power 1.

The data was spectrally whitened with IHS Kingdom for the purpose of frequency enhancement. Data exhibits a good frequency response across the upper second below the seabed, with an effective frequency range of 18 - 56Hz at 50% power (Figure 11). The data exhibits a dominant frequency in the upper second of approximately 41Hz, resulting in a mean vertical resolvability of typically 34ft and a layer detectability of 6ft. The data is considered good to excellent quality.

In summary and with reference to NTL No. 2008-G04:

a) The data provides imaging of sufficient resolution of the shallow section allowing a clear analysis of the shallow conditions.
b) The data can be loaded to a workstation at 16-bit resolution or greater and is unscaled.
c) There is no trace or sample decimation.
d) The sample interval and bin size are maintained throughout the assessment area.
e) The data possess a frequency content of 50Hz or higher at 50% power in the first second below the seabed.
f) Seabed reflection is free of gaps and is defined by a wavelet of stable shape and phase, allowing auto-tracking of the seabed event with minimum user intervention and guidance.
g) There are no significant acquisition artifacts throughout the dataset.
h) Merge points in the data are marked by no time shifts and very minimal amplitude changes, and are not a detriment to interpretation.
i) Processed bin sizes are 98.4213ft x 82.0212ft
j) The sample rate of the data is 10 feet sample rate data.
k) An accurate velocity model has been utilized in the shallow section allowing optimum structural and stratigraphy resolution with no evidence of under- or over-migration.
l) There is no significant multiple energy.

The proposed activities are not within an area defined by BOEM as having high archaeological potential (see NTL No. 2011-JOINT-G-01). An archeological assessment within the Magnus Prospect Blocks KC920, 921, and 965 of the Keathley Canyon Area and Blocks 881 and 925 of the Walker Ridge Area, Gulf of Mexico was performed by Fugro USA Marine, Inc. in February 2018.

1. LOCATION COORDINATES

1.1 Proposed WR925-A Alt Well Location

Proposed WR925-A Alt Well Location (With Surface Location in WR881)							
Location Coordinates							
NAD 27 Datum - Clarke 1866 Ellipsoid					UTM Zone 15 - CM 93° West		
Latitude	26°	03'	36.861"	North	Easting	1,998,292	US ft. E
Longitude	91°	54'	34.363	West	Northing	9,457,488	US ft. N
FWL Walker Ridge 881		2,452ft	US ft.	Inline	6218		
FSL Walker Ridge 881		1,008ft	US ft.	Crossline	18549		
Water Depth: -7,797ft.		Slope: 1.0° West					
Nearest Shoreline		188 Nautical Miles @ 17.50°					
Port of Operation Fourchon		203 Nautical Miles @ 26.12°					
Nearest Manned Platform		A-Structure A (Lucius) KC875		8.81 Nautical Miles @ 300°			

Proposed WR925-AA Alt Well Location (With Surface Location in WR881)							
Location Coordinates							
NAD 27 Datum - Clarke 1866 Ellipsoid					UTM Zone 15 - CM 93° West		
Latitude	26°	03'	35.659"	North	Easting	1,998,471	US ft. E
Longitude	91°	54'	32.409	West	Northing	9,457,368	US ft. N
FWL Walker Ridge 881		2,631ft	US ft.	Inline	6222		
FSL Walker Ridge 881		888ft	US ft.	Crossline	18553		
Water Depth: -7,793ft.		Slope: 2.6° NW					
Nearest Shoreline		188 Nautical Miles @ 17.50°					
Port of Operation Fourchon		203 Nautical Miles @ 26.12°					
Nearest Manned Platform		A-Structure (Lucius) KC875		8.7Nautical Miles @ 302°			

Proposed WR925-AAA Alt Well Location (With Surface Location in WR881)							
Location Coordinates							
NAD 27 Datum - Clarke 1866 Ellipsoid					UTM Zone 15 - CM 93° West		
Latitude	26°	03'	36..787"	North	Easting	1,998,131	US ft. E
Longitude	91°	54'	36.124	West	Northing	9,457,479	US ft. N
FWL Walker Ridge 881		2,231ft	US ft.	Inline	6217		
FSL Walker Ridge 881		999ft	US ft.	Crossline	18545		
Water Depth: -7,798ft.		Slope: <1.0° WNW					
Nearest Shoreline		188 Nautical Miles @ 17.50°					
Port of Operation Fourchon		203 Nautical Miles @ 26.12°					

Nearest Manned Platform	**A-Structure (Lucius) KC875**	**9.1Nautical Miles @ 301°**

Location WR925-AA Alt is 214ft from WR925-A Alt on a bearing of 123°. Location WR925-AAA Alt is 160ft from WR925-A Alt on a bearing of 266°. Contact 20 explained in more detailed in the following section is located around 2,050ft to the SSE. Geological conditions at seabed and sub-seabed will be similar to those encountered at the proposed WR925-A Alt.

2. VELOCITY DATA

2.1 Seabed Depth

3D Seismic Data was provided in-depth, therefore no depth conversion was required. Additionally, AUV-multibeam depth was acquired by Fugro.

2.1 Sub-seabed Depth

3D Seismic Data was provided in-depth, therefore no depth conversion was required to convert mapped horizons.

3. SEABED CONDITIONS

3.1 Seabed Depth

Seabed depth at the proposed well location is -7,797ft below the sea surface (Figure 1). The seafloor gradient at the proposed well is 1.0° to the southeast.

3.2 Seafloor Morphology and Man-Made Features

The proposed WR925-A Alt (With surface location in WR881) well location is in the southwest of Block WR881. At the proposed well location, the seabed is smooth (Figure 2). Soft clays and silts with occasional slightly coarser interbeds are predicted at the seabed. The lithology, below the surficial sediments, is interpreted to consist of clays, silts, and occasional slightly coarser-grained interbeds. Sediments appear conducive for jetting of seabed casing with no hard layers predicted.

The proposed well is located within a mini basin occurring approximately 6,584ft to the east of Bryant Canyon. The proposed well is located on the eastern edge of a north to south trending elongated low-relief ridge. These ridges are due to underlying salt movement. No seabed surficial failures are expected at the proposed well. A slope failure apron occurs 2,538ft to the west of the proposed well but does not impact the proposed well location.

There are no anomalous seabed amplitudes indicative of hydrocarbon macroseep observed within a 2,000ft radius of the proposed location (Figure 3). Backscatter data shows relatively uniform amplitudes associated with clays and silt drape. No seabed fluid venting areas were identified within 2,000ft of the proposed well and no sites were identified in the study area.

No existing seabed infrastructure occurs within 2,000ft of the proposed well.

The archeological assessment identified a seabed contact within 2,000ft of the proposed well. The sonar contact (Contact 20) is located 2,055ft to the SSE. According to the archaeological report produced by Fugro, Contact 20 is described as possible modern debris with dimensions of 18.8ft x 6.3ft and less than 1.0ft in height.

No other features are observed within a 2,000ft radius that could affect well emplacement or jetting of a casing.

4. SUB-SEABED CONDITIONS

4.1 Ocean Geo Solutions Hazard Classification Scheme

4.1.1 Shallow Gas Classification

Shallow gas detection is normally made in the first instance by recognition of anomalously high amplitude ('bright' spots). This parameter allied to a number of other characteristics, such as acoustic masking, underlying velocity pulldown, structural closure, edge effects, frequency reduction, and basal 'flat' spots are indicative of shallow gas accumulations. High amplitude polarity-reversed reflectors are particularly relevant to shallow gasified sands, particularly within the topmost kilometer of sediments below the seabed. The quantitative degree of these gas risks is further detailed as:

High Risk of Gas –Anomalously high amplitudes coupled with multiple other well-defined subsidiary indicators, such as acoustic masking, velocity pulldown, structural closure, phase reversal, frequency reduction, etc. Predicted Gas Risk considered *probable*.

Moderate Risk of Gas –Anomalously high amplitudes coupled with two other well-defined subsidiary indicators, such as acoustic masking, velocity pulldown, structural closure, phase reversal, frequency reduction, etc. Predicted Gas Risk considered *likely*.

Slight Risk of Gas –Anomalously high amplitudes coupled with one to two other well-defined subsidiary indicators, or very high amplitude alone. Predicted Gas Risk considered *possible*.

4.1.2 Shallow Water Flow Classification

High Shallow Water Flow Risk –Potential sand-prone interval, overlain by a well-defined seal with significant rapidly-deposited overburden, together with a tie to a known Shallow Water Flow zone in a nearby well. Shallow Water Flow considered *probable*.

Moderate Shallow Water Flow Risk–A potential sand-prone interval, overlain by a well-defined clay seal with significant rapidly deposited overburden. Shallow Water Flow considered *likely*.

Slight Shallow Water Flow Risk –Possible sand-prone interval, overlain by a poor or breached seal, or slowly deposited overburden. Or a moderate or high-risk type deposit, where a nearby well has disproved the flow zone. Shallow Water Flow considered unlikely but still *possible*.

4.2 Geology and Lithology

The sub-seabed geology has been divided into four units, Units 1, 2, 3, and 4. These are separated by Horizons H10, H20, H30, and H40 (Figures 5 through 9).

4.3 Unit 1

The lithology within the upper part of Unit 1 from the seabed to approximately 50ft below seabed of sediments are interpreted as probably soft clays and silts as shown on the Seismic Profiler Data Example (Figure 6). From -7,847ft to -8,015ft below sea surface (50ft to 218ft below seabed) is characterized by well-layered and low and slightly moderate-amplitude reflectors interpreted as clays, silts, with occasional minor slightly coarser-grained interbeds.

From -8,015ft to -8,420ft below sea surface (218ft to 623ft below seabed) presents as slightly chaotic and well-layered, low-amplitude reflectors interpreted as clays and silts.

No gas hazards or shallow water flow risks are interpreted within Unit 1 at the wellbore or within 2,000ft.

Horizon H10 marks the base of this unit at -8,420ft below sea surface (623ft below seabed). Horizon H10 presents some character indicative of a minor thin sand interbed.

4.4 Unit 2

The upper part of Unit 2 from -8,420ft to -8,681ft below sea surface (623ft to 884ft below seabed) consists of slightly-chaotic, low and moderate-amplitude reflectors interpreted as clays and silts with several sand interbeds. A better defined <30ft thick sand interbed is interpreted at -8,565ft below sea surface (768ft below seabed). The well-path will not traverse any clearly identified risk of gas hazards within this interval, however, the <30ft thick sand presents significantly increased amplitudes, but no other indication of shallow gas. Given this character, a **Slight Risk of Gas** and a **Slight Shallow Water Flow Risk** is assigned. Additionally, due to the increased potential for poorly consolidated material at the level of the interbed minor wellbore stability and drilling fluid circulation problems may occur.

From -8,681ft to -9,086ft below sea surface (884ft to 1,289ft below seabed) is characterized by low-amplitude reflectors interpreted as well-layered clays, silts, and occasional minor sands.

The well-path will not intersect any major faults within Unit 2.

No anomalies indicative of shallow gas are present within the deeper part of this interval. The nearest risk of gas at these depths is located 1,276ft to the east upslope from the well-path.

Horizon H20 marks the base of this unit at –9,086ft below sea surface (1,289ft below seabed). At this level a minor sand interbed is interpreted and minor wellbore stability and drilling fluid circulation problems may occur at the level of this horizon.

4.5 Unit 3

The upper part of Unit 3 from -9,086ft to -9,566ft below sea surface (1,289ft to 1,769ft below seabed) presents as slightly-chaotic, low-amplitude reflectors interpreted as channel infill clays and silts.

From -9,566ft to -9,850ft below sea surface (1,769ft to 2,053ft below seabed) is characterized by tilted, well-layered moderate amplitude reflectors interpreted as clays and silts with several minor sands. Due to the possibility of increasing sediment lithology variability in this interval minor drilling fluid circulation and wellbore stability problems may occur.

From -9,850ft to -10,104ft below sea surface (2,053ft to 2,307ft below seabed) is characterized by well-layered low amplitude reflectors interpreted as clays and silts with occasional sands.

The lower interval in Unit 3 from -10,104ft to -11,059ft below sea surface (2,307ft to 3,262ft below seabed) presents as well-layered and slightly-chaotic, low and moderate-amplitude reflectors interpreted as clays, silts, and several sands/ marl interbeds. The interbeds within this interval have been uplifted and tilted, with the potential for any fluid within the deeper parts of the mini-basin possibly migrating upslope. Given this setting where there is the potential for deeper mini basin pressures to be transmitted into this shallower section (if pore connectivity exists) a **Slight Shallow Water Flow Risk** is assigned.

No anomalies indicative of shallow gas are present within the deeper part of this interval. The nearest risk of gas at these depths is located 1,147ft to the east upslope from the well-path.

The well-path will intersect a possible minor fault at -10,625ft below sea surface (2,828ft below seabed). Minor wellbore stability and drilling fluid circulation problems may occur at the level of the fault.

Horizon H30 marks the base of this unit at –11,059ft below sea surface (3,262t below seabed).

4.6 Unit 4

The upper part of Unit 4 from -11,059ft to -11,464ft below sea surface (3,262ft to 3,667ft below seabed presents as well-layered, low and moderate-amplitude reflectors interpreted as clays and silts with several sands. Minor wellbore stability and drilling fluid circulation problems are considered possible.

The lower interval from -11,464ft to -12,165ft below sea surface (3,667ft to 4,368ft below seabed) is characterized by well-layered, low-amplitude reflectors interpreted as clays and silts.

The well-path will not intersect any faults within Unit 4.

Horizon H40 marks the base of this unit and the base of this interpretation at –12,165ft below sea surface (4,368ft below seabed).

4.7 Shallow Gas Assessment

Within Unit 2 a **Slight Risk of Gas** is assigned at the level of a <30ft sand interbed at -8,565ft below sea surface (768ft below seabed).

4.8 Shallow Water Flow Assessment

Within Unit 2 a **Slight Shallow Water Flow Risk** is assigned at the level of a <30ft sand interbed at -8,565ft below sea surface (768ft below seabed).

Within Unit 3 a **Slight Shallow Water Flow Risk** is assigned from -10,104ft to -11,059ft below sea surface (2,307ft to 3,262ft below seabed).

5. CONCLUSIONS AND RECOMMENDATIONS

- Seabed

  No major drilling hazards or problems are interpreted.

- Unit 1

  None Predicted.

- Unit 2

  Within Unit 2 a **Slight Risk of Gas** and a **Slight Shallow Water Flow Risk** is assigned at the level of a <30ft sand interbed at -8,565ft below sea surface (768ft below seabed). Drilling Caution is advised, and appropriate drilling methodology is recommended to deal with a possible short-lived non-persistent water flow event.

- Unit 3

  Minor wellbore stability and drilling fluid circulation problems are possible at the level of Horizon H20 at -9,086ft below sea surface (1,289ft below seabed).

  Within Unit 3 a **Slight Shallow Water Flow Risk** is assigned from -10,104ft to -11,059ft below sea surface (2,307ft to 3,262ft below seabed). Appropriate drilling methodology is recommended to deal with a possible short-lived non-persistent water flow event.

  The well-path will intersect a fault t -10,625ft below sea surface (2,828ft below seabed). Minor wellbore and drilling fluid circulation problems may occur at the level of the fault. Casing seats should avoid all fault intersections as formation integrity could be compromised.

- Unit 4

  Minor wellbore stability and drilling fluid circulation problems are possible within the interval from -11,059ft to -11,464ft below sea surface (3,262ft to 3,667ft below seabed).

We appreciate the opportunity to work with you on this project and look forward to continuing as your geohazards consultants. Please contact us if you have any questions or if we can be of further assistance.

Sincerely,
Ocean Geo Solutions Inc.

Andrew Haigh
Geophysical Manager

D Haigh

Denise Haigh
Quality Assurance

Copies Submitted: 4 copies to Trey Kramer at Anadarko Petroleum Corporation

Attachments:
Proposed WR925-A Alt Well Location
Seabed Depth Extract
Seabed Morphology Extract
Seabed Amplitude Extract
Geohazard Summary Extract
Side Scan Sonar Data Example
Seismic Profiler Data Example
Inline Data Example
Crossline Data Example
Top Hole Prognosis
ROV Plat
Power Spectrum
Bathymetry Plat
Public Information Plat
Proprietary Information Plat
Vicinity Plat
10-Mile Radius Plat

Seabed Depth Extract

Proposed WR925-A Alt Well Location (1,998,292ft E / 9,457,488ft N)

Proposed AA Alt Well Location

Proposed AAA Alt Well Location

Side scan sonar contact

Block boundaries

-7797 Depth in feet below sea surface to seabed, contoured at 10ft intervals

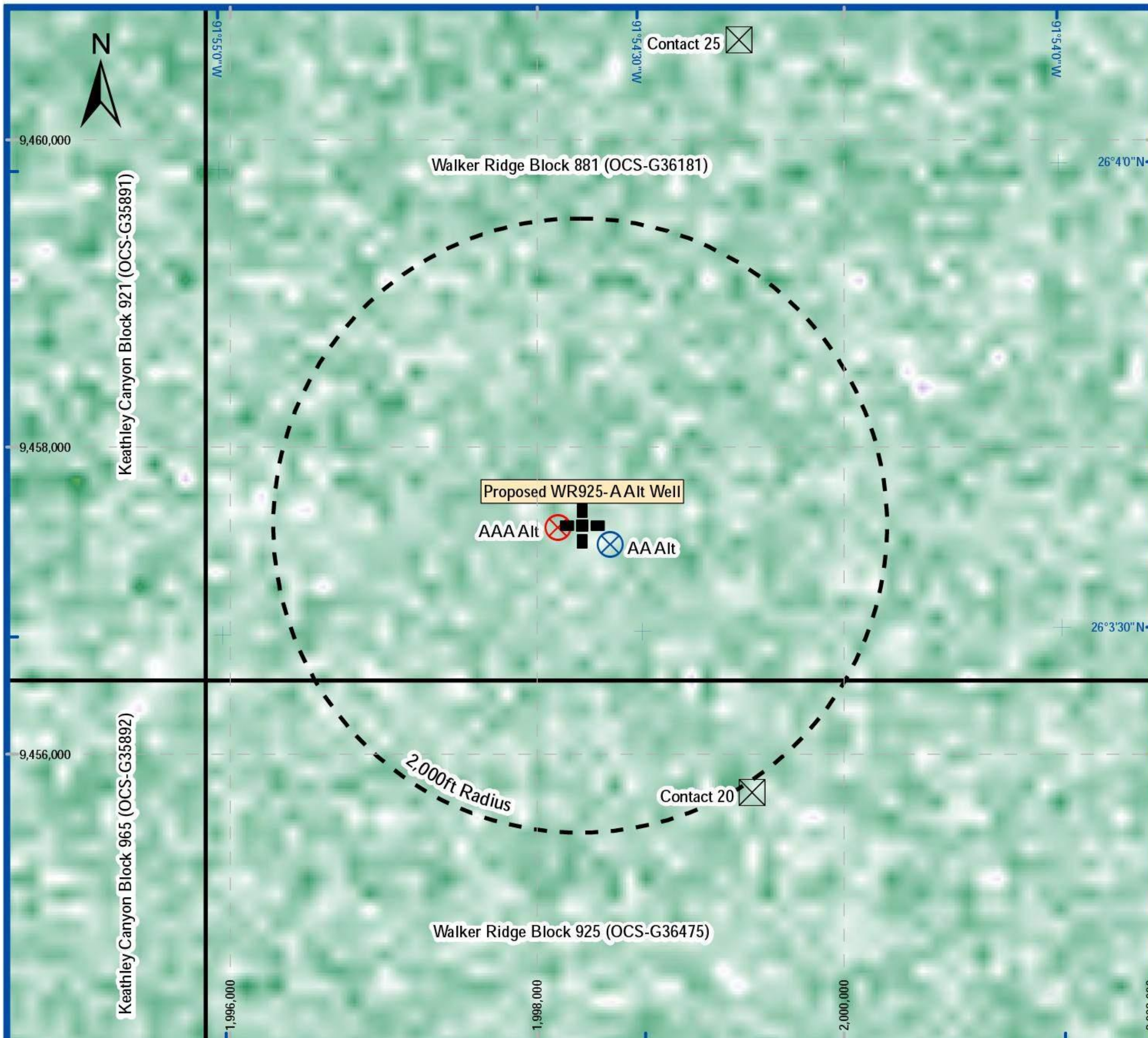
Seabed Depth (Feet)

Chart Scale 1" = 1,000'

0 500 1,000 2,000 Feet

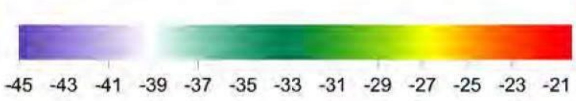
0 150 300 600 Meters

Figure 1
(WR925-A Alt)



Seabed Backscatter Amplitude Extract

- Proposed WR925-A Alt Well Location (1,998,292ft E / 9,457,488ft N)
- Proposed AA Alt Well Location
- Proposed AAA Alt Well Location
- Side scan sonar contact
- Block boundaries



Relative Seabed Backscattered Amplitude

Chart Scale 1" = 1,000'

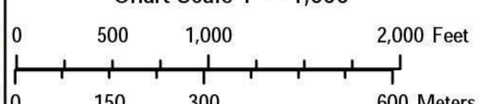
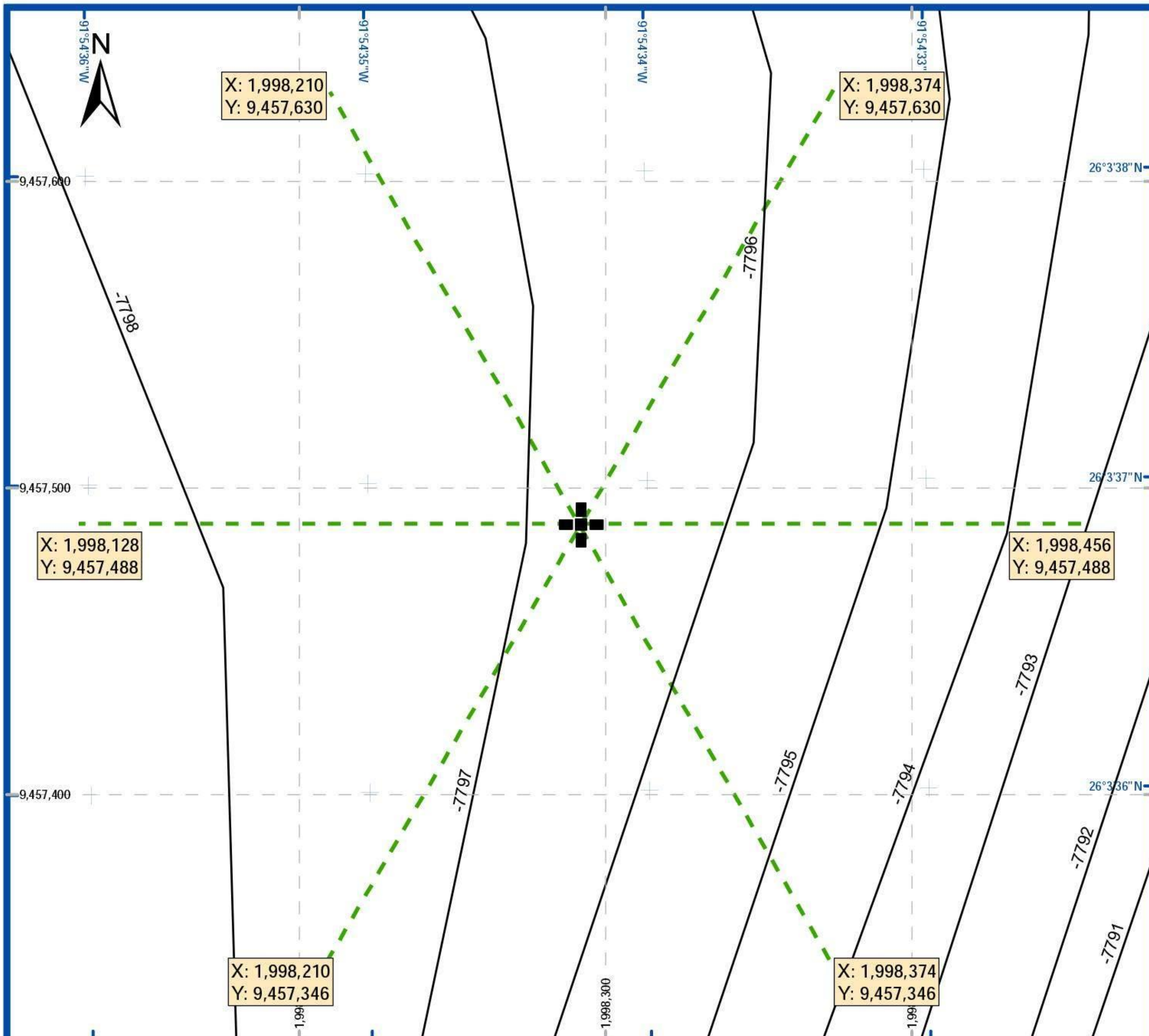


Figure 3
(WR925-A Alt)



ROV Plat (WR925-A Alt)

Proposed WR925-A Alt Well Location
(1,998,292ft E / 9,457,488ft N)

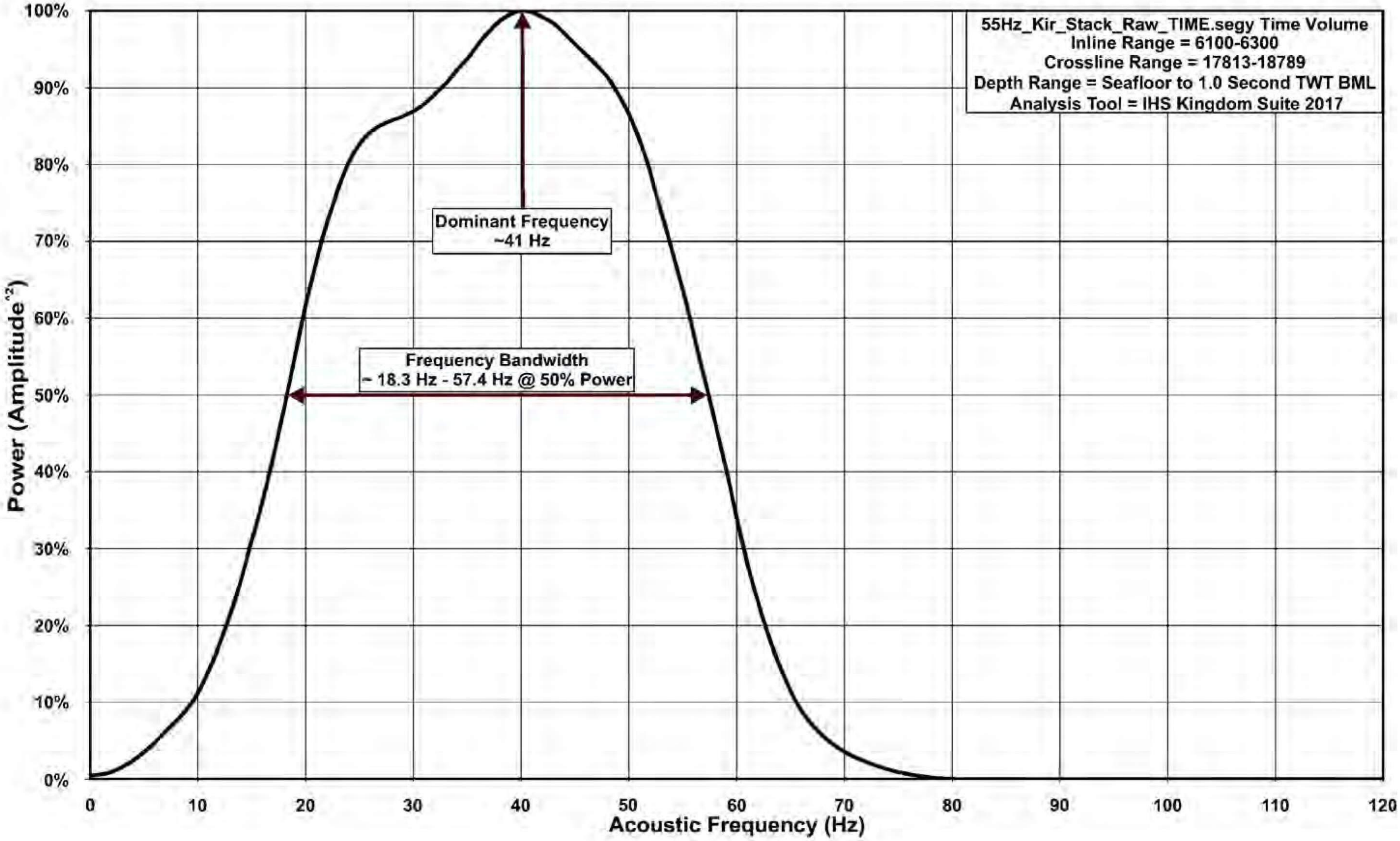
--7797 Depth in feet below sea surface to seabed, contoured at 1ft intervals

Chart Scale 1" = 50'

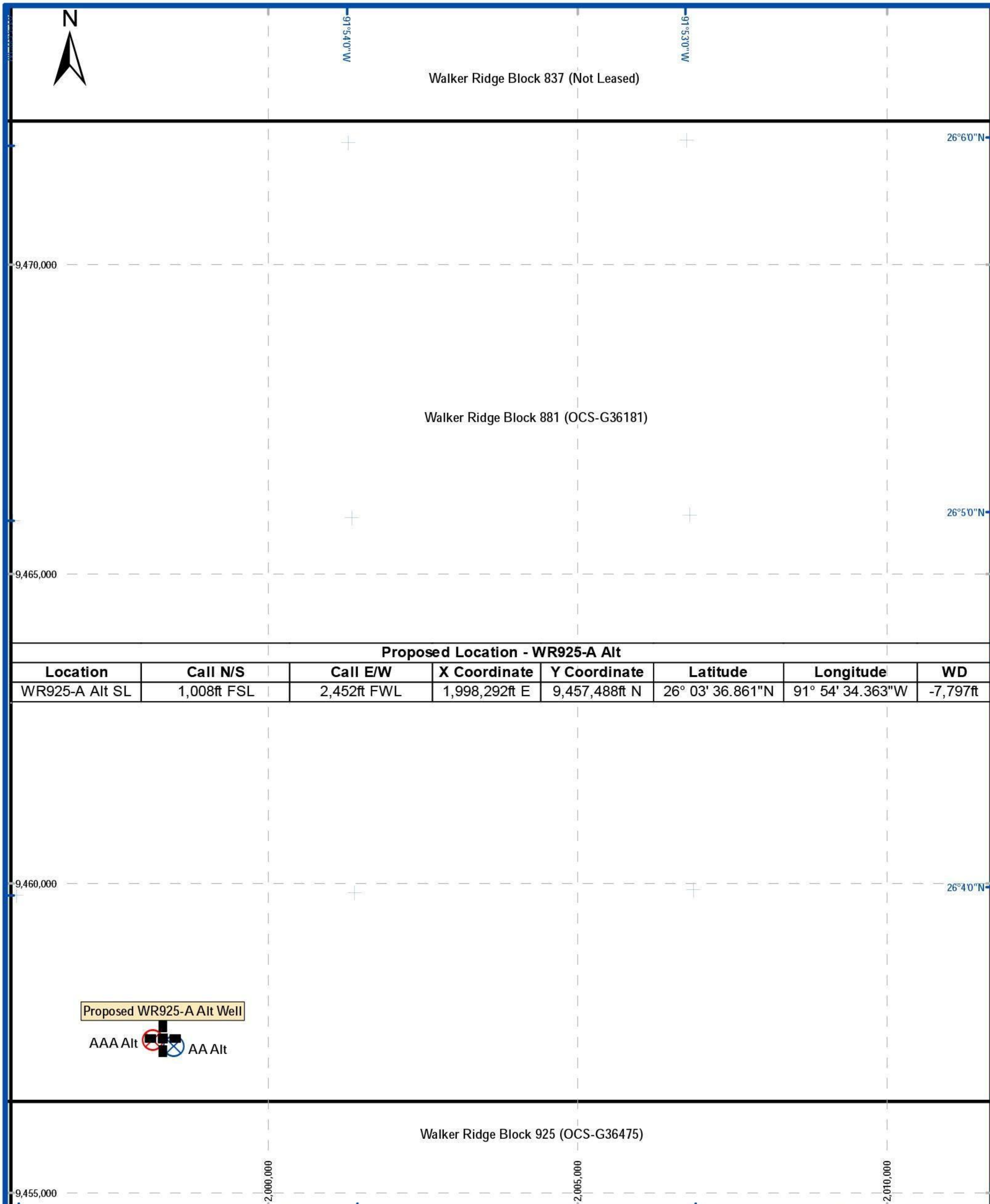
0 50 100 200 Feet

0 12.5 25 50 Meters

Figure 10
(WR925-Alt)



WR925-A Alt	Power Spectrum	Figure 11



Proposed Location - WR925-A Alt							
Location	**Call N/S**	**Call E/W**	**X Coordinate**	**Y Coordinate**	**Latitude**	**Longitude**	**WD**
WR925-A Alt SL	1,008ft FSL	2,452ft FWL	1,998,292ft E	9,457,488ft N	26° 03' 36.861"N	91° 54' 34.363"W	-7,797ft

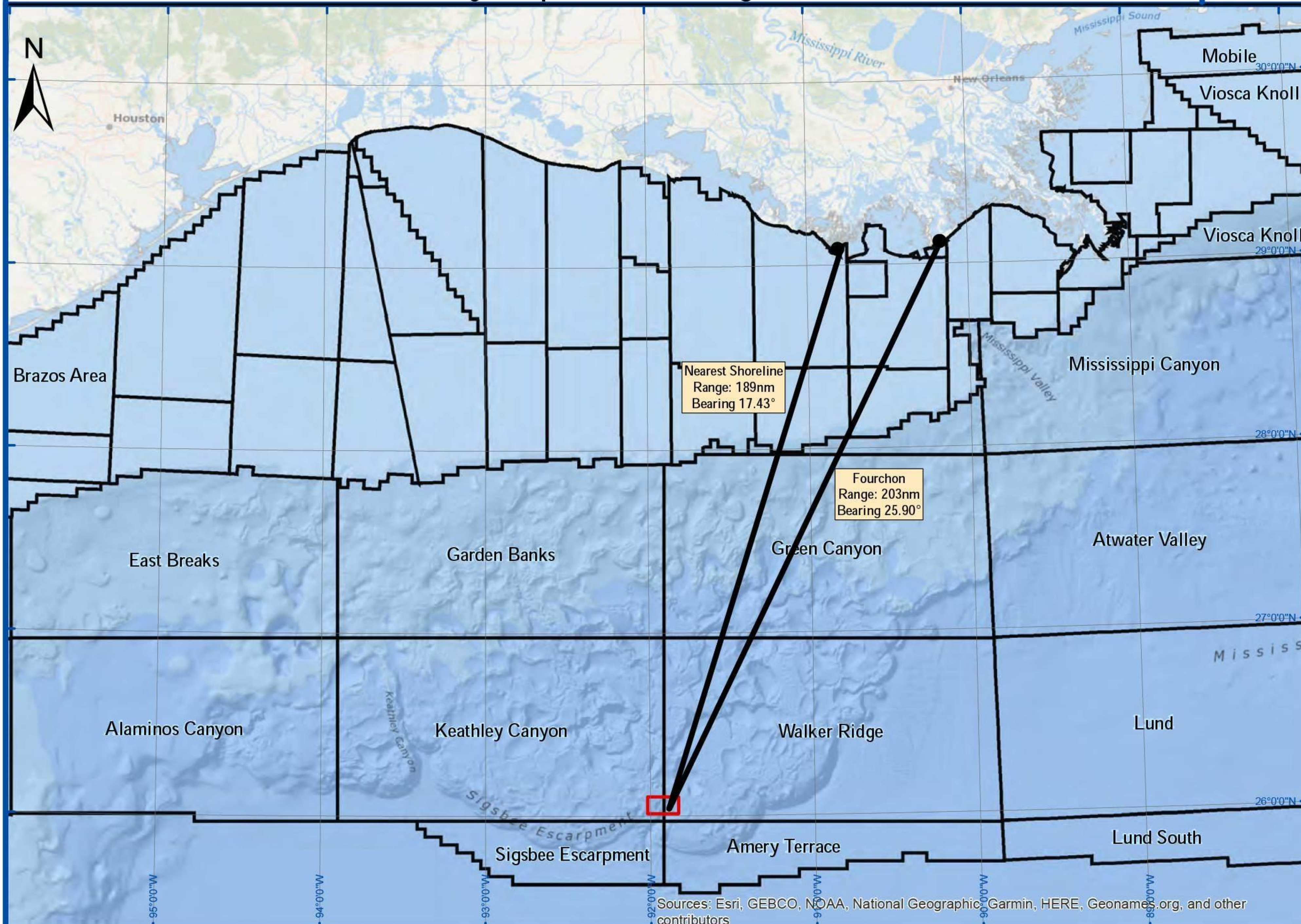
Chart scale 1" = 2,000'
0 500 1,000 2,000 Feet
0 125 250 500 Meters

Well Location Plat - Public Information

Figure 13

Vicinity Map - Walker Ridge Block 925

Figure 15



Legend

- Seabed Well
- Platform
- Not Leased
- Leased
- Pipeline

10 MILE RADIUS SEABED INFRASTRUCTURE
WALKER RIDGE - BLOCK 925

0 5 10 Miles

1 inch = 2.5 miles

Ocean Geo Solutions

Anadarko Petroleum Corporation

May 7, 2019

Figure 16

APPENDIX A – PUBLIC SHALLOW HAZARDS STATEMENTS

Public Shallow Hazards Statement – Proposed WR925-A Alt Location

April 30, 2019

US Department of the Interior
Bureau of Ocean Energy Management
1201 Elmwood Park Blvd.
New Orleans, LA 70213-2394

Reference: Shallow Hazards Analysis
Walker Ridge Block 881
(OCS-G 36181)

Ladies/Gentlemen:

Anadarko Petroleum Corporation contracted Ocean Geo Solutions Inc. to prepare a Well Clearance Letter for the Proposed WR925-A Alt well location (With surface location in WR881), Walker Ridge Area (OCS-G-36181). This letter addresses seabed and shallow geologic conditions that may impact exploratory drilling operations within 2,000ft of the proposed well site. The depth limit of this site clearance assessment is Horizon H40 at -12,165ft below sea surface (4,368ft below seabed)

Seabed Hazards. The proposed location exhibits a smooth seabed. Soft clays and silts with occasional slightly coarser interbeds are predicted at the seabed. The lithology, below the surficial sediments, is interpreted to consist of clays, silts, and occasional slightly coarser-grained interbeds. Sediments appear conducive for jetting of seabed casing with no hard layers predicted.

The proposed well is located within a mini basin occurring approximately 6,584ft to the east of Bryant Canyon. The proposed well is located on the eastern edge of a north to south trending elongated low-relief ridge. These ridges are due to underlying salt movement. No seabed surficial failures are expected at the proposed well. A slope failure apron occurs 2,538ft to the west of the proposed well.

There are no anomalous seabed amplitudes indicative of hydrocarbon macroseep observed within a 2,000ft radius of the proposed location (Figure 3). Backscatter data shows relatively uniform amplitudes associated with clays and silt drape. No seabed fluid venting areas were identified within 2,000ft of the proposed well and no sites were identified in the study area.

No existing seabed infrastructure occurs within 2,000ft of the proposed well.

The archeological assessment identified a seabed contact within 2,000ft of the proposed well. The sonar contact (Contact 20) is located 1,758ft to the south. According to the archaeological report produced by Fugro, Contact 20 is described as possible modern debris with dimensions of 18.8ft x 6.3ft and less than 1.0ft in height.

No other features are observed within a 2,000ft radius that could affect well emplacement or jetting of a casing.

Sub-Seabed Hazards. No identified amplitude anomalies indicative of shallow gas occur at the well-path. Several anomalies occur within the 2,000ft radius of the proposed well location within Units 2 and 3. A <30ft thick sand interbeds within Unit 2 has been assigned a **Slight Risk of Gas**.

A **Slight Shallow Water Flow Risk** is assigned to an interpreted sand interbed in Unit 2 and also within an interval in Unit 3 due to the presence of slightly tilted interbeds and the possibility that fluid may migrate upslope along these tilted interbeds to the borehole. Some intervals with the potential to contain sands may induce minor wellbore and drilling fluid circulation problems.

The well-path will traverse a possible minor fault in Unit 3.

Proposed WR925-A Alt Well Location (With Surface Location in WR881)							
Location Coordinates							
NAD 27 Datum - Clarke 1866 Ellipsoid					UTM Zone 15 - CM 93° West		
Latitude	26°	03'	36.861"	North	Easting	1,998,292	US ft. E
Longitude	91°	54'	34.363	West	Northing	9,457,488	US ft. N
FWL Walker Ridge 881		2,452ft	US ft.		Inline	6218	
FSL Walker Ridge 881		1,008ft	US ft.		Crossline	18549	
Water Depth: -7,797ft.		Slope: 1.0° West					
Nearest Shoreline		188 Nautical Miles @ 17.50°					
Port of Operation Fourchon		203 Nautical Miles @ 26.12°					
Nearest Manned Platform		A-Structure A (Lucius) KC875			8.81 Nautical Miles @ 300°		

Proposed WR925-AA Alt Well Location (With Surface Location in WR881)							
Location Coordinates							
NAD 27 Datum - Clarke 1866 Ellipsoid					UTM Zone 15 - CM 93° West		
Latitude	26°	03'	35.659"	North	Easting	1,998,471	US ft. E
Longitude	91°	54'	32.409	West	Northing	9,457,368	US ft. N
FWL Walker Ridge 881		2,631ft	US ft.		Inline	6222	
FSL Walker Ridge 881		888ft	US ft.		Crossline	18553	
Water Depth: -7,793ft.		Slope: 2.6° NW					
Nearest Shoreline		188 Nautical Miles @ 17.50°					
Port of Operation Fourchon		203 Nautical Miles @ 26.12°					
Nearest Manned Platform		A-Structure (Lucius) KC875			8.7Nautical Miles @ 302°		

Ocean Geo Solutions

Proposed WR925-AAA Alt Well Location (With Surface Location in WR881)							
Location Coordinates							
NAD 27 Datum - Clarke 1866 Ellipsoid					**UTM Zone 15 - CM 93° West**		
Latitude	**26°**	**03'**	**36..787"**	**North**	**Easting**	**1,998,131**	**US ft. E**
Longitude	**91°**	**54'**	**36.124**	**West**	**Northing**	**9,457,479**	**US ft. N**

FWL Walker Ridge 881	**2,231ft**	**US ft.**	**Inline**	**6217**
FSL Walker Ridge 881	**999ft**	**US ft.**	**Crossline**	**18545**
Water Depth: -7,798ft.	**Slope: <1.0° WNW**			
Nearest Shoreline	**188 Nautical Miles @ 17.50°**			
Port of Operation Fourchon	**203 Nautical Miles @ 26.12°**			
Nearest Manned Platform	**A-Structure (Lucius) KC875**	**9.1Nautical Miles @ 301°**		

Conclusions and Recommendations. No major problems are anticipated at the seabed. No existing seabed infrastructure occurs within 2,000ft of the proposed well. The nearest sonar contact (Contact 20) is located 1,758ft to the south. According to the archaeological report produced by Fugro, Contact 20 is described as possible modern debris with a width of 6.3ft, <1.0ft in height, and 18.8ft in length.

A **Slight Risk of Gas** is interpreted within an interpreted sand interbed in Unit 2. A **Slight Shallow Water Flow Risk** is assigned to the same sand interbed in Unit 2 and also within an interval in Unit 3.

The well-path will traverse a minor fault in Unit 3.

Sincerely,
Anadarko Petroleum Corporation

APPENDIX B – Sensitive Sessile Benthic Community Statement

Sensitive Sessile Benthic Communities Statement – Proposed WR925-A Alt Well Location

Anadarko Petroleum Corporation.
April 30, 2019

US Department of the Interior
Bureau of Ocean Energy Management
1201 Elmwood Park Blvd.
New Orleans, LA 70213

Reference: Sensitive Sessile Benthic Community Summary
Proposed WR925-A Alt Well Location (With Surface location in WR881 (OCS-G 36181)

Ladies/Gentlemen:
Anadarko Petroleum Corporation contracted Ocean Geo Solutions Inc. to prepare a Well Clearance Letter for the Proposed WR925-A Alt (With surface location in WR881), Walker Ridge Area (OCS-G-36181). This letter addresses location proximity to potential sensitive sessile benthic community sites. This well will be drilled from a dynamically-positioned drilling module; therefore, an anchoring assessment is not required.

This sensitive sessile benthic community summary letter is issued as a supplement to the Well Clearance Letter for this proposed well. A Biological, Physical and Socio-economic Map is included illustrating the areas of potential seabed impact.

Potential Sensitive Sessile Benthic Communities
Features or areas that could support high-density sensitive sessile benthic communities are *not* located within 2,000 feet of any proposed mud and cuttings discharge location. No areas with the potential to host benthic communities were identified within the study area.

Backscatter data shows relatively uniform amplitudes associated with clays and silt drape. No seabed fluid venting areas were identified within 2,000ft of the proposed well and no sites were identified in the study area. Several areas exhibiting over consolidated seabed were identified. The nearest area with over consolidated seabed is located 6,815ft to the west of the proposed well.

The archeological assessment identified a seabed contact within 2,000ft of the proposed well. The sonar contact (Contact 20) is located 1,758ft to the south. According to the archaeological report produced by Fugro, Contact 20 is described as possible modern debris with a width of 6.3ft, <1.0ft in height, and 18.8ft in length

Proposed WR925-A Alt Well Location (With Surface Location in WR881)							
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Longitude	91°	54'	32.409	West	Northing	9,457,368	US ft. N
FWL Walker Ridge 881		2,631ft		US ft.	Inline	6222	
FSL Walker Ridge 881		888ft		US ft.	Crossline	18553	
Water Depth: -7,793ft.		Slope: 2.6° NW					
Nearest Shoreline		188 Nautical Miles @ 17.50°					
Port of Operation Fourchon		203 Nautical Miles @ 26.12°					
Nearest Manned Platform		A-Structure (Lucius) KC875			8.7Nautical Miles @ 302°		

Proposed WR925-AAA Alt Well Location (With Surface Location in WR881)							
Location Coordinates							
NAD 27 Datum - Clarke 1866 Ellipsoid					UTM Zone 15 - CM 93° West		
Latitude	26°	03'	36..787"	North	Easting	1,998,131	US ft. E
Longitude	91°	54'	36.124	West	Northing	9,457,479	US ft. N
FWL Walker Ridge 881		2,231ft		US ft.	Inline	6217	
FSL Walker Ridge 881		999ft		US ft.	Crossline	18545	
Water Depth: -7,798ft.		Slope: <1.0° WNW					
Nearest Shoreline		188 Nautical Miles @ 17.50°					
Port of Operation Fourchon		203 Nautical Miles @ 26.12°					
Nearest Manned Platform		A-Structure (Lucius) KC875			9.1Nautical Miles @ 301°		

There are no areas with the potential to host a Sensitive Sessile Benthic Community within 2,000ft of the proposed location.

Conclusions and Recommendations: The Proposed WR925-A Alt, WR925-AA Alt, and WR925-AAA Alt Well Locations (With surface location in WR881) will not impact any sites favorable for the development of sensitive sessile benthic communities.

Sincerely,
Anadarko Petroleum Corporation

Attachment C-4

Some pages omitted due to proprietary data

Well Clearance Letter for **Anadarko Petroleum Corporation**

Project:
Proposed WR925-E Location
Walker Ridge Block WR925, Offshore Gulf of Mexico

Description:
3D Geohazard Assessment

Project Number:
2019-115

Report Status:
Final

Ocean Geo Solutions
8399 Westview Drive, Suite 200, Houston, 77055, USA
www.oceangeosolutions.com

REPORT AUTHORISATION AND DISTRIBUTION

Compilation	Geophysics	L Fuentes
Authorization	Geophysics	A Haigh
	Quality Assurance	D Haigh

Revision	Date	Title
0	February 8, 2019	Draft
1	March 25, 2019	Final

Distribution

4 copies

Anadarko Petroleum Corporation
1201 Lake Robbins Drive
The Woodlands, TX 77380

For the attention of:
Trey Kramer

SERVICE WARRANTY

USE OF THIS REPORT

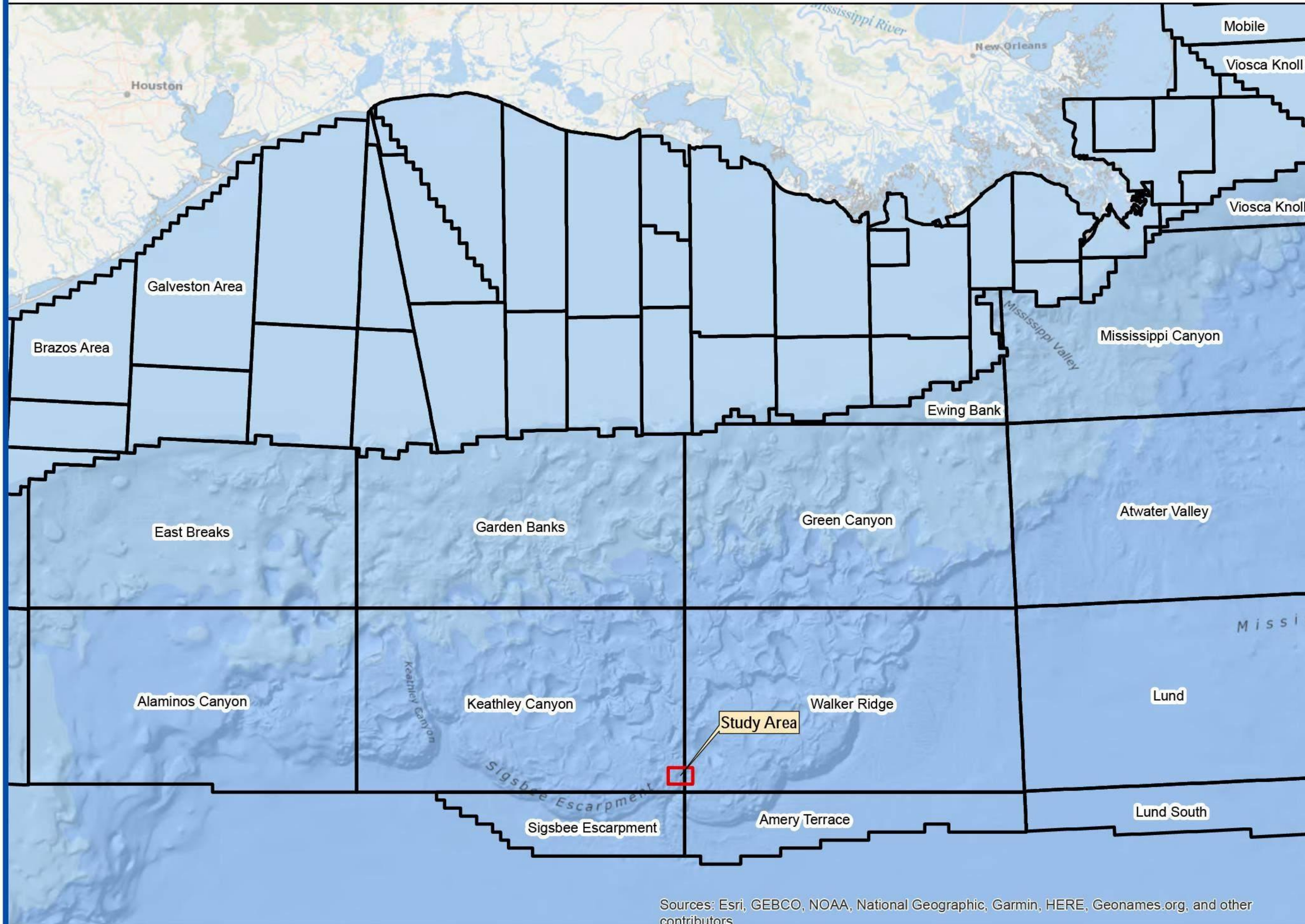
This report has been prepared with due care, diligence and with the skill reasonably expected of a reputable contractor experienced in the types of work, carried out under the contract. As such, the findings in this report are based on an interpretation of data which is a matter of opinion on which professionals may differ and, unless clearly stated, is not a recommendation of any course of action.

Ocean Geo Solutions, Inc. has prepared this report for the client identified on the front cover in fulfillment of its contractual obligations under the referenced contract, and the only liabilities Ocean Geo Solutions, Inc. will accept are those contained therein.

Please be aware that further distribution of this report, in whole or part, or the use of the data for a purpose not expressly stated within the contractual work scope is at the client's sole risk, and Ocean Geo Solutions, Inc recommends that this disclaimer is included in any such distribution.

OCEAN GEO SOLUTIONS, INC
8399 Westview Dr, Suite 200, Houston, Texas 77055, USA
Telephone 713 481 4630 Fax 713 464 8275
www.oceangeosolutions.com

Location Map



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LIST OF FIGURES

Ocean Geo Solutions

WELL CLEARANCE LETTER – PROPOSED WR925-E WELL LOCATION

March 25, 2019
Anadarko Petroleum Corporation
1201 Lake Robbins Drive,
The Woodlands
Texas, 77380

Attention: **Trey Kramer**

Well Clearance Letter
Proposed WR925-E Well Location
Walker Ridge Block WR925
Offshore Gulf of Mexico

Ocean Geo Solutions Inc. was contracted by Anadarko Petroleum Corporation. to prepare a Well Clearance Letter for the proposed WR925-E Well Location in Block 925, Walker Ridge Area (OCS-G- 36475). This assessment addresses seafloor and shallow geologic conditions that may impact drilling operations within 2,000ft of the proposed well site. The depth limit of this geohazard assessment is Horizon H40 at -9,838ft below sea surface (2,024ft below seabed). We understand that Anadarko Petroleum Corporation plans to drill the proposed development well from a dynamically positioned drillship; therefore, an anchoring assessment was not requested. Relevant letter-size chart extracts, data examples, and a Top Hole Prognosis are presented with this Well Clearance Letter.

This well site assessment incorporates 3D seismic data and high –resolution autonomous underwater vehicle (AUV)-acquired multibeam, side scan sonar, and sub-bottom profiler data. The regional 3D seismic data was interpreted by Fugro and the multibeam, side scan sonar, and sub-bottom profiler data was acquired by Fugro.

3D Geophysical Survey. Anadarko Petroleum Corporation provided the 3D dataset to Ocean Geo Solutions Inc. on tape media in SEG-Y format for loading onto a Seismic Micro-Technology (SMT) workstation. The 3D data cube contains a survey with 10 feet sample rate data to a record length of 15,000ft below the sea surface. Inlines are oriented northeast to southwest have a numerical increment of one, and exhibit a line spacing of 98.4213ft. Crosslines are oriented northwest to southeast, have a numerical increment of four, and exhibit a line spacing of 82.0212ft.

- Acquired by CGG, March 2018.
- Lucius DCS WAZ TTI PSDM Re-Imaged, 55Hz Kirchoff Stack
- Processing Flow:
- Anti-aliasing
- Resample to 6ms
- Sailline Denoise
- Debubble
- 3D FP Deghost
- Designautre and Datum correction
- SRME Q correction

- DC WAZ Data Regularize 55Hz Kirchhoff Migration
- Diverge Z power 1.

The data was spectrally whitened with IHS Kingdom for the purpose of frequency enhancement. Data exhibits a good frequency response across the upper second below the seabed, with an effective frequency range of 18 - 56Hz at 50% power (Figure 11). The data exhibits a dominant frequency in the upper second of approximately 41Hz, resulting in a mean vertical resolvability of typically 34ft and a layer detectability of 6ft. The data is considered good to excellent quality.

In summary and with reference to NTL No. 2008-G04:

a) The data provides imaging of sufficient resolution of the shallow section allowing a clear analysis of the shallow conditions.
b) The data can be loaded to a workstation at 16-bit resolution or greater and is unscaled.
c) There is no trace or sample decimation.
d) The sample interval and bin size are maintained throughout the assessment area.
e) The data possess a frequency content of 50Hz or higher at 50% power in the first second below the seabed.
f) Seabed reflection is free of gaps and is defined by a wavelet of stable shape and phase, allowing auto-tracking of the seabed event with minimum user intervention and guidance.
g) There are no significant acquisition artifacts throughout the dataset.
h) Merge points in the data are marked by no time shifts and very minimal amplitude changes and are not a detriment to interpretation.
i) Processed bin sizes are 98.4213ft x 82.0212ft
j) The sample rate of the data is 10 feet sample rate data.
k) An accurate velocity model has been utilized in the shallow section allowing optimum structural and stratigraphy resolution with no evidence of under- or over-migration.
l) There is no significant multiple energy.

The proposed activities are not within an area defined by BOEM as having high archaeological potential (see NTL No. 2011-JOINT-G-01). An archeological assessment within the Magnus Prospect Blocks KC920, 921, and 965 of the Keathley Canyon Area and Blocks 881 and 925 of the Walker Ridge Area, Gulf of Mexico was performed by Fugro USA Marine, Inc. in February 2018.

1. LOCATION COORDINATES

1.1 Proposed WR925-E Well Location

Proposed WR925-E Well Location (Surface)							
Location Coordinates							
NAD 27 Datum - Clarke 1866 Ellipsoid					UTM Zone 15 - CM 93° West		
Latitude	26°	03'	21.930"	North	Easting	2,001,603	US ft. E
Longitude	91°	53'	58.179	West	Northing	9,456,009	US ft. N
FWL Walker Ridge 925		5,763ft	US ft.		Inline	6253	
FNL Walker Ridge 925		471ft	US ft.		Crossline	18613	
Water Depth: -7,814ft.		Slope: <1.0° ESE					
Nearest Shoreline		189 Nautical Miles @ 17.43°					
Port of Operation Fourchon		203 Nautical Miles @ 25.90°					
Nearest Manned Platform		A-Structure (Lucius) KC875			9.0 Nautical Miles @ 298°		

Proposed WR925-EE Well Location (Surface)							
Location Coordinates							
NAD 27 Datum - Clarke 1866 Ellipsoid					UTM Zone 15 - CM 93° West		
Latitude	26°	03'	22.915"	North	Easting	2,001,703	US ft. E
Longitude	91°	53'	57.077	West	Northing	9,456,109	US ft. N
FWL Walker Ridge 925		5,863ft	US ft.		Inline	6253	
FNL Walker Ridge 925		371ft	US ft.		Crossline	18621	
Water Depth: -7,815ft.		Slope: <1.0° SE					
Nearest Shoreline		189 Nautical Miles @ 17.43°					
Port of Operation Fourchon		203 Nautical Miles @ 25.90°					
Nearest Manned Platform		A-Structure (Lucius) KC875			9.0 Nautical Miles @ 301°		

Location WR925-EE is 142ft from WR925-E on a bearing of 44°. Geologic conditions at the seabed and sub-seabed are similar to those encountered at the proposed WR925-E well location. At the seabed Contact 21 discussed in the following section, will occur at 2,032ft to the ESE. A **Slight Risk of Gas** and a **Slight Shallow Water Flow Risk** will occur at the level of a <30ft thick sand interbed within Unit 2 and within Unit 3. Various intervals interpreted to contain poorly consolidated sands may cause minor wellbore stability and drilling fluid circulation problems. Two minor faults will be traversed in Unit 2 and Unit4.

2. VELOCITY DATA

2.1 Seabed Depth

3D Seismic Data was provided in-depth, therefore no depth conversion was required. Additionally, AUV-multibeam depth was acquired by Fugro.

2.1 Sub-seabed Depth

3D Seismic Data was provided in-depth, therefore no depth conversion was required to convert mapped horizons.

3. SEABED CONDITIONS

3.1 Seabed Depth

Seabed depth at the proposed well location is -7,814ft below the sea surface (Figure 1). The seafloor gradient at the proposed well is <1.0° to the ESE.

3.2 Seafloor Morphology and Man-Made Features

The proposed WR925-E well location is in the north part of Block WR925. At the proposed well location, the seabed is smooth (Figure 2). Soft clays and silts are predicted at the seabed. The lithology, below the surficial sediments, is interpreted to consist of further clays and silts with occasional sands. Sediments appear conducive for jetting of seabed casing with no hard layers predicted.

The proposed well is located also to the north of an area with increased seafloor rugosity and minor buried faults. This is due to the effect of the underlying salt movement in these parts of the study area.

There are no anomalous seabed amplitudes indicative of hydrocarbon macroseep observed within a 2,000ft radius of the proposed location (Figure 3). Backscatter data shows relatively uniform amplitudes associated with clays and silt drape. No seabed fluid venting areas were identified within 2,000ft of the proposed well and no sites were identified in the study area.

No existing seabed infrastructure occurs within 2,000ft of the proposed well.

The archeological assessment did not identify any seabed contacts within 2,000ft of the proposed well. The nearest sonar contact (Contact 21) is located 2,107ft to the east. According to the Archaeological report produced by Fugro, Contact 21 is described as possible modern debris with a width of 5.3ft, <1.0ft in height, and 13.5ft in length. Contact 20 is located 2,172ft to the ESE. This contact is also described as possible modern debris with a width of 6.3ft, <1.0ft in height, and 18.8ft in length.

No other features are observed within a 2,000ft radius that could affect well emplacement or jetting of a casing.

4. SUB-SEABED CONDITIONS

4.1 Ocean Geo Solutions Inc. Hazard Classification Scheme

4.1.1 Shallow Gas Classification

Shallow gas detection is normally made in the first instance by recognition of anomalously high amplitude ('bright' spots). This parameter allied to a number of other characteristics, such as acoustic masking, underlying velocity pulldown, structural closure, edge effects, frequency reduction, and basal 'flat' spots is indicative of shallow gas accumulations. High amplitude polarity-reversed reflectors are particularly relevant to shallow gasified sands, particularly within the topmost kilometer of sediments below the seabed. The quantitative degree of these gas risks are further detailed as:

High Risk of Gas –Anomalously high amplitudes coupled with multiple other well-defined subsidiary indicators, such as acoustic masking, velocity pulldown, structural closure, phase reversal, frequency reduction, etc. Predicted Gas Risk considered *probable*.

Moderate Risk of Gas –Anomalously high amplitudes coupled with two other well-defined subsidiary indicators, such as acoustic masking, velocity pulldown, structural closure, phase reversal, frequency reduction, etc. Predicted Gas Risk considered *likely*.

Slight Risk of Gas –Anomalously high amplitudes coupled with one to two other well-defined subsidiary indicators, or very high amplitude alone. Predicted Gas Risk considered *possible*.

4.1.2 Shallow Water Flow Classification

High Shallow Water Flow Risk –Potential sand-prone interval, overlain by a well-defined seal with significant rapidly-deposited overburden, together with a tie to a known Shallow Water Flow zone in a nearby well. Shallow Water Flow considered *probable*.

Moderate Shallow Water Flow Risk–A potential sand-prone interval, overlain by a well-defined clay seal with significant rapidly deposited overburden. Shallow Water Flow considered *likely*.

Slight Shallow Water Flow Risk –Possible sand-prone interval, overlain by a poor or breached seal, or slowly deposited overburden. Or a moderate or high-risk type deposit, where a nearby well has disproved the flow zone. Shallow Water Flow considered unlikely but still *possible*.

4.2 Geology and Lithology

The sub-seabed geology has been divided into four units, Units 1, 2, 3, and 4. These are separated by Horizons H10, H20, H30, and H40 (Figures 5 through 9).

4.3 Unit 1

The lithology within the upper part of Unit 1 from the seabed to approximately 55ft below seabed of sediments are interpreted as probably soft clays and silts as shown on the Seismic Profiler Data Example (Figure 6). From -7,869ft to -7,972ft below sea surface (55ft to 158ft below seabed) is characterized by well-layered and low and slightly moderate-amplitude reflectors interpreted as clays, silts, and possible minor slightly coarser-grained interbeds.

From -7,972ft to -8,060ft below sea surface (158ft to 246ft below seabed) is characterized by slightly chaotic to well-layered, low-amplitude reflectors interpreted as low energy channel infill or mass-transport deposits with clays and silts.

The lower part of Unit A from -8,060ft to -8,320ft below sea surface (246ft to 506ft below seabed) presents as well-layered, low-amplitude reflectors interpreted as clays, silts, and occasional sand interbeds. A <20ft thick sand interbed is interpreted at the level of Horizon H10 and minor wellbore stability and drilling fluid circulation problems may occur.

No gas hazards or shallow water flow risks are interpreted within Unit 1 at the wellbore or within 2,000ft. -

Horizon H10 marks the base of this unit at 8,320ft below sea surface (506ft below seabed).

4.4 Unit 2

Unit 2 from -8,320ft to -8,785ft below sea surface (663ft to 971ft below seabed) is characterized by chaotic, moderate-amplitude reflectors interpreted as clays, silts, and occasional sands.

Within this interval a <30ft thick sand interbed is interpreted at -8,477ft below sea surface (663ft below seabed). Due to the elevated amplitude response at this interpreted interbed a **Slight Risk of Gas** is assigned. In addition, the interbed marks a change to underlying tilted interbeds and the possibility for some fluid transmission along these interbeds to the possible sand cannot be discounted. Therefore, a **Slight Shallow Water Flow Risk** is assigned.

From -8,785ft to -9,195ft below sea surface (971ft to 1,381ft below seabed) slightly-chaotic, low and occasional slightly-elevated amplitude reflectors are observed interpreted as clays, silts, and several sands. Due to the possibility of contacting poorly consolidated granular material in this interval minor wellbore stability and drilling fluid circulation problems may occur. No risk of gas is assigned at these depths at the proposed well or within a 2,000ft radius.

The well-path will intersect a minor fault within Unit 2 at -8,785ft below the sea surface (971ft below seabed). Minor wellbore stability and drilling fluid circulation problems may occur at the level of the fault.

Horizon H20 marks the base of this unit at –9,195ft below sea surface (1,381ft below seabed).

4.5 Unit 3

Unit 3 from -9,195ft to -9,315ft below sea surface (1,381ft to 1,501ft below seabed) presents as well-layered and slightly-chaotic, low and moderate-amplitude reflectors interpreted as clays, silts, and several sands/ marl interbeds. This interval has been disrupted and rotated out of position by the adjacent salt movement. A risk of gas anomaly associated with possible sand interbed within this interval occurs approximately 1,178ft to the north. The anomalous interbed does show connectivity with the updip well-path, hence, a **Slight Risk of Gas** is interpreted within Unit 3. Additionally, due to the presence of connectivity to downdip tilted interbeds a **Slight Shallow Water Flow Risk** is also assigned.

The well-path will not intersect any faults within Unit 3.

Horizon H30 marks the base of this unit at –9,315ft below sea surface (1,501ft below seabed).

4.6 Unit 4

Unit 4 from -9,315ft to -9,838ft below sea surface (1,501ft to 2,024ft below seabed) is characterized by significantly tilted interbeds presenting as well-layered, amorphous low amplitude reflectors interpreted as clays and silts with occasional sands.

The well-path will traverse a fault at -9,384ft below sea surface (1,570ft below seabed).

Horizon H40 marks the base of this unit and the base of this interpretation at –9,838ft below sea surface (2,024ft below seabed).

4.7 Shallow Gas Assessment

Within Unit 2 a **Slight Risk of Gas** is assigned at the level of a <30ft thick sand interbed at -8,477ft below sea surface (663ft below seabed).

Within Unit 3 a **Slight Risk of Gas** is assigned from -9,195ft to -9,315ft below sea surface (1,381ft to 1,501ft below seabed).

4.8 Shallow Water Flow Assessment

Within Unit 2 a **Slight Shallow Water Flow Risk** is assigned at the level of a <30ft thick sand interbed at -8,477ft below sea surface (663ft below seabed).

Within Unit 3 a **Slight Shallow Water Flow Risk** is assigned from -9,195ft to -9,315ft below sea surface (1,381ft to 1,501ft below seabed).

5. CONCLUSIONS AND RECOMMENDATIONS

- Seabed

  No significant hazards or problems are interpreted at the seabed.

- Unit 1

  Minor wellbore stability and drilling fluid circulation problems are possible at the level of Horizon H10 at -8,320ft below sea surface (506ft below seabed).

- Unit 2

  Within Unit 2 a **Slight Risk of Gas** and a **Slight Shallow Water Flow Risk** is interpreted at the level of a <30ft thick sand interbed occurring at -8,477ft below sea surface (663ft below seabed). Drilling Caution is advised and appropriate drilling methodology is recommended to deal with a possible short-lived non-persistent water flow event.

  Minor wellbore stability and drilling fluid circulation problems are possible within the interval from -8,785ft to -9,195ft below sea surface (971ft to 1,381ft below seabed).

  The well-path will intersect a minor fault at -8,785ft below sea surface (971ft below seabed). Minor wellbore stability and drilling fluid circulation problems may occur at the level of the fault. Casing seats should avoid all fault intersections.

- Unit 3

  Within Unit 3 a **Slight Risk of Gas** and a **Slight Shallow Water Flow Risk** is assigned from -9,195ft to -9,315ft below sea surface (1,384ft to 1,501ft below seabed). Drilling Caution is advised and appropriate drilling methodology is recommended to deal with a possible short-lived non-persistent water flow event.

- Unit 4

  Minor wellbore stability and drilling fluid circulation problems are possible within the interval from -9,315ft to -9,838ft below sea surface (1,501ft to 2,024ft below seabed).

  The well-path will intersect a fault at -9,384ft below sea surface (1,570ft below seabed). Minor wellbore stability and drilling fluid circulation problems may occur at the level of the fault. Casing seats should avoid all fault intersections.

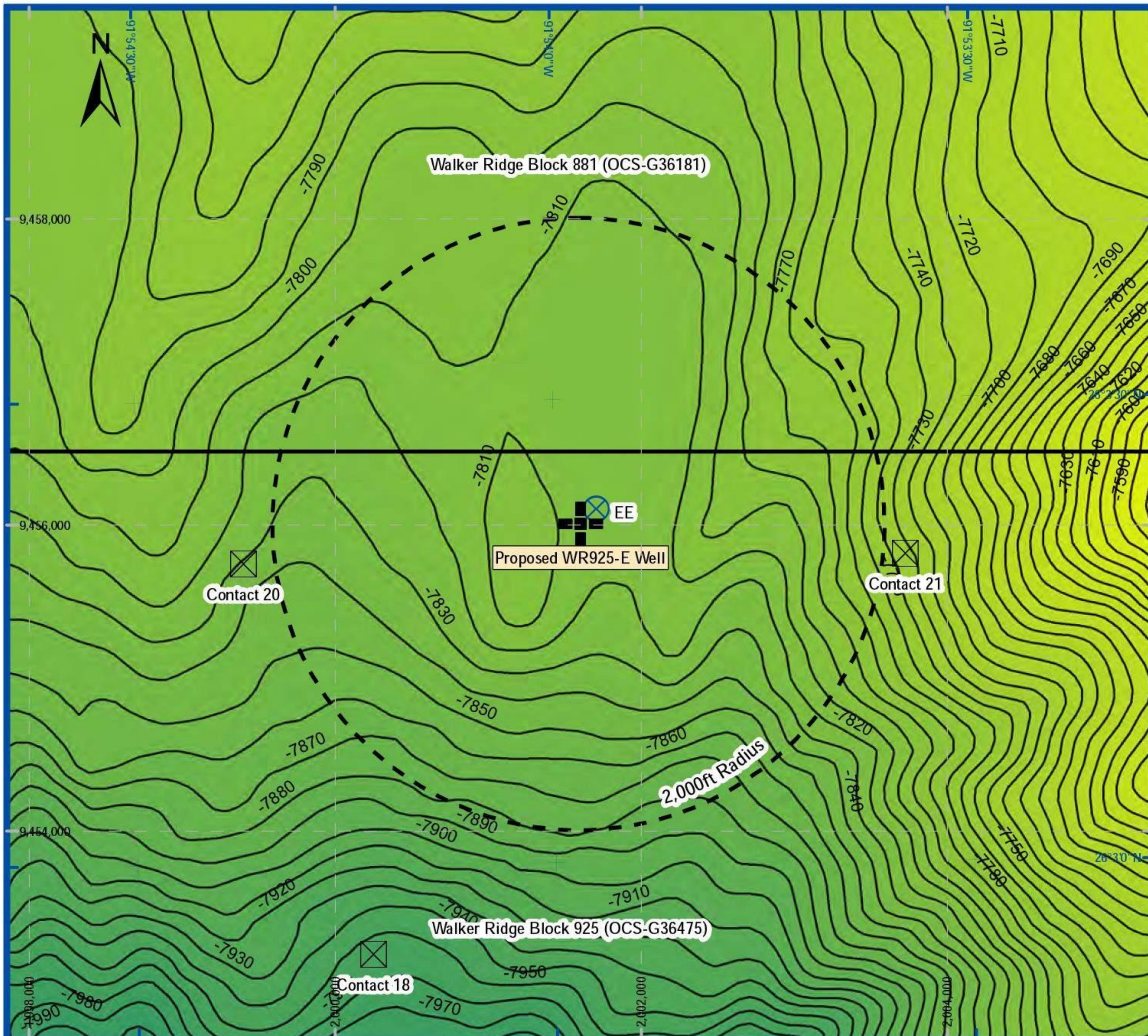
We appreciate the opportunity to work with you on this project and look forward to continuing as your geohazards consultants. Please contact us if you have any questions or if we can be of further assistance.

Sincerely,
Ocean Geo Solutions Inc.

Andrew Haigh	Denise Haigh
Geophysical Manager	Quality Assurance

Copies Submitted: 4 copies to Trey Kramer at Anadarko Petroleum Corporation

Attachments:
Proposed WR925-E Well Location
Seabed Depth Extract
Seabed Morphology Extract
Seabed Amplitude Extract
Geohazard Summary Extract
Side Scan Sonar Data Example
Seismic Profiler Data Example
Inline Data Example
Crossline Data Example
Top Hole Prognosis
ROV Plat
Power Spectrum
Bathymetry Plat
Public Information Plat
Proprietary Information Plat
Vicinity Plat
10-Mile Radius Plat



Seabed Depth Extract

- Proposed WR925-E Well Location (2,001,603ft E / 9,456,009ft N)
- Proposed EE Well Location
- Side scan sonar contact

-7814 Depth in feet below sea surface to seabed, contoured at 10ft intervals

-8800 -8600 -8400 -8200 -8000 -7800 -7600 -7400 -7200

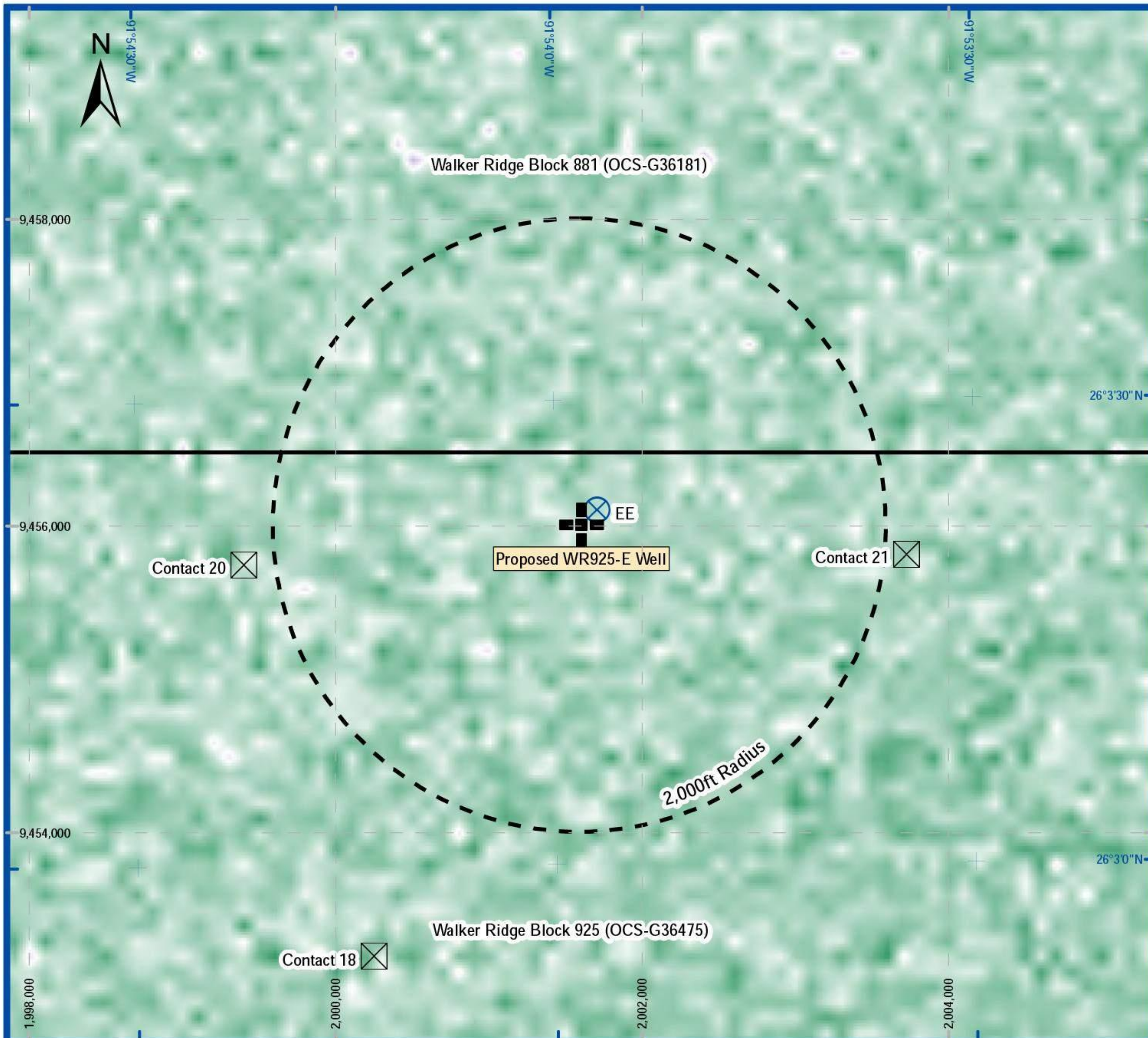
Seabed Depth (Feet)

Chart Scale 1" = 1,000'

0 500 1,000 2,000 Feet

0 150 300 600 Meters

Figure 1
(WR925-E)



Seabed Backscatter Amplitude Extract

Proposed WR925-E Well Location (2,001,603ft E / 9,456,009ft N)

Proposed EE Well Location

Side scan sonar contact

-45 -43 -41 -39 -37 -35 -33 -31 -29 -27 -25 -23 -21

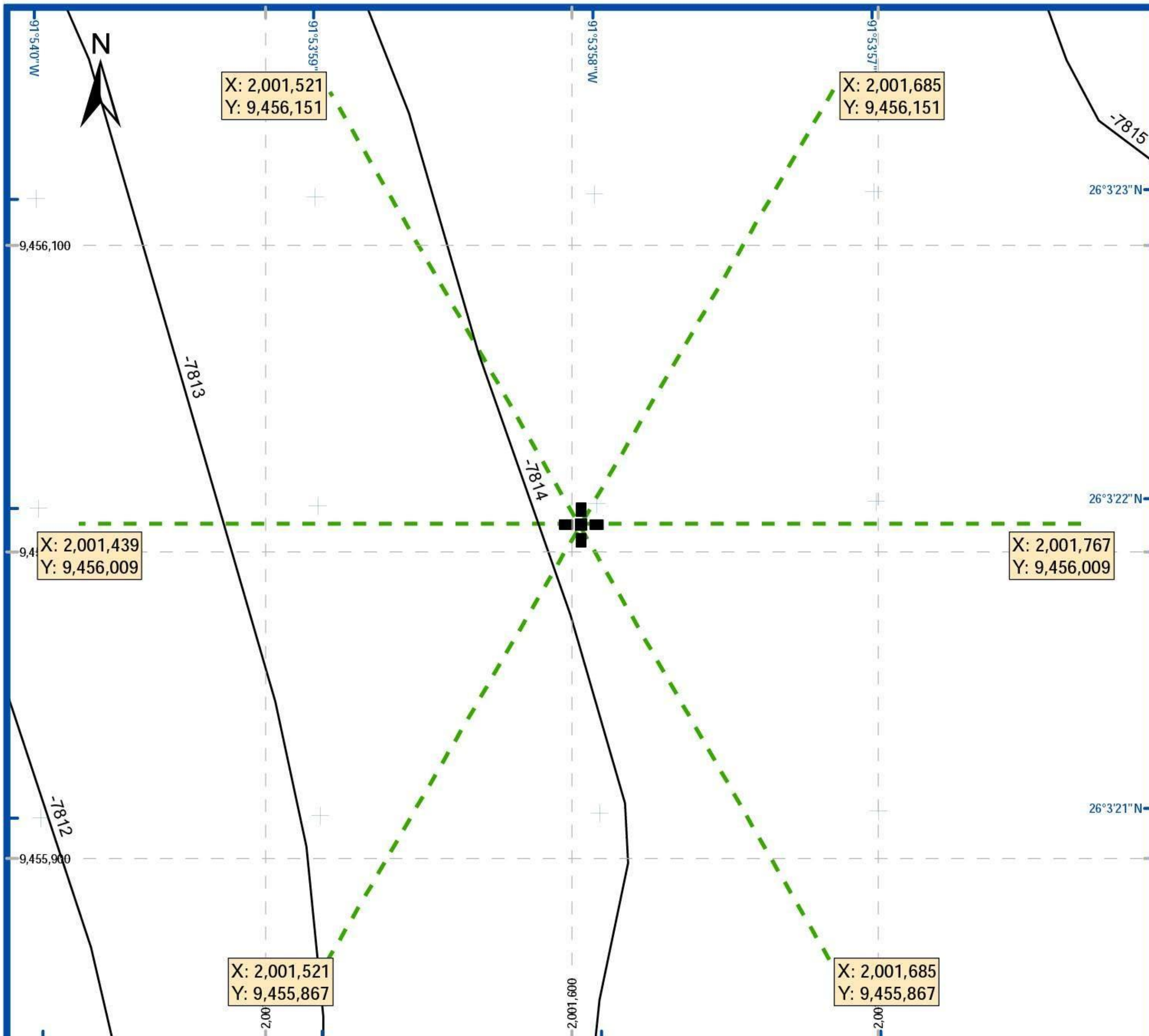
Relative Seabed Backscattered Amplitude

Chart Scale 1" = 1,000'

0 500 1,000 2,000 Feet

0 150 300 600 Meters

Figure 3
(WR925-E)



ROV Plat (WR925-E)

Proposed WR925-E Well Location
(2,001,603ft E / 9,456,009ft N)

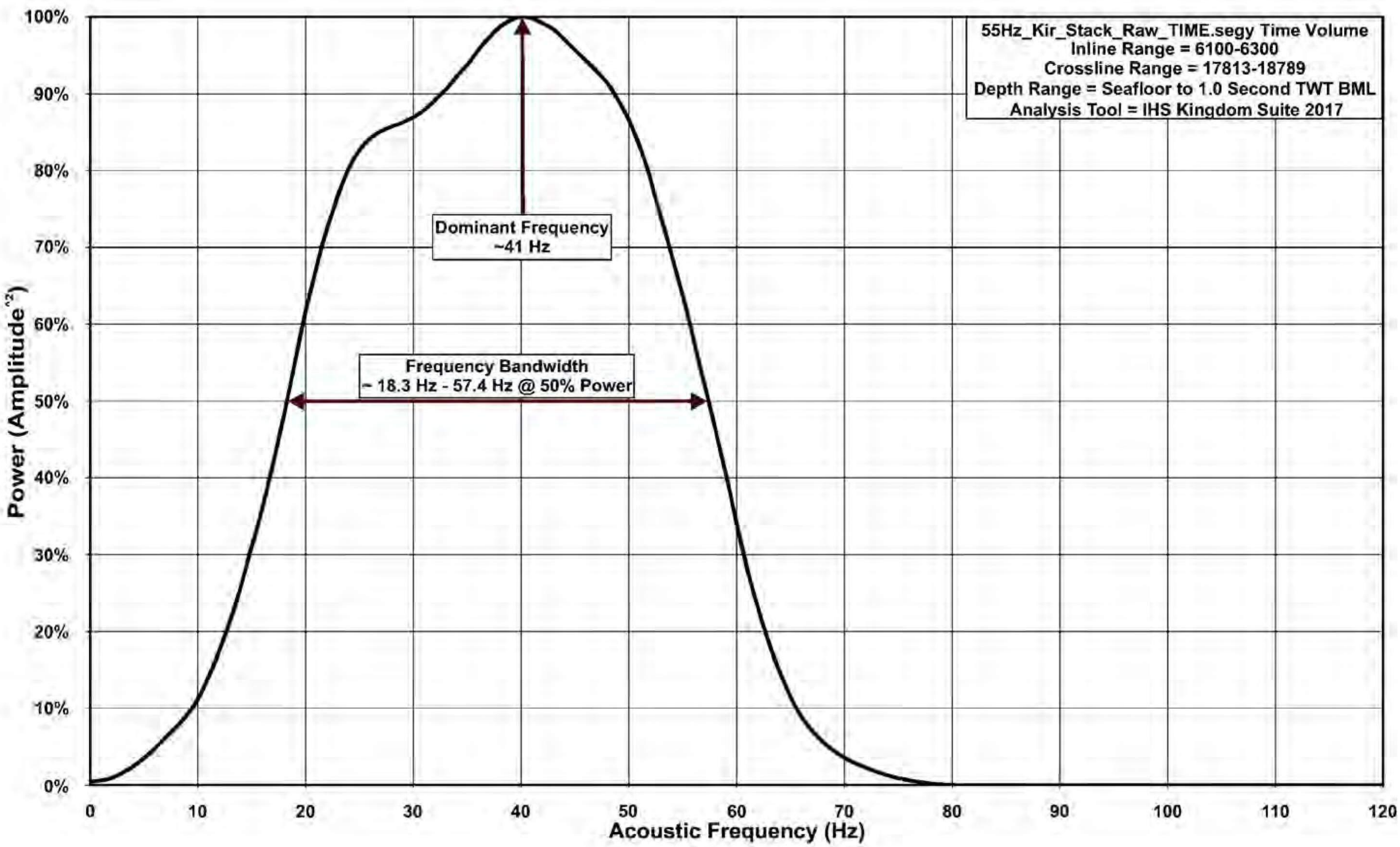
-7814 Depth in feet below sea surface to seabed, contoured at 1ft intervals

Chart Scale 1" = 50'

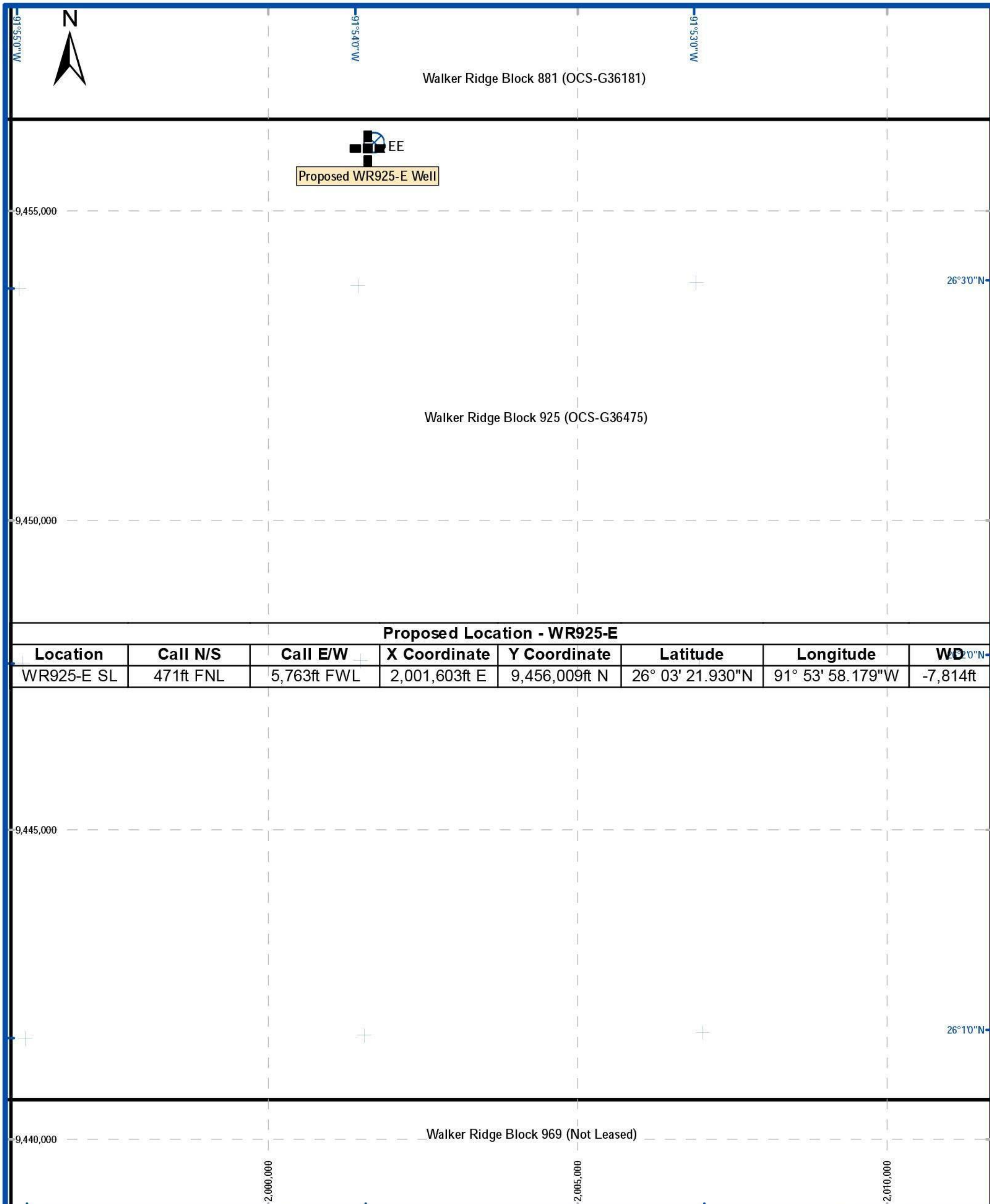
0 50 100 200 Feet

0 12.5 25 50 Meters

Figure 10
(WR925-E)



WR925-E	Power Spectrum	Figure 11



Proposed Location - WR925-E

Location	Call N/S	Call E/W	X Coordinate	Y Coordinate	Latitude	Longitude	WD
WR925-E SL	471ft FNL	5,763ft FWL	2,001,603ft E	9,456,009ft N	26° 03' 21.930"N	91° 53' 58.179"W	-7,814ft

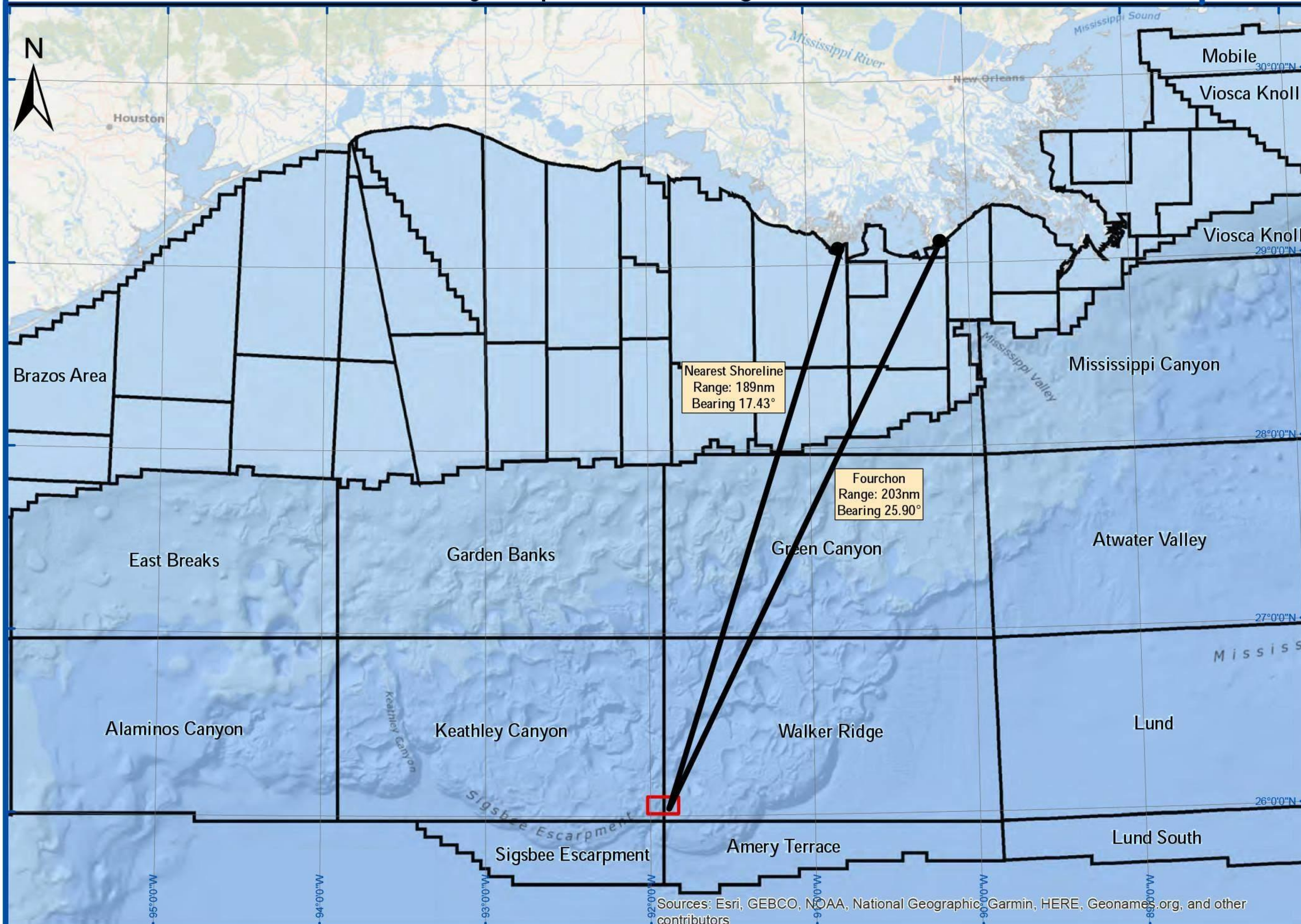
Chart scale 1" = 2,000'
0 500 1,000 2,000 Feet
0 125 250 500 Meters

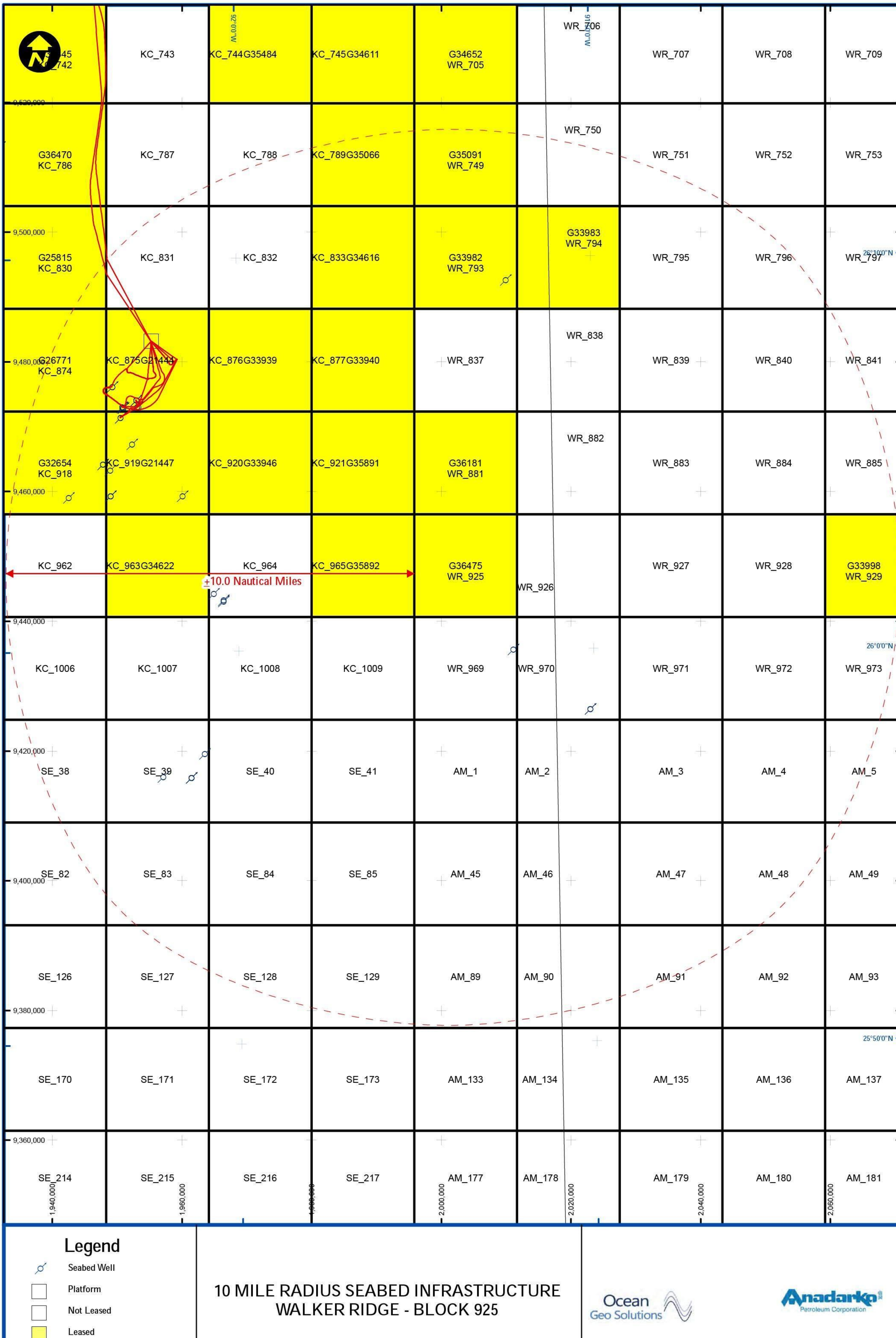
Well Location Plat - Public Information

Figure 13

Vicinity Map - Walker Ridge Block 925

Figure 15





10 MILE RADIUS SEABED INFRASTRUCTURE
WALKER RIDGE - BLOCK 925

0 5 10 Miles

1 inch = 2.5 miles

Ocean Geo Solutions

Anadarko Petroleum Corporation

March 25, 2019

Figure 16

APPENDIX A – PUBLIC SHALLOW HAZARDS STATEMENTS

Public Shallow Hazards Statement – Proposed WR925-E Location

March 25, 2019

US Department of the Interior
Bureau of Ocean Energy Management
1201 Elmwood Park Blvd.
New Orleans, LA 70213-2394

Reference: Shallow Hazards Analysis
Walker Ridge Block 925
(OCS-G 36475)

Ladies/Gentlemen:

Anadarko Petroleum Corporation contracted Ocean Geo Solutions Inc. to prepare a Well Clearance Letter for the Proposed WR925-E well location in Block 925, Walker Ridge Area (OCS-G-36475). This letter addresses seabed and shallow geologic conditions that may impact exploratory drilling operations within 2,000ft of the proposed well site. The depth limit of this site clearance assessment is Horizon H40 at -9,838ft below sea surface (2,024ft below seabed)

Seabed Hazards. The proposed location exhibits a smooth seabed. The proposed well is located within two-relief undulations that are part of a rugose seabed to the south of the proposed well. No seabed hazards are expected at the proposed well.

There are no anomalous seabed amplitudes indicative of hydrocarbon macro-seep observed within a 2,000ft radius of the proposed location. Backscatter data shows relatively uniform amplitudes associated with clays and silt drape. No seabed fluid venting areas were identified within 2,000ft of the proposed well and no sites were identified in the study area. Several areas exhibiting over consolidated seabed were identified. The nearest area with over consolidated seabed is located 8,871ft to the northwest of the proposed well.

No existing seabed infrastructure occurs within 2,000ft of the proposed well.

The archeological assessment did not identify any seabed contacts within 2,000ft of the proposed well. The nearest sonar contact (Contact 21) is located 2,107ft to the east. According to the Archaeological report produced by Fugro, Contact 21 is described as possible modern debris with a width of 5.3ft, <1.0ft in height, and 13.5ft in length. Contact 20 is located 2,172ft to the ESE. This contact is also described as possible modern debris with a width of 6.3ft, <1.0ft in height, and 18.8ft in length.

Sub-Seabed Hazards. No identified amplitude anomalies indicative of shallow gas occur at the well-path. A sand interbed within Unit 2 and an interval within Unit 3 has been assigned a **Slight Risk of Gas**. The well-path will penetrate two small faults in Units 2 and 4.

A **Slight Shallow Water Flow Risk** is assigned to the level of an interbed in Unit 2 and within an interval in Unit 3.

Intervals of possible sands may induce minor wellbore and drilling fluid circulation problems.

Proposed WR925-E Well Location (Surface)							
Location Coordinates							
NAD 27 Datum - Clarke 1866 Ellipsoid				UTM Zone 15 - CM 93° West			
Latitude	26°	03'	21.930"	North	Easting	2,001,603	US ft. E
Longitude	91°	53'	58.179	West	Northing	9,456,009	US ft. N
FWL Walker Ridge 925		5,763ft	US ft.	Inline	6253		
FNL Walker Ridge 925		471ft	US ft.	Crossline	18613		
Water Depth: -7,814ft.		Slope: <1.0° ESE					
Nearest Shoreline		189 Nautical Miles @ 17.43°					
Port of Operation Fourchon		203 Nautical Miles @ 25.90°					
Nearest Manned Platform		A-Structure (Lucius) KC875		9.0 Nautical Miles @ 298°			

Proposed WR925-EE Well Location (Surface)							
Location Coordinates							
NAD 27 Datum - Clarke 1866 Ellipsoid				UTM Zone 15 - CM 93° West			
Latitude	26°	03'	22.915"	North	Easting	2,001,703	US ft. E
Longitude	91°	53'	57.077	West	Northing	9,456,109	US ft. N
FWL Walker Ridge 925		5,863ft	US ft.	Inline	6253		
FNL Walker Ridge 925		371ft	US ft.	Crossline	18621		
Water Depth: -7,815ft.		Slope: <1.0° SE					
Nearest Shoreline		189 Nautical Miles @ 17.43°					
Port of Operation Fourchon		203 Nautical Miles @ 25.90°					
Nearest Manned Platform		A-Structure (Lucius) KC875		9.0 Nautical Miles @ 301°			

Conclusions and Recommendations. No major problems are anticipated at the seabed. No existing seabed infrastructure occurs within 2,000ft of the proposed well. The nearest sonar contact (Contact 21) is located 2,107ft to the east. According to the Archaeological report produced by Fugro, Contact 21 is described as possible modern debris with a width of 5.3ft, <1.0ft in height, and 13.5ft in length. Contact 20 is located 2,172ft to the ESE. This contact is also described as possible modern debris with a width of 6.3ft, <1.0ft in height, and 18.8ft in length

A **Slight Risk of Gas** is interpreted at the level of a sand interbed in Unit 2 and an interval within Unit 3. A **Slight Shallow Water Flow Risk** is assigned to the same interbed in Unit 2 and within an interval in Unit 3. The well-path will traverse a fault in Unit 2 and Unit 4.

Sincerely,
Anadarko Petroleum Corporation

APPENDIX B – Sensitive Sessile Benthic Community Statement

Sensitive Sessile Benthic Communities Statement – Proposed WR925-E Well Location

Anadarko Petroleum Corporation.

March 25, 2019

US Department of the Interior
Bureau of Ocean Energy Management
1201 Elmwood Park Blvd.
New Orleans, LA 70213

Reference: Sensitive Sessile Benthic Community Summary
Proposed WR925-E Well Location in Walker Ridge WR925 (OCS-G 36475)

Ladies/Gentlemen:
Anadarko Petroleum Corporation contracted Ocean Geo Solutions Inc. to prepare a Well Clearance Letter for the Proposed WR925-E well location in Block 925, Walker Ridge Area (OCS-G-36475). This letter addresses location proximity to potential sensitive sessile benthic community sites. This well will be drilled from a dynamically-positioned drilling module; therefore, an anchoring assessment is not required.

This sensitive sessile benthic community summary letter is issued as a supplement to the Well Clearance Letter for this proposed well. A Biological, Physical and Socio-economic Map is included illustrating the areas of potential seabed impact.

Potential Sensitive Sessile Benthic Communities
Features or areas that could support high-density sensitive sessile benthic communities are *not* located within 2,000 feet of any proposed mud and cuttings discharge location. No areas with the potential to host benthic communities were identified within the study area.

Backscatter data shows relatively uniform amplitudes associated with clays and silt drape. No seabed fluid venting areas were identified within 2,000ft of the proposed well and no sites were identified in the study area. Several areas exhibiting over consolidated seabed were identified. The nearest area with over consolidated seabed is located 8,871ft to the northwest of the proposed well. *These areas do not have any fluid venting at the seabed.*

The archeological assessment did not identify any seabed contacts within 2,000ft of the proposed well. The nearest sonar contact (Contact 21) is located 2,107ft to the east. According to the Archaeological report produced by Fugro, Contact 21 is described as possible modern debris with a width of 5.3ft, <1.0ft in height, and 13.5ft in length. Contact 20 is located 2,172ft to the ESE. This contact is also described as possible modern debris with a width of 6.3ft, <1.0ft in height, and 18.8ft in length.

Proposed WR925-E Well Location (Surface)							
Location Coordinates							
NAD 27 Datum - Clarke 1866 Ellipsoid					UTM Zone 15 - CM 93° West		
Latitude	26°	03'	21.930"	North	Easting	2,001,603	US ft. E
Longitude	91°	53'	58.179	West	Northing	9,456,009	US ft. N
FWL Walker Ridge 925	5,763ft	US ft.	Inline	6253			
FNL Walker Ridge 925	471ft	US ft.	Crossline	18613			
Water Depth: -7,814ft.	Slope: <1.0° ESE						
Nearest Shoreline	189 Nautical Miles @ 17.43°						
Port of Operation Fourchon	203 Nautical Miles @ 25.90°						
Nearest Manned Platform	A-Structure (Lucius) KC875	9.0 Nautical Miles @ 298°					

Proposed WR925-EE Well Location (Surface)							
Location Coordinates							
NAD 27 Datum - Clarke 1866 Ellipsoid					UTM Zone 15 - CM 93° West		
Latitude	26°	03'	22.915"	North	Easting	2,001,703	US ft. E
Longitude	91°	53'	57.077	West	Northing	9,456,109	US ft. N
FWL Walker Ridge 925	5,863ft	US ft.	Inline	6253			
FNL Walker Ridge 925	371ft	US ft.	Crossline	18621			
Water Depth: -7,815ft.	Slope: <1.0° SE						
Nearest Shoreline	189 Nautical Miles @ 17.43°						
Port of Operation Fourchon	203 Nautical Miles @ 25.90°						
Nearest Manned Platform	A-Structure (Lucius) KC875	9.0 Nautical Miles @ 301°					

There are no areas with the potential to host a Sensitive Sessile Benthic Community within 2,000ft of the proposed location.

Conclusions and Recommendations: The Proposed WR925-E and the proposed WR925-EE Well Locations in WR925 will not impact any sites favorable for the development of sensitive sessile benthic communities.

Sincerely,
Anadarko Petroleum Corporation

SECTION D
HYDROGEN SULFIDE INFORMATION

Discussions regarding geologic information are considered proprietary and have been omitted from this public copy of the EP.

In accordance with 30 CFR 250.490(c), Anadarko requests that the area of proposed operations be classified by the BOEM as H_2S absent.

H_2S Contingency Plan

An H_2S Contingency Plan is not required for the activities proposed in this plan.

Modeling Report

Modeling reports are not required for the activities proposed in this plan.

SECTION E
BIOLOGICAL, PHYSICAL, AND SOCIOECONOMIC INFORMATION

(a) Chemosynthetic Communities Report

The seafloor disturbing activities proposed in this plan are in approximately 7,560'-7,815' of water. The wells will be drilled with a DP drillship or DP semi-submersible.

Maps

A map prepared using 3-D seismic data to depict bathymetry, seafloor and shallow geological features, and surface locations of the proposed wells is included in **Section C.**

Analysis

Features or areas that could support high-density chemosynthetic communities are not located within 2,000' of each proposed muds and cuttings discharge location.

Features or areas that could support high-density chemosynthetic communities are not located within 250' of any seafloor disturbances.

(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 2008-G04, extended by NTL 2015-N02.

(c) Topographic Features Statement (Shunting)

Anadarko 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 2008-G04, extended by NTL 2015-N02, 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 2008-G04, extended by NTL 2015-N02.

(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 2008-G04, extended by NTL 2015-N02.

(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 2008-G04, extended by NTL 2015-N02.

(g) 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 550, Subpart B, effective May 14, 2007, and further outlined in Notice to Lessees (NTL) 2008-G04 (extended by NTL 2015-N02), 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:

Species	Scientific Name	Status	Potential Presence		Critical Habitat Designated in Gulf of Mexico
			Lease Area	Coastal	
Marine Mammals					
Sperm whale	*Physeter macrocephalus*	E	X	--	None
Florida manatee	*Trichechus manatus latirostris*	E	--	X	Florida (Peninsular)
Blue whale	*Balaenoptera musculus*	E	X[a]	--	None
Fin whale	*Balaenoptera physalus*	E	X[a]	--	None
Humpback whale	*Megaptera novaeangliae*	E	X[a]	--	None
North Atlantic right whale	*Eubalaena glacialis*	E	X[a]	--	None
Sei whale	*Balaenoptera borealis*	E	X[a]	--	None
Sea Turtles					
Loggerhead turtle	*Caretta caretta*	T	X	X	None
Green turtle	*Chelonia mydas*	T, E[b]	X	X	None
Leatherback turtle	*Dermochelys coriacea*	E	X	X	None
Hawksbill turtle	*Eretmochelys imbricata*	E	X	X	None
Kemp's ridley turtle	*Lepidochelys kempii*	E	X	X	None
Birds					
Piping Plover	*Charadrius melodus*	T	--	X	Coastal Texas, Louisiana, Mississippi, Alabama, and Florida (Panhandle)
Whooping Crane	*Grus americana*	E	--	X	Coastal Texas (Aransas National Wildlife Refuge)
Fishes					
Gulf sturgeon	*Acipenser oxyrinchus desotoi*	T	--	X	Coastal Louisiana, Mississippi, Alabama, and Florida (Panhandle)
Terrestrial Mammals					
Beach mice (Alabama, Choctawhatchee, Perdido Key, St. Andrew)	*Peromyscus polionotus*	E	--	X	Alabama and Florida (Panhandle) beaches

Abbreviations: E = Endangered; T = Threatened.

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

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

The Environmental Impact Analysis in **Section N** of this plan further discusses potential impacts and mitigation measures related to threatened and endangered species.

(h) Archaeological Report

Walker Ridge 881/925 is not located in an area designated as having high archaeological potential and, as such, an Archaeological Report is not required per NTL No. 2011-JOINT-G01. However, an Archaeological Report prepared by Fugro covering Keathley Canyon 920/921/965 and Walker Ridge 881/925 (Fugro Document No.: 02.18031334-Magnus) has been included with this submittal for each of the locations proposed under the EP. The survey was conducted in accordance with the latest guidelines established by the BOEMRE in 2011.

(i) Air and Water Quality Information

This EP does not propose activities for which the State of Florida is an affected State. Therefore, the discussion required per NTL 2008-G04, extended by NTL 2015-N02, is not applicable to this EP.

(j) Socioeconomic Information

The activities proposed in this plan are not located offshore Florida. Therefore, socioeconomic information required per NTL 2008-G04, extended by NTL 2015-N02, is not applicable to this EP.

SECTION F
WASTE AND DISCHARGE INFORMATION

The following estimates were prepared utilizing Anadarko's experience with similar drilling operations. Estimated maximum discharge rates are reflected below.

(a) Projected Generated Wastes

Type of Waste	Composition	Projected Amount	Treatment/Storage/Disposal
Synthetic-based drilling fluids	Synthetic-based drilling muds	16,000 bbls/well	Re-use and/or transport to shore on vessel in DOT approved containers to Fourchon, Louisiana and on to base/transfer station. If recycled, returned to vendor (Bariod or MI).
Cuttings wetted with synthetic-based fluids	Cuttings coated with synthetic drilling muds/fluids, including drilled out cement	8,215 bbls/well	Treated and discharge overboard **Note, an estimated 5-10% of cuttings may be transported to shore in DOT approved containers and on to the base/transfer station if oil still remains.*
Water-based drilling fluids	Water based drilling muds (NaCl saturated, seawater, freshwater, barite)	80,000 bbls/well*	Discharge overboard or at seafloor
Cuttings wetted with water-based fluids	Cuttings coated with water-based drilling muds/fluids	1,976 bbls/well	Discharge overboard
Chemical product waste (well treatment fluids)	Ethylene glycol Methanol	3,667 bbls total 917 bbls total	Transport to shore on vessel in DOT approved containers to Fourchon, Louisiana for pick up.
Completion Fluids	Brine, spent acid, prop sand, debris	3,000 bbls/well	Transport to shore on vessel in DOT approved containers to Fourchon, Louisiana and on to Newpark Base.
Non-pollutant completion fluids	Low density uninhibited completion brines	5,000 bbls/well	Discharge overboard
Workover fluids	Brine, spent acid, prop sand, debris	3,000 bbls/well	Transport to shore on vessel in DOT approved containers to Fourchon, Louisiana and on to Newpark Base.
Trash and debris	Refuse generated during operations	1,833 bbls total	Transport to shore on vessel in disposal bags by vessel to shorebase for pickup by municipal operations. An approved waste disposal facility will be utilized, such as Recycled Material in ARC, New Iberia, LA. Trash disposed of at SWDI landfill.
*Sanitary Wastes	Treated human body waste	5,500,000 gals total	Chlorinate and discharge overboard
*Domestic Waste	Gray water	5,500,000 gals total	Chlorinate and discharge overboard
Deck drainage	Platform washings and rainwater	3,850,000 bbls total	Treat for oil and grease and discharge overboard
Produced water	N/A	N/A	N/A
Desalinization Unit	Seawater	385,000 bbls total	Discharge overboard
Wash water	Drill water (fresh)	55,000 bbls total	Discharge overboard
Blowout preventer fluid	Blend (3% Stack Magic & Filtered Fresh Water)	145,357 gals total	Discharge at seafloor
Ballast water	Seawater	47,650 m3/year	Discharge overboard

Cont.

Bilge water	Seawater	348,700 bbls total	Discharge overboard through 15 ppm equipment
Excess cement at the seafloor	Nitrified cement slurry	1,500 bbls/well	Discharge at seafloor
Fire water	Seawater	137,142 bbls/day/well	Discharge overboard
Cooling water	Seawater	137,142 bbls/day/well	Discharge overboard
Produced Sand	N/A	N/A	N/A
Used oil	Excess oil from engines	3,942 bbls total	Transport in DOT approved containers to shore for recycling at an approved facility such as Martin Energy Services in Jennings, LA or Aaron Oil Company in Berwick, LA.

***The actual volume ordered out will be an estimated 30,000 bbls/well of mud. Once on location this volume will be cut back and mixed with seawater to different desired mud weights which will increase the volume that is discharged at the seafloor. The estimated volume that will be discharged at the seafloor will be approximately 100,000 bbls/well.*

(b) Projected Ocean Discharges

Type of Waste	Total Amount to be Discharged	Discharge Rate	Discharge Method
*Sanitary Wastes	5,500,000 gals total	25 gals per person daily	Chlorinate and discharge overboard
*Domestic waste	5,500,000 gals total	25 gals per person daily	Chlorinate and discharge overboard
Deck drainage	3,850,000 bbls total	3,500 bbls/day/well	Treat for oil and grease and discharge
Blowout preventer fluid	145,357 gals total	925 gals/week/well; Vents on a weekly basis	Discharge at seafloor
Desalinization Unit	385,000 bbls total	350 bbls/day/well	Discharge overboard
Wash water	55,000 bbls total	50 bbls/day/well	Discharge overboard
Ballast water	47,650 m3/year total	Not continuous	Discharge overboard
Bilge water	348,700 bbls total	317 bbls/day/well	Discharge overboard through 15 ppm equipment
Excess cement at the seafloor	16,500 bbls total	20 bbls/min	Discharge at seafloor
Fire water	150,856,200 bbls total	137,142 bbls/day/well	Discharge overboard
Cooling water	150,856,200 bbls total	137,142 bbls/day/well	Discharge overboard
Cuttings wetted with Water-based fluids	21,736 bbls total	1,000 bbls/hr max	Discharge overboard
Water-based drilling fluids	880,000 bbls total**	1,000 bbls/hr max	Discharge overboard or at seafloor
Cuttings wetted with Synthetic-based fluids	90,364 bbls total	N/A	Treated and discharge overboard **Note, an estimated 5-10% of cuttings may be transported to shore in DOT approved containers and on to the base/transfer station if oil still remains.*
Non-pollutant completion fluids	55,000 bbls total	100 bbl/hour	Discharge overboard

**The rig is designed for maximum personnel capacity of 200 people. The discharge rates are based off of maximum personnel capacity but will generally not have this many personnel onboard during drilling and/or completion operations.*
***The volume ordered out will be an estimated 35,000 bbls/well of mud. Once on location this volume will be cut back and mixed with seawater to different desired mud weights which will increase the volume that is discharged at the seafloor. The estimated volume that will be discharged at the seafloor will be approximately 80,000 bbls/well. (80,000 bbls/well x 11 well locations=880,000 bbls total)*
****The rate for cuttings wetted with synthetic-based fluids varies depending on the hole section and the stage of the actual drilling process. Therefore the estimated maximum daily average for the largest hole section has been denoted, as smaller hole sections will have a decreased rate.*

(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 2008-G04, extended by NTL 2015-N02, is not applicable to this EP.

SECTION G
AIR EMISSIONS INFORMATION

(a) Screening Questions

Screening Questions for EP's	Yes	No
Is any calculated Complex Total (CT) Emission amount (in tons) associated with your proposed exploration activities more than 90% of the amounts calculated using the following formulas: $CT = 3400D^{2/3}$ for CO, and $CT = 33.3D$ for the other air pollutants (where D = distance to shore in miles)?		No
Do your emission calculations include any emission reduction measures or modified emission factors?		No
Are your proposed exploration activities located east of 87.5 W longitude?		No
Do you expect to encounter H_2S at concentrations greater than 20 parts per million (ppm)?		No
Do you propose to flare or vent natural gas for more than 48 continuous hours from any proposed well?		No
Do you propose to burn produced hydrocarbon liquids?		No

(b) Emissions Worksheets

Air emission worksheets have been prepared utilizing the maximum horsepower rating from an Anadarko contracted DP drillship, the *Diamond Ocean BlackHawk.* The Diamond *Ocean BlackHawk* has six main engines. The average number of engines on-line at once will be four engines. A different rig may be utilized (DP drillship or DP semi-submersible); but the horsepower rating, average engine load, and air emissions will be equal to, or less than, the calculated plan emission amounts shown on the following pages. Air emission worksheets are enclosed as **Attachment G-1.**

(c) Summary Information

The following table summarizes information regarding the peak year emissions generated from the Plan Emissions and Complex Total Emissions for Walker Ridge 881/925:

If drilled with a DP Drillship or a DP Semi-Submersible (Horsepower equal to, or less than, the *Diamond Ocean BlackHawk*):

WR 881 (Surface)

Air Pollutant		Plan Emission Amounts[1] (tons)	Calculated Exemption Amounts[2] (tons)		Calculated Complex Total Emission Amounts[3] (tons)
Particulate matter (PM)		58.64	7,026.30		115.80
Sulphur dioxide (SO_2)		33.63	7,026.30		66.41
Nitrogen oxides (NO_x)		2,016.44	7,026.30		3,981.51
Volatile organic compounds (VOC)		61.07	7,026.30		120.03
Carbon monoxide (CO)		443.68	120,503.75		872.42

***Plan emissions amounts (tons) are based on 100 days per well.**

****The complex total emission amounts (tons) are based on 2 wells per year for 200 days total.**

WR 925 (Surface)

Air Pollutant		Plan Emission Amounts[1] (tons)	Calculated Exemption Amounts[2] (tons)		Calculated Complex Total Emission Amounts[3] (tons)
Particulate matter (PM)		58.64	7,026.30		58.64
Sulphur dioxide (SO_2)		33.63	7,026.30		33.63
Nitrogen oxides (NO_x)		2,016.44	7,026.30		2,016.44
Volatile organic compounds (VOC)		61.07	7,026.30		61.07
Carbon monoxide (CO)		443.68	120,503.75		443.68

***Plan emissions amounts (tons) are based on 100 days per well.**

****The complex total emission amounts (tons) are based on 1 well per year for 100 days total.**

Please note the emissions are below the allowable emission threshold for each block.

The air emission calculations were calculated by:

Bridget O’Farrell
Regulatory Analyst
(832) 636-1694
Bridget.OFarrell-Villarreal@anadarko.com

EXPLORATION PLAN (EP)
AIR QUALITY SCREENING CHECKLIST

COMPANY	Anadarko Petroleum Corporation
AREA	WR
BLOCK	881
LEASE	G36181
PLATFORM	
WELL	WR 881 A,AA,B,D,F,FF;WR 925 A Alt., AA Alt., AAA Alt.
COMPANY CONTACT	Bridget O'Farrell
TELEPHONE NO.	832-636-1694
REMARKS	Drill/complete 9 wells with surface location(s) in WR 881

Proposed Activity	Start Date	End Date	No. of Days
Drill, complete, conduct flowtest-WR 881 Location A	11/16/2019	2/24/2020	100 (2019=60, 2020=40)
Drill, complete, conduct flowtest-WR 925 Location A Alt.	2/25/2020	6/4/2020	100 (2020)
Drill, complete, conduct flowtest-WR 925 Location AA Alt.	3/01/2021	6/09/2021	100 (2021)
Drill, complete, conduct flowtest-WR 881 Location F	5/01/2022	8/09/2022	100 (2022)
Drill, complete, conduct flowtest-WR 881 Location B	9/15/2022	12/24/2022	100 (2022)
Drill, complete, conduct flowtest-WR 881 Location AA	3/01/2023	6/09/2023	100 (2023)
Drill, complete, conduct flowtest-WR 881 Location D	5/1/2024	8/09/2024	100 (2024)
Drill, complete, conduct flowtest-WR 925 Location AAA Alt.	1/1/2025	4/11/2025	100 (2025)
Drill, complete, conduct flowtest-WR 881 Location F	1/01/2026	4/11/2026	100 (2026)

EMISSIONS FACTORS

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

Equipment/Emission Factors	units	PM	SOx	NOx	VOC	CO	REF.	DATE
NG Turbines	gms/hp-hr		0.00247	1.3	0.01	0.83	AP42 3.2-1& 3.1-1	10/96
NG 2-cycle lean	gms/hp-hr		0.00185	10.9	0.43	1.5	AP42 3.2-1	10/96
NG 4-cycle lean	gms/hp-hr		0.00185	11.8	0.72	1.6	AP42 3.2-1	10/96
NG 4-cycle rich	gms/hp-hr		0.00185	10	0.14	8.6	AP42 3.2-1	10/96
Diesel Recip. < 600 hp.	gms/hp-hr	1	0.1835	14	1.12	3.03	AP42 3.3-1	10/96
Diesel Recip. > 600 hp.	gms/hp-hr	0.32	0.1835	11	0.33	2.4	AP42 3.4-1	10/96
Diesel Boiler	lbs/bbl	0.084	0.3025	0.84	0.008	0.21	AP42 1.3-12,14	9/98
NG Heaters/Boilers/Burners	lbs/mmscf	7.6	0.593	100	5.5	84	P42 1.4-1, 14-2, & 14	7/98
NG Flares	lbs/mmscf		0.593	71.4	60.3	388.5	AP42 11.5-1	9/91
Liquid Flaring	lbs/bbl	0.42	6.83	2	0.01	0.21	AP42 1.3-1 & 1.3-3	9/98
Tank Vapors	lbs/bbl				0.03		E&P Forum	1/93
Fugitives	lbs/hr/comp.				0.0005		API Study	12/93
Glycol Dehydrator Vent	lbs/mmscf				6.6		La. DEQ	1991
Gas Venting	lbs/scf				0.0034			

Sulphur Content Source	Value	Units
Fuel Gas	3.33	ppm
Diesel Fuel	0.05	% weight
Produced Gas(Flares)	3.33	ppm
Produced Oil (Liquid Flaring)	1	% weight

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT	PHONE	REMARKS
Anadarko Petroleum Corporation	WR	881	G36181		WR 881 A,AA,B,D,F,FF;WR 925 A Alt., AA Alt., AAA Alt.		Bridget O'Farrell	832-636-1694	

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	D/YR	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
DRILLING	PRIME MOVER>600hp diesel	60348	2914.8084	69955.40	24	60	42.54	24.39	1462.18	43.87	319.02	30.63	17.56	1052.77	31.58	229.69
	PRIME MOVER>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	PRIME MOVER>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	PRIME MOVER>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	BURNER diesel	0			0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	AUXILIARY EQUIP<600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3 days/week	VESSELS>600hp diesel(crew)	10800	521.64	12519.36	24	26	7.61	4.37	261.67	7.85	57.09	2.38	1.36	81.64	2.45	17.81
2 days/week	VESSELS>600hp diesel(supply)	9266	447.5478	10741.15	24	17	6.53	3.75	224.51	6.74	48.98	1.33	0.76	45.80	1.37	9.99
Support Vessel	VESSELS>600hp diesel	27493	1327.9119	31869.89	24	6	19.38	11.11	666.13	19.98	145.34	1.40	0.80	47.96	1.44	10.46
FACILITY	DERRICK BARGE diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTALLATION	MATERIAL TUG diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(crew)	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(supply)	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	MISC.	BPD	SCF/HR	COUNT												
	TANK-	0			0	0				0.00					0.00	
DRILLING	OIL BURN	0			0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WELL TEST	GAS FLARE		416666		24	2		0.25	29.75	25.12	161.87		0.01	0.71	0.60	3.88
2019	YEAR TOTAL						76.06	43.86	2644.24	103.56	732.31	35.73	20.49	1228.88	37.45	271.85
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES											7026.30	7026.30	7026.30	7026.30	120503.75
	211.0															

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT	PHONE	REMARKS
Anadarko Petroleum Corporation	WR	881	G36181		WR 881 A,AA,B,D,F,FF;WR 925 A Alt., AA Alt., AAA Alt.		Bridget O'Farrell	832-636-1694	

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	D/YR	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
DRILLING	PRIME MOVER>600hp diesel	60348	2914.8084	69955.40	24	140	42.54	24.39	1462.18	43.87	319.02	71.46	40.98	2456.46	73.69	535.95
	PRIME MOVER>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	PRIME MOVER>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	PRIME MOVER>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	BURNER diesel	0			0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	AUXILIARY EQUIP<600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3 days/week	VESSELS>600hp diesel(crew)	10800	521.64	12519.36	24	60	7.61	4.37	261.67	7.85	57.09	5.48	3.14	188.41	5.65	41.11
2 days/week	VESSELS>600hp diesel(supply)	9266	447.5478	10741.15	24	40	6.53	3.75	224.51	6.74	48.98	3.13	1.80	107.76	3.23	23.51
Support Vessel	VESSELS>600hp diesel	27493	1327.9119	31869.89	24	6	19.38	11.11	666.13	19.98	145.34	1.40	0.80	47.96	1.44	10.46
FACILITY	DERRICK BARGE diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTALLATION	MATERIAL TUG diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(crew)	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(supply)	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	MISC.	BPD	SCF/HR	COUNT												
	TANK-	0			0	0				0.00					0.00	
DRILLING	OIL BURN	0			0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WELL TEST	GAS FLARE		416666		24	2		0.25	29.75	25.12	161.87		0.01	0.71	0.60	3.88
2020	YEAR TOTAL						**76.06**	**43.86**	**2644.24**	**103.56**	**732.31**	**81.47**	**46.72**	**2801.30**	**84.62**	**614.92**
EXEMPTION CALCULATION	**DISTANCE FROM LAND IN MILES**											**7026.30**	**7026.30**	**7026.30**	**7026.30**	**120503.75**
	211.0															

(1) NOx emission factors is based on engine manufacture data. The main engines are IMO Tier II certified engines.

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL	CONTACT	PHONE	REMARKS
Anadarko Petroleum Corporation	WR	881	G36181		WR 881 A,AA,B,D,F,FF;WR 925 A Alt., AA Alt., AAA Alt.	Bridget O'Farrell	832-636-1694	

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	D/YR	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
DRILLING	PRIME MOVER>600hp diesel	60348	2914.8084	69955.40	24	100	42.54	24.39	1462.18	43.87	319.02	51.04	29.27	1754.61	52.64	382.82
	PRIME MOVER>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	PRIME MOVER>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	PRIME MOVER>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	BURNER diesel	0			0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	AUXILIARY EQUIP<600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3 days/week	VESSELS>600hp diesel(crew)	10800	521.64	12519.36	24	43	7.61	4.37	261.67	7.85	57.09	3.93	2.25	135.02	4.05	29.46
2 days/week	VESSELS>600hp diesel(supply)	9266	447.5478	10741.15	24	29	6.53	3.75	224.51	6.74	48.98	2.27	1.30	78.13	2.34	17.05
Support Vessel	VESSELS>600hp diesel	27493	1327.9119	31869.89	24	6	19.38	11.11	666.13	19.98	145.34	1.40	0.80	47.96	1.44	10.46
FACILITY	DERRICK BARGE diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTALLATION	MATERIAL TUG diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(crew)	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(supply)	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	MISC.	BPD	SCF/HR	COUNT												
	TANK-	0			0	0				0.00					0.00	
DRILLING	OIL BURN	0			0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WELL TEST	GAS FLARE		416666		24	2		0.25	29.75	25.12	161.87		0.01	0.71	0.60	3.88
2021	YEAR TOTAL						76.06	43.86	2644.24	103.56	732.31	58.64	33.63	2016.44	61.07	443.68
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES											7026.30	7026.30	7026.30	7026.30	120503.75
	211.0															

(1) NOx emission factors is based on engine manufacture data. The main engines are IMO Tier II certified engines.

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL	CONTACT	PHONE	REMARKS
Anadarko Petroleum Corporation	WR	881	G36181		WR 881 A,AA,B,D,F,FF;WR 925 A Alt., AA Alt., AAA Alt.	Bridget O'Farrell	832-636-1694	

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	D/YR	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
DRILLING	PRIME MOVER>600hp diesel	60348	2914.8084	69955.40	24	200	42.54	24.39	1462.18	43.87	319.02	102.09	58.54	3509.22	105.28	765.65
	PRIME MOVER>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	PRIME MOVER>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	PRIME MOVER>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	BURNER diesel	0			0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	AUXILIARY EQUIP<600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3 days/week	VESSELS>600hp diesel(crew)	10800	521.64	12519.36	24	86	7.61	4.37	261.67	7.85	57.09	7.86	4.50	270.05	8.10	58.92
2 days/week	VESSELS>600hp diesel(supply)	9266	447.5478	10741.15	24	57	6.53	3.75	224.51	6.74	48.98	4.47	2.56	153.56	4.61	33.50
Support Vessel	VESSELS>600hp diesel	27493	1327.9119	31869.89	24	6	19.38	11.11	666.13	19.98	145.34	1.40	0.80	47.96	1.44	10.46
FACILITY	DERRICK BARGE diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTALLATION	MATERIAL TUG diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(crew)	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(supply)	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	MISC.	BPD	SCF/HR	COUNT												
	TANK-	0			0	0				0.00					0.00	
DRILLING	OIL BURN	0			0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WELL TEST	GAS FLARE		416666		24	2		0.25	29.75	25.12	161.87		0.01	0.71	0.60	3.88
2022	YEAR TOTAL						**76.06**	**43.86**	**2644.24**	**103.56**	**732.31**	**115.80**	**66.41**	**3981.51**	**120.03**	**872.42**
EXEMPTION CALCULATION	**DISTANCE FROM LAND IN MILES**											**7026.30**	**7026.30**	**7026.30**	**7026.30**	**120503.75**
	211.0															

(1) NOx emission factors is based on engine manufacture data. The main engines are IMO Tier II certified engines.

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT	PHONE	REMARKS
Anadarko Petroleum Corporation	WR	881	G36181		WR 881 A,AA,B,D,F,FF;WR 925 A Alt., AA Alt., AAA Alt.		Bridget O'Farrell	832-636-1694	

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	D/YR	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
DRILLING	PRIME MOVER>600hp diesel	60348	2914.8084	69955.40	24	100	42.54	24.39	1462.18	43.87	319.02	51.04	29.27	1754.61	52.64	382.82
	PRIME MOVER>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	PRIME MOVER>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	PRIME MOVER>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	BURNER diesel	0			0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	AUXILIARY EQUIP<600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3 days/week	VESSELS>600hp diesel(crew)	10800	521.64	12519.36	24	43	7.61	4.37	261.67	7.85	57.09	3.93	2.25	135.02	4.05	29.46
2 days/week	VESSELS>600hp diesel(supply)	9266	447.5478	10741.15	24	29	6.53	3.75	224.51	6.74	48.98	2.27	1.30	78.13	2.34	17.05
Support Vessel	VESSELS>600hp diesel	27493	1327.9119	31869.89	24	6	19.38	11.11	666.13	19.98	145.34	1.40	0.80	47.96	1.44	10.46
FACILITY	DERRICK BARGE diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTALLATION	MATERIAL TUG diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(crew)	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(supply)	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	MISC.	BPD	SCF/HR	COUNT												
	TANK-	0			0	0				0.00					0.00	
DRILLING	OIL BURN	0			0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WELL TEST	GAS FLARE		416666		24	2		0.25	29.75	25.12	161.87		0.01	0.71	0.60	3.88
2023	YEAR TOTAL						76.06	43.86	2644.24	103.56	732.31	58.64	33.63	2016.44	61.07	443.68
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES											7026.30	7026.30	7026.30	7026.30	120503.75
	211.0															

(1) NOx emission factors is based on engine manufacture data. The main engines are IMO Tier II certified engines.

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT	PHONE	REMARKS
Anadarko Petroleum Corporation	WR	881	G36181		WR 881 A,AA,B,D,F,FF;WR 925 A Alt., AA Alt., AAA Alt.		Bridget O'Farrell	832-636-1694	

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	D/YR	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
DRILLING	PRIME MOVER>600hp diesel	60348	2914.8084	69955.40	24	100	42.54	24.39	1462.18	43.87	319.02	51.04	29.27	1754.61	52.64	382.82
	PRIME MOVER>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	PRIME MOVER>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	PRIME MOVER>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	BURNER diesel	0			0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	AUXILIARY EQUIP<600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3 days/week	VESSELS>600hp diesel(crew)	10800	521.64	12519.36	24	43	7.61	4.37	261.67	7.85	57.09	3.93	2.25	135.02	4.05	29.46
2 days/week	VESSELS>600hp diesel(supply)	9266	447.5478	10741.15	24	29	6.53	3.75	224.51	6.74	48.98	2.27	1.30	78.13	2.34	17.05
Support Vessel	VESSELS>600hp diesel	27493	1327.9119	31869.89	24	6	19.38	11.11	666.13	19.98	145.34	1.40	0.80	47.96	1.44	10.46
FACILITY	DERRICK BARGE diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTALLATION	MATERIAL TUG diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(crew)	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(supply)	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	MISC.	BPD	SCF/HR	COUNT												
	TANK-	0			0	0				0.00					0.00	
DRILLING	OIL BURN	0			0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WELL TEST	GAS FLARE		416666		24	2		0.25	29.75	25.12	161.87		0.01	0.71	0.60	3.88
2024	YEAR TOTAL						**76.06**	**43.86**	**2644.24**	**103.56**	**732.31**	**58.64**	**33.63**	**2016.44**	**61.07**	**443.68**
EXEMPTION CALCULATION	**DISTANCE FROM LAND IN MILES**											**7026.30**	**7026.30**	**7026.30**	**7026.30**	**120503.75**
	211.0															

(1) NOx emission factors is based on engine manufacture data. The main engines are IMO Tier II certified engines.

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT	PHONE	REMARKS
Anadarko Petroleum Corporation	WR	881	G36181		WR 881 A,AA,B,D,F,FF;WR 925 A Alt., AA Alt., A		Bridget O'Farrell	832-636-1694	

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	D/YR	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
DRILLING	PRIME MOVER>600hp diesel	60348	2914.8084	69955.40	24	100	42.54	24.39	1462.18	43.87	319.02	51.04	29.27	1754.61	52.64	382.82
	PRIME MOVER>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	PRIME MOVER>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	PRIME MOVER>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	BURNER diesel	0			0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	AUXILIARY EQUIP<600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3 days/week	VESSELS>600hp diesel(crew)	10800	521.64	12519.36	24	43	7.61	4.37	261.67	7.85	57.09	3.93	2.25	135.02	4.05	29.46
2 days/week	VESSELS>600hp diesel(supply)	9266	447.5478	10741.15	24	29	6.53	3.75	224.51	6.74	48.98	2.27	1.30	78.13	2.34	17.05
Support Vessel	VESSELS>600hp diesel	27493	1327.9119	31869.89	24	6	19.38	11.11	666.13	19.98	145.34	1.40	0.80	47.96	1.44	10.46
FACILITY	DERRICK BARGE diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTALLATION	MATERIAL TUG diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(crew)	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(supply)	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	MISC.	BPD	SCF/HR	COUNT												
	TANK-	0			0	0				0.00					0.00	
DRILLING	OIL BURN	0			0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WELL TEST	GAS FLARE		416666		24	2		0.25	29.75	25.12	161.87		0.01	0.71	0.60	3.88
2025	YEAR TOTAL						76.06	43.86	2644.24	103.56	732.31	58.64	33.63	2016.44	61.07	443.68
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES											7026.30	7026.30	7026.30	7026.30	120503.75
	211.0															

(1) NOx emission factors is based on engine manufacture data. The main engines are IMO Tier II certified engines.

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT			PHONE	REMARKS					
Anadarko Petroleum Corporation	WR	881	G36181		WR 881 A,AA,B,D,F,FF;WR 925 A Alt., AA Alt., A		Bridget O'Farrell			832-636-1694						
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**	**D/YR**	**PM**	**SOx**	**NOx**	**VOC**	**CO**	**PM**	**SOx**	**NOx**	**VOC**	**CO**
DRILLING	PRIME MOVER>600hp diesel	60348	2914.8084	69955.40	24	100	42.54	24.39	1462.18	43.87	319.02	51.04	29.27	1754.61	52.64	382.82
	PRIME MOVER>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	PRIME MOVER>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	PRIME MOVER>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	BURNER diesel	0			0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	AUXILIARY EQUIP<600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3 days/week	VESSELS>600hp diesel(crew)	10800	521.64	12519.36	24	43	7.61	4.37	261.67	7.85	57.09	3.93	2.25	135.02	4.05	29.46
2 days/week	VESSELS>600hp diesel(supply)	9266	447.5478	10741.15	24	29	6.53	3.75	224.51	6.74	48.98	2.27	1.30	78.13	2.34	17.05
Support Vessel	VESSELS>600hp diesel	27493	1327.9119	31869.89	24	6	19.38	11.11	666.13	19.98	145.34	1.40	0.80	47.96	1.44	10.46
FACILITY	DERRICK BARGE diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTALLATION	MATERIAL TUG diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(crew)	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(supply)	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	MISC.	**BPD**	**SCF/HR**	**COUNT**												
	TANK-	0			0	0				0.00					0.00	
DRILLING	OIL BURN	0			0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WELL TEST	GAS FLARE		416666		24	2		0.25	29.75	25.12	161.87		0.01	0.71	0.60	3.88
2026	**YEAR TOTAL**						**76.06**	**43.86**	**2644.24**	**103.56**	**732.31**	**58.64**	**33.63**	**2016.44**	**61.07**	**443.68**
EXEMPTION CALCULATION	**DISTANCE FROM LAND IN MILES**											**7026.30**	**7026.30**	**7026.30**	**7026.30**	**120503.75**
	211.0															

(1) NOx emission factors is based on engine manufacture data. The main engines are IMO Tier II certified engines.

SUMMARY

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL
Anadarko Petroleum Corporation	WR	881	G36181		WR 881 A,AA,B,D,F,FF;WR 925 A Alt., AA Alt., AAA Alt.

Year	Emitted		Substance		
	PM	SOx	NOx	VOC	CO
2019	35.73	20.49	1228.88	37.45	271.85
2020	81.47	46.72	2801.30	84.62	614.92
2021	58.64	33.63	2016.44	61.07	443.68
2022	115.80	66.41	3981.51	120.03	872.42
2023	58.64	33.63	2016.44	61.07	443.68
2024	58.64	33.63	2016.44	61.07	443.68
2025	58.64	33.63	2016.44	61.07	443.68
2026	58.64	33.63	2016.44	61.07	443.68
Allowable	7026.30	7026.30	7026.30	7026.30	120503.75

EXPLORATION PLAN (EP)
AIR QUALITY SCREENING CHECKLIST

COMPANY	Anadarko Petroleum Corporation
AREA	WR
BLOCK	925
LEASE	G36475
PLATFORM	
WELL	**WR 925 E,EE**
COMPANY CONTACT	Bridget O'Farrell
TELEPHONE NO.	832-636-1694
REMARKS	**Drill/complete 2 wells with surface location(s) in WR 925**

WR 925 A Alt., AA Alt. AAA Alt. have a surface location in WR 881.
Reference the WR 881 AQR.

Proposed Activity	Start Date	End Date	No. of Days
Drill, complete, conduct flowtest-WR 925 Location E	6/05/2020	9/13/2020	100 (2020)
Drill, complete, conduct flowtest-WR 925 Location EE	9/01/2021	12/10/2021	100 (2021)

EMISSIONS FACTORS

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

Equipment/Emission Factors	units	PM	SOx	NOx	VOC	CO	REF.	DATE
NG Turbines	gms/hp-hr		0.00247	1.3	0.01	0.83	AP42 3.2-1& 3.1-1	10/96
NG 2-cycle lean	gms/hp-hr		0.00185	10.9	0.43	1.5	AP42 3.2-1	10/96
NG 4-cycle lean	gms/hp-hr		0.00185	11.8	0.72	1.6	AP42 3.2-1	10/96
NG 4-cycle rich	gms/hp-hr		0.00185	10	0.14	8.6	AP42 3.2-1	10/96
Diesel Recip. < 600 hp.	gms/hp-hr	1	0.1835	14	1.12	3.03	AP42 3.3-1	10/96
Diesel Recip. > 600 hp.	gms/hp-hr	0.32	0.1835	11	0.33	2.4	AP42 3.4-1	10/96
Diesel Boiler	lbs/bbl	0.084	0.3025	0.84	0.008	0.21	AP42 1.3-12,14	9/98
NG Heaters/Boilers/Burners	lbs/mmscf	7.6	0.593	100	5.5	84	P42 1.4-1, 14-2, & 14	7/98
NG Flares	lbs/mmscf		0.593	71.4	60.3	388.5	AP42 11.5-1	9/91
Liquid Flaring	lbs/bbl	0.42	6.83	2	0.01	0.21	AP42 1.3-1 & 1.3-3	9/98
Tank Vapors	lbs/bbl				0.03		E&P Forum	1/93
Fugitives	lbs/hr/comp.				0.0005		API Study	12/93
Glycol Dehydrator Vent	lbs/mmscf				6.6		La. DEQ	1991
Gas Venting	lbs/scf				0.0034			

Sulphur Content Source	Value	Units
Fuel Gas	3.33	ppm
Diesel Fuel	0.05	% weight
Produced Gas(Flares)	3.33	ppm
Produced Oil (Liquid Flaring)	1	% weight

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT	PHONE	REMARKS
Anadarko Petroleum Corporation	WR	925	G36475		WR 925 E,EE		Bridget O'Farrell	832-636-1694	

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	D/YR	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
DRILLING	PRIME MOVER>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	PRIME MOVER>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	PRIME MOVER>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	PRIME MOVER>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	BURNER diesel	0			0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	AUXILIARY EQUIP<600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3 days/week	VESSELS>600hp diesel(crew)	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2 days/week	VESSELS>600hp diesel(supply)	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Support Vessel	VESSELS>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FACILITY	DERRICK BARGE diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTALLATION	MATERIAL TUG diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(crew)	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(supply)	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	MISC.	BPD	SCF/HR	COUNT												
	TANK-	0			0	0				0.00					0.00	
DRILLING	OIL BURN	0			0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WELL TEST	GAS FLARE		0		0	0		0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
2019	YEAR TOTAL						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES											7026.30	7026.30	7026.30	7026.30	120503.75
	211.0															

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT	PHONE	REMARKS
Anadarko Petroleum Corporation	WR	925	G36475		WR 925 E,EE		Bridget O'Farrell	832-636-1694	

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	D/YR	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
DRILLING	PRIME MOVER>600hp diesel	60348	2914.8084	69955.40	24	100	42.54	24.39	1462.18	43.87	319.02	51.04	29.27	1754.61	52.64	382.82
	PRIME MOVER>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	PRIME MOVER>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	PRIME MOVER>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	BURNER diesel	0			0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	AUXILIARY EQUIP<600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3 days/week	VESSELS>600hp diesel(crew)	10800	521.64	12519.36	24	43	7.61	4.37	261.67	7.85	57.09	3.93	2.25	135.02	4.05	29.46
2 days/week	VESSELS>600hp diesel(supply)	9266	447.5478	10741.15	24	29	6.53	3.75	224.51	6.74	48.98	2.27	1.30	78.13	2.34	17.05
Support Vessel	VESSELS>600hp diesel	27493	1327.9119	31869.89	24	6	19.38	11.11	666.13	19.98	145.34	1.40	0.80	47.96	1.44	10.46
FACILITY	DERRICK BARGE diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTALLATION	MATERIAL TUG diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(crew)	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(supply)	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	MISC.	BPD	SCF/HR	COUNT												
	TANK-	0			0	0				0.00					0.00	
DRILLING	OIL BURN	0			0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WELL TEST	GAS FLARE		416666		24	2		0.25	29.75	25.12	161.87		0.01	0.71	0.60	3.88
2020	YEAR TOTAL						**76.06**	**43.86**	**2644.24**	**103.56**	**732.31**	**58.64**	**33.63**	**2016.44**	**61.07**	**443.68**
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES											**7026.30**	**7026.30**	**7026.30**	**7026.30**	**120503.75**
	211.0															

(1) NOx emission factors is based on engine manufacture data. The main engines are IMO Tier II certified engines.

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT			PHONE	REMARKS					
Anadarko Petroleum Corporation	WR	925	G36475		WR 925 E,EE			Bridget O'Farrell		832-636-1694						
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**	**D/YR**	**PM**	**SOx**	**NOx**	**VOC**	**CO**	**PM**	**SOx**	**NOx**	**VOC**	**CO**
DRILLING	PRIME MOVER>600hp diesel	60348	2914.8084	69955.40	24	100	42.54	24.39	1462.18	43.87	319.02	51.04	29.27	1754.61	52.64	382.82
	PRIME MOVER>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	PRIME MOVER>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	PRIME MOVER>600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	BURNER diesel	0			0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	AUXILIARY EQUIP<600hp diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3 days/week	VESSELS>600hp diesel(crew)	10800	521.64	12519.36	24	43	7.61	4.37	261.67	7.85	57.09	3.93	2.25	135.02	4.05	29.46
2 days/week	VESSELS>600hp diesel(supply)	9266	447.5478	10741.15	24	29	6.53	3.75	224.51	6.74	48.98	2.27	1.30	78.13	2.34	17.05
Support Vessel	VESSELS>600hp diesel	27493	1327.9119	31869.89	24	6	19.38	11.11	666.13	19.98	145.34	1.40	0.80	47.96	1.44	10.46
FACILITY	DERRICK BARGE diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTALLATION	MATERIAL TUG diesel	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(crew)	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(supply)	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	MISC.	**BPD**	**SCF/HR**	**COUNT**												
	TANK-	0			0	0				0.00					0.00	
DRILLING	OIL BURN	0			0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WELL TEST	GAS FLARE		416666		24	2		0.25	29.75	25.12	161.87		0.01	0.71	0.60	3.88
2021	**YEAR TOTAL**						**76.06**	**43.86**	**2644.24**	**103.56**	**732.31**	**58.64**	**33.63**	**2016.44**	**61.07**	**443.68**
EXEMPTION CALCULATION	**DISTANCE FROM LAND IN MILES**											**7026.30**	**7026.30**	**7026.30**	**7026.30**	**120503.75**
	211.0															

(1) NOx emission factors is based on engine manufacture data. The main engines are IMO Tier II certified engines.

SUMMARY

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL
Anadarko Petroleum Corporation	WR	925	G36475		WR 925 E,EE

Year	Emitted Substance				
	PM	SOx	NOx	VOC	CO
2019	0.00	0.00	0.00	0.00	0.00
2020	58.64	33.63	2016.44	61.07	443.68
2021	58.64	33.63	2016.44	61.07	443.68
2022	0.00	0.00	0.00	0.00	0.00
2023	0.00	0.00	0.00	0.00	0.00
2024	0.00	0.00	0.00	0.00	0.00
2025	0.00	0.00	0.00	0.00	0.00
2026	0.00	0.00	0.00	0.00	0.00
Allowable	7026.30	7026.30	7026.30	7026.30	120503.75

SECTION H
OIL SPILL INFORMATION

(a) Oil Spill Response Planning

(i) OSRP Information

All the proposed activities and facilities in this EP are covered by the Regional Oil Spill Response Plan (OSRP) approved on August 14, 2015 for Anadarko Petroleum Corporation and its subsidiary Anadarko US Offshore LLC. (Company Numbers 00981 and 02219 respectively) in accordance with 30 CFR Part 254. June 2017 updates for the OSRP were acknowledged by BSEE July 12, 2017 and in compliance with 30 CFR 254.30(a). Non-regulatory required OSRP updates were submitted to BSEE on June 19, 2018 and acknowledged as in compliance July 18, 2018. The OSRP biennial update will be submitted by June 30, 2019.

(ii) Spill Response Sites

Primary Response Equipment Location(s)	Preplanned Staging Location(s)
Galveston, Texas	Galveston, Texas
Harvey, Louisiana	Harvey, Louisiana
Houma, Louisiana	Fourchon, Louisiana
Lake Charles, Louisiana	Cameron, Louisiana
Leeville, Louisiana	Leeville, Louisiana
Venice, Louisiana	Venice, Louisiana

(iii) OSRO Information

Anadarko maintains a contract with Clean Gulf Associates (CGA) for spill response equipment. Various equipment locations are staged throughout the Gulf of Mexico. CGA equipment can be referenced on their website: http://www.cleangulfassoc.com/. Personnel would be obtained from the Marine Spill Response Corporation's (MSRC) STARS network, including a supervisor to operate the equipment.

In addition Anadarko has a contract with the Marine Spill Response Corporation (MSRC) for spill response equipment. MSRC stages equipment throughout the Gulf of Mexico and has recently completed a large expansion of its resources, with particular focus on deepwater. The expansion is known as "Deep Blue". MSRC capabilities and a complete equipment listing are available on-line at: http://www.msrc.org/.

Anadarko is a member of the Marine Well Containment Company (MWCC), which provides access to containment response capabilities and includes subsea dispersant injection equipment.

(iv) Worst-Case Scenario Determination

Category	Regional OSRP	EP	EP
Type of Activity	Exploratory	Exploratory	Exploratory
Facility Location (area/block)	GC 683	WR 881	WR 925
Facility Designation	GC 683, Location G	WR 881, Location A	WR 925, Location A Alt.
Distance to Nearest Shoreline	120 miles	211 miles	211 miles
Storage Tanks (total)	N/A	N/A	N/A
Flowlines (on facility)	N/A	N/A	N/A
Pipelines	N/A	N/A	N/A
Uncontrolled Blowout	403,608 bopd*	240,441 bopd	250,000 bopd**
Type of Oil(s)	Oil	Oil	Oil
API Gravity	28.9°	30.0°	30.0°

* *As approved under Plan Control No.: S-7623.*
** *Rounded up from the Merlin calculation of 249,593 bopd.*

Anadarko has determined that the worst-case scenarios from the activities proposed in this Initial Supplemental EP does not supersede the worst-case scenario for Green Canyon 683. The OSRP was previously updated to reflect Green Canyon 683, Location G as the exploratory worst case discharge since Anadarko no longer owns Walker Ridge 51.

Since Anadarko has the capability to respond to the worst-case spill scenario included in our Regional OSRP, and since the worst-case scenarios determined for our EP do not replace the worst-case scenario in our Regional OSRP approved on August 14, 2015; I hereby certify that Anadarko has the capability to respond, to the maximum extent practicable, to a worst-case discharge, or a substantial threat of such a discharge, resulting from the activities proposed in our EP. June 2017 updates for the OSRP were acknowledged by BSEE July 12, 2017 and in compliance with 30 CFR 254.30(a). Non-regulatory required OSRP updates were submitted to BSEE on June 19, 2018 and acknowledged as in compliance July 18, 2018. The OSRP biennial update will be submitted by June 30, 2019.

(b) Worst-Case Discharge Volume Assumptions

Worst-case discharge (WCD) calculations and assumptions within this section utilized guidelines and requirements pursuant with NTL 2015-N01 (formerly NTL 2010-N06). Discussions regarding geologic information are considered proprietary and have been omitted from this public copy of the EP.

(c) Oil Spill Response Discussion

For the purpose of NEPA analysis, the largest spill volume originating from the proposed activity would be an uncontrolled blowout of the well during drilling operations at 250,000 bopd with an API gravity of 30° (Walker Ridge 925, Location A Alt.). A discussion of the blowout scenario from this proposed activity is included within this Initial Supplemental EP in accordance with NTL No. 2015-N01.

Land Segment and Resource Identification Modeling

Trajectory of a spill and the probability of its impacting a land segment have been projected utilizing information in the Oil Spill Risk Analysis Model (OSRAM) for the Central Gulf of Mexico. Additional information may be referenced in the "Oil-Spill Risk Analysis: Contingency Planning Statistics for Gulf of Mexico OCS Activities" (OCS Report MMS 2004-026), using the average conditional probability for 3, 10, and 30 day impacts.

Walker Ridge 881/925 is located within Launch Area 49. According to the OSRAM, the trajectory indicates a 1-2% probability of potential impact to the shoreline from Calhoun County, Texas to Plaquemines Parish, Louisiana. The results are shown in Table H-2.

Matagorda County and/or Cameron Parish are identified as the most probable potential impacted parish or county within the Gulf of Mexico for this operation.

Response

Anadarko will make every effort to respond to the worst-case discharge as effectively as possible. Response equipment available to respond to the worst-case discharge and the estimated time of a spill response from oil spill detection to equipment deployment on-site is included in **Table H-3.** The table estimates individual times needed for procurement, load out, travel time to the site and deployment. In the event of an actual incident equipment and times can vary.

For the purpose of response scenario discussion, an uncontrolled blowout of the well would be considered the largest potential spill volume at 250,000 bopd. An ADIOS weathering model was run based on a similar type of oil expected to be produced from this well. Based on this information, approximately 13% (75,000 bbls) of the initial volume would be evaporated/dispersed within 24 hours.

If approved and appropriate, 4 sorties (8,000 gallons) from the Basler aircraft and 8 sorties (9,600 gallons) from two DC-3 aircrafts could disperse approximately 7,540 barrels of oil.

If the conditions are appropriate, and the necessary approvals and permits have been obtained, in-situ burning may be utilized. Based on in-situ burn operations during Deepwater Horizon, approximately 5% (8,750 bbls) of the total initial worst case discharge could be burned.

Although unlikely in a spill lasting thirty (30) days, potential shoreline impact in Matagorda County and/or Cameron Parish could occur depending on environmental conditions (wind, currents and temperature) at the time of an incident. Nearshore response may include the use of shoreline boom on beach areas, or protection/sorbent boom on vegetated areas. Surveillance and real time trajectories would aide in determining the most appropriate strategies to respond to a spill.

Table H.3 provides an example of offshore and nearshore equipment, response times, and personnel to respond to a spill of 175,000 bbls, which is the estimated amount that would remain considering natural evaporation/dispersion at 24 hours. This amount could be further reduced through the application of aerial and subsea dispersants, and in-situ burning provided such applications/actions were approved.

Anadarko's contingency plan for dealing with this worst-case discharge would be to activate its Spill Management Team and equipment resources as described in its Gulf of Mexico Regional Oil Spill Response Plan (OSRP) and provide continuous support for the duration of the event. Response resources are activated and supplemented according to need. These resources would remain engaged in the response until the incident is deemed complete or until released by Unified Command.

Anadarko is also a member of the Marine Well Containment Company (MWCC), which provides access to containment response capabilities and includes subsea dispersant injection equipment.

In the event of a blowout, Anadarko may:

1. Evacuate personnel, if necessary. Deploy emergency responders in an effort to preserve human life, if necessary.

2. Assess the damage and attempt to stop the flow at the source, if safe to do so, to reduce the amount of oil discharged.

3. Notify agencies.

4. Assess the amount of oil that has been spilled and calculate additional potential of oil flow. A continuous aerial surveillance program would be used to assess the growth of the slick and the volume of oil on the water. Observations of the size of the slick on the water, combined with observations at the source, would be used to provide a constant update. Additional potential to release fuel from the remaining tanks onboard the appropriate DP drillship or DP semi-submersible drilling rig would be determined by marine surveyors. Operations and Unified Command would continue to assess the adequacy of response equipment capacities based on this continually updated mass balance.

5. Convene the Spill Management Team (SMT). Organize Unified Command and establish objectives and priorities.

6. Monitor the oil spill with aerial surveillance and obtain trajectories. If oil is seaward bound, going away from land, discuss additional strategies with Unified Command.

7. If oil is moving in the direction of a shoreline and weather conditions are favorable, request approval to utilize dispersants.

   a. Prior to commencing application operations, conduct an on-site survey in consultation with natural resource specialists to determine if any threatened or endangered species are present in the projected application area or otherwise at risk from dispersant application.

   b. Upon approval, mobilize one Basler aircraft and two DC-3 aircrafts from Houma if needed, with surveillance aircraft and spotter. Rotate aircraft, spraying the leading edge of the spill and working back to the source. Monitor/sample for effectiveness (USCG SMART Team). Truck additional dispersants from CGA or MSRC stockpile, if necessary.

   c. Dispersants are most effective when applied as soon after discharge as possible, since weathering of the oil decreases dispersant effectiveness. The estimated window of opportunity for most effective use of dispersants is within 48-72 hours post-release. The oil may still be dispersible after 72 hours on the water surface, but the effectiveness of dispersant use would likely be diminished after the oil has been on the water for more than three days. Ultimately, the USCG SMART monitoring protocol will be used to determine whether or not dispersant operations are effective.

   d. Once the CGA HOSS barge is on location and in the skimming mode, dispersants would only be used if required and approved.

8. Deploy offshore mechanical oil containment and recovery equipment. Attempt to recover as much oil at sea as possible, utilizing:

   a. The CGA HOSS barge, will be positioned in a stationary mode, will be situated down-wind and down-current from location for long-duration, high-volume skimming. Based on average travel times, the HOSS barge could be on location within approximately 33 hours of the release. The de-rated skimming capacity of the HOSS barge is 76,285 bbls per day. However, only the oil encountered by a skimmer can be recovered. In order to maximize oil encounter rate, boom will be deployed in a V-configuration in front of the HOSS barge to funnel oil to the skimmers. If necessary, temporary barges can be activated to support continuous skimming operations. (These barges arrive on-site at approximately the same time as the HOSS barge.) For an on-going release, multiple barges are deployed to provide for continuous off-loading of skimmer storage vessels and shuttling of recovered oil to an onshore waste handling facility. Sufficient barges are available to provide enough temporary storage for continuous recovery operations.

b. CGA's Fast Response Vessels (FRV) could arrive on-scene between approximately 13-17 hours of the initial release. These skimmers operate downstream of the HOSS barge and are used to recover pockets and streamers of oil that may move past the large stationary skimmer. FRVs have approximately 249 barrels of on-board storage. Approval will be requested to decant water after gravity separation, through a hose forward of the skimmer, to optimize temporary storage capacity. Auto boom will be utilized to concentrate oil so that it is thick enough to be skimmed.

9. Dispersants, Fast Response Vessels (FRV), Oil Spill Response Vessels (OSRV or R/V) would typically work daylight hours only. The HOSS barge can operate continuously, including night operations. Available technology will be considered such as remote sensing devices that will enable 24 hour surveillance, trajectories, and planning. All response vessels are designed to be able to remain offshore continuously throughout the response. Even if sea conditions prohibit effective skimming, these resources would remain offshore until skimming operations could be commenced again. Safety would remain the first priority.

10. Prepare site-specific Waste Management Plan, Site Safety Plan, Decontamination Plans, Communications and Medical Plans.

11. If oil becomes a threat to any shoreline, data from the aerial surveillance, weather reports, and trajectories would be used to direct onshore teams to deploy protection/containment boom with reference to Area Contingency Plans and in coordination with State and Federal On-Scene Coordinators.

    a. Implement pre-designated strategies.

    b. Identify resources at risk in spill vicinity.

    c. Develop/implement appropriate protection tactics.

12. Establish site-specific Wildlife Rescue and Rehabilitation Plan.

The following types of additional support may be required for a blowout lasting 120 days.

- Additional Oil Spill Removal Organization (OSRO) personnel to relieve equipment operators
- Vessels for supporting offshore operations
- Field safety personnel
- Continued surveillance and monitoring of oil movement
- Helicopter, video cameras
- Infra red (night time spill tracking) capabilities, X-band radar
- Barge to transport recovered oil from offshore skimming system, and temporary storage barges to onshore disposal sites that are identified in Area Contingency Plans (ACP)
- Logistics needed to support equipment:
  - Staging areas
  - Parts, trailers, and mechanics to maintain skimmers and boom
  - Fueling facilities
  - Decontamination stations
  - Dispersant stockpile transported from Houston to Houma or other potential command post locations
  - Communications equipment and technicians
- Logistics needed to support responder personnel
  - Medical aid stations
  - Safety personnel
  - Food
  - Berthing
  - Additional clothing/safety supplies
  - Decontamination stations

Louisiana CZM Containment Response Information

Anadarko has the capability to respond and contain, to the maximum extent practicable as defined in 30 CFR 254.6 and 30 CFR 250.26(d)(1), to the estimated worst case discharge (WCD) associated with the proposed activity within 30 days. Deployment time for surface containment equipment is subject to availability and location, weather conditions, potential security zones around the spill site, and site/well specific assessment data. Personnel safety is always first and foremost. Refer to further details on equipment and timing provided in **Section H–Oil Spill Information** and **Table H-3** of the EP.

The potential WCD will be further evaluated during the Application for Permit to Drill (APD) process, including the Well Containment Screening Tool (WCST) and associated subsea containment plan for enhanced planning purposes.

There will be no new or unusual technology deployed that has not been previously deployed for Gulf of Mexico oil spill prevention, control, and/or cleanup.

Table H-1

Worst Case Discharge Calculation
(Based on an Uncontrolled Blowout)

Calculations for Uncontrolled Blowout > 10 miles from shore:		**WR 881/925**
i.	Type of Oil (crude, condensate, diesel)	Crude
ii.	API Gravity	30.0°
iii.	EP Location Used for NTL No. 2015-N01 WCD for WR 881/925	WR 925, Location A Alt.
iv.	Largest Anticipated WCD Rate during blowout	250,000 bopd*
v.	**WCD Total for Drilling Operations for WR 881/925 (> 10 miles from shore):**	250,000 bopd*

**Highest WCD for EP. Rounded up from the Merlin calculation of 249,593 bopd.*

Table H-2

Trajectory by Land Segment

Following are the average conditional probabilities (expressed as percent chance) that an oil spill starting at a particular launch area will contact a land segment as included in the Oil Spill Risk Analysis Model (OSRAM) for the Central Gulf of Mexico. This information can be found on the website using 3/10/30 day potential impact, as applicable. The results are listed below.

Area/Block	OCS-G	Launch Area	Land Segment and/or Resource	Conditional Probability (%)		
				3 days	10 days	30 days
Walker Ridge 881/925 Drilling (211 miles from shore)	G36181/G36475	LA 49 Central Planning Area	Calhoun County, TX Matagorda County, TX Brazoria County, TX Galveston County, TX Jefferson County, TX Cameron Parish, LA Vermilion Parish, LA Terrebonne Parish, LA Plaquemines Parish, LA	-- -- -- -- -- -- -- -- --	-- -- -- -- -- -- -- -- --	1 2 1 1 1 2 1 1 1

Table H-3

WCD Scenario Drilling Activities – Based on a single well uncontrolled blowout (211 miles from shore)
Walker Ridge 925, Location A Alt. (Highest WCD in EP)
250,000 bopd (initial volume)
175,000 bopd (after evaporation/dispersion)
API Gravity 30.0°

Offshore Equipment from Spill Detection to Equipment Deployment Response Time: Walker Ridge 925

Dispersants/Surveillance

Dispersant/Surveillance	Dispersant Capacity (gal)	Storage Capacity	Persons Req.	From	Hrs to Procure	Hrs to Loadout	Travel to site	Total Hrs
ASI								
Basler 67T	2000	NA	2	Houma	2	2	1	5
DC 3	1200	NA	2	Houma	2	2	1.3	5.3
DC 3	1200	NA	2	Houma	2	2	1.3	5.3
Aero Commander	NA	NA	2	Houma	2	2	1	5
MSRC								
C-130 Spray AC	3,250	NA	2	Kiln	3	0	0.8	3.8
King Air BE90 Spray AC	250	NA	2	Kiln	3	0	1.3	4.3

Offshore Response

Offshore Equipment Pre-determined Staging	EDRC	Storage Capacity	VOO	Persons Required	From	Hrs to Procure	Hrs to Loadout	Hrs to GOM	Travel to Spill Site	Hrs to Deploy	Total Hrs
CGA											
HOSS Barge	76285	4000	3 Tugs	8	Harvey	7	0	5	20	1	33
95' FRV	22885	249	NA	6	Venice	2	0	2	9.5	0	13.5
95' FRV	22885	249	NA	6	Leeville	2	0	2	9	0	13
95' FRV	22885	249	NA	6	Galveston	2	0	2	13	0	17
95' FRV	22885	249	NA	6	Vermilion	2	0	2	10	0	14
Boom Barge (CGA-300) 42" Auto Boom (25000')	NA	NA	1 Tug 50 Crew	4 (Barge) 2 (Per Crew)	Leeville	4	0	6	26	1.5	37.5
Kirby Offshore (available through contract with CGA)											
RO Barge	NA	80000+	1 Tug	6	Venice	33	0	2	25	0	60
RO Barge	NA	80000+	1 Tug	6	Venice	33	0	2	25	0	60
RO Barge	NA	80000+	1 Tug	6	Venice	33	0	2	25	0	60
RO Barge	NA	100000+	1 Tug	6	Venice	33	0	2	25	0	60
RO Barge	NA	100000+	1 Tug	6	Venice	33	0	2	25	0	60
RO Barge	NA	110000+	1 Tug	6	Venice	33	0	2	25	0	60
RO Barge	NA	130000+	1 Tug	6	Venice	33	0	2	25	0	60
RO Barge	NA	140000+	1 Tug	6	Venice	33	0	2	25	0	60
RO Barge	NA	150000+	1 Tug	6	Venice	33	0	2	25	0	60

Spill Team Area Responders (STARS) called out by Marine Spill Response Corporation (MSRC)
Vessel of Opportunity=VOO
EMS=Enterprise Marine Services
K-Sea=K-Sea Operating Partnership

Offshore Equipment Pre-determined Staging	EDRC	Storage Capacity	VOO	Persons Required	From	Hrs to Procure	Hrs to Loadout	Hrs to GOM	Travel to Spill Site	Hrs to Deploy	Total Hrs
MSRC											
Louisiana Responder Transrec 350 + OSRV *2,640' 67" Curtain Pressure Boom*	10567	4000	NA	14	Fort Jackson	2	0	4.5	21	1	28.5
MSRC 452 Offshore Barge 1 Crucial Disk 88/30 1 Desmi Ocean *2,640' 67" Curtain Pressure Boom*	11122 3017	45000	3 Tugs	6	Fort Jackson	2.5	0	6	38.5	1	48
Mississippi Responder Transrec 350 + OSRV *2,640' 67" Curtain Pressure Boom*	10567	4000	NA	14	Pascagoula	2	0	2	25	1	30
MSRC 402 Offshore Barge 2 Crucial Disk 88/30 *2,640' 67" Curtain Pressure Boom*	22244	40300	3 Tugs	6	Pascagoula	2.5	0	3	46	1	52.5
S.T. Benz Responder LFF 100 Brush + OSRV *2,640' 67" Curtain Pressure Boom*	18086	4000	NA	14	Fourchon	2	0	1	15	1	19
MSRC 360 Offshore Barge 1 Crucial Disk 88/30 *1,320' 67" Curtain Pressure Boom*	11122	36000	3 Tugs	6	Tampa	2.5	0	2	43	1	48.5
Florida Responder Transrec 350 + OSRV *2,640' 67" Curtain Pressure Boom*	10567	4000	NA	14	Miami	2	0	2	60	1	65
Gulf Coast Responder Transrec 350 + OSRV *2,640' 67" Curtain Pressure Boom*	10567	4000	NA	14	Lake Charles	2	0	4	18	1	25
Texas Responder Transrec 350 + OSRV *2,640' 67" Curtain Pressure Boom*	10567	4000	NA	14	Galveston	2	0	1	20	1	24
MSRC 570 Offshore Barge 2 Crucial Disk 88/30 *2,640' 67" Curtain Pressure Boom*	22244	56900	3 Tugs	6	Galveston	2.5	0	2	37	1	42.5
Southern Responder Transrec 350 + OSRV *2,640' 67" Curtain Pressure Boom*	10567	4000	NA	14	Ingleside	2	0	1	27	1	31
MSRC 403 Offshore Barge 1 Crucial Disk 88/30 *2,640' 67" Curtain Pressure Boom*	11122	40300	3 Tugs	6	Ingleside	2.5	0	2	50	1	55.5

Staging Area: Fourchon

Offshore Equipment Preferred Staging	EDRC	Storage Capacity	VOO	Persons Req.	From	Hrs to Procure	Hrs to Loadout	Travel to Staging	Travel to Site	Hrs to Deploy	Total Hrs
T&T Marine (Available through contract with CGA)											
Aqua Guard Triton RBS (1)	22323	2000	1 Utility	6	Galveston	4	12	11.8	15	2	44.8
Aqua Guard Triton RBS (1)	22323	2000	1 Utility	6	Harvey	4	12	2.7	15	2	35.7
Koseq Skimming Arms (10) Lamor brush	228850	10000	5 Utility	30	Galveston	24	24	11.8	15	2	76.8
Koseq Skimming Arms (6) MariFlex 150 HF	108978	6000	3 Utility	18	Galveston	24	24	11.8	15	2	76.8
Koseq Skimming Arms (2) Lamor brush	45770	2000	1 Utility	6	Harvey	24	24	2.7	15	2	67.7
Koseq Skimming Arms (4) MariFlex 150 HF	72652	4000	2 Utility	12	Harvey	24	24	2.7	15	2	67.7
CGA											
FRU (1) + 100 bbl Tank (2)	4251	200	1 Utility	6	Morgan City	2	2	2.7	15	1	22.7
FRU (1) + 100 bbl Tank (2)	4251	200	1 Utility	6	Vermilion	2	2	4.5	15	1	24.5
FRU (1) + 100 bbl Tank (2)	4251	200	1 Utility	6	Galveston	2	2	11.8	15	1	31.8
FRU (1) + 100 bbl Tank (2)	4251	200	1 Utility	6	Aransas Pass	2	2	16.5	15	1	36.5
FRU (1) + 100 bbl Tank (2)	4251	200	1 Utility	6	Lake Charles	2	2	6.8	15	1	26.8
FRU (2) + 100 bbl Tank (4)	8502	400	2 Utility	12	Venice	2	2	5	15	1	25
FRU (2) + 100 bbl Tank (4)	8502	400	2 Utility	12	Leeville	2	2	0.4	15	1	20.4
MSRC											
Crucial Disk 56/30 Skimmer (1)	5671	400	1 Utility	6	Ingleside	1	2	16	26	1	46
Foilex 250 Skimmer (1)	3977	400	1 Utility	6	Ingleside	1	2	16	26	1	46
GT-185 Skimmer w Adaptor (1)	1371	400	1 Utility	6	Ingleside	1	2	16	26	1	46
Stress I Skimmer (1)	15840	400	1 Utility	6	Ingleside	1	2	16	26	1	46
Foilex 250 Skimmer (1)	3977	400	1 Utility	6	Galveston	1	2	11.8	26	1	41.8
GT-185 Skimmer w Adaptor (2)	2742	800	2 Utility	12	Galveston	1	2	11.8	26	1	41.8
Stress I Skimmer (1)	15840	400	1 Utility	6	Galveston	1	2	11.8	26	1	41.8
Walosep W4 Skimmer (1)	3017	400	1 Utility	6	Galveston	1	2	11.8	26	1	41.8
GT-185 Skimmer w Adaptor (1)	1371	400	1 Utility	6	Port Arthur	1	2	8.5	26	1	38.5

** Utility Boats, Crew Boats, Supply Boats, or Fishing Vessels*

Staging Area: Fourchon

Offshore Equipment Preferred Staging	EDRC	Storage Capacity	VOO	Persons Req.	From	Hrs to Procure	Hrs to Loadout	Travel to Staging	Travel to Site	Hrs to Deploy	Total Hrs
MSRC											
Desmi Skimmer (1)	3017	400	1 Utility	6	Lake Charles	1	2	6.8	26	1	36.8
Foilex 250 Skimmer (1)	3977	400	1 Utility	6	Lake Charles	1	2	6.8	26	1	36.8
Stress I Skimmer (2)	31680	800	2 Utility	12	Lake Charles	1	2	6.8	26	1	36.8
GT-185 Skimmer w Adaptor (1)	1371	400	1 Utility	6	Lake Charles	1	2	6.8	26	1	36.8
LFF 100 Brush Skimmer (1) *1,320' 67" Curtain Pressure Boom*	18086	400	1 PSV	14	Lake Charles	1	2	6.8	26	1	36.8
LFF 100 Brush Skimmer (1) *1,320' 67" Curtain Pressure Boom*	18086	400	1 PSV	14	Lake Charles	1	2	6.8	26	1	36.8
Transrec 350 Skimmer (1) *1,320' 67" Curtain Pressure Boom*	10567	400	1 PSV	14	Lake Charles	1	2	6.8	26	1	36.8
GT-185 Skimmer w Adaptor (1)	1371	400	1 Utility	6	Baton Rouge	1	2	4.5	26	1	34.5
Transrec 350 Skimmer (1) *1,320' 67" Curtain Pressure Boom*	10567	400	1 PSV	14	Houma	1	2	2	26	1	32
Stress I Skimmer (1)	15840	400	1 Utility	6	Port Fourchon	1	2	0	26	1	30
LFF 100 Brush Skimmer (1) *1,320' 67" Curtain Pressure Boom*	18086	400	1 PSV	14	Port Fourchon	1	2	0	26	1	30
LFF 100 Brush Skimmer (1) *1,320' 67" Curtain Pressure Boom*	18086	400	1 PSV	14	Port Fourchon	1	2	0	26	1	30
GT-185 Skimmer w Adaptor (1)	1371	400	1 Utility	6	Belle Chasse	1	2	3	26	1	33
Walosep W4 Skimmer (1)	3017	400	1 Utility	6	Belle Chasse	1	2	3	26	1	33
Foilex 250 Skimmer (1)	3977	400	1 Utility	6	Belle Chasse	1	2	3	26	1	33
Stress I Skimmer (1)	15840	400	1 Utility	6	Belle Chasse	1	2	3	26	1	33
Foilex 200 Skimmer (1)	1989	400	1 Utility	6	Belle Chasse	1	2	3	26	1	33
Crucial Disk 56/30 Skimmer (1)	5671	400	1 Utility	6	Belle Chasse	1	2	3	26	1	33
Crucial Disk 88/30 Skimmer (1) *1,320' 67" Curtain Pressure Boom*	11122	400	1 PSV	14	Fort Jackson	1	2	4.7	26	1	34.7
Crucial Disk 88/30 Skimmer (1) *1,320' 67" Curtain Pressure Boom*	11122	400	1 PSV	14	Fort Jackson	1	2	4.7	26	1	34.7

Staging Area: Fourchon

Offshore Equipment Preferred Staging	EDRC	Storage Capacity	VOO	Persons Req.	From	Hrs to Procure	Hrs to Loadout	Travel to Staging	Travel to Site	Hrs to Deploy	Total Hrs
MSRC											
Stress I Skimmer (1)	15840	400	1 Utility	6	Pascagoula	1	2	6	26	1	36
GT-185 Skimmer (1)	1371	400	1 Utility	6	Pascagoula	1	2	6	26	1	36
Stress II Skimmer (1)	3017	400	1 Utility	6	Pascagoula	1	2	6	26	1	36
Crucial Disk 56/30 Skimmer (1)	5671	400	1 Utility	6	Tampa	1	2	21.5	26	1	51.5
Stress I Skimmer (1)	15840	400	1 Utility	6	Tampa	1	2	21.5	26	1	51.5
GT-185 Skimmer w Adaptor (1)	1371	400	1 Utility	6	Tampa	1	2	21.5	26	1	51.5
Desmi Skimmer (1)	3017	400	1 Utility	6	Miami	1	2	27.5	26	1	57.5
GT-185 Skimmer w Adaptor (1)	1371	400	1 Utility	6	Miami	1	2	27.5	26	1	57.5
Stress I Skimmer (1)	15840	400	1 Utility	6	Miami	1	2	27.5	26	1	57.5
Walosep W4 Skimmer (1)	3017	400	1 Utility	6	Miami	1	2	27.5	26	1	57.5

Staging Area: Fourchon

Offshore Equipment Preferred Staging	EDRC	Storage Capacity	VOO	Persons Req.	From	Hrs to Procure	Hrs to Loadout	Travel to Staging	Travel to Site	Hrs to Deploy	Total Hrs
CGA											
Hydro-Fire Boom	NA	NA	8 Utility	40	Harvey	2	4	2.7	15	6	29.7
MSRC											
67" Curtain Pressure Boom (18480')	NA	NA	14*	7	Lake Charles	1	2	6.8	26	1	36.8
67" Curtain Pressure Boom (8895')	NA	NA	12*	6	Pascagoula	1	2	6	26	1	36
2000' Hydro Fire Boom	NA	NA	8*	8	Lake Charles	1	4	6.8	26	6	36.8

Nearshore Equipment from Spill Detection to Equipment Deployment Response Time: Walker Ridge 925

Nearshore Response

Nearshore Equipment Pre-determined Staging	EDRC	Storage Capacity	VOO	Persons Required	From	Hrs to Procure	Hrs to Loadout	Hrs to GOM	Travel to Spill Site	Hrs to Deploy	Total Hrs
CGA											
Trinity SWS	21500	249	NA	4	Galveston	2	6	N/A	48	0	56
Trinity SWS	21500	249	NA	4	Morgan City	2	6	N/A	48	0	56
Trinity SWS	21500	249	NA	4	Leeville	2	6	N/A	48	0	56
Trinity SWS	21500	249	NA	4	Venice	2	6	N/A	48	0	56
46' FRV	15257	65	NA	4	Aransas Pass	2	0	2	16	0	20
46' FRV	15257	65	NA	4	Morgan City	2	0	2	6	0	10
46' FRV	15257	65	NA	4	Lake Charles	2	0	2	2.5	0	6.5
46' FRV	15257	65	NA	4	Venice	2	0	2	12	0	16
MSRC											
30 ft. Kvichak *Marco I Skimmer (1)*	3588	24	NA	6	Ingleside	1	1	2	13	0	17
30 ft. Kvichak *Marco I Skimmer (1)*	3588	24	NA	6	Galveston	1	1	2	3.6	0	7.6
MSRC Lightning 2 LORI Brush Pack	5000	50	NA	6	Tampa	2	0	1	30.4	1	34.4
MSRC Quick Strike 2 LORI Brush Pack	5000	50	NA	6	Lake Charles	2	0	1	3	1	7
30 ft. Kvichak *Marco I Skimmer (1)*	3588	24	NA	6	Belle Chasse	1	1	2	11	0	15
30 ft. Kvichak *Marco I Skimmer (1)*	3588	24	NA	6	Pascagoula	1	1	2	18	0	22
Enterprise Marine Services LLC (Available through contract with CGA)											
CTCo 2603	NA	25000	1 Tug	6	Amelia	28	12	4	15	1	60
CTCo 2604	NA	20000	1 Tug	6	Amelia	28	12	4	15	1	60
CTCo 2605	NA	20000	1 Tug	6	Amelia	28	12	4	15	1	60
CTCo 2606	NA	20000	1 Tug	6	Amelia	28	12	4	15	1	60
CTCo 2607	NA	23000	1 Tug	6	Amelia	28	12	4	15	1	60
CTCo 2608	NA	23000	1 Tug	6	Amelia	28	12	4	15	1	60
CTCo 2609	NA	23000	1 Tug	6	Amelia	28	12	4	15	1	60
CTCo 5001	NA	47000	1 Tug	6	Amelia	28	12	4	15	1	60
Kirby Offshore (available through contract with CGA)											
RO Barge	NA	80000+	1 Tug	6	Venice	26.7	0	2	31.3	0	60

Shoreline Protection Boom	VOO	Persons Req.	Storage/Warehouse Location	Hrs to Procure	Hrs to Loadout	Travel to Staging	Travel to Deployment Site	Hrs to Deploy	Total Hrs
OMI Environmental (available through MSA)									
12,500’ 18” Boom	6 Crew	12	New Iberia	1	1	4	2	3	11
6,400’ 18” Boom	3 Crew	6	Houston	1	1	4	2	3	11
3,500’ 18” Boom	2 Crew	4	Port Arthur	1	1	2	2	3	9
8,000’ 18” Boom	3 Crew	6	Port Allen	1	1	5	2	3	12
2,500’ 18” Boom	1 Crew	2	Morgan City	1	1	5	2	3	12
1,000’ 18” Boom	1 Crew	2	Hackberry	1	1	1	2	3	8

Wildlife Response	EDRC	Storage Capacity	VOO	Persons Req.	From	Hrs to Procure	Hrs to Load Out	Travel to Staging	Travel to Deployment	Hrs to Deploy	Total Hrs
CGA											
Wildlife Support Trailer	NA	NA	NA	2	Harvey	2	2	7	1	2	14
Bird Scare Guns (48)	NA	NA	NA	2	Harvey	2	2	7	1	2	14
Bird Scare Guns (12)	NA	NA	NA	2	Galveston	2	2	4.8	1	2	11.8
Bird Scare Guns (12)	NA	NA	NA	2	Aransas Pass	2	2	9.5	1	2	16.5
Bird Scare Guns (24)	NA	NA	NA	2	Lake Charles	2	2	1.5	1	2	8.5
Bird Scare Guns (24)	NA	NA	NA	2	Leeville	2	2	6.8	1	2	14.8

Response Asset	Total
Offshore EDRC (bbls)	1,194,343
Offshore Recovered Oil Storage (bbls)	1,265,296+
Nearshore / Shallow Water EDRC (bbls)	245,864
Nearshore / Shallow Water Recovered Oil Storage (bbls)	295,692+

SECTION I
Environmental Monitoring and Environmental Mitigation Measures

(a) Monitoring

If required, Anadarko will monitor loop currents per NTL 2018-G01.

Anadarko subscribes to Wilkins Weather Service which provides real-time weather conditions such as tropical depressions, storms and/or hurricanes entering the Gulf of Mexico.

Additional measures to avoid, minimize, and mitigate environmental impacts is included in **Section N–Environmental Impact Analysis.**

(b) Incidental Takes

Although marine mammals may be seen in the area, Anadarko does not believe that its operations proposed under this EP will result in the harassment, capture, collection or killing of any mammals covered by the Marine Mammal Protection Act.

Anadarko will operate in accordance with applicable regulations in order to avoid or minimize incidental takes of marine mammals and other species, including:

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

SECTION J
LEASE STIPULATIONS INFORMATION

Gulf of Mexico Lease Sale 249–Walker Ridge 881

Gulf of Mexico Lease Sale 251–Walker Ridge 925

Protected Species

This stipulation is meant to reduce the potential taking of federally protected threatened or endangered species and marine mammals. Anadarko will operate in accordance with BOEM NTL 2016-G01 to minimize the risk of vessel strikes to protected species and will report observations of injured or dead protected species. Anadarko will operate in accordance with BSEE NTL 2015-G03 to prevent intentional and/or accidental introduction of debris into the marine environment.

There is no reason to believe that any of the endangered, protected, or threatened species and marine mammals as listed in the ESA will be incidentally "taken" as a result of the operations under this plan. In the event of an incidental take, Anadarko's mitigation measures will adhere and be implemented in accordance to the requirements set forth in NTL 2008-G04, extended by NTL 2015-N02.

SECTION K
Support Vessels and Aircraft Information

(a) General

Type	Max. Total Fuel Tank Storage Capacity	Max. No. in Area at any Time	Trip Frequency or Duration
Supply Vessel	336,227 gallons	1	2 trips/week
Helicopter	735.3 gallons	1	10 trips/week
Crew Vessel	70,000 gallons	1	3 trips/week
Crew Vessel for Flowback Ops	70,000 gallons	1	5 days total/well
Support Vessel	450,698 gallons	1	3 days total/well
Tug Boats	158,000 gallons	N/A	N/A

(b) Diesel Oil Supply Vessels

Fuel for the rig will be transported via a supply vessel as follows:

Size of fuel supply vessel:	230'
Carrying capacity of fuel supply vessel:	336,227 gallons
Frequency that fuel supply vessel will visit the facilities:	Twice per week
Routes the fuel supply vessel will use to travel between the onshore support base and proposed facility:	Shortest route from shore-base to block

(c) Drilling Fluids Transportation

The following estimates were prepared utilizing Anadarko's experience with similar drilling operations. Estimated quantities are reflected in the table below.

Type of Material	Quantity Being Transported	Transportation Method
Water-based drilling fluid (NaCl saturated, seawater, freshwater, barite) for Pump and Dump	13 gallon tote tanks (liquids) 40-63 sacks on pallet (sack chemicals)*	Supply boat
Synthetic-based drilling fluid (internal olefin, ester)	13 gallon tote tanks (liquids) 40-63 sacks on pallet (sack chemicals)**	Supply boat
Oil-based drilling fluid	N/A	N/A

Note: The estimated amount of tote tanks and size of sacks may vary during drilling operations.

(d) Produced Liquid Hydrocarbons Transportation Vessels

Produced liquid hydrocarbons from future flow tests on wells in Walker Ridge 881/925 will be transported by a flowback vessel. Anadarko estimates flaring a max volume of 15 MMSCF/well total during the 48-hour flow test period.

Transport Method	Vessel Capacity (estimated)	Average Volume to be Loaded (per vessel)	No. of Transfers (Yearly Average)
Flowback/ Crew Vessel	3,000 – 10,000 bbls	5,000 – 10,000 bopd	1-2/well

(e) Solid and Liquid Wastes Transportation

Type of Waste	Composition	Total Projected Amount	Rate	Transport Method	Name/Location of Facility	Disposal Method
Synthetic-based drilling fluid or mud	Synthetic-based drilling muds	176,000 bbls total	16,000 bbls/year/well	Re-use and/or transport to shore on vessel in DOT approved containers.	An approved waste disposal facility will be utilized, such as Port Fourchon, LA and on to Newpark Fourchon Transfer Station #1 & #2. Newpark Transfer Station Morgan City. Newpark Transfer Station Port Arthur. USLL Galveston and Fourchon Transfer Station. If recycled, returned to vendor (Bariod or MI).	Re-used and/or recycled; if can't be reused and/or recycled the waste is disposed of at an approved waste disposal facility, such as Newpark (injection disposal facility) or USLL (landfarm).
Cuttings wetted with synthetic-based muds	Cuttings coated with synthetic drilling muds, including drilled out cement	90,365 bbls total	8,215 bbls/year/well **An estimated 5-10% of cuttings may be transported to shore*	Re-use and/or transport to shore on vessel in DOT approved containers.	An approved waste disposal facility will be utilized, such as Port Fourchon, LA and on to Newpark Fourchon Transfer Station #1 & #2. Newpark Transfer Station Morgan City. Newpark Transfer Station Port Arthur. USLL Galveston & Fourchon Transfer Station. If recycled, returned to vendor (Bariod or MI).	Re-used and/or recycled; if can't be reused and/or recycled the waste is disposed of at an approved waste disposal facility, such as Newpark (injection disposal facility) or USLL (landfarm).
Chemical product waste (well treatment fluids)	Ethylene glycol Methanol	3,667 bbls total 917 bbls total	100 bbls/month/well 25 bbls/month/well	Transport to shore on vessel in DOT approved containers for pick up.	An approved waste disposal facility will be utilized, such as Chemwaste in Sulphur, LA and Veolia Port Arthur, TX or to Newpark, Port Arthur as non-hazardous waste.	Can be returned to vendor and/or used at another facility; MEG is solidified and disposed of in a landfill. Methanol is incinerated or used for fuels blending.
Completion fluids	Brine, spent acid, prop sand, debris	33,000 bbls total	3,000 bbls/year/well	Transport to shore on vessel in DOT approved containers and/or vessel tanks for pick up.	An approved waste disposal facility will be utilized, such as Port Fourchon, LA and on to Newpark Fourchon Transfer Station #1 & #2. Newpark Transfer Station Morgan City. Newpark Transfer Station Port Arthur. USLL Galveston and Fourchon Transfer Station	Unused brine can be returned to vendor and/or stored for use on another job. Used brine and spent acid is transferred to an approved waste disposal facility, such as Newpark's Processing & Transfer facility for injection.

Type of Waste	Composition	Total Projected Amount	Rate	Transport Method	Name/Location of Facility	Disposal Method
Workover fluids	Brine, spent acid, prop sand, debris	33,000 bbls total	3,000 bbls/year/well	Transport to shore on vessel in DOT approved containers and/or vessel tanks for pick up.	An approved waste disposal facility will be utilized, such as Port Fourchon, LA and on to Newpark Fourchon Transfer Station #1 & #2. Newpark Transfer Station Morgan City. Newpark Transfer Station Port Arthur. USLL Galveston and Fourchon Transfer Station	Unused brine can be returned to vendor and/or stored for use on another job. Used brine and spent acid is transferred to Newpark's Processing & Transfer facility for injection.
Trash and debris	Refuse generated during operations	1,833 bbls total	50 bbls/month/well	Transport to shore on vessel in disposal bags or DOT approved containers by vessels to shorebase for pickup by municipal operations.	An approved waste disposal facility will be utilized, such as Recycled Material in ARC, New Iberia, LA. Trash disposed of at SWDI landfill.	Recycled and/or disposed in landfill.
Used oil	Excess oil from engines	3,942 bbls total	430 bbls/120 days/well	Transport on vessel in DOT approved containers to shore for pick up.	An approved waste disposal facility will be utilized, such as Martin Energy Services in Jennings, LA or Aaron Oil Company in Berwick, LA.	Recycled

Total projected amount assumes 11 wells at 100 days/well (100 days to drill and complete)
*****Rate per day is an estimated max.average and may vary during drilling operational phases. The total amount is rounded to nearest whole number.***

(f) Vicinity Map

A vicinity map is included in this section as **Attachment K-1.**

Attachment K-1

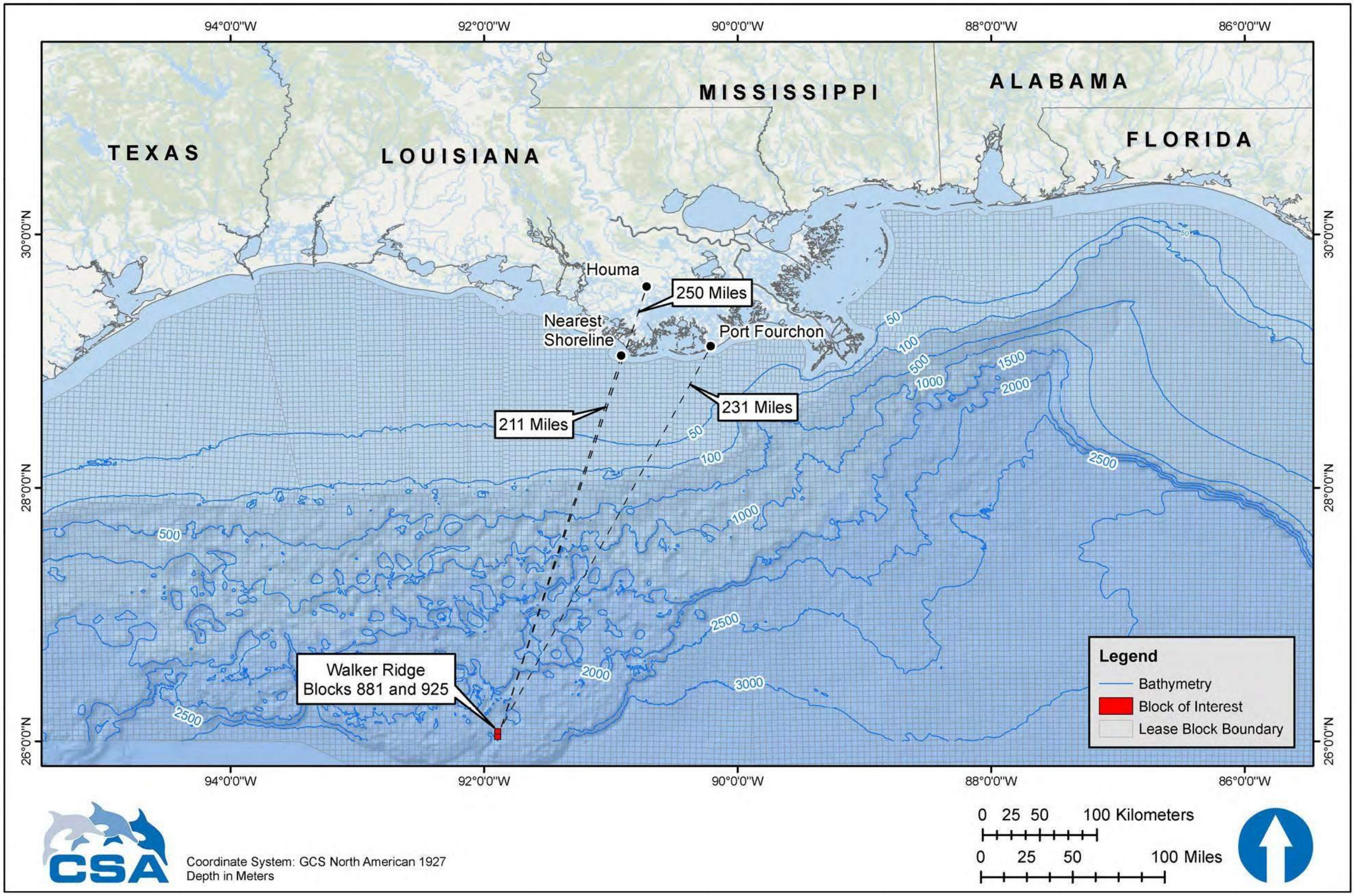


Figure 1. Location of Walker Ridge Blocks 881 and 925.

SECTION L
ONSHORE SUPPORT FACILITIES INFORMATION

(a) General

Per NTL 2008-G04, extended by NTL 2015-N02, the following tables reflect the onshore facilities Anadarko will utilize to provide supplies and service support for the activities proposed in this Exploration Plan.

Name	Primary Location	Existing/New/ Modified
Anadarko Service Base (vessel/helicopter base)	Fourchon, LA	Existing
Anadarko Service Base (helicopter base)	Houma, LA	Existing

Name	*Alternate Locations	Existing/New/ Modified
Anadarko Service Base	Galveston, TX	Existing
Anadarko Service Base	Cameron, LA	Existing
Anadarko Service Base	Lake Charles, LA	Existing
Anadarko Service Base	Houma, LA	Existing
Anadarko Service Base	Pascagoula, MS	Existing

***In the unlikely event Anadarko's primary service base cannot be utilized Anadarko will exercise the use of an alternate service base during drilling and/or completion operations.**

(b) Support Base Construction or Expansion

No onshore support base construction or expansion is planned for these activities. Therefore dredging or filling activities associated with construction or expansion of facilities will not be applicable.

(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

Disposed wastes describe those wastes generated by the proposed activity that are disposed of by means other than by release into the water of the GOM at the site where they are generated. These wastes can be disposed of by offsite release, injection, encapsulation, or placement at either onshore or offshore permitted locations for the purposes of returning them back to the environment.

Type of Waste	Composition	Total Projected Amount	Rate	Transport Method	Name/Location of Facility	Disposal Method
Synthetic-based drilling fluid or mud	Synthetic-based drilling muds	176,000 bbls total	16,000 bbls/year/well	Re-use and/or transport to shore on vessel in DOT approved containers.	An approved waste disposal facility will be utilized, such as Port Fourchon, LA and on to Newpark Fourchon Transfer Station #1 & #2. Newpark Transfer Station Morgan City. Newpark Transfer Station Port Arthur. USLL Galveston and Fourchon Transfer Station. If recycled, returned to vendor (Bariod or MI).	Re-used and/or recycled; if can't be reused and/or recycled the waste is disposed of at an approved waste disposal facility, such as Newpark (injection disposal facility) or USLL (landfarm).
Cuttings wetted with synthetic-based muds	Cuttings coated with synthetic drilling muds, including drilled out cement	90,365 bbls total	8,215 bbls/year/well **An estimated 5-10% of cuttings may be transported to shore*	Re-use and/or transport to shore on vessel in DOT approved containers.	An approved waste disposal facility will be utilized, such as Port Fourchon, LA and on to Newpark Fourchon Transfer Station #1 & #2. Newpark Transfer Station Morgan City. Newpark Transfer Station Port Arthur. USLL Galveston & Fourchon Transfer Station. If recycled, returned to vendor (Bariod or MI).	Re-used and/or recycled; if can't be reused and/or recycled the waste is disposed of at an approved waste disposal facility, such as Newpark (injection disposal facility) or USLL (landfarm).
Chemical product waste (well treatment fluids)	Ethylene glycol Methanol	3,667 bbls total 917 bbls total	100 bbls/month/well 25 bbls/month/well	Transport to shore on vessel in DOT approved containers for pick up.	An approved waste disposal facility will be utilized, such as Chemwaste in Sulphur, LA and Veolia Port Arthur, TX or to Newpark, Port Arthur as non-hazardous waste.	Can be returned to vendor and/or used at another facility; MEG is solidified and disposed of in a landfill. Methanol is incinerated or used for fuels blending.
Completion fluids	Brine, spent acid, prop sand, debris	33,000 bbls total	3,000 bbls/year/well	Transport to shore on vessel in DOT approved containers and/or vessel tanks for pick up.	An approved waste disposal facility will be utilized, such as Port Fourchon, LA and on to Newpark Fourchon Transfer Station #1 & #2. Newpark Transfer Station Morgan City. Newpark Transfer Station Port Arthur. USLL Galveston and Fourchon Transfer Station	Unused brine can be returned to vendor and/or stored for use on another job. Used brine and spent acid is transferred to an approved waste disposal facility, such as Newpark's Processing & Transfer facility for injection.

Type of Waste	Composition	Total Projected Amount	Rate	Transport Method	Name/Location of Facility	Disposal Method
Workover fluids	Brine, spent acid, prop sand, debris	33,000 bbls total	3,000 bbls/year/well	Transport to shore on vessel in DOT approved containers and/or vessel tanks for pick up.	An approved waste disposal facility will be utilized, such as Port Fourchon, LA and on to Newpark Fourchon Transfer Station #1 & #2. Newpark Transfer Station Morgan City. Newpark Transfer Station Port Arthur. USLL Galveston and Fourchon Transfer Station	Unused brine can be returned to vendor and/or stored for use on another job. Used brine and spent acid is transferred to Newpark's Processing & Transfer facility for injection.
Trash and debris	Refuse generated during operations	1,833 bbls total	50 bbls/month/well	Transport to shore on vessel in disposal bags or DOT approved containers by vessels to shorebase for pickup by municipal operations.	An approved waste disposal facility will be utilized, such as Recycled Material in ARC, New Iberia, LA. Trash disposed of at SWDI landfill.	Recycled and/or disposed in landfill.
Used oil	Excess oil from engines	3,942 bbls total	430 bbls/120 days/well	Transport on vessel in DOT approved containers to shore for pick up.	An approved waste disposal facility will be utilized, such as Martin Energy Services in Jennings, LA or Aaron Oil Company in Berwick, LA.	Recycled

Total projected amount assumes 11 wells at 100 days/well (100 days to drill and complete)
*****Rate per day is an estimated max.average and may vary during drilling operational phases. The total amount is rounded to nearest whole number.***

SECTION M
COASTAL ZONE MANAGEMENT ACT INFORMATION

Texas

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

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

No operations are proposed in or near any critical areas. The proposed activities are explorative in nature, so no facility construction is proposed. The proposed activities are located approximately 255 miles from the Texas shoreline; therefore we expect no adverse impacts to CNRAs or beach access and use rights of the public. All activities shall be conducted in a manner that minimizes significant impacts to coastal resources. No adverse effects to Texas' coastal area are expected in association with the proposed activities.

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

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

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

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

(Category 5)
Prevention, Response, and Remediation of Oil Spills

The proposed activities will be covered under the Regional Oil Spill Response Plan. The plan is in place, practiced, and updated as necessary. The best practical techniques shall be utilized to prevent the release of pollutants or toxic substances into the environment. All involved vessels and facilities are designed to be capable of prompt response and adequate removal of accidental discharges of oil. In addition, the proposed activities are 255 miles from shore; therefore no damages to natural resources are expected as the result of an unauthorized discharge of oil into coastal waters.

(Category 6)
Discharge of Municipal and Industrial Waste Water to Coastal Waters

No discharges from the proposed activities will occur in coastal waters. The proposed activities are 255 miles from shore; therefore there will be no effect on coastal waters.

(Category 8)
Development in Critical Areas

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

(Category 9)
Construction of Waterfront Facilities and Other Structures on Submerged lands

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

(Category 10)
Dredging and Dredged Material Disposal and Placement

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

(Category 11)
Construction in the Beach / Dune System

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

(Category 15)
Alteration of Coastal Historic Areas

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

(Category 16)
Transportation

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

(Category 17)
Emission of Air Pollutants

The proposed activities shall be carried out in conformance with applicable air quality laws, standards, and regulations. Emissions from the proposed activities are not expected to have significant impacts on onshore air quality because of the prevailing atmospheric conditions, emission heights, emission rates, and the distance of these emissions from the coastline. The proposed activities will occur approximately 255 miles from shore and will be within the exemption limits set by BOEM, therefore, no impacts to Texas' coastal zone is expected.

(Category 18)
Appropriations of Water

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

(Category 20)
Marine Fishery Management

The proposed activities are located approximately 255 miles from shore and are not expected to have any effect on marine fishery management or fishery migratory patterns within waters in the coastal zone of Texas.

(Category 22)
Administrative Policies

The necessary information for applicable agencies to make an informed decision on the proposed activities has been provided In conclusion, all activities shall be consistent with Texas' coastal management program and shall comply with all relevant rules and regulations. No activities are planned within any critical areas. Activities will be carried out avoiding unnecessary conflicts with other uses of the vicinity.

STATE OF TEXAS

CONSISTENCY CERTIFICATION
FOR

INITIAL SUPPLEMENTAL EXPLORATION
PLAN

WALKER RIDGE BLOCK 881/925
OCS-G36181/OCS-G36475

The proposed activities described in detail in this OCS Plan comply with Texas' approved Coastal Zone Management Program(s) and will be conducted in a manner consistent with such Program(s).

Anadarko Petroleum Corporation

Bridget O'Farrell

Bridget O'Farrell, Certifying Official
June 2019

LOUISIANA

Issues identified in the Louisiana Coastal Zone Management Program include the following: general coastal use guidelines, levees, linear facilities (pipelines); dredged soil deposition; shoreline modifications, surface alterations, hydrologic and sediment transport modifications, waste disposal; uses that result in the alteration of waters draining into coastal waters; oil, gas, or other mineral activities; and air and water quality.

Relevant enforceable policies were considered in certifying consistency for Louisiana.

STATE OF LOUISIANA

CONSISTENCY CERTIFICATION FOR

INITIAL SUPPLEMENTAL EXPLORATION PLAN

WALKER RIDGE BLOCK 881/925 OCS-G36181/OCS-G36475

The proposed activities described in detail in this OCS Plan comply with Louisiana's approved Coastal Zone Management Program(s) and will be conducted in a manner consistent with such Program(s).

Anadarko Petroleum Corporation

Bridget O'Farrell

Bridget O'Farrell, Certifying Official
June 2019

MISSISSIPPI

As authorized by the Federal Coastal Zone Management Act (CZMA), The State of Mississippi developed a Coastal Management Program (CMP) to allow for the review of proposed Federal license and permit activities affecting any coastal use or resources, in or outside of the Mississippi Coastal Zone.

The OCS related oil and gas exploratory and development activities having potential impact on the Mississippi Coastal Zone are based on the location of the proposed facilities, access to those sites, best practical techniques for drilling locations, drilling equipment guidelines for the prevention of adverse environmental effects, effective environmental protection, emergency plans and contingency plans.

Below are goals identified by the State of Mississippi and our comments and/or corresponding cross references:

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

The activities proposed in this plan are based out of Fourchon, Louisiana. The activities will not provide any industrial expansion on the coastal area of Mississippi. Therefore Mississippi coastal areas will be conserved for water dependent industry.

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

Goal 2 is addressed in **Section N–Environmental Impact Analysis.** The nearest proposed activities will be 285 miles from the Mississippi coast.

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

Goal 3 is addressed in **Section N–Environmental Impact Analysis.** Little impact to the seafood industry can be expected due to the activities occurring 285 miles from the Mississippi coast.

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

Goal 4 is addressed in **Section B–General Information, Section G–Air Emissions Information, and Section N–Environmental Impact Analysis.**

<u>Goal 5</u>: To put to beneficial use to the fullest extent of which they are capable the water resources of the state, and to prevent the waste, unreasonable use, or unreasonable method of use of water.

The activities proposed in this plan are based in Fourchon, Louisiana. As such, Mississippi's water resources should not be impacted by the proposed activities. Activities occurring at the sites in the OCS will be conducted in accordance with our Regional Oil Spill Response Plan referenced in **Section H** of this plan.

<u>Goal 6</u>: To preserve the state's historical and archaeological resources, to prevent their destruction, and to enhance these resources wherever possible.

Goal 6 is addressed in Section B–General Information, and **Section N–Environmental Impact Analysis.**

<u>Goal 7</u>: To encourage the preservation of natural scenic qualities in the coastal area.

Goal 7 is addressed in Section F–Wastes and Discharge Information, Section H–Oil Spill Information, Section G–Air Emissions Information, and **Section N–Environmental Impact Analysis.**

<u>Goal 8</u>: To assist local governments in the provision of public facilities services in a manner consistent with the coastal program.

As the proposed activities are located 285 miles from the Mississippi coast and are based out of a shorebase in Fourchon, Louisiana local governments should not be affected.

STATE OF MISSISSIPPI

CONSISTENCY CERTIFICATION FOR

INITIAL SUPPLEMENTAL EXPLORATION PLAN

WALKER RIDGE BLOCK 881/925
OCS-G36181/OCS-G36475

The proposed activities described in detail in this OCS Plan comply with Mississippi's approved Coastal Zone Management Program(s) and will be conducted in a manner consistent with such Program(s).

Anadarko Petroleum Corporation

Bridget O'Farrell

Bridget O'Farrell, Certifying Official
June 2019

SECTION N
ENVIRONMENTAL IMPACT ANALYSIS

Environmental Impact Analysis

For an

INITIAL SUPPLEMENTAL EXPLORATION PLAN

Walker Ridge Blocks 881 and 925
(OCS-G 36181 and OCS-G 36475)
Offshore Louisiana

June 2019

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Environmental Impact Analysis
For an
INITIAL SUPPLEMENTAL EXPLORATION PLAN
Walker Ridge Blocks 881 and 925
(OCS-G 36181 and OCS-G 36475)
Offshore Louisiana

DOCUMENT NO. CSA-ANADARKO-FL-19-3414-01-REP-01-FIN

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Acronyms and Abbreviations

ac	acre
ADIOS2	Automated Data Inquiry for Oil Spills 2
Anadarko	Anadarko Petroleum Corporation
bbl	barrels
BOEM	Bureau of Ocean Energy Management
BOEMRE	Bureau of Ocean Energy Management, Regulation and Enforcement
BSEE	Bureau of Safety and Environmental Enforcement
CFR	Code of Federal Regulations
CGA	Clean Gulf Associates
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
dB re 1 µPa	decibels relative to 1 micropascal
dB re 1 µPa m	decibels relative to 1 micropascal meter
dB re 1 μPa^2 s	decibels relative to 1 micropascal squared second
DP	dynamically positioned
DPS	Distinct Population Segment
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIA	Environmental Impact Analysis
EIS	Environmental Impact Statement
EP	Exploration Plan
ESA	Endangered Species Act
FAD	fish-aggregating device
GPS	global positioning system
GMFMC	Gulf of Mexico Fishery Management Council
H_2S	hydrogen sulfide
ha	hectare
HAPC	Habitat Area of Particular Concern
HOSS	high-volume open sea skimmer
hertz	Hz
IPF	impact-producing factor
LARS	launch and recovery system
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
MSRC	Marine Spill Response Corporation
MWCC	Marine Well Containment
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
OSRA	Oil Spill Risk Analysis
OSRP	Oil Spill Response Plan
PAH	polycyclic aromatic hydrocarbon
PM	particulate matter
SBM	synthetic-based drilling muds
SO_x	sulfur oxides
UME	Unusual Mortality Event
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compound
WBM	water-based drilling muds
WCD	worst-case discharge
WR	Walker Ridge

Introduction

Anadarko Petroleum Corporation (Anadarko) is submitting an Initial Supplemental Exploration Plan (EP) for Walker Ridge (WR) Blocks 881 (WR 881) and 925 (WR 925). Under this EP, Anadarko proposes to drill and complete 11 wells: WR 881 A, AA, B, D, F, and FF, A Alt., AA Alt., AAA Alt., E, and EE. The Environmental Impact Analysis (EIA) provides information on potential environmental impacts of Anadarko's proposed drilling activities for these exploration wells.

The project area is approximately 211 miles (340 km) from the nearest shoreline (Louisiana), 231 miles (372 km) from the onshore support base at Port Fourchon, Louisiana, and 250 miles (403 km) from the helicopter base at Houma, Louisiana (**Figure 1**). The water depth at the proposed wellsites ranges from approximately 7,560 to 7,815 ft (2,304 to 2,382 m). The mobile offshore drilling unit (MODU) has not yet been determined, but will be a dynamically positioned (DP) drillship or DP semisubmersible rig. Drilling/completion operations are expected to require approximately 100 days total per well beginning in late 2019, inclusive of drilling and completion activities.

The EIA for this EP was prepared for submittal to BOEM in accordance with applicable regulations, including 30 Code of Federal Regulations (CFR) 550.212(o) and 550.227. The EIA is a project- and site-specific analysis of Anadarko's planned activities under this EP. The EIA complies with guidance provided in existing Notices to Lessees and Operators (NTLs) issued by BOEM and its predecessors, Minerals Management Service (MMS) and Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), including NTLs 2008-G04 (extended by 2015-N02) and 2015-N01. Potential impacts from oil and gas operations were analyzed at a broader level in the 2017 to 2022 Programmatic Environmental Impact Statement (EIS) for the Outer Continental Shelf (OCS) Oil and Gas Leasing Program (BOEM, 2016a) and in lease sale EISs for the Western and Central Gulf of Mexico Planning Areas (BOEM, 2012a; b; 2013a; 2014a; 2015b; 2016b; 2017a; c). The most recent lease sale EISs contain updated environmental baseline information in light of the Macondo (*Deepwater Horizon*) incident and addressed potential impacts of a catastrophic spill (BOEM, 2012a; b; 2013a; 2014a; 2015b; 2016b; 2017a; c). The analyses from those documents are incorporated here by reference.

All the proposed activities and facilities discussed in this EP are covered by Anadarko's Gulf of Mexico Regional Oil Spill Response Plan (OSRP) last approved on 14 August 2015 for Anadarko and its subsidiary, Anadarko US Offshore LLC (Company Numbers 00981 and 02219, respectively), in accordance with 30 CFR Part 254. The June 2017 biennial updates were acknowledged by the Bureau of Safety and Environmental Enforcement (BSEE) on 12 July 2017; 5 October 2017 updates were acknowledged by BSEE on 2 November 2017. Non-regulatory required OSRP updates were submitted to BSEE on 19 June 2018 and acknowledged as in compliance in 18 July 2018. The OSRP details Anadarko's plan to rapidly and effectively manage oil spills that may result from drilling and production operations. Anadarko has designed its spill response program based on a regional capability of response to spills ranging from small operational spills to a worst-case discharge (WCD) from a well blowout. Anadarko's spill response program meets the response planning requirements of the relevant coastal states and applicable federal oil spill planning regulations. The OSRP also includes information regarding Anadarko's regional oil spill organization and dedicated response assets, potential spill risks, and local environmental sensitivities. It describes personnel and equipment mobilization, incident management team organization, and an overview of actions to be taken and notifications necessary in the event of a spill.

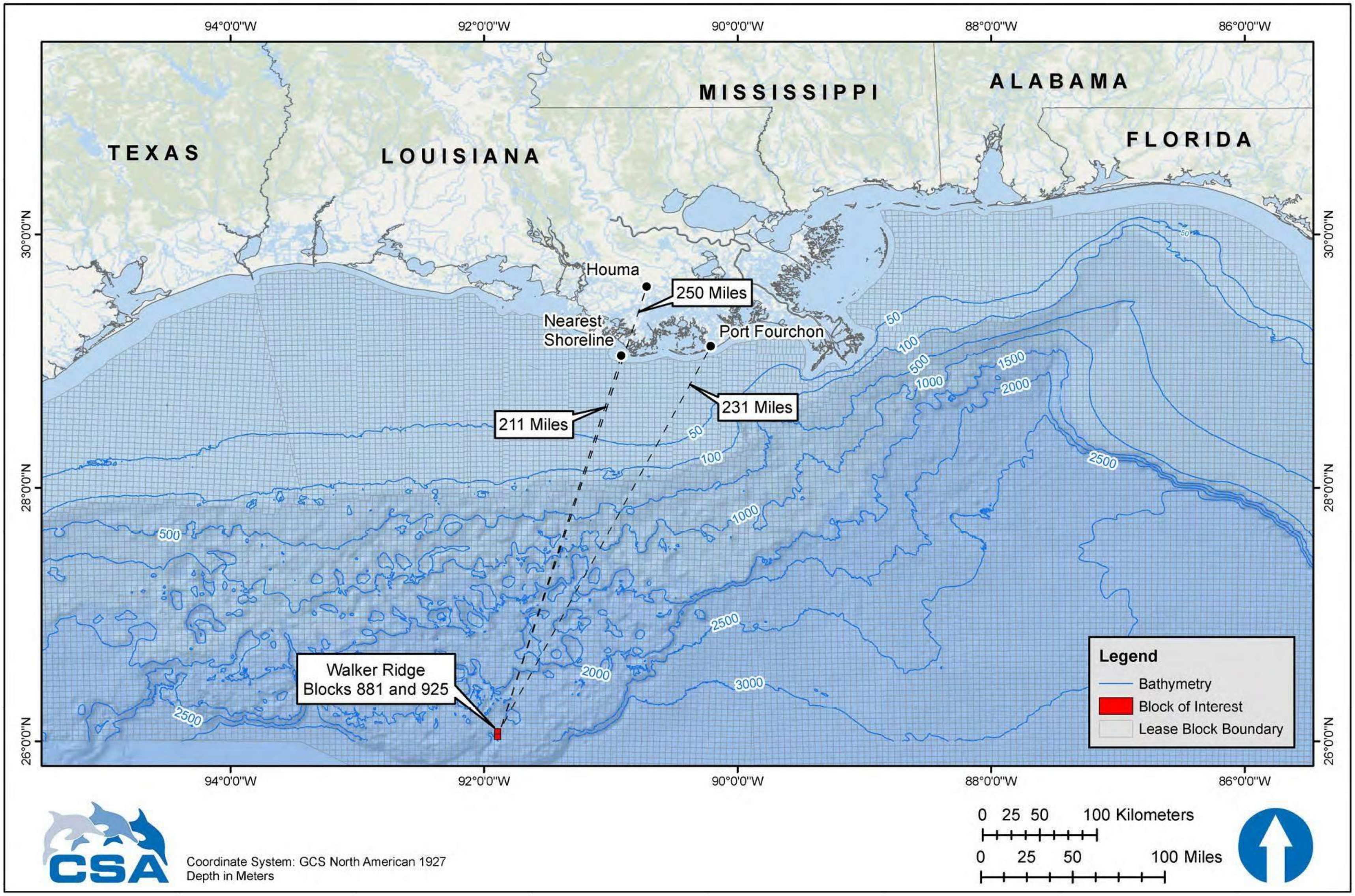

Figure 1. Location of Walker Ridge Blocks 881 and 925.

Sections A through **I** of the EIA provide information required by NTL 2008-G04 and 2015-N01. The main impact-related discussions are in **Section A** (Impact-Producing Factors) and **Section C** (Impact Analysis). **Table 1** lists and summarizes the NTLs that are applicable to the EIA.

Table 1. Notices to Lessees and Operators (NTLs) that are applicable to the 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.
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 instructional placards at prominent locations on offshore vessels and structures; and mandates a yearly marine trash and debris awareness training and certification process.
BOEM 2015-N02	Elimination of Expiration Dates on Certain Notices to Lessees and Operators Pending Review and Reissuance	Eliminates expiration dates (past or upcoming) of all NTLs currently posted on the Bureau of Ocean Energy Management (BOEM) website.
BOEM 2015-N01	Information Requirements for Exploration Plans, Development and Production Plans, and Development Operations Coordination Documents on the OCS for Worst Case Discharge (WCD) and Blowout Scenarios	Provides guidance regarding information required in WCD descriptions and blowout scenarios.
BOEM 2014-G04	Military Warning and Water Test Areas	Provides contact links to individual command headquarters for military warning and water test areas in the Gulf of Mexico.
BSEE 2014-N01	Elimination of Expiration Dates on Certain Notices to Lessees and Operators Pending Review and Reissuance	Eliminates expiration dates (past or upcoming) of all NTLs currently posted on the Bureau of Safety and Environmental Enforcement (BSEE) website.
BSEE 2012-N06	Guidance to Owners and Operators of Offshore Facilities Seaward of the Coast Line Concerning Oil Spill Response Plans (OSRPs)	Provides clarification, guidance, and information concerning the preparation of an OSRP; and recommends the description of a response strategy for WCD scenarios to ensure that the capability to respond to oil spills is both efficient and effective.
2011-JOINT-G01	Revisions to the List of Outer Continental Shelf (OCS) Blocks Requiring Archaeological Resource Surveys and Reports	Provides new information on which OCS blocks require archaeological surveys and reports; and identifies required survey line spacing in each block. This NTL augments NTL 2005-G07.

Table 1. (Continued).

NTL	Title	Summary
2010-N10	Statement of Compliance with Applicable Regulations and Evaluation of Information Demonstrating Adequate Spill Response and Well Containment Resources	Informs operators using subsea or surface blowout preventers on floating facilities that applications for well permits must include a statement signed by an authorized company official stating that the operator will conduct all activities in compliance with all applicable regulations, including the increased safety measures regulations (75 *Federal Register* 63346); and informs operators that BOEM will evaluate whether each operator has submitted adequate information demonstrating that it has access to and can deploy containment resources to promptly respond to a blowout or other loss of well control.
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); and 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.
2008-G04	Information Requirements for Exploration Plans and Development Operations Coordination Documents	Provides guidance on the information requirements for OCS plans, including EIA requirements and information regarding compliance with the provisions of the Endangered Species Act and Marine Mammal Protection Act.
2005-G07	Archaeological Resource Surveys and Reports	Provides guidance on regulations regarding archaeological discoveries; specifies requirements for archaeological resource surveys and reports; and outlines options for protecting archaeological resources.

A. Impact-Producing Factors

Based on the description of Anadarko's proposed activities, a series of impact-producing factors (IPFs) have been identified. **Table 2** identifies the environmental resources that may be affected in the left column and identifies sources of impacts (IPFs) associated with the proposed project across the top. **Table 2**, adapted from Form BOEM-0142, has been 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 of the routine activities and accidental events could affect specific resources. An "X" indicates that an IPF could reasonably be expected to affect a resource and a dash (--) indicates no impact or negligible impact. Where there may be an impact, an analysis is provided in **Section C**. The potential IPFs for the proposed activity are discussed in the following subsections:

- MODU presence (including noise and lights;
- Physical disturbance to the seafloor;
- Air 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 potentially affected environmental resources.

Environmental Resources	Impact-Producing Factors									
	MODU Presence (including noise and lights)	Physical Disturbance to Seafloor	Air Pollutant Emissions	Effluent Discharges	Water Intake	Onshore Waste Disposal	Marine Debris	Support Vessel/Helicopter Traffic	Accidents	
									Small Fuel Spill	Large Oil Spill
Physical/Chemical Environment										
Air quality	--	--	X(9)	--	--	--	--	--	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)
West Indian manatee (endangered)	--	--	--	--	--	--	--	X(8)	--	X(6,8)
Non-endangered marine mammals (protected)	X	--	--	--	--	--	--	X	X(6)	X(6)
Sea turtles (endangered/threatened)	X(8)	--	--	--	--	--	--	X(8)	X(6,8)	X(6,8)
Piping Plover (threatened)	--	--	--	--	--	--	--	--	--	X(6)
Whooping Crane (endangered)	--	--	--	--	--	--	--	--	--	X(6)
Oceanic whitetip shark (threatened)	X	--	--	--	--	--	--	--	--	X(6)
Giant manta ray (threatened)	X	--	--	--	--	--	--	--	--	X(6)
Gulf sturgeon (threatened)	--	--	--	--	--	--	--	--	--	X(6)
Nassau grouper (threatened)	--	--	--	--	--	--	--	--	--	X(6)
Beach mouse (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)

X indicates potential impact; dash (--) indicates no impact or negligible impact; numbers refer to table footnotes; MODU = mobile offshore drilling unit.

Table 2 Footnotes and Applicability to this Program:

(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.*
   - None of these conditions (a through d) are applicable. The lease is not within or near any marine sanctuary, topographic feature, or no-activity zone. There are no known submarine banks in the project area.

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

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

(4) *Activities on blocks designated by the BOEM as being in water depths 300 m or greater.*
   - No impacts on high-density deepwater benthic communities are anticipated. There are no features that could support significant high-density deepwater benthic communities within 2,000 ft (610 m) of the proposed project location (Ocean Geo Solutions, 2019a; b; c; d; e; f). Because a dynamic positioning (DP) drilling vessel will be used, there will be no seafloor disturbances from the use of anchors.

(5) *Exploration or production activities where hydrogen sulfide (H_2S) concentrations greater than 500 ppm might be encountered.*
   - Walker Ridge Blocks 881 and 925 were classified as H_2S absent under a previously approval Initial Exploration Plan.

(6) *All activities that could result in an accidental spill of produced liquid hydrocarbons or diesel fuel that you determine would impact these environmental resources. If the proposed action is located a sufficient distance from a resource that no impact would occur, the EIA can note that in a sentence or two.*
   - Accidental hydrocarbon spills could affect the resources marked (**X**) in the "Accidents" portion of the matrix and potential 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.*
   - The project area in Walker Ridge Blocks 881 and 925 are not on BOEM's list of archaeology survey blocks (BOEM, 2011) and no impacts on archaeological resources are expected.

(8) *All activities that you determine might have an adverse effect on endangered or threatened marine mammals or sea turtles or their critical habitats.*
   - Impact-producing factors that may affect marine mammals, sea turtles, or their critical habitats include drilling vessel presence and emissions, vessel 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 MODU Presence (Including Noise and Lights)

The exploration wells proposed in this EP will be drilled using a DP MODU. DP MODUs use a global positioning system (GPS), specific computer software, and sensors in conjunction with their own propellers and thrusters to maintain position. The precise location of the MODU is monitored by operators using satellite navigation. Thrusters positioned at various locations around the MODU's hull are activated as needed to maintain position. This process, known as station-keeping, allows operations at sea in water depths or locations where mooring or anchoring is impractical or not feasible. The MODU will be on site for an estimated 100 days per well, and will maintain exterior lighting in accordance with applicable federal navigation and aviation safety regulations (International Regulations for Preventing Collisions at Sea, 1972 [72 COLREGS], Part C).

The MODU operations and equipment can be expected to produce noise associated with propulsion machinery that transmits directly to the water during station-keeping, wellhead installation, and maintenance operations. Additional sound and vibration are transmitted through the hull to the water from auxiliary machinery, such as generators, pumps, and compressors (Richardson et al., 1995). The noise levels produced by DP vessels for station-keeping are largely dependent on the level of thruster activity required to keep position; therefore, they vary based on local ocean currents, sea and weather conditions, and operational requirements. Representative source levels for DP vessels range from 184 to 190 decibels relative to one micropascal meter (dB re 1 µPa m) with a primary amplitude frequency below 600 hertz (Hz) (Blackwell and Greene Jr., 2003; McKenna et al., 2012; Kyhn et al., 2014).

When drilling, the drill string represents a long vertical sound source (McCauley, 1998). Based on available data, source levels generated during drilling, in the absence of thrusters, can be expected to range between 154 and 176 dB re 1 µPa m (Nedwell et al., 2001). Source levels associated with drilling activities have a maximum broadband (10 Hz to 10 kHz) energy of about 190 dB re 1 µPa m (Hildebrand, 2005). The use of thrusters, whether drilling or not, can elevate sound source levels to approximately 188 dB re 1 µPa m (Nedwell and Howell, 2004). Nedwell and Howell (2004) reported that the majority of noise from a semi-submersible drilling rig occurred below 600 Hz and sound pressure levels increased by 10 to 20 dB when drilling was active. Within the low bandwidths (<600 Hz), measured sound pressure levels were shown to be greatly influenced by the drilling rig for up to 1.2 miles (2 km) but at distances beyond 3.1 miles (5 km), the drill rig did not contribute significantly to the overall sound pressure levels in that bandwidth.

A.2 Physical Disturbance to the Seafloor

In water depths of 1,969 ft (600 m) or greater, DP MODUs disturb a small area of the seafloor around the wellbore where the bottom template and blowout preventer are located. Depending on the specific well configuration, the total disturbed area is estimated to be 0.25 hectare (ha) (0.62 acre [ac]) per well (BOEM, 2012a). For the 11 wells proposed in this EP, the total potential area of seafloor disturbance could be 2.75 ha (6.8 ac). However, the overall area of seafloor disturbance could be lower due to the geographic proximity of the proposed wells.

A.3 Air Emissions

Offshore air pollutant emissions will result from MODU operations as well as support vessel (both supply and crew vessels) and helicopter transits. These emissions occur mainly from combustion of diesel and aviation fuel (Jet-A). The combustion of fuels occurs in diesel-powered generators, pumps, or motors and from lighter fuel motors. Primary air pollutants typically associated with emissions from internal combustion engines are suspended particulate matter (PM), sulfur oxides (SO_x), nitrogen oxides (NO_x), volatile organic compounds (VOCs), and carbon monoxide (CO).

The Air Quality Emissions Report (see EP Section G) prepared in accordance with BOEM requirements demonstrates that the projected emissions are below exemption levels set by the applicable regulations in 30 CFR 550.303. Based on this and the distance from shore, it can be concluded that the emissions will not significantly affect the air quality of the onshore area for any of the criteria pollutants. No further analysis or control measures are required.

A.4 Effluent Discharges

The discharges will include treated sanitary and domestic wastes, deck drainage, desalination unit brine, wash water, blowout preventer fluid, non-pollutant completion fluids, uncontaminated ballast and bilge water, noncontact cooling water, fire water, water-based drilling muds (WBM) and cuttings, cuttings wetted with synthetic-based drilling muds (SBM), and excess cement. All offshore discharges will be in accordance with requirements of the National Pollutant Discharge Elimination System (NPDES) General Permit No. GMG290006 issued by the U.S. Environmental Protection Agency (USEPA), including permit compliance terms, discharge volumes, discharge rates, and associated monitoring requirements.

WBM and cuttings will be released at the seafloor during initial well-drilling intervals. The marine riser that enables the return of muds and cuttings to the surface vessel will not be in place during the initial drilling intervals, requiring deposition of drilling muds and cuttings on the seafloor until the riser is in place. Excess cement slurry also will be released at the seafloor during casing installation for the riserless portion of the drilling operations. Once the riser is in place, SBM will be used and collected on the MODU through the riser. The collected SBM will be re-used by the vendor or transported to Port Fourchon, Louisiana, for recycling and disposal at an approved facility. Cuttings wetted with SBMs will be treated and discharged to the seafloor in accordance with the NPDES permit. An estimated 5 to 10% of SBM cuttings may be transported to shore for disposal at appropriate waste facility. Final drilling fluid and cement volumes for the proposed activities have not been determined.

A.5 Water Intake

Seawater will be drawn from the ocean for once-through, non-contact cooling of machinery on the MODU. 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 MODU ultimately selected for this project will be in compliance with all cooling water intake structure requirements.

A.6 Onshore Waste Disposal

Wastes generated during the proposed activities are tabulated in EP Section F. A total of approximately 1,500 barrels (bbl) of trash and debris will be generated over the life of the project. Trash will be transported to shore in disposal bags for final disposal by municipal operators in accordance with applicable regulations. Other wastes transported to shore for re-use, recycling, or disposal include SBM and associated cuttings, chemical product waste (well treatment fluids), completion fluids, workover fluids, and used oil. All wastes will be transported to shore in containers approved by the U.S. Department of Transportation for re-use, recycling, or disposal in accordance with applicable regulations.

A.7 Marine Debris

Anadarko will comply with all regulations relating to solid waste handling, transportation and disposal, including the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) Annex V requirements as well as USEPA, U.S. Coast Guard (USCG), and BOEM regulations. These regulations include prohibitions and compliance requirements regarding the deliberate discharging of containers and other similar materials (i.e., trash and debris) into the marine environment as well as the protective measures to be implemented to prevent the accidental loss of solid materials into the marine environment. For example, the BSEE regulations 30 CFR 250.300(a) and (b)(6) prohibit operators from deliberately discharging containers and other similar materials (i.e., trash and debris) into the marine environment, and 30 CFR 250.300(c) requires durable identification markings on equipment, tools, containers (especially drums), and other materials. The USEPA and USCG regulations require operators to be proactive in avoiding accidental loss of solid materials 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. In addition to the regulations in 30 CFR 250, BSEE issued 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 training and certification process for marine trash and debris awareness

A.8 Vessel Traffic

The project will be supported by one supply vessel, one crew vessel, and one support vessel. All vessels will be based out of Port Fourchon, Louisiana. The supply vessel will make an estimated two round trips per week between the port and the project area while the crew vessel and the support vessel will make an estimated three round trips per week between the port and the project area. The vessels typically will transit to and from the project area via the most direct route from the shorebase. Anadarko will use existing shorebase facilities at Port Fourchon, Louisiana, for the onshore support of crew and supply vessel activities. No port terminal expansion or construction is planned.

Offshore support vessels associated with the proposed project will contribute to the overall acoustic environment by transmitting noise through both air and water. The support vessels will use conventional diesel-powered screw propulsion. Vessel noise is a combination of narrow-band (tonal) and broadband sound (Richardson et al., 1995; Hildebrand, 2009; McKenna et al., 2012). Tones typically dominate up to approximately 50 Hz, whereas broadband sounds may extend to 100 kHz. The primary sources of vessel noise are propeller cavitation, propeller singing, and propulsion; other sources include auxiliary engine noise, flow noise from water dragging along the hull, and bubbles breaking in the vessel's wake (Richardson et al., 1995). The intensity of noise from support vessels is roughly related to ship size, weight, and speed. Broadband source levels for smaller boats (a category that includes supply and other service vessels) are in the range of 150 to 180 dB re 1 µPa m (Richardson et al., 1995; Hildebrand, 2009; McKenna et al., 2012).

The project will be supported by one helicopter that will make an estimated 10 round trips per week between the project area and the heliport in Houma, Louisiana. The helicopter will be used to transport personnel as well as small supplies and will take the most direct route of travel between the heliport and the project area when air traffic and weather conditions permit. Helicopters typically maintain a minimum altitude of 700 ft (213 m) while in transit offshore, 1,000 ft (305 m) over unpopulated areas or across coastlines, and 2,000 ft (610 m) over populated areas and sensitive habitats such as wildlife refuges and park properties (BOEM, 2012a). 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). Anadarko will use existing air transportation (helicopter) facilities in Houma, Louisiana. No terminal expansion or construction is planned.

Dominant tones in noise spectra from helicopters are below 500 Hz with a source level of approximately 149 to 151 dB re 1 Pa m (for a Bell 212 helicopter) (Richardson et al., 1995). Levels of noise received underwater from passing aircraft depend on the aircraft's altitude, the aspect (direction and angle) of the aircraft relative to the receiver, receiver depth, water depth, and seafloor type (Richardson et al., 1995). Received level diminishes with increasing receiver depth when an aircraft is directly overhead, but may be stronger at mid-water than at shallow depths when an aircraft is not directly overhead (Richardson et al., 1995). Because of the relatively high expected airspeeds during transits and these physical variables, aircraft-related noise (including both airborne and underwater noise) is expected to be very brief in duration.

A.9 Accidents

The accidents addressed in the EIA focus on the following two potential types:

- a small diesel fuel spill, which is the most likely type of spill during OCS oil and gas activities (discussed in **Section A.9.1**); and
- a large oil spill, up to and including WCD for this EP (as detailed in EP Section H) and discussed in **Section A.9.2**.

The following subsections summarize assumptions about the size and fate of these spills as well as Anadarko's spill response plans. Potential impacts are analyzed in **Section C**.

Recent EISs (BOEM, 2014b; 2015b; 2016b; 2017a; c) analyze other types of accidents relevant to offshore oil and gas operations that could lead to potential impacts to the marine environment: loss of well control, vessel collisions, and chemical spills. These types of accidents, along with a hydrogen sulfide (H_2S) release, are discussed briefly below.

<u>Loss of Well Control</u>. 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, and/or water. In addition to the potential release of gas, condensate, oil, sand, or water, the loss of well control can also

resuspend and disperse bottom sediments (BOEM, 2012a; 2017a; c). 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). Not all loss of well control events result in a blowout (BOEM, 2017d).

Anadarko has a robust system in place to prevent loss of well control. Measures to prevent a blowout, reduce the likelihood of a blowout, and conduct effective and early intervention in the event of a blowout are described in the NTL 2015-N01 package submitted with this EP, as required by BOEM. The potential for a loss of well control event will be minimized by adhering to the requirements of applicable regulations such as the Well Control Rule (75 *FR* 63365) and NTL 2010-N10, which specify additional safety measures for OCS activities.

Vessel Collisions. BSEE data show that there were 168 OCS-related collisions between 2007 and 2017 (BSEE, 2017). Most collisions involved 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 vessel collided with a drilling platform in the Main Pass lease area, spilling 1,500 bbl of diesel fuel (BOEM, 2017a). Diesel fuel is the product most frequently spilled, but oil, natural gas, corrosion inhibitor, hydraulic fluid, and lube oil have also been released as a result of vessel collisions. As summarized by BOEM (2017d), vessel collisions occasionally occur during routine drilling and completion activities. Some of these collisions have caused spills of diesel fuel or chemicals. Anadarko will comply with all USCG- and BOEM-mandated safety requirements to minimize the potential for vessel collisions.

Chemical Spills. Chemicals are stored and used for pipeline hydrostatic testing, during drilling, and in-well completion operations. The relative quantities of their use are reflected in the largest volumes spilled (BOEM, 2017a). Completion fluids contribute the largest quantity of chemical used and comprise the largest releases. Between 5 and 15 chemical spills are anticipated each year in the Gulf of Mexico as a result of offshore drilling programs, with the majority being <50 bbl in size. The most common chemicals spilled are methanol, ethylene glycol, and zinc bromide.

H_2S Release. WR 881 and 925 are classified as "H_2S absent".

A.9.1 Small Fuel Spill

Spill Size. According to the analysis by BOEM (2017a), the most likely type of small spill (<1,000 bbl) resulting from OCS activities is a containment 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 volume for spills ≤1 bbl is 0.024 bbl, and the median volume for spills of 1 to 10 bbl is 3 bbl (Anderson et al., 2012). For the EIA, a small diesel fuel spill of 3 bbl is used. Operational experience suggests that the most likely cause of such a spill would be a rupture of the fuel transfer hose resulting in a loss of contents (<3 bbl of fuel) (BOEM, 2012a).

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

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

A sheen from a small fuel spill within the marine environment are expected to persist for relatively short periods of time, ranging from minutes (for a <1 bbl spill) to hours (for a 1 to 10 bbl spill) to a few days (for a 10 to 1,000 bbl spill), and will rapidly spread out, evaporate, and disperse into the water column (BOEM, 2012a).

For the purposes of the EIA, the fate of a small diesel fuel spill was estimated using NOAA's Automated Data Inquiry for Oil Spills (ADIOS2) model (NOAA, 2019). This model uses the physical properties of oils in its database to estimate the rate of evaporation and dispersion over time as well as changes in the density, viscosity, and water content of the product spilled. Based on the model results, it is estimated that more than 90% of a small diesel spill would evaporate or disperse within 24 hours. Based on results of the ADIOS2 model, the estimated sea surface area that could have diesel fuel on it during this 24-hour period would range from 0.5 to 5 ha (1.2 to 12 ac), depending on sea state and weather conditions.

The ADIOS2 model results, coupled with spill trajectory information discussed in the following subsection for a large spill, indicate that a small fuel spill would not likely impact coastal or shoreline resources because of the distance to the nearest shoreline; the project area is 211 miles (340 km) from the nearest shoreline. The lack of persistence of small oil spills in the environment and the project's distance from shore make it unlikely that a small spill within the project area would make landfall prior to dissipating (BOEM, 2012a; 2017a).

Spill Response. In the unlikely event that spill prevention procedures fail to avoid a fuel spill, response equipment and trained personnel will be activated so that spill effects will be localized and result in only short-term environmental consequences. EP Section H provides a detailed discussion of Anadarko's response to a spill.

A.9.2 Large Oil Spill (Worst Case Discharge)

Spill Size. The WCD scenario for this project is defined as an uncontrollable oil discharge from the subsea wellbore resulting from a blowout incident during installation operations. The scenario assumes that the wellhead fails mechanically and a blowout occurs at the seafloor, allowing the entire wellbore fluid to flow up the existing production string. The maximum total volume during a blowout could potentially be 20,250,000 bbl.

Blowout Scenario. In accordance with NTL 2015-N01 and as required by 30 CFR 550.213g, a scenario for a potential blowout of a well, and the highest volume of liquid hydrocarbons potentially released, has been detailed and is provided within this EP. An estimated 7 to 21 days will be required to mobilize equipment and to begin drilling a relief well under the blowout scenario. This assumes 0 to 4 days to suspend current operations on an existing well and 7 days to mobilize and be ready to spud the relief well. The estimated time to drill the relief well is 55 to 60 days for an estimated total of 62 to 81 days from time of blowout to completion of a relief well. The maximum total volume of liquid hydrocarbons released during a blowout is potentially 20,250,000 bbl, assuming 81 days for the maximum duration of a blowout, multiplied by the worst-case daily uncontrolled volume (250,000 bbl per day).

The detailed analysis of the WCD calculations can be found in EP Section H, as required by NTL 2015-N01 and 30 CFR 550.219(a)(2)(iv). Descriptions of the measures to be undertaken by Anadarko to prevent a blowout, reduce the likelihood of a blowout, and conduct effective and early intervention in the event of a blowout are included in the analysis. Anadarko will also comply with NTL 2010-N10 and the Well Control Rule (75 *FR* 63365) which specify additional safety measures for OCS activities.

Spill Probability. Holand (1997) estimated a probability of 0.0021 for a deep drilling blowout during exploration drilling based on U.S. Gulf of Mexico data. The International Association of Oil & Gas Producers (2010) conducted an analysis and estimated a blowout frequency of 0.0017 per exploratory well for non-North Sea locations. BOEM updated OCS spill frequencies (bbl spilled per bbl produced) to include the Macondo incident. According to ABS Consulting Inc. (2016), the spill rate for spills >1,000 bbl dropped to 0.22 spills per billion barrels produced. According to the BSEE analysis conducted for the Final Drilling Safety Rule issued in 2010, the baseline risk of a catastrophic blowout is estimated to be once every 26 years.

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 (herein referred to as the 30-day OSRA model), is a computer simulation of oil spill transport that uses realistic data for winds and currents to estimate spill trajectory. The OSRA report by Ji et al. (2004), provides conditional contact probabilities for shoreline segments.

The results for the 30-day OSRA model for Launch Area 49 (where WR 881 and 925 are located) are presented in **Table 3**. The model predicts a <0.5% conditional probability of shoreline contact within 3 or 10 days of a spill. Within 30 days, the model predicts 1 to 2% conditional probability of shoreline contact from Calhoun County, Texas to Plaquemines Parish, Louisiana (**Table 3**). Counties with a conditional probability for shoreline contact of <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 (Ji et al., 2004). Values are conditional probabilities that a hypothetical spill in the project area (represented by Oil Spill Risk Analysis Launch Area 49) could contact shoreline segments within 3, 10, or 30 days.

Shoreline Segment	County or Parish, State	Conditional Probability of Contact[1] (%)		
		3 Days	10 Days	30 Days
C07	Calhoun, Texas	--	--	1
C08	Matagorda, Texas	--	--	2
C09	Brazoria, Texas	--	--	1
C10	Galveston, Texas	--	--	1
C12	Jefferson, Texas	--	--	1
C13	Cameron, Louisiana	--	--	2
C14	Vermilion, Louisiana	--	--	1
C17	Terrebonne, Louisiana	--	--	1
C20	Plaquemines, Louisiana	--	--	1

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

The OSRA modeling runs reported by Ji et al. (2004) did not evaluate the fate of a spill over periods longer than 30 days, nor did they estimate the fate of a release that continues for weeks or months. Also, as noted by 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 been used by BOEM to evaluate contact probabilities for spills greater than 1,000 bbl.

BOEM (2017d) presented additional OSRA modeling to simulate a spill that continues for 90 consecutive days, with each trajectory tracked for 60 days during four seasons. In this updated OSRA model (herein referred to as the 60-day OSRA model), 60 days was chosen as a conservative estimate of the maximum duration that spilled oil would persist on the sea surface following a spill (BOEM, 2017d). The spatial resolution was limited, with seven launch points to represent the entire northern Gulf of Mexico. These launch points were deliberately located in areas identified as having a high possibility of containing large oil reserves. The 60-day OSRA model launch point most appropriate for modeling a spill in the project area is Launch Point 3. The 60-day OSRA results for Launch Point 3 are presented in **Table 4**.

Table 4. Shoreline segments with a 1% or greater conditional probability of contact from a spill starting at Launch Point 3 based on the 60-day Oil Spill Risk Analysis. Values are conditional probabilities that a hypothetical spill in the project area could contact shoreline segments within 60 days.

Season	Spring				Summer				Fall				Winter			
Day	3	10	30	60	3	10	30	60	3	10	30	60	3	10	30	60
County or Parish	Conditional Probability of Contact[1] (%)															
Cameron, Texas	--	--	--	--	--	--	--	2	--	--	--	1	--	--	--	1
Willacy, Texas	--	--	--	--	--	--	--	1	--	--	--	1	--	--	--	2
Kenedy, Texas	--	--	--	--	--	--	1	5	--	--	--	2	--	--	--	3
Kleberg, Texas	--	--	--	--	--	--	1	3	--	--	1	2	--	--	--	2
Nueces, Texas	--	--	--	--	--	--	--	2	--	--	1	2	--	--	--	3
Aransas, Texas	--	--	--	--	--	--	--	2	--	--	1	2	--	--	--	3

Table 4. (Continued).

Season	Spring				Summer				Fall				Winter			
Day	3	10	30	60	3	10	30	60	3	10	30	60	3	10	30	60
County or Parish	Conditional Probability of Contact[1] (%)															
Calhoun, Texas	--	--	--	--	--	--		3	--	--	1	2	--	--	1	4
Matagorda, Texas	--	--	3	5	--	--	1	4	--	--	2	5	--	--	3	10
Brazoria, Texas	--	--	3	3	--	--	2	5	--	--	1	2	--	--	3	8
Galveston, Texas	--	--	3	5	--	--	2	3	--	--	1	2	--	--	2	5
Jefferson, Texas	--	--	4	5	--	--	1	1	--	--	--	--	--	--	1	2
Cameron, Louisiana	--	--	9	11	--	--	1	3	--	--	--	2	--	--	1	3
Vermilion, Louisiana	--	1	5	6	--	--	1	1	--	--	--	--	--	--	1	2
Iberia, Louisiana	--	1	3	3	--	--	--	--	--	--	--	--	--	--	--	1
St. Mary, Louisiana	--	–	1	1	--	--	--	--	--	--	--	--	--	--	--	--
Terrebonne, Louisiana	--	5	12	13	--	--	1	2	--	--	1	1		1	2	2
Lafourche, Louisiana	--	2	5	6	--	--	1	2	--	--	--	--	--	--	1	2
Jefferson, Louisiana	--	–	1	1	--	--	--	1	--	--	--	--	--	--	--	--
Plaquemines, Louisiana	--	3	10	10	--	--	2	3	--	--	--	--	--	--	2	2
St. Bernard, Louisiana	--	--	1	1	--	--	--	--	--	--	--	--	--	--	--	--
Baldwin, Alabama	--	--	1	1	--	--	--	--	--	--	--	--	--	--	--	--
Escambia, Florida	--	--	1	1	--	--	--	--	--	--	--	--	--	--	--	--
Okaloosa, Florida	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--
Bay, Florida	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--
State Coastline	Conditional Probability of Contact[1] (%)															
Texas	--	--	13	19	--	--	7	30	--	--	7	21	--	--	11	44
Louisiana	--	12	46	52	--	2	6	12	--	1	2	4	--	2	8	12
Mississippi	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Alabama	--	--	1	1	--	--	--	--	--	--	--	--	--	--	--	--
Florida	--	--	2	5	--	--	--	2	--	--	--	--	--	--	--	1

[1] Conditional probability refers to the probability of contact within the stated time period assuming that a spill has occurred (-- indicates <0.5%). Modified from BOEM (2017d).

From Launch Point 3, potential shoreline contacts within 60 days range from Calhoun County, Texas, to Bay County, Florida. Based on statewide contact probabilities within 60 days, Texas has the highest likelihood of contact during summer, fall and winter (ranging from 19% to 44% within 60 days), while Louisiana has the highest probability of contact in the spring (52% within 60 days). The model predicts potential contact with Mississippi shorelines for all seasons to be unlikely, with <0.5% conditional probability within 60 days. Potential contact with Alabama shorelines are predicted only in the spring season with a contact probability of 1% or less within 30 or 60 days. Potential contact with Florida shorelines are predicted during spring, summer, and winter with probabilities of contact 5% or less within 60 days. Based on the 60-day trajectories, counties or parishes with greater than 10% contact probability during any season include Cameron and Terrebonne parishes in Louisiana (**Table 4**).

<u>Weathering</u>. Following an oil spill, several physical, chemical, and biological processes, collectively called weathering, interact to change the physical and chemical properties of the oil, thereby influencing 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 particulate matter, and stranding on shore or sedimentation to the seafloor (National Research Council, 2003b; International Tanker Owners Pollution Federation Limited, 2018).

Weathering decreases the concentration of oil and produces changes in its chemical composition, physical properties, and toxicity (Tarr et al., 2016). The more toxic, light aromatic and aliphatic hydrocarbons are lost rapidly by evaporation and dissolution from a slick on the water surface. For example, the light, paraffinic crude oil spilled during the *Deepwater Horizon* incident lost approximately 55% of its weight to evaporation during the first 3 to 5 days while floating on the sea surface (Daling et al., 2014). Several studies in the aftermath of the Macondo spill concluded that approximately 25% of mass below n-C_8 was lost during the oil's ascent to the surface, before an increased rate of weathering occurred once on the surface due to photo-oxidation (Lewan et al., 2014; Faksness et al., 2015; Stout and Payne, 2016; Stout et al., 2016).

Evaporated hydrocarbons are degraded rapidly by sunlight. Biodegradation of oil on the water surface and in the water column by marine bacteria is a dynamic process; microbes have been shown to first degrade the n-alkanes and then the light aromatics from the oil. Other petroleum components are biodegraded more slowly (Hazen et al., 2016). Photo-oxidation affects mainly the medium and high molecular weight PAHs in the oil on the water surface.

Spill Response. Anadarko's Regional OSRP was last approved on 14 August 2015 for Anadarko and its subsidiary, Anadarko US Offshore LLC (Company Numbers 00981 and 02219, respectively), in accordance with 30 CFR Part 254. The June 2017 biennial updates were acknowledged by BSEE on 12 July 2017; 5 October 2017 updates were acknowledged by BSEE on 2 November 2017. Non-regulatory required OSRP updates were submitted to BSEE on 19 June 2018 and acknowledged as in compliance on 18 July 2018. The OSRP provides a detailed plan that enables Anadarko to respond rapidly and effectively manage response efforts for oil spills that may result from drilling and production operations. The OSRP contains detailed information on "Quick Response" procedures, including:

- responsibilities of all Anadarko and contract personnel to report any observed discharge from known or unknown sources;
- procedures to locate and determine the size of a discharge; and
- contact information for alerting the spill management team, complete with names, phone numbers, and locations.

In the event of a large oil spill up to and including a WCD, Anadarko has access to surface and subsea response/containment capabilities that could be implemented through various organizations under contract. Anadarko's primary spill response equipment provider is Clean Gulf Associates (CGA).

CGA has skimming vessels capable of operating in shallow waters, nearshore areas, and offshore areas. These vessels have oleophilic brush pack skimming systems operating in troughs built into the hulls; below-deck storage; and marine electronics packages including marine, aircraft, and company-frequency radios, radar, moving map plotters, GPS, satellite phones, and depth finders. CGA also offers Fast Response Systems staged throughout the Gulf of Mexico available for offshore use.

The CGA high-volume open sea skimmer (HOSS) barge consists of a skimming system built into an oil recovery barge. There are 1,000-bbl recovered oil storage tanks built into the hull where oil can be separated and offloaded. Skimming operations are conducted from the control room overlooking the skimmer deck. The estimated daily recovery capacity for the HOSS barge is approximately 43,000 bbl of surface oil. CGA has recently acquired Koseq skimming arms and Aqua Guard skimmers to enhance its readiness. In addition, an x-band radar/infrared tracking system has been installed on the HOSS barge. Additional CGA equipment can be referenced online at http://www.cleangulfassoc.com/equipment.

Anadarko also has a contract with the Marine Spill Response Corporation (MSRC) for additional spill response equipment. MSRC has a dedicated fleet for the Atlantic/Gulf of Mexico region and additional available equipment staged throughout the U.S. MSRC equipment staged throughout the Gulf of Mexico includes oil spill response vessels, fast response vessels, oil spill response barges, platform supply vessels, and shallow water barges. Various equipment is outfitted with x-band radar and infrared technology for detecting surface oil. Additional MSRC capabilities and a complete equipment listing are available online at http://www.msrc.org/.

Anadarko is a member of the Marine Well Containment Company (MWCC). In the event of an incident, MWCC can provide a 15,000 psi single ram capping stack and dispersant injection capability. MWCC can install and operate the interim containment system, including subsea flowlines, manifolds, and risers. The interim system is engineered to be used in depths up to 10,000 ft (3,048 m) and has the capacity to contain 60,000 bbl of liquid per day (and 120 million standard cubic feet per day of gas) with potential for expansion.

Additionally, MWCC 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) that enable water sampling and monitoring to water depths of 9,843 ft (3,000 m). The two 8 ft × 20 ft (2.4 m × 6.1 m) containers have been certified for offshore use by Det Norske Veritas and the American Bureau of Shipping. The LARS is a combined winch, A-frame, and 9,843 ft (3,000 m) long cable, customized for the instruments in the containers.

The containers are designed to enable rapid mobilization of necessary equipment to an incident site, including redundant systems to avoid downtime and supplies for sample handling and storage. Once deployed on a suitable vessel, the mobile containers then act as work spaces for scientists and operations personnel. See EP Section H for a detailed description of Anadarko's site-specific spill response measures for the plan.

B. Affected Environment

The project area is approximately 211 miles (340 km) from the nearest shoreline (Louisiana), 231 miles (372 km) from the onshore support base at Port Fourchon, Louisiana, and 250 miles (403 km) from the helicopter base at Houma, Louisiana (**Figure 1**). The water depth at the location of the proposed activities is approximately 7,560 to 7,815 ft (2,304 to 2,382 m) (**Figure 2**).

The site clearance letters for the 8 proposed wellsites in blocks WR 881 and 925 noted no existing seabed infrastructure within 2,000 ft (610 m) of proposed wellsites (Ocean Geo Solutions, 2019a; b; c; d; e; f).

The seafloor location of all proposed wellsites is relatively smooth with gradients of 4.3° or less. No high-density deepwater benthic or chemosynthetic communities or archaeological avoidance zones were noted within 2,000 ft (610 m) of the proposed wellsite locations (Ocean Geo Solutions, 2019a; b; c; d; e; f).

A detailed description of the regional potentially affected environment, 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, is provided in recent EISs (2012a; 2013a; 2014a; 2015b; 2016b; 2017a; c). These regional descriptions remain valid and are incorporated by reference. General background information is presented in the following sections, and brief descriptions of each potentially affected resource, including site-specific and new information if available, are presented in **Section C**.

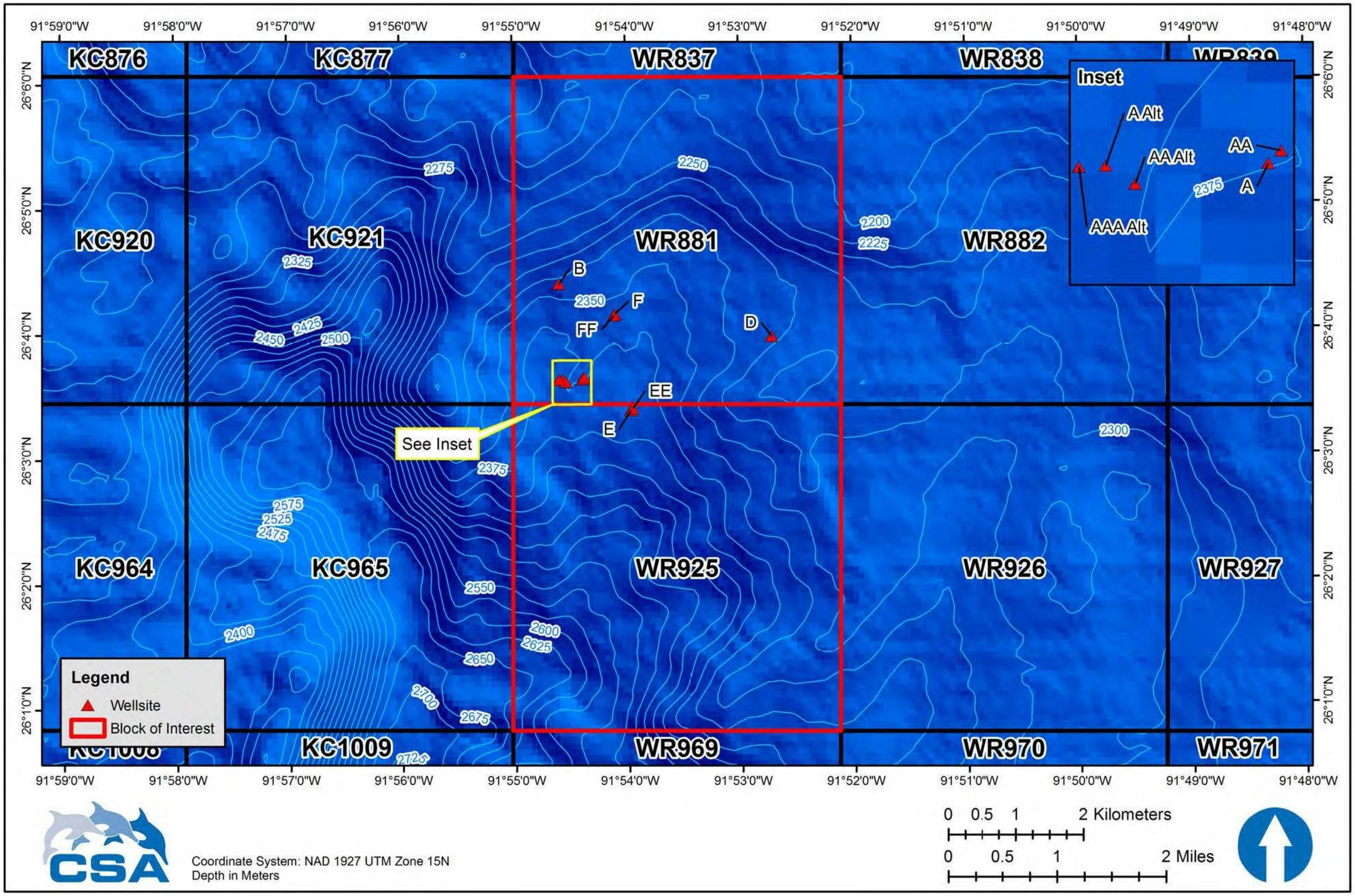

Figure 2. Surface hole locations of the proposed wellsites in Walker Ridge (WR) Blocks 881 and 925. Naming convention of the wellsites are based on the bottom hole locations.

C. Impact Analysis

This section analyzes the potential direct and indirect impacts of routine activities and accidents. Impacts have been analyzed extensively in the multiscale EISs for the Western and Central Gulf of Mexico Planning Areas (BOEM, 2012a; 2013b; 2014a; 2015b; 2017a; c). The information in these documents is incorporated by reference. Potential site-specific issues are addressed in this section. The following sections are organized by the Environmental Resources identified in **Table 2** and address each potential IPF.

C.1 Physical/Chemical Environment

C.1.1 Air Quality

There are no site-specific air quality data for the project area. However, because of the distance from shore-based pollution sources and the relatively small number of sources of pollutants offshore, air quality at the proposed wellsites 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, the ambient air quality of coastal counties along the Gulf of Mexico is relatively good (BOEM, 2012a). As of April 2019, Mississippi, Alabama, and Florida Panhandle coastal counties are in attainment of the National Ambient Air Quality Standards (NAAQS) for all criteria pollutants (USEPA, 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 maintenance status for lead based on the 2008 Standard (USEPA, 2019).

As noted earlier, based on calculations made pursuant to applicable regulations, emissions from drilling activities are not expected to be significant because they are below exemption levels. Therefore, the only potential effects to air quality would be from air pollutant emissions associated with routine drilling activities and accidental spills (a small diesel fuel spill or a large oil spill). Potential impacts from air emissions to resources listed in **Table 2** are discussed below.

Impacts of Air Pollutant Emissions

Air pollutant emissions are the only routine IPF likely to affect air quality in addition to two types of accidents (a small diesel fuel spill and a large oil spill) (**Table 2**). Offshore air pollutant emissions will result from MODU, helicopter, and support vessel operations. These emissions occur mainly from combustion or burning of diesel fuel and Jet-A aircraft fuel. The combustion of fuels occurs primarily in diesel-powered generators, pumps, or motors as well as from lighter fuel motors. Primary air pollutants typically associated with OCS activities are suspended PM, SO_x, NO_x, VOCs, and CO. As noted by BOEM (2017b), air pollutant emissions from routine activities are projected to have minimal impacts to onshore air quality because of the prevailing atmospheric conditions, anticipated emission rates, anticipated heights of emission sources, and the distance from shore of the proposed activities and associated pollutant concentrations. The Air Quality Emissions Report (see EP Section G) prepared in accordance with BOEM requirements shows that the projected emissions are below exemption levels. Given the levels of expected emissions and the distance of the project from shore, emissions from the proposed activities described in this EP are not likely to contribute to violations of any NAAQS on shore. Therefore, according to 30 CFR 550.303, the emissions would not significantly affect the air quality of the onshore area for any of the criteria pollutants.

Greenhouse gas emissions contribute to climate change, with important 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 small incremental contribution to greenhouse gas emissions from all OCS activities. According to Programmatic and OCS lease sale EISs (BOEM, 2012a; 2016a), estimated CO_2 emissions from OCS oil and gas sources represent 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 climate change impacts evaluated in the Programmatic EIS (BOEM, 2016a).

The Breton Wilderness Area, in coastal Louisiana, which is part of the Breton National Wildlife Refuge (NWR), is designated under the Clean Air Act as a Prevention of Significant Deterioration Class I air quality area. BOEM is required to notify the National Park Service and U.S. Fish and Wildlife Service (USFWS) if emissions from proposed projects may affect the Breton Class I area. Additional review and mitigation measures may be required for sources within 186 miles (300 km) of the Breton Class I area that exceed emission limits agreed upon by the administering agencies (National Park Service, 2010). The project area is approximately 283 miles (455 km) from the Breton Wilderness Area. Based on Anadarko's Air Quality Emissions report (EP Section G), no significant impacts on coastal air quality are expected, including in the Breton Wilderness Area. Anadarko will comply with all BOEM requirements regarding air emissions.

Impacts of a Small Diesel Fuel Spill

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

A small diesel fuel spill would affect air quality near the spill site by introducing VOCs into the atmosphere through evaporation. The ADIOS2 model (**Section A.9.1**) indicates that more than 90% of a small diesel spill would evaporate or disperse within 24 hours. The sea surface area covered with small diesel fuel would range from 0.5 to 5 ha (1.2 to 12.4 ac), depending on sea state and weather conditions. A small diesel fuel spill would not likely affect coastal air quality because the spill would not be expected to make landfall or reach coastal waters prior to natural dispersion (**Section A.9.1**).

Impacts of a Large Oil Spill

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

A large oil spill could affect air quality by introducing VOCs into the atmosphere through evaporation from the slick. The extent and persistence of any impacts would depend on the meteorological and oceanographic conditions at the time and the effectiveness of spill response measures. Real-time wind and current data from the project area would be available at the time of a spill and would be used to assess the fate and effects of VOCs released. Additional air quality impacts could occur if response measures included *in situ* burning of the floating oil. Burning could generate a plume of black smoke and result in emissions of NO_x, SO_x, CO, and PM as well as greenhouse gases. However, *in situ* burning would occur as a response measure only if authorized by the USEPA.

Depending on the spill trajectory, meteorological and oceanographic conditions, and the effectiveness of spill response measures, coastal air quality could also be affected. Based on the 30-day OSRA modeling (**Table 3**), coastal areas would likely not be affected within 3 or 10 days of a spill (<0.5 % conditional probability); however, coastal areas between Calhoun County, Texas, and Plaquemines Parish, Louisiana may be affected within 30 days of a spill (1 to 2% conditional probability). Based on the 60-day OSRA modeling estimates (**Table 4**), the potential shoreline contacts range from Cameron County, Texas to Bay County, Florida (up to 13% conditional probability within 60 days). However, due to the project area's distance from the nearest shoreline, most adverse impacts to air quality are likely to occur in offshore waters, and substantial impacts to onshore air quality are not expected.

C.1.2 Water Quality

There are no site-specific baseline water quality data for the project area. Because the project location is in deep, offshore waters, water quality is expected to be good with low levels of contaminants. Deepwater areas in the northern Gulf of Mexico are relatively homogeneous with respect to temperature, salinity, and oxygen (BOEM, 2017a). Kennicutt (2000) noted that the deepwater region has little evidence of contaminants in the dissolved or particulate phases of the water column. However, there are localized occurrences of natural seepage of oil, gas, and brines in near-surface sediments and up through the water column. Based on the site clearance letters for proposed wellsites, no natural seeps were noted in the vicinity of the proposed wellsites (Ocean Geo Solutions, 2019a; b; c; d; e; f).

IPFs that could affect water quality are effluent discharges associated with routine operations and two types of accidents: a small fuel spill and a large oil spill. These IPFs with potential impacts listed in **Table 2** are discussed below.

Impacts of Effluent Discharges

Discharges of treated SBM cuttings will produce temporary, localized increases in suspended solids in the water column around the drilling rig. After discharge, SBM retained on cuttings would be expected to adhere tightly to the cuttings particles and, consequently, would not produce much additional turbidity as the cuttings sink through the water column (Neff et al., 2000). In general, turbid water can be expected to extend between a few hundred meters and several kilometers down current from the discharge point, with suspended solids concentrations decreasing with distance (National Research Council, 1983; Neff, 1987). All NPDES permit limitations and requirements will be implemented during proposed activities; therefore, there should not be persistent impacts to water quality from the overboard releases of treated sanitary and domestic wastes and deck drainage in the project area.

Treated sanitary and domestic wastes, including those from support vessels, may have a slight transient effect on water quality in the immediate vicinity of these discharges. Treated sanitary and domestic wastes may have elevated levels of nutrients, organic matter, and chlorine but should dilute rapidly to undetectable levels within tens to hundreds of meters from the source. All NPDES permit limitations and requirements, as well as USCG regulations (as applicable), will be met; therefore, little or no impact on water quality from the overboard release of treated sanitary and domestic wastes is anticipated.

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

Other discharges in accordance with the NPDES permit, such as non-pollutant completion fluids, uncontaminated wash, ballast and bilge water, and non-contact cooling and fire water are expected to dilute rapidly, resulting in little or no impact on water quality.

Impacts of a Small Diesel Fuel Spill

Potential impacts of a small fuel spill on water quality are expected to be consistent with those analyzed and discussed by BOEM (2012a; 2015b; 2016a; 2017a; c). **Section A.9.1** discusses the size and fate of a potential small diesel fuel spill as a result of Anadarko's proposed activities. EP Section H provides detail on spill response measures in addition to the summary information provided in the EIA.

The water-soluble fractions of diesel are dominated by two- and three-ringed PAHs, which are moderately volatile (National Research Council, 2003b). 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 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, 2017a). It is possible for the 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 solid loads (National Research Council, 2003b) and would not be expected to occur to any appreciable degree in offshore waters of the Gulf of Mexico.

It is estimated that more than 90% of a small diesel spill would evaporate or disperse within 24 hours (**Section A.9.1**). The sea surface area covered with a very thin layer of diesel fuel would range from 0.5 to 5 ha (1.2 to 12 ac), 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 prior to breaking up (**Section A.9.1**).

Impacts of a Large Oil Spill

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

Most of the spilled oil would be expected to form a slick at the surface, though small droplets in the water may adhere to suspended sediments and be removed from the water column (Operational Science Advisory Team, 2010; Valentine et al., 2014). Information from the Macondo spill indicates 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; Spier et al., 2013). Subsea dispersants would be applied only after approval from the USEPA.

A report by Kujawinski et al. (2011) indicated that chemical components of subsea dispersants used during the Macondo spill persisted for up to 2 months and were detected up to 186 miles (300 km) from the wellsite in water depths of 3,280 to 3,937 ft (1,000 to 1,200 m). Although dispersants were detected by laboratory analysis in 353 of the 4,114 water samples, concentrations were significantly below the chronic screening level for dispersants (BOEM, 2012a).

Hazen et al. (2010) studied the impacts and fate of deepwater oil after the 2010 *Deepwater Horizon* incident. Initial studies suggested that the potential exists for rapid intrinsic bioremediation (bacterial degradation) of subsea dispersed oil in the water column by deep-sea indigenous microbial activity without significant oxygen depletion (Hazen et al., 2010), although other studies showed that oil bioremediation caused oxygen drawdown in deep waters (Kessler et al., 2011; Dubinsky et al., 2013). Additional studies investigated the effects of deepwater dissolved hydrocarbon gases (e.g., methane, propane, and ethane) and the microbial response to a deepwater oil spill. Results suggest that deepwater dissolved hydrocarbon gases may promote rapid hydrocarbon respiration by low-diversity bacterial blooms, thus priming indigenous bacterial populations for rapid hydrocarbon degradation of subsea oil (Kessler et al., 2011; Du and Kessler, 2012; Valentine et al., 2014). A 2017 study identified water temperature, taxonomic composition of the initial bacterial community, and dissolved nutrient levels as factors that may regulate oil degradation rates by deep-sea indigenous microbes (Liu et al., 2017).

The extent and persistence of impacts would depend on the meteorological and oceanographic conditions at the time and the effectiveness of spill response measures. Real-time wind and current data from the project area would be available at the time of a spill and would be used to assess the fate and effects of VOCs released. Weathering processes that affect spilled oil on the sea include adsorption (sedimentation), biodegradation, dispersion, dissolution, emulsification, evaporation, and photo oxidation. Most crude oil blends will emulsify quickly when spilled, creating a stable mousse that presents a more persistent cleanup and removal challenge (NOAA, 2017b).

Because the project area location is 211 miles (340 km) from the nearest shoreline, any water quality impacts would likely occur in offshore waters. Depending on the spill trajectory and the effectiveness of spill response measures, coastal water quality could be affected. The 30-day OSRA modeling (**Table 4**) indicates nearshore waters and embayments from Calhoun County, Texas to Plaquemines Parish, Louisiana are unlikely to be affected within 3 or 10 days (<0.5% conditional probability). The potential for water quality to be affected in these coastal areas increases within 30 days of a spill, but remains unlikely (1 to 2% conditional probability). Based on the 60-day OSRA modeling estimates (**Table 4**), the potential for shoreline contact from Cameron County, Texas to Bay County, Florida ranges from 1 to 13% conditional probability within 60 days of a spill.

C.2 Seafloor Habitats and Biota

According to BOEM (2016a), existing information for the deepwater Gulf of Mexico indicates that the seafloor is composed primarily of soft sediments; exposed hard substrate habitats and associated biological communities are rare. The water depth at the proposed wellsites ranges from approximately 7,560 to 7,815 ft (2,304 to 2,382 m). Based on the geohazards evaluation summarized in the site clearance letters (see **EP Section C**), there are no interpreted features or areas capable of supporting densely populated benthic communities within 2,000 ft (610 m) of the location of the proposed wellsites (Ocean Geo Solutions, 2019a; b; c; d; e; f).

C.2.1 Soft Bottom Benthic Communities

There are no site-specific benthic community data from the project area. However, data from the Northern Gulf of Mexico Continental Slope Habitats and Benthic Ecology Study (Wei, 2006; Rowe and Kennicutt, 2009; Wei et al., 2010; Carvalho et al., 2013) can be used to describe typical baseline benthic communities in the area. **Table 5** summarizes data from nearby stations that are also in comparable water depths.

Table 5. Baseline benthic community data from stations near the project area and/or in similar water depths sampled during the Northern Gulf of Mexico Continental Slope Habitats and Benthic Ecology Study.

Station	Faunal Zone	Water Depth (m)	Density		
			Meiofauna (individuals m^{-2})	Macroinfauna (individuals m^{-2})	Megafauna (individuals ha^{-1})
NB5	3W	2,063	117,263	706	1,600
B3	3W	2,618	155,817	814	362

Meiofaunal and megafaunal data from Rowe and Kennicutt (2009); macroinfaunal data from Wei (2006).
-- = unavailable.

Meiofaunal (animals passing through a 0.3-millimeter sieve but retained on a 0.062-millimeter sieve) densities in water depths representative of the project area typically range from approximately 117,000 to 156,000 individuals m^{-2} (Rowe and Kennicutt, 2009). Nematodes, nauplii, and harpacticoid copepods were the three dominant meiofaunal groups, accounting for 90% of total abundance.

The benthic macroinfauna (animals retained on a 0.3-millimeter sieve) is characterized by small mean individual sizes and low densities, both of which reflected intrinsically low primary production in surface water of the Gulf of Mexico continental slope (Wei, 2006). Densities decrease exponentially with water depth (Carvalho et al., 2013). Densities at nearby stations ranged from approximately 700 to 800 individuals m^{-2} (**Table 5**). Based on an equation presented by Wei (2006) in which densities decrease exponentially with water depth, the macroinfaunal density at a water depth of the proposed wellsites is expected to be range from approximately 1,234 to 1,165 individuals m^{-2}; however, actual densities at the proposed project location are unknown.

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 are divided into eastern and western subzones. The project area is located in Zone 3W, which consists of stations on the mid Texas-Louisiana Slope. 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.

The megafaunal densities at a nearby stations ranged from approximately 360 to 1,600 individuals ha^{-1} (**Table 5**). Common megafauna in the northern Gulf of Mexico include motile groups such as decapods, ophiuroids, holothurians, and demersal fishes as well as sessile groups such as sponges and anemones.

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

IPFs that may affect benthic communities are physical disturbance to the seafloor in the immediate vicinity of the wellsites, subsea effluent discharges, and potential effects from a large oil spill resulting from a well blowout at the seafloor. Effluent discharges at the surface and a small diesel fuel spill would not affect benthic communities because both would float and dissipate on the sea surface. The IPFs with potential impacts to soft bottom benthic communities listed in **Table 2** are discussed below.

Impacts of Physical Disturbance to the Seafloor

In water depths such as those in the project area, the areal extent of physical disturbance to the seafloor from the DP MODU will be small compared to the project area itself. DP MODUs disturb the seafloor only around the wellbore (surface hole location) where the bottom template and blowout preventer are located (**Section A.2**).

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

Impacts of Effluent Discharges

Drilling muds and cuttings are the only effluents from the MODU with the potential to affect benthic communities. 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 during casing installation for 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 potential impacts could be burial and smothering of benthic organisms within several meters to tens of meters around the wellbore.

Soft bottom sediments disturbed by cuttings, drilling muds, and cement slurry will eventually be recolonized through larval settlement and migration from adjacent areas. Because some deep-sea biota grow and reproduce slowly, recovery could require several years.

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 (2002; 2004). In general, treated cuttings with adhering SBM tend to clump together and form thick cuttings piles close to the drillsite. Areas of SBM cuttings deposition may develop elevated organic carbon concentrations and anoxic conditions (Continental Shelf Associates, 2006). Where SBM cuttings accumulate in concentrations of approximately 1,000 mg kg^{-1} or higher in bottom sediments, benthic infaunal communities may be adversely affected because of 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 decomposed by microbes, the area will gradually return 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 relatively small. Based on the monitoring studies discussed above, benthic community impacts are expected to be concentrated within approximately 1,640 ft (500 m) of each wellsite. Soft bottom communities are ubiquitous along the northern Gulf of Mexico continental slope (Gallaway, 1988; Gallaway et al., 2003; Rowe and Kennicutt, 2009); however, drilling discharges during this project are not expected to have a significant impact on soft bottom benthic communities on a regional basis.

Impacts of a Large Oil Spill

The most likely effects of a subsea blowout on benthic communities would be within a few hundred meters of the wellsite. BOEM (2012b) estimated that a severe subsurface blowout could resuspend and disperse sediments within a 984 ft (300 m) radius. While 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 resuspended for more than 30 days and dispersed over a much wider area. Based on previous studies, surface sediments at the project area are assumed to largely be silt and clay (Rowe and Kennicutt, 2009). Affected areas would be recolonized by benthic organisms over a period of months to years (National Research Council, 2003b).

While impacts on benthic communities from large oil spills are anticipated to be confined to the immediate vicinity of the blowout location, additional benthic community impacts could extend beyond the immediate vicinity of the wellhead, depending on the circumstances of the incident (BOEM, 2016b). During the Macondo spill, the use of subsea dispersants at the wellhead caused the formation of subsurface oil plumes (NOAA, 2011c; Spier et al., 2013). The subsurface plumes 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). Montagna et al. (2013) mapped the benthic footprint of the Macondo spill and estimated that the most severe impacts to soft bottom benthic communities (e.g., reduction of faunal abundance and diversity) extended 0.62 miles (3 km) from the wellhead in all directions, covering an area of approximately 9.3 $miles^2$ (24 km^2). Moderate impacts were observed up to 10.5 miles (17 km) to the southwest and 5.3 miles (8.5 km) to the northeast of the wellhead, covering an area of

57.1 miles^2 (148 km^2). NOAA (2016a) documented a footprint of over 772 miles^2 (2,000 km^2) of injury to benthic habitats surrounding the Macondo spill 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, 2016a).

While the behavior and impacts of subsurface oil plumes are not well known, the Macondo findings indicate that plume-related 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 Macondo spill. Washburn et al. (2017) noted that richness, diversity, and evenness were affected within a radius of 0.62 miles (1 km) of the wellhead. Reuscher et al. (2017) found that meiofauna and macrofauna community diversity was significantly lower in areas that were impacted by Macondo oil. Demopoulos et al. (2016) reported an abnormally high variability in meiofaunal and macrofaunal density in areas near the Macondo wellhead, which supports the Valentine et al. (2014) supposition that hydrocarbon deposition and impacts in the vicinity of the Macondo wellhead were patchy. While there were some indications of a partial recovery of benthic fauna, a full recovery had not occurred as of 2015 (Montagna et al., 2016; Reuscher et al., 2017; Washburn et al., 2017).

C.2.2 High-Density Deepwater Benthic Communities

As defined by NTL 2009-G40, high-density deepwater benthic communities are features or areas that could support chemosynthetic communities, deepwater corals, and other associated hard bottom communities. Chemosynthetic communities were discovered in the central Gulf of Mexico in 1984 and have been studied extensively (e.g., Volkes, 1963; Boland, 1986; Callender et al., 1990; MacDonald, 2002). Deepwater coral communities are also known from numerous locations in the Gulf of Mexico (Brooke and Schroeder, 2007; CSA International, 2007; Brooks et al., 2012). These communities occur almost exclusively on exposed authigenic carbonate rock created by a biogeochemical (microbial) process.

In water depths such as those encountered in the project area, the DP MODU will disturb the seafloor only in the immediate vicinity of the drill sites (**Section A.2**). Based on the site clearance letters (Ocean Geo Solutions, 2019a; b; c; d; e; f), there is no evidence of the presence of high-density deepwater benthic or chemosynthetic communities within 2,000 ft (610 m) of the project area. The nearest known high-density deepwater benthic community is located in Garden Banks Block 476, approximately 90 miles (160 km) from the project area (MacDonald et al., 1995; U.S. Geological Survey, 2011; BOEM, nd).

A large oil spill from a well blowout at the seafloor is the only IPF that could affect high-density deepwater benthic communities (**Table 2**) A small fuel spill would not affect benthic communities because the diesel fuel would float and dissipate on the sea surface. Because a DP vessel will be used, there will be no physical disturbance to the seafloor from anchoring during the drilling activities analyzed in the EIA. Physical disturbance and effluent discharge are not considered to be IPFs for deepwater benthic communities, because these communities are not known to be present within in the immediate vicinity of the proposed wellsites.

Impacts of a Large Oil Spill

A large oil spill caused by a seafloor blowout could cause direct impacts on benthic communities within approximately 984 ft (300 m) of the blowout location (i.e., caused by the physical impacts of a blowout) (BOEM, 2012a). Because there is no evidence of the presence of high-density deepwater benthic or chemosynthetic communities within 2,000 ft (610 m) of the proposed wellsites (Ocean Geo Solutions, 2019a; b; c; d; e; f), a caldera, if formed would not be expected to impact any high-density deepwater benthic or chemosynthetic communities.

Additional benthic community impacts could extend beyond the immediate vicinity of the wellheads, depending on the specific circumstances (BOEM, 2016b). During the Macondo spill, subsurface plumes were reported at a water depth of approximately 3,609 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). While the behavior and impacts of subsurface plumes are not well known, a subsurface plume could contact high-density deepwater benthic communities beyond the 984 ft (300 m) radius estimated by BOEM (2012a), depending on its extent, trajectory, and persistence (Spier et al., 2013). Oil plumes that contact sensitive benthic communities before degrading could potentially impact the resource (BOEM, 2017a). Potential impacts on sensitive resources would be an integral part of the decision and approval process for the use of dispersants, and such approval would be obtained from the USEPA prior to the use of dispersants.

Potential impacts of oil on high-density deepwater benthic communities are discussed by BOEM (2012a; 2015b; 2016a; 2017a; c). Although chemosynthetic communities live among hydrocarbon seeps, natural seepage typically is constant and occurs at low rates as compared to the potential rates of oil release from a blowout. In addition, seep organisms also 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 or deepwater corals. 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 (BOEM, 2012a; 2017a; c). Sublethal effects could be long lasting and affect the resilience of coral colonies to natural disturbances (e.g., elevated water temperature and diseases) (BOEM, 2012a; 2015b; 2016b; 2017a; c). Based on information learned from the Macondo spill, a few patches of live bottom habitats may be affected by a large oil spill, but the Gulf-wide ecosystem of live bottom communities would not be expected to suffer significant effects (BOEM, 2016b).

The potential for a large spill to affect deepwater corals can also be inferred based on the impacts of the Macondo spill during an October 2010 survey of deepwater coral habitats near the Macondo spill site (BOEMRE, 2010). Much of the soft coral observed in an area measuring approximately 50 ft × 130 ft (15 m × 40 m) was covered by what appeared to be a brown flocculent material containing oil from the Macondo spill and with signs of widespread stress, including varying degrees of tissue loss and excess mucous production (White et al., 2012). The research team concluded that the observed coral injuries likely resulted from exposure to the subsurface oil plume (White et al., 2012). Apparent recovery of some affected areas by March 2012 correlated negatively with the proportion of the coral covered with floc in late 2010 (Hsing et al., 2013). Fisher et al. (2014a) reported two additional coral areas affected by the Macondo spill; 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 Macondo spill were also affected. In addition to direct impacts on corals and other sessile epifauna, the spill also affected macroinfauna associated with these hard bottom communities (Fisher et al., 2014b). Based on data from Girard et al. (2018), recovery at these locations could take up to three decades and biomass is expected to decrease by 3% to 14%.

C.2.3 Designated Topographic Features

The project area is not within or near a designated topographic feature or a no-activity zone as identified in NTL 2009-G39. The nearest designated Topographic Feature Stipulation Block is approximately 120 miles (198 km) from the project area in Green Canyon Block 90. There are no IPFs associated with routine operations that could affect designated topographic features (**Table 2**).

Due to the distance from the project area, it is unlikely that topographic features would be affected by accidental spills. A small fuel spill would float and dissipate on the surface and would not reach these seafloor features. In the event of an oil spill from a well blowout, a surface slick would not contact these seafloor features. If a subsurface plume was to occur, impacts on these features would be unlikely because of the distance of the spill from these features, the depth of the features, and the currents that surround the features. Near-bottom currents in the region generally flow along the isobaths (Nowlin et al., 2001) and typically would not carry a plume up onto the continental shelf edge. This assumption is consistent with the deposition patterns inferred by Valentine et al. (2014) for the subsurface plume from the Macondo spill. Felder et al. (2014) hypothesized that the Macondo spill may have affected two topographic features located 96 miles (155 km) and 168 miles (270 km) west of the Macondo site (Sackett Bank and Ewing Bank, respectively) but there was no definitive evidence of Macondo oil from either bank. Although there are mechanisms that could result in oil contacting topographic features, it is expected that most of the oil would rise to the surface and that the most heavily oiled sediments would likely be deposited before reaching these features (BOEM, 2012a). In the unlikely event oil does contact topographic features, lethal effects to benthic organisms would be unlikely because the distance between the spill source and topographic features would likely prevent concentrated oil from contacting any designated feature.

C.2.4 Pinnacle Trend Area Live Bottoms

The project area is not covered by the Live Bottom (Pinnacle Trend) Stipulation. The nearest pinnacle trend blocks, as defined by NTL 2009-G39, are approximately 298 miles (480 km) from the project area in Main Pass Block 290. There are no IPFs associated with routine operations that could affect pinnacle trend live bottom areas (**Table 2**).

Due to their distance from the project area, it is unlikely that pinnacle trend live bottom areas would be affected by an accidental spill. A small diesel fuel spill would float on the surface and would not reach these seafloor features. In the event of an oil spill from a well blowout, a surface slick would be unlikely to contact these seafloor features. If a subsurface plume were to occur, impacts on these features 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 would not be expected to carry a plume up onto the continental shelf edge. This assumption is consistent with the deposition patterns inferred by Valentine et al. (2014) for the subsurface plume from the Macondo spill. Although there are mechanisms that could result in oil contacting these features, it is expected that most of the oil would rise to the surface, thereby reducing potential impacts to these features.

C.2.5 Eastern Gulf Live Bottoms

The project area is not covered by the Live Bottom (Low-Relief) Stipulation, which applies mainly to Eastern Gulf of Mexico Planning Area leases in water depths of 328 ft (100 m) or less. The nearest block covered by the live bottom stipulation, as defined by NTL 2009-G39, is approximately 337 miles (542 km) from the project area in Destin Dome Block 573. There are no IPFs associated with routine drilling activities that could affect Eastern Gulf live bottom areas (**Table 2**).

Because of their distance from the project area, it is unlikely that Eastern Gulf live bottom areas would be affected by an accidental spill. A small diesel fuel spill would float and dissipate on the surface and would not reach these seafloor features. In the event of an oil spill from a well blowout, a surface slick would not likely contact these seafloor features. If a subsurface plume were to occur, impacts on these features 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 be expected to carry a plume up onto the continental shelf. This assumption is consistent with the deposition patterns inferred by Valentine et al. (2014) for the subsurface plume from the Macondo spill. Although there are mechanisms that could result in oil contacting these features, it is expected that most of the oil would rise to the surface, thereby reducing potential impacts to benthic communities.

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

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

Endangered or threatened species that may occur in the project area and/or along the northern Gulf Coast are listed in **Table 6**. The table also indicates the location of critical habitat (if designated in the Gulf of Mexico). Critical habitat is defined as (1) specific areas within the geographical area occupied by the species at the time of listing that contain physical or biological features essential to conservation and may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by the species if the agency determines that the area itself is essential for conservation. The National Marine Fisheries Service (NMFS) has jurisdiction for ESA-listed marine mammals (cetaceans), sea turtles in the marine environment, and fishes. The USFWS has jurisdiction for ESA-listed birds, the West Indian manatee (*Trichechus manatus*), and sea turtles on their nesting beaches.

Coastal endangered or threatened species include the West Indian manatee, Piping Plover (*Charadrius melodus*), Whooping Crane (*Grus americana*), Gulf sturgeon (*Acipenser oxyrinchus desotoi*), and four subspecies of beach mouse. Critical habitat has been designated for all of these species as indicated in **Table 6** and discussed in individual subsections. Two other coastal species (Bald Eagle [*Haliaeetus leucocephalus*] and Brown Pelican [*Pelecanus occidentalis*]) are no longer federally listed as endangered or threatened; these are discussed in **Section C.4.2**.

Table 6. Federally listed endangered, threatened, and candidate species potentially present in the project area and along the northern Gulf Coast.

Species	Scientific Name	Status	Potential Presence		Critical Habitat Designated in Gulf of Mexico
			Project Area	Coastal	
Marine Mammals					
Sperm whale	*Physeter macrocephalus*	E	X	--	None
Bryde's whale	*Balaenoptera edeni*	P/E[a]	X	--	None
West Indian manatee	*Trichechus manatus*[b]	E	--	X	Florida (Peninsular)
Sea Turtles					
Loggerhead turtle	*Caretta caretta*	T, E[c]	X	X	Nesting beaches and nearshore reproductive habitat in Mississippi, Alabama, and Florida; *Sargassum* spp. habitat (includes most of central and western Gulf)
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					
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)
Sharks and 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 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 mouse (subspecies: Alabama, Choctawhatchee, Perdido Key, St. Andrew)	*Peromyscus polionotus*	E	--	X	Alabama and Florida (Panhandle) beaches

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

[a]Gulf of Mexico Bryde's whales are protected by the Marine Mammal Protection Act (MMPA). Per 84 FR 15446, NMFS determined the Gulf of Mexico Bryde's whale warranted listing as Endangered under the Endangered Species Act (ESA). The listing will be effective on 15 May 2019.

[b]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.

[c]The Northwest Atlantic Ocean distinct population segment (DPS) of loggerhead turtles is designated as threatened (76 *Federal Register* [FR] 58868). NMFS and the USFWS designated critical habitat for this DPS, including beaches and nearshore reproductive habitat in Mississippi, Alabama, and the Florida Panhandle as well as *Sargassum* spp. habitat throughout most of the central and western Gulf of Mexico (79 FR 39756 and 79 FR 39856).

The sperm whale (*Physeter macrocephalus*), five species of sea turtles, and the oceanic whitetip shark (*Carcharhinus longimanus*) are the only endangered or threatened species likely to occur in or near the project area. The listed sea turtles are the leatherback turtle (*Dermochelys coriacea*), Kemp's ridley turtle (*Lepidochelys kempii*), hawksbill turtle (*Eretmochelys imbricate*), loggerhead turtle (*Caretta caretta*), and green turtle (*Chelonia mydas*). 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.3.4**). No critical habitat has been designated in the Gulf of Mexico for the leatherback turtle, Kemp's ridley turtle, hawksbill turtle, green turtle, sperm whale, or oceanic whitetip shark. Five endangered mysticetes (blue whale [*Balaenoptera musculus*], fin whale [*Balaenoptera physalus*], humpback whale [*Megaptera novaeangliae*], North Atlantic right whale [*Eubalaena glacilis*], and sei whale [*Balaenoptera borealis*]) have been reported in the Gulf of Mexico, but are considered rare or extralimital (Würsig et al., 2000). These species are not included in the most recent NMFS stock assessment report (Hayes et al., 2017) or in the most recent BOEM multisale EIS (BOEM, 2017a). Therefore, they are not considered further in the EIA. The threatened giant manta ray (*Manta birostris*) is known from the Gulf of Mexico and could occur in the project area but is most commonly observed in the Gulf of Mexico at the Flower Garden Banks. The Nassau grouper (*Epinephelus striatus*) has been observed in the Gulf of Mexico at the Flower Garden Banks but is most commonly observed in shallow tropical reefs of the Caribbean and is not expected to occur in the project area.

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 (**Section C.3.11**). There are no other endangered animals or plants in the Gulf of Mexico that are reasonably likely to be adversely affected by either routine or accidental events. Other species occurring at certain locations in the Gulf of Mexico such as the smalltooth sawfish (*Pristis pectinata*) and 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. Resident populations of sperm whales occur within the Gulf of Mexico. A species description is presented in the recovery plan for this species (NMFS, 2010b). Gulf of Mexico sperm whales are classified as an endangered species and a strategic stock (defined as a stock that may have unsustainable human-caused impacts) by NOAA Fisheries (Waring et al., 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 (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, 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 Gulf of Mexico 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 multiyear tracking study show female sperm whales typically concentrated along the upper continental slope between the 656- and 3,280-ft (200- and 1,000-m) 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 as well as groups of bachelor males. The 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. In these mitigation surveys, sperm whales were the most common large cetacean encountered (Barkaszi et al., 2012). Study results also showed that sperm whales transit through the vicinity of the project area. Movements of satellite-tracked individuals suggest that this area of the Gulf continental slope is within the home range of the Gulf of Mexico population (within the 95% utilization distribution) (Jochens et al., 2008).

IPFs that could affect sperm whales include MODU presence, noise, and lights; support vessel and helicopter traffic; and two types of accidents (a small diesel 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 NTL BSEE-2015-G03 (**Table 1**) will minimize the potential for marine debris-related impacts on sperm whales. The IPFs with potential impacts listed in **Table 2** are discussed below.

Impacts of MODU Presence, Noise, and Lights

Noise from routine drilling activities has the potential to disturb individuals or groups of sperm whales or mask the sounds sperm whales would normally produce and hear. It is unlikely that any auditory injury would result from drilling activites. Behavioral responses to noise by marine mammals vary widely; overall they are short-term and include temporary displacement or cessation of feeding, resting, or social interactions (NMFS, 2009a; Gomez et al., 2016). Additionally, behavioral changes resulting in auditory masking sounds may induce an animal to produce more calls, make longer calls, or shift the frequency of the calls. For example, masking caused by vessel noise was found to reduce the number of whale calls in the Gulf of Mexico (Azzara et al., 2013).

NMFS (2018b) lists sperm whales in the same hearing group (i.e., mid-frequency cetaceans) as dolphins, toothed whales, beaked whales, and bottlenose whales (estimated hearing range from 150 Hz to 160 kHz). Sperm whale sounds generally consist of clicks that have a bandwidth of 100 Hz to 30 kHz (Erbe et al., 2017). For sperm whales, acoustic energy peaks at around 15 kHz and is generally concentrated below 10 kHz, although diffuse energy up to and past 20 kHz is common (Weilgart and Whitehead, 1993; Goold and Jones, 1995; Møhl et al., 2003; Erbe et al., 2017). Source levels of clicks are generally 186 ± 0.9 dB re 1 μPa m with extremes up to 236 dB re 1 μPa m (Møhl et al., 2003; Mathias et al., 2013).

Noise produced by the drilling rigs, DP thrusters, and drilling operations are all classified as nonimpulsive sound source and are within the hearing frequency sensitivity of sperm whales. As discussed in **Section A.1**, drilling noise can produce broadband (10 Hz to 10 kHz) sound pressure levels of approximately 190 dB re 1 μPa m (Hildebrand, 2005). Therefore, vessel-related noise is likely to be heard by sperm whales. As sound pressure levels produced during active drilling operations may have greater amplitudes than vessel noise alone, they may have a greater likelihood of eliciting a behavioral response.

NMFS analyzed the potential for impacts of drilling-related noise on sperm whales in its Biological Opinion for the Five-Year Oil and Gas Leasing Program in the Central and Western Planning Areas of the Gulf of Mexico (NMFS, 2007). The analysis noted that drilling activities produce low sound source levels and concluded that drilling is not expected to produce amplitudes sufficient to cause hearing or behavioral effects in sperm whales; therefore, these effects are insignificant (NMFS, 2007). It is expected that, due to the relatively stationary nature of the proposed activities, sperm whales would move away from the proposed operations area, and noise levels that could cause auditory injury would be avoided. However, observations of sperm whales near offshore oil and gas operations suggest an inconsistent response to anthropogenic marine sound (Jochens et al., 2008).

The most recent acoustic criteria (NMFS, 2018b) are based on received sound exposure level accumulations that equate to the onset of marine mammal auditory threshold shifts. For mid frequency cetaceans exposed to a non-impulsive source (such as drilling operations), permanent threshold shifts are estimated to occur when the mammal has received a cumulative sound exposure level of 198 decibels relative to 1 micropascal squared second (dB re 1 μPa^2 s) over a 24-hour period. Similarly, temporary threshold shifts are estimated to occur when the mammal has received a sound exposure level of 178 dB re 1 μPa^2 s over a 24-hour period. Based on transmission loss calculations (Urick, 1983b), open water propagation of noise produced by typical sources with DP thrusters in use during drilling, are not expected to produce root-mean-square sound pressure levels greater than 160 dB re 1 μPa beyond 105 ft (32 m) from the source. Due to the short propagation distance of high sound pressure levels, the transient nature of sperm whales, and the stationary nature of drilling activities, it is not expected that any sperm whales will receive exposure levels necessary for the onset of auditory threshold shifts.

There are other OCS facilities and activities near the project area, and the region as a whole has a large number of similar noise sources. Noise associated with this project will contribute to an increase in the ambient noise environment of the Gulf of Mexico, but it is not expected in amplitudes sufficient to cause auditory injuries to sperm whales. The proposed activity may cause disturbance effects; primarily avoidance or temporary displacement from the project area. Vessel lighting and presence are not identified as IPFs for sperm whales (NMFS, 2007; BOEM, 2012a; 2016b; 2017a; c).

Impacts of Support Vessel and Helicopter Traffic

Support vessel traffic has the potential to disturb sperm whales and there is also a risk of vessel strikes, which are identified as a threat in the recovery plan for this species (NMFS, 2010b). To reduce the potential for vessel strikes, BOEM issued NTL BOEM-2016-G01, which recommends protected species identification training and that vessel operators and crews maintain a vigilant watch for marine mammals and slow down or stop their vessel to avoid striking protected species. 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 of 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 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.

Dependent on flight altitude, helicopter traffic also has the potential to disturb sperm whales. Smultea et al. (2008) documented responses of sperm whales offshore Hawaii to a fixed-wing aircraft flying at an altitude of 800 ft (245 m). A reaction to the initial pass of the aircraft was observed during 3 of 24 sightings (12%). 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 the 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.

Helicopters used in support operations maintain a minimum altitude of 700 ft (213 m) while in transit offshore, and the 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. In the event that a whale is seen during transit, the helicopter will not approach or circle the animal. Although responses are possible, Smultea et al. (2008) and NMFS (2007) concluded that this helicopter flight altitude would minimize the potential for disturbing sperm whales.

Impacts of a Small Fuel Spill

Potential spill impacts on marine mammals, including sperm whales, are discussed by NMFS (2007) and BOEM (2017a; c). Oil impacts on marine mammals are discussed by Geraci and St. Aubin (1990) and by the Marine Mammal Commission (MMC) (2011). For proposed activities in this EP, 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 Anadarko's preventative measures that will be implemented during routine operations, including fuel transfer. In the unlikely event of a spill, implementation of Anadarko's OSRP could mitigate and lessen the potential for impacts on sperm whales. 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 diesel 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, the volume released, and the effectiveness of spill response measures. **Section A.9.1** discusses the likely fate of a small diesel fuel spill and indicates that more than 90% would evaporate or disperse naturally within 24 hours. Results of an ADIOS2 model run (**Section A.9.1**) indicate that the area of the sea surface with diesel fuel on it would range from 0.5 to 5 ha (1.2 to 12 ac), depending on sea state and weather conditions.

Direct physical and physiological effects to sperm whales due to 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 exposure to 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 diesel 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 NMFS (2007) and BOEM (2017a; c). Oil impacts on marine mammals are discussed by Geraci and St. Aubin (1990) and by the MMC (2011). For this EP, 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 caused by response activities and materials (e.g., vessel traffic, noise, dispersants) (MMC, 2011). Natural or chemical dispersion of oil could cause a subsurface plume which would have the possibility of contacting sperm whales. Potential 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 oiled 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., 2017). Complications related to 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, including displacement from preferred habitat, disruption of social structure, change in prey availability and foraging distribution and/or patterns, change in reproductive behavior/productivity, and change in movement patterns or migration (MMC, 2011). Ackleh et al. (2012) hypothesized that sperm whales may have temporarily relocated away from areas near the Macondo spill in 2010.

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

C.3.2 West Indian Manatee (Threatened)

Most of the Gulf of Mexico West Indian manatee population is located in peninsular Florida (U.S. Fish and Wildlife Service, 2001). Critical habitat has been designated in southwest Florida in Manatee, Sarasota, Charlotte, Lee, Collier, and Monroe Counties, although increased sightings in warmer months indicate the north and northwest regions of the Gulf of Mexico are also important regions for manatees (Hieb et al., 2017). 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 (U.S. Fish and Wildlife Service, 2001).

IPFs that could 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 211 miles (340 km) from the nearest shoreline. As explained in **Section A.9.1**, a small fuel spill would not be expected to make landfall or reach coastal waters prior to breaking up. Compliance with NTL BSEE-2015-G03 (**Table 1**) will minimize the potential for marine debris-related impacts on manatees. The IPFs with potential impacts listed in **Table 2** are discussed below.

Impacts of Support Vessel and Helicopter Traffic

Support vessel traffic has the potential to disturb manatees and there is also a risk of vessel strikes, which are identified as a threat in the recovery plan for this species (U.S. Fish and Wildlife Service, 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 through these waters. To reduce the potential for vessel strikes, BOEM and BSEE have issued NTL BOEM-2016-G01, which recommends protected species identification training for vessel operators and crews; recommends that vessel 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. Implementation of these NTL's mitigation measures will reduce the potential for vessel strikes, and no significant impacts on manatees are expected.

Dependent 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 and 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. This mitigation measure will minimize the potential for disturbing manatees, and no significant impacts are expected.

Impacts of a Large Oil Spill

Based on the 30-day OSRA modeling (**Table 3**), coastal areas are unlikely to be affected within 3 or 10 days of a spill (<0.5% conditional probability). Coastal areas between Calhoun County, Texas and Plaquemines Parish, Louisiana may be affected within 30 days of a spill, however the likelihood is low (1 to 2% conditional probability). In addition, manatee critical habitat does not exist in these areas and manatees are unlikely to be present. Based on the 60-day OSRA modeling estimates (**Table 4**), the potential for shoreline contact ranges from Cameron County, Texas to Bay County, Florida (1 to 13% conditional probability within 60 days). This range does not include any areas of designated manatee critical habitat.

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

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

C.3.3 Non-Endangered Marine Mammals (Protected)

All marine mammal species are protected under the MMPA. Excluding the endangered species that have been discussed in **Sections C.3.1** and **C.3.2**, there are 21 additional marine mammal species that may be found in the Gulf of Mexico. This includes one species of mysticete whale, the dwarf sperm whale (*Kogia sima*) and pygmy sperm whale (*Kogia breviceps*), four species of beaked whales, and 14 species of delphinid whales and dolphins. The most common non-endangered cetaceans in the deepwater environment are the odontocetes, such as the pantropical spotted dolphin (*Stenella attenuata*), spinner dolphin (*Stenella longirostris*), and Clymene dolphin (*Stenella clymene*). A brief summary is presented in this subsection, and additional information on protected marine mammals is discussed by BOEM (2017a).

<u>Bryde's Whale</u>.

The Bryde's whale (*Balaenoptera edeni*) is the only year-round resident baleen whale in the northern Gulf of Mexico. 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 15 April 2019, NMFS issued a final rule to list the Gulf of Mexico DPS of Bryde's whale as Endangered under the ESA. The listing is effective on 15 May 2019. The Bryde's whale distribution is most frequently sighted in the waters over the Desoto Canyon between the 328 ft (100 m) and 3,280 ft (400 m) isobaths (Rosel et al., 2016; Hayes et al., 2018). Based on the available data, it is possible that Bryde's whales could occur in the project area.

Dwarf and pygmy sperm whales. At sea, it is difficult to differentiate dwarf sperm whales from pygmy sperm whales, and sightings are often grouped together as "*Kogia* spp." Both species have a global 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., 2016). Either species could occur in the project area.

Beaked whales. Four species of beaked whales are known to occur in the Gulf of Mexico: 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. 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).

Because of the difficulties of at-sea identification, beaked whales in the Gulf of Mexico are identified as either 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., 2016).

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, false killer whale (*Pseudorca crassidens*), Fraser's dolphin (*Lagenodelphis hosei*), killer whale (*Orcinus orca*), melon-headed whale (*Peponocephala electra*), pantropical spotted dolphin (*Stenella attenuata*), pygmy killer whale (*Feresa attenuata*), short-finned pilot whale (*Globicephala macrorhynchus*), Risso's dolphin (*Grampus griseus*), rough-toothed dolphin (*Steno bredanensis*), spinner dolphin, 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).

The bottlenose dolphin is a common inhabitant of the northern Gulf of Mexico, particularly within continental shelf waters. There are two bottlenose dolphin ecotypes, 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 may occur within the project area. Inshore populations in the northern Gulf of Mexico are separated into 31 geographically distinct population units, or stocks, for management purposes by NMFS (Hayes et al., 2018).

IPFs that could affect non-endangered marine mammals include MODU presence, noise, and lights; vessel traffic; and two types of accidents (a small fuel spill and a large oil spill). Any impact on marine mammals is expected to be negligible because of rapid dispersion, the small area of ocean affected, the intermittent nature of the discharges, and the mobility of marine mammals. Implementation of NTL BSEE-2015-G03 (**Table 1**) mitigation measures will reduce the potential for marine debris-related impacts on marine mammals. The IPFs with potential impacts listed in **Table 2** are discussed below.

Impacts of MODU Presence, Noise, and Lights

The presence of the MODU presents an attraction to pelagic food sources that may attract cetaceans. Some odontocetes have shown increased feeding activity around lighted platforms at night (Todd et al., 2009). 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. Vessel lighting is not considered as IPFs for marine mammals.

Noise from routine drilling operations has the potential to disturb marine mammals. A discussed in **Section A.1**, noise impacts would be expected at greater distances when thrusters are in use than with vessel and drilling noise alone and are dependent on variables relating to sea state conditions, thruster type, and usage. Three functional hearing groups are represented in the 21 non-endangered cetceans found in the Gulf of Mexico (NMFS, 2018b). Eighteen of the 20 odonotocete species are considered to be in the mid-frequency functional hearing group, two species (*Kogia* spp.) are in the high frequency functional hearing group, and one species (Bryde's whale) is in the low frequency functional hearing group (NMFS, 2018b). Thruster and drilling noise will affect each group differently depending on the frequency bandwiths produced by operations. Generally, noise produced by drilling is dominated by frequencies below 10 kHz. Thus, out of range for the high frequency group whereas the low frequency group is more likely to be disturbed by the low frequency output of drilling sound sources.

For mid frequency cetaceans exposed to a non-impulsive source (like drilling operations), permanent threshold shifts are estimated to occur when the mammal has received a sound exposure level of 198 dB re 1 μPa^2 s over a 24-hour period (NMFS, 2018b). Similarly, temporary threshold shifts are estimated to occur when a mammal has received a cummulative sound exposure level of 178 dB re 1 μPa^2 s over a 24-hour period. For low frequency cetaceans, specifically the Bryde's whale, permanent and temporary threshold shift onset is estimated to occur at 199 and 179 dB re 1 μPa^2 s, repectively. Based on transmission loss calculations (see Urick, 1983a), open water propagation of noise produced by typical sources with DP thrusters in use during drilling, are not expected to produce root-mean-square sound pressure levels greater than 160 dB re 1 µPa beyond 105 ft (32 m) from the source. Due to the short propagation distance of high root-mean-square sound pressure levels, the transient nature of marine mammals and the stationary nature of drilling 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 (2005) presents criteria that are used in the interim to determine behavioral disturbance thresholds for marine mammals and are applied equally across all functional hearing groups. Received root-mean-square sound pressure levels of 120 dB re 1 µPa from a non-impulsive source are considered high enough to elicit a behavioral reaction in some marine mammal species. The 120-dB isopleth may extend tens to hundreds of kilometers from the source depending on the propagation environment.

There are other OCS facilities and activities near the project area, and the region as a whole has a large number of similar sources. Marine mammal species in the northern Gulf of Mexico have been exposed to noise from anthropogenic sources for a long period of time and over large geographic areas and likely do not represent a naïve population with regard to sound (National Research Council, 2003a). Due to the limited scope, timing, and geographic extent of drilling activities, this project would represent a small, temporary contribution to the overall noise regime, and any short-term behavioral impacts are not expected to be biologically significant to marine mammal populations.

Impacts of Support Vessel and Helicopter Traffic

Vessel traffic has the potential to disturb marine mammals, and there is also a risk of vessel strikes. Data concerning the frequency of vessel strikes are presented in a previous multisale EIS (BOEM, 2012a). To reduce the potential for vessel strikes, BOEM and BSEE have issued NTL BOEM-2016-G01, which recommends protected species identification training for vessel operators and crews; recommends that vessel 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. These mitigation measures are only effective during daylight hours, or in sea and weather conditions where cetaceans are sighted. Compliance with NTL BOEM-2016-G01 (**Table 1**) mitigation measures will minimize the potential of vessel strikes as well as reduce the chance for disturbing marine mammals during these periods. If collisions occur during periods of poor visibility or at night, it is likely that it may result in the death of the cetacean. Impacts to non-listed cetaceans are not expected to be significant at the population (stock) level.

Aircraft 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. Maintaining this flight altitude will minimize the potential for disturbing marine mammals, and no significant impacts are expected (BOEM, 2017a).

Impacts of a Small Fuel Spill

Potential spill impacts on marine mammals are discussed by BOEM (2017a; c), and oil impacts on marine mammals in general are discussed by Geraci and St. Aubin (1990). For this EP, there are no unique site-specific issues with respect to spill impacts on these animals.

Section A.9.1 discusses the size and fate of a potential small diesel fuel spill as a result of Anadarko's proposed activities. 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. The extent and persistence of any impacts would depend on the meteorological and oceanographic conditions at the time, volume released, and effectiveness of spill response measures. More than 90% would evaporate or disperse naturally within 24 hours; and the estimated area of the sea surface with diesel fuel on it would range from 0.5 to 5 ha (1.2 to 12 ac), depending on sea state and weather conditions (**Section A.9.1**).

Potential 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 oiled prey; and stress from the activities and noise of response vessels and aircraft (MMC, 2011). However, because of 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 are expected.

Impacts of a Large Oil Spill

Potential spill impacts on marine mammals are discussed by BOEM (2017a; c). For this EP, there are no unique site-specific issues.

Potential impacts of oil spills on marine mammals could include direct impacts from oil exposure as well as indirect impacts caused by 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 oiled prey; and stress from the activities and noise of response vessels and aircraft. Complications related to the above could lead to dysfunction of immune and reproductive systems (De Guise et al., 2017), physiological stress, declining physical condition, and death. Kellar et al. (2017) estimated that the 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 could include displacement of animals from preferred habitat (McDonald et al., 2017a), disruption of social structure, change in prey availability and foraging distribution and/or patterns, change in reproductive behavior/productivity, and change in movement patterns or migration (MMC, 2011).

Data from the Macondo spill, as analyzed and summarized by NOAA (2016a), indicate the scope of potential impacts from a large spill. Tens of thousands of marine mammals were exposed to the slick, where they likely inhaled, aspirated, ingested, physically contacted, and absorbed oil components (NOAA, 2016a; Takeshita et al., 2017). 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, 2016a). According to the National Wildlife Federation (2016a), nearly all of the 21 species of dolphins and whales that live in the northern Gulf of Mexico had demonstrable, quantifiable injuries. NMFS (2014a) documented 13 dolphins and whales stranded alive, and over 150 dolphins and whales were found dead during the oil spill response. Because of the known low detection rates of carcasses (Williams et al., 2011), it is possible that the number of marine mammal deaths was underestimated. Also, necropsies to confirm the cause of death could not be conducted for many of these marine mammals; therefore, some cause of deaths reported as unknown are likely attributable to oil interaction. Many dolphins in Barataria Bay, Louisiana, had evidence of disease conditions associated with petroleum exposure and toxicity (Schwacke et al., 2014). 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 low probability 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. It is expected that impacts to non-listed marine mammals from a large oil spill resulting in the death of individuals would be adverse but not significant at a population level.

In the aftermath of the Macondo spill, an unusual mortality event (UME) of unprecedented size affected marine mammal stock areas in the Gulf of Mexico. The UME began in April 2010 and ended in July 2014 (NOAA, 2016b). Carmichael et al. (2012) hypothesized that the unusual number of bottlenose dolphin strandings in the northern Gulf of Mexico in 2010 and 2011 may have been associated with environmental perturbations including sustained cold weather and the Macondo spill in 2010 as well as large volumes of cold freshwater discharge in the early months of 2011. 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 UME 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 Macondo spill were proposed as a cause. Therefore, if a large spill occurred, similar impacts to marine mammals could be expected.

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, booms) (BOEM, 2017a; b). 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, 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. The application of dispersants is likely to reduce the chance of harmful impacts as the dispersants would remove oil from the surface, thereby reducing the risk of contact and rendering it less likely to adhere to skin, baleen plates, or other body surfaces (BOEM, 2017a). The use of trained observers during remediation activities will reduce the likelihood of capture and/or entrainment (BOEM, 2017a; b) of marine mammals. It is expected that impacts to non-listed marine mammals from oil spill response activities resulting in the death of individuals would be adverse but not likely significant at a population level.

C.3.4 Sea Turtles (Endangered/Threatened)

Five species of endangered or threatened sea turtles may be found near the project area. Endangered species are the leatherback, Kemp's ridley, and hawksbill turtles. As of May 6, 2016, the entire North Atlantic DPS of the green turtle is listed as threatened (81 FR 20057). The DPS of loggerhead turtles that occur in the Gulf of Mexico is listed as threatened, although other DPSs are endangered.

Critical habitat has been designated for the loggerhead turtle in the Gulf of Mexico as shown in **Figure 3**. 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* spp. habitat that includes most of the Western and Central Planning Areas of and parts of the southern portion of the Eastern Planning Area (NMFS, 2014b).

Loggerhead turtles in the Gulf of Mexico are part of the Northwest Atlantic Ocean DPS (76 FR 58868). 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 at these same nesting beaches. NMFS also designated large areas of shelf and oceanic waters, termed *Sargassum* spp. habitat in the Gulf of Mexico (and Atlantic Ocean) as critical habitats. *Sargassum* is a genus of brown algae (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). The project area is located inside the designated *Sargassum* critical habitat for loggerhead sea turtles (**Figure 3**).

Leatherbacks and loggerheads are the most likely species to be present near the project area as adults. Green, hawksbill, and Kemp's ridley turtles are typically inner-shelf and nearshore species and are 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* spp. and other flotsam.

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);
- 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 the beaches of the Yucatan Peninsula (U.S. Fish and Wildlife Service, 2016a); and
- Kemp's ridley turtles – The main Kemp's ridley nesting site is Rancho Nuevo beach, Tamaulipas, Mexico (NMFS, 2011). A much smaller but growing population nests in Padre Island National Seashore, Texas, mostly as a result of reintroduction efforts (NMFS, 2011). As of April 2019, a total of 62 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 in southern Texas, is the most important nesting location for this species in the U.S. Kemp's ridley turtles typically do not nest anywhere near the project area, although there have been occasional reports of nesting in Alabama (Share the Beach, 2016).

IPFs that could affect sea turtles include MODU presence, noise, and lights; support vessel and helicopter traffic; and two types of accidents (a small fuel spill and a large oil spill). Any impacts on sea turtles from effluent discharges are expected to be negligible because of rapid dispersion, the small area of ocean affected, and the intermittent nature of the discharges. Implementation of NTL BSEE-2015-G03 (**Table 1**) mitigation measures will reduce the potential for marine debris-related impacts on sea turtles. The IPFs with potential impacts listed in **Table 2** are discussed below.

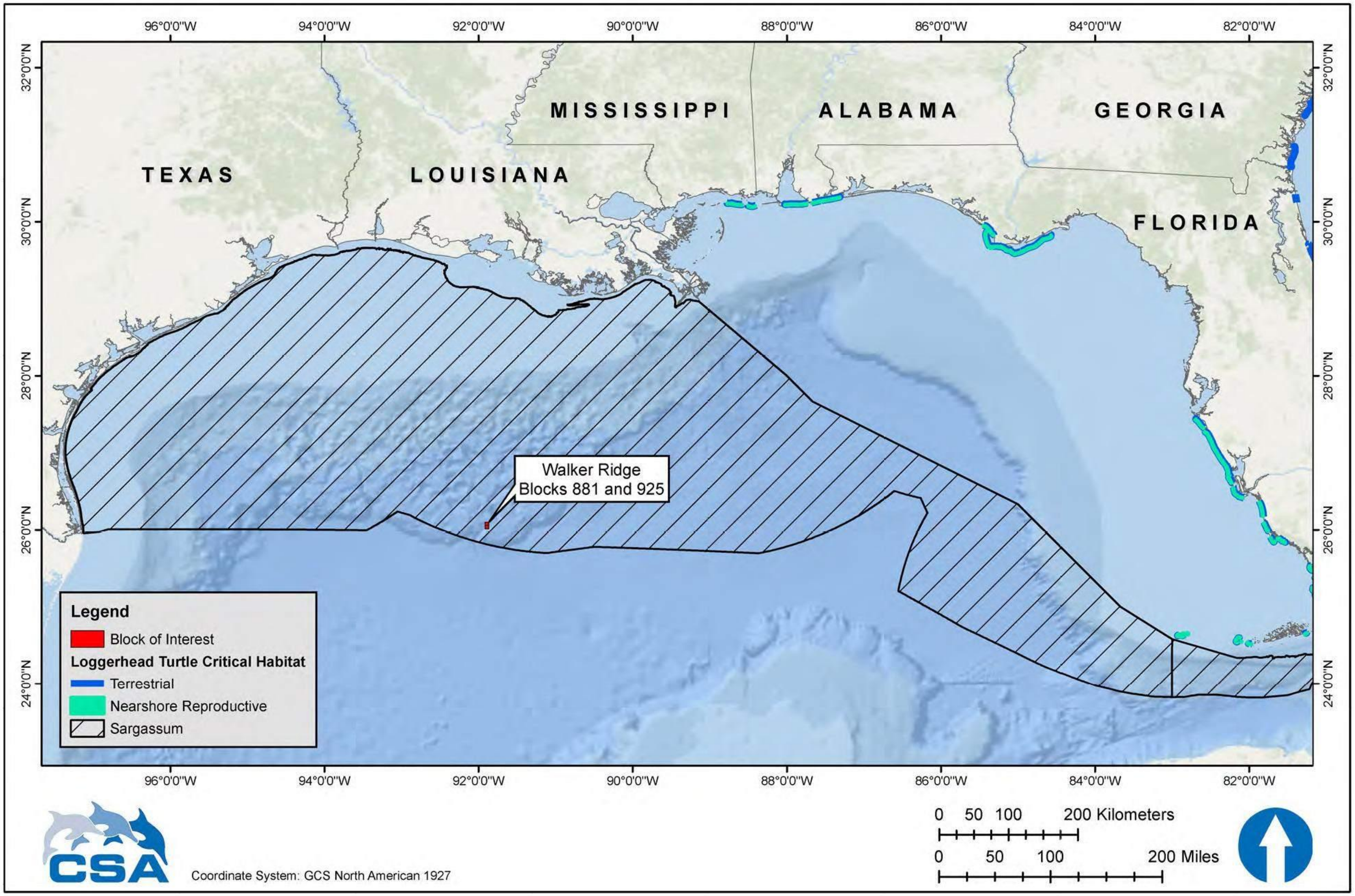

Figure 3. Location of loggerhead turtle critical habitat in the northern Gulf of Mexico. The critical habitat includes terrestrial habitat (nesting beaches) and nearshore reproductive habitat in Mississippi, Alabama, and the Florida Panhandle as well as *Sargassum* spp. habitat.

Impacts of MODU Presence, Noise, and Lights

Offshore drilling activities produce a broad array of 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 Opinions (NMFS, 2015) lists the sea turtle underwater acoustic root-mean-square sound pressure level injury threshold as 207 dB re 1 µPa; Blackstock et al. (2018) identified the sea turtle underwater acoustic root-mean-square sound pressure level behavioral threshold as 175 dB re 1 µPa. No distinction is made between impulsive and continuous sources for these thresholds. Based on transmission loss calculations (see Urick, 1983a), open water propagation of noise produced by typical sources with DP thrusters in use during drilling, are not expected to produce root-mean-square sound pressure levels greater than 160 dB re 1 µPa beyond 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 activities. Any impacts would likely be short-term behavioral changes such as diving and evasive swimming, disruption of activities, or departure from the area. Because of the limited scope and short duration of drilling activities, these short-term impacts are not expected to be biologically significant to sea turtle populations.

Artificial lighting can disrupt the nocturnal orientation of sea turtle hatchlings (Tuxbury and Salmon, 2005; Berry et al., 2013; Simões et al., 2017). However, hatchlings may rely less on light cues when they are offshore than when they are emerging on the beach (Salmon and Wyneken, 1990). NMFS (2007) concluded that the effects of lighting from offshore structures on sea turtles are insignificant.

Impacts of Support Vessel and Helicopter Traffic

Noise generated from vessel traffic has the potential to disturb sea turtles, and there is also a risk of vessel strikes. Data show that a vessel strike is one cause of sea turtle mortality in the Gulf of Mexico (NMFS, 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 and BSEE have issued NTL BOEM-2016-G01, which recommends protected species identification training for vessel operators and crews; recommends that vessel 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 (**Table 1**) will reduce the potential for vessel strikes during periods of daylight and during sea and weather conditions that permit sighting of turtles on the sea surface. If a project-related vessel strikes a sea turtle, it is likely that it will result in the death of the individual turtle. Lethal ship strike to these listed species is not likely but, if it occurs, could be significant to the population (NMFS, 2007).

Noise generated from support 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, 2012a).

Impacts of a Small Fuel Spill

Potential spill impacts on sea turtles are discussed by NMFS (2007) and BOEM (2017a; b). For this EP, there are no unique site-specific issues with respect to spill impacts on sea turtles. **Section A.9.1** discusses the size and fate of a potential small diesel fuel spill as a result of Anadarko's proposed activities. EP Section H 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 on sea turtles to occur would be brief.

The extent and persistence of any impacts would depend on the meteorological and oceanographic conditions at the time of the spill, the volume released, and the effectiveness of spill response measures. More than 90% would evaporate or disperse naturally within 24 hours; and the estimated area of the sea surface with diesel fuel on it would range from 0.5 to 5 ha (1.2 to 12 ac), depending on sea state and weather conditions (**Section A.9.1**).

Potential 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 oiled prey; and stress from the activities and noise of response vessels and aircraft (NMFS, 2014a). However, because of the limited areal extent and short duration of water quality impacts from a small fuel spill, no significant impacts are expected.

<u>Loggerhead Turtle Critical Habitat – Nesting Beaches</u>. A small diesel fuel spill in the project area would be unlikely to affect sea turtle nesting beaches because the project area is 211 miles (340 km) from the nearest shoreline. Loggerhead turtle nesting beaches and nearshore reproductive habitat designated as critical habitat are located in Mississippi, Alabama, and the Florida Panhandle, at least 341 miles (548 km) from the project area. As explained in **Section A.9.1**, a small diesel fuel spill would not be expected to make landfall or reach coastal waters prior to breaking up.

<u>Loggerhead Turtle Critical Habitat – *Sargassum* habitat</u>. The project area is located inside the *Sargassum* portion of the loggerhead turtle critical habitat (**Figure 2**). If fuel did contact the *Sargassum* habitat, juvenile sea turtles could come into contact with or ingest oil, resulting in death, injury, or other sublethal effects. However, the small area of the sea surface estimated to be affected by a small spill (0.5 to 5 ha [1.2 to 12 ac]) would represent a negligible percentage of the available *Sargassum* habitat in the region (the total area of the designated *Sargassum* portion of the loggerhead critical habitat is 40,662,810 ha [100,480,000 ac]).

Impacts of a Large Oil Spill

Impacts of oil spills on sea turtles could include direct impacts from oil exposure as well as indirect impacts caused by response activities and materials (e.g., vessel traffic, noise, dispersants). Potential direct physical and physiological effects could 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 affected food; and stress from the activities and noise of response vessels and aircraft. Complications related to the above could lead to dysfunction of immune and reproductive systems, physiological stress, declining physical condition, and death. Behavioral responses could include displacement of animals from prime habitat, disruption of social structure, change in food availability and foraging distribution and/or patterns, change in reproductive behavior/productivity, and change in movement patterns or migration (NOAA, 2010; NMFS, 2014a). In the unlikely event of a spill, implementation of Anadarko's OSRP is expected to minimize the potential for these types of impacts on sea turtles. EP Section H 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 Macondo spill provide an indication of potential effects of a large oil spill on sea turtles. NOAA (2016a) estimated that between 4,900 and up to 7,600 large juvenile and adult sea turtles (Kemp's ridleys, loggerheads, and hard-shelled 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 hard-shelled sea turtles not identified to species) were killed by the Macondo spill. Nearly 35,000 hatchling sea turtles (loggerheads, Kemp's ridleys, and green turtles) were also injured by response activities (NOAA, 2016a). Evidence from McDonald et al. (2017b) suggests that 402,000 turtles were exposed to oil in the aftermath of the Macondo spill, including 54,800 which were likely to have been heavily oiled.

Spill response activities could also kill sea turtles and interfere with nesting. NOAA (2016a) concluded that after the Macondo spill 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, 2016a; 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.

<u>Loggerhead Turtle Critical Habitat – Nesting Beaches</u>. 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 would be subject to the same types of oil spill exposure hazards as adults. Hatchlings that contact oil residues while crossing a beach could exhibit a range of effects, from acute toxicity to impaired movement and bodily functions (NMFS, 2007).

Based on the 30-day OSRA modeling (**Table 3**), coastal areas are unlikely to be affected within 3 or 10 days of a spill (<0.5% conditional probability). Coastal areas between Calhoun County, Texas and Plaquemines Parish, Louisiana may be affected within 30 days of a spill, however the likelihood is low (1 to 2% conditional probability). Based on the 60-day OSRA modeling estimates

(**Table 4**), the potential for shoreline contact ranges from Cameron County, Texas to Bay County, Florida (up to 13% conditional probability within 60 days). The nearest nearshore reproductive critical habitat for the loggerhead turtle is located in Jackson County, Mississippi approximately 341 miles (548 km) from the project area (**Figure 3**), and is predicted by the 60-day OSRA model to have <0.5% or less conditional probability of contact within 60 days of a spill.

Loggerhead Turtle Critical Habitat – *Sargassum* habitat. The project area is located inside the *Sargassum* habitat portion of the loggerhead turtle critical habitat (**Figure 2**). Because of the large area designated as *Sargassum* habitat for loggerhead turtles, a large spill could result in a substantial part of the *Sargassum* habitat in the northern Gulf of Mexico being oiled. For example, the 2010 Macondo spill affected approximately one-third of the *Sargassum* habitat in the northern Gulf of Mexico (BOEM, 2014a; b). It is extremely unlikely that the entire *Sargassum* portion of loggerhead critical habitat would be affected by a large spill. Because *Sargassum* spp. is a floating, pelagic species, it would only be affected by oil that is present near the surface.

The effects of oiling on *Sargassum* spp. vary with spill severity, but moderate to heavy oiling that could occur during a large spill could cause complete mortality to *Sargassum* spp. and its associated communities (BOEM, 2016a; 2016b). *Sargassum* spp. also have the potential to sink during a large spill, thus temporarily removing the habitat and possibly being an additional pathway of oil exposure to the benthic environment (Powers et al., 2013). Lower levels of oiling may cause sub-lethal effects, including a reduction in growth, productivity, and recruitment of organisms associated with *Sargassum* spp. The *Sargassum* spp. algae itself could be less impacted by light to moderate oiling than associated organisms because of a waxy outer layer that might help protect it from oiling (BOEM, 2016b). *Sargassum* spp. have an annual seasonal growth cycle and annual dispersal cycle from the Gulf of Mexico to the western Atlantic. A large spill could affect a large portion of the annual algal crop; however, because of its ubiquitous distribution and seasonal cycle, recovery of the *Sargassum* spp. community would be expected to occur within 1 to 2 years (BOEM, 2016a).

In the event of a large spill, the level of vessel and aircraft activity associated with spill response could disturb sea turtles and potentially result in vessel strikes, entanglement, or other injury or stress. Response vessels would operate in accordance with NTL BOEM-2016-G01 (**Table 1**) to reduce the potential for striking or disturbing these animals; however, events leading to the death of individual sea turtles from spill response activities could result in substantial impacts to local populations.

C.3.5 Piping Plover (Threatened)

The Piping Plover is a migratory shorebird that overwinters along the southeastern U.S. and Gulf of Mexico coasts. This threatened species is in decline as a result of hunting, habitat loss and modification, predation, and disease (U.S. Fish and Wildlife Service, 2003). Critical overwintering habitat has been designated, including beaches in Texas, Louisiana, Mississippi, Alabama, and Florida (**Figure 4**). Piping Plovers inhabit coastal sandy beaches and mudflats, feeding by probing for invertebrates at or just below the surface. They use beaches adjacent to foraging areas for roosting and preening (U.S. Fish and Wildlife Service, 2003).

IPFs potentially affecting Piping Plovers include helicopter traffic crossing over selected coastal habitats and a large oil spill. These IPFs with potential impacts listed in **Table 2** are discussed below. It is assumed that helicopters will maintain an altitude of 1,000 ft (305 m) over unpopulated areas or across coastlines. Therefore, it is not likely that the crossing of helicopters over coastlines will significantly impact overwintering Piping Plovers.

A small diesel fuel spill in the project area would be unlikely to affect Piping Plovers because a diesel fuel would not be expected to make landfall or reach coastal waters prior to natural dispersion (**Section A.9.1**).

Impacts of a Large Oil Spill

The project area is 211 miles (340 km) from the nearest Piping Plover critical habitat in Terrebone Parish, Louisiana. Based on the 30-day OSRA modeling (**Table 3**), coastal areas are unlikely to be affected within 3 or 10 days of a spill (<0.5% conditional probability). Coastal areas between Calhoun County, Texas and Plaquemines Parish, Louisiana may be affected within 30 days of a spill, however the likelihood is low (1 to 2% conditional probability). The 60-day OSRA modeling (**Table 4**) predicts a 13% or less probability of shoreline contact within 60 days of a spill between Cameron County, Texas to Bay County, Florida, a stretch of shoreline that includes numerous areas of Piping Plover Critical habitat.

Plovers could physically oil themselves while foraging on oiled shores or secondarily contaminate themselves through ingestion of oiled intertidal sediments and prey (BOEM, 2017a). Plovers 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 these birds are most common along the coastal Gulf or if spills contacted their critical habitat. Impacts could also occur from vehicular traffic on beaches and other activities associated with spill cleanup.

Anadarko has extensive resources available to protect and rehabilitate wildlife in the event of a spill reaching the shoreline, as detailed in their Regional OSRP. Impacts resulting in the deaths of individual Piping Plovers could be significant to the local population, depending on the number of individuals lost.

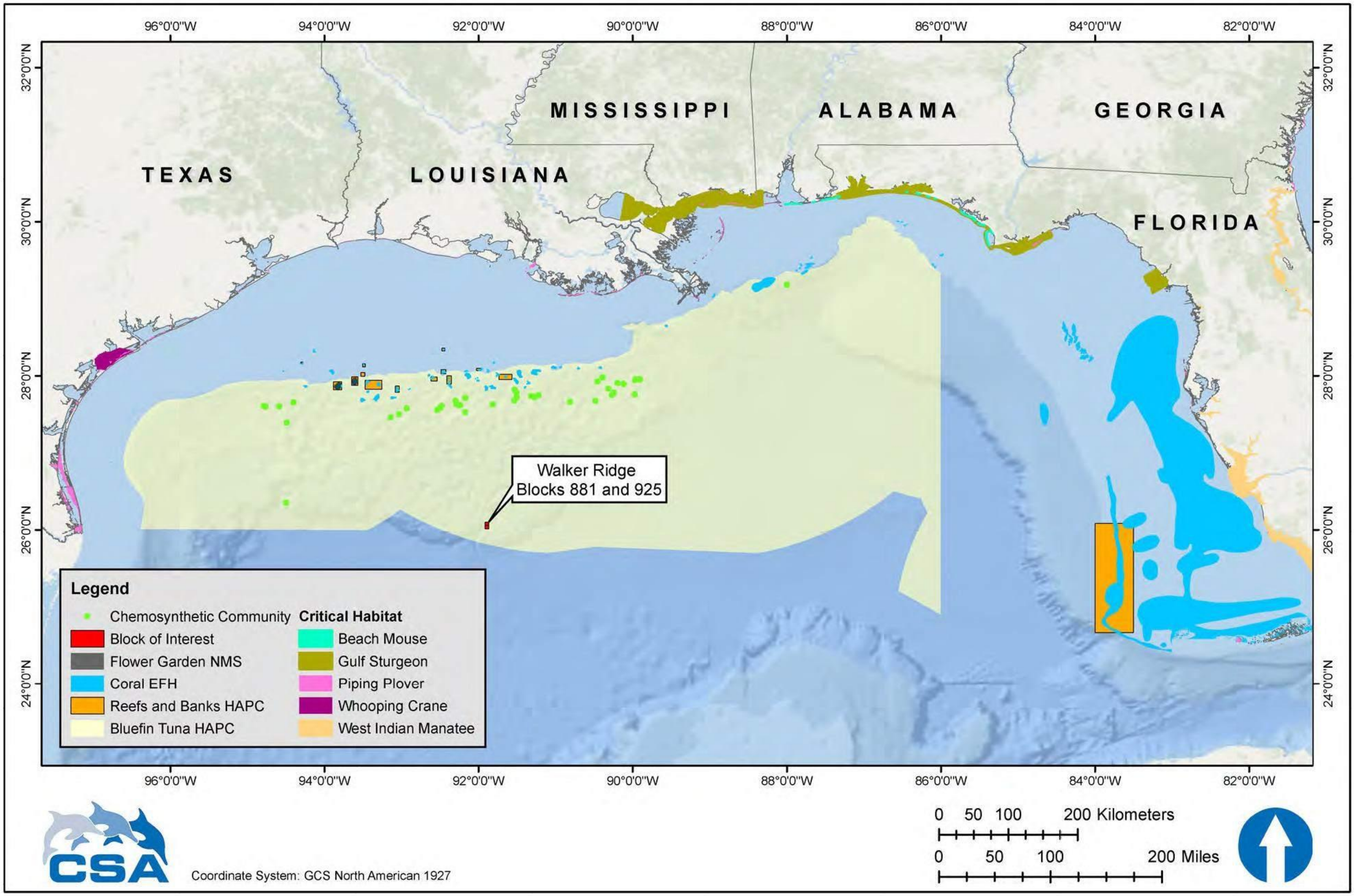

Figure 4. Location of selected environmental features in relation to the project area. EFH=Essential Fish Habitat; HAPC= Habitat Area of Particular Concern; NMS=National Marine Sanctuary.

C.3.6 Whooping Crane (Endangered)

The Whooping Crane is an omnivorous wading bird listed as an endangered species. Three wild populations live in North America (National Wildlife Federation, 2016b). One population winters along the Texas coast at Aransas NWR and summers at Wood Buffalo National Park in Canada. This population represents the majority of the world's population of free-ranging Whooping Cranes, reaching an estimated population of 505 at Aransas NWR during the 2017 to 2018 winter (U.S. Fish and Wildlife Service, 2018). 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 (U.S. Fish and Wildlife Service, 2007). Approximately 9,000 ha (22,240 ac) of salt flats in Aransas NWR and adjacent islands make up the principal wintering grounds of the Whooping Crane. Aransas NWR (located in Aransas and Calhoun counties, Texas) is designated as critical habitat for the species.

The only IPF potentially affecting Whooping Cranes is a large oil spill. A small diesel fuel spill in the project area would be unlikely to affect Whooping Cranes because of the distance from Aransas NWR. As explained in **Section A.9.1**, a small fuel spill would not be expected to make landfall or reach coastal waters prior to breaking up.

Impacts of a Large Oil Spill

A large oil spill is unlikely to affect Whooping Cranes as the project area is approximately 319 miles (513 km) from the nearest shoreline that is designed as critical habitat for Whooping Cranes (Aransas NWR). The 30-day OSRA model (**Table 3**) predicts that there is 1% probability that an oil spill in the project area would reach a shoreline designated as critical habitat for the Whooping Crane in Calhoun or Aransas Counties, Texas. The 60-day OSRA model (**Table 4**) predicts that a 1 to 3% conditional probability of contact in Aransas County, Texas within 60 days of a spill.

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, especially if spills occur during winter months when Whooping Cranes are most common along the Texas coast if the spill contacts their critical habitat in Aransas NWR. Impacts could also occur from vehicular traffic on beaches and other activities associated with spill cleanup. Anadarko has extensive resources available to protect and rehabilitate wildlife in the event of a spill reaching the shoreline, as detailed in their OSRP. Impacts leading to the death of individual Whooping Cranes would be significant at a species level.

C.3.7 Oceanic Whitetip Shark (Threatened)

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

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

IPFs that could affect the oceanic whitetip shark include MODU presence, noise, and lights, and a large oil spill. 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. Any impacts on oceanic whitetip sharks from effluent discharges are expected to be negligible because of rapid dispersion, the small area of ocean affected, and the intermittent nature of the discharges. The IPFs with potential impacts listed in **Table 2** are discussed below.

Impacts of MODU Presence, Noise, and Lights

Offshore drilling activities produce a broad array of sounds at frequencies and intensities that may be detected by elasmobranchs including the threatened oceanic whitetip shark. The general frequency range for elasmobranch hearing is approximately between 20 Hz and 1 kHz (Ladich and Fay, 2013), which includes frequencies exhibited by individual species such as the nurse shark (*Ginglymostoma cirratum*; 300 and 600 Hz) and the lemon shark (*Negaprion brevirostris*; 20 Hz to 1 kHz) (Casper and Mann, 2006). These frequencies overlap with sound pressure levels associated with drilling activities (typically 10 Hz to 10 kHz) (Hildebrand, 2005). Impacts from offshore drilling activities (i.e., continuous sound) could include masking or behavioral change (Popper et al., 2014). However, because of the limited propagation distances of high sound pressure levels from the drilling activities, 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 are typically found in surface waters (Andrzejaczek et al., 2018), 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 of individuals. 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.

C.3.8 Giant Manta Ray (Threatened)

The giant manta ray was listed as threatened under the ESA on January 22, 2018 (effective February 21, 2018) by NMFS (83 FR 2916). The species is a slow-growing, migratory, and planktivorous elasmobranch, inhabiting tropical, subtropical, and temperate bodies of water worldwide (NOAA, 2018).

Commercial fishing is the primary threat to giant manta rays (NOAA, 2018). 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, 2018). 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 based on unique underbelly coloration (Flower Garden Banks National Marine Sanctuary, 2018). Genetic and photographic evidence in the Flower Garden Banks over 25 years of monitoring showed that 95% of identified giant manta ray male individuals were smaller than mature size (Stewart et al., 2018).

IPFs that may affect giant manta rays include MODU presence, noise, and lights, and a large oil spill. 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. Any impacts on giant manta rays from effluent discharges are expected to be negligible because of rapid dispersion, the small area of ocean affected, and the intermittent nature of the discharges. The IPFs with potential impacts listed in **Table 2** are discussed below.

Impacts of MODU Presence, Noise, and Lights

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

Impacts of a Large Oil Spill

A large oil spill in the project area could reach coral reefs at the Flower Garden Banks which is the only known location of giant manta ray aggregations in the Gulf of Mexico. Individuals may occur anywhere in the Gulf. In the unlikely event of a large oil spill impacting areas with giant manta rays, individual rays could be affected by direct ingestion of oil which could cover their gill filaments or gill rakers, or by ingestion of oiled plankton. Giant manta rays typically feed in shallow waters of less than 33 ft (10 m) depth (NOAA, 2018). Because of this shallow water feeding behavior, giant manta rays would 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 181 miles [291 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.

C.3.9 Gulf Sturgeon (Threatened)

The Gulf sturgeon is a threatened fish species that inhabits major rivers and inner shelf waters from the Mississippi River to the Suwannee River, Florida (Barkuloo, 1988; Wakeford, 2001). The Gulf sturgeon is anadromous and migrates from the sea upstream into coastal rivers to spawn in freshwater. The historic range of the species extended from the Mississippi River to Charlotte Harbor, Florida (Wakeford, 2001). Populations have been depleted or even extirpated throughout the species' historical range by fishing, shoreline development, dam construction, water quality changes, and other factors (Barkuloo, 1988; Wakeford, 2001). These declines prompted the listing of the Gulf sturgeon as a threatened species in 1991. The best-known populations occur in the Apalachicola and Suwannee Rivers in Florida (Carr, 1996; Sulak and Clugston, 1998), the Choctawhatchee River in Alabama (Fox et al., 2000), and the Pearl River in Mississippi/Louisiana (Morrow et al., 1998). 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 4**). 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 affect Gulf sturgeon. There are no IPFs associated with routine project activities that could affect these fish. 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 (**Section A.9.1**). The IPFs with potential impacts listed in **Table 2** are discussed below.

Impacts of a Large Oil Spill

Potential spill impacts on Gulf sturgeon are discussed by NOAA (2007) in its Biological Opinion for the Five-Year Oil and Gas Leasing Program in the Central and Western Planning Areas of the Gulf of Mexico and by BOEM (2012a). For this EP, there are no unique site-specific issues with respect to this species.

The project area is approximately 328 miles (528 km) from the nearest Gulf sturgeon critical habitat.

The 30-day OSRA modeling (**Table 3**) predicts that a spill in the project area has a 1% conditional probability of contacting any coastal areas containing Gulf sturgeon critical habitat within 30 days of a spill. The 60-day OSRA modeling (**Table 4**) predicts that a spill in the project area has up to a 1% or less conditional probability of contacting any coastal areas containing Gulf sturgeon critical habitat within 60 days of a spill.

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

NOAA (2016a) 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 and infections, and a decreased ability to heal (NOAA, 2016a). Impacts resulting in the deaths of individual Gulf sturgeons may be significant to the local population, based on the number of individuals lost.

C.3.10 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 (rare), the Florida Keys, Bermuda, the Yucatan Peninsula, and the Caribbean, including the U.S. Virgin Island and Puerto Rico (NOAA, nd). There has been one confirmed sighting of Nassau grouper from the Flower Garden Banks in the Gulf of Mexico at a water depth of 118 ft (36 m) (Foley et al., 2007). Three additional unconfirmed reports (i.e. lacking photographic evidence) of Nassau grouper have also been documented from mooring buoys and the coral cap region of the West Flower Garden flats (Foley et al., 2007).

There are no IPFs associated with routine project activities that could affect Nassau grouper. A small fuel spill would not affect Nassau grouper because the fuel would float and dissipate on the sea surface and would not be expected to reach the Flower Garden Banks or the Florida Keys. A large oil spill is the only relevant IPF.

Impacts of a Large Oil Spill

Based on the 60-day OSRA modeling results (**Table 4**), 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 181 miles [291 km]), and the difference in water depth between the project area (7,560 to 7,815 ft [2,304 to 2,382 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 181 miles [291 km]), and the shallow location of the coral cap of the Banks. Near-bottom currents in the region are predicted to flow along the isobaths (Nowlin et al., 2001) and typically would not carry a plume up onto the continental shelf edge. Valentine et al. (2014) observed the spatial distribution of excess hopane, a crude oil tracer from *Deepwater Horizon* spill sediment core samples, to be in the deeper waters and not transported up the shelf, thus confirming that near-bottom currents flow along the isobaths.

In the unlikely event that an oil slick should reach Nassau grouper habitat, oil droplets or oiled sediment particles could come into contact with Nassau grouper present on the reefs. Potential impacts include the direct ingestion of oil which could cover their gill filaments or gill rakers, ingestion of oiled prey, or the absorption of dissolved petroleum products through the gills.

In the event of a large oil spill, due to the distance between the project area and the Flower Garden Banks and the Florida Keys, it is unlikely that oil would impact Nassau grouper habitats. It is possible that a large oil spill could contact individual Nassau grouper fish, but due to the low density of individuals estimated to exist in the Gulf of Mexico, population-level effects are unlikely.

C.3.11 Beach Mouse (Endangered)

Four subspecies of endangered beach mouse 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 for all four subspecies in **Figure 4**. Species descriptions are presented by BOEM (2012a).

A large oil spill is the only IPF that could affect the beach mouse. There are no IPFs associated with routine project activities that could affect these animals because of the distance from shore and the lack of any onshore support activities near their habitat. A small fuel spill in the project area would not affect the beach mouse because a small fuel spill would not be expected to make landfall or reach coastal waters prior to breaking up (**Section A.9.1**). The large oil spill IPF with potential impacts listed in **Table 2** is discussed below.

Impacts of a Large Oil Spill

Potential spill impacts on the endangered beach mouse subspecies are discussed by BOEM (2017a). For this EP, there are no unique site-specific issues with respect to these animals.

The project area is approximately 368 miles (592 km) from the nearest beach mouse critical habitat. The 30-day OSRA results (**Table 3**) predicts <0.5% conditional probability of oil contact with beach mouse critical habitat within 30 days of a spill. The 60-day OSRA modeling (**Table 4**) predicts that a spill in the project area has a 1% or less conditional probability of reaching either the Alabama or Florida shorelines inhabited by beach mice within 60 days of a spill.

In the event of oil contacting these beaches, beach mice could experience several types of potential direct and indirect impacts. Contact with spilled oil could cause skin and eye irritation and subsequent infection; matting of fur; irritation of sweat glands, ear tissues, and throat tissues; disruption of sight and hearing; asphyxiation from inhalation of fumes; and toxicity from ingestion of oil and oiled food. Potential 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; c). However, any such impacts are unlikely due to the distance from shore and response actions that would occur in the event of a spill. Impacts leading to the death of individual beach mice could be significant at a species level.

C.3.12 Threatened Coral Species

Seven threatened coral species are known from the northern Gulf of Mexico and Florida Keys: elkhorn coral, staghorn coral, lobed star coral, mountainous star coral, boulder star coral, pillar coral, and rough cactus coral. Elkhorn coral, lobed star coral, mountainous star coral, and boulder star coral have been reported from the coral cap region of the Flower Garden Banks (NOAA, 2014), but are unlikely to be present as regular residents in the northern Gulf of Mexico because they typically inhabit coral reefs in shallow, clear, tropical, or subtropical waters. Staghorn coral, pillar coral, and rough cactus coral are only known to inhabit reefs in the Florida Keys and Dry Tortugas within this range (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 (potential impacts listed in **Table 2**) and is discussed below.

Impacts of a Large Oil Spill

A large oil spill would be unlikely to reach coral reefs at the Flower Garden Banks or elkhorn coral critical habitat in the Florida Keys (Monroe County, Florida). The 60-day OSRA modeling (**Table 4**) predicts the conditional probability of oil contacting the Florida Keys is 0.5% or less. A surface slick would not contact corals growing on the seafloor, but could feasibly impact planktonic larvae. If a subsurface plume were to occur, impacts on the Flower Garden Banks would be unlikely due to the distance from the project area and the difference in water depths.

Near-bottom currents in the region are predicted to flow along the isobaths (Nowlin et al., 2001) and typically would not carry a plume up onto the continental shelf edge. Valentine et al. (2014) observed the spatial distribution of excess hopane, a crude oil tracer from Macondo spill 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 including corals. As discussed by BOEM (2017a) impacts could include loss of habitat, biodiversity, and live coral coverage; destruction of hard substrate; change in sediment characteristics; and reduction or loss of one or more commercial and recreational fishery habitats. Sublethal effects could be long-lasting and affect the resilience of coral colonies to natural disturbances (e.g., elevated water temperature and diseases) (BOEM, 2017a).

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

C.4 Coastal and Marine Birds

C.4.1 Marine Birds

Marine birds include seabirds and other species that may occur in the pelagic environment of the project area (Clapp et al., 1982a; Clapp et al., 1982b; 1983; Davis and Fargion, 1996; Davis et al., 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 shorebirds and coastal nesting birds, see **Section C.4.2**.

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

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.

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. Some birds may be attracted to offshore structures and vessels because of the lights and the fish populations that aggregate around these structures (Russell, 2005).

IPFs that could affect marine birds include MODU presence, noise, and lights; support vessel and helicopter traffic; and two types of accidents (a small fuel spill and a large oil spill). Any impacts on the birds from effluent discharges is expected to be negligible because of rapid dispersion, the small area of ocean affected, the intermittent nature of the discharges, and the mobility of these animals. Implementation of BSEE NTL 2015-G03 (**Table 1**) mitigation measures will reduce the potential for marine debris-related impacts on birds. The IPFs with potential impacts listed in **Table 2** are discussed below.

Impacts of MODU Presence, Noise, and Lights

Birds migrating over water have been known to strike offshore structures, resulting in death or injury (Russell, 2005; Ronconi et al., 2015). 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). However, offshore structures may in some cases serve as suitable stopover habitats for most trans-Gulf migrant species, particularly in the spring (Russell, 2005).

Because of the limited scope and duration of drilling activities as described in this EP, any impacts on populations of either seabirds or trans-Gulf migrant birds are not expected to be significant.

Impacts of Support Vessel and Helicopter Traffic

Support vessels and helicopters are unlikely to substantially disturb marine birds in open, offshore waters. Schwemmer et al. (2011) showed that several sea birds exhibited 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 vessel traffic, and the impact would not be significant.

Impacts of a Small Fuel Spill

Potential spill impacts on marine birds are discussed by BOEM (2017a; c). For this EP, there are no unique site-specific issues with respect to spill impacts on these animals.

Section A.9.1 discusses the size and fate of a potential small diesel fuel spill as a result of Anadarko's proposed activities. EP Section H 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.

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

Impacts of a Large Oil Spill

Potential spill impacts on marine birds are discussed by BOEM (2017a; c). For this EP, there are no unique site-specific issues with respect to spill impacts on marine birds.

Marine seabirds could be exposed to oil from a spill at the project area. Davis et al. (2000) reported that terns, storm-petrels, shearwaters, and jaegers were the most frequently sighted seabirds in the deepwater (>200 m) Gulf of Mexico. Haney et al. (2014) estimated that seabird densities over the open ocean were 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 Macondo spill provide relevant information about the species of marine birds that may be affected in the event of a large oil spill. Birds that have been treated for oiling include several pelagic species such as the Northern Gannet (*Morus bassanus*), Magnificent Frigatebird, and Masked Booby (*Sula dactylatra*) (U.S. Fish and Wildlife Service, 2011). The Northern Gannet was among the species with the largest numbers of birds affected by the spill. NOAA reports that at least 93 resident and migratory bird species across all five Gulf Coast states were exposed to oil from the Macondo spill in multiple habitats, including offshore/open waters, island waterbird colonies, barrier islands, beaches, bays, and marshes (NOAA, 2016a). 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 from 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, 2016a). Additionally, oiled birds could return to their nests and contaminate juveniles or eggs. It is expected that impacts to marine birds from a large oil spill resulting in the death of individual birds would be adverse but not significant at population levels.

C.4.2 Coastal Birds

Threatened and endangered bird species (Piping Plover and Whooping Crane) have been discussed previously in **Sections C.3.5** and **C.3.6**. The Brown Pelican was delisted from federal Endangered status in 2009 (U.S. Fish and Wildlife Service, 2016b) 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 (State of Louisiana Department of Wildlife and Fisheries, 2005) 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, indicate that Brown Pelicans do not occur in deep offshore waters (Fritts and Reynolds, 1981; Davis and Fargion, 1996; Davis et al., 2000). Nearly half the southeastern population of Brown Pelicans lives in the northern Gulf Coast, generally nesting on protected islands (U.S. Fish and Wildlife Service, 2010b).

The Bald Eagle was delisted from its federal Threatened status in the lower 48 states on June 28, 2007 but still receives protection under the Migratory Bird Treaty Act of 1918 and the Bald and Golden Eagle Protection Act of 1940 (U.S. Fish and Wildlife Service, 2015). The Bald Eagle is a terrestrial raptor widely distributed across the southern U.S., including coastal habitats along the Gulf of Mexico. The Gulf Coast is inhabited by both wintering migrant and resident Bald Eagles (Johnsgard, 1990; Ehrlich et al., 1992).

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 breed on beaches, flats, dunes, bars, barrier islands, and similar habitats include the Sandwich Tern, Wilson's Plover (*Charadrius wilsonia*), Black Skimmer (*Rynchops niger*), Forster's Tern (*Sterna forsteri*), Gull-Billed Tern (*Gelochelidon nilotica*), Laughing Gull, Least Tern, and Royal Tern (U.S. Fish and Wildlife Service, 2010b). Additional information is presented by BOEM (2012a; 2017a).

IPFs that could affect coastal birds include support vessel and helicopter traffic and a large oil spill. A small fuel spill in the project area would be unlikely to affect shorebirds or coastal nesting birds due to the project area's distance from the nearest shoreline. As explained in **Section A.9.1**, a small fuel spill would not be expected to make landfall or reach coastal waters prior to natural dispersion. Compliance with NTL BSEE-2015-G03 (**Table 1**) will reduce the potential for marine debris-related impacts on shorebirds. The IPFs with potential impacts listed in **Table 2** are discussed below.

Impacts of Support Vessel and Helicopter Traffic

Vessels may transit coastal areas near Port Fourchon, Louisiana. These activities could periodically disturb individuals or groups of birds within sensitive coastal habitats (e.g., wetlands that may support feeding, resting, or breeding birds).

Vessel traffic may disturb some foraging and resting birds. The disturbances will be limited to flushing birds away from vessel pathways. Flushing distances vary among species and individuals (Rodgers and Schwikert, 2002; Schwemmer et al., 2011). 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 an outboard-powered boat (Rodgers and Schwikert, 2002). The MODU will not approach nesting or breeding areas on the shoreline, so disturbance to nesting birds, eggs, and chicks is not expected. Vessel operators will use designated navigation channels and comply with posted speed and wake restrictions while transiting sensitive inland waterways. Because of the limited scope and short duration of drilling activities, any short-term impacts are not expected to be biologically significant to coastal bird populations.

Aircraft traffic can cause some disturbance to birds onshore and offshore. Responses are highly dependent on the type of aircraft, bird species, activities that animals were previously engaged in, and previous exposures to overflights (Efroymson et al., 2000). Helicopters seem to cause the most intense responses when compared with other anthropogenic disturbances for some species (Bélanger and Bédard, 1989). 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 (Efroymson et al., 2000). With adherence to the Federal Aviation Administration guidelines, it is likely that individual birds would experience, at most, only short-term behavioral disruption from aircraft traffic.

Impacts of Large Oil Spill

Based on the 30-day OSRA modeling (**Table 3**), coastal areas are unlikely to be affected within 3 or 10 days of a spill (<0.5% conditional probability). Coastal areas between Calhoun County, Texas and Plaquemines Parish, Louisiana may be affected within 30 days of a spill, however the likelihood is low (1 to 2% conditional probability). Based on the 60-day OSRA modeling estimates (**Table 4**), the potential for shoreline contact ranges from Cameron County, Texas to Bay County, Florida within 60 days of a spill (up to 13% conditional probability).

Coastal birds can be exposed to oil as they float on the water's surface, dive during foraging, or wade in oiled coastal waters. Oiled birds can lose the ability to fly, dive for food, or float on the water, which could lead to drowning (U.S. Fish and Wildlife Service, 2010a). Oil interferes with the water repellency of feathers and can cause hypothermia in the right conditions. As birds groom themselves, they can ingest and inhale the oil on their bodies. Scavengers such as Bald Eagles and gulls can be exposed to oil by feeding on carcasses of oiled fish and wildlife. While ingestion can kill animals immediately, more often it results in lung, liver, and kidney damage, which can lead to death (BOEM, 2017a). Bird eggs may be harmed if an oiled adult sits on the nest.

Data from the Macondo spill provide an indication of the potential impacts of a large spill on coastal bird populations. According to NOAA (2016a), 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, 2016a). Species with the largest numbers of estimated mortalities were American White Pelican (*Pelecanus erythrorhynchos*), Black Skimmer, Black Tern (*Chlidonias niger*), Brown Pelican, Laughing Gull, Least Tern, Northern Gannet, and Royal Tern (NOAA, 2016a).

Brown Pelicans are especially at risk from direct and indirect impacts from spilled oil within inner shelf and inshore waters, such as embayments. The range of this species is generally limited to these waters and surrounding coastal habitats. Brown Pelicans feed on mid-size fish that they capture by diving from above ("plunge diving") and then scooping the fish into their expandable gular pouch. This behavior makes them susceptible to plumage oiling if they feed in areas with surface oil or an oil sheen. They may also capture prey that has been physically contaminated with oil or has ingested oil. Issues for Brown Pelicans include direct contact with oil, disturbance from cleanup activities, and long-term habitat contamination (BOEM, 2012a).

The Bald Eagle also may be especially at risk from direct and indirect impacts from spilled oil. This species often captures fish within shallow water areas (snatching prey from the surface or wading into shallow areas to capture prey with their bill) and so may be susceptible to plumage oiling and, as with the Brown Pelican, they may also capture prey that has been physically contaminated with oil or has ingested oil (BOEM, 2012a).

It is expected that impacts to coastal birds from a large oil spill resulting in the death of individual birds would be adverse but not significant at population levels.

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 mid-water fauna to characterize vertical distribution of mesopelagic fishes in deepwater areas of the Gulf of Mexico revealed high species richness, but the community was dominated by relatively few families and species.

IPFs that could affect pelagic communities and ichthyoplankton include MODU presence, noise, and lights; effluent discharges; seawater intake; and two types of accidents (a small fuel spill and a large oil spill). The IPFs with potential impacts listed in **Table 2** are discussed below.

Impacts of MODU Presence, Noise, and Lights

The MODU, as a floating structure in the deepwater environment, will act as fish-aggregating devices (FADs). In oceanic waters, the FAD effect would be most pronounced for epipelagic fishes such as tunas, dolphinfish (*Coryphaena hippurus*), billfishes, and jacks, which are commonly attracted to fixed and drifting structures (Higashi, 1994; Relini et al., 1994; Holand, 1997). 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 fishes. Noise could potentially cause 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 they apply only to species of fish with swim bladders that provide some hearing (pressure detection) function.

Popper et al. (2014) estimated sound exposure level 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 (Hawkins and Popper, 2014). Noise may also influence fish behaviors, such as predator-avoidance, foraging, reproduction, and intraspecific interactions (Picciulin et al., 2010; Bruintjes and Radford, 2013; McLaughlin and Kunc, 2015; Nedelec et al., 2017). Fish aggregating is likely to occur to some degree due to the presence of the MODU, but the impacts would be limited in geographic scope and no population level impacts are expected.

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 sound exposure levels of 206 dB re 1 μPa^2 s but resulted in no increased mortality between the exposure and control groups. Non-impulsive noise sources (such as drilling operations) are expected to be far less injurious than impulsive noise. Based on transmission loss calculations (see Urick, 1983a), open water propagation of noise produced by typical sources with DP thrusters in use during drilling, are not expected to produce root-mean-square sound pressure levels greater than 160 dB re 1 µPa beyond 32 m from the source. Because of the limited propagation distances of high sound pressure levels and the periodic and transient nature of ichthyoplankton, no impacts to these life stages are expected.

Impacts of Effluent Discharges

Discharges of treated WBM- and SBM-associated cuttings will produce temporary, localized increases in suspended solids in the water column around the drilling rig. 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). All NPDES permit limits and requirements will be met for these types of discharges.

WBM and cuttings will also be released at the seafloor during the initial well intervals, before the marine riser is set that allows their return to the surface vessel. Excess cement slurry and blowout preventer fluid will also be released at the seafloor. These discharges could smother or cover benthic communities in the vicinity of the discharge location. Impacts will be limited to the immediate area of the discharge, with little to no impact to fisheries resources.

Treated sanitary, domestic wastes, water-based bentonite gel, and guar gel will have little or no impact on the pelagic environment in the immediate vicinity of these discharges. These wastes may have elevated levels of nutrients, organic matter, and chlorine, but should dilute rapidly to undetectable levels within tens to hundreds of meters from the source. As a result of quick dilution, minimal impacts on water quality, plankton, and nekton are anticipated.

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

Other effluent discharges in accordance with the NPDES permit, such as desalination unit brine, uncontaminated ballast water, uncontaminated water from testing of the firewater system, and non-contact cooling water, are expected to dilute rapidly and have little or no potential for impact on water column biota.

Impacts of Seawater Intake

Seawater will be drawn from the ocean for once-through, non-contact cooling of machinery on the MODU. The MODU used for this project will be in compliance with all cooling water intake requirements of the NPDES permit to comply with Section 316(b) of the Clean Water Act.

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 the cooling intake structure to the discharge structure and mechanical damage (turbulence in pumps and condensers). Because of the limited scope and short duration of drilling activities, any short-term impacts of entrainment are not expected to be biologically significant to plankton or ichthyoplankton populations (BOEM, 2017a).

Impacts of a Small Diesel Fuel Spill

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

Section A.9.1 discusses the size and fate of a potential small diesel fuel spill as a result of Anadarko's proposed activities. 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 could have localized impacts (i.e., hydrocarbon contamination) on phytoplankton, zooplankton, ichthyoplankton, and nekton. Because of the limited areal extent, short duration of water quality impacts, and patchy presence of these groups, a small diesel 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 (2017a; c). For this EP, there are no unique site-specific issues.

A large oil spill could directly affect water column biota including phytoplankton, zooplankton, ichthyoplankton, and nekton. A large spill that persisted for weeks or months would be more likely to affect these communities. While adult and juvenile fishes may actively avoid a large spill, planktonic eggs and larvae would be unable to avoid contact. Eggs and larvae of fishes are especially vulnerable to oiling because they inhabit the upper layers of the water column, and they will die if exposed to certain toxic fractions of spilled oil. 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 shelf concentrations peak (BOEM, 2016b). Adult and juvenile fishes could also be impacted through the ingestion of oiled prey. It is expected that impacts to pelagic communities and ichthyoplankton from a large oil spill resulting in the death of individual fishes would be adverse but not significant at population levels.

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 located approximately 117 miles (188 km) from the project area.

Highly migratory pelagic fishes, which occur as transients in the project area, are the only remaining group for which EFH has been identified in the deepwater Gulf of Mexico. Species in this group, including tunas, swordfishes, billfishes, and sharks, are managed by NMFS. Highly migratory species with EFH at or near the project area include the following (NMFS, 2009b):

- Atlantic bluefin tuna (*Thunnus thynnus*) (spawning, eggs, larvae, adults)
- Bigeye thresher shark (*Alopias superciliosus*) (all)
- Bigeye tuna (*Thunnus obesus*) (adults)
- Blue marlin (*Makaira nigricans*) (juveniles, adults)
- Longbill spearfish (*Tetrapturus pfluegeri*) (juveniles, adults)
- Longfin mako shark (*Isurus paucus*) (all)
- Oceanic whitetip shark (all)
- Skipjack tuna (*Katsuwonus pelamis*) (spawning, adults Swordfish (*Xiphias gladius*) (larvae, juveniles, adults)
- Tiger shark (*Galeocerdo cuvier*) (adults)
- White marlin (*Kajikia albidus*) (juveniles, adults)
- Yellowfin tuna (*Thunnus albacares*) (spawning, juveniles, adults)

Research indicates that the central and western Gulf of Mexico may be important spawning habitat for Atlantic bluefin tuna, 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 4**). 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).

An amendment to the original EFH Generic Amendment was finalized in 2005 (Gulf of Mexico Fishery Management Council, 2005). One of the most significant changes in this amendment reduced the extent of EFH relative to the 1998 Generic Amendment by removing the EFH description and identification from waters between 100 fathoms and the seaward limit of the Exclusive Economic Zone (EEZ). The Highly Migratory Species Fisheries Management Plan was amended in 2009 to update EFH and HAPC to include the bluefin tuna spawning area (NMFS, 2009b).

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 to 2022 WPA/CPA Multisale EIS (BOEM, 2017a). The necessary components of the EFH consultation were completed and there is ongoing coordination among NMFS, BOEM, and BSEE, including discussions of mitigation (BOEM, 2016c).

Other HAPCs have been identified in the Gulf of Mexico by the (Gulf of Mexico Fishery Management Council, 2005). These include the Florida Middle Grounds, Madison-Swanson Marine Reserve, Tortugas North and South Ecological Reserves, Pulley Ridge, and several other reefs and banks of the northwestern Gulf of Mexico (listed as reefs and banks on **Figure 3**). The nearest HAPC is Rezak Sidner Bank, which is located approximately 126 miles (203 km) from the project area.

IPFs that could affect EFH include MODU presence, noise, and lights; effluent discharges; seawater intake; and two types of accidents (a small fuel spill and a large oil spill). The IPFs with potential impacts listed in **Table 2** are discussed below.

Impacts MODU Presence, Noise, and Lights

The MODU, as floating structure in the deepwater environment, will act as a FAD. In oceanic waters, the FAD effect would be most pronounced for epipelagic fishes such as tunas, dolphinfish, billfishes, and jacks, which are commonly attracted to fixed and drifting surface structures (Holland, 1990; Higashi, 1994; Relini et al., 1994). The FAD effect would possibly enhance feeding of epipelagic predators by attracting and concentrating smaller fish species.

Vessel noise could potentially cause acoustic masking for fishes, thereby reducing their ability to hear biologically relevant sounds (Radford et al., 2014). Noise may also influence fish behaviors such as predator avoidance, foraging, reproduction, and intraspecific interactions (Picciulin et al., 2010; Bruintjes and Radford, 2013; McLaughlin and Kunc, 2015; Nedelec et al., 2017). Further discussion on impact to fish from sound and injury criteria are discussed in **Section C.5.1**. Because the project activities are temporary and high sound pressure levels from the drilling activities have short propagation distances, any impacts to EFH for highly migratory pelagic fishes are biologically insignificant.

Impacts of Effluent Discharges

Effluent discharges affecting EFH by diminishing ambient water quality include drilling muds and cuttings, excess cement, treated sanitary and domestic wastes, deck drainage, non-pollutant completion fluid, and miscellaneous discharges such as desalination unit brine, uncontaminated cooling water, fire water, and bilge and ballast water. Impacts on water quality have been discussed previously. No significant impacts on EFH for highly migratory pelagic fishes are expected from these discharges.

Impacts of Seawater Intake

As noted previously, cooling water intake will entrain and impinge plankton, including fish eggs and larvae (ichthyoplankton). Because of the limited scope and short duration of drilling activities, any short-term impacts on EFH for highly migratory pelagic fishes due to water intake are not expected to be biologically significant if operated in compliance with USEPA requirements. No significant impacts on EFH for highly migratory pelagic fishes are expected from these discharges if discharged according to NPDES permit conditions.

Impacts of a Small Diesel Fuel Spill

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

Section A.9.1 discusses the size and fate of a potential small diesel fuel spill as a result of Anadarko's proposed activities. EP Section H 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 diesel fuel spill could have localized impacts on EFH for highly migratory pelagic fishes, including tunas, swordfishes, billfishes, and sharks. These species occur as transients in the project area. A spill would also produce a 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.

A small diesel fuel spill would not affect EFH for corals and coral reefs, the nearest of which is located approximately 117 miles (188 km) from the project area. A small diesel fuel spill would float and dissipate on the sea surface and would not contact these seafloor features.

Impacts of a Large Oil Spill

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

An oil spill in offshore waters would temporarily increase hydrocarbon concentrations on the water surface and potentially in the subsurface as well. Given the extent of EFH designations in the Gulf of Mexico (Gulf of Mexico Fishery Management Council, 2005; National Marine Fisheries Service, 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, 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 by increasing hydrocarbon concentrations in the water column, with the potential for lethal or sublethal impacts on spawning tuna. Potential impacts would depend in part on the timing of a spill, as this species migrates to the Gulf of Mexico to spawn in April, May, and June (NMFS, 2009b).

The nearest area designated as EFH for corals is approximately 117 miles (188 km) from the project area. An accidental spill could reach or affect this feature, although near-bottom currents in the region are expected to flow along the isobaths (Nowlin et al., 2001; Valentine et al., 2014) and typically would not carry a plume up onto the continental shelf edge.

C.6 Archaeological Resources

C.6.1 Shipwreck Sites

Based on NTL 2011-JOINT-G01, WR 881 and 925 are not on BOEM's list of archaeology survey blocks (BOEM, 2011), and water depth at the proposed wellsites is well beyond the 197 ft (60 m) depth contour used by BOEM as the seaward extent for prehistoric archaeological site potential in the Gulf of Mexico. The site clearance letters for the proposed wellsites noted no sonar contacts recommended for avoidance based on archaeological potential (Ocean Geo Solutions, 2019a; b; c; d; e; f).

A large oil spill is the only IPF considered. A small fuel spill would not affect shipwrecks because the oil would float and dissipate on the sea surface. The IPFs with potential impacts listed in **Table 2** are discussed below.

Impacts of a Large Oil Spill

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

Beyond the seafloor blowout radius, there is the potential for impacts from oil, dispersants, and depleted oxygen levels (BOEM, 2017a). These impacts could include chemical contamination as well as alteration of the rates of microbial activity (BOEM, 2017a). Additionally, the shipwreck-associated sediment microbiomes may also be impacted (i.e., reduced biodiversity) (Hamdan et al., 2018). During the Macondo spill, subsurface plumes were reported at a water depth of approximately 3,609 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, 2011c). While the behavior and impacts of subsurface plumes are not well known, a subsurface plume could have the potential to contact shipwreck sites beyond the 984 ft (300 m) radius estimated by BOEM (2012a), depending on its extent, trajectory, and persistence (Spier et al., 2013). If oil from a subsea spill should come into contact with wooden shipwrecks on the seafloor, it could adversely affect their condition or preservation. Should there be any indication that potential shipwreck sites could be affected, in accordance with NTL 2005-G07, Anadarko will immediately halt operations, take steps to ensure that the site is not disturbed, and contact the Regional Supervisor, Leasing and Environment, within 48 hours of its discovery. Anadarko would cease all operations within 1,000 ft (305 m) of the site until the Regional Supervisor provides instructions on steps to take to assess the site's potential historic significance and protect it.

A spill entering shallow coastal waters could conceivably contaminate an undiscovered shipwreck site. Based on the 30-day OSRA modeling (**Table 3**), coastal areas are unlikely to be affected within 3 or 10 days of a spill (<0.5% conditional probability). Coastal areas between Calhoun County, Texas and Plaquemines Parish, Louisiana may be affected within 30 days of a spill, however the likelihood is low (1 to 2% conditional probability). Based on the 60-day OSRA modeling estimates (**Table 4**), the potential for shoreline contact ranges from Cameron County, Texas to Bay County, Florida within 60 days of a spill (up to 13% conditional probability). If an oil spill contacted a coastal historic site, such as a fort or a lighthouse, the impacts may be temporary and reversible (BOEM, 2017a).

C.6.2 Prehistoric Archaeological Sites

Prehistoric archaeological sites are not expected in the project area. With water depths at the proposed wellsites ranging from approximately 7,560 to 7,815 ft (2,304 to 2,382 m), the project area is well beyond the 197 ft (60 m) depth contour used by BOEM as the seaward extent for prehistoric archaeological site potential in the Gulf of Mexico. Based on this, the only IPF associated with activities in the project area that could affect prehistoric archaeological sites is a large oil spill. A small diesel fuel spill would not affect prehistoric archaeological resources because the oil would float and dissipate on the sea surface. The IPFs with potential impacts listed in **Table 2** are discussed below.

Impacts of a Large Oil Spill

Because of the water depth and the lack of prehistoric archaeological sites found in the project area, it is highly unlikely that any such resources would be affected by the physical effects of a subsea blowout, which are limited to an estimated radius of 984 ft (300 m) (BOEM, 2012a).

Along the northern Gulf Coast, prehistoric sites occur frequently along the barrier islands and mainland coast and along the margins of bays and bayous (BOEM, 2012b). Based on the 30-day OSRA modeling (**Table 3**), coastal areas are unlikely to be affected within 3 or 10 days of a spill (<0.5% conditional probability). Coastal areas between Calhoun County, Texas and Plaquemines Parish, Louisiana may be affected within 30 days of a spill, however the likelihood is low (1 to 2% conditional probability). Based on the 60-day OSRA modeling estimates (**Table 4**), the potential for shoreline contact ranges from Cameron County, Texas to Bay County, Florida within 60 days of a spill (up to 13% conditional probability).

If a spill did reach a prehistoric site along these shorelines, it could coat fragile artifacts or site features and compromise the potential for radiocarbon dating organic materials in a site. Coastal prehistoric sites also could be damaged by spill cleanup operations (e.g., by destroying fragile artifacts and disturbing the provenance of artifacts and site features). BOEM (2017d) notes that some unavoidable direct and indirect impacts on coastal historic resources could occur, resulting in the loss of information.

C.7 Coastal Habitats and Protected Areas

Coastal habitats in the northeastern Gulf of Mexico that may be affected by oil and gas activities are described by BOEM (2016a; 2017a; c) and are tabulated in the OSRP. Coastal habitats inshore of the project area include coastal and barrier island beaches and dunes, wetlands, oyster reefs, and submerged seagrass beds. Most of the northeastern Gulf of Mexico is fringed by coastal and barrier island beaches, with wetlands, oyster reefs, and submerged seagrass beds occurring in sheltered areas behind the barrier islands and in estuaries.

Because of the distance from shore, the only IPF associated with routine activities in the project area that could affect beaches and dunes, wetlands, oyster reefs, seagrass beds, coastal wildlife refuges, wilderness areas, or any other managed or protected coastal area is support vessel traffic. The support base at Port Fourchon, Louisiana, is not located within a wildlife refuge or wilderness area. Potential impacts of vessel traffic are briefly addressed below.

A large oil spill is the only accidental IPF that could affect coastal habitats and protected areas. A small diesel fuel spill in the project area would be unlikely to affect coastal habitats because the project area is 211 miles (340 km) from the nearest shoreline. As explained in **Section A.9.1**, a small diesel fuel spill would not be expected to make landfall or reach coastal waters prior to natural dispersion. The IPFs with potential impacts listed in **Table 2** are discussed below.

Impacts of Support Vessel Traffic

Support operations are detailed in EP Section G. For OCS activities in general, vessel operations may have a minor incremental impact on coastal and barrier island beaches, wetlands, oyster reefs, and protected areas. Vessel wakes produced by heavy vessel traffic can, over time, erode shorelines along inlets, channels, and harbors, resulting in localized land loss. Impacts to beaches, wetlands, oyster reefs, and protected areas will be minimized by following the speed and wake restrictions in harbors and channels.

Operations of the MODU is not anticipated to have a significant impact on submerged seagrass beds. While submerged seagrass beds have the potential to be uprooted, scarred, or lost due to direct contact from vessels, use of navigation channels and adherence to local requirements and implemented programs will decrease the likelihood of impacts to submerged seagrass beds BOEM (2017a; c)

Impacts of a Large Oil Spill

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

Based on the 30-day OSRA modeling (**Table 3**), coastal areas are unlikely to be affected within 3 or 10 days of a spill (<0.5% conditional probability). Coastal areas between Calhoun County, Texas and Plaquemines Parish, Louisiana may be affected within 30 days of a spill, however the likelihood is low (1 to 2% conditional probability). Based on the 60-day OSRA modeling estimates (**Table 4**), the potential for shoreline contact ranges from Cameron County, Texas to Bay County, Florida within 60 days of a spill (up to 13% conditional probability). The shorelines within the geographic range predicted by the 60-day OSRA modeling (**Table 4**) include extensive barrier beaches and wetlands, with submerged seagrass beds occurring in sheltered areas behind the barrier islands and in estuaries. NWRs and other protected areas along the coast are discussed by BOEM (2017a) and Anadarko's OSRP. Based on the 30-day OSRA, coastal and near-coastal wildlife refuges, wilderness areas, and state and national parks within the geographic range of the potential shoreline contacts within 30 days are presented in **Table 7**.

Table 7. Wildlife refuges, wilderness areas, and state and national parks and preserves within the geographic range of 1% or greater conditional probability of shoreline contacts within 30 days of a hypothetical spill from Launch Point C049 based on the 30-day Oil Spill Risk Analysis (OSRA) model.

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

The level of potential impacts from oil spills on coastal habitats depends on many factors, including oil characteristics, the geographic location of the landfall, and the weather and oceanographic conditions during 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 could be significantly affected because of the inherent toxicity of hydrocarbon and non-hydrocarbon components of the spilled substances (Beazley et al., 2012; Lin and Mendelssohn, 2012; 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 Macondo spill, Silliman et al. (2012) reported that vegetation in previously healthy marshes largely recovered to a pre-oiling state within 18 months. At 103 salt marsh locations that spanned 267 miles (430 km) of shoreline in Louisiana, Mississippi, and Alabama, Silliman et al. (2016) determined a threshold for oil impacts on marsh edge erosion with higher erosion rates occurring for approximately 1 to 2 years after the *Deepwater Horizon* spill at sites with the highest amounts of plant stem oiling (90% to 100%). Thus, displaying a large-scale ecosystem loss. In addition to the direct impacts of oil, cleanup activities in marshes may accelerate erosion rates and retard recovery rates (BOEM, 2017a). Impacts associated with an extensive oiling of coastal wetland habitat from a large oil spill are expected to be significant.

A review of studies by BOEM (2012a) determined that effects of oil on marsh vegetation depend on the type of oil, the type of vegetation, and environmental factors of the area. Impacts to slightly oiled vegetation are considered short term and reversible, as recent studies suggest that they will experience plant die-back followed by recovery without replanting (BOEM, 2012a). Vegetation coated with oil experiences the highest mortality rates due to decreased photosynthesis (BOEM, 2012a). A review of the literature 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).

C.8 Socioeconomic and Other Resources

C.8.1 Recreational and Commercial Fishing

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

It is unlikely that any commercial fishing activity other than longlining will occur at or near the project area due to the water depth (7,560 to 7,815 ft [2,304 to 2,382 m]). Benthic species targeted by commercial fishers occur on the upper continental slope, well inshore of the project area. Royal red shrimp (*Pleoticus robustus*) are caught by trawlers in water depths of approximately 820 to 1,804 ft (250 to 550 m) (Stiles et al., 2007). Tilefishes (primarily *Lopholatilus chamaeleonticeps*) are caught by bottom longlining in water depths from approximately 540 to 1,476 ft (165 to 450 m) (Continental Shelf Associates, 2002) .

Most recreational fishing activity in the region occurs in water depths less than 656 ft (200 m) (Continental Shelf Associates, 1997; 2002; Keithly and Roberts, 2017). In deeper water, the main attraction to recreational fishers is petroleum rigs offshore Texas and Louisiana. Due to the project site's distance from shore, it is unlikely that recreational fishing activity is occurring in the area.

The only routine IPF that could affect fisheries and, therefore, commercial and recreational fishing, is MODU presence, noise, and lights. Two potential accident IPFs that could affect fisheries are a small diesel fuel spill and a large oil spill. Other factors such as effluent discharges are likely to have negligible impacts on commercial or recreational fisheries because of rapid dispersion, the small area of ocean affected, and the intermittent nature of the discharges. The IPFs with potential impacts listed in **Table 2** are discussed below.

Impacts of MODU Presence, Noise, and Lights

There is a slight possibility of pelagic longlines becoming entangled with an offshore vessel. 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.

Because it is unlikely that any recreational fishing activity is occurring in the project area, no adverse impacts are anticipated.

Impacts of a Small Fuel Spill

Pelagic longlining activities in the project area, if any, could be interrupted in the event of a small diesel fuel spill. Fishing activities could be interrupted due to the activities of response vessels operating in the project area. Given the open ocean location of the project area, the duration of a small spill, the window of opportunity for impacts to occur is expected to be very small. **EP Section H** provides detail on spill response measures.

Impacts of a Large Oil Spill

Potential spill impacts on fishing activities are discussed by BOEM (2017a). For this EP, there are no unique site-specific issues with respect to this activity.

Pelagic longlining activities in the project area and other fishing activities in the northern Gulf of Mexico could be interrupted in the event of a large oil spill. A spill may or may not result in fishery closures, depending on the duration of the spill, the oceanographic and meteorological conditions at the time, and the effectiveness of spill response measures. Data from the Macondo spill 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 EEZ. BOEM (2012a) notes that fisheries closures from a large spill event could have a negative effect on short-term fisheries catch and marketability.

According to BOEM (2012a; 2017a; c), 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 commercially valuable fish species in the Gulf of Mexico have planktonic eggs or larvae which may be affected by a large oil spill in deep water (BOEM, 2017a). The probability of an offshore spill affecting these nearshore environments is also low. Should a large oil spill occur, economic impacts on commercial and recreational fishing activities would likely occur, but are difficult to predict because impacts would differ by fishery and season (BOEM, 2017a; c). An analysis of the effects of the Macondo spill 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).

C.8.2 Public Health and Safety

A large oil spill is the only accidental IPF that could affect public health and safety. A small diesel fuel spill in the project area would not have any impacts on public health and safety because it would affect only a small area of the open ocean, 211 miles (340 km) from the nearest shoreline, and nearly all of the diesel fuel would evaporate or disperse naturally within 24 hours (see **Section A.9.1**). The IPFs with potential impacts listed in **Table 2** are discussed below.

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 Anadarko's OSRP and the MODU's emergency response plans.

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, including skin contact or breathing VOCs. Oil is a highly flammable material; any smoke or vapors from an oil fire can cause irritation, and in large quantities may pose a health hazard.

Studies conducted after the Macondo spill provide relevant information about the types of health issues that may occur in the event of a large oil spill. Wildlife cleaning and rehabilitation workers have reported concerns including scrapes and cuts, itchy or red skin or rash, and symptoms of headache or feeling faint, dizzy, or fatigued (King and Gibbins, 2011). Hand, shoulder, or back pain was also reported by some wildlife-cleaning workers as well. Awkward postures, repetitive motions, and heavy lifting tasks were noted by investigators as contributing to musculoskeletal symptoms. Personnel working on offshore vessels or providing direct oversight to offshore vessels, including USCG personnel, civilian contractors, and other responders who were exposed to oil and dispersants, had a 7 to 12 times higher prevalence of upper respiratory symptoms and cough than those not exposed (Centers for Disease Control and Prevention, 2010). Another potential occupational hazard for spill response workers in general was heat stress from work in a hot and humid environment (King and Gibbins, 2011). Initial symptoms from cleanup workers who sought medical care in Louisiana were typical of acute exposure to hydrocarbons or H_2S (e.g., headaches, dizziness, nausea, vomiting, cough, respiratory distress, and chest pain) (Solomon and Janssen, 2010). Impacts associated with a large oil spill to public safety are expected to be adverse but not significant.

C.8.3 Employment and Infrastructure

There are no IPFs associated with routine drilling activities that are expected to affect employment and infrastructure. The project involves support from contractors and associated third-party services, and existing shorebase facilities in Port Fourchon, 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 negligible impacts on socioeconomic conditions such as local employment and existing offshore and coastal infrastructure. A large oil spill is the only accidental IPF that could affect employment and infrastructure. 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. The IPFs with potential impacts listed in **Table 2** are discussed below.

Impacts of a Large Oil Spill

Potential socioeconomic impacts of an oil spill are discussed by BOEM (2017a; c). For this EP, there are no unique site-specific issues with respect to employment and coastal infrastructure. A large spill could cause economic impacts in several ways: it could result in extensive fishery closures that put fishermen out of work; it could result in temporary employment as part of the response effort; it could result in adverse publicity that affects employment in coastal recreation and tourism industries; and it could result in suspension of OCS drilling activities, including service and support operations that are an important part of local economies.

In addition to the analyses presented by BOEM (2012a), a study explored the economic impacts of the Macondo spill on oil and gas industry employment due to suspension of deepwater drilling (U.S. Department of Commerce, 2010). The study indicates that during the moratorium, the number of oil industry workers in the Gulf of Mexico fell by approximately 2,000 and may have indirectly caused a temporary loss of 8,000 to 12,000 jobs along the Gulf Coast. The total spending by drilling operators is estimated to have declined by US$1.8 billion over a 6-month period; this direct reduction in spending affected employment in the industries that supply the Gulf drilling industry and in all other industries affected by declines in consumer and business spending (U.S. Department of Commerce, 2010).

As noted by BOEM (2012a), the potential short-term social and economic consequences for the Gulf Coast region should a large spill occur include the opportunity cost of employment and expenditures that could have gone to production or consumption rather the spill cleanup efforts. Nonmarket effects such as traffic congestion, strains on public services, shortages of commodities or services, and disruptions to the normal patterns of activities or expectations could also occur in the short term. These negative, short-term social and economic consequences of a spill are expected to be modest in terms of projected cleanup expenditures and the number of people employed in cleanup and remediation activities (BOEM, 2017a). Net employment impacts from a spill would not be expected to exceed 1% of baseline employment in any given year (BOEM, 2017a).

C.8.4 Recreation and Tourism

For this EP, there are no unique site-specific issues with respect to this recreation and tourism. There are no known recreational uses of the project area. Recreational resources and tourism in coastal areas would not be affected by any routine activities due to the distance from shore.

Compliance with NTL BSEE-2015-G03 (**Table 1**) will minimize the chance of trash or debris being lost overboard from the MODU and subsequently washing up on beaches.

A large oil spill is the only accidental IPF that could affect recreation and tourism. A small diesel fuel spill in the project area would be unlikely to affect recreation and tourism because, as explained in **Section A.9.1**, it would not be expected to make landfall or reach coastal waters prior to breaking up. The IPFs with potential impacts listed in **Table 2** are discussed below.

Impacts of a Large Oil Spill

Potential impacts of an oil spill on recreation and tourism are discussed by BOEM (2017a; c). For this EP, there are no unique site-specific issues with respect to these impacts.

Impacts on recreation and tourism would vary depending on the duration of the spill and its fate including the effectiveness of response measures. A large spill that reached coastal waters and shorelines could adversely affect recreation and tourism by contaminating beaches and wetlands, resulting in negative publicity that encourages people to stay away.

Based on the 30-day OSRA modeling (**Table 3**), coastal areas are unlikely to be affected within 3 or 10 days of a spill (<0.5% conditional probability). Coastal areas between Calhoun County, Texas and Plaquemines Parish, Louisiana may be affected within 30 days of a spill, however the likelihood is low (1 to 2% conditional probability). Based on the 60-day OSRA modeling estimates (**Table 4**), the potential for shoreline contact ranges from Cameron County, Texas to Bay County, Florida within 60 days of a spill (up to 13% conditional probability).

According to BOEM (2017a), should an oil spill occur and contact a beach area or other recreational resource, it would cause some disruption during the impact and cleanup phases of the spill. However, these effects are also likely to be small in scale and of short duration, in part because the probability of an offshore spill contacting most beaches is small. In the unlikely event that a spill occurs that is sufficiently large to affect 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 Macondo spill on recreation and tourism provide some insight into the potential effects of a large spill. NOAA (2016a) 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 Macondo spill 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).

C.8.5 Land Use

Land use along the northern Gulf Coast is discussed by BOEM (2017a). There are no routine IPFs that could affect land use. The project will use existing onshore support facilities in Port Fourchon, Louisiana. The land use at the existing shorebase sites is industrial. The project will not involve any new construction or changes to existing land use and therefore will not have any impacts. Levels of boat 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 IPF. A small diesel fuel spill would not have any impacts on land use, as the response would be staged out of existing shorebases and facilities. The IPFs with potential impacts listed in **Table 2** are discussed below.

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 Macondo spill, temporary staging areas were established in Louisiana, Mississippi, Alabama, and Florida for spill response and cleanup efforts. 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 accidental oil spill is not likely to significantly affect land use and coastal infrastructure in the region, in part because an offshore spill would have a small probability of contacting onshore resources. BOEM (2016b) states that landfill capacity would probably not be an issue at any phase of an oil spill event or the long-term recovery. In the case of the Macondo spill and response, the USEPA reported that existing landfills receiving oil spill waste had plenty of 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).

C.8.6 Other Marine Uses

The project area is not located within any USCG-designated fairway, shipping lane, or Military Warning Area. Anadarko will comply with BOEM requirements and lease stipulations to avoid impacts to other marine uses.

There are no IPFs from routine project activities that are likely to affect other marine uses of the project area. A large oil spill is the only relevant accident-related IPF on other marine uses. A small diesel fuel spill would not have any impacts on other marine uses because spill response activities would be mainly within the project area and the duration would be brief. The IPFs with potential impacts listed in **Table 2** are discussed below.

Impacts of a Large Oil Spill

In the event of a large spill requiring numerous response vessels, coordination would be required to manage the vessel traffic for safe operations. Other OCS activities located nearby the location of a large spill may be temporarily interrupted, which could include evacuation of non-essential personnel. Anadarko will comply with BOEM requirements and lease stipulations to avoid impacts on uses of the area by military vessels and aircraft.

D. Environmental Hazards

D.1 Geologic Hazards

The proposed wellsites in Walker Ridge Blocks 881 and 925 are in a favorable location for the proposed activities, are situated along a relatively benign seafloor, and no seafloor or subsurface faults will be penetrated by the proposed wellsites (Ocean Geo Solutions, 2019a; b; c; d; e; f).See EP Section C for supporting geological and geophysical information.

D.2 Severe Weather

Under most circumstances, weather is not expected to have any effect on the proposed activities. Extreme weather, including high winds, strong currents, and large waves, was considered in the design criteria for the MODU that will be used for this project. High winds and limited visibility during a severe storm could disrupt support activities and make it necessary to suspend some activities and potentially evacuate the vessel for safety reasons until the storm or weather event passes. Evacuation in the event of a hurricane or other severe weather would increase the number and frequency of vessel trips to and from the project area.

D.3 Currents and Waves

Metocean conditions such as sea states, wind speed, and ocean currents will be continuously monitored. Under most circumstances, physical oceanographic conditions are not expected to have an effect on the proposed activities. Strong currents (e.g., caused by Loop Current eddies and intrusions) and large waves were considered in the design criteria for the MODU that will be used this project. High waves during a severe storm could disrupt support activities (i.e., vessel traffic) and make it necessary to suspend some activities on for safety reasons until the storm or weather event passes.

E. Alternatives

No formal alternatives were evaluated in the EIA for this EP. However, various technical and operational options were considered by Anadarko in developing the proposed action.

F. Mitigation Measures

The proposed action includes numerous mitigation measures required by laws, regulations, and BSEE and BOEM lease stipulations and NTLs. The project will comply with all applicable federal, state, and local requirements concerning air pollutant emissions, discharges to water, and solid waste disposal. All project activities will be conducted under guidance by Anadarko's OSRP and Safety and Environmental Management System. Additional information can be found in EP Section H.

G. Consultation

The EIA was prepared by CSA Ocean Sciences Inc. for Anadarko. No additional persons or agencies beyond those cited as Preparers (**Section H**) were consulted during the preparation of the EIA.

H. Preparers

The EIA was prepared by CSA Ocean Sciences Inc. Contributors included

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I. References

ABS Consulting Inc. 2016. 2016 Update of Occurrence Rates for Offshore Oil Spills. Prepared for the Bureau of Ocean Energy Management and the Bureau of Safety and Environmental Enforcement. Contract # E15PX00045, Deliverable 7. https://www.bsee.gov/sites/bsee.gov/files/osrr-oil-spill-response-research//1086aa.pdf.

Ackleh, A.S., G.E. Ioup, J.W. Ioup, B. Ma, J.J. Newcomb, N. Pal, N.A. Sidorovskaia, and C. Tiemann. 2012. Assessing the *Deepwater Horizon* oil spill impact on marine mammal population through acoustics: endangered sperm whales. Journal of the Acoustical Society of America 131(3): 2306-2314.

Anderson, C.M., M. Mayes, and R. LaBelle. 2012. Update of Occurence Rates for Offshore Oil Spills. U.S. Department of the Interior, Bureau of Ocean Energy Management and Bureau of Safety and Environmental Enforcement. OCS Report BOEM 2012-069, BSEE 2012-069.

Andrzejaczek, S., A.C. Gleiss, L.K.B. Jordan, C.B. Pattiaratchi, L.A. Howey, E.J. Brooks, and M.G. Meekan. 2018. Temperature and the vertical movements of oceanic whitetip sharks, *Carcharhinus longimanus*. Scientific Reports 8:8351.

Azzara, A.J., W.M. von Zharen, and J.J. Newcomb. 2013. Mixed-methods analytic approach for determining potential impacts of vessel noise on sperm whale click behavior. Journal of the Acoustical Society of America 134(6): 4566-4574.

Baguley, J.G., P.A. Montagna, C. Cooksey, J.L. Hyland, H.W. Bang, C.L. Morrison, A. Kamikawa, P. Bennetts, G. Saiyo, E. Parsons, M. Herdener, and M. Ricci. 2015. Community Response of Deep-sea Soft sediment Metazoan Meiofauna to the *Deepwater Horizon* Blowout and Oil Spill. Marine Ecology Progress Series 528: 127-140.

Barkaszi, M.J., M. Butler, R. Compton, A. Unietis, and B. Bennett. 2012. Seismic survey mitigation measures and marine mammal observer reports. New Orleans, LA. OCS Study BOEM 2012-015.

Barkaszi, M.J. and C.J. Kelly. 2018. (In Press). Seismic Survey mitigation Measures and Protected Species Observer Reports: Synthesis Reports. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study BOEM 2018-XXX. 141 pp + apps.

Barkuloo, J.M. 1988. Report on the Conservation Status of the Gulf of Mexico sturgeon, *Acipenser oxyrinchus desotoi*. U.S. Department of the Interior, U.S. Fish and Wildlife Service. Panama City, FL.

Baum, J.K. and R.A. Myers. 2004. Shifting baselines and the decline of pelagic sharks in the Gulf of Mexico. Ecology Letters 7(2): 135-145.

Baum, J.K., E. Medina, J.A. Musick, and M. Smale. 2015. *Carcharhinus longimanus*. The IUCN Red List of Threatened species. http://dx.doi.org/10.2305/IUCN.UK.2015.RLTS.T39374A85699641.en

Beazley, M.J., R.J. Martinez, S. Rajan, J. Powell, Y.M. Piceno, L.M. Tom, G.L. Andersen, T.C. Hazen, J.D. Van Nostrand, J. Zhou, B. Mortazavi, and P.A. Sobecky. 2012. Microbial community analysis of a coastal salt marsh affected by the *Deepwater Horizon* oil spill. PLoS One 7(7): e41305.

Beerkircher, L., C.A. Brown, and V. Restrepo. 2009. Pelagic observer program data summary, Gulf of Mexico bluefin tuna (*Thunnus thynnus*) spawning season 2007 and 2008; and analysis of observer coverage levels. p. NOAA Technical Memorandum NMFS-SEFSC-588.

Bélanger, L. and J. Bédard. 1989. Responses of Staging Greater Snow Geese to Human Disturbance. Journal of Wildlife Management 53(3): 713-719.

Berry, M., D.T. Booth, and C.J. Limpus. 2013. Artificial lighting and disrupted sea-finding behaviour in hatchling loggerhead turtles (*Caretta caretta*) on the Woongarra coast, south-east Queensland, Australia. Australian Journal of Zoology 61(2): 137-145.

Biggs, D.C. and P.H. Ressler. 2000. Water column biology. In: Deepwater Program: Gulf of Mexico Deepwater Information Resources Data Search and Literature Synthesis. Volume I: Narrative Report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2000-049.

Blackstock, S.A., J.O. Fayton, P.H. Hulton, T.E. Moll, K. Jenkins, S. Kotecki, E. Henderson, V. Bowman, S. Rider, and C. Martin. 2018. Quantifying acoustic impacts on marine mammals and sea turtles: methods and analytical approach for phase III training and testing. NUWC-NPT Technical Report August 2018. N.U.W.C. Division. Newport, Rhode Island.

Blackwell, S.B. and C.R. Greene Jr. 2003. Acoustic measurements in Cook Inlet, Alaska, during August 2001. Greeneridge Sciences, Inc., for NMFS, Anchorage, AK. 43 pp.

Boehm, P., D. Turton, A. Raval, D. Caudle, D. French, N. Rabalais, R. Spies, and J. Johnson. 2001. Deepwater program: Literature review, environmental risks of chemical products used in Gulf of Mexico deepwater oil and gas operations. Volume I: Technical report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2001-011.

Boland, G.S. 1986. Discovery of co-occurring bivalve Acesta sp. and chemosynthetic tube worms Lamellibrachia. Nature 323: 759.

Bolle, L.J., C.A.F. de Jong, S.M. Bierman, P.J.G. Van Beek, O.A. van Keeken, P.W. Wessels, C.J.G. van Damme, H.V. Winter, D. de Haan, and R.P.A. Dekeling. 2012. Common Sole Larvae Survive High Levels of Pile-Driving Sound in Controlled Exposure Experiments. PLoS One 7(3): e33052.

Bonde, R.K. and T.J. O'Shea. 1989. Sowerby's beaked whale (*Mesoplodon bidens*) in the Gulf of Mexico. Journal of Mammology 70: 447-449.

Brooke, S. and W.W. Schroeder. 2007. State of deep coral ecosystems in the Gulf of Mexico region: Texas to the Florida Straits, pp 271-306. In: S.E. Lumdsen, T.F. Hourigan, A.W. Bruckner and G. Dorr, The State of Deep Coral Ecosystems of the United States. NOAA Technical Memorandum CRCP-3, Silver Spring, MD.

Brooks, J.M., C. Fisher, H. Roberts, E. Cordes, I. Baums, B. Bernard, R. Church, P. Etnoyer, C. German, E. Goehring, I. McDonald, H. Roberts, T. Shank, D. Warren, S. Welsh, and G. Wolff. 2012. Exploration and research of northern Gulf of Mexico deepwater natural and artificial hard-bottom habitats with emphasis on coral communities: Reefs, rigs, and wrecks — "Lophelia II" Interim report. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study BOEM 2012-106.

Bruintjes, R. and A.N. Radford. 2013. Context-dependent impacts of anthropogenic noise on individual and social behaviour in a cooperatively breeding fish. Animal Behaviour 85(6): 1343-1349.

Bureau of Ocean Energy Management. 2011. Archaeology Survey Blocks. http://www.boem.gov/Environmental-Stewardship/Archaeology/surveyblocks-pdf.aspx

Bureau of Ocean Energy Management. 2012a. Gulf of Mexico OCS Oil and Gas Lease Sales: 2012-2017. Western Planning Area Lease Sales 229, 233, 238, 246, and 248. Central Planning Area Lease Sales 227, 231, 235, 241, and 247. Final Environmental Impact Statement. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS EIS/EA BOEM 2012-019.

Bureau of Ocean Energy Management. 2012b. Gulf of Mexico OCS Oil and Gas Lease Sale: 2012. Central Planning Area Lease Sale 216/222. Final Supplemental Environmental Impact Statement. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS EIS/EA BOEM 2012-058.

Bureau of Ocean Energy Management. 2013a. Gulf of Mexico OCS Oil and Gas Lease Sales: 2013-2014. Western Planning Are Lease Sale 233. Central Planning Area 231. Final Supplemental Environmental Impact Statement. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS EIS/EA BOEM 2013-0118.

Bureau of Ocean Energy Management. 2013b. Gulf of Mexico OCS Oil and Gas Lease Sales: 2014 and 2016. Eastern Planning Area Lease Sales 225 and 226. Final Environmental Impact Statement. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS EIS/EA 2013-200 .

Bureau of Ocean Energy Management. 2014a. Gulf of Mexico OCS Oil and Gas Lease Sales: 2015-2017. Central Planning Area Lease Sales 235, 241, and 247. Final Supplemental Environmental Impact Statement. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS EIS/EA BOEM 2014-655.

Bureau of Ocean Energy Management. 2014b. Gulf of Mexico OCS Oil and Gas Lease Sales: 2014-2016. Western Planning Area Lease Sales 238, 246, and 248. Final Supplemental Environmental Impact Statement. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS EIS/EA BOEM 2013-0118.

Bureau of Ocean Energy Management. 2015a. Gulf of Mexico OCS Oil and Gas Lease Sales: 2016 and 2017. Central Planning Area Lease Sales 241 and 247; Eastern Planning Area Lease Sale 226. Final Supplemental Environmental Impact Statement. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS EIS/EA BOEM 2015-033.

Bureau of Ocean Energy Management. 2015b. Gulf of Mexico OCS Oil and Gas Lease Sales: 2016 and 2017. Central Planning Area Lease Sales 241 and 247; Eastern Planning Area Lease Sale 226. Final Supplemental Environmental Impact Statement. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS EIS/EA BOEM 2015-033.

Bureau of Ocean Energy Management. 2016a. Outer Continental Shelf Oil and Gas Leasing Program: 2017-2022. Final Programmatic Environmental Impact Statement. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS EIS/EIA BOEM 2016-060.

Bureau of Ocean Energy Management. 2016b. Gulf of Mexico OCS Oil and Gas Lease Sale: 2016. Western Planning Area Lease Sale 248. Final Supplemental Environmental Impact Statement. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS EIS/EA BOEM 2016-005.

Bureau of Ocean Energy Management. 2016c. Essential Fish Habitat Assessment for the Gulf of Mexico. U.S. Department of the Interior. New Orleans, LA. OCS Report BOEM 2016-016.

Bureau of Ocean Energy Management. 2017a. Gulf of Mexico OCS Oil and Gas Lease Sales: 2017-2022. Gulf of Mexico Lease Sales 249, 250, 251, 252, 253, 254, 256, 257, 259, and 261. Final Multisale Environmental Impact Statement. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA.

Bureau of Ocean Energy Management. 2017b. Gulf of Mexico OCS Oil and Gas Lease Sale. Final Supplemental Environmental Impact Statement 2018. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS EIS/EA BOEM 2017-074.

Bureau of Ocean Energy Management. 2017c. Gulf of Mexico OCS Oil and Gas Lease Sale. Final Supplemental Environmental Impact Statement 2018. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS EIS/EA BOEM 2017-074.

Bureau of Ocean Energy Management. 2017d. Catastrophic Spill Event Analysis: High-Volume, Extended Duration Oil Spill Resulting from Loss of Well Control on the Gulf of Mexico Outer Continental Shelf. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS Report BOEM 2017-007.

Bureau of Ocean Energy Management. nd. Chemosynthetic Community Locations in the Gulf of Mexico. http://www.boem.gov/Chemo-Community-Locations-in-the-GOM/

Bureau of Ocean Energy Management, Regulation, and Enforcement. 2010. Federal & Academic Scientists Return from Deep-sea Research Cruise in Gulf of Mexico: Scientists Observe Damage to Deep-sea Corals. U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement. http://www.noaanews.noaa.gov/stories2010/20101104_coralcruise.html

Bureau of Safety and Environmental Enforcement. 2017. Offshore Incident Statistics. U.S. Department of the Interior, Bureau of Safety and Environmental Enforcement. https://www.bsee.gov/stats-facts/offshore-incident-statistics

Callender, W.R., G.M. Staff, E.N. Powell, and I.R. MacDonald. 1990. Gulf of Mexico hydrocarbon seep communities; V. Biofacies and shell orientation of autochthonous shell beds below storm wave base. Palaios 5: 2-14.

Camhi, M.D., E.K. Pikitch, and e. E.A. Babcock. 2008. Sharks of the Open Ocean: Biology, Fisheries, and Conservation. Oxford, UK., Blackwell Publishing Ltd. pp.

Camilli, R., C.M. Reddy, D.R. Yoerger, B.A. Van Mooy, M.V. Jakuba, J.C. Kinsey, C.P. McIntyre, S.P. Sylva, and J.V. Maloney. 2010. Tracking hydrocarbon plume transport and biodegradation at *Deepwater Horizon*. Science 330(6001): 201-204.

Carmichael, R.H., W.M. Graham, A. Aven, G. Worthy, and S. Howden. 2012. Were multiple stressors a 'perfect storm' for northern Gulf of Mexico bottlenose dolphins (*Tursiops truncatus*) in 2011? PLoS One 7(7): e41155.

Carr, A. 1996. Suwanee River sturgeon, pp 73-83. In: M.H. Carr, A Naturalist in Florida. Yale University Press, New Haven, CT.

Carroll, M., B. Gentner, S. Larkin, K. Quigley, N. Perlot, L. Degner, and A. Kroetz. 2016. An analysis of the impacts of the *Deepwater Horizon* oil spill on the Gulf of Mexico seafood industry. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study BOEM 2016-020.

Carvalho, R., C.-L. Wei, G.T. Rowe, and A. Schulze. 2013. Complex depth-related patterns in taxonomic and functional diversity of polychaetes in the Gulf of Mexico. Deep Sea Research I 80: 66-77.

Casper, B.M., P.S. Lobel, and H.Y. Yan. 2003. The hearing sensitivity of the little skate, *Raja erinacea*: a comparison of two methods. Environmental Biology of Fishes 68: 371–379.

Casper, B.M. and D.A. Mann. 2006. Evoked potential audiograms of the nurse shark (*Ginglymostoma cirratum*) and the yellow stingray (*Urobatis jamaicensis*). Environmental Biology of Fishes 76: 101-108.

Centers for Disease Control and Prevention. 2010. Health Hazard Evaluation of *Deepwater Horizon* Response Workers. HETA 2010-0115. http://www.cdc.gov/niosh/hhe/pdfs/interim_report_6.pdf.

Clapp, R.B., R.C. Banks, D. Morgan-Jacobs, and W.A. Hoffman. 1982a. Marine birds of the southeastern United States and Gulf of Mexico. Part I. Gaviiformes through Pelicaniformes. U.S. Fish and Wildlife Service, Office of Biological Services. Washington, DC. . FWS/OBS-82/01.

Clapp, R.B., D. Morgan-Jacobs, and R.C. Banks. 1982b. Marine birds of the southeastern United States and Gulf of Mexico. Part II. Anseriformes. U.S. Fish and Wildlife Service, Office of Biological Services. Washington DC. FWS/OBS 82/20.

Clapp, R.B., D. Morgan-Jacobs, and R.C. Banks. 1983. Marine birds of the southeastern United States and Gulf of Mexico. Part III. Charadriiformes. U.S. Fish and Wildlife Service, Office of Biological Services. Washington, DC. FWS/OBS-83/30.

Continental Shelf Associates, Inc. 2006. Effects of oil and gas exploration and development at selected continental slope sites in the Gulf of Mexico. Volume II: Technical report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA.

Continental Shelf Associates, Inc,. 1997. Characterization and trends of recreational and commercial fishing from the Florida Panhandle. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. USGS/BRD/CR 1997 0001 and OCS Study MMS 97-0020.

Continental Shelf Associates, Inc. 2002. Deepwater Program: Bluewater fishing and OCS activity, interactions between the fishing and petroleum industries in deepwaters of the Gulf of Mexico. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2002-078.

Continental Shelf Associates, Inc. 2004. Final Report: Gulf of Mexico Comprehensive Synthetic Based Muds Monitoring Program.

Cruz-Kaegi, M.E. 1998. Latitudinal variations in biomass and metabolism of benthic infaunal communities. Ph.D. Dissertation, Texas A&M University, College Station, TX. .

CSA International, Inc. 2007. Characterization of northern Gulf of Mexico deepwater hard-bottom communities with emphasis on *Lophelia* coral. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2007-044.

Daling, P.S., F. Leirvik, I.K. Almås, P.J. Brandvik, B.H. Hansen, A. Lewis, and M. Reed. 2014. Surface weathering and dispersability of MC252 crude oil. Marine Pollution Bulletin 15(87): 1-2.

Davis, R.W. and G.S. Fargion, (eds.). 1996. Distribution and abundance of cetaceans in the north-central and western Gulf of Mexico: Technical report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 96-0026.

Davis, R.W., W.E. Evans, and B. Würsig. 2000. Cetaceans, sea turtles, and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical Report. U.S. Geological Survey, Biological Resources Division, USGS/BRD/CR 1999 0006 and U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2000-003.

De Guise, S., M. Levin, E. Gebhard, L. Jasperse, L. Burdett Hart, C.R. Smith, S. Venn-Watson, R. Townsend, R. Wells, B. Balmer, E. Zolman, T. Rowles, and L. Schwacke. 2017. Changes in immune functions in bottlenose dolphins in the northern Gulf of Mexico associated with the *Deepwater Horizon* oil spill. Endangered Species Research 33: 291-303.

Demopoulos, A.W.J., J.R. Bourque, E. Cordes, and K.M. Stamler. 2016. Impacts of the *Deepwater Horizon* oil spill on deep-sea coral-associated sediment communities. Marine Ecology Progress Series 561: 51-68.

Ditty, J.G. 1986. Ichthyoplankton in neritic waters of the northern Gulf of Mexico off Louisiana: Composition, relative abundance, and seasonality. Fishery Bulletin 84(4): 935-946.

Ditty, J.G., G.G. Zieske, and R.F. Shaw. 1988. Seasonality and depth distribution of larval fishes in the northern Gulf of Mexico above 26°00'N. Fishery Bulletin 86(4): 811-823.

Du, M. and J.D. Kessler. 2012. Assessment of the spatial and temporal variability of bulk hydrocarbon respiration following the *Deepwater Horizon* oil spill. Environmental Science and Technology 46: 10499-10507.

Dubinsky, E.A., M.E. Conrad, R. Chakraborty, M. Bill, S.E. Borglin, J.T. Hollibaugh, O.U. Mason, Y.M. Piceno, F.C. Reid, W.T. Stringfellow, L.M. Tom, T.C. Hazen, and G.L. Andersen. 2013. Succession of hydrocarbon-degrading bacteria in the aftermath of the *Deepwater Horizon* oil spill in the Gulf of Mexico. Environmental Science and Technology 47.

Eastern Research Group, Inc. 2014. Assessing the impacts of the *Deepwater Horizon* oil spill on tourism in the Gulf of Mexico region. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study BOEM 2014-661.

Efroymson, R.A., W.H. Rose, S. Nemeth, and G.W. Sutter II. 2000. Ecological risk assessment framework for low altitude overflights by fixed-wing and rotary-wing military aircraft. Oak Ridge National Laboratory. Oak Ridge, TN. ORNL/TM-2000/289 ES-5048.

Ehrlich, P.R., D.S. Dobkin, and D. Wheye. 1992. Birds in Jeopardy: The Imperiled and Extinct Birds of the United States and Canada, including Hawaii and Puerto Rico. Palo Alto, CA, Stanford University Press. pp.

Erbe, C., R. Dunlop, K.C.S. Jenner, M.N.M. Jenner, R.D. McCauley, I. Parnum, M. Parsons, T. Rogers, and C. Salgado-Kent. 2017. Review of underwater and in-air sounds emitted by Australian and Antarctic marine mammals. Acoustics Australia 45: 179-241.

Faksness, L.G., D. Altin, T. Nordtug, P.S. Daling, and B.H. Hansen. 2015. Chemical comparison and acute toxicity of water accommodated fraction (WAF) of source and field collected Macondo oils from the Deepwater Horizon oil spill. Mar. Poll. Bull. 91: 222-229.

Felder, C.R., B. Thoma, W.E. Schmidt, T. Sauvage, S.L. Self-Krayesky, and A. Christoserdov. 2014. Seaweeds and Decapod Crustaceans on Gulf Deep Banks after the Macondo Spill. BioScience 64(9): 808-819.

Fisher, C.R., A.W.J. Demopoulos, E.E. Cordes, I.B. Baums, H.K. White, and J.R. Borque. 2014a. Coral communities as indicators of ecosystem-level impacts of the *Deepwater Horizon* spill. BioScience 64: 796-807.

Fisher, C.R., P.Y. Hsing, C.L. Kaiser, D.R. Yoerger, H.H. Roberts, W.W. Shedd, E.E. Cordes, T.M. Shank, S.P. Berlet, M.G. Saunders, E.A. Larcom, and J.M. Brooks. 2014b. Footprint of *Deepwater Horizon* blowout impact to deep-water coral communities. Proceedings of the National Academy of Sciences USA 111(32): 11744-11749.

Florida Fish and Wildlife Conservation Commission. 2018. Florida's endangered and threatened species. https://myfwc.com/media/1945/threatened-endangered-species.pdf.

Florida Fish and Wildlife Conservation Commission. n.d.-a. Loggerhead nesting in Florida. http://myfwc.com/research/wildlife/sea-turtles/nesting/loggerhead/

Florida Fish and Wildlife Conservation Commission. n.d.-b. Green turtle nesting in Florida. http://myfwc.com/research/wildlife/sea-turtles/nesting/green-turtle/

Florida Fish and Wildlife Conservation Commission. n.d.-c. Leatherback nesting in Florida. http://myfwc.com/research/wildlife/sea-turtles/nesting/leatherback/

Florida Fish and Wildlife Conservation Commission. n.d.-d. Listed Invertebrates. https://myfwc.com/wildlifehabitats/profiles/

Flower Garden Banks National Marine Sanctuary. 2018. Manta Catalog. https://flowergarden.noaa.gov/science/mantacatalog.html

Foley, K.A., C. Caldow, and E.L. Hickerson. 2007. First confirmed record of Nassau Grouper *Epinephelus striatus* (Pisces: Serranidae) in the Flower Garden Banks National Marine Sanctuary. Gulf of Mexico Science 25(2): 162-165.

Fonseca, M.S., G. Piniak, and N. Cosentino-Manning. 2017. Effect of the Cosco Busan oil spill on the ecology of eelgrass, *Zostera marina* in San Francisco Bay. Marine Pollution Bulletin 115: 29-38.

Fox, D.A., J.E. Hightower, and F.M. Parauka. 2000. Gulf Sturgeon Spawning Migration and Habitat in the Choctawhatchee River System, Alabama–Florida. Transactions of the American Fisheries Society 129(3): 811-826.

Fritts, T.H. and R.P. Reynolds. 1981. Pilot study of the marine mammals, birds, and turtles in OCS areas of the Gulf of Mexico. U.S. Department of the Interior, Fish and Wildlife Service, Biological Services Program. FWS/OBS 81/36.

Gallaway, B.J. and G.S. Lewbel. 1982. The ecology of petroleum platforms in the northwestern Gulf of Mexico: a community profile. U.S. Fish and Wildlife Service, Biological Services Program and U.S. Department of the Interior, Bureau of Land Management. Washington, D.C. FWS/OBS-82/27 and USGS Open File Report 82-03. http://www.nwrc.usgs.gov/techrpt/82-27text.pdf

Gallaway, B.J., J.G. Cole, and R.G. Fechhelm. 2003. Selected Aspects of the Ecology of the Continental Slope Fauna of the Gulf of Mexico: A Synopsis of the Northern Gulf of Mexico Continental Slope Study, 1983-1988. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2003-072.

Gallaway, B.J., (ed.). 1988. Northern Gulf of Mexico Continental Slope Study, Final report: Year 4. Volume II: Synthesis report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 88-0053.

Geraci, J.R. and D.J. St. Aubin. 1990. Sea Mammals and Oil: Confronting the Risks. San Diego, CA, Academic Press. 298 pp.

Girard, F., K. Shea, and C.R. Fisher. 2018. Projecting the recovery of a long-lived deep-sea coral species after the *Deepwater Horizon* oil spill using state-structured models. Journal of Applied Ecology 55: 1812-1822.

Gitschlag, G., B. Herczeg, and T. Barcack. 1997. Observations of sea turtles and other marine life at the explosive removal of offshore oil and gas structures in the Gulf of Mexico. Gulf Research Reports 9(4): 247-262.

Gomez, C., J.W. Lawson, A.J. Wright, A.D. Buren, D. Tollit, and V. Lesage. 2016. A systematic review on the behavioural responses of wild marine mammals to noise: the disparity between science and policy. Canadian Journal of Zoology 94: 801-819.

Goold, J.C. and S.E. Jones. 1995. Time and frequency domain characteristics of sperm whale clicks. Journal of the Acoustical Society of America 98: 1,279-271,291.

Gulf of Mexico Fishery Management Council. 2005. Generic Amendment Number 3 for addressing Essential Fish Habitat Requirements, Habitat Areas of Particular Concern, and adverse effects of fishing in the following Fishery Management Plans of the Gulf of Mexico: Shrimp fishery of the Gulf of Mexico, United States waters red drum fishery of the Gulf of Mexico, reef fish fishery of the Gulf of Mexico coastal migratory pelagic resources (mackerels) in the Gulf of Mexico and South Atlantic, stone crab fishery of the Gulf of Mexico, spiny lobster in the Gulf of Mexico and South Atlantic, coral and coral reefs of the Gulf of Mexico. Tampa, FL. Gulf of Mexico Fishery Management Council. 104 pp. https://gulfcouncil.org/wp-content/uploads/March-2005-FINAL3-EFH-Amendment.pdf

Hamdan, L.J., J.L. Salerno, A. Reed, S.B. Joye, and M. Damour. 2018. The impact of the *Deepwater Horizon* blowout on historic shipwreck-associated sediment microbiomes in the northern Gulf of Mexico. Scientific Reports 8: 9057.

Haney, C.J., H.J. Geiger, and J.W. Short. 2014. Bird mortality from the *Deepwater Horizon* oil spill. Exposure probability in the Gulf of Mexico. Marine Ecology Progress Series 513: 225-237.

Hayes, S.A., E. Josephson, K. Maze-Foley, P.E. Rosel, B. Byrd, T.V.N. Cole, L. Engleby, L.P. Garrison, J. Hatch, A. Henry, S.C. Horstman, J. Litz, M.C. Lyssikatos, K.D. Mullin, C. Orphanides, R.M. Pace, D.L. Palka, M. Soldevilla, and F.W. Wenzel. 2017. US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2016. NOAA Technical Memorandum NMFS-NE-241.

Hayes, S.A., E. Josephson, K. Maze-Foley, P.E. Rosel, B. Byrd, S. Chavez-Rosales, T.V.N. Cole, L. Engleby, L.P. Garrison, J. Hatch, A. Henry, S.C. Horstman, J. Litz, M.C. Lyssikatos, K.D. Mullin, C. Orphanides, R.M. Pace, D.L. Palka, M. Soldevilla, and F.W. Wenzel. 2018. US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2017. NOAA Technical Memorandum NMFS-NE-245.

Hazen, T.C., E.A. Dubinsky, T.Z. DeSantis, G.L. Andersen, Y.M. Piceno, N. Singh, J.K. Jansson, A. Probst, S.E. Borglin, J.L. Fortney, W.T. Stringfellow, M. Bill, M.E. Conrad, L.M. Tom, K.L. Chavarria, T.R. Alusi, R. Lamendella, D.C. Joyner, C. Spier, J. Baelum, M. Auer, M.L. Zemla, R. Chakraborty, E.L. Sonnenthal, P. D'Haeseleer, H.Y. Holman, S. Osman, Z. Lu, J.D. Van Nostrand, Y. Deng, J. Zhou, and O.U. Mason. 2010. Deep-sea oil plume enriches indigenous oil-degrading bacteria. Science 330(6001): 204-208.

Hazen, T.C., R.C. Prince, and N. Mahmoudi. 2016. Marine oil biodegradation. Environmental Science and Technology 50: 2121-2129.

Hieb, E.E., R.H. Carmichael, A. Aven, C. Nelson-Seely, and N. Taylor. 2017. Sighting demographics of the West Indian manatee Trichechus manatus in the north-central Gulf of Mexico supported by citizen-sourced data. Endangered Species Research 32: 321-332.

Higashi, G.R. 1994. Ten years of fish aggregating device (FAD) design development in Hawaii. Bulletin of Marine Science 55(2-3): 651-666.

Hildebrand, J.A. 2005. Impacts of anthropogenic sound, pp 101-124. In: J.E. Reynolds III, W.F. Perrin, R.R. Reeves, S. Montgomery and T.J. Ragen, Marine mammal research: conservation beyond crisis. Johns Hopkins University Press, Baltimore, MD.

Hildebrand, J.A. 2009. Anthropogenic and natural sources of ambient noise in the ocean. Marine Ecology Progress Series 395: 5-20.

Hildebrand, J.A., S. Baumann-Pickering, K.E. Frasier, J.S. Trickey, K.P. Merkens, S.M. Wiggins, M.A. McDonald, L.P. Garrison, D. Harris, T.A. Marques, and L. Thomas. 2015. Passive acoustic monitoring of beaked whale densities in the Gulf of Mexico. Scientific Reports 5(16343).

Holand, P. 1997. Offshore Blowouts: Causes and Control. Houston, TX, Gulf Publishing Co 163 pp.

Holland, K.N. 1990. Horizontal and vertical movements of yellowfin and bigeye tuna associated with fish aggregating devices. Fishery Bulletin 88: 493-507.

Hsing, P.-Y., B. Fu, E.A. Larcom, S.P. Berlet, T.M. Shank, A.F. Govindarajan, A.J. Lukasiewicz, P.M. Dixon, and C.R. Fisher. 2013. Evidence of lasting impact of the *Deepwater Horizon* oil spill on a deep Gulf of Mexico coral community. Elementa: Science of the Anthropocene 1(1): 000012.

Intergovernmental Panel on Climate Change. 2014. Climate Change 2014: Impacts, Adaptation and Vulnerability. http://www.ipcc.ch/report/ar5/wg2/.

International Association of Oil & Gas Producers. 2010. Risk assessment data directory: Blowout frequencies. OGP Report No. 434 2. 13 pp.

International Tanker Owners Pollution Federation Limited. 2018. Weathering. https://www.itopf.org/knowledge-resources/documents-guides/fate-of-oil-spills/weathering/

Ji, Z.-G., W.R. Johnson, C.F. Marshall, and E.M. Lear. 2004. Oil-Spill Risk Analysis: Contingency Planning Statistics for Gulf of Mexico OCS Activities. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Report MMS 2004-026.

Jochens, A., D.C. Biggs, D. Benoit-Bird, D. Engelhaupt, J. Gordon, C. Hu, N. Jaquet, M. Johnson, R.R. Leben, B. Mate, P. Miller, J.G. Ortega-Ortiz, A. Thode, P. Tyack, and B. Würsig. 2008. Sperm whale seismic study in the Gulf of Mexico: Synthesis report. M.M.S. U.S. Department of the Interior, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2008-006.

Johnsgard, P.A. 1990. Hawks, Eagles, and Falcons of North America; Biology and Natural History. Washington, D.C., Smithsonian Institution Press. pp.

Keithly, W.R. and K.J. Roberts. 2017. Commercial and recreational fisheries of the Gulf of Mexico, pp 1039-1188. In: C.H. Ward, Habitats and Biota of the Gulf of Mexico: Before the Deepwater Horizon Oil Spill. Volume 2: Fish Resources, Fisheries, Sea Turtles, Avian Resources, Marine Mammals, Diseases and Mortalities. Springer, New York.

Kellar, N.M., T.R. Speakman, C.R. Smith, S.M. Lane, B.C. Balmer, M.L. Trego, K.N. Catelani, M.N. Robbins, C.D. Allen, R.S. Wells, E.S. Zolman, T.K. Rowles, and L.H. Schwacke. 2017. Low reproductive success rates of common bottlenose dolphins *Tursiops truncatus* in the northern Gulf of Mexico following the *Deepwater Horizon* disaster (2010-2015). Endangered Species Research 33: 143-158.

Kennicutt, M.C. 2000. Chemical Oceanography, pp. 123 139. In: Continental Shelf Associates, Inc. Deepwater Program: Gulf of Mexico deepwater information resources data search and literature synthesis. Volume I: Narrative report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2000-049.

Kessler, J.D., D.L. Valentine, M.C. Redmond, M. Du, E.W. Chan, S.D. Mendes, E.W. Quiroz, C.J. Villanueva, S.S. Shusta, L.M. Werra, S.A. Yvon-Lewis, and T.C. Weber. 2011. A persistent oxygen anomaly reveals the fate of spilled methane in the deep Gulf of Mexico. Science 331: 312-315.

Ketten, D.R. and S.M. Bartol. 2005. Functional Measures of Sea Turtle Hearing, Woods Hole Oceanographic Institution: ONR Award No: N00014-02-0510.

King, B.S. and J.D. Gibbins. 2011. Health hazard evaluation of *Deepwater Horizon* response workers. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. Health Hazard Evaluation Report HETA 2010-0115 & 2010-0129-3138.

Kujawinski, E.B., M.C. Kido Soule, D.L. Valentine, A.K. Boysen, K. Longnecker, and M.C. Redmond. 2011. Fate of dispersants associated with the *Deepwater Horizon* oil spill. Environmental Science and Technology 45(4): 1298-1306.

Kyhn, L.A., S. Sveegaard, and J. Tougaard. 2014. Underwater noise emissions from a drillship in the Arctic. Marine Pollution Bulletin 86: 424-433.

Ladich, F. and R.R. Fay. 2013. Auditory evoked potential audiometry in fish. Reviews in Fish Biology and Fisheries 23(3): 317-364.

Lane, S.M., C.R. Smith, J. Mitchell, B.C. Balmer, K.P. Barry, T. McDonald, C.S. Mori, P.E. Rosel, T.K. Rowles, T.R. Speakman, F.I. Townsend, M.C. Tumlin, R.S. Wells, E.S. Zolman, and L.H. Schwacke. 2015. Reproductive outcome and survival of common bottlenose dolphins sampled in Barataria Bay, Louisiana, USA, following the *Deepwater Horizon* oil spill. Proceedings of the Royal Society B: Biological Sciences 282(1818).

Lauritsen, A.M., P.M. Dixon, D. Cacela, B. Brost, R. Hardy, S.L. MacPherson, A. Meylan, B.P. Wallace, and B. Witherington. 2017. Impact of the *Deepwater Horizon* oil spill on loggerhead turtle *Caretta caretta* nest densities in northwest Florida. Endangered Species Research 33: 83-93.

Lewan, M.D., A. Warden, R.F. Dias, Z.K. Lowry, T.L. Hannah, P.G. Lillis, R.F. Kokaly, T.M. Hoefen, G.A. Swayze, C.T. Mills, S.H. Harris, and G.S. Plumlee. 2014. Asphaltene content and composition as a measure of *Deepwater Horizon* oil spill losses within the first 80 days. Org. Geochem. 75: 54-60.

Lin, Q. and I.A. Mendelssohn. 2012. Impacts and recovery of the *Deepwater Horizon* oil spill on vegetation structure and function of coastal salt marshes in the northern Gulf of Mexico. Environmental Science and Technology 46(7): 3737-3743.

Lin, Q., I.A. Mendelssohn, S.A. Graham, A. Hou, J.W. Fleeger, and D.R. Deis. 2016. Response of salt marshes to oiling from the *Deepwater Horizon* spill: Implications for plant growth, soil surface-erosion, and shoreline stability. Science of the Total Environment 557-558: 369-377.

Liu, J., H.P. Bacosa, and Z. Liu. 2017. Potential environmental factors affecting oil-degrading bacterial populations in deep and surface waters of the northern Gulf of Mexico. Frontiers in Microbiology 7: 2131.

Lohoefener, R., W. Hoggard, K.D. Mullin, C. Roden, and C. Rogers. 1990. Association of sea turtles with petroleum platforms in the north central Gulf of Mexico. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 90-0025.

Lutcavage, M.E., P.L. Lutz, G.D. Bossart, and D.M. Hudson. 1995. Physiologic and clinicopathologic effects of crude oil on loggerhead sea turtles. Archives of Environmental Contamination and Toxicology 28(4): 417-422.

Lutcavage, M.E., P. Plotkin, B. Witherington, and P.L. Lutz. 1997. Human impacts on sea turtle survival, pp 387-409. In: P.L. Lutz and J.A. Musick, The Biology of Sea Turtles. CRC Press, Boca Raton, FL.

MacDonald, I.R., W.W. Schroeder, and J.M. Brooks. 1995. Northern Gulf of Mexico Chemosynthetic Ecosystems Study. Final Report. Volume II: Technical Report. OCS Study MMS 95-0022. 335 pp.

MacDonald, I.R. 2002. Stability and Change in Gulf of Mexico Chemosynthetic Communities. Volume II: Technical Report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2002-036.

Main, C.E., H.A. Ruhl, D.O.B. Jones, A. Yool, B. Thornton, and D.J. Mayor. 2015. Hydrocarbon contamination affects Deep-sea benthic oxygen uptake and microbial community composition. Deep Sea Research. Part I: Oceanographic Research Papers 100: 79-87.

Marine Mammal Commission. 2011. Assessing the long-term effects of the BP *Deepwater Horizon* oil spill on marine mammals in the Gulf of Mexico: A statement of research needs. http://www.mmc.gov/wp-content/uploads/longterm_effects_bp_oilspil.pdf

Marshall, A., M.B. Bennett, G. Kodja, S. Hinojosa-Alvarez, F. Galvan-Magana, M. Harding, G. Stevens, and T. Kashiwagi. 2018. *Mobula birostris* (amended version of 2011 assessment). The IUCN Red List of Threatened Species. 2018: e.T198921A126669349. http://www.iucnredlist.org/details/198921/0

Mathias, D., A.M. Thode, J. Straley, and R.D. Andrews. 2013. Acoustic tracking of sperm whales in the Gulf of Alaska using a two element vertical array and tags. Journal of the Acoustical Society of America 134: 2446–2461.

McCauley, R. 1998. Radiated underwater noise measured from the drilling rig *Ocean General*, rig tenders *Pacific Ariki* and *Pacific Frontier*, fishing vessel *Reef Venture* and natural sources in the Timor sea, northern Australia. Prepared for Shell Australia, Melbourne. 52 pp. http://cmst.curtin.edu.au/local/docs/pubs/1998-19.pdf.

McDonald, T.L., F.E. Hornsby, T.R. Speakman, E.S. Zolman, K.D. Mullin, C. Sinclair, P.E. Rosel, L. Thomas, and L.H. Schwacke. 2017a. Survival, density, and abundance of common bottlenose dolphins in Barataria Bay (USA) following the *Deepwater Horizon* oil spill. Endangered Species Research 33: 193-209.

McDonald, T.L., B.A. Schroeder, B.A. Stacy, B.P. Wallace, L.A. Starcevich, J. Gorham, M.C. Tumlin, D. Cacela, M. Rissing, D.B. McLamb, E. Ruder, and B.E. Witherington. 2017b. Density and exposure of surface-pelagic juvenile sea turtles to *Deepwater Horizon* oil. Endangered Species Research 33: 69-82.

McKenna, M.F., D. Ross, S.M. Wiggins, and J.A. Hildebrand. 2012. Underwater radiated noise from modern commercial ships. Journal of the Acoustical Society of America 131: 92-103.

McLaughlin, K.E. and H.P. Kunc. 2015. Changes in the acoustic environment alter the foraging and sheltering behaviour of the cichlid *Amititlania nigrofasciata*. Behavioural processes 116: 75-79.

Mendelssohn, I.A., G.L. Andersen, D.M. Baltx, R.H. Caffey, K.R. Carman, J.W. Fleeger, S.B. Joyce, Q. Lin, E. Maltby, E.B. Overton, and L.P. Rozas. 2012. Oil impacts on coastal wetlands: Implications for the Mississippi River delta ecosystem after the *Deepwater Horizon* oil spill. BioScience 62(6): 562-574.

Mississippi Natural Heritage Program. 2018. Natural Heritage Program Online Database. Museum of Natural Science, Mississippi Deptartment of Wildlife, Fisheries, and Parks. https://www.mdwfp.com/museum/seek-study/heritage-program/nhp-online-data/

Møhl, B., M. Wahlberg, and P.T. Madsen. 2003. The monopulsed nature of sperm whale clicks. Journal of the Acoustical Society of America 114(2): 1143-1154.

Montagna, P.A., J.G. Baguley, C. Cooksey, I. Hartwell, L.J. Hyde, J.L. Hyland, R.D. Kalke, L.M. Kracker, M. Reuscher, and A.C. Rhodes. 2013. Deep-sea benthic footprint of the *Deepwater Horizon* blowout. PLoS One 8(8): e70540.

Montagna, P.A., J.G. Baguley, C. Cooksey, and J.L. Hyland. 2016. Persistent impacts to the deep soft-bottom benthos one year after the Deepwater Horizon event. Integrated Environmental Assessment and Management 13(2): 342-351.

Morrow, J.V.J., J.P. Kirk, K.J. Killgore, H. Rugillio, and C. Knight. 1998. Status and recovery of Gulf sturgeon in the Pearl River system, Louisiana-Mississippi. North American Journal of Fisheries Management 18: 798-808.

Mullin, K.D., W. Hoggard, C. Roden, R. Lohoefener, C. Rogers, and B. Taggart. 1991. Cetaceans on the upper continental slope in the north-central Gulf of Mexico. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 91-0027.

Mullin, K.D. 2007. Abundance of cetaceans in the oceanic Gulf of Mexico based on 2003-2004 ship surveys. U.S. Department of Commerce, National Marine Fisheries Service, Southeast Fisheries Science Center. Pascagoula, MS.

National Marine Fisheries Service. 2007. Endangered Species Act, Section 7 Consultation – Biological Opinion. Gulf of Mexico Oil and Gas Activities: Five Year Leasing Plan for Western and Central Planning Areas 2007-2012. U.S. Department of Commerce, National Oceanic and Atmospheric Administration. St. Petersburg, FL. http://www.nmfs.noaa.gov/ocs/mafac/meetings/2010_06/docs/mms_02611_leases_2007_2012.pdf

National Marine Fisheries Service and U.S. Fish and Wildlife Service. 2008. Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtle (*Caretta caretta*), Second Revision. http://www.nmfs.noaa.gov/pr/pdfs/recovery/turtle_loggerhead_atlantic.pdf

National Marine Fisheries Service. 2009a. Sperm Whale (*Physeter macrocephalus*) 5-Year Review: Summary and Evaluation. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Sustainable Fisheries, Highly Migratory Species Management Division. Silver Spring, MD.

National Marine Fisheries Service. 2009b. Final Amendment 1 to the Consolidated Atlantic Highly Migratory Species Fishery Management Plan Essential Fish Habitat. Highly Migratory Species Management Division, Office of Sustainable Fisheries. Silver Spring, MD. http://pbadupws.nrc.gov/docs/ML1219/ML12195A241.pdf

National Marine Fisheries Service. 2010a. *Deepwater Horizon*/BP oil spill: size and percent coverage of fishing area closures due to BP oil spill. http://sero.nmfs.noaa.gov/deepwater_horizon/size_percent_closure/index.html

National Marine Fisheries Service. 2010b. Final recovery plan for the sperm whale (*Physeter macrocephalus*). Silver Spring, MD. http://www.nmfs.noaa.gov/pr/pdfs/health/oil_impacts.pdf

National Marine Fisheries Service. 2011. Species of concern: Atlantic bluefin tuna, *Thunnus thynnus*. http://www.nmfs.noaa.gov/pr/pdfs/species/bluefintuna_detailed.pdf

National Marine Fisheries Service, U.S. Fish and Wildlife Service and Secretaría de Medio Ambiente y Recursos Naturales. 2011. Bi-National Recovery Plan for the Kemp's Ridley Sea Turtle (*Lepidochelys kempii*), Second Revision. http://www.nmfs.noaa.gov/pr/pdfs/recovery/kempsridley_revision2.pdf

National Marine Fisheries Service. 2014a. Sea turtles, dolphins, and whales and the Gulf of Mexico oil spill. http://www.nmfs.noaa.gov/pr/health/oilspill/gulf2010.htm

National Marine Fisheries Service. 2014b. Loggerhead Sea Turtle Critical Habitat in the Northwest Atlantic Ocean. http://www.nmfs.noaa.gov/pr/species/turtles/criticalhabitat_loggerhead.htm

National Marine Fisheries Service. 2014c. Gulf sturgeon (*Acipenser oxyrinchus desotoi*). http://www.nmfs.noaa.gov/pr/species/fish/gulfsturgeon.htm

National Marine Fisheries Service. 2015. Endangered Species Act Section 7 Consultation Biological Opinion for the Virginia Offshore Wind Technology Advancement Project. NER-2015-12128

National Marine Fisheries Service. 2018a. Oceanic whitetip shark. https://www.fisheries.noaa.gov/species/oceanic-whitetip-shark

National Marine Fisheries Service. 2018b. Revisions to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts. NOAA Technical Memorandum NMFS-OPR-59.

National Oceanic and Atmospheric Administration. 2005. Interim Sound Threshold Guidance. http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/threshold_guidance.html

National Oceanic and Atmospheric Administration. 2006. Fact Sheet: Small Diesel Spills (500-5,000 gallons). NOAA Scientific Support Team, Hazardous Materials Response and Assessment Division. Seattle, WA.

National Oceanic and Atmospheric Administration. 2010. Oil and Sea Turtles. Biology, Planning, and Response. U.S. Department of Commerce, National Ocean Service, Office of Response and Restoration. 111 pp. http://response.restoration.noaa.gov/sites/default/files/Oil_Sea_Turtles.pdf

National Oceanic and Atmospheric Administration. 2011a. Joint Analysis Group. *Deepwater Horizon* oil spill: Review of preliminary data to examine subsurface oil in the vicinity of MC252#1, May 19 to June 19, 2010. U.S. Department of Commerce, National Ocean Service. Silver Spring, MD. NOAA Technical Report NOS OR&R 25. http://service.ncddc.noaa.gov/rdn/www/media/documents/activities/jag-reports/NTR-NOS-ORR-25-082011.pdf

National Oceanic and Atmospheric Administration. 2011b. Joint Analysis Group, *Deepwater Horizon* oil spill: Review of R/V Brooks McCall data to examine subsurface oil. U.S. Department of Commerce, National Ocean Service. Silver Spring, MD. NOAA Technical Report NOS OR&R 24. http://service.ncddc.noaa.gov/rdn/www/media/documents/activities/jag-reports/NTR-NOS-ORR-24-062011.pdf

National Oceanic and Atmospheric Administration. 2011c. Joint Analysis Group, *Deepwater Horizon* oil spill: Review of preliminary data to examine oxygen levels in the vicinity of MC252#1 May 8 to August 9, 2010. U.S. Department of Commerce, National Ocean Service. Silver Spring, MD. NOAA Technical Report NOS OR&R 26. http://service.ncddc.noaa.gov/rdn/www/media/documents/activities/jag-reports/NTR-NOS-ORR-26-082011.pdf

National Oceanic and Atmospheric Administration. 2016a. *Deepwater Horizon* Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement. http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan/

National Oceanic and Atmospheric Administration. 2016b. Cetacean Unusual Mortality Event in Northern Gulf of Mexico (2010-2014). http://www.nmfs.noaa.gov/pr/health/mmume/cetacean_gulfofmexico.htm

National Oceanic and Atmospheric Administration. 2017a. Small Diesel Spills (500 - 5,000 gallons). U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of Response and Restoration. http://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/resources/small-diesel-spills.html

National Oceanic and Atmospheric Administration. 2017b. Oil Types. Office of Response and Restoration. http://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/oil-types.html

National Oceanic and Atmospheric Administration. 2018. Giant Manta Ray - *Manta birostris*. https://www.fisheries.noaa.gov/species/giant-manta-ray

National Oceanic and Atmospheric Administration. 2019. ADIOS 2 (Automated Data Inquiry for Oil Spills). http://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/response-tools/downloading-installing-and-running-adios.html

National Oceanic and Atmospheric Administration. nd. Nassau Grouper. https://www.fisheries.noaa.gov/species/nassau-grouper

National Park Service. 2010. Breton Wilderness 300 km Radius. https://www.fws.gov/refuges/airquality/docs/Breton_WA300km.pdf

National Research Council. 1983. Drilling Discharges in the Marine Environment. Washington, DC. National Academy Press. 180 pp.

National Research Council. 2003a. Ocean Noise and Marine Mammals. Washington, DC. National Academy Press. 204 pp.

National Research Council. 2003b. Oil in the Sea III: Inputs, Fates, and Effects. Washington, DC. National Academy Press. 182 pp. + app.

National Wildlife Federation. 2016a. Oil Spill Impacts on Marine Mammals. http://www.nwf.org/What-We-Do/Protect-Habitat/Gulf-Restoration/Oil-Spill/Effects-on-Wildlife/Mammals.aspx

National Wildlife Federation. 2016b. Wildlife Library: Whooping Crane. http://www.nwf.org/wildlife/wildlife-library/birds/whooping-crane.aspx

Natural Resources Defense Council. 2014. A petition to list the Gulf of Mexico Bryde's whale (*Balaenoptera edeni*) as endangered under the Endangered Species Act. https://www.nrdc.org/sites/default/files/wil_14091701a.pdf

Nedelec, S.L., A.N. Radford, L. Pearl, B. Nedelec, M.I. McCormick, M.G. Meekan, and S.D. Simpson. 2017. Motorboat noise impacts parental behaviour and offspring survival in a reef fish. Proceedings of the Royal Society B: Biological Sciences 1856: 20170143.

Nedwell, J.R., K. Needham, and B. Edwards. 2001. Report on measurements of underwater noise from the Jack Bates Drill Rig. Report No. 462 R 0202. Subacoustech Ltd., Southhampton, UK. 49 pp.

Nedwell, J.R. and D. Howell. 2004. A review of offshore windfarm related underwater noise sources. Report No. 544 R 0308. Subacoustech Ltd., Southampton, UK. 63 pp.

Neff, J.M. 1987. Biological effects of drilling fluids, drill cuttings and produced waters, pp 469-538. In: D.F. Boesch and N.N. Rabalais, Long Term Effects of Offshore Oil and Gas Development. Elsevier Applied Science Publishers, London, UK.

Neff, J.M., S. McKelvie, and R.C. Ayers. 2000. Environmental impacts of synthetic based drilling fluids. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2000-064.

National Oceanic and Atmospheric Administration. 2014. Flower Garden Banks National Marine Sanctuary. http://flowergarden.noaa.gov/about/cnidarianlist.html

Nowlin, W.D.J., A.E. Jochens, S.F. DiMarco, R.O. Reid, and M.K. Howard. 2001. Deepwater Physical Oceanography Reanalysis and Synthesis of Historical Data: Synthesis Report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2001-064.

Ocean Geo Solutions. 2019a. Well Clearance Letter, Proposed Well WR881-A and WR881-AA, Block 881, Walker Ridge Area. Report No. 2019-112.

Ocean Geo Solutions. 2019b. Well Clearance Letter, Proposed Well WR881-B, Block 881, Walker Ridge Area. Report No. 2019-113.

Ocean Geo Solutions. 2019c. Well Clearance Letter, Proposed Well WR881-D, Block 881, Walker Ridge Area. Report No. 2019-114.

Ocean Geo Solutions. 2019d. Well Clearance Letter, Proposed Well WR881-F and WR881-FF, Block 881, Walker Ridge Area. Report No. 2019-116.

Ocean Geo Solutions. 2019e. Well Clearance Letter, Proposed Well WR925-E and WR925-EE, Block 925, Walker Ridge Area. Report No. 2019-115.

Ocean Geo Solutions. 2019f. Well Clearance Letter, Proposed WR925-A Alt Location, Walker Ridge Area. Report No. 2019-142.

Operational Science Advisory Team. 2010. Summary report for sub-surface and sub sea oil and dispersant detection: Sampling and monitoring. Prepared for Paul F. Zukunft, U.S. Coast Guard Federal On Scene Coordinator, *Deepwater Horizon* MC252. http://www.restorethegulf.gov/sites/default/files/documents/pdf/OSAT_Report_FINAL_17DEC.pdf.

Oxford Economics. 2010. Potential impact of the Gulf oil spill on tourism. Report prepared for the U.S. Travel Association. http://www.mississippiriverdelta.org/blog/files/2010/10/Gulf_Oil_Spill_Analysis_Oxford_Economics_710.pdf.

Picciulin, M., L. Sebastianutto, A. Codarin, A. Farina, and E.A. Ferrero. 2010. In situ behavioural responses to boat noise exposure of *Gobius cruentatus* (Gmelin, 1789; fam. Gobiidae) and Chromis chromis (Linnaeus, 1758; fam. Pomacentridae) living in a Marine Protected Area. Journal of Experimental Marine Biology and Ecology 386(1): 125-132.

Popper, A.N., A.D. Hawkins, R.R. Fay, D. Mann, S. Bartol, T.J. Carlson, S. Coombs, W.T. Ellison, R.L. Gentry, M.B. Halvorsen, S. Lokkeborg, P. Rogers, B.L. Southall, D. Zeddies, and W.N. Tavolga. 2014. Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report. ASA S3/SC1.4 TR-2014 prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI. ASA Press, Springer.

Powers, S.P., F.J. Hernandez, R.H. Condon, J.M. Drymon, and C.M. Free. 2013. Novel pathways for injury from offshore oil spills: Direct, sublethal and indirect effects of the *Deepwater Horizon* oil spill on pelagic *Sargassum* communities. PLoS One 8(9): e74802.

Prouty, N.G., C.R. Fisher, A.W.J. Demopoulos, and E.R.M. Druffel. 2016. Growth rates and ages ofdeep-sea corals impacted by the Deepwater Horizon oil spill. Deep-Sea Research II 129: 196-212.

Radford, A.N., E. Kerridge, and S.D. Simpson. 2014. Acoustic communication in a noisy world: Can fish compete with anthropogenic noise? . Behavioral Ecology 25(5): 1,022 - 021,030.

Rathbun, G.B. 1988. Fixed-wing airplane versus helicopter surveys of manatees. Marine Mammal Science 4(1): 71-75.

Relini, M., L.R. Orsi, and G. Relini. 1994. An offshore buoy as a FAD in the Mediterranean. Bulletin of Marine Science 55(2-3): 1099-1105.

Reuscher, M.G., J.G. Baguley, N. Conrad-Forrest, C. Cooksey, J.L. Hyland, C. Lewis, P.A. Montagna, R.W. Ricker, M. Rohal, and T. Washburn. 2017. Temporal patterns of *Deepwater Horizon* impacts on the benthic infauna of the northern Gulf of Mexico continental slope. PLoS One 12(6): e0179923.

Richards, W.J., T. Leming, M.F. McGowan, J.T. Lamkin, and S. Kelley-Farga. 1989. Distribution of fish larvae in relation to hydrographic features of the Loop Current boundary in the Gulf of Mexico. ICES Marine Science Symposia 191: 169-176.

Richards, W.J., M.F. McGowan, T. Leming, J.T. Lamkin, and S. Kelley-Farga. 1993. Larval fish assemblages at the Loop Current boundary in the Gulf of Mexico. Bulletin of Marine Science 53(2): 475-537.

Richardson, W.J., C.R. Greene Jr., C.I. Malme, and D.H. Thomson. 1995. Marine Mammals and Noise. San Diego, CA, Academic Press. pp.

Rodgers, J.A. and S.T. Schwikert. 2002. Buffer-Zone Distances to Protect Foraging and Loafing Waterbirds from Disturbance by Personal Watercraft and Outboard-Powered Boats. Conservation Biology 16(1): 216-224.

Ronconi, R.A., K.A. Allard, and P.D. Taylor. 2015. Bird interactions with offshore oil and gas platforms: Review of impacts and monitoring techniques. Journal of Environmental Management 147: 34-45.

Rosel, P.E., P. Corkeron, L. Engleby, D. Epperson, K.D. Mullin, M.S. Soldevilla, and B.L. Taylor. 2016. Status Review of Bryde's Whales (*Balaenoptera edeni*) in the Gulf of Mexico under the Endangered Species Act. N.O.a.A. Administration. NOAA Technical Memorandum NMFS-SEFSC-692.

Ross, S.W., A.W.J. Demopoulos, C.A. Kellogg, C.L. Morrison, M.S. Nizinski, C.L. Ames, T.L. Casazza, D. Gualtieri, K. Kovacs, J.P. McClain, A.M. Quattrini, A.Y. Roa-Varón, and A.D. Thaler. 2012. Deepwater Program: Studies of Gulf of Mexico lower continental slope communities related to chemosynthetic and hard substrate habitats. U.S. Department of the Interior, U.S. Geological Survey. U.S. Geological Survey Open-File Report 2012-1032.

Rowe, G.T. and M.C. Kennicutt. 2009. Northern Gulf of Mexico Continental Slope Habitats and Benthic Ecology Study. Final Report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2009-039.

Rudd, M.B., R.N.M. Ahrens, W.E. Pine III, and S.K. Bolden. 2014. Empirical spatially explicit natural mortality and movement rate estimates for the threatened Gulf Sturgeon (*Acipenser oxyrinchus desotoi*). Canadian Journal of Fisheries and Aquatic Sciences 71: 1407-1417.

Russell, R.W. 2005. Interactions between migrating birds and offshore oil and gas platforms in the northern Gulf of Mexico: Final Report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2005-009.

Sadovy, Y. 1997. The case of the disappearing grouper; *Epinephelus striatus*, the Nassau grouper in the Caribbean and western Atlantic. Proceedings of the Gulf and Caribbean Fisheries Institute 45: 5-22.

Salmon, M. and J. Wyneken. 1990. Do swimming loggerhead sea turtles (*Caretta caretta L.*) use light cues for offshore orientation? Marine and Freshwater Behaviour and Physiology 17(4): 233-246.

Samuel, Y., S.J. Morreale, C.W. Clark, C.H. Greene, and M.E. Richmond. 2005. Underwater, low-frequency noise in a coastal sea turtle habitat. Journal of the Acoustical Society of America 117(3): 1465-1472.

Schwacke, L.H., C.R. Smith, F.I. Townsend, R.S. Wells, L.B. Hart, B.C. Balmer, T.K. Collier, S. De Guise, M.M. Fry, J.L.J. Guillette, and S.V. Lamb. 2014. Health of common bottlenose dolphins (*Tursiops truncatus*) in Barataria Bay, Louisiana, following the Deepwater Horizon oil spill. Environmental Science Technology 48(1): 93-103.

Schwemmer, P., B. Mendel, N. Sonntag, V. Dierschke, and S. Garthe. 2011. Effects of ship traffic on seabirds in offshore waters: implications for marine conservation and spatial planning. Ecological Applications 21(5): 1851-1860.

Share the Beach. 2016. Nesting season statistics. http://www.alabamaseaturtles.com/nesting-season-statistics/

Silliman, B.R., J. van de Koppel, M.W. McCoy, J. Diller, G.N. Kasozi, K. Earl, P.N. Adams, and A.R. Zimmerman. 2012. Degradation and resilience in Louisiana salt marshes after the BP-*Deepwater Horizon* oil spill. Proceedings of the National Academy of Sciences USA 109(28): 11234-11239.

Silliman, B.R., P.M. Dixon, C. Wobus, Q. He, P. Daleo, B.B. Hughes, M. Rissing, J.M. Willis, and M.W. Hester. 2016. Thresholds in marsh resilience to the Deepwater Horizon oil spill. Scientific Reports 6: 32520.

Simões, T.N., A.C.d. Silva, and C.C.d.M. Moura. 2017. Influence of artificial lights on the orientation of hatchlings of *Eretmochelys imbricata* in Pernambuco, Brazil. Zoologia 34: e13727.

Smultea, M.A., J.R. Mobley Jr., D. Fertl, and G.L. Fulling. 2008. An unusual reaction and other observations of sperm whales near fixed wing aircraft. Gulf and Caribbean Research 20: 75-80.

Solomon, G.M. and S. Janssen. 2010. Health effects of the Gulf oil spill. JAMA 304(10): 1118-1119.

Spier, C., W.T. Stringfellow, T.C. Hazen, and M. Conrad. 2013. Distribution of hydrocarbons released during the 2010 MC252 oil spill in deep offshore waters. Environmental Pollution 173: 224-230.

State of Louisiana Department of Wildlife and Fisheries. 2005. Chapter 4 - Conservation habits and species assessments. http://www.wlf.louisiana.gov/sites/default/files/pdf/document/32857-chapter-4-conservation-habitats-and-species-assessments/13_chapter_4_conservation_habitats__species_assessmen.pdf

Stewart, J.D., M. Nuttall, E.L. Hickerson, and M.A. Johnston. 2018. Important juvenile manta ray habitat at Flower Garden Banks National Marine Sanctuary in the northwestern Gulf of Mexico. Marine Biology 165:111.

Stiles, M.L., E. Harrould-Kolieb, R. Faure, H. Ylitalo-Ward, and M.F. Hirshfield. 2007. Deep sea trawl fisheries of the southeast U.S. and Gulf of Mexico: rock shrimp, royal red shrimp, calico scallops. 18 pp.

Stout, S.A., J.R. Payne, S.D. Emso-Mattingly, and G. Baker. 2016. Weathering of field-collected floating and stranded Macondo oils during and shortly after the *Deepwater Horizon* oil spill. Marine Pollution Bulletin 105: 7-22.

Stout, S.A. and J.R. Payne. 2016. Macondo oil in deep-sea sediments: Part 1 – sub-sea weathering of oil deposited on the seafloor. Marine Pollution Bulletin 111: 365-380.

Sulak, K.J. and J.P. Clugston. 1998. Early life history stages of Gulf sturgeon in the Suwanee River, Florida. Transactions of the American Fisheries Society 127: 758-771.

Takeshita, R., L. Sullivan, C.R. Smith, T.K. Collier, A. Hall, T. Brosnan, T.K. Rowles, and L.H. Schwacke. 2017. The *Deepwater Horizon* oil spill marine mammal injury assessment. Endangered Species Research 33: 95-106.

Tarr, M.A., P. Zito, E.B. Overton, G.M. Olson, P.L. Adhikari, and C.M. Reddy. 2016. Weathering of oil in the marine environment. Oceanography 29(3): 126-135.

Todd, V.L.G., W.D. Pearse, N.C. Tegenza, P.A. Lepper, and I.B. Todd. 2009. Diel echolocation activity of harbour porpoises (*Phocoena phocoena*) around North Sea offshore gas installations. ICES Journal of Marine Science 66: 734-745.

Turtle Island Restoration Network. 2019. Kemp's Ridley Sea Turtle Count on the Texas Coast. https://seaturtles.org/turtle-count-texas-coast/

Tuxbury, S.M. and M. Salmon. 2005. Competitive interactions between artificial lighting and natural cues during seafinding by hatchling marine turtles. Biological Conservation 121: 311-316.

U.S. Department of Commerce, Economics and Statistics Administration. 2010. Estimating the effects of the deepwater drilling moratorium on the Gulf coast economy. Inter-agency economic report. http://www.esa.doc.gov/Reports/estimating-economic-effects-deepwater-drilling-moratorium-gulf-coast-econom

U.S. Environmental Protection Agency. 2016. Questions and answers about the BP oil spill in the Gulf Coast. http://archive.epa.gov/bpspill/web/html/qanda.html

U.S. Environmental Protection Agency. 2019. The green book nonattainment areas for criteria pollutants.

U.S. Fish and Wildlife Service, Gulf States Marine Fisheries Commission and National Marine Fisheries Service. 1995. Gulf Sturgeon Recovery/Management Plan. U.S. Department of Interior, U.S. Fish and Wildlife Service, Southeast Region. Atlanta, GA. http://www.nmfs.noaa.gov/pr/pdfs/recovery/sturgeon_gulf.pdf

U.S. Fish and Wildlife Service. 2001. Florida manatee recovery plan (*Trichechus manatus latirostris*), Third Revision. U.S. Department of the Interior, Southeast Region. Atlanta, GA.

U.S. Fish and Wildlife Service. 2003. Recovery plan for the Great Lakes Piping Plover (*Charadrius melodus*). U.S. Department of the Interior. Fort Snelling, MN.

U.S. Fish and Wildlife Service. 2007. International Recovery Plan: Whooping Crane (*Grus americana*), Third Revision. U.S. Department of the Interior. Albequerque, NM.

U.S. Fish and Wildlife Service. 2010a. Effects of oil on wildlife and habitat. http://www.fws.gov/home/dhoilspill/pdfs/DHJICFWSOilImpactsWildlifeFactSheet.pdf

U.S. Fish and Wildlife Service. 2010b. Bech-nesting birds of the Gulf. http://www.fws.gov/home/dhoilspill/pdfs/DHBirdsOfTheGulf.pdf

U.S. Fish and Wildlife Service. 2011. FWS *Deepwater Horizon* Oil Spill Response. Bird Impact Data and Consolidated Wildlife Reports. *Deepwater Horizon* Bird Impact Data from the DOI - ERDC NRDA Database 12 May 2011. http://www.fws.gov/home/dhoilspill/pdfs/Bird%20Data%20Species%20Spreadsheet%2005122011.pdf

U.S. Fish and Wildlife Service. 2015. Bald and Golden Eagle Information. http://www.fws.gov/birds/management/managed-species/bald-and-golden-eagle-information.php

U.S. Fish and Wildlife Service. 2016a. Hawksbill sea turtle (*Eretmochelys imbricata*). http://www.fws.gov/northflorida/SeaTurtles/Turtle%20Factsheets/hawksbill-sea-turtle.htm

U.S. Fish and Wildlife Service. 2016b. Find Endangered Species. http://www.fws.gov/endangered/

U.S. Fish and Wildlife Service. 2018. Whooping Crane Survey Results: Winter 2017-2018.

U.S. Geological Survey. 2011. Cold-water coral ecosystem studies: U.S. Gulf of Mexico. http://fl.biology.usgs.gov/pdf/20100504Gulf_corals_v1.pdf

Urick, R.J. 1983a. Principles of underwater sound. Los Altos Hills, CA, Peninsula Publishing. 423 pp.

Urick, R.J. 1983b. Principles of underwater sound. Los Altos Hills, CA, Peninsula Publishing. pp.

Valentine, D.L., G.B. Fisher, S.C. Bagby, R.K. Nelson, C.M. Reddy, S.P. Sylva, and M.A. Woo. 2014. Fallout plume of submerged oil from *Deepwater Horizon*. Proceedings of the National Academy of Sciences USA 111(45): 906-915.

Venn-Watson, S., K.M. Colegrove, J. Litz, M. Kinsel, K. Terio, J. Saliki, S. Fire, R.H. Carmichael, C. Chevis, W. Hatchett, J. Pitchford, M.C. Tumlin, C. Field, S. Smith, R. Ewing, D. Fauquier, G. Lovewell, H. Whitehead, D. Rotstein, W.E. McFee, and E. Fougeres. 2015. Adrenal Gland and Lung Lesions in Gulf of Mexico Common Bottlenose Dolphins (*Tursiops truncates*) Found Dead following the *Deepwater Horizon* Oil Spill. PLoS One 10(5): e0126538.

Volkes, H.E. 1963. Studies on tertiary and recent giant Limidae. Tulane Studies in Geology 1: 75-92.

Wakeford, A. 2001. State of Florida conservation plan for Gulf sturgeon (*Acipencer oxyrinchus desotoi*). Florida Marine Research Institute Technical Report TR-8.

Waring, G.T., E. Josephson, K. Maze-Foley, and P.E. Rosel. 2016. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2015. U.S. Department of Commerce, National Oceanic and Atmospheric Administration. NOAA Technical Memorandum NMFS NE 238.

Washburn, T.W., M.G. Reuscher, P.A. Montagna, and C. Cooksey. 2017. Macrobenthic community structure in the deep Gulf of Mexico one year after the Deepwater Horizon blowout. Deep-Sea Research Part I 127(21-30).

Wei, C.-L. 2006. The bathymetric zonation and community structure of deep-sea macrobenthos in the northern Gulf of Mexico. M.S. Thesis, Texas A&M University. http://repository.tamu.edu/handle/1969.1/4927

Wei, C.-L., G.T. Rowe, G.F. Hubbard, A.H. Scheltema, G.D.F. Wilson, I. Petrescu, J.M. Foster, M.K. Wickstein, M. Chen, R. Davenport, Y. Soliman, and Y. Wang. 2010. Bathymetric zonation of deep-sea macrofauna in relation to export of surface phytoplankton production. Marine Ecology Progress Series 39: 1-14.

Weilgart, L. and H. Whitehead. 1993. Coda communication by sperm whales (*Physeter macrocephalus*) off the Galapagos Islands. Canadian Journal of Zoology 71: 744-752.

White, H.K., P.Y. Hsing, W. Cho, T.M. Shank, E.E. Cordes, A.M. Quattrini, R.K. Nelson, R. Camilli, A.W.J. Demopoulos, C. German, J.M. Brooks, H. Roberts, W.W. Shedd, C.M. Reddy, and C. Fisher. 2012. Impact of the Deepwater Horizon oil spill on a deep-water coral community in the Gulf of Mexico. Proceedings of the National Academy of Sciences USA 109(50): 20303-20308.

Williams, R., E. Ashe, and P.D. O'Hara. 2011. Marine mammals and debris in coastal waters of British Columbia, Canada. Marine Pollution Bulletin 62(6): 1303-1316.

Wilson, C.A., A. Pierce, and M.W. Miller. 2003. Rigs and reefs: A comparison of the fish communities at two artificial reefs, a production platform, and a natural reef in the northern Gulf of Mexico. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2003-009.

Wilson, C.A., M.W. Miller, Y.C. Allen, K.M. Boswell, and D.L. Nieland. 2006. Effects of depth, location, and habitat type on relative abundance and species composition of fishes associated with petroleum platforms and Sonnier Bank in the northern Gulf of Mexico. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region. New Orleans, LA. OCS Study MMS 2006-037.

Würsig, B., S.K. Lynn, T.A. Jefferson, and K.D. Mullin. 1998. Behaviour of cetaceans in the northern Gulf of Mexico relative to survey ships and aircraft. Aquatic Mammals 24(1): 41-50.

Würsig, B., T.A. Jefferson, and D.J. Schmidly. 2000. The Marine Mammals of the Gulf of Mexico. College Station, TX, Texas A&M University Press. 256 pp.

SECTION O
ADMINISTRATIVE INFORMATION

(a) Proprietary Information

Proprietary copies of this plan contain information not available to the public and include structure maps, seismic information, cross sections, depths of wells, etc.

(b) Bibliography

- Shallow Hazards and Archaeology Assessment (combined report)
  Prepared by Fugro (Document No. 02.18031334-Magnus)
- Site Clearance Letters
- Final Notice of Sale Package for Gulf of Mexico Lease Sale 249/251

Receipt

Tracking Information

Pay.gov Tracking ID: 26I3JI3D

Agency Tracking ID: 75769813836

Form Name: BOEM Exploration Plan

Application Name: BOEM Exploration Plan - BF

Payment Information

Payment Type: Debit or credit card

Payment Amount: $22,038.00

Transaction Date: 06/12/2019 06:17:01 PM EDT

Payment Date: 06/12/2019

Region: Gulf of Mexico

Contact: Bridget O'Farrell 832-636-1694

Company Name/No: Anadarko Petroleum Corporation, 00981

Lease Number(s): 36181, 36475, , ,

Area-Block: Walker Ridge WR, 881: Walker Ridge WR, 925: , : , : ,

Surface Locations: 6

Account Information

Cardholder Name: Bridget O'Farrell

Card Type: Visa

Card Number: ************9234