Ocean Discharge Criteria Evaluation
for The General Permit GMG290000
January 2026

I. Introduction

The U.S. Environmental Protection Agency (EPA), Region 6, is modifying the National Pollutant Discharge Elimination System (NPDES) general permit for discharges from new and existing sources and new discharges of oil and gas extraction activities in its jurisdictional area of the Outer Continental Shelf (OCS) of the Gulf of America. The permit will apply to exploration, development and production phases for both existing and new sources within the Western Planning Area and portions of the Central Planning Area of the U.S. Department of the Interior (DOI), Bureau of Ocean Energy Management (BOEM). This Ocean Discharge Criteria Evaluation (ODCE) addresses the U.S. Environmental Protection Agency's (EPA) regulations for preventing unreasonable degradation of the receiving waters in portions of the Gulf of America covered under this General Permit. The permit modification will add monitoring requirement for discharge duration, and change the compliance date for the acute toxicity limitation for Well Treatment, Completion and Workover (TCW) Fluids, from May 11, 2025, to May 11, 2028

This Ocean Discharge Criteria Evaluation (ODCE) addresses the EPA's regulations for preventing unreasonable degradation of the receiving waters in portions of the Gulf of America covered under this General Permit.

1.1 Background

Section 402 of the Clean Water Act (CWA) authorizes EPA to issue National Pollutant Discharge Elimination System (NPDES) permits to regulate discharges to waters of the United States. Sections 402 and 403 of the CWA require that an NPDES permit for a discharge into the territorial seas (baseline to 3 miles), or farther offshore in the contiguous zone or the ocean, be issued in compliance with EPA's regulations for preventing unreasonable degradation of the receiving waters in Title 40 of the Code of Federal Regulations [CFR] Part 125, Subpart M.

Prior to permit issuance, discharges must be evaluated against EPA's published criteria for determination of unreasonable degradation. Unreasonable degradation is defined in the NPDES regulations (40 CFR 125.121[e]) as the following.

1. Significant adverse changes in ecosystem diversity, productivity, and stability of the biological community within the area of discharge and surrounding biological communities;

2. Threat to human health through direct exposure to pollutants or through consumption of exposed aquatic organisms; or

3. Loss of aesthetic, recreational, scientific or economic values, which is unreasonable in relation to the benefit derived from the discharge.

Ten factors are specified at 40 CFR 125.122 for determining unreasonable degradation. They are the following.

1. The quantities, composition, and potential for bioaccumulation or persistence of the pollutants to be discharged;

2. The potential transport of such pollutants by biological, physical or chemical processes;

3. The composition and vulnerability of the biological communities which may be exposed to such pollutants, including the presence of unique species or communities of species, the presence of species identified as endangered or threatened pursuant to the Endangered Species Act, or the presence of those species critical to the structure or function of the ecosystem, such as those important for the food chain;

4. The importance of the receiving water area to the surrounding biological community, including the presence of spawning sites, nursery/forage areas, migratory pathways, or areas necessary for other functions or critical stages in the life cycle of an organism;

5. The existence of special aquatic sites including, but not limited to, marine sanctuaries and refuges, parks, national and historic monuments, national seashores, wilderness areas, and coral reefs;

6. The potential impacts on human health through direct and indirect pathways;

7. Existing or potential recreational and commercial fishing, including finfishing and shellfishing;

8. Any applicable requirements of an approved Coastal Zone Management plan;

9. Such other factors relating to the effects of the discharge as may be appropriate; and

10. Marine water quality criteria developed pursuant to Section 304(a)(1).

On the basis of the analysis in this ODCE, the Regional Administrator will determine whether the general permit may be issued. The Regional Administrator can make one of three findings:

1. The discharges will not cause unreasonable degradation of the marine environment and issue the permit.

2. The discharges will cause unreasonable degradation of the marine environment and may deny the permit or impose more stringent permit conditions and/or monitoring.

3. There is insufficient information to determine, before permit issuance, that there will be no unreasonable degradation of the marine environment, and issue the permit if, on the basis of available information, that:

- Such discharge will not cause irreparable harm1 to the marine environment during the period in which monitoring will take place.
- There are no reasonable alternatives to the on-site disposal of these materials.
- The discharge will be in compliance with additional permit conditions set out under (40 CFR 125.123(d)).

1.2 Scope

The proposed modified general permit covers discharges from offshore oil and gas activities that fall into three operational categories:

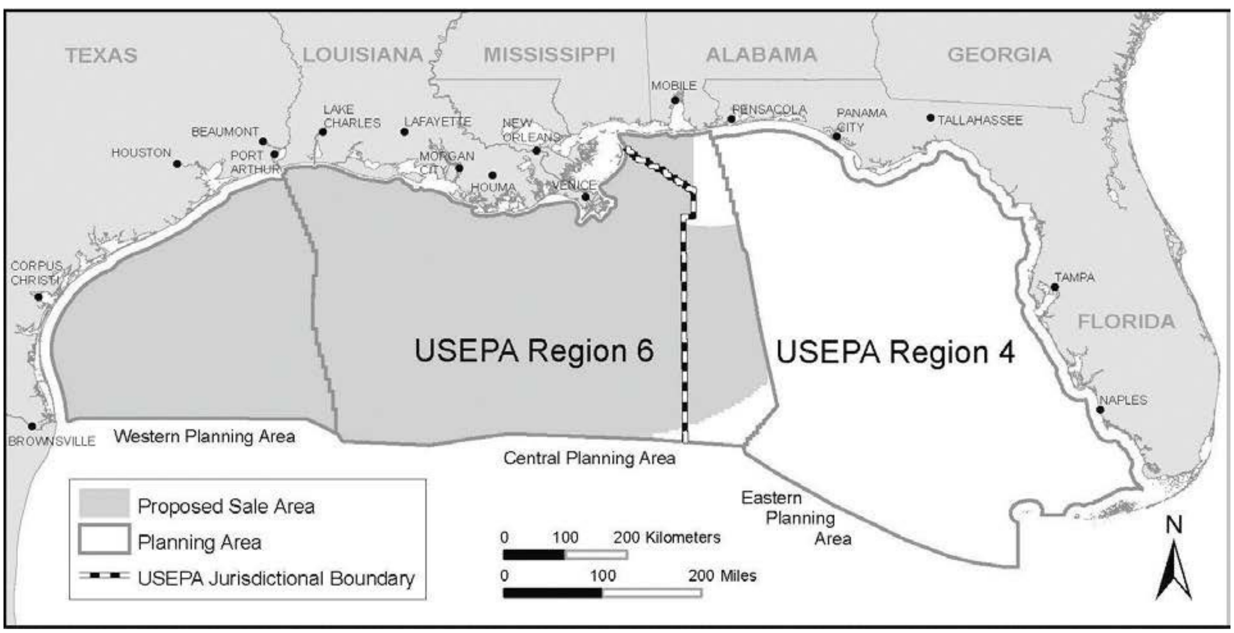
1. Exploratory drilling operations, which identify the location of producing formations.
2. Development operations conducted on platforms from which multiple wells are drilled.
3. Production operations that occur during and after developmental drilling.

The general permit has authorized discharges of the following waste streams: drilling fluids, drill cuttings, deck drainage, produced water, produced sand, well treatment, completion and workover fluids, sanitary wastes, domestic wastes, excess cement, blowout preventer control fluids, desalination unit discharges, fire control system test water, non- contact cooling water, ballast and bilge water, leak tracer fluids, umbilical steel tube storage fluid, riser tensioner fluid, pipeline brine and subsea well preservation and cleaning fluids.
This ODCE evaluates the impacts from the waste discharges regulated under the permit including drilling fluids; drill cuttings; deck drainage; produced water; produced sand; well treatment, completion, and workover fluids; sanitary waste; domestic waste; and miscellaneous wastes. In this evaluation the ODCE addresses the 10 factors for determining unreasonable degradation as outlined above and at 40 CFR § 125.122. It also assesses whether the information exists to make a "no unreasonable degradation" determination, including any recommended permit conditions that may be necessary to reach that conclusion.

Discharges from exploration, development, and production of oil and gas resources, particularly drilling fluids, well treatment and workover fluids, cuttings, and produced water, have the demonstrated potential to adversely affect the marine environment. These effects include both toxic effects and physical effects (smothering and sediment texture alterations). Based on available data, demonstrated effects have been shown to be relatively localized, within 1,000 meters of the discharge for drilling fluids and cuttings and within several hundred meters for produced waters. Permit conditions and limitations have been imposed to mitigate potential impacts and to specifically address the whole effluent toxicity. Pipeline brine and hydraulic control fluids discharged in high volume may also have effects on marine organisms. Whole effluent toxicity testing requirements are established in the permit to ensure that discharges of brines or hydraulic control fluids will not adversely affect the most sensitive marine species. Also, because discharges of brines or hydraulic control fluids are intermittent and at short duration, the impact of these discharges is expected much lower than produced water. This ODCE focuses on impacts caused by discharges of drilling fluids, drill cuttings, produced water, and TCW fluids. In this evaluation the ODCE addresses the 10 factors for determining unreasonable degradation as outlined above and at 40 CFR 125.122. It also assesses whether the information exists to make a "no unreasonable degradation" determination, including any recommended permit conditions that may be necessary to reach that conclusion.

1.3 Area of Coverage

The permit coverage area consists of lease areas that are located in and discharging to Federal waters in the Gulf of America, specifically located in the Central to Western portions of the Gulf of America (GMG290000). The lease areas under Region 6 that begin in the Central portion include: Chandeleur, Chandeleur East, Breton Sound, Main Pass, Main Pass South and East, Viosca Knoll (but only those blocks under Main Pass South and East; the Viosca Knoll blocks between Main Pass and Mobile are under EPA Region 4 jurisdiction), South Pass, South Pass South and East, West Delta, West Delta South, Mississippi Canyon, Atwater Valley, Lund, and Lund South. These named lease areas and all lease areas westward are part of Region 6. In Texas, where the state has mineral rights to three leagues, some operators with state lease tracts are required to request coverage under this Federal NPDES general permit. In addition, permit coverage consists of produced water discharges to those Federal waters from lease blocks located in State territorial seas. This includes produced water from wells located in the area of coverage, which is sent on-shore for treatment and subsequently sent back to the Outer Continental Shelf to be discharged. This permit does not authorize discharges from facilities located in or discharging to State territorial seas or from facilities defined as "onshore", "coastal", or "stripper" (see 40 CFR Part 435, Subparts C, D, and F).



Source BOEM 2012

Figure 1-1. USEPA Region 4 and 6 water quality jurisdictional boundaries.

1.4 Evaluation of the Ten Ocean Discharge Criteria

Brief evaluations of the ten factors focus on drilling fluids, drill cuttings, and produced water are summarized below:

Factor One: The quantities, composition, and potential for bioaccumulation or persistence of the pollutants to be discharged; and
Factor Six: The potential impacts on human health through direct and indirect pathways.

TOXICITY

Potential Impacts from Toxicity of Drilling Fluids and Cuttings

Of the major ingredients of water-based drilling fluids, only chrome or ferrochrome lignosulfonate and sodium hydroxide are considered even moderately toxic to marine organisms. Most of the metals found in used drilling fluids appear in forms which have low toxicities or limited bioavailability to marine organisms. Although most major ingredients of drilling fluids apparently have low toxicities to marine organisms, some of the specialty additives that are frequently used to solve specific problems are toxic. The most toxic of these additives have been shown to be diesel fuel, chromate salts, surfactants, paraformaldehyde, and other biocides.

The components of drilling fluids of major environmental concern are petroleum hydrocarbons and heavy metals. The concern is whether they can accumulate in tissues to concentrations high enough to be toxic to the animals themselves and/or to higher trophic levels. The majority of petroleum hydrocarbons in water-based drilling fluids will be adsorbed to the clay fraction of the drilling fluid and will be dispersed in the water column with the slow-settling fraction. Most of the hydrocarbons may eventually desorb from the clay and evaporate to the atmosphere, be degraded by bacteria, or be deposited with the clay on the bottom. Hydrocarbons in solution are generally much more bioavailable to marine organisms than those which are absorbed in bottom sediments.

Elevated levels of heavy metals discharged with drilling fluids have been reported in the vicinity of offshore exploratory wells. As with petroleum hydrocarbons, the bioavailability of sediment-absorbed metals is generally low.

Critical determinants of the impacts of discharged drilling fluids and cuttings on water column biota are the rate and extent of the dispersion and dilution processes. The effects of a material like drilling fluid on water column organisms will depend not only on its inherent toxicity, but also on actual exposure concentrations and durations. Offshore field studies have shown that dril1ing fluids discharged to open ocean waters generally are diluted to low concentrations at which they are not expected to produce adverse effects in water column organisms.

Field investigations have shown that, in all but deep or high-energy environments, drilling fluids and cuttings initially will settle very rapidly from the discharge plume to the bottom. The severity of impact of deposition on the benthos is directly related to the amount of material accumulating on the substrate, which in turn is related to the amount and physical characteristics of the material discharged, and to the environmental conditions, such as current speed and water depth, at the time and site of discharge. In low energy and depositional environments, more material accumulates, and there may be a reduction in the abundance of some benthic species. In high energy environments, less drilling fluids or cuttings accumulate, and the impact on benthos would be minimal and of short duration. In general, however, factors enhancing local dispersion contribute to regional-scale, low-level contamination. Such types of pollutant effects, if they occur, have historically been very difficult to identify and ascribe cause and effect relationships.

Potential Impact from Toxicity of Produced Water

The chemical properties of produced water that could cause harmful effects in marine organisms and ecosystems include elevated salinity, altered ion ratios, low dissolved oxygen, heavy metals, petroleum hydrocarbons and other organics. In addition, deck drainage may contain a variety of chemicals such as detergents, solvents, and metals. Chemicals such as biocides, coagulants, corrosion inhibitors, cleaners, and dispersants also may appear in the effluent waters. The major constituents of concern in produced water are petroleum hydrocarbons and heavy metals. Other produced water constituents or properties have either been shown to be unlikely contributors to significant impacts in the marine environment (elevated salinity and altered ion ratios) or their impacts have not been quantified.

The majority of bioassays that have been conducted with produced water indicate that most are not extremely toxic to finfish and shellfish. Produced water has a fairly low toxicity (on the order of 1-10% for 96-hour LC50s). The most toxic produced waters tested may have been treated with biocides. The most sensitive organisms evaluated were larval brown shrimp and pink salmon fry. In offshore areas, produced water is apparently diluted very rapidly following discharge. Significant elevations in salinity, elevated concentrations of hydrocarbons or metals, or decreased dissolved oxygen are not usually observed at distances greater than several hundred meters from the point of discharge. Because of the apparent degree of mixing with sea water, most physical/chemical features of produced water do not appear to pose a hazard to water column biota in open waters. Effects on the benthos in these areas are expected to be localized or of a relatively small magnitude.

Potential Impact from Toxicity of Well Treatment, Completion and Workover Fluids

Well treatment fluids are acid in water solutions (i.e., using hydrochloric acid, hydrofluoric acid, and acetic acid). Formation solubility, reaction time, and reaction products determine the type of acid used. A treatment operation consists of a preparation solution of ammonium chloride (3-5 %) to force the hydrocarbons into the formation; an acid solution; and a post-flush of ammonium chloride the remains in the formation for 12 - 24 hours to force the acid farther into the formation before being pumped out. Solvents also may be used for well treatment, including hydrofluoric acid, hydrochloric acid, ethylene diaminetetraacetic acid (EDTA), ammonium chloride, nitrogen, methanol, xylene, and toluene. Additives such as corrosion inhibitors, mutual solvents, acid neutralizers, diverters, sequestering agents, and antisluding agents are often added to treatment fluid solutions. The pollutant concentrations for a well treatment fluid used in two wells at a Total Human Models for Safety (THUMS) facility in California are presented in Table 3-8.

The volume of fluids needed for workover, treatment, and completion operations depends on the type of well and the specific operation being performed. Chevron has based estimates average volumes of fluids (accounting for reuse of the fluids) as 300 bbl of workover fluids per job and 250 bbl of treatment fluids 3 − 16 per treatment operation. Based on an assumption of one treatment or one workover every four years, an average of 200 bbl of treatment or workover fluid can be expected to be used per well every four years. Discharges are typically brief in duration and small in volume.

An industry-wide TCW fluids toxicity study was performed from 2017-2020 as a requirement of the 2017 permit. During the reissuance of the 2023 permit, EPA reviewed the results of the study, which included a robust WET data set. Results of the data indicated reasonable potential for WET, a high degree of toxicity amongst the various types of TCW discharges, and high toxicity at low concentrations. A summary of the data is presented in the Table 1 below:

Table 1. EPA Summary of TCW Fluids Toxicity Study

	Summary
Duration of discharges	Vary from 1hr to ongoing.
Discharge volumes	median ~473 bbls
Categories of TCW Fluids (Page 22)	Cat I - Brine Based Completion Fluids (biocides, acidifications, antiscalants, defoamers, viscosifiers, pHcontrol, surfactants)
	Cat II
	Cat III- Workover and Treatment Fluids (polymers, gels, biocides, corrosion inhibitors, …)
	Cat IV
Suspected sources of toxicity	Cat I- Mysids sensitive to ionic composition (Ca2+), minnows to the organics
	Cat III- both species sensitive to DOC, TOC, TSS, organics
Samples Collected (Page 20)	28 Samples Total (13 used Cat I and 15 used Cat III)

	9 - Treatment Well Operations (hydraulic fracturing, chemical treatment, wellbore cleanout, acidizing)
	13- completion well operations
	5- workover well operations (maintenance or remedial brines)
Avg CDs	Cat I - 0.41% Cat II- 0.37% but ranged 0.03% - 1.25%
Dilution series for all tests	0.1%, 0.3%, 0.8%, 2%, 6%, 18%, 50%
Tox Results	Cat I- MINNOW: mean LC50 was 4.4% but ranged 0.2% to >50% MYSID: mean LC50 1.6% but ranged 0.19% to 35.2%.
	Table 16 page 62 (Cat I NOECs varied but for mysids, half the samples came back 0.3%)
	Cat III- MINNOW: mean LC50 was 3.8% but ranged 0.2% to 38.7% MYSID: mean LC50 was 1.1% but ranged 0.05% to 13.1%
	Table 17 page 63 (Cat III NOECS. For mysid there were 3 samples that were <0.1%. Overall half of them were at the lowest of the series at 0.1%)

The 2023 General Permit was reissued with acute toxicity limitations and chronic monitoring for discharges. Permit requirements included a two-year compliance schedule for the limitation, and the option to obtain acute results from the chronic tests. The permit modification changes the compliance date from May 11, 2025, to May 11, 2028 and includes the requirement to monitor discharge duration so that EPA may continue to further assess discharges and toxicity. 86% of discharge samples reported since the 2023 permit effective date passed acute toxicity testing. A summary of acute failures from May 2023 to May 2025 is presented in table 5 below. Effects on species are expected to be localized or of a relatively small magnitude, since the discharges are brief in duration and small in volume.

Table 5. Summary of acute toxicity failures from May 2023 to May 2025.

Monitoring Period Start Date	Flow "barrels per day"	Parameter Code 51713- A.bahia 51712- M.beryllina	NOEC	CD	Samples that failed out of samples taken on that event)
5/1/2024	41040.	51712	0	0.64	2/2 failed
		51713	0	0.64	
1/1/2024	11184.	51713	0.1	0.39	1/4 failed
11/1/2023	18469.	51713	0.22	0.44	1/2 failed
11/1/2024	46224.	51713	0.16	0.65	1/2 failed
9/1/2023	3157.	51712	0.12	0.48	2/2 failed
		51713	0.24	0.48	
8/1/2023	11888.	51712	0.39	0.1	5/6 failed
1/1/2024	32091.	51713	0.39	0.1	
		51713	0.2	0.39	
		51712	0.14	0.56	
		51713	0.14	0.56	
2/1/2024	8146.	51713	0.2	0.1	
12/1/2024	11104.	51712	0.2	0.39	2/2 failed
		51713	0.2	0.39	
11/1/2024	41400.	51713	0.33	0.65	1/4 failed

7/5/2023	23952.	51712	0.11	0.48	2/2 failed
		51713	0.44	0.48	
1/1/2024	800.	51712	0.22	0.44	1/2 failed
12/1/2023	473.	51713	0.22	0.44	1/4 failed
3/1/2024	650.	51712	0.1	0.39	2/2 failed
		51713	0.1	0.39	
5/1/2024	719.	51713	11	0.44	1/2 failed
8/1/2023	660.	51713	0.22	0.44	1/2 failed
12/1/2023	319.	51713	0.1	0.19	
11/1/2023	4685.	51712	0.05	0.21	2/2 failed
		51713	0.05	0.21	
4/1/2024	10705.	51713	0.1	0.39	1/2 failed
12/1/2023	15936.	51712	0	0.44	1/2 failed
10/1/2024	1449.	51713	0.22	0.44	1/2 failed
12/1/2024	22608.	51712	0.12	0.48	2/2 failed
		51713	0.12	0.48	

Table 3-8. Analysis of Fluids from an Acidizing Well Treatment

Analyte	Concentration (ug/l)	Analyte	Concentration (ug/l)
Aluminum	53.1	Tin	6.66
Antimony	< 3.9	Titanium	0.68
Arsenic	< 1.9	Vanadium	36.1
Barium	12.6	Yttrium	0.19
Beryllium	< 0.1	Zinc	28.5
Boron	31.9	Aniline	434
Cadmium	0.4	Naphthalene	ND
Calcium	35.3	o-Toluidine	1,852
Chromium	19	2-Methylnaphthalene	ND
Cobalt	< 1.9		
		2,4,5-Trimethylanine	2,048
Copper	3.0	Oil and Grease	619
Iron	572	pH	2.48
Lead	< 9.82		
Magnesium	162		
Molybdenum	< 0.96		
Nickel	52.9		
Selenium	< 2.9		
Silver	< 0.7		
Sodium	1,640		
Thallium	5.0		

Source: EPA, 1993.

POTENTIAL FOR BIOACCUMULATION

Exposure to oil will vary widely between species. The species that feed in benthic environments by routing in silt or mud to expose prey may ingest larger amounts of hydrocarbons because a wide variety of petroleum components settle and aggregate in benthic environments. Contamination of organisms and sediments may be additive over a long period of time. Sperm whales, pygmy sperm whales, and Risso's dolphins feed on benthic organisms, and therefore may be particularly vulnerable to ingestion of oil while feeding. Most odontocetes (toothed whales) feed on fish, mollusks, and crustaceans in the water column. The ingestion of petroleum components by most toothed whales is not likely, except in play activities and as contamination in food. Dolphins that feed on fish concentrated near oil and gas structures, and on offal from shrimp trawls near OCS structures, are most likely to ingest fish with elevated hydrocarbon concentrations. Such fish may have higher parasite loads, bacterial infections, and other maladies associated with hydrocarbon pollution, but such factors may not affect marine mammals except under extreme conditions.

Ingestion of petroleum suspended in the water column and floating on the surface is most probable for the Mysticetes (baleen whales). The large quantities of water that are filtered by these large whales during feeding may contain petroleum. It is doubtful that sufficient petroleum would be ingested to cause death or serious, prolonged physiological alterations, but fouling of baleen plates, irritations of buccal membranes, and disruption of absorption of nutrients is possible.

Because of the low bioavailability of sediment-absorbed hydrocarbons, most benthic animals can tolerate relatively high concentrations of sediment hydrocarbons, which can ease result from the addition of lubricants or pills to drilling muds. Some impacts on the benthos could occur if large amounts of hydrocarbon-laden drilling fluid solids accumulate in a particular area. Also, if produced water discharges interact with bottom sediments, hydrocarbon accumulation would be expected to occur. This interaction is not expected to occur frequently on the Federal OCS and appears to be relatively localized when it does occur.

Field studies have suggested that low levels of sediment metal accumulation (generally < 10-fold) and thus bioaccumulation could occur in the vicinity of development or production operations. Such effects should be localized (within 1,000 m of the platform) based on available data.

Factor Two: The potential transport of such pollutants by biological, physical or chemical processes.

DRILLING FLUIDS

Drilling fluids contain quantities of coarse material, fine material, dissolved solids, and free liquids. Upon discharge, this mixture separates rapidly. An upper plume is formed from shear forces and local turbulent flow at the discharge pipe. This plume will migrate to its level of neutral buoyancy while particulates slowly settle to the bottom. This plume is advected with prevailing currents. The fine solids settle at a rate depending on aggregate particle size, which therefore is very dependent on flocculation. This upper plume contains about five to seven percent, by weight, of the total drilling fluid discharge.

A lower plume contains the majority of discharged materials. Coarser materials fall rapidly out of the bottom of the lower plume, with a transit time so brief that the influence of current is minimal. The lower plume components deposit on the bottom within a few meters from the discharge point. If water depths are great enough to prevent bottom impact, the lower plume also will teach its level of neutral buoyancy. Fine particulates within the lower plume will be advected with ambient current flow, similar to their behavior in the upper plume.

Both upper and lower plumes are affected by three different transport processes or pathways: physical, chemical, and biological. Physical transport processes affect concentrations of discharge components in the water column through dilution, dispersion, and settling. Physical processes include currents, turbulent mixing, settling, and diffusion. These processes include current speed and direction, tidal regime, kinetic energy availability, and the characteristics of the receiving water such as density stratification. Chemical and biological processes produce changes in the structure and/or speciation of materials that affect their bioavailability and toxicity. Chemical processes include the dissolution of substances in seawater, particle flocculation, complexation of compounds that may remove them from the water column, redox/ionic changes, and absorption of dissolved pollutants on solids. Biological processes include bioaccumulation in soft or hard tissues, fecal agglomeration and settling of materials, and physical reworking to mix solids into the sediment (bioturbation).

Data from exploratory drilling operations have been used to examine deposition of metals resulting from drilling operations. These data indicate that several metals are deposited, in a distance-dependent manner, around platforms, including cadmium, chromium, lead, mercury, nickel, vanadium, and zinc. The only two metals clearly associated with drilling fluids that appear to be elevated around rigs or platforms are barium and chromium. Metals that appear to be elevated as a result of drilling activities, and are not solely related to drilling fluids, include cadmium, mercury, nickel, lead, vanadium, and zinc. Cadmium, lead, and zinc in drilling fluids are the result of the use of pipe dope or pipe thread compounds. Mercury, nickel, and zinc may originate from sacrificial anodes. Cadmium, lead, and vanadium may also originate from the release of oil in drilling operations. This release can result from burning, incidental discharges or spills from the rig or supply boat traffic or use as a lubricant in drilling fluids. Vanadium also may derive from wearing of drill bits. In a Gulf of America platform study, brine (formation water) discharges were identified as an additional potential source of metal contamination.

It is concluded of a study that barium and probably other drilling fluid contaminants associated with the settleable fraction of drilling muds are relatively mobile. Thus, drilling discharges are expected to be spread over a large area (i.e., > 3 km from their discharge source) on time scales of a year or so. These data are consistent with other data that indicate drilling discharges can be distributed widely.

In summary, U.S. EPA (1985) evaluated bioaccumulation data for drilling fluids and components and concluded the following:

1. Several metals can be accumulated, including barium, cadmium, chromium, lead. strontium, and zinc.

2. In terms of results, observations that militate against any significant potential for adverse effects are: enrichment factors are generally low (barium and chromium excluded), depuration release levels are high, and no gross functional alterations, resulting from metal accumulation following high exposures to drilling fluids or compounds have been reported.

3: Such a conclusion is largely compromised by several other observations. Test results indicate that uptake kinetics are not simple, with saturation plateaus beyond the scope and predictive power of studies that have been conducted. Test design problems also contribute to equivocal interpretations and to poor utility in hazard assessment analyses. These design problems include the choice of inappropriate drilling fluid fractions as test substances, the use of only one effective exposure concentration for fluid solids exposures, and the choice of tissues for analyses that are inappropriate for the species.

4. Because of (a) the extreme persistence of metals, (b) the elevation of sediment metal levels resulting from drilling discharges, (c) the notable toxicity of some of the metals examined (cadmium and lead), and (d) the inability to estimate potential effects from environmentally realistic exposures, metals accumulation should be considered an area requiring further study.

PRODUCED WATER

The major physical transport processes affecting the fate of discharged produced water and associated chemicals include dispersion, volatilization, and adsorption/sedimentation. Hydrocarbons that become associated with sedimentary particles by adsorption can accumulate around production platforms, either settling to the seafloor through the water column or more directly through interaction of the discharge plume and the bottom.
Because produced waters are a continuous source of light aromatic hydrocarbons over the life of a field (generally 10 to 30+ years), there is a potential for these chemicals to accumulate in sediments. This situation differs from most oil spill situations, where after the spill ends, chemicals are rapidly lost, and the sediments generally exhibit declining lighter aromatics with time.

Chemical processes important to the fate of produced water constituents generally are those that affect metal and petroleum hydrocarbon behavior in marine systems. An important factor affecting the fate of hydrocarbons in produced water is volatilization. Produced water contains a high fraction of volatile compounds (e.g., benzene, xylenes, toluene), that can easily evaporate. However, because produced water can be much more dense than seawater (salinities >150 ppt are not uncommon), discharge plumes sink rapidly, and elevated levels of benzene in bottom water have been observed. For compounds with higher molecular weights, a major chemical process involves biodegradation of compounds over time. Polynuclear aromatic hydrocarbons tend to be more resistant to such degradation and thus can persist in the environment (primarily in sediment) for extended periods.

Biological transport processes include (1) ingestion and excretion in fecal pellets, (2) reworking of sediment to move material to deeper layers (bioturbation), (3) bioaccumulation in soft and hard tissues, and (4) biomagnification. Organisms remove material from suspension through ingestion of fine (1-50 µm) suspended particulate matter and excretion of large fecal pellets (30-3,000 µm) with a settling velocity typical of coarse silt or fine sand grains. Zooplankton play a major role in transporting metals and petroleum hydrocarbons from the upper water levels to the sea bottom, with the largest fraction of ingested metals moving through the animal with unassimilated food and excreted in a more concentrated state in fecal pellets. For example, a population of calanoid copepods grazing on an oil slick could transport three tons of oil per km^2 (0.386 mi^2) per day to the bottom.

Factor Three: The composition and vulnerability of the biological communities which may be exposed to such pollutants, including the presence of unique species or communities of species, the presence of species identified as endangered or threatened pursuant to the Endangered Species Act, or the presence of those species critical to the structure or function of the ecosystem, such as those important for the food chain;
Factor Seven: Existing or potential recreational and commercial fishing, including finfishing and shellfishing; and
Factor Nine: Such other factors relating to the effects of the discharge as may be appropriate.

POTENTIAL IMPACT OF DISCHARGES ON BENTHOS

The effects of drilling and production discharges on benthos result from that portion of the material that settles to the bottom where it can be incorporated into the sediments, resuspended, transported, and dispersed. For drilling fluids, the concentration of solids in bottom sediments depends on the types and quantities of drilling fluids discharged, hydrographic conditions at the time of discharge, and the height above the bottom at which the discharge is made. In high energy environments, little drilling fluid and cuttings accumulate and impacts on the benthos are minimal and of short duration. In low energy environments, more material accumulates and there can be localized impacts on benthic organisms. In the case of produced water, in shallow water environments where suspended sediment concentrations are high, dissolved and colloidal hydrocarbons and metals from produced water tend to become adsorbed to suspended particles and settle to the bottom. In deeper waters, elevated levels of hydrocarbons are restricted to a much smaller area of the bottom or are not detected at all.

Drilling Fluids

The major ingredients of water-based drilling fluids, bentonite clay and barite, are practically inert toxicologically, although they may cause physical damage to marine organisms through abrasion or clogging, or alter benthic community structure due to sediment texture changes.

In OCS areas, the impacts of drilling fluids and cuttings discharges may be very localized or patchy in distribution, and may be difficult to distinguish from the effects of other local changes due to drilling activities. These activities include the rain of organic material from the fouling community on the rig and increased predator pressure due to the reef effect or seabed scour around drilling structures. Most offshore field studies have shown a minimal impact of water-based drilling fluid discharges on the benthos except immediately adjacent to platforms where a cuttings pile was formed and persisted. Some changes in the local infaunal community structure will occur due to burial and the altered sediment character. The increased bottom microrelief afforded by the accumulation of cuttings may also attract fish and other motile animals and alter the character of epibenthic infaunal communities.

Produced Water

The benthic community is most likely to be impacted by produced water discharges, especially if the produced water is hypersaline. Organic and metallic pollutants in produced water will likely affect the benthos even if the plume does not impact the bottom directly, because these chemical constituents would be expected to quickly absorb to suspend matter in the water column and eventually settle to the bottom. In areas where a hypersaline produced water plume contacts the bottom, benthic impacts may occur as a result of anoxic and hypersaline conditions. The extent of these effects will depend on the duration, volume, and dispersion of the plume. Given the oceanographic conditions over most of the Federal OCS covered by the general permit, it is unlikely that the benthic community would be disrupted to any great degree beyond the immediate vicinity of the discharge or to any measurable degree in an area much farther than a few hundred meters.

POTENTIAL IMPACT ON THREATENED AND ENDANGERED SPECIES

Endangered Species

There are 14 federally endangered and threatened species that occur in the Gulf of America: three birds, five reptiles, one fish, and seven marine mammals. Table 2 provides an overview of the federally listed species, vulnerability and status.

Table 2. Federally Listed and Endangered/Threatened Species Overview

Common Name	Scientific Name	Global Status	Federal Status	State Status
Gulf sturgeon	*Acipenser oxyrinchus desotoi*	G3-Vulnerable	Threatened	Not listed
Found throughout the Gulf of America. Gulf sturgeon numbers declined due to overfishing throughout most of the 20th century. The decline was exacerbated by habitat loss from the construction of water control structures, such as dams and sills, mostly after 1950. In several rivers throughout the range, dams have severely restricted sturgeon access to historic migration routes and spawning areas. Threats and potential threats include habitat modifications associated with dredged material disposal, removal of trees and roots, and other navigation maintenance activities; incidental take by commercial fishermen; poor water quality from contamination by pesticides, heavy metals, and industrial chemicals; aquaculture and incidental or accidental introductions; and the Gulf sturgeon's slow growth and late maturation (USFWS 2003).				
Piping plover	*Charadrius melodus*	G3-Vulnerable	Threatened	Threatened
Winter along Gulf Coast beaches from Florida to Mexico, and Atlantic coast from Florida to North Carolina. The Texas coast has had at most 1,900 wintering individuals. Strong threats related primarily to human activity; disturbance by humans, predation, and development pressure are pervasive threats. Current favorable population trends depend on intensive management. Primary threats are destruction and degradation of summer and winter habitat, shoreline erosion, human disturbance of nesting and foraging birds, and predation (Burger, 1993).				
Whooping crane	*Grus americana*	G1-Critically imperiled	Endangered	Endangered
One self-sustaining population nests in Canada, winters primarily along the Texas coast; wild population in 2006 was 338 with about 215 individuals in the only self-sustaining Aransas-Wood Buffalo National Park population that nests in Wood Buffalo National Park and adjacent areas in Canada and winters in coastal marshes in Texas. Critical habitat designated in Texas includes Aransas, Calhoun, and Refugio Counties. Main factors affecting the populations of whooping crane along the Gulf coast are insecticides, nest disturbance, and habitat loss related to onshore recreation and shore-front development. Current threats to wild cranes include collisions with manmade objects such as power lines and fences, accidental shooting, predators (especially predation of flightless chicks), specimen collection, human disturbance, disease and both West Nile virus and H5N1 avian influenza virus, habitat destruction and contamination, severe weather (drought), and a loss of two-thirds of the original genetic material. (CWS and USFWS, 2007)				
Green sea turtle	*Chelonia mydas*	G3-Vulnerable	Threatened	Threatened
Distributed worldwide in warm oceans; exploited heavily for meat and eggs and as a component of other products; nesting and feeding habitats are being destroyed/degraded by pollution and development; large decline over the long term, more recently possibly stable or increasing in some areas. In Texas, range throughout the Gulf of America; an occasional visitor to the Texas coast. Major threats include degradation of nesting habitat, including beach lighting, human predation on nesting females and foraging turtles (e.g., for meat and use in commercial products); collection of eggs for human consumption; predation on eggs and hatchlings; mortality in fishing gear and other debris; collisions with boats; contact with chemical pollutants; and epidemic outbreaks of fibropapilloma or "tumor" infections (Mitchell, 1991, Ehrhart and Witherington, 1992, Tuato`o-Bartley et al., 1993, Losey et al., 1994, Barrett, 1996, NMFS and USFWS, 2007).				
Hawksbill sea turtle	*Eretmochelys imbricata*	G3-Vulnerable	Endangered	Endangered
Widely distributed in tropical and subtropical seas, but due to heavy exploitation much less abundant than in the past, and likely declining; at least 20,000 females nest each year; nesting locations have been reduced due to beach development and disturbance. In Texas, range throughout the Gulf of America - an occasional visitor to the Texas coast. Greatest threat is harvest for commercial (e.g., tortoiseshell trade) and subsistence (meat, eggs,) purposes (NMFS and USFWS, 2007).				

Leatherback sea turtle	*Dermochelys coriacea*	G2-Imperiled	Endangered	Endangered
Oceanic distribution is nearly worldwide, but there are few nesting sites; many nesting areas have few breeding females and suffer from human predation; range and number of occurrences have undergone reduction; recent severe population declines at some nesting locations. A rare visitor to the Texas coast. Major threats include egg collecting and mortality associated with bycatch in longline, trawl, and gillnet fisheries throughout the range (Spotila et al. 2000, Ferraroli et al. 2004, Lewison et al. 2004). Other concerns include harvest of adult females at nest beaches for meat and oil, nesting habitat loss, pollution, and adult ingestion of floating plastics and trash (Lewison et al., 2004).				
Loggerhead turtle	*Caretta caretta*	G3-Vulnerable	Threatened	Threatened
Wide distribution and not uncommon in warm oceans and seas; many nesting sites are protected, though perhaps not adequately; subject to many threats that land conservation alone cannot solve. In Texas, range throughout the Gulf of America - an occasional visitor to the Texas coast. Threatened through direct exploitation for food (including eggs) and curio materials, incidental take (chiefly by drowning in shrimp trawls), and by habitat degradation, including beach development, beachfront lighting (Peters and Verhoeven 1994, Salmon and Witherington 1995), ocean pollution (including marine debris, which may be ingested), and dredging (direct kills and injuries).				
Kemp's ridley sea turtle	*Lepidochelys kempii*	G1-Critically imperiled	Endangered	Endangered
Range centered in Gulf of America; only one major nesting area, along Gulf Coast of Tamaulipas, Mexico; population includes 7,000-8,000 adult females and is increasing; May be found throughout Gulf of Aneruca but nesting limited to southern Texas. Major threats include degradation of beach and coastal marine/estuarine habitats and mortality in commercial fisheries; vulnerable to oil spills. Present significant threats: beach and coastal development; various coastal marine habitat degradation (e.g., bottom trawling and dredging of inshore and nearshore areas); mortality in shrimp nets and other fishing; boat collisions; oil spills and exposure to other contaminants; and entanglement and ingestion of marine debris (especially plastics) (Thompson, 1990; CSTC, 1990; USFWS, 1992, 1998; NMFS and USFWS, 2007).				
West Indian manatee	*Trichechus manatus*	G2-Imperiled	Endangered	Endangered
Small range in coastal areas from the southeastern U.S. to northeastern South America; extremely rare in Texas; population size probably not much larger than a few thousand adults; high mortality rate, often a result of boat collisions and hunting; threat from boat collisions is increasing despite improved regulations; low reproductive rate; population stable or possibly increasing in Florida and Puerto Rico, but a good estimate of the population in Florida is now several years old, status and trend poorly known elsewhere. Threats include habitat loss and degradation, and mortality from boat collisions, hunting, fishing, red tide poisoning, entrapment in water control structures, entanglement in fishing gear, and exposure to cold temperatures.				
Oceanic whitetip shark	*Carcharhinus longimanus*		Threatened	Not listed
The oceanic whitetip shark is found throughout the world in tropical and sub-tropical waters. It is a pelagic species, generally found offshore in the open ocean, on the outer continental shelf, or around oceanic islands in deep water areas. The most significant decline reported was a 99.9% decrease in abundance in the Gulf of Mexico since the 1950s based on a comparison of longline research surveys from 1954 to 1957 and data from fisheries observers collected on commercial pelagic longline sets from 1995 to 1999. Threats include commercial fishing and bycatch and harvest for international trade. Thus, while it is likely that significant historical declines occurred, it appears that the population in the Northwest Atlantic may have stabilized. This may be due to management actions implemented in 1993 and subsequent regulations (see Young, C.N., Carlson, J.K., The biology and conservation status of the oceanic whitetip shark, 2020).				
Giant manta ray	*Mobula birostris*		Threatened	Not listed
The giant manta ray is found worldwide in tropical, subtropical, and temperate bodies of water and is commonly found offshore, in oceanic waters, and in productive coastal areas. The species has also been observed in estuarine waters, oceanic inlets, and within bays and intercoastal waterways. Today the species may be negatively affected by overfishing and bycatch and harvest for international trade. The species became threatened largely due to targeted hunting for their gill plates and other body parts and bycatch.				
Rice's whale	*Balaenoptera rice*	G3-Vulnerable	Endangered	Not listed
Previously known as Sperm Whale. Occurs widely in all oceans; protected by international and national regulations; total population is large (several hundred thousand) but trend is difficult to determine; threatened by general deterioration of marine ecosystem. Historically hunted for spermaceti, ambergris, and oil. No longer threatened by direct catching, but entanglement in fishing gear may cause mortality in some areas. Potentially				

threatened by ocean pollution and ingestion of plastics. Since the introduction of fast ferries into the Canary Islands in 1999, significant increases in collisions fatal to whales, mainly sperm whales, have been observed (Tregenza et al., 2004).				
Red Knot	*Calidris canutus*	G4-Apparantely secure	Threatened	Threatened
Large and small groups of red knots, sometimes numbering in the thousands, may occur in suitable habitats all along the Atlantic and Gulf coasts of South and North America. Migrates annually between n its breeding grounds in the central Canadian Arctic and four wintering regions: the Southeast United States and through the Caribbean; the Western Gulf of America from Mississippi through Central America; northern Brazil and extending west along the northern coast of South America; and Tierra del Fuego at the southern tip of South America (mainly in Chile) and extending north along the Patagonian coast of Argentina. At a landscape scale, development and disturbance are thought to have significantly reduced red knot use of Mustang Island, Texas and the Gulf coast of Florida in recent decades North America.				
Eastern Black Rail	*Laterallus jamaicensis jamaicensis*	G3-Vulnerable	Threatened	Threatened
Historically, the eastern black rail was also present during breeding months at inland and coastal locations throughout southeastern coastal States (the Southeast), a region that included North Carolina, South Carolina, Georgia, Florida, Tennessee, Mississippi, Alabama, Louisiana, and Texas. results suggest there are two populations of eastern black rail in the south-central United States: A migratory population breeding in Colorado and Kansas, and wintering in Texas; and a non-migratory population living in Texas year-round. In areas with extensive beach erosion, e.g. McFaddin Beach, a windy day can push the GoM into saltmarsh areas where black rails can be found. This encroachment can deposit contaminants directly into black rail habitat, a situation that would not typically be observed within a healthy beach environment.				
Sources: Texas Parks and Wildlife Department (https://tpwd.texas.gov/gis/rtest/) NOAA Threatened and Endangered Species List—Gulf of America | NOAA Fisheries				

POTENTIAL IMPACT OF DISCHARGES ON FISHERIES

Although several types of discharges will take place during oil and gas exploratory development, and production activities, only those discharges which would occur in sufficient volume to elicit a potential impact on finfish and shellfish populations, and thus the fisheries, are discussed here. These discharges are drilling fluids, cuttings and produced water. Other discharges (sanitary waste, deck drainage; completion fluids, etc.) may have associated toxic effects, but the volume of discharges from these sources are relatively small in comparison. Further consideration may need to be given to these discharges in shallow or low energy areas or where there is a high concentration of facilities. However, in the case of its single facility, any potential effects could be so localized as to have no significant impact on entire fish populations.

SOCIOECONOMIC CONSEQUENCES OF DISCHARGES ON FISHERIES

Any impacts on fisheries around offshore platforms in the territorial seas are expected to be relatively localized and short-term. In a low energy environment, the produced water discharge plume may contact the bottom. This may create anoxic conditions in the immediate vicinity of the discharge. The species that have a greater potential to be affected by oil and gas discharges in the territorial seas are demersal or bottom feeding fish. There also is the potential for toxic effects, although only for a limited area. The energetics and water depths in which oil and gas platforms are found in the open waters of the Territorial Seas of Texas will minimize fisheries impacts because of the relatively rapid mixing of the produced water plume and relatively limited potential for produced water plumes to interact with sediments.

Oil and gas structures are a major focus of all forms of offshore recreational fishing and some types of commercial fishing. Platforms receive the most attention by sport fishermen in the Texas Territorial Seas. The preferred fishing locations for private and charter boat fishermen in portions of the western and central Gulf are oil and gas structures, and the ones located in nearshore areas close to major coastal population access points are visited most often.

There are clear economic issues related to the large commercial and recreational fishing industries. In addition, there are socioeconomic issues related to onshore impacts from offshore oil and gas activities. The coastal areas of Texas vary substantially in socio-economic patterns, although economic growth and decline has been closely tied to activity in the oil and gas industry.

The pace of oil and gas development in the Gulf of America is expected to remain largely consistent with past levels. As a result, the nature and extent of impacts to land use and the existing infrastructure are not expected to change appreciably from past experience. The oil and gas industry has been an integral part of the Gulf of America economy for decades, and the continuation of industry activities under the terms of the proposed permit is not expected to result in any major land use, infrastructure, transportation, or waste disposal capacity impacts for the region.

Factor Four: The importance of the receiving water area to the surrounding biological community, including the presence of spawning sites, nursery/forage areas, migratory pathways, or areas necessary for other functions or critical stages in the life cycle of an organism.

Habitats

Seagrasses

Seagrasses are vascular plants that serve a variety of ecologically important functions. As primary producers, seagrasses are a direct food source and also contribute nutrients to the water column. Seagrass communities serve as a nursery habitat for juvenile fish and invertebrates and seagrass blades provide substrate for epiphytes. Species such as *Thalassia testudinum* have an extensive root system that stabilize substrate, and broad ribbonlike blades that increase sedimentation. Seagrasses mainly occur in shallow, clear, highly saline waters. Seagrass beds do not occur in the proposed activity area (MMS, 2000).

Offshore Habitats

Offshore habitats include the water column and the sea floor. The western Gulf benthos consist primarily of low relief soft bottom areas. Soft bottom areas contain biological assemblages consisting of such sessile invertebrates as sea fans, sea whips, hydroids, anemones, ascideians sponges, bryozoans, seagrasses, or corals living upon and attached to naturally occurring hard or rocky formation with fishes and other fauna. Live bottom types include pinnacle trend, low relief, offshore seagrasses, and coral reef communities. Coral reef communities are not found within the proposed permit coverage area and are therefore not discussed in this document. Within the eastern Gulf, live bottom communities are scattered across the west Florida shelf and at the outer edge of the Mississippi/Alabama shelf.

Deepwater Benthic Resources

Deepwater benthic habitats, as discussed here, refer to those in water depths greater than 305 m (1000 ft). A number of unique habitat and community types occur in the deep waters of the Gulf of America.

Chemosysthetic Communities

The following descriptions of chemosynthetic communities in the deepwater Gulf of America are taken from pages IV3 to IV7 in: *Gulf of Mexico Deepwater Operations and Activities, Environmental Assessment (MMS, 2000)*:

Description

Chemosynthetic communities are remarkable in that they utilize a carbon source independent of photosynthesis and the sun dependent photosynthetic food chain that supports all other life on earth. Although the process of chemosynthesis is entirely microbial, chemosynthetic bacteria and their production can support thriving assemblages of higher organisms through symbiosis. The first discovery of deepsea chemosynthetic communities including higher animals was unexpectedly made at hydrothermal vents in the eastern Pacific Ocean during geological explorations (Corliss et al., 1979). The principal organisms included tube worms, clams, and mussels that derive their entire food supply from symbiotic chemosynthetic bacteria, which obtain their energy needs from chemical compounds in the venting fluids. Similar communities were first discovered in the Eastern Gulf of Mexico in 1983 at the bottom of the Florida Escarpment in areas of "cold" brine seepage (Paull et al., 1984). The fauna here was found to be generally similar to vent communities including tube worms, mussels, and rarely, vesicomyid clams.

Cemosynthetic communities in the Central Gulf of Mexico were fortuitously discovered by two groups concurrently in November 1984. During investigations by Texas A&M University to determine the effects of oil seepage on benthic ecology (until this investigation, all effects of oil seepage were assumed to be detrimental), bottom trawls unexpectedly recovered extensive collections of chemosynthetic organisms including tube worms and clams (Kennicutt et al., 1985). At the same time, LGL Ecological Research Associates was conducting a research cruise as part of the multiyear MMS Northern Gulf of Mexico Continental Slope Study (LGL and Texas A&M University, 1986). Bottom photography resulted in clear images of vesicomyid clam chemosynthetic communities. A subsequent LGL/MMS cruise also photographically documented tube worm communities in situ in the Central Gulf of Mexico (Boland, 1986) prior to the initial submersible investigations and firsthand descriptions of Bush Hill in 1986 (Rosman et al., 1987; MacDonald et al., 1989).

Distribution

The northern Gulf of Mexico slope includes a stratigraphic section more than 10 km thick and has been profoundly influenced by salt movement. Oil in most of the Gulf slope fields is generated by Mesozoic source rocks from Upper Jurassic to Upper Cretaceous in age (Sassen et al., 1993). Migration conduits supply fresh hydrocarbon materials through a vertical scale of 68 km toward the surface. The surface expressions of hydrocarbon migration are referred to as seeps. Geological evidence demonstrates that hydrocarbon and brine seepage persist in spatially discrete areas for thousands of years. The time scale for oil and gas migration (combination of buoyancy and pressure) from source systems is on the scale of millions of years (Sassen, 1997).

There is a clear relationship between known hydrocarbon discoveries at great depth in the Gulf slope and chemosynthetic communities, hydrocarbon *seepage, and authigenic minerals including carbonates at the seafloor (Sassen et al., 1993). While the hydrocarbon reservoirs are broad areas several kilometers beneath the Gulf, chemosynthetic communities are isolated areas involving thin veneers of sediment only a few meters thick. Seepage from hydrocarbon seeps tends to be diffused through the overlying sediment, so the corresponding hydrocarbon seep communities tend to be larger (a few hundred meters wide) than chemosynthetic communities found around the hydrothermal vents of the Eastern Pacific (MacDonald, 1992). There are large differences in the concentrations of hydrocarbons at seep sites.*

The widespread nature of Gulf of Mexico chemosynthetic communities was first documented during contracted investigations by the Geological and Environmental Research Group (GERG) of Texas A&M University for the Offshore Operators Committee (Brooks et al., 1986). The occurrence of chemosynthetic organisms dependent on hydrocarbon seepage has been documented in water depths as shallow as 290 m (Roberts et al., 1990) and as deep as 2,200 m (MacDonald, 1992). This depth range specifically places chemosynthetic communities in the deepwater region of the Gulf of Mexico, which is defined as water depths greater than 305 m (1,000 It). Chemosynthetic communities are not found on the continental shelf. At least 43 communities are now known to exist in 41 OCS blocks. Although a systematic survey has not been done to identify all chemosynthetic communities in the Gulf, there is evidence indicating that many more such communities exist. The depth limits of discoveries probably reflect the limits of exploration (lack of submersibles capable of depths over 1,000 m). MacDonald et al. (1993 and 1996) have analyzed remote sensing images from space that reveal the presence of oil slicks across the northcentral Gulf of Mexico. Results confirmed extensive natural oil seepage in the Gulf, especially in water depths greater than 1,000 m. A total of 58 additional potential locations were documented where seafloor sources were capable of producing perennial oil slicks (MacDonald et al., 1996). Estimated seepage rates ranged from 4 to 70 bbl/day compared to less than 0.1 bbl/day for ship discharges (both normalized for 1,000 mi2 (3,430 km2)). This evidence considerably increases the area where chemosynthetic communities dependent on hydrocarbon seepage may be expected. The densest aggregations of chemosynthetic organisms have been found at water depths of around 500 m and deeper. The best known of these communities was named Bush Hill by the investigators who first described it (MacDonald et al., 1989). It is a surprisingly large and dense community of chemosynthetic tube worms and mussels at a site of natural petroleum and gas seepage over a salt diapir in Green Canyon Block 185. The seep site is a small knoll that rises about 40 m above the surrounding seafloor in about 580m water depth.

Stability

According to Sassen (1997) the role of hydrates at chemosynthetic communities has been greatly underestimated. The biological alteration of frozen gas hydrates was first discovered during the recent MMS study "Stability and Change in Gulf of Mexico Chemosynthetic Communities." It is hypothesized (MacDonald, 1998) that the dynamics of hydrate alteration could play a major role as a mechanism for regulation of the release of hydrocarbon gases to fuel biogeochemical processes and could also play a substantial role in community stability Recorded, bottom water temperature excursions of several degrees in some areas such as the Bush Hill site (45 °C at 500m depth) are believed to result in dissociation of hydrates, resulting in an increase in gas fluxes (MacDonald et al., 1994). Although not as destructive as the volcanism at vent sites of the midocean ridges, the dynamics of shallow hydrate formation and movement will clearly affect sessile animals that form part of the seepage barrier. There is potential of a catastrophic event where an entire layer of shallow hydrate could break free of the bottom and result in considerable impact to local communities of chemosynthetic fauna. At deeper depths (>1,000 m), the bottom water temperature is colder (by approximately 3°C) and undergoes less fluctuation. The formation of more stable and probably deeper hydrates influences the flux of light hydrocarbon gases to the surface, thus influencing the surface morphology and characteristics of chemosynthetic communities. Within complex communities such as Bush Hill, oil seems less important than previously thought (MacDonald, 1998).

Through taphonomic studies (death assemblages of shells) and interpretation of seep assemblage composition from cores, Powell (1995) reported that, overall, seep communities were persistent over periods of 5001,000 years. Some sites retained optimal habitat over geological time scales. Powell reported evidence of mussel and clam communities persisting in the same sites for 5004,000 years. Powell also found that both the composition of species and trophic tiering of hydrocarbon seep communities tend to be fairly constant across time, with temporal variations only in numerical abundance. He found few cases in which the community type changed (from mussel to clam communities, for example) or had disappeared completely. Faunal succession was not observed. Surprisingly, when recovery occurred after a past destructive event, the same chemosynthetic species reoccupied a site. There was little evidence of catastrophic burial events, but two instances were found in mussel communities in Green Canyon Block 234. The most notable observation reported by Powell (1995) was the nearly perpetual uniqueness of each chemosynthetic community site.

Precipitation of authigenic carbonates and other geologic events will undoubtedly alter surface seepage patterns over periods of 12 years, although through direct observation, no changes in chemosynthetic fauna distribution or composition were observed at seven separate study sites (MacDonald et al., 1995). A slightly longer period (12 years) can be referenced in the case of Bush Hill, the first community described in situ in

1986. No mass die-off's or largescale shifts in faunal composition have been observed (with the exception of collections for scientific purposes) over the 12year history of research at this site.

Biology

MacDonald et al. (1990) has described four general community types. These are communities dominated by Vestimentiferan tube worms (Lamellibrachia c.f: barhami and Escarpia n.sp.), mytilid mussels (Seep Mytilid Ia, Ib, and III, and others), vesicomyid clams (Vesicomya cordata and Calyptogena ponderosa), and infaunal lucinid or thyasirid clams (Lucinoma sp. or Thyasira sp.). These faunal groups tend to display distinctive characteristics in terms of how they aggregate, the size of aggregations, the geological and chemical properties of the habitats in which they occur and, to some degree, the heterotrophic fauna that occur with them. Many of the species found at these cold seep communities in the Gulf are new to science and remain undescribed. As an example, at least six different species of seep mussels have been collected but none is yet described.

Individual lamellibranchid tube worms, the longer of two taxa found at seeps (the other is Escarpia sp.) can reach lengths of 3 m and live hundreds of years (Fisher et al., 1997). Growth rates determined from recovered marked tube worms have been variable, ranging from no growth of 13 individuals measured one year to a maximum growth of 20 mm per year in a Lamellibrachia individual. Average growth rate was 2.5 mm/yr for escarpids and 7.1 mm/yr for lamellibrachids. These are slower growth rates than those of their hydrothermal vent relatives, but Lamellibrachia individuals can reach lengths 23 times that of the largest known hydrothermal vent species. Individuals of Lamellibrachia sp. in excess of 3 m have been collected on several occasions representing probable ages in excess of 400 years (Fisher, 1995). Vestimentiferan tube worm spawning is not seasonal and recruitment is episodic.

Growth rates for methanotrophic mussels at cold seep sites have recently been reported (Fisher, 1995). General growth rates were found to be relatively high. Adult mussel growth rates were similar to mussels from a littoral environment at similar temperatures. Fisher also found that juvenile mussels at hydrocarbon seeps initially grow rapidly, but the growth rate drops markedly in adults; they grow to reproductive size very quickly. Both individuals and communities appear to be very long lived. These methanedependent mussels (Type Ia) have strict chemical requirements that tie them to areas of the most active seepage in the Gulf of Mexico. As a result of their rapid growth rates, mussel recolonization of a disturbed seep site could occur relatively rapidly. There is some early evidence that mussels also have some requirement of a hard substrate and could increase in numbers if suitable substrate is increased on the seafloor (Fisher, 1995).

Unlike mussel beds, chemosynthetic clam beds may persist as a visual surface phenomenon for an extended period without input of new living individuals because of low dissolution rates and low sedimentation rates. Most clam beds investigated by Powell (1995) were inactive. Living individuals were rarely encountered. Powell reported that over a 50year timespan, local extinctions and recolonization should be gradual and exceedingly rare.

Extensive mats of free-living bacteria are also evident at hydrocarbon seep sites. These bacteria may compete with the major fauna for sulfide and methane energy sources and may also contribute substantially to overall production (MacDonald, 1998). The white "nonpigmented" mats were found to be an autotrophic sulfur bacteria Beggiatoa species, and the orange mats possessed an unidentified nonautotrophic metabolism (MacDonald, 1998).

Preliminary information has been presented by Carney (1993) concerning the nonchemosynthetic animals (heterotrophs) found in the vicinity of hydrocarbon seeps. Heterotrophic species at seep sites are a mixture of species unique to seeps and those that are a normal component from the surrounding environment. Carney reports a potential imbalance that could occur as a result of chronic disruption. Because of sporadic recruitment patterns, predators could gain an advantage, resulting in exterminations in local populations of mussel beds.

The following descriptions of nonchemosynthetic communities in the deepwater Gulf of America are taken from pages IV14 to IV16 in: *Gulf of Mexico Deepwater Operations and Activities, Environmental Assessment (MMS, 2000)*:

Nonchemosynthetic Benthic Communities
Description

More than chemosynthetic communities are found on the bottom of the deep Gulf of Mexico. Other types of communities include the full spectrum of living organisms also found on the continental shelf or other areas of the marine environment. Major groups include bacteria and other microbenthos, meiofauna (0.0630.3 mm), macrofauna (greater than 0.3 mm), and megafauna (larger organisms such as crabs, sea pens, crinoids, demersal fish, *etc.). All of these groups are represented throughout the entire Gulf from the continental shelf to the deepest abyss of the Gulf at about 3,850 m (12,630 fit). Enhanced densities of these heterotrophic communities (nonchemosynthetic) occurring in association with chemosynthetic communities have been described (Carney, 1993). Some of these heterotrophic communities found at and near seep sites are a mixture of species unique to seeps and those that are a normal component from the surrounding environment. Because of their very close proximity to chemosynthetic communities, their relevance (and possible impact mitigation) is best considered as part of the previous chemosynthetic community analysis and associated mitigation measures (e.g., NTL 98*

There are also rare examples of deepwater communities that would not be considered typical of the deep Gulf of Mexico continental slope. One example is represented by what was reported as a deepwater coral reef by Moore and Bullis (1960). In an area measuring 300 m in length and more than 20 nmi from the nearest known chemosynthetic community (Viosca Knoll Block 907), a trawl collection from a depth of 421 512 m retrieved more than 300 pounds of the scleractinian coral Lophelia prolifera. This type of unusual and unexpected community may exist in many other areas of the deep Gulf of Mexico. Because of the difficulty and expense of exploring the deep sea, only a very small percentage of the bottom has been studied below a depth of 300 m.

Past Research

The first substantial collections of deep Gulf benthos were made during the cruises of the U.S. Coast and Geodetic Steamer Blake between 1877 and 1880. Rowe and Menzel (1971) reported that their deep Gulf of Mexico infauna data were the first quantitative data published for this region. Pequegnat (1983) summarized this early work including research through the early 1970's and his own data from research at 264 stations across the deep Gulf in the 1960's at depths ranging from 150 to 3,850 m. The Pequegnat final report for MMS, primarily qualitative in nature, first described numerous hypotheses of depth zonation patterns and aspects of faunal differences between the eastern and western Gulf of Mexico.

The first major quantitative deepwater benthos study in the Gulf of Mexico was that of LGL Ecological Research Associates Inc. (Gallaway et al., 1988) as part of the MMS Northern Gulf of Mexico Continental Slope Study. This multiyear project is certainly the most comprehensive of all previous research in the Gulf of Mexico deep sea. Gallaway et al. (1988) reported that after their benthic study results, it was possible to predict with a reasonable degree of certainty the basic composition of the faunal communities on the northern Gulf of Mexico slope between 300 and 2,500 m between 85° and 94° W. longitude, approximately 75 percent of the northern Gulf slope area. There was a reasonable degree of agreement between the faunal distribution results of the LGL study (Gallaway et al., 1988) and Pequegnat (1983). Because of the fact that the deep Gulf has only recently been investigated in any systematic way, a large number of species obtained during the LGL/MMS study were new to science.

Bacteria

Limited research has been done on bacteria in the deep sea and especially in the deep Gulf of Mexico. Controls of bacterial abundance in marine sediments remain poorly understood (Schmidt et al., 1998). Recent results also reported by Schmidt et al. (1998) suggest that bacterial abundance is relatively constant over a wide variety of geographic regions when direct bacterial counts are scaled to fluid volume (pore water) compared to the traditional dimension of dry sediment mass. In any event, the counts of bacteria in marine sediments center around 10 bacteria per ml fluid volume, in other words, literally trillions per m2.

Meiofauna

The density of meiofauna was reported as approximately two orders of magnitude greater than the density of macrofauna throughout the depth range of the Gulf of Mexico continental slope by LGL/MMS (Gallaway et al., 1988). Overall mean abundance was 707 individuals per 10 cm2 (707,000 per m2). Densities were generally similar to those previously reported and generally decreased with increasing depth. A total of 43 major groups were identified. Of these, representatives of five taxa of permanent meiofauna (Nematode, Harpacticoidea, Polychaeta, Ostracoda, and Kinorhyncha), along with naupliar larvae (temporary meiofauna), comprised 98 percent of the collections as reported by Gallaway et al. (1988). The range of density values obtained for meiofauna varied by one order of magnitude. Some comparisons with depth showed a decisive decrease of abundance with depth (at the 5% statistical level), but this trend was not consistent through all seasons and areas of the Gulf.

Macrofauna

Gallaway et al. (1988) reported a total of 1,569 different taxa of macrofauna on the continental slope, 90 percent of those identified to the level of genus or species. Nearly all macrofaunal species were infaunal invertebrates, although some taxa were normally found in surficial sediments, considered nominally epifaunal or surface dwelling. The major group was annelid taxa including 626 ~olychette taxa. Overall abundance of macrofauna ranged from 518 to 5,369 individuals per m. Overall, there was a general pattern of decreased macrofaunal density with depth.

Megafauna

Megafauna collections were made utilizing two techniques in Gallaway et al. (1988), benthic photography and the use of an otter trawl ranging in depth between 300 and 2,882 m. Based on fish and invertebrates collected by trawling, invertebrates were four to five times more abundant than benthic fishes throughout all transects and designated depth zones. Other trends included higher densities of all megafauna in the study's eastern Gulf transect area (between 85°40' and 85°15' W.) and lowest in the central area (between 89°40' and 89°20' W.), and a tendency of densities to decrease below a depth of 1,550 m. Overall, benthic fish densities ranged from 0 to 704 fish per hectare (10,000 m2). Overall megafauna invertebrates ranged from 0 to 4,368 individuals per hectare. Results of the LGL studies (Gallaway et al., 1988) supported the zonation scheme proposed by Pequegnat (1983).

All 60 stations in the MMS continental slope study (Gallaway et al., 1988) were also sampled by quantitative photographic methods. Although up to 800 images were obtained at each of the stations, due to the relatively small area "sampled" by each photograph (approximately 2 m2), abundance of most megafauna taxa was low. Megafauna that did appear in benthic photographs generally indicated much higher densities than that obtained by trawling, with variations being more than four orders of magnitude in some cases. Overall density from photography was 8,449 animals per ha. The highest density of any organism sampled by photography was that of a small sea cucumber (never obtained by trawling) resulting in a peak density of 154,669 individuals per ha.

While the previous groups of sediment dwelling organisms could be considered immobile and unable to avoid disturbances caused by OCS activities, megafauna could be categorized into two groups: a nonmotile or very slow-moving group including many invertebrates, and a motile group including fish, crustaceans, and some other types of invertebrates such as semi pelagic sea cucumbers.

Factor Five: The existence of special aquatic sites including, but not limited to, marine sanctuaries and refuges, parks, national and historic monuments, national seashores, wilderness areas, and coral reefs;

The Flower Garden Banks has been determined to be a National Marine Sanctuary and is within the geographical area covered under this permit. This permit action does not authorize discharges in Areas of Biological Concern and National Marine Sanctuaries. Also, facilities which adversely affect properties listed or eligible for listing in the National Register of Historic Places are not authorized to discharge under this permit.

Factor Eight: Any applicable requirements of an approved Coastal Zone Management plan.

The Environmental Protection Agency (EPA) determined that activities authorized by this reissued permit are consistent with the local and state Coastal Zone Management Plans. Both the Louisiana Department of Natural Resources and the Railroad Commission of Texas concurred with the EPA's consistency determination when EPA reissued previous permits. Letters to request for consistency determination were sent to state agencies for concurrence during the public comment period.

Factor Ten: Marine water quality criteria developed pursuant to Section 304(a)(1).

Compliance with Federal water quality criteria and State water quality standards at the edge of a 100-rn mixing zone was assessed in the 1991 ODCE. The Federal marine water quality criteria for aquatic life (acute and chronic) and human health (for fish consumption) are presented in Table 3 for pollutants present in drilling fluids and produced water. Discharges of drilling fluids and produced water covered by the OCS general permit will occur in Federal waters outside the boundaries of state waters. Issuance of the permit does not require compliance of State water quality standards.

Table 3. Federal Water Quality Criteria

Pollutant	Marine (Aquatic Life) Acute Criteria (pg/l)	Marine (Aquatic Life) Chronic Criteria (pg/I)	Human Health (Fish Consumption) Criteria (pg/I)
Organics			

Benzene	(5,100)b	(255)	40
Bis(2-cthylhexyl)phthalate	300,000	3,000	5.88
Ethylbenzene	(430)	(21.5)	3,280
Naphthalene	(380)	(3.8)	27,000
Phenol	(5,800)	(290)	769,000
Toluene	(3,700)	(3,200)	424,000
Metals			
Arsenic	69	36	.0175
Cadmium	43	9.3	NAc
Lead	140	5.6	NA
Mercury	2.1	0.025	0.146
Zinc	95	86	NA

a Source: U.S. EPA, 1989.
b ()indicates a lowest observed effect level.
c NA: Not Available.

Using the number of dilutions and dispersions available for average case drilling fluid discharge scenarios (898 dilutions and 4,203 dispersions; see Section 4.2.3 of 1991 ODCE), ambient concentrations are projected for at the edge of a 100-rn mixing zone. A comparison of the projected ambient pollutant concentrations for both muds with and without lubricity (mineral oil) with Federal water quality criteria is presented in Table 9-2.

Table 9-2 Drilling Fluid Pollutant Concentrations Compared to Federal Water Quality Criteria

Pollutant	Effluent Concentration (µg/l)	Ambient Concentration (µg/l) a	Marine Acute Criteria (µg/l)	Marine Chronic Criteria (µg/l)	Human Health Criteria (µg/l)
Drilling Fluids with No Lubricity					
Arsenic	6,160	1.47 b	69	36	0.0175
Cadmium	531	0.126	43	9.3	NA c
Copper	6920	1.65	2.9	2.9	NA
Lead	26,700	6.359	140	5.6	NA
Manganese	9,570	2.28	NA	NA	100
Mercury	488	0.116	2.1	0.025	0.146

Zinc	109,000	25.9	95	86	NA
Drilling Fluids with Lubricity and a Pill (Mineral Oil)					
Arsenic	17,200	4.09 b	69	36	0.0175
Cadmium	1,480	0.352	43	9.3	NA
Copper	19,300	4.59	2.9	2.9	NA
Lead	74,400	17.7 d	140	5.6	NA
Manganese	26,700	6.35	NA	NA	100
Mercury	1,360	0.324 e	2.1	0.025	0.146
Zinc	305,000	72.6	95	86	NA
Naphthalene	1,580	1.76	380	3.8	27,000

a Ambient concentrations are calculated for the edge of a 100-meter mixing zone as the effluent concentration ÷ number of dispersions available for metals (4,203) or dilutions available for organics (898).

b The ambient concentration of arsenic is higher than the human health criterion (for fish consumption) by a factor of 84 for muds with no lubricity and a factor of 234 for muds with lubricity and a pill.
c NA = Not Available.
d The ambient concentration of lead is higher than the marine chronic criterion by a factor of 1.1 for muds without lubricity and a factor of 3 for muds with lubricity and a pill.
e The ambient concentration of mercury is higher than the marine chronic criterion by a factor of 5 for muds without lubricity and for muds with lubricity and a pill, the marine chronic criterion is exceeded by a factor of 13 and the human health criterion by a factor of 2.
f The ambient concentration of copper is higher than the marine chronic and the marine acute criteria both by a factor of 2.

Ambient concentrations of arsenic are higher than the human health criterion for both muds without lubricity (by a factor of 84) and muds with lubricity (by a factor of 234). The marine chronic criterion for lead is exceeded by the ambient concentration by a factor of 1.1 for muds without lubricity (which, given the level of this analysis, would not be significantly higher than a rounding error) and by a factor of 3 for muds with lubricity added. Mercury ambient concentrations exceed the marine chronic criterion also. These values are higher than the criterion by a factor of *5* for muds without lubricity and a factor of 13 for muds with lubricity. The muds with lubricity also failed to meet the human health criterion for mercury by a factor of 2. The ambient concentration of copper in muds with lubricity exceeded the marine acute and the marine chronic criteria by a factor of 2.

For produced water, the average ease discharge scenario used for comparisons at the edge of a 100 m mixing zone was based on the modeling results presented in Section 4 of this document (see Table 4-12) and the average case as documented in EPA (1985). This average case, based on an industry-wide 30-well survey, is characterized by an average discharge rate of 9,577 bbl/hr. For a 10,000 bbl/br discharge rate, the average number of dilutions available used for estimation of pollutant concentrations is 222. The comparison of the ambient concentrations of pollutants with the Federal water quality criteria is presented in Table 9- 3.

Table 9-3. Produced Water Pollutant Concentrations Compared to Federal Water Quality Criteria

			Federal Water Quality Criteria (µg/l)

Pollutant	Effluent Conc. (pg/i)	Ambient Conc. a (pg/i)	Marine Acute Criteria	Marine Chronic Criteria	Human Health Criteria
ORGANICS				.	
Beuzene	1,829	824	5,100	255	40
Ethylbenzene	505	227	430	21.5	3,280
Naphthalene	138	0.622	380	3.8	27,000
Toluene	1,545	6.99	3,700	3,200	424,000
Bis(2-ethylhexyl) phthalate	101	0A55	300,000	3,000	5.88
Phenol	953	4.29	5,800	290	769,000
m-xylene	153	0.689	3,700	37	677
2-Butanone	1,670	7.52	1,950,000	97,500	462,000
METALS					
Arsenic	309	139'	69	36	0.0175
Copper	113	0.509	2.9	23	NA b
Zinc	2,360	10.6	95	86	NA

a Effluent concentration values are divided by the number of dilutions predicted by the UDKHDEN model at 100 meters from the discharge point (222 dilutions).
b NA = Not Available.
c The ambient concentration of arsenic exceeds the human health criterion by a factor of 80.
The projected ambient concentration of arsenic at 100 m from the discharge point exceeds the human health criterion (for fish consumption) by a factor of 80. All other projected ambient pollution concentrations are at levels below their respective criteria.

The 2017 general permit authorized discharges of small amounts of non-aquatic-based drilling fluids that are adhered to marine risers, diverter systems testing, and blow-out preventers (BOPs) in the category of de minimis discharges and clarifies the quantity of de minimis discharge to discharges that do not include any discharges of leakages.

The 2012 permit required operators to conduct a water-based drilling fluid characterization study so that the EPA may evaluate whether or not to establish chemical-specific effluent limitations for drilling fluids is necessary in order to further protect aquatic life. The EPA received 25 total metal data sets, 5 dissolved metal data sets, and 84 total metal data sets in solid-phase. Ranges of drilling fluid data reported for each metal are shown in the following table:

Table 4. Summary of Drilling Fluid Characterization Study Data

Constituent	Marine Chronic Criteria (Dissolved) (mg/l)*	Concentration in Total Form (mg/l)	Concentration in Dissolved Form (mg/l)	Concentration Range in Solid Phase (mg/kg)
Arsenic	0.036	0.001 - 16.0	0.00314 – 0.527	< 0.1 – 88.8
Cadmium	0.0088	0.0008 – 0.282	0.0073 - < 0.20	0.045 - < 2.27
Chromium IV	0.050	0.004 - < 2.0	<0.004 - < 0.04	< 0.68 – 11.4
Copper	0.0031	0.001 - 42.3	<0.02 - < 0.95	<0.1 – 97.0
Free Cyanide	0.001	0.02 - < 1.93	<0.02 - 0.20	0.0235 - < 1.99
Lead	0.0081	0.007 - 115	0.0115 – 5.57	1.67 – 490
Mercury	0.00094	0.000042 - 0.244	0.000076 - 0.00976	<0.0009 – 0.624
Nickel	0.0082	0.005 - 4.14	<0.01 - < 0.25	<0.499 – 12.5
Selenium	0.071	0.001 - < 0.5	0.0118 - < 0.25	< 0.17 - < 2.27
Silver	Not Established	0.0008 - < 0.5	<0.0016 – 0.261	0.0723 – 3.0
Zinc	0.081	0.0025 - 57.4	0.0389 – 2.4	1.56 – 218

EPA's National Recommended Water Quality Criteria
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm#altable

Analysis of the total form of metal, instead of dissolved form, was permitted because laboratories had difficulty filtering drilling fluids to obtain dissolved metal concentrations due to the viscous nature of the fluids. Using the average dilution or dispersion values available for drilling fluid discharge scenarios (898 dilutions for organics and 4,203 dispersions for metals; see Section 4.2.3 of 1991 Ocean Discharge Criteria Evaluation), ambient concentrations could be projected at the edge of a 100-rn mixing zone. Based on dissolved concentrations shown above, a discharge of drilling fluid would be unlikely to cause exceedance of federal water quality criteria, which are established in dissolved metal form, at the edge of mixing zone. EPA has determined not to retain the current characterization study requirement.

The 2012 issued permit also required operators to conduct a produced water characterization study so EPA may evaluate whether discharges of produced water will cause exceedance of national water quality criteria or not. Based on data from 10 individual reports and one joint report (about 40 participants) received by EPA, the range of concentrations reported for each metal is listed as below:

Table 5. Summary of Produced Water Characterization Study Data

Constituent	Concentration Range (mg/l)	Marine Chronic Criteria (mg/l)*
Dissolved Arsenic	< 0.05 – 0.106	0.036
Dissolved Cadmium	< 0.01 – 0.05	0.0088
Dissolved Chromium VI	< 0.01	0.050
Dissolved Copper	< 0.035 – 0.05	0.0031
Free Cyanide	0.0047 – 0.253	0.001
Dissolved Lead	< 0.035 – 0.05	0.0081
Dissolved Mercury	< 0.000042 – 0.005	0.00094
Dissolved Nickel	< 0.05 - < 0.4	0.0082
Dissolved Selenium	0.05 – 0.19	0.071
Dissolved Silver	< 0.04 - < 0.1	Not Established
Dissolved Zinc	0.005 – 2.95	0.081

- EPA's National Recommended Water Quality Criteria http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm#altable

The criteria dilution range listed in the permit for produced water at the edge of 100-meter mixing zone is between 0.07 % and 11.72 % depending on discharge rate, pipe size and the distance of discharge point from sea floor. (For example, the critical dilution ranges for the average rate of 10,000 bbl/day from 0.39% in deep water to 3.39% in shallow water.) In the worst scenario for high discharge volumes (> 50,000 bbl/day) within a shallow depth of waterbody, there may be the potential to cause exceedance of water quality criteria at the edge of mixing zone. For instance, copper, cyanide, nickel and zinc may exceed the federal recommended criteria at the worst scenario of 11.72 % critical dilution. EPA has used the 7-day chronic toxicity testing to detect an aggregate effect of produced water on aquatic life, and toxic metals or chemicals may cause the failure of toxicity testing. Facilities which discharge 4,600 bbl/day are required to perform toxicity test once a quarter until they pass all tests for the full year. Then, they may conduct annual toxicity test. The current permit states that "This permit may be reopened to require chemical specific effluent limits, additional testing, and/or other appropriate actions to address toxicity." If the discharge of produced water fails its toxicity test, EPA proposes a monthly retest frequency for 7-day toxicity testing until it passes the toxicity retests. EPA also proposes to require a toxicity reduction evaluation (TRE) in case the operator could not quickly identify the cause of testing failure. Each failure of toxicity test is considered a violation of the permit. EPA issued the final rule on Use of Sufficiently Sensitive Test Methods (79 FR 49001) to ensure that analytical methods are sensitive enough to detect pollutants to a level of water quality criteria. EPA proposes that an operator may use analytical methods which are sensitive to detect Minimum Quantification Levels (MQLs) developed by EPA for EPA Region 6's NPDES permits to demonstrate in compliance with the Sufficiently Sensitive Test Methods rule. The operator may also choose other options (e.g., adjust the discharge rate, add a diffuser, etc.) to comply with the toxicity limits. Based on the most recent information available, discharges of produced water and drilling fluids authorized by this permitting action will not likely exceed EPA recommended water quality criteria.