Offshore Information for Area Contingency Planning

Gulf of Mexico

Offshore Worst Case Discharge Scenarios and Modeling

Southeast Texas and Southwest Louisiana ACP (Port Arthur)

Technical Document #2
Appendix 2C

May 2022

Record of Changes

Change Number	Change Description	Section Number	Change Date	Name
1				
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1 Introduction

In 2019, the Bureau of Safety and Environmental Enforcement (BSEE) sponsored a project in cooperation with the United States Coast Guard (USCG) to improve the content of the coastal zone area contingency plans (ACPs) with respect to the information necessary to effectively plan for and respond to large oil spills from offshore oil and gas facilities. This collaboration between BSEE, USCG District Eight, resource trustees, state agencies, oil spill removal organizations (OSROs), and Area Committees resulted in a series of technical documents that provide offshore information for the Gulf of Mexico (GOM) on:

- Oil and Gas Infrastructure (GOM Technical Document #1)
- **Worst Case Discharge Scenarios (GOM Technical Document #2 and Appendices 2A-F)**
- Response Concept of Operations (GOM Technical Document #3)
- Response Strategies and BMPs (GOM Technical Document #4)
- Sensitive Species Profiles (GOM Technical Document #5).

These documents were developed specifically for incorporation by reference into the coastal zone ACPs and are hosted on the BSEE Oil Spill Preparedness Division's (OSPD) website.

The WCD scenario information in Technical Document #2 is organized into three main components: Section 2 contains a description of key modeling concepts and reference scales that are useful for understanding the oil spill trajectory data and figures that have been developed for each of the WCD scenarios. Section 3 contains a series of tables that collate and summarize key information regarding all of the WCD scenarios that were developed for the GOM. Appendices 2A – 2F contain specific, more detailed WCD scenario modeling data and trajectory figures for each of the ACP Planning Areas in the GOM. Appendix 2C contains the modeling information for two offshore WCD Scenarios located in the Southeast Texas and Southwest Louisiana ACP.

2 Genesis Crude Pipeline Discharge

2.1 Scenario Description

The Genesis Crude Pipeline Discharge WCD Scenario is a pipeline discharge with the following key parameters.

Table 1. Scenario Key Parameters.

Discharge Depth (m)	Distance from Shore (NM)	Oil Type	Spill Type	Discharge Duration (days)	Discharge Flowrate (bbl/day)	Total Oil Discharged (bbl)
Surface	12	Med-Light Crude API = 32	Pipeline Discharge	1	21,875	21,875

2.2 Potential Oil Contact with the Environment and Resources at Risk

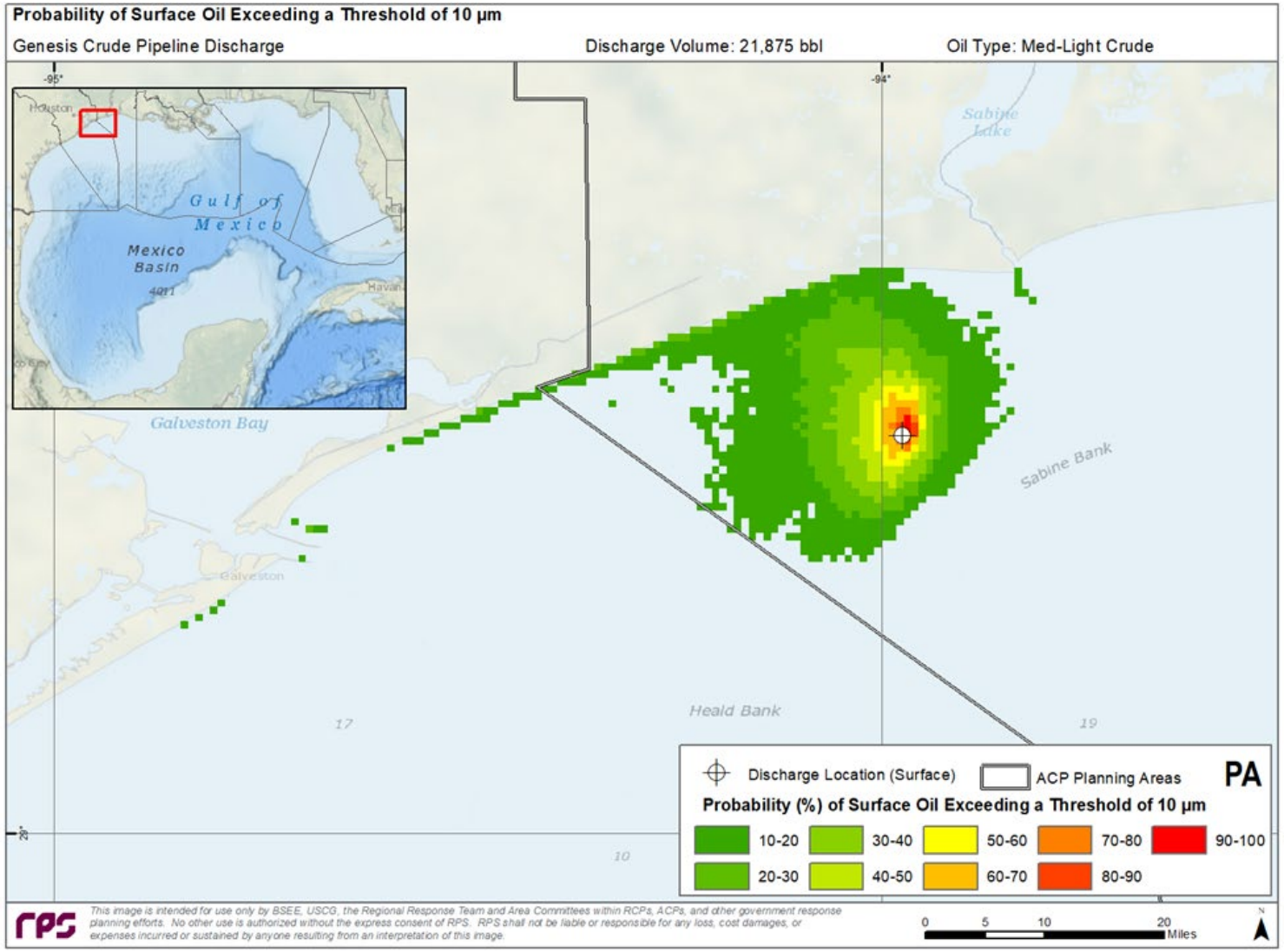

Figure 1. Probability Footprint for Oil on the Water Surface with Average Thickness greater than the Ecological Threshold of 10 µm.

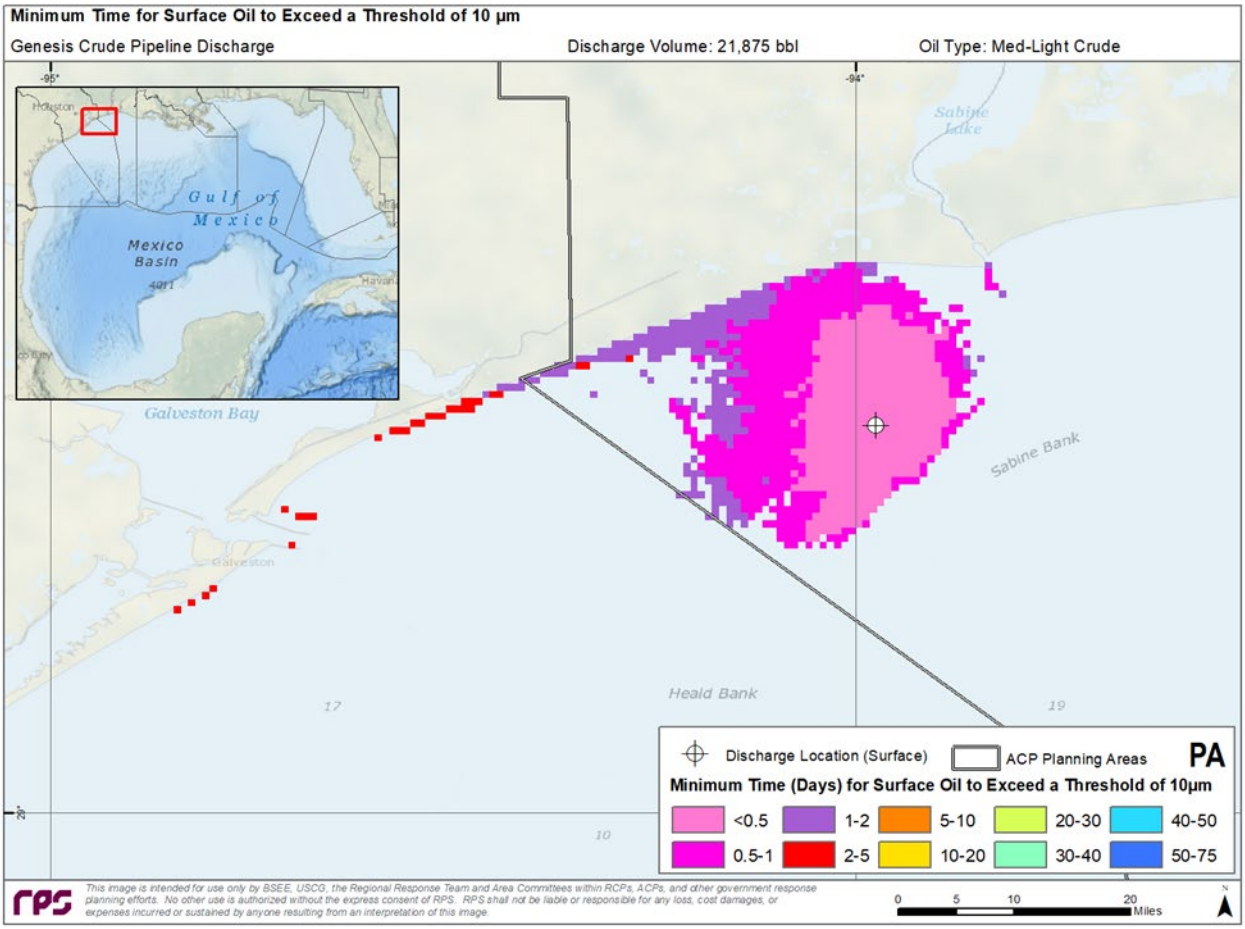

Figure 2. Minimum Travel Time for Oil on the Water Surface with Average Thickness greater than the Ecological Threshold of 10 µm.

Table 2. Oil Spill Stochastic Results – Predicted Shoreline Impacts.

Percentage of Simulations Reaching shore (%)	Percent volume of discharged oil reaching shore (%)		Time to Reach Shore (days)	
	Maximum	Average	Minimum	Average
100	52	32	0.7	2.1

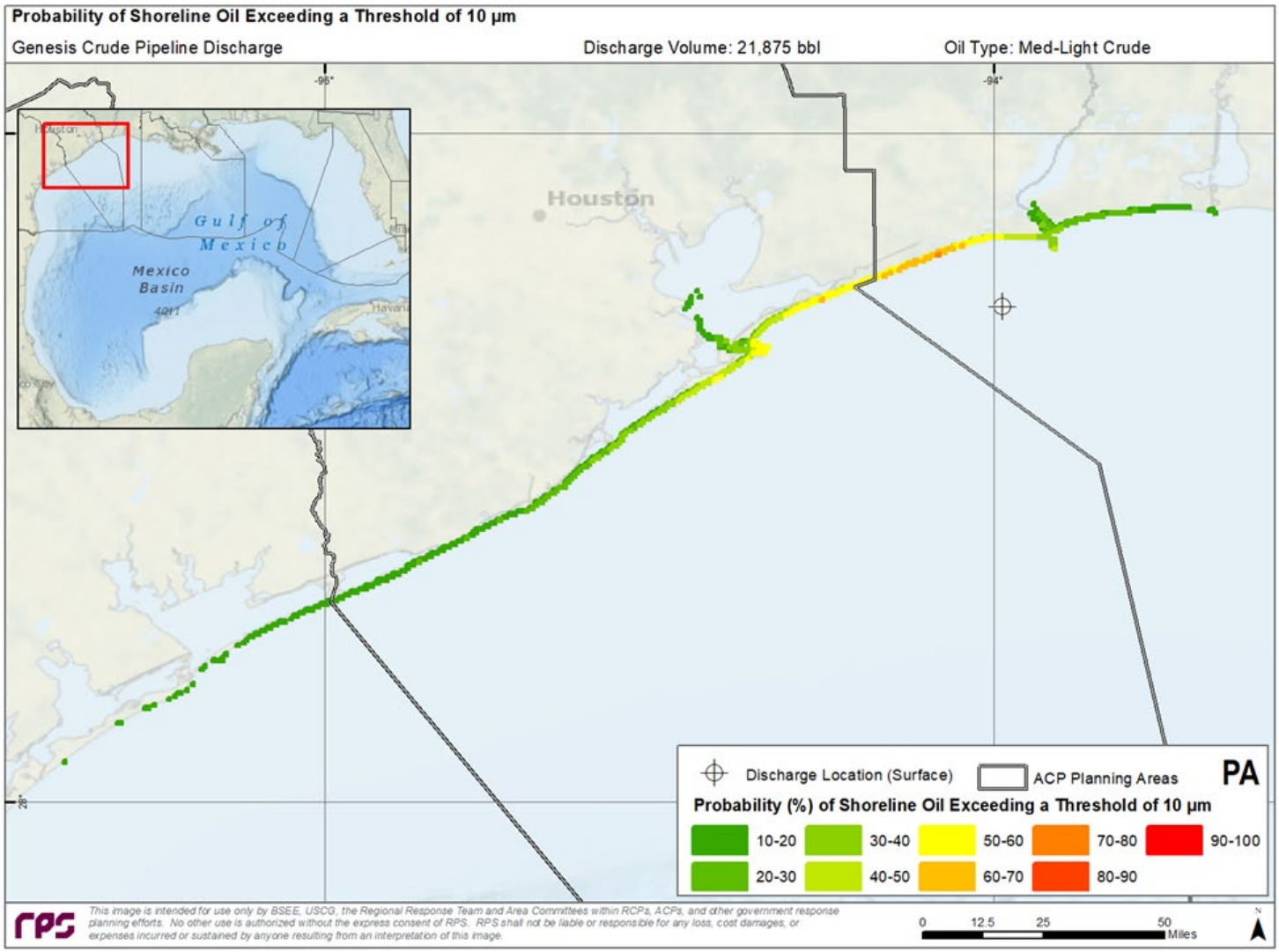

Figure 3. Probability Footprint for Oil on the Shoreline with Average Thickness greater than the Ecological Threshold of 10 µm. This thickness of oil may appear on the shore as dark stain or film. 10 µm is a conservative ecological screening threshold for potential sublethal effects on fauna and birds on the shoreline.

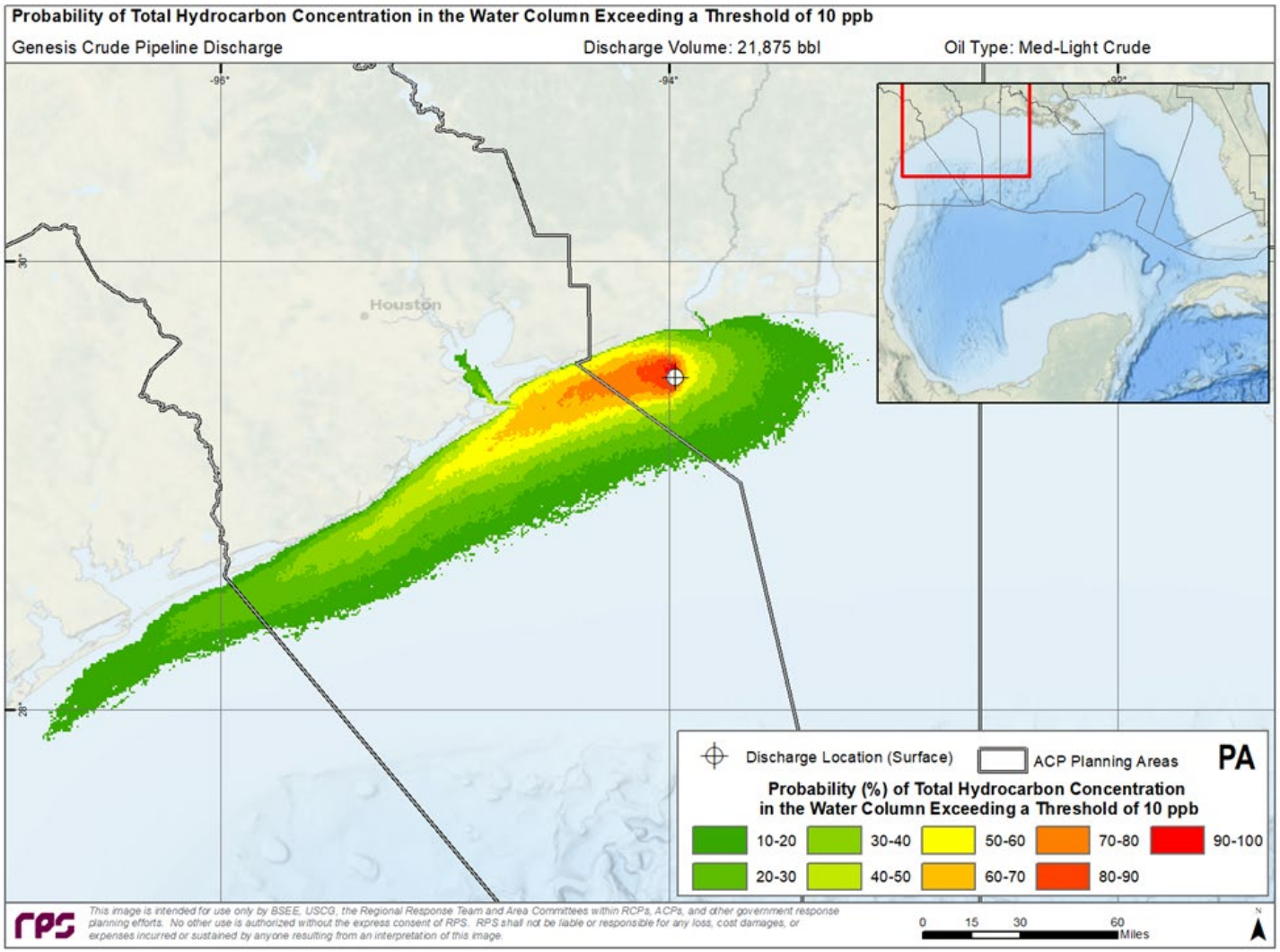

Figure 4. Probability Footprint for Total Hydrocarbon Concentration (THC) concentrations in the Water Column greater than the Ecological Threshold of 10 µg/L (~10 ppb). 10 ppb (µg/L) of whole oil (THC) corresponds to ~0.1 µg/L (~1 ppb) of dissolved Polycyclic Aromatic Hydrocarbons (PAHs) for fresh crude oils. This threshold can result in sublethal impacts to early life stages of fish and invertebrates in the upper ~20 meters of the water column if exposed to UV light.

The "worst case" deterministic simulation is a single oil trajectory run using the time period and ambient conditions that resulted in the greatest length of shoreline oiling. The simulation resulted in oiling in the following cumulative amounts:

- Oiled Surface Area Exceeding 0.04 µm (Socioeconomic Impact) = 10,011 mi2
- Oiled Surface Area Exceeding 10 µm (Ecological Impact) = 139 mi2
- Oiled Shoreline Exceeding 10 µm (Ecological Impact) = 246 mi
- Water Column Oil Exposure Exceeding 10 ppb Dissolved PAH (Ecological Impact) = 309 million m3
- Time to Shore = 5.9 days

These impact values are calculated considering no response measures are taken to secure the source of the spill or to contain, remove, or disperse oil at the scene.

Table 3. Mass balance at the end of the worst case deterministic simulation (% of the total volume of oil discharged*).

Total Oil Discharged	Surface	Evaporated	Water Column	Sediment	Ashore	Degraded
21,875 bbl	<0.1%	38.2%	12.9%	1.2%	18.0%	29.6%

*Important to note these values are not indicative of the maximum amount of oil in each compartment, but instead show the final amount of oil in each compartment.

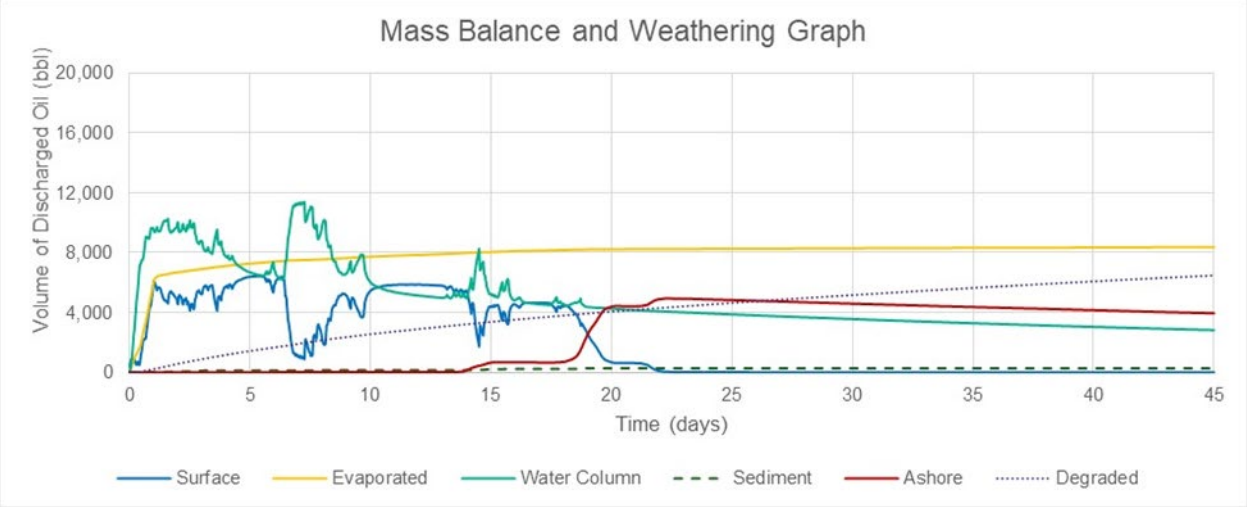

Figure 5. Mass Balance over Time for worst case deterministic simulation.

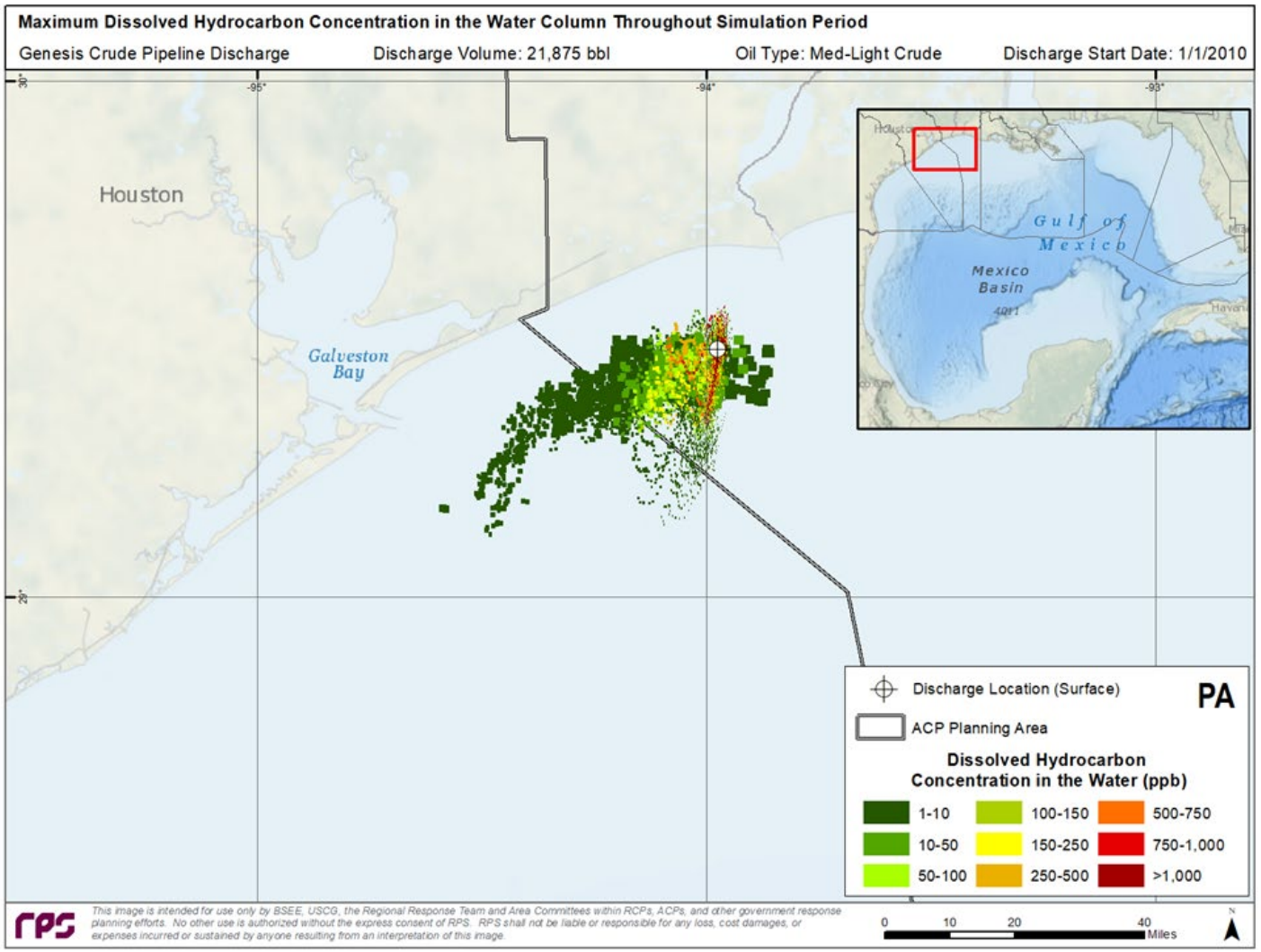

Figure 6. Cumulative Maximum Concentration of Dissolved Polycyclic Aromatic Hydrocarbons (PAH) within the water column at any time during the worst case deterministic simulation period. Dissolved PAH concentrations greater than ~10 µg/L (~10 ppb) could affect plankton in the upper ~20 m and impart sublethal to lethal effects on other water column biota (adult, juvenile fish, and invertebrates).

2.3 Response Planning Information

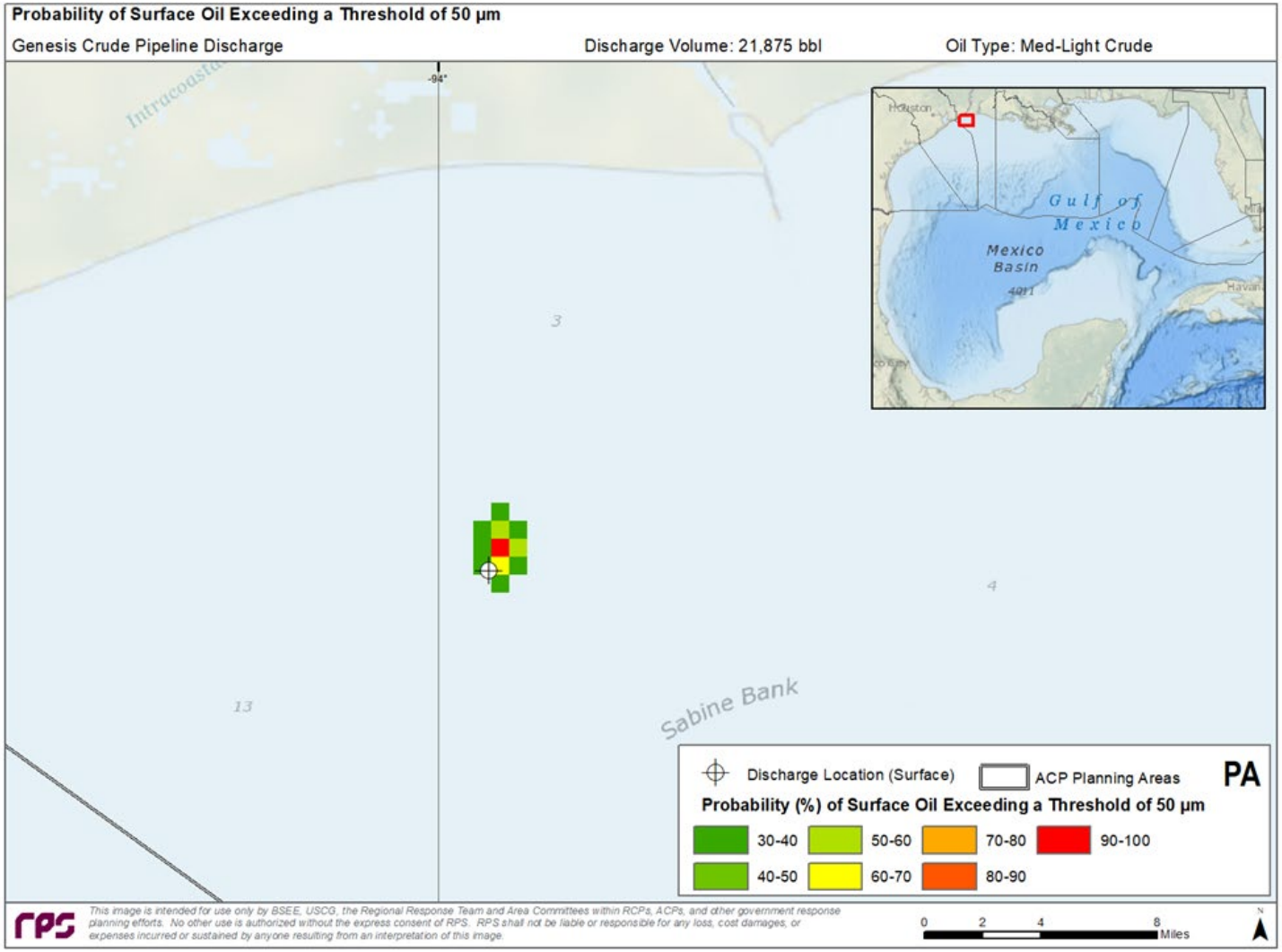

Figure 7. Probability Footprint for Surface Oil exposure greater than 50 µm. In this thickness range, oil will appear as a continuous to discontinuous patches of dark oil in quantities where high volume on-water mechanical recovery operations will be the most productive.

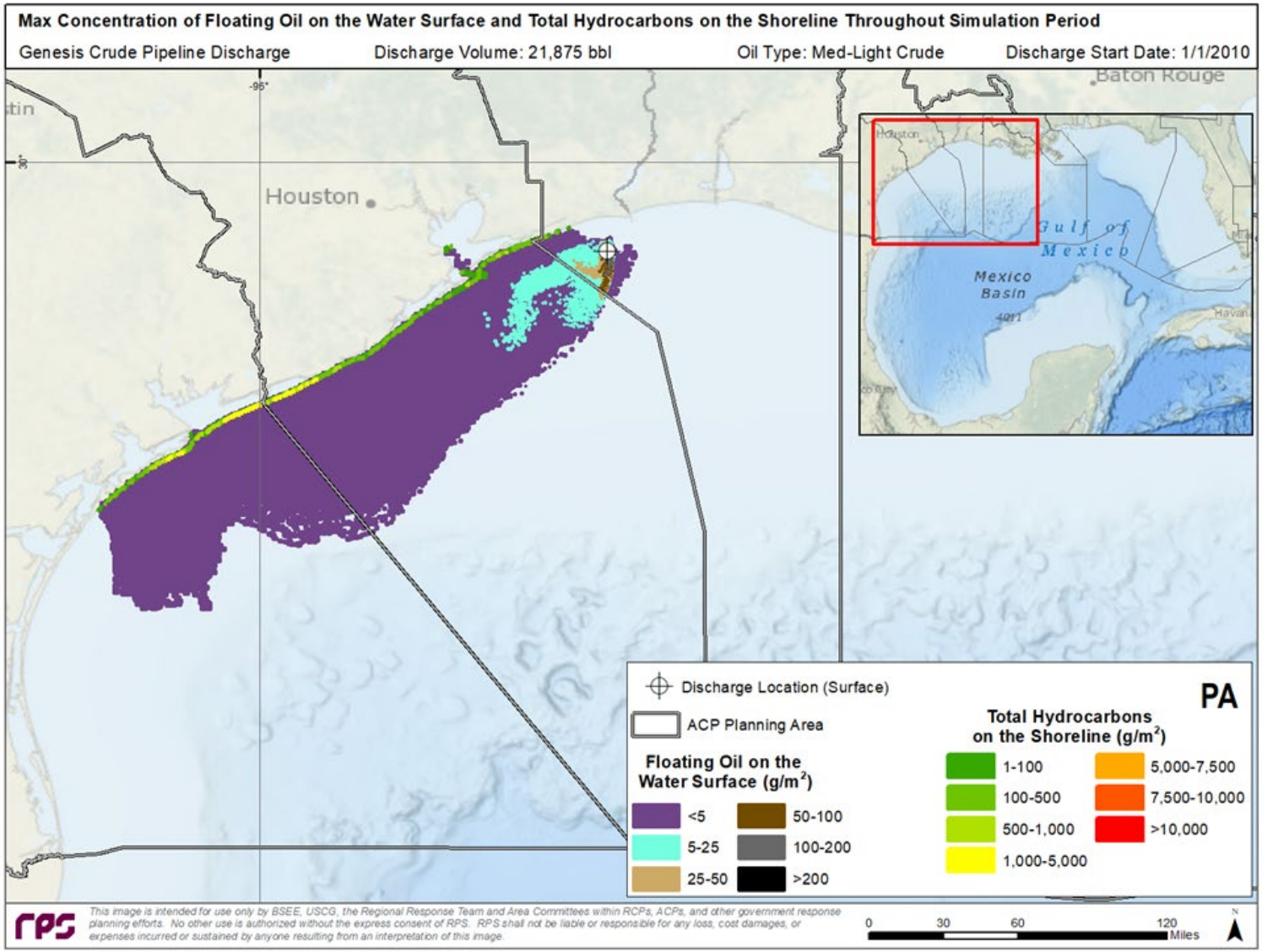

Figure 8. Cumulative Maximum Concentration of Floating Oil on the Water surface and Total Hydrocarbons on the Shoreline at any time during the worst case deterministic simulation.

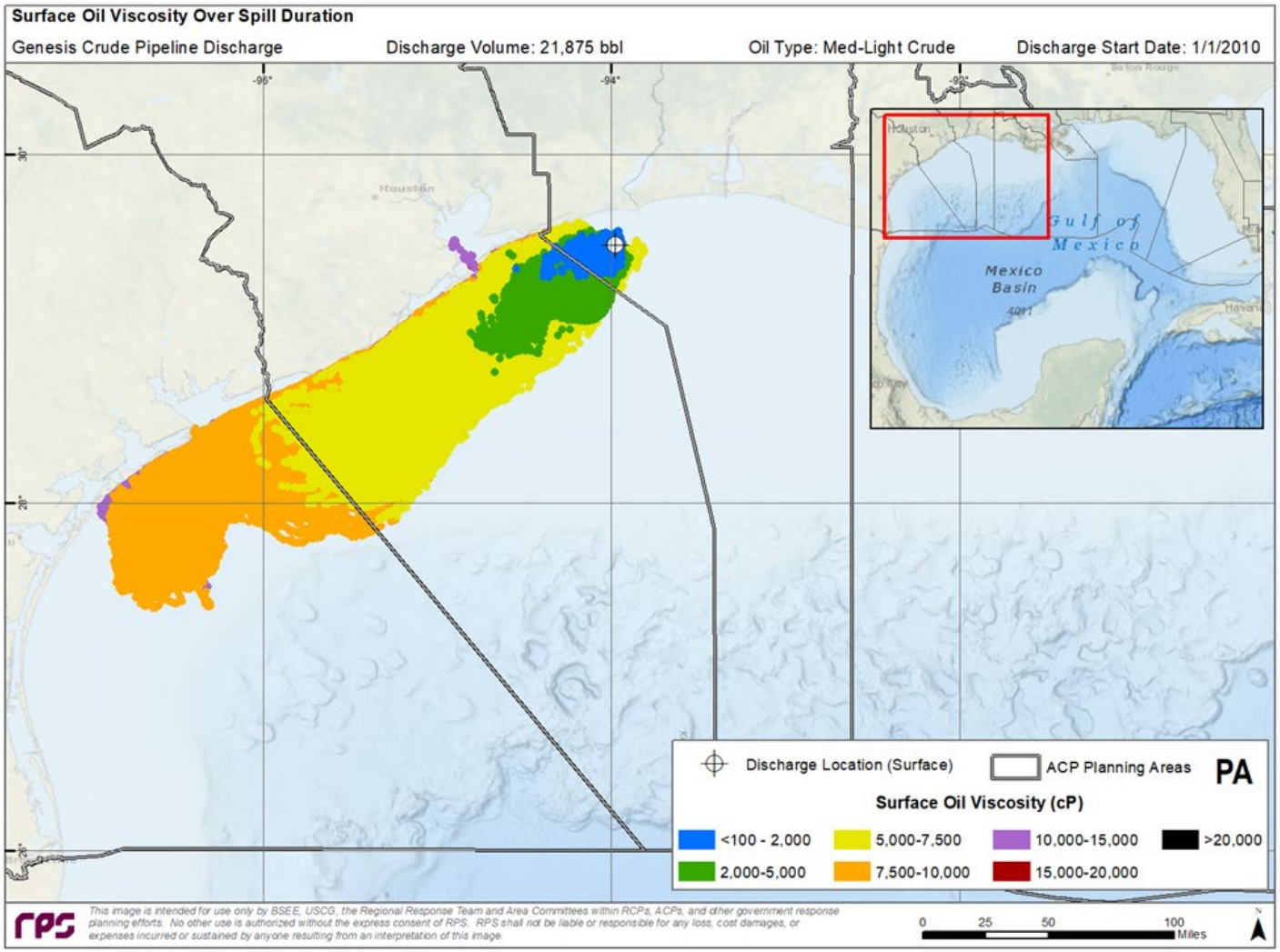

Figure 9. Cumulative footprint of exposure to surface floating oil greater than the minimum oil viscosity over a 45-day period for the worst case deterministic simulation. Viscosities greater than those mapped may be present at any location at any specific time in the simulation. This graphic provides a perspective of how oil viscosity may change as oil is transported away from the discharge site over time, and what areas may be amenable to dispersant operations where enough quantities of oil are present.

3 Kosmos Drilling Sioux Falls SL 1 Well Blowout

3.1 Scenario Description

The Kosmos Drilling Sioux Falls SL 1 Well Blowout WCD Scenario is a subsea well blowout with the following key parameters.

Table 4. Scenario Key Parameters.

Discharge Depth (m)	Distance from Shore (NM)	Oil Type	Spill Type	Discharge Duration (days)	Discharge Flowrate (bbl/day)	Total Oil Discharged (bbl)
589	130	Medium Light Crude API = 35	Subsea Well Blowout	30	354,845	10,645,350

3.2 Potential Oil Contact with the Environment and Resources at Risk

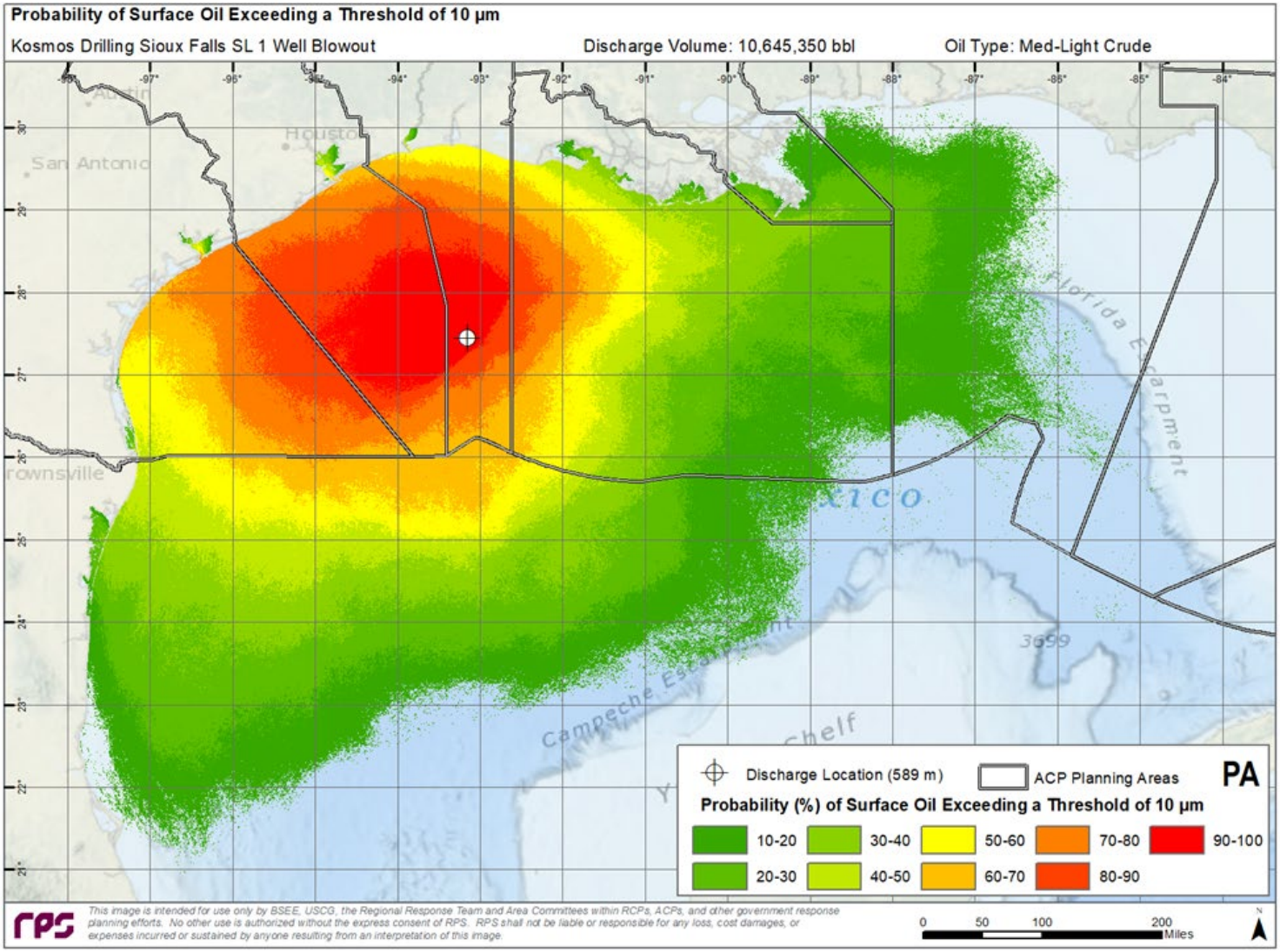

Figure 10. Probability Footprint for Oil on the Water Surface with Average Thickness greater than the Ecological Threshold of 10 µm.

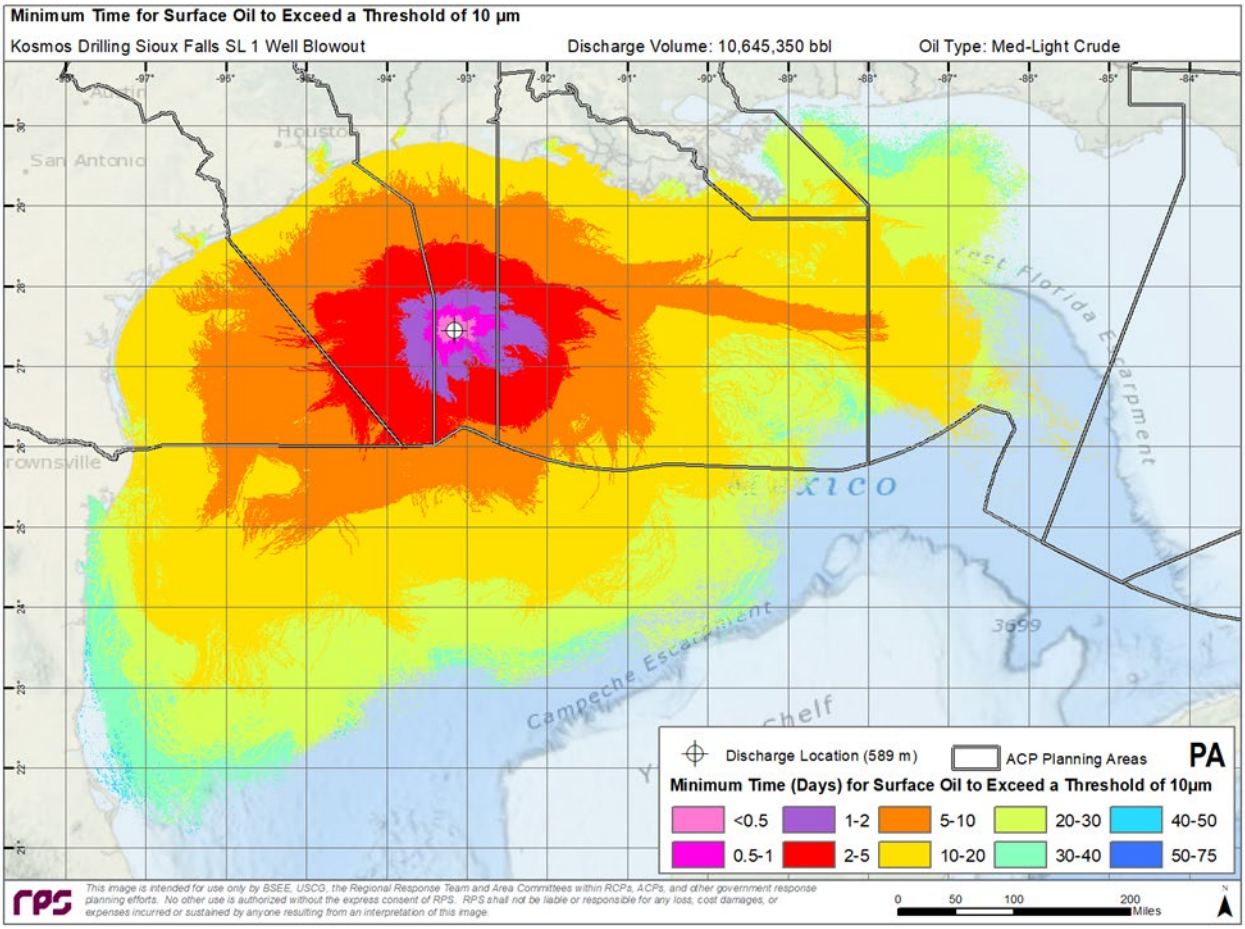

Figure 11. Minimum Travel Time for Oil on the Water Surface with Average Thickness greater than the Ecological Threshold of 10 µm.

Table 5. Oil Spill Stochastic Results – Predicted Shoreline Impacts.

Percentage of Simulations Reaching shore (%)	Percent volume of discharged oil reaching shore (%)		Time to Reach Shore (days)	
	Maximum	Average	Minimum	Average
100	17	6	11.1	23.2

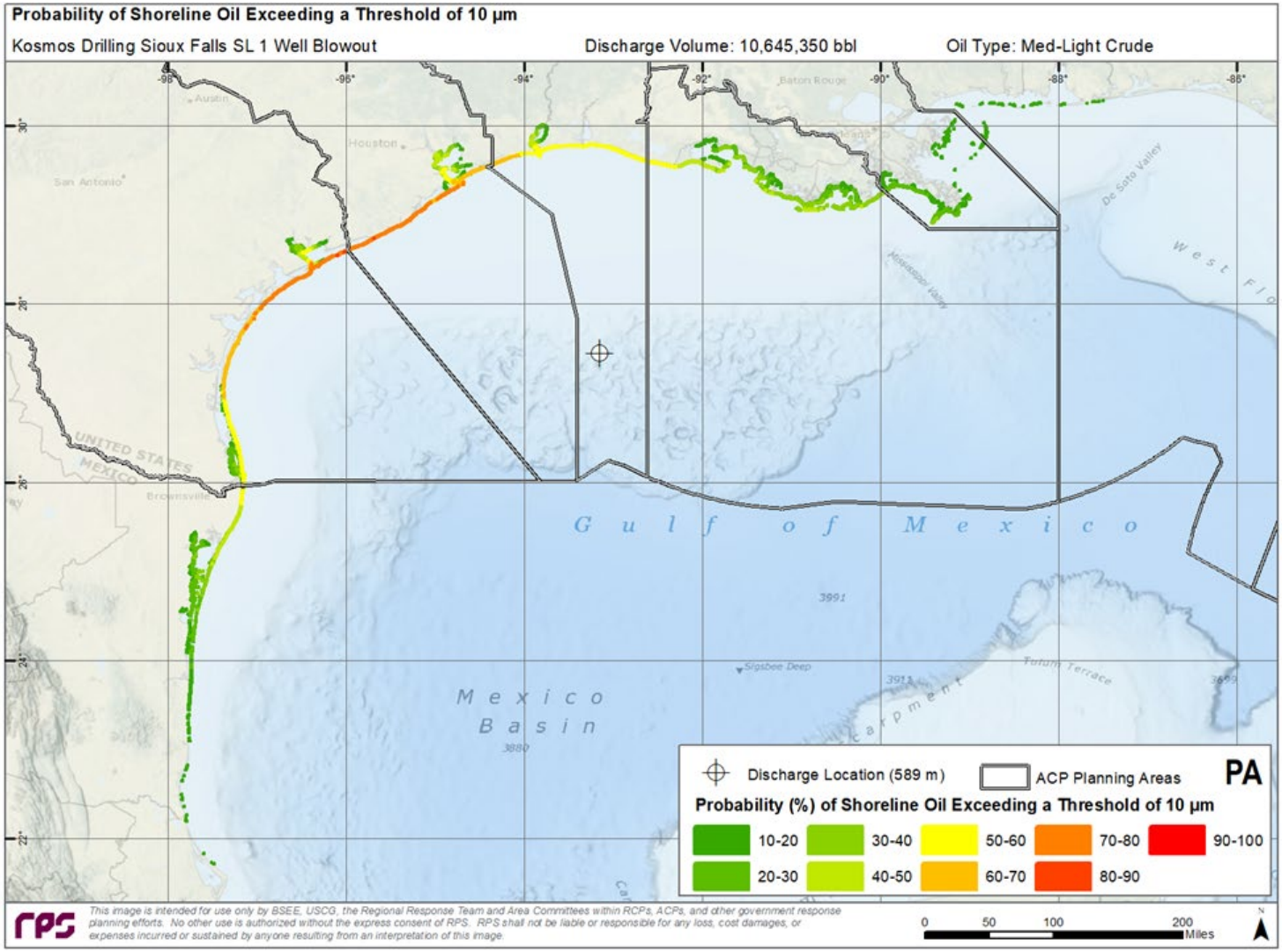

Figure 12. Probability Footprint for Oil on the Shoreline with Average Thickness greater than the Ecological Threshold of 10 µm.

This thickness of oil may appear on the shore as dark stain or film. 10 µm is a conservative ecological screening threshold for potential sublethal effects on fauna and birds on the shoreline.

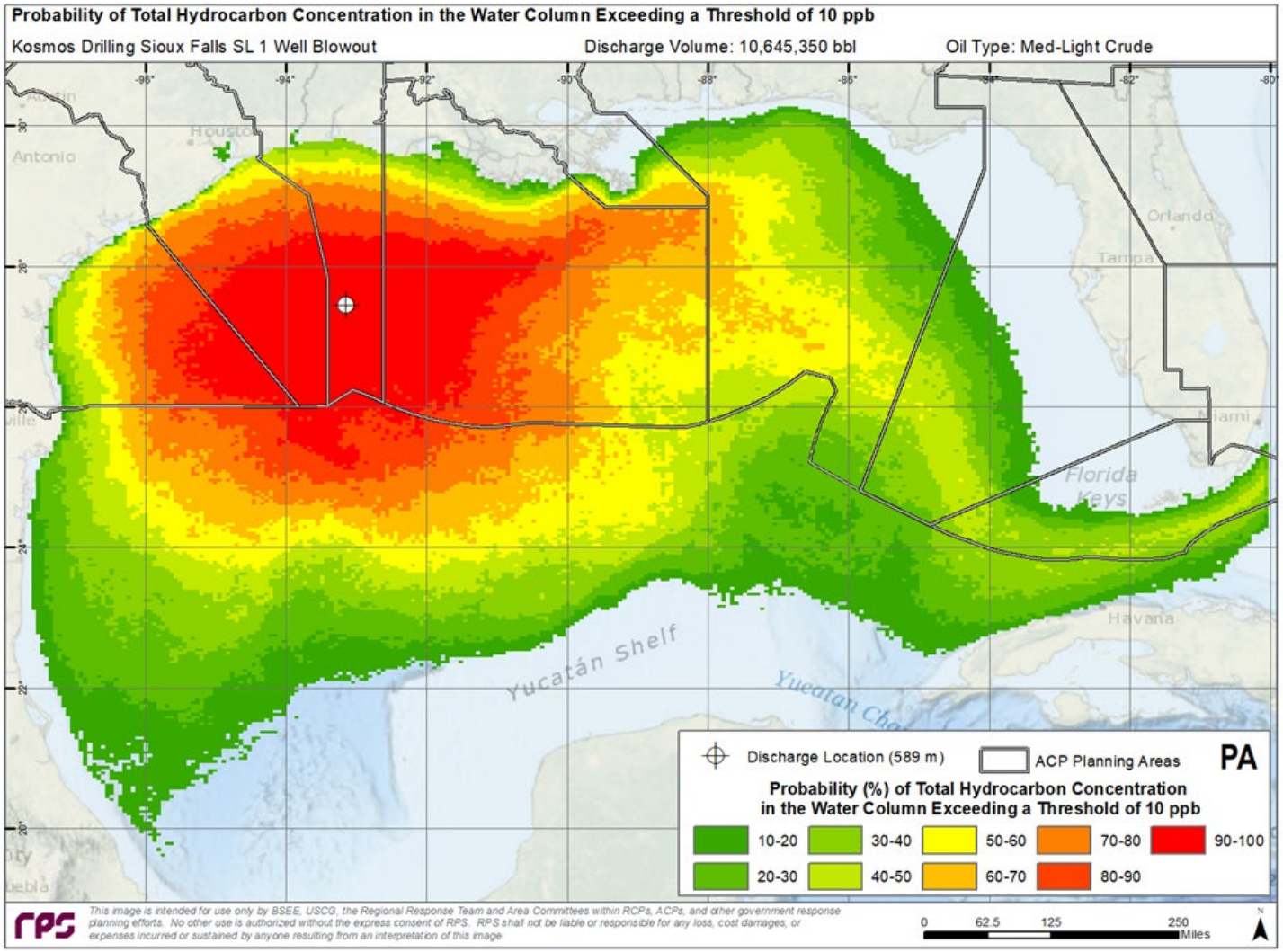

Figure 13. Probability Footprint for Total Hydrocarbon Concentration (THC) concentrations in the Water Column greater than the Ecological Threshold of 10 µg/L (~10 ppb). 10 ppb (µg/L) of whole oil (THC) corresponds to ~0.1 µg/L (~1 ppb) of dissolved Polycyclic Aromatic Hydrocarbons (PAHs) for fresh crude oils. This threshold can result in sublethal impacts to early life stages of fish and invertebrates in the upper ~20 meters of the water column if exposed to UV light.

The "worst case" deterministic simulation is a single oil trajectory run using the time period and ambient conditions that resulted in the greatest length of shoreline oiling. The simulation resulted in oiling in the following cumulative amounts:

- Oiled Surface Area Exceeding 0.04 µm (Socioeconomic Impact) = 159,874 mi^2
- Oiled Surface Area Exceeding 10 µm (Ecological Impact) = 36,390 mi^2
- Oiled Shoreline Exceeding 10 µm (Ecological Impact) = 1,546 mi
- Water Column Oil Exposure Exceeding 10 ppb Dissolved PAH (Ecological Impact) = 120,900 million m^3
- Time to Shore = 12.9 days

These impact values are calculated considering no response measures are taken to secure the source of the spill or to contain, remove, or disperse oil at the scene.

Table 6. Mass balance at the end of the worst case deterministic simulation (% of the total volume of oil discharged*).

Total Oil Discharged	Surface	Evaporated	Water Column	Sediment	Ashore	Degraded
10,645,350 bbl	0.4%	47.4%	7.5%	5.3	12.2	27.0

*Important to note these values are not indicative of the maximum amount of oil in each compartment, but instead show the final amount of oil in each compartment.

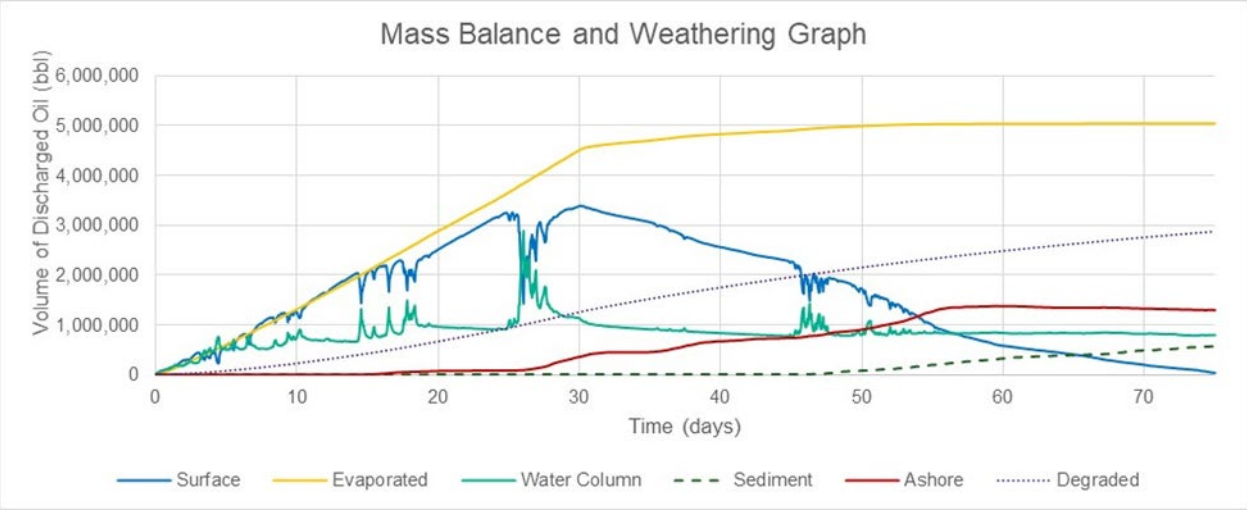

Figure 14. Mass Balance over Time for worst case deterministic simulation.

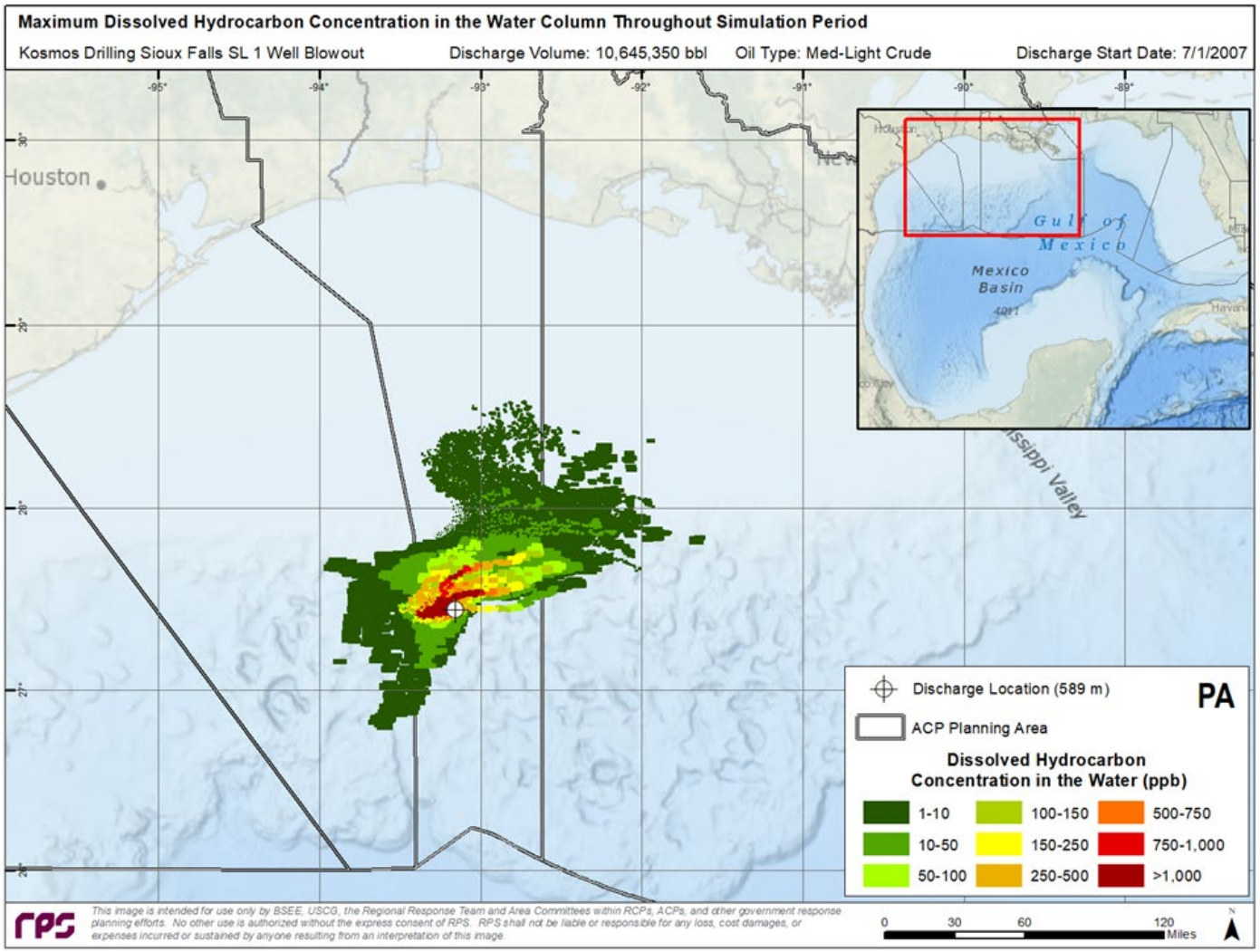

Figure 15. Cumulative Maximum Concentration of Dissolved Polycyclic Aromatic Hydrocarbons (PAH) within the water column at any time during the worst case deterministic simulation period. Dissolved PAH concentrations greater than ~10 µg/L (~10 ppb) could affect plankton in the upper ~20 m and impart sublethal to lethal effects on other water column biota (adult, juvenile fish, and invertebrates).

3.3 Response Planning Information

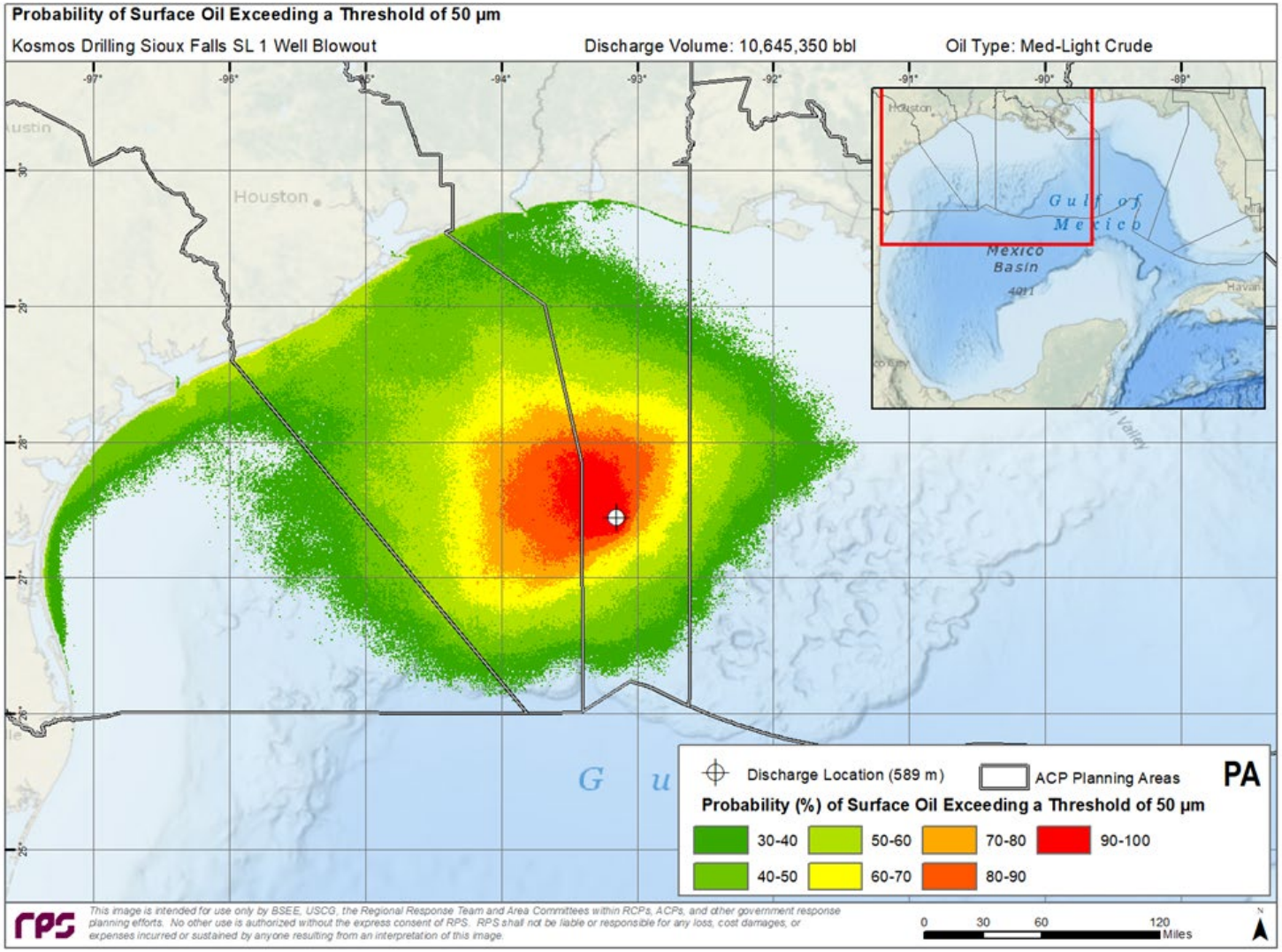

Figure 16. Probability Footprint for Surface Oil exposure greater than 50 µm. In this thickness range, oil will appear as a continuous to discontinuous patches of dark oil in quantities where high volume on-water mechanical recovery operations will be the most productive.

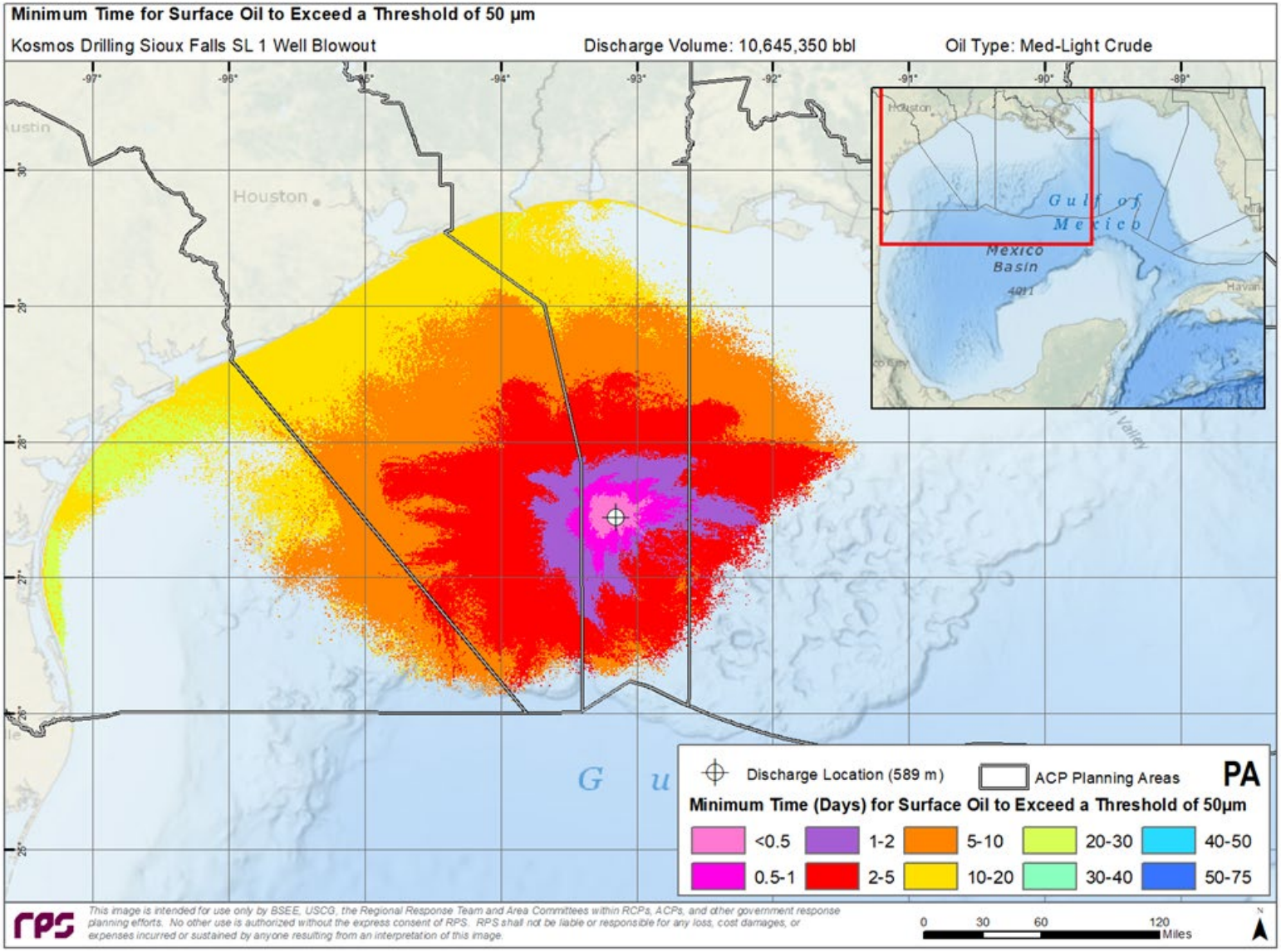

Figure 17. Minimum Travel Time for Surface Oil exposure greater than 50 µm.

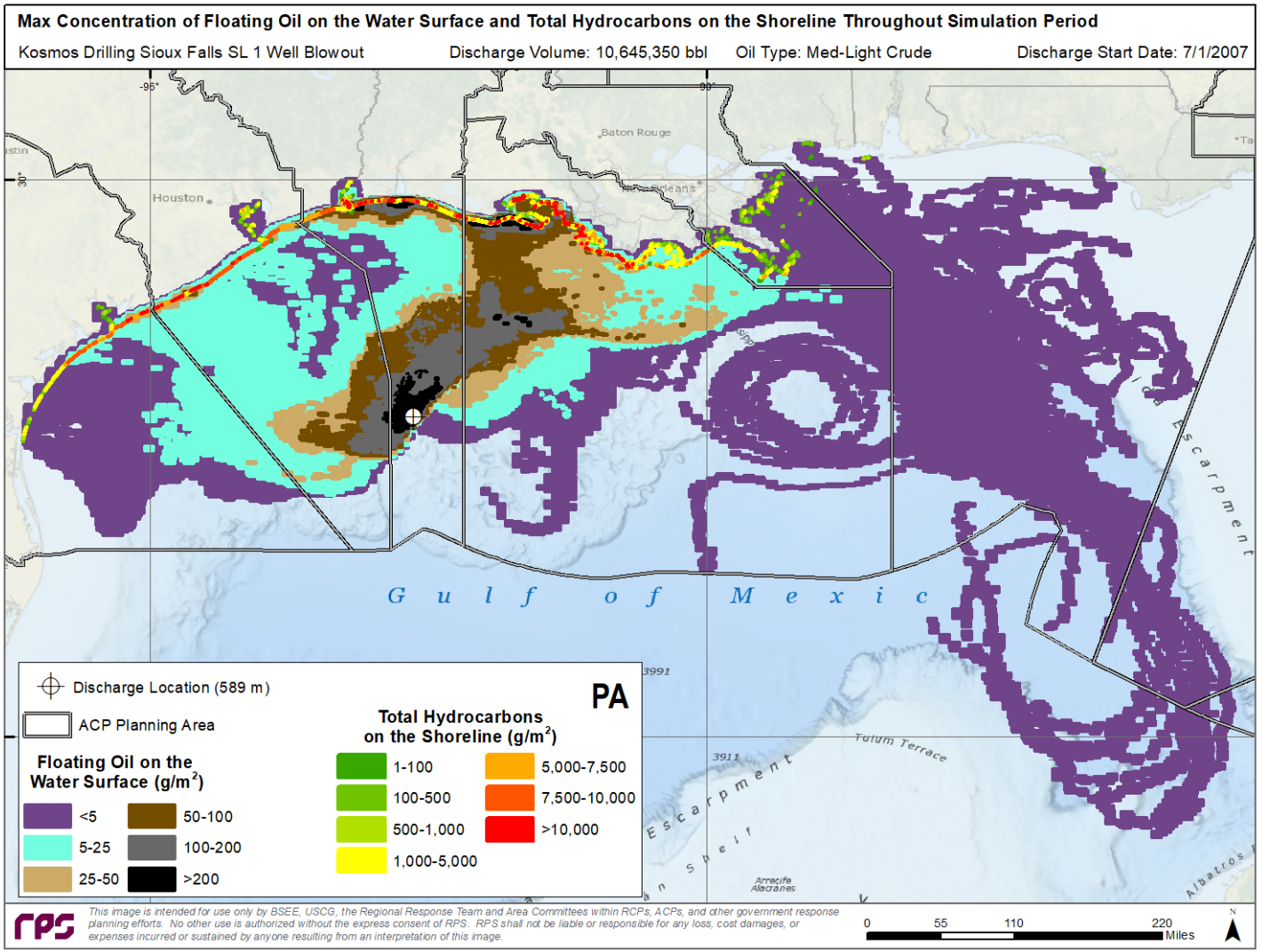

Figure 18. Cumulative Maximum Concentration of Floating Oil on the Water Surface and Total Hydrocarbons on the Shoreline at any time during the worst-case deterministic simulation.

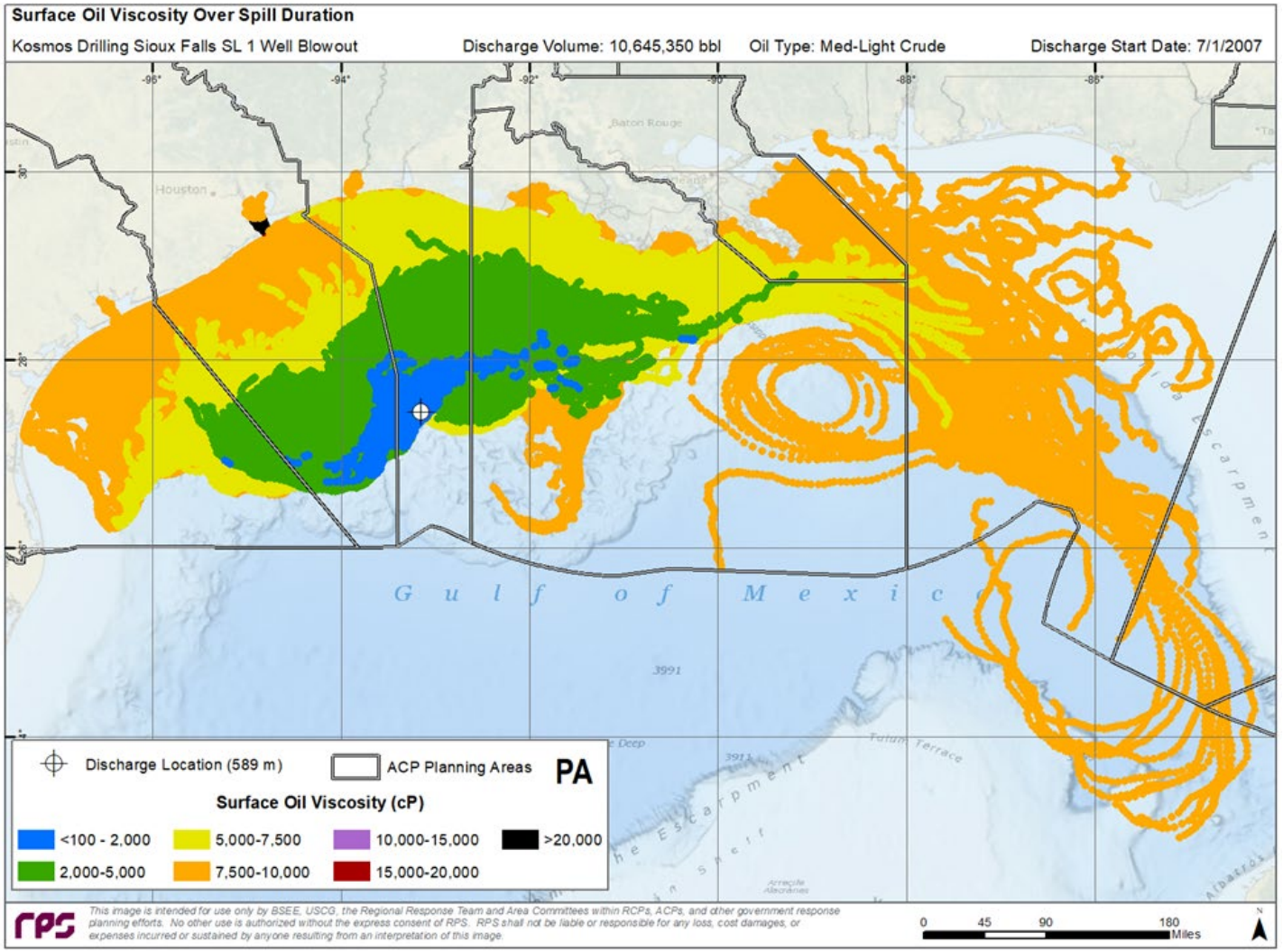

Figure 19. Cumulative footprint of exposure to surface floating oil greater than the minimum oil viscosity over a 75-day period for the worst case deterministic simulation. Viscosities greater than those mapped may be present at any location at any specific time in the simulation. This graphic provides a perspective of how oil viscosity may change as oil is transported away from the discharge site over time and what areas may be amenable to dispersant operations where enough quantities of oil are present.