Attachment E - Oil Spill Trajectory Modeling

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E.1 Background

This appendix presents the results of pat drifter and trajectory studies and oil spill modeling conducted for Platform Irene and the Platform Irene to LOGP offshore pipeline. The modeling was conducted to determine the movement and fate of an oil spill occurring at either of these two locations. Two models were examined, the Minerals Management Service (MMS) Oil Spill Risk Analysis (OSRA) and the General National Oceanic and Atmospheric Administration Office of Response and Restoration (NOAA) Oil Modeling Environment (GNOME). Each are publicly available models.

E.2 Drifter Studies

The trajectories of drifters released near the project area generally reflect the surface flow patterns measured by long-term current-meter moorings (Crowe and Schwarzlose, 1972; Schwartzlose and Reid, 1972; Chelton, 1987; Winant et al., 1999, see the Section 5.6, Oceanography and Marine Water Quality in this EIR). Namely, northwestward transport is observed throughout much of the year except during strong upwelling events that are most prevalent between April and June. Prevailing winds near Point Arguello are directed to the southeast except during brief, three-to-four-day periods when winter storms disrupt the normal pattern as they pass through the region. Surface currents near the project area are generally directed to the northwest, in opposition to, and uncoupled with the prevailing southeastward winds (Savoie et al., 1991; SAIC, 1995). During the spring and early summer, brief episodes of intensified southward-directed winds result in a reversal of surface currents. For periods of up to a week, near-surface flows turn toward the southeast in opposition to the northwestward current direction that is maintained throughout most of the water column.

The opposing directions of the wind and surface currents near Point Arguello are evident in drifter studies. CalCOFI drifter bottles released north of the Santa Barbara Channel in December 1969 migrated northward at speeds exceeding 15 cm/s. However at other times of the year, drift bottles released near Point Conception were recovered both to the north and to the south near San Diego. For release points near Point Arguello in 1984, many of the CCCCS surface drifters traveled south in response to strong southward directed winds (Chelton, 1987). It was only during a brief period when southward winds weakened in July that the majority of drifters moved northward. However, the CCCCS drifter design is susceptible to a downwind motion of about 0.5% of the wind speed and thus may not accurately represent surface currents alone.

The drifters used in the Santa Barbara Channel to Santa Maria Basin (SMB) coastal circulation study were designed to minimize the influence of wind and wave drift in favor of tracking surface currents over a depth of about 1 m (Davis et al., 1982). As a result, flow statistics derived from the drifters compared well with that of the moored current meters (Dever et al., 1998). Discrepancies in mean flow direction have been ascribed to sampling bias (Dever, 2001b). Beginning in January 1995, many of these drifters were deployed within the Santa Maria Basin, including locations near the Tranquillon Ridge Field. Few of the drifters released near the Point Arguello to Point Conception region beached before exiting the region (Dever et al., 2000; Winant et al., 1999). In a manner consistent with the long-term current meter data collected as part of CaMP, initial offshore movement was followed by northward movement into the SMB in fall and winter. Spring and summer deployments were more likely to show southward flow toward San Miguel Island. Few drifters moved eastward into the Santa Barbara Channel.

The complex interaction between winds and surface currents near Point Conception makes predictions of oil spill trajectories difficult. During much of the year, but especially in the fall and winter, the northwestward surface flow is in direct opposition to the prevailing winds. Certainly these surface currents, as determined by current meters and drifters, have a direct bearing on the fate and effects of potential oil spills resulting from the proposed project. However, winds also influence the spread and trajectory of oil slicks on the sea surface. Empirical data from the open ocean suggests that leading edge of an oil slick would drift at about 3% of the wind speed and oil-following drifters have been evaluated based on their ability to match this “3% rule” (Reed et al., 1988). However, there is no rigorously defensible theoretical basis or empirical data to support the application of this rule in coastal flow regimes.

Drifters deployed during the Santa Barbara Channel to Santa Maria Basin coastal circulation study tended to travel toward the south only about 31% of the time and only about 15% of these intersected the shoreline.

Drifters, with their measurable mass and finite vertical profile below the sea surface, cannot capture the behavior of an oil slick that is typically only a few millimeters thick (Reed et al., 1988). Furthermore, dispersion and weathering affect the spread of oil on the sea surface, and buoys cannot capture the changing slick dynamics across a wide range of winds, waves, and currents. Goodman et al. (1995) and Simecek-Beatty (1994) tested the oil-tracking ability of several drifter designs, including the Davis et al. (1982) design used in the Santa Barbara Channel-SMB coastal circulation study. They found that Davis-type drifters lagged behind simulated oil slicks presumably because they are optimized to track surface currents with minimal influence by winds and waves. In cases where winds opposed surface currents, the Davis-type drifters moved into the prevailing wind and in a direction opposite of the simulated oil slicks made from wood chips. This is similar to the case in the southern SMB where the northward-flowing Davidson current often opposes the prevailing southward-directed winds.

E.3 MMS OSRA Model

The oil-spill risk analyses described in this evaluation were performed using the MMS numerical Oil Spill Risk Analysis (OSRA) model for the Pacific Region. It calculates probabilities of shoreline impact, as well as ocean area impact, after applying a drift equivalent to 3.5% of the prevailing wind velocity in its trajectory computations. Because of the heavy influence of southward-directed winds near Point Conception, the model results indicate that the probability of shoreline impacts along the Channel Islands to the south is far higher than at sites along the central coast to the north. The influence of southward directed winds in the model effectively overcomes the northwestward surface currents observed over part of the year in the field programs. This contrasts with other drifter studies which tend to show travel toward the south only about 31% of the time and only about 15% of these intersect the shoreline (Browne, 2000). In Browne's analysis, northward transport has a slight edge with 32% of the trajectories traveling to the north and contacting the coast about 23% of the time. For more discussion on surface transport and drifters, please see Section 5.6, Oceanography and Marine Water Quality, in this EIR.

The OSRA Model utilizes a seasonally averaged ocean currents for four seasons: winter, spring, summer and fall. The seasonally average current fields are provided by Scripps Institution of Oceanography and are based on several years of current meter and free-floating drifter data. Shoreline segments are divided into their respective quad areas and the probability of impact on each quad is calculated. Weathering factors are not addressed.

The use of the seasonal average ocean currents tends to smooth out the effect of the northward currents which may occur and thereby reduce the northward movement of the trajectories.

The complexity of opposing winds and currents near the project area makes the reconciliation between OSRA model results and drifter observations difficult. Because the applicability of the "3.5% wind rule" in complex coastal flow regimes has not been rigorously quantified, this environmental evaluation also addressed the GNOME model which indicates more northward impacts (see following section) due to its separation of flow regimes.

However, drifters, with their measurable mass and finite vertical profile below the sea surface, cannot capture the behavior of an oil slick that is typically only a few millimeters thick (Reed et al., 1988). Newer style drifters (called "oil following") have been deployed recently and may provide better data when available. Furthermore, dispersion and weathering affects the spread of oil on the sea surface, and buoys cannot capture the changing slick dynamics across a wide range of winds, waves, and currents.

E.4 OSRA Results

The MMS has developed OSRA reports for the Pacific Region OCS, amongst other regions. Because oil spills may occur from activities associated with offshore oil exploration, production, and transportation, the MMS conducts a formal risk assessment to evaluate the risk of oil spill contact from existing and proposed oil and gas operations. Contact is evaluated at each block in a grid encompassing the entire ocean region as well as grids located along the shoreline. Risks are examined for spills from 23 OCS platforms, 11 pipelines, 10 potentially developed units and the transportation routes. The analysis assumes that a spill has occurred and estimates the trajectories of the hypothetical oil spills from potential accident sites to land and ocean segment locations. It then provides conditional probabilities of oil impacting a given area.

The trajectory simulation portion of the MMS OSRA model consists of many hypothetical oil-spill trajectories. The trajectories are the consequence of the integrated action of temporally and spatially varying wind and ocean current fields on the hypothetical oil spills. Collectively, they represent a statistical set of the winds and currents that will occur over the life of the production period. The analysis uses a combination of observed and theoretically computed ocean currents and winds. Most of the ocean currents used were generated by a numerical model. They were supplemented with many direct observations of the currents in the Santa Barbara Channel resulting from deployments of surface drifting buoys. The sea surface winds over the study area were derived from an atmospheric model and from measured winds at buoy, platform, island and land-based wind stations. The studies are conducted for four seasons (winter, spring, summer and fall) when currents and winds are different. More information on the study is available at the MMS web site.

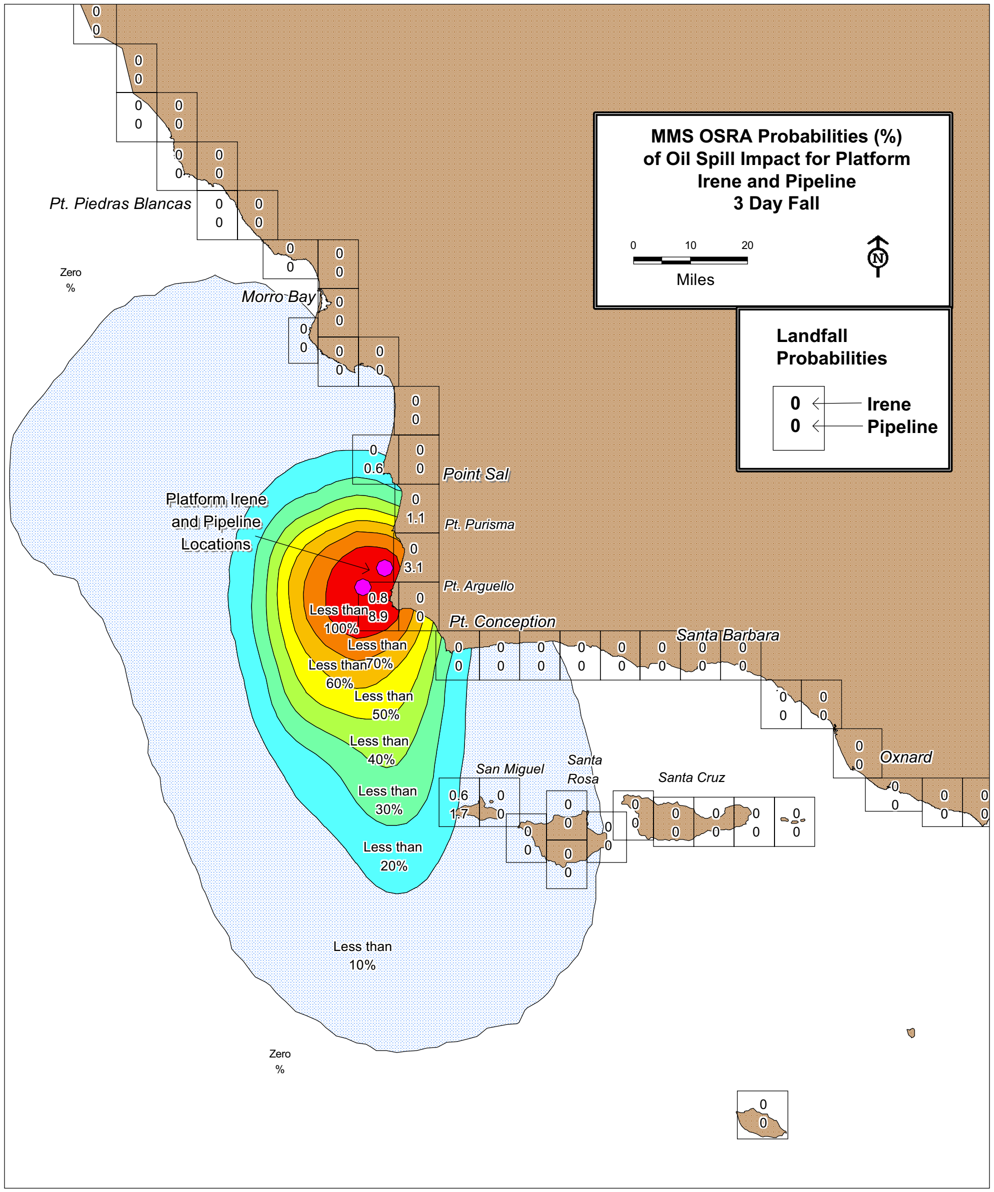
Results of the oil spill trajectory model are presented below for Platform Irene and the Irene oil/emulsion pipeline. This figure shows both the conditional probabilities of oil impacting different locations on the ocean and the conditional probabilities of oil impacting the designated land segments. Conditional probabilities are shown within each land segment block for both Platform Irene and the oil/emulsion pipeline. Ocean impact areas are similar for Platform Irene and the pipeline. Information is presented for all 4 seasons (spring, summer, winter, fall) and for the periods of 3 and 10 days. The 30 day annual average is also shown.

The OSRA trajectory analysis indicates that, generally, an oil spill would travel to the south of the spill, impacting ocean areas beyond the Channel Islands during all seasons. The probability of a northward traveling spill is greater during the winter and fall months with spills potentially reaching as far north as Piedras Blancas. Conditional probabilities of contacting land range up to 15.3% during the springtime for Point Arguello due east of Platform Irene and the pipelines.

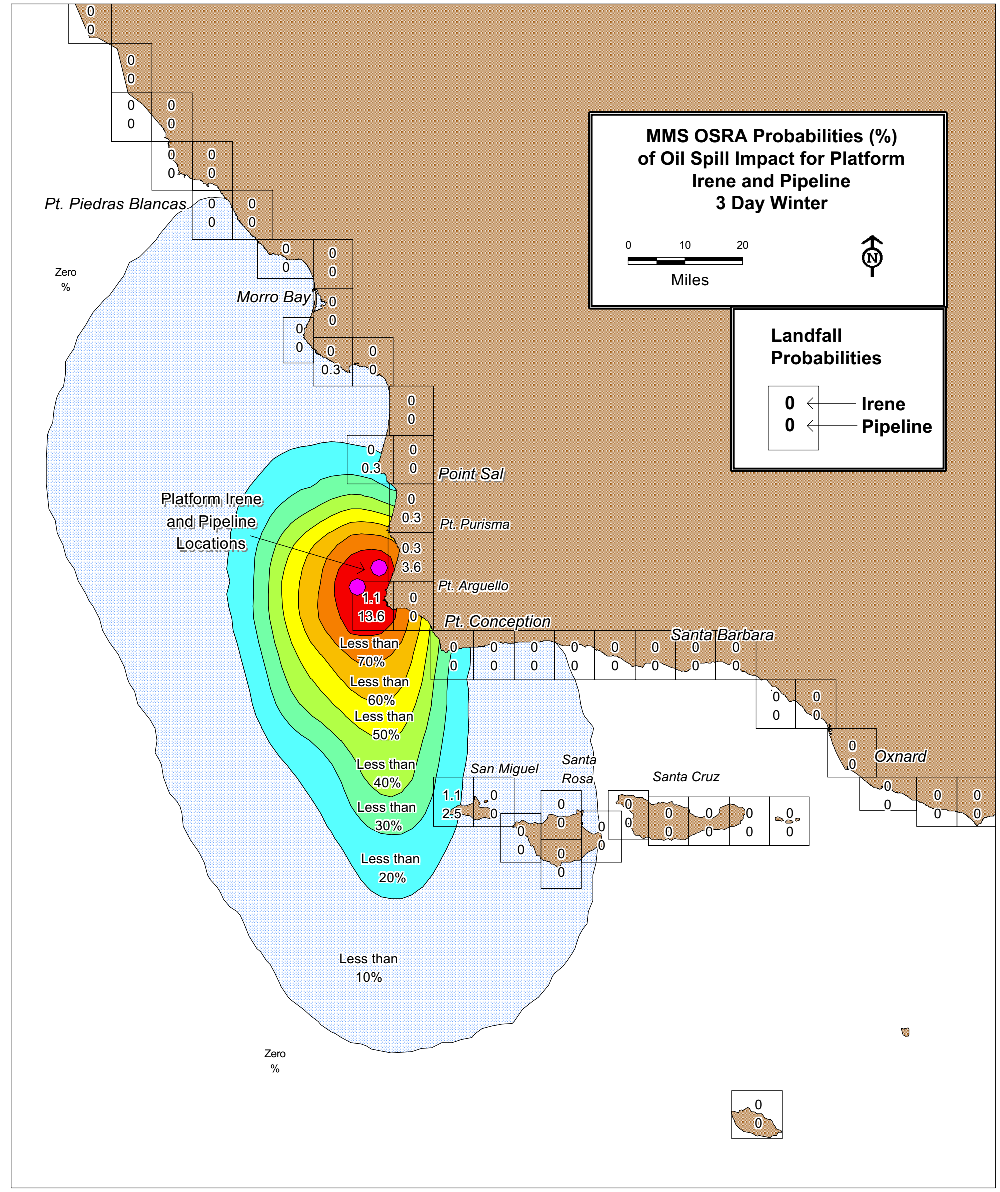
E.5 GNOME Model

GNOME is a publicly available oil spill trajectory model that simulates oil movement due to winds, currents, tides, and spreading. GNOME was developed by the Hazardous Materials Response Division (HAZMAT) of the NOAA OR&R.

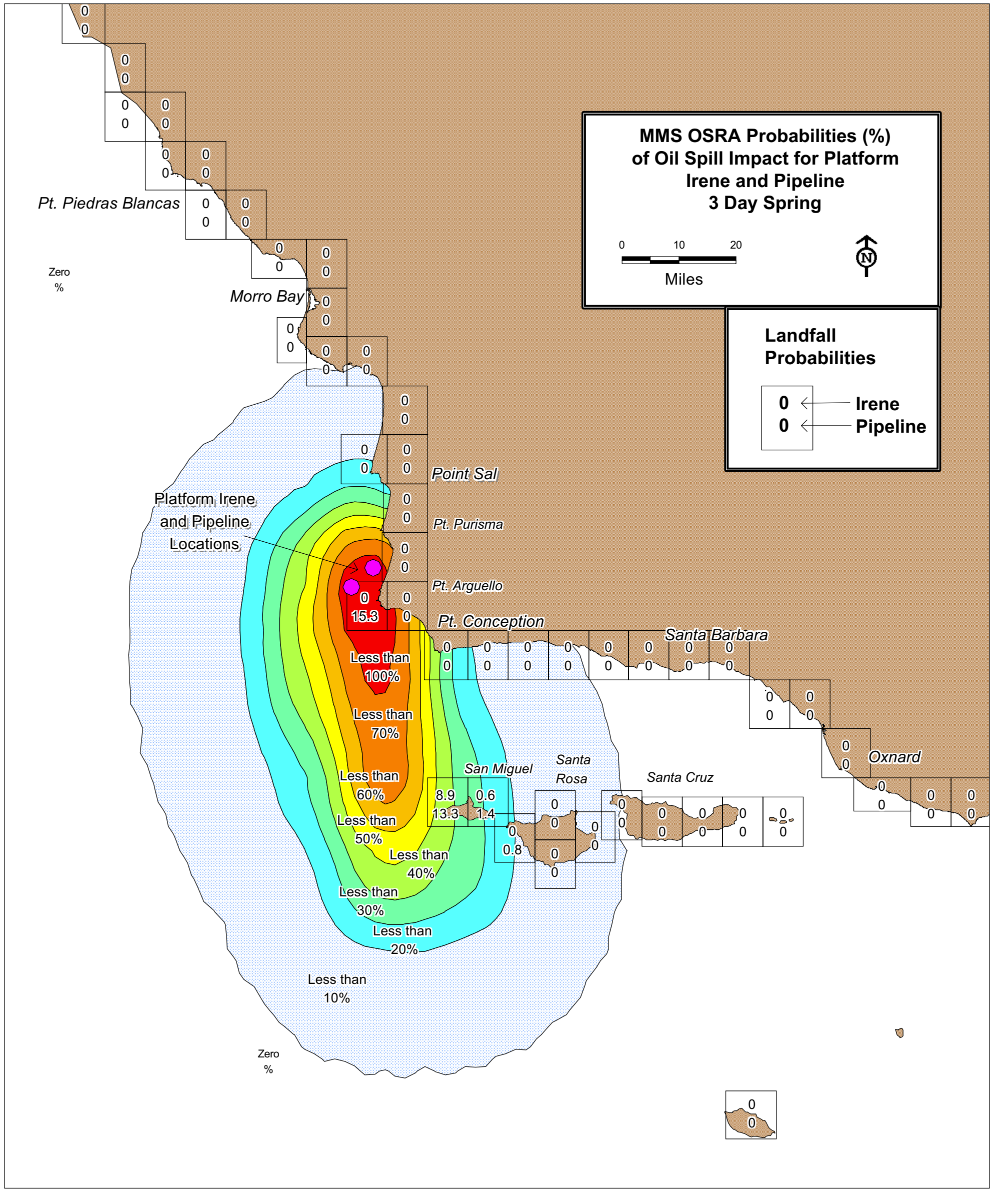
The GNOME Model includes variables that account for weatherization of the released materials as well as a separate set of ocean current regimes for the Santa Barbara Channel and SMB. Wind speed and direction as well as variability can be input to the model. This enables the analysis of specific spill situations with given meteorological conditions.



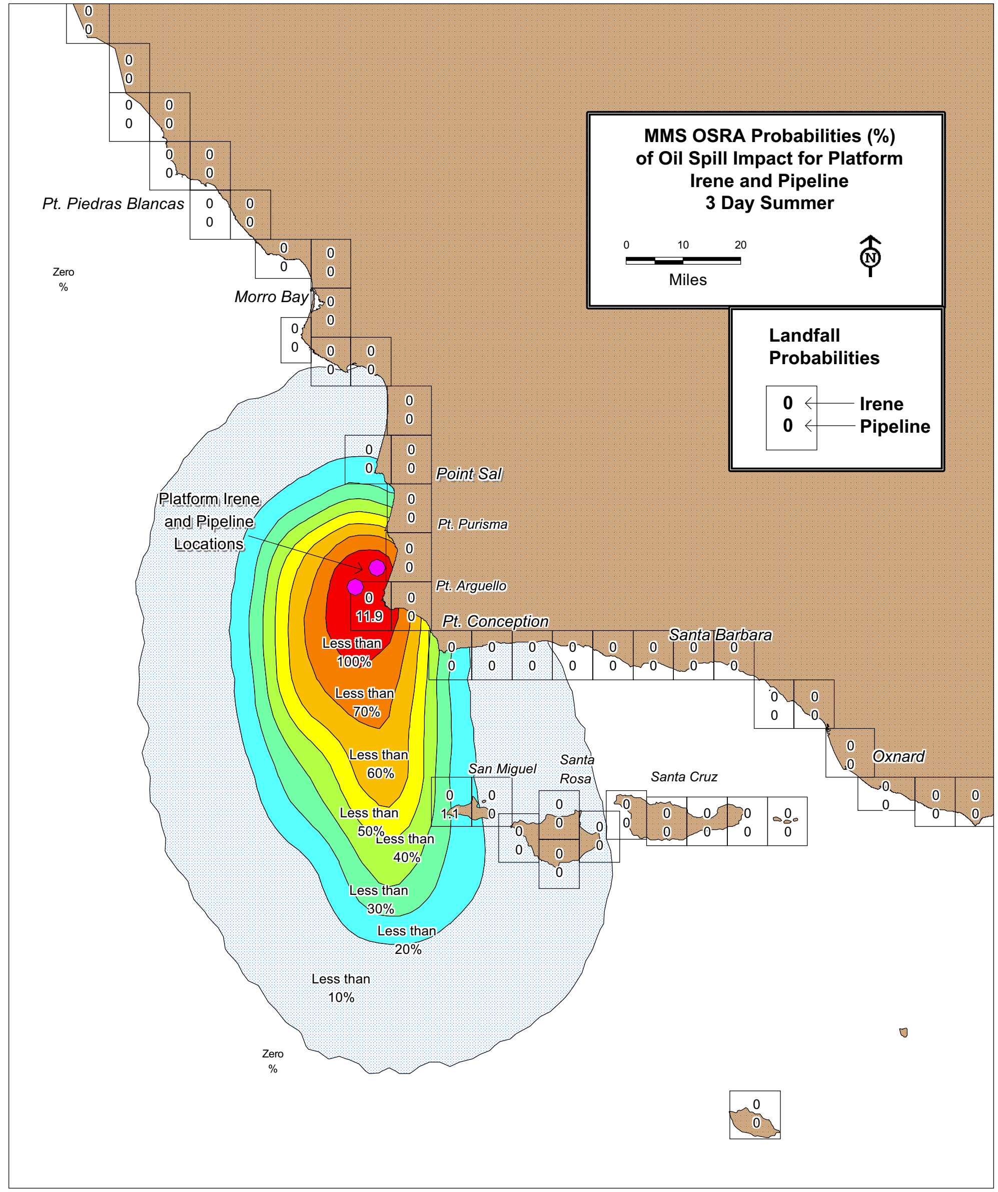
MMS OSRA Probabilities (%)
of Oil Spill Impact for Platform
Irene and Pipeline
3 Day Fall
0 10 20
Miles
Landfall
Probabilities
0 Irene
0 Pipeline
Pt. Piedras Blancas
Morro Bay
Point Sal
Pt. Purisma
Pt. Arguello
Pt. Conception
Santa Barbara
Oxnard
San Miguel
Santa Rosa
Santa Cruz
Platform Irene
and Pipeline
Locations
Less than 100%
Less than 70%
Less than 60%
Less than 50%
Less than 40%
Less than 30%
Less than 20%
Less than 10%
Zero %
Zero %



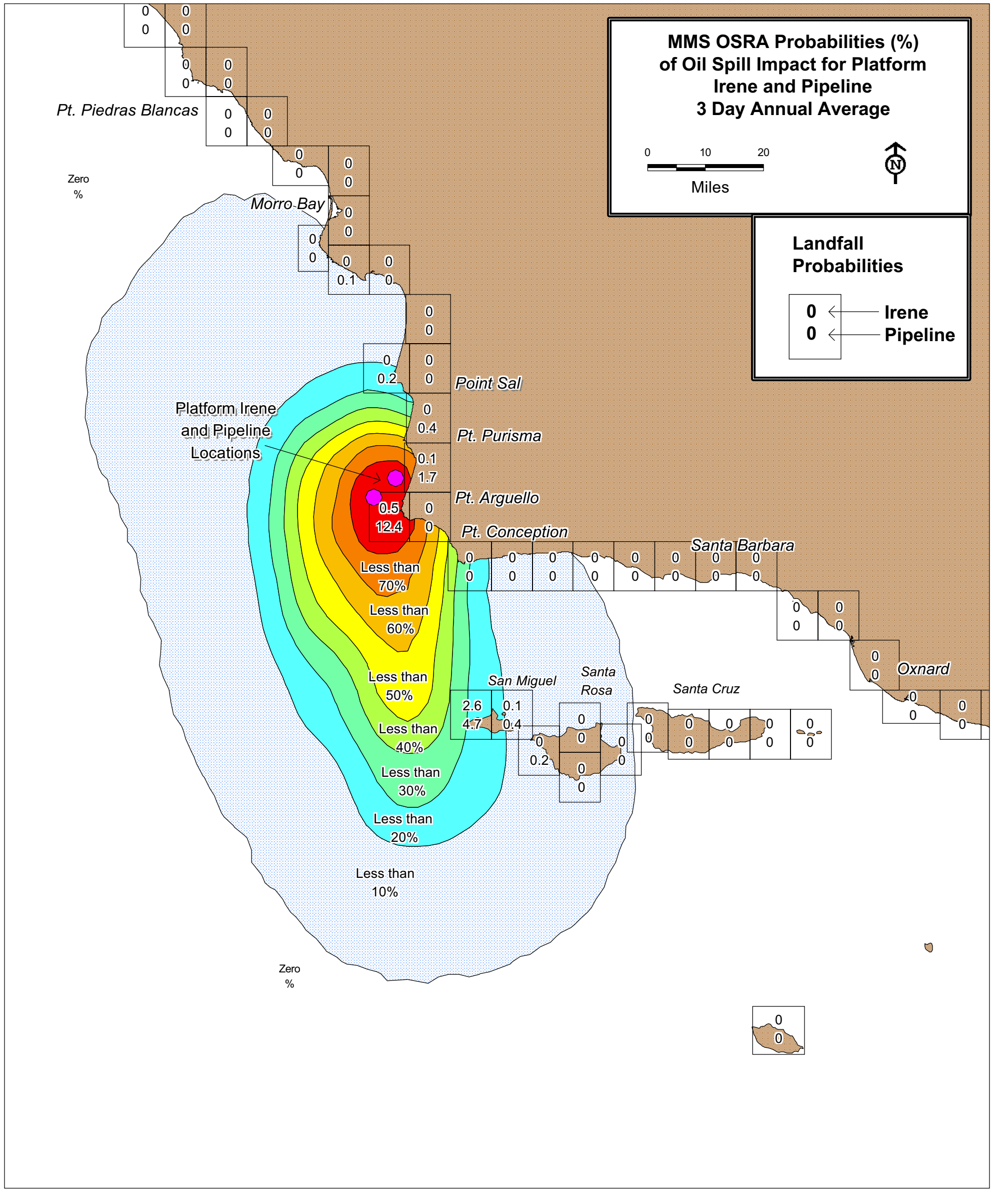
MMS OSRA Probabilities (%)
of Oil Spill Impact for Platform
Irene and Pipeline
3 Day Winter
0 10 20
Miles
Landfall
Probabilities
0 Irene
0 Pipeline
Pt. Piedras Blancas
Morro Bay
Point Sal
Pt. Purisma
Pt. Arguello
Pt. Conception
Santa Barbara
Oxnard
San Miguel
Santa Rosa
Santa Cruz
Platform Irene
and Pipeline
Locations
Less than 70%
Less than 60%
Less than 50%
Less than 40%
Less than 30%
Less than 20%
Less than 10%
Zero %
Zero %



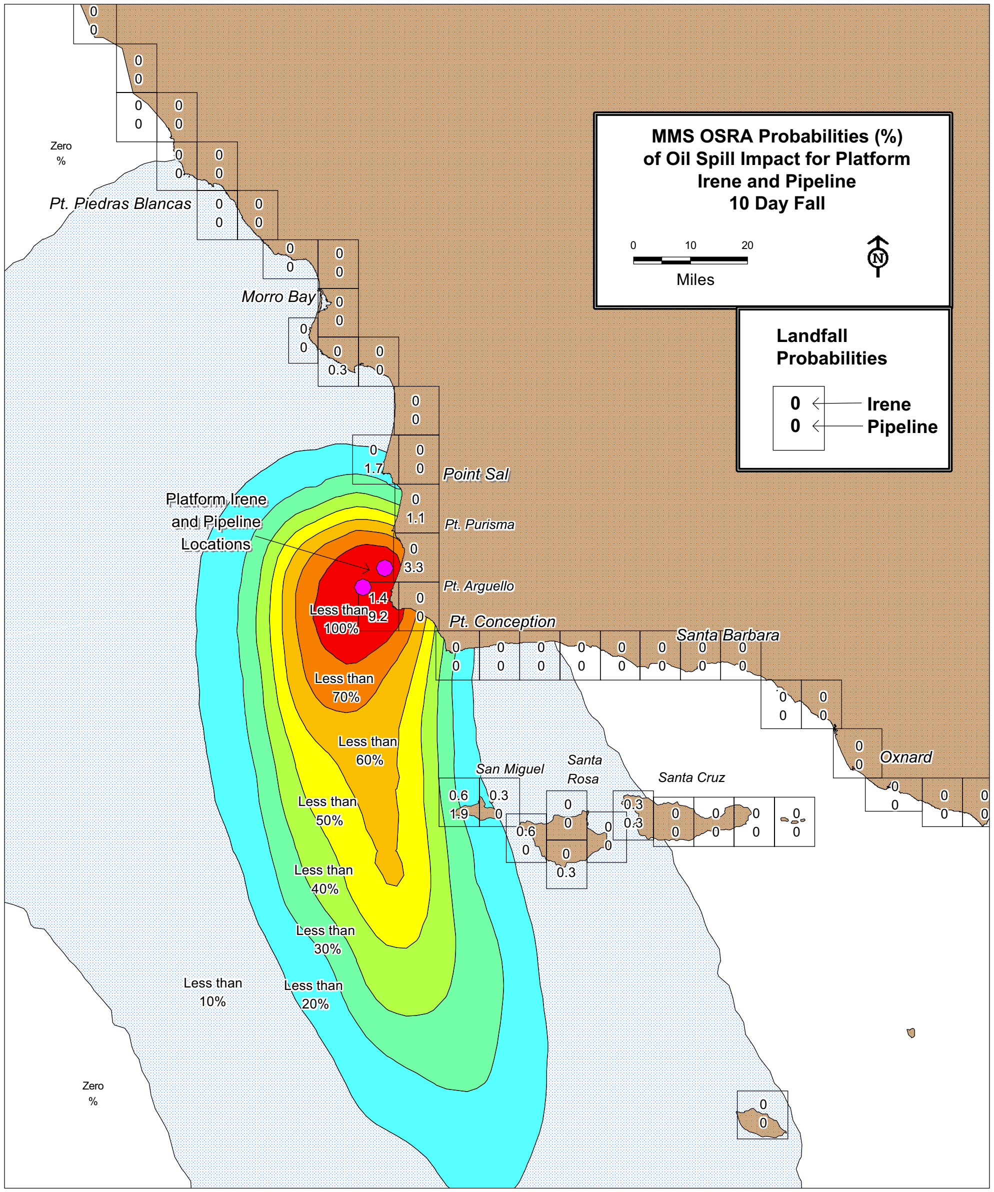
MMS OSRA Probabilities (%)
of Oil Spill Impact for Platform
Irene and Pipeline
3 Day Spring
Miles
Landfall
Probabilities
Irene
Pipeline
Pt. Piedras Blancas
Morro Bay
Point Sal
Pt. Purisma
Pt. Arguello
Pt. Conception
Santa Barbara
Oxnard
San Miguel
Santa Rosa
Santa Cruz
Platform Irene
and Pipeline
Locations
Less than 100%
Less than 70%
Less than 60%
Less than 50%
Less than 40%
Less than 30%
Less than 20%
Less than 10%
Zero %

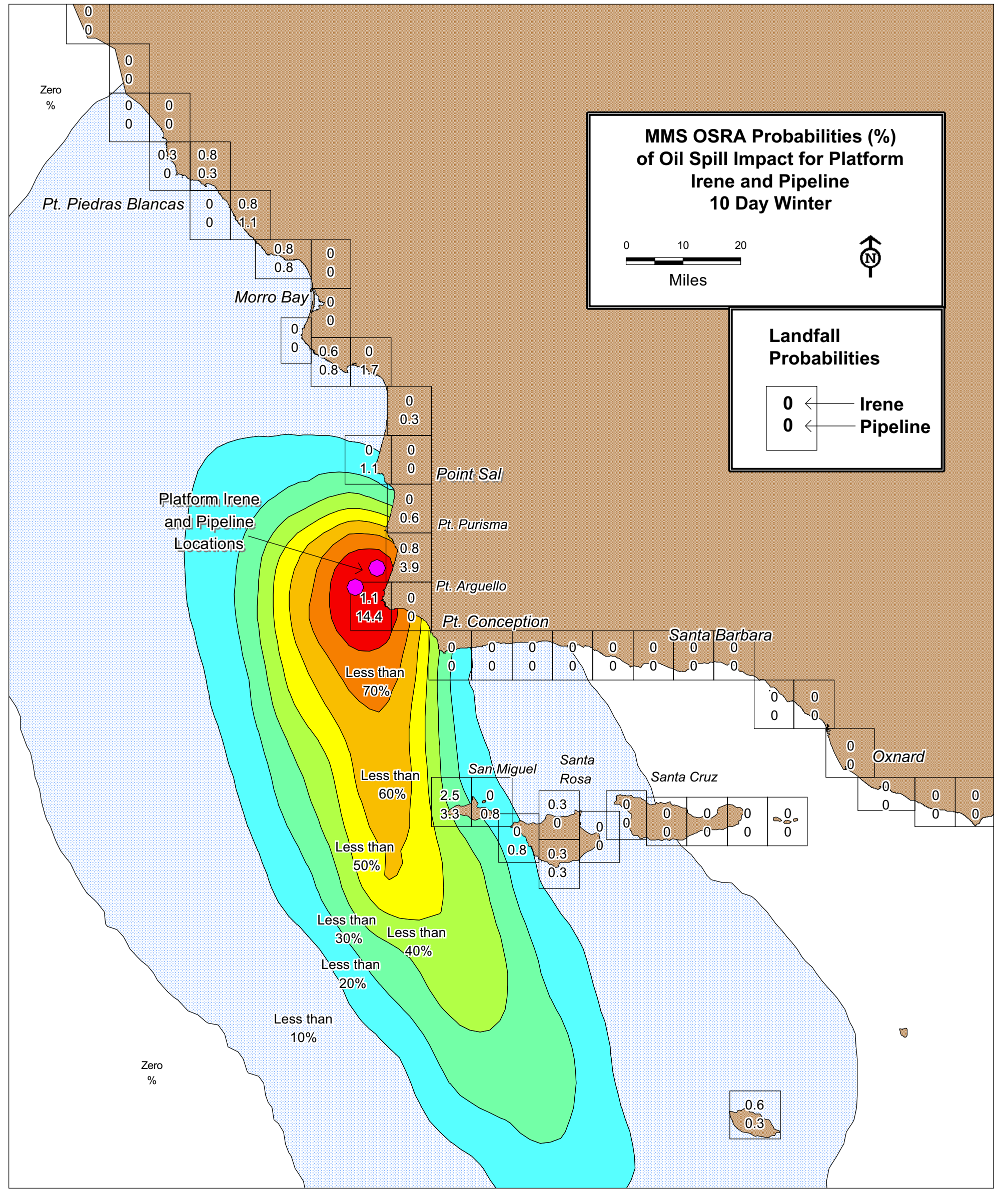


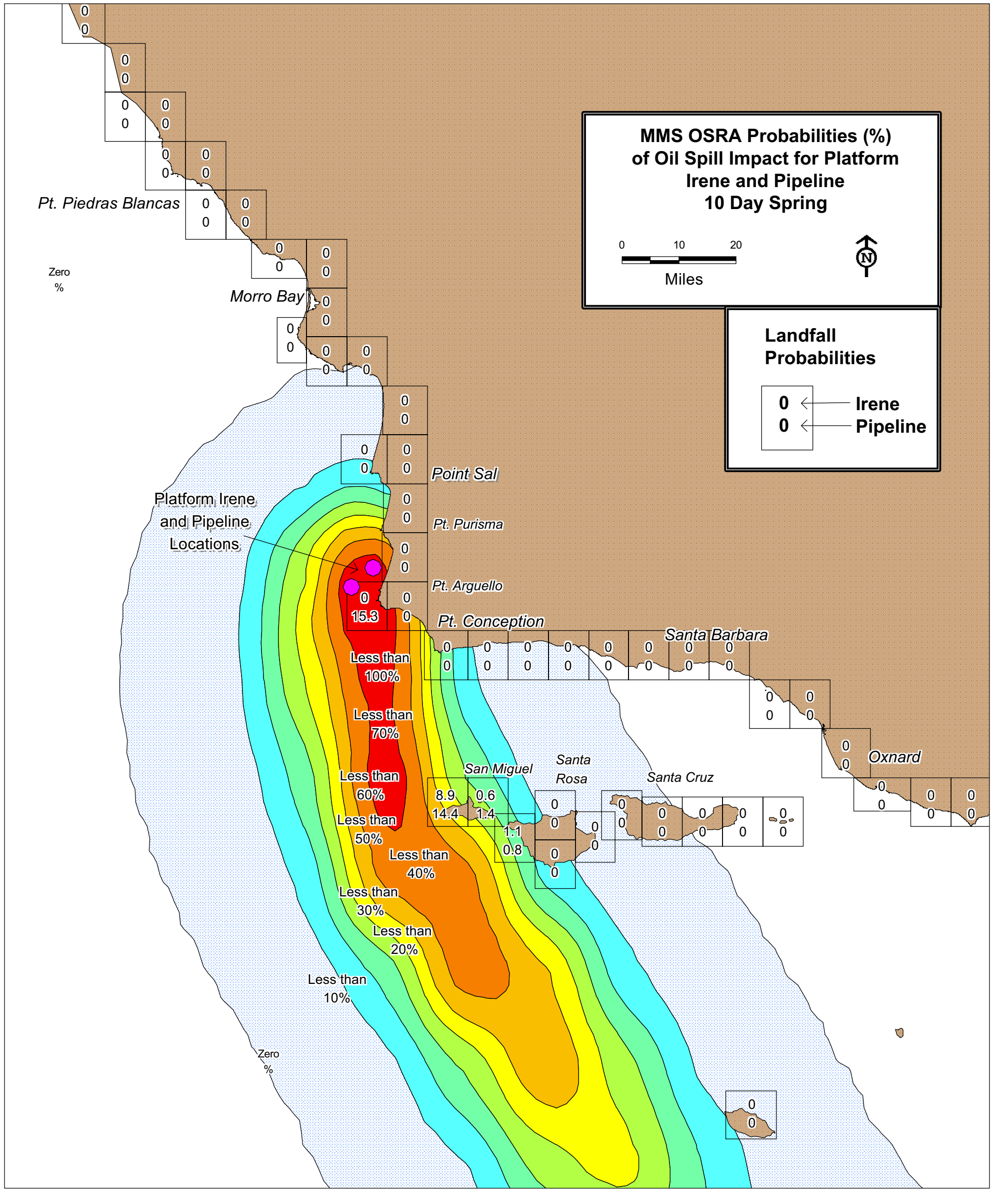
MMS OSRA Probabilities (%)
of Oil Spill Impact for Platform
Irene and Pipeline
3 Day Summer
Miles
Landfall
Probabilities
Irene
Pipeline
Pt. Piedras Blancas
Morro Bay
Point Sal
Pt. Purisma
Pt. Arguello
Pt. Conception
Santa Barbara
Oxnard
San Miguel
Santa Rosa
Santa Cruz
Platform Irene
and Pipeline
Locations
Less than 100%
Less than 70%
Less than 60%
Less than 50%
Less than 40%
Less than 30%
Less than 20%
Less than 10%
Zero %



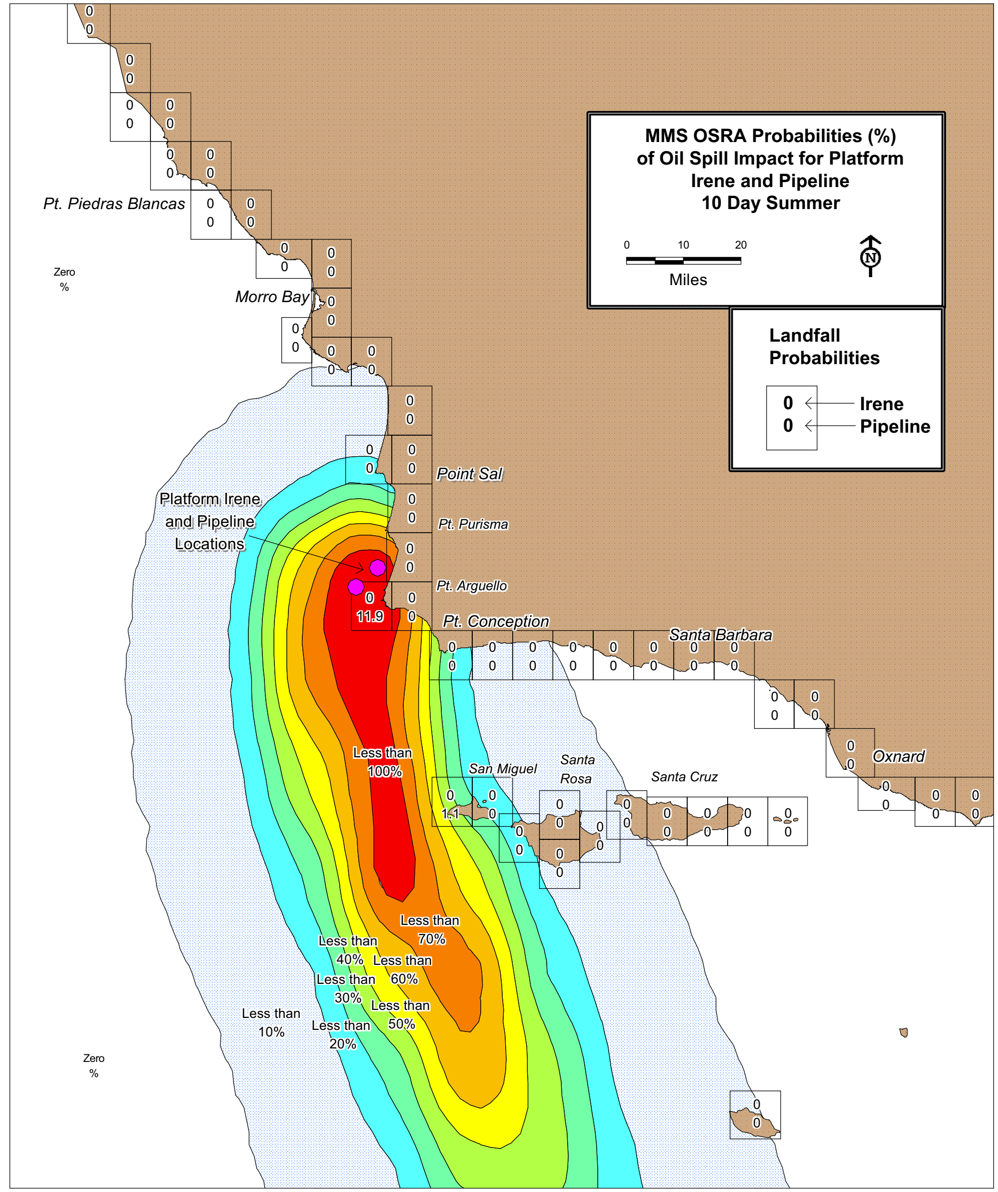
MMS OSRA Probabilities (%)
of Oil Spill Impact for Platform
Irene and Pipeline
3 Day Annual Average
0 10 20
Miles
N
Landfall
Probabilities
0 Irene
0 Pipeline
Pt. Piedras Blancas
Morro Bay
Point Sal
Pt. Purisma
Pt. Arguello
Pt. Conception
Santa Barbara
Oxnard
San Miguel
Santa
Rosa
Santa Cruz
Platform Irene
and Pipeline
Locations
Zero
%
Less than
70%
Less than
60%
Less than
50%
Less than
40%
Less than
30%
Less than
20%
Less than
10%
0.2
0.4
0.1
1.7
0.5
12.4
2.6
4.7
0.1
0.4
0.2


MMS OSRA Probabilities (%)
of Oil Spill Impact for Platform
Irene and Pipeline
10 Day Fall
0 10 20
Miles
N
Landfall
Probabilities
0 Irene
0 Pipeline
Zero %
Pt. Piedras Blancas
Morro Bay
Point Sal
Pt. Purisma
Pt. Arguello
Pt. Conception
Santa Barbara
Oxnard
San Miguel
Santa Rosa
Santa Cruz
Platform Irene and Pipeline Locations
Less than 100%
Less than 70%
Less than 60%
Less than 50%
Less than 40%
Less than 30%
Less than 20%
Less than 10%
Zero %

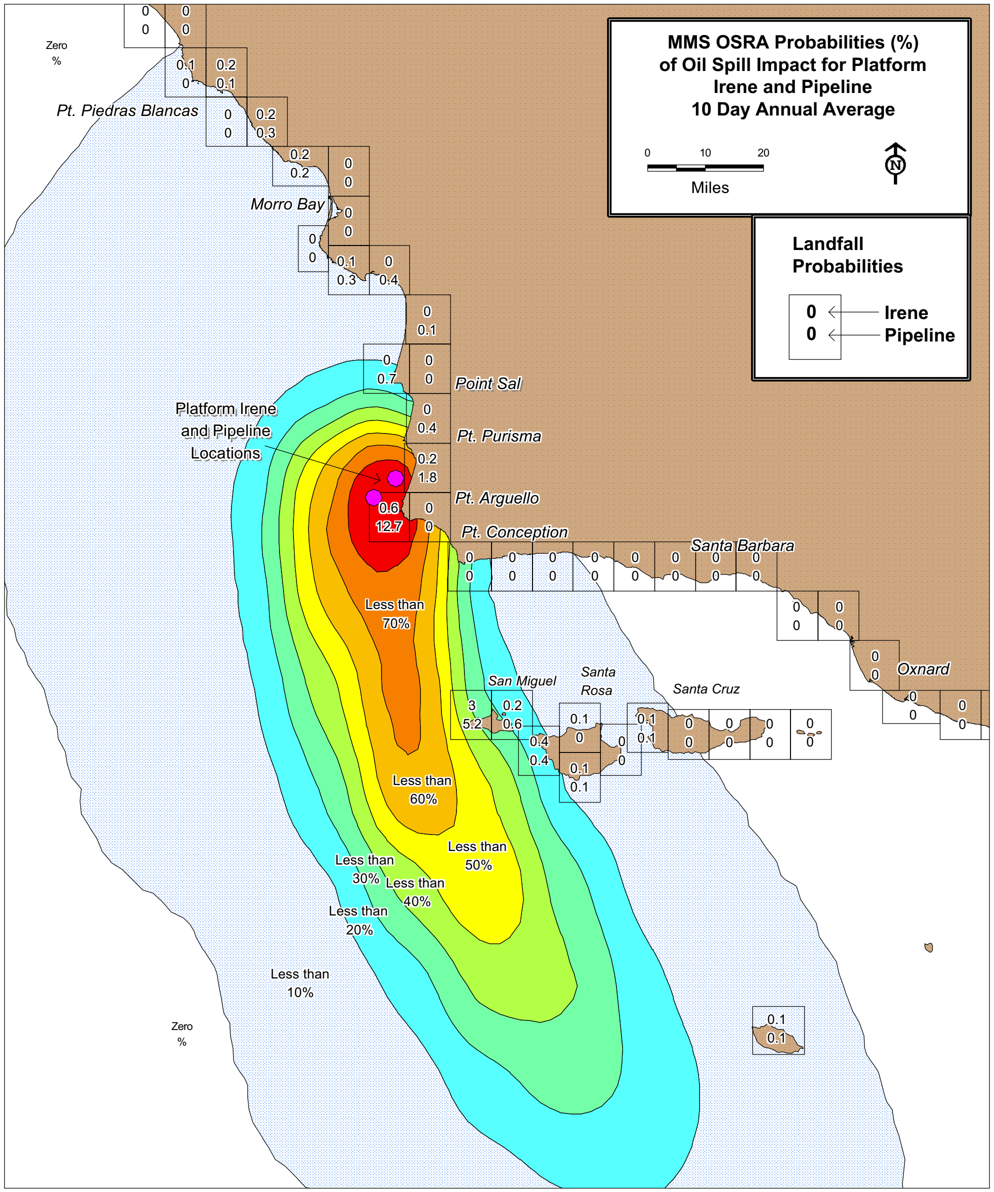

MMS OSRA Probabilities (%)
of Oil Spill Impact for Platform
Irene and Pipeline
10 Day Winter
0 10 20
Miles
N
Landfall
Probabilities
0 Irene
0 Pipeline
Zero %
Pt. Piedras Blancas
Morro Bay
Point Sal
Pt. Purisma
Pt. Arguello
Pt. Conception
Santa Barbara
Oxnard
San Miguel
Santa Rosa
Santa Cruz
Platform Irene and Pipeline Locations
Less than 70%
Less than 60%
Less than 50%
Less than 40%
Less than 30%
Less than 20%
Less than 10%
Zero %



MMS OSRA Probabilities (%)
of Oil Spill Impact for Platform
Irene and Pipeline
10 Day Spring
0 10 20
Miles
N
Landfall
Probabilities
0 Irene
0 Pipeline
Pt. Piedras Blancas
Zero %
Morro Bay
Point Sal
Pt. Purisma
Pt. Arguello
Pt. Conception
Santa Barbara
Oxnard
Platform Irene
and Pipeline
Locations
0
15.3
Less than 100%
Less than 70%
Less than 60%
Less than 50%
Less than 40%
Less than 30%
Less than 20%
Less than 10%
San Miguel
Santa Rosa
Santa Cruz
8.9
14.4
0.6
1.4
1.1
0.8
Zero %



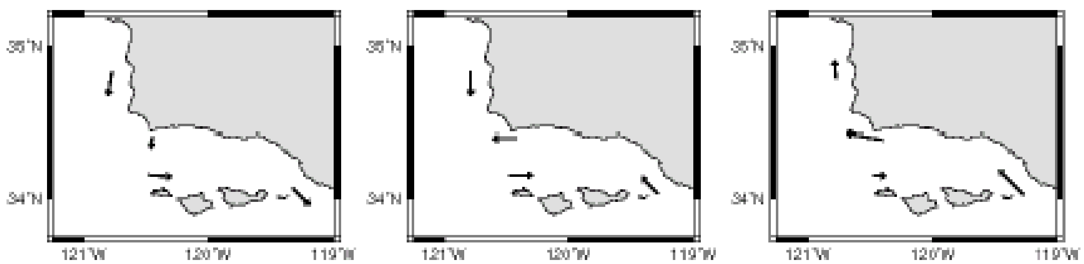
MMS OSRA Probabilities (%)
of Oil Spill Impact for Platform
Irene and Pipeline
10 Day Summer
0 10 20
Miles
N
Landfall
Probabilities
0 Irene
0 Pipeline
Pt. Piedras Blancas
Zero %
Morro Bay
Point Sal
Pt. Purisma
Pt. Arguello
Pt. Conception
Santa Barbara
Oxnard
Platform Irene
and Pipeline
Locations
0
11.9
Less than 100%
San Miguel
Santa Rosa
Santa Cruz
1.1
Less than 70%
Less than 40%
Less than 60%
Less than 30%
Less than 50%
Less than 10%
Less than 20%
Zero %


MMS OSRA Probabilities (%)
of Oil Spill Impact for Platform
Irene and Pipeline
10 Day Annual Average
0 10 20
Miles
N
Landfall
Probabilities
Irene
Pipeline
Pt. Piedras Blancas
Morro Bay
Point Sal
Pt. Purisma
Platform Irene
and Pipeline
Locations
Pt. Arguello
Pt. Conception
Santa Barbara
Oxnard
San Miguel
Santa
Rosa
Santa Cruz
Less than
70%
Less than
60%
Less than
50%
Less than
40%
Less than
30%
Less than
20%
Less than
10%
Zero
%

However, in order to assess the probabilities of a specific modeled end result, wind distributions and ocean current time dependant distributions would need to be obtained and many modeling runs conducted for the area.

The GNOME model operates by generating “splots” associated with each spill scenario. The fate of the splots is either to remain on the water, to be beached, to be weathered and disappear or to travel out of the modeling space. The movement of the splots is defined by the ocean current “regime” and the wind influences.

Ocean currents in GNOME are essentially divided into three regimes for the Santa Barbara Channel and the Santa Maria Basin: upwelling, convergent and relaxation. Each of these is shown figuratively below.



Upwelling State   Convergent State   Relaxation State

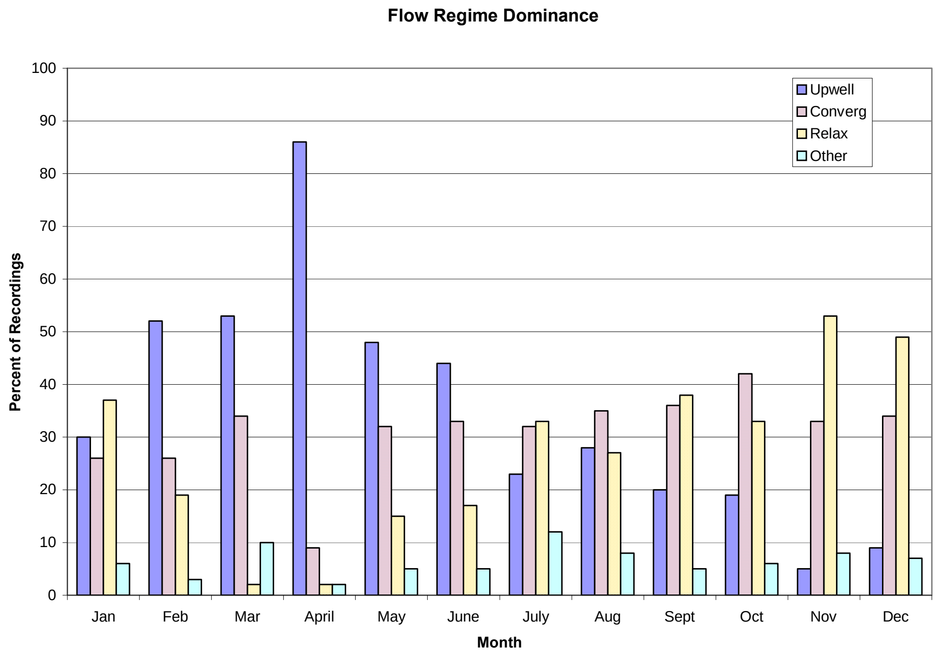
Upwelling
The upwelling state is named for the upwelling of cold (approximately 11°C) subsurface waters near Point Conception that often accompanies this state. The upwelling state occurs primarily in spring, although it has also been observed in other seasons. In terms of the conceptual models of the momentum balance, the upwelling state occurs when strong (>10 m/s), persistent (several days or more), upwelling favorable (equatorward) winds overwhelm any poleward, along-shelf pressure gradient.

Convergent
The convergent state is named for the convergence of southward flow west of Point Arguello with westward flow south of Point Conception. The convergent state occurs primarily in summer, although it has also been observed in other seasons. In terms of the conceptual models of the momentum balance, the convergent state tends to occur when upwelling favorable winds and a strong poleward, along-shelf pressure gradient exist. The most characteristic feature of the resulting flow field is a strong cyclonic recirculation in the western Santa Barbara Channel with about equal strength in the northern and southern limbs of the recirculation.

Relaxation
The relaxation state is named for the time periods when winds off Point Conception “relax” from their usual equatorward direction. The relaxation state occurs primarily in fall and early winter. In terms of the conceptual models of the momentum balance, the relaxation state occurs when poleward, along-shelf pressure gradients overwhelm

upwelling favorable or weak winds. The most characteristic feature of the resulting flow field is a strong westward flow (>50 cm/s) through the Santa Barbara Channel and to the SMB. Flow in the SMB is strongest along the mainland coast

Each of the three ocean current states includes a counter-clockwise circulation pattern in the Santa Barbara Channel. The frequency of occurrence of each flow regime is shown below.



E.6 GNOME Model Results

The GNOME model was run for the same oceanographic and meteorological conditions as were modeled in the MMS Report, Delineation Drilling Activities in Federal Waters Offshore Santa Barbara, California: Draft Environmental Impact Statement, 2001 (MMS 2001-046). These conditions are summarized below:

Current Regime	Meteorological Conditions	Timeframe
Upwelling	8 m/s NW	3 days 10 days
Convergent	7 m/s NW	3 days 10 days
Relaxation	4 m/s NW 4 m/s SW 0 m/s	3 days 10 days

These meteorological conditions are not intended to be all encompassing of the meteorological conditions that could be present during a spill scenario. Although the GNOME model takes ocean currents into account to a large degree, wind effects still have a large influence. Generally, winds originating from the east do not produce beach impacts and were therefore not included.

The model was run for releases at three locations: Platform Irene, the pipeline midpoint, and the pipeline shoreline located about 0.25 miles offshore.

The results of the modeling runs are shown in the following table and the following three figures. All splots for all the modeling runs are shown on each figure.

Flow Regimes
This figure shows the strong influence of the flow regime on the fate of the oil spilled. For the convergent and upwelling scenarios, occurring most frequently during the spring and summer, these two regimes produce oil spills that move in the southern direction impacting Point Arguello, Jalama Beach, Point Conception and San Migual, Santa Rosa and the Santa Cruz Islands. The counter-clockwise currents in the Santa Barbara Channel prevent oil from impacting the Coastline south of Point Conception.

Time Period
Two timeframes were examined in the modeling: 3 days and 10 days. This was conducted in correlation with the MMS study (MMS-2001-046). The model indicated that after 3 days, impacts would range as far south as Point Conception and almost to the Channel Islands. Northward movement after 3 days during relaxation regimes would move as far north as Guadalupe. After 10 days, impacts would reach at least the Channel Islands to the South and Pismo and Avila Beach and Piedras Blancas to the north. These impacts shown are only for a limited set of meteorological conditions.

Release Point
Releases were modeled for three locations: Platform Irene, the midpoint of the pipeline, and the pipeline shoreline location about 0.25 miles from the shoreline. Impacts from spills at Platform Irene were the most far reaching due to their location farther from shore. However, all three release points could impact the Channel Islands.

Wind Direction
Releases were modeled for three wind directions correlated with the ocean current flow regimes. Winds from the south-west were modeled along with the relaxation regimes, winds from the northwest were modeled along with the upwelling and convergent regimes, and neutral winds were modeled with the relaxation regime. The wind direction figure shows the importance of wind direction as south-west winds drove the spilled oil into the coastline between Surf and Pismo Beach. Winds from the north-west moved the oil towards the south impacting Point Arguello, Jalama, Point Conception, and the Channel Islands.

GNOME Modeling Results

Release Point	Flow Regime	Wind Speed, m/s	Wind Direction	Release Duration, Days	Current Operations: Amount Released, Barre	Current Operations: Amount in Water, barrels	Current Operations: Amount on Beach, barrel	Current Operations: Amount Weathered	Current Operations: Amount off Map	Proposed Operations: Amount Released, Barre	Proposed Operations: Amount in Water, barrels	Proposed Operations: Amount on Beach, barrel	Proposed Operations: Amount Weathered	Proposed Operations: Amount off Map	Beach Impacted Areas
Irene	Upwell	8	NW	3	425	261	1	163	0	5020	3087	10	1923	0	PA, PC, J
Irene	Upwell	8	NW	10	425	8	168	195	54	5020	94	1984	2303	638	PA, PC, J, North Side of SM, SR, SC
Irene	Conv.	7	NW	3	425	261	1	163	0	5020	3087	10	1925	0	PA, PC, J
Irene	Conv.	7	NW	10	425	9	103	191	122	5020	106	1217	2256	1441	PA, PC, J, North Side of SM, SR
Irene	Relax.	4	NW	3	425	214	48	163	0	5020	2528	567	1925	0	S, PA
Irene	Relax.	4	NW	10	425	203	25	197	0	5020	2398	295	2327	0	S, PA, J
Irene	Relax.	0	-	3	425	262	1	163	0	5020	3095	5	1925	0	S
Irene	Relax.	0	-	10	425	224	3.4	197	0	5020	2646	40	2327	0	S, PP, PS, G
Irene	Relax.	4	SW	3	425	92	170	163	0	5020	1087	2008	1925	0	S, PP, PS
Irene	Relax.	4	SW	10	425	47	181	197	0	5020	555	2138	2327	0	PP, PS, G, P
PL Mid	Upwell	8	NW	3	1749	82	996	671	0	3671	173	2090	1408	0	S, PA, PC
PL Mid	Upwell	8	NW	10	1749	103	815	802	29	3671	216	1710	1684	60	PA, J, PC, SR, SC
PL Mid	Conv.	7	NW	3	1749	399	679	671	0	3671	838	1425	1408	0	S, PA, J, PC
PL Mid	Conv.	7	NW	10	1749	337	543	815	49	3671	708	1140	1710	104	S, PA, J, PC, SM, SR
PL Mid	Relax.	4	NW	3	1749	428	654	671	0	3671	898	1373	1408	0	S, PA
PL Mid	Relax.	4	NW	10	1749	761	177	811	0	3671	1598	371	1702	0	S, PA, J
PL Mid	Relax.	0	-	3	1749	1066	12	671	0	3671	2237	26	1408	0	S, PP
PL Mid	Relax.	0	-	10	1749	909	25	811	0	3671	1909	52	1702	0	S, PP, PS, G, P
PL Mid	Relax.	4	SW	3	1749	272	807	671	0	3671	570	1693	1408	0	S, PP, PS
PL Mid	Relax.	4	SW	10	1749	267	671	811	0	3671	561	1408	1702	0	S, PP, PS
PL. Shore	Upwell	8	NW	3	2868	69	1701	1098	0	6718	162	3984	2572	0	S
PL. Shore	Upwell	8	NW	10	2868	66	1471	1331	0	6718	155	3446	3118	0	S
PL. Shore	Conv.	7	NW	3	2868	92	1678	1098	0	6718	216	3931	2572	0	S
PL. Shore	Conv.	7	NW	10	2868	258	1279	1331	0	6718	604	2996	3118	0	S, PA, J, PC
PL. Shore	Relax.	4	NW	3	2868	410	1359	1098	0	6718	960	3183	2572	0	S, PA
PL. Shore	Relax.	4	NW	10	2868	619	918	1331	0	6718	1450	2150	3118	0	S, PA
PL. Shore	Relax.	0	-	3	2868	1560	209	1098	0	6718	3654	490	2572	0	S, PA, PP
PL. Shore	Relax.	0	-	10	2868	1494	43	1331	0	6718	3500	101	3118	0	S, PA, PP, PS
PL. Shore	Relax.	4	SW	3	2868	419	1351	1098	0	6718	981	3165	2572	0	S, PP
PL. Shore	Relax.	4	SW	10	2868	399	1139	1331	0	6718	935	2668	3118	0	S, PP, PS

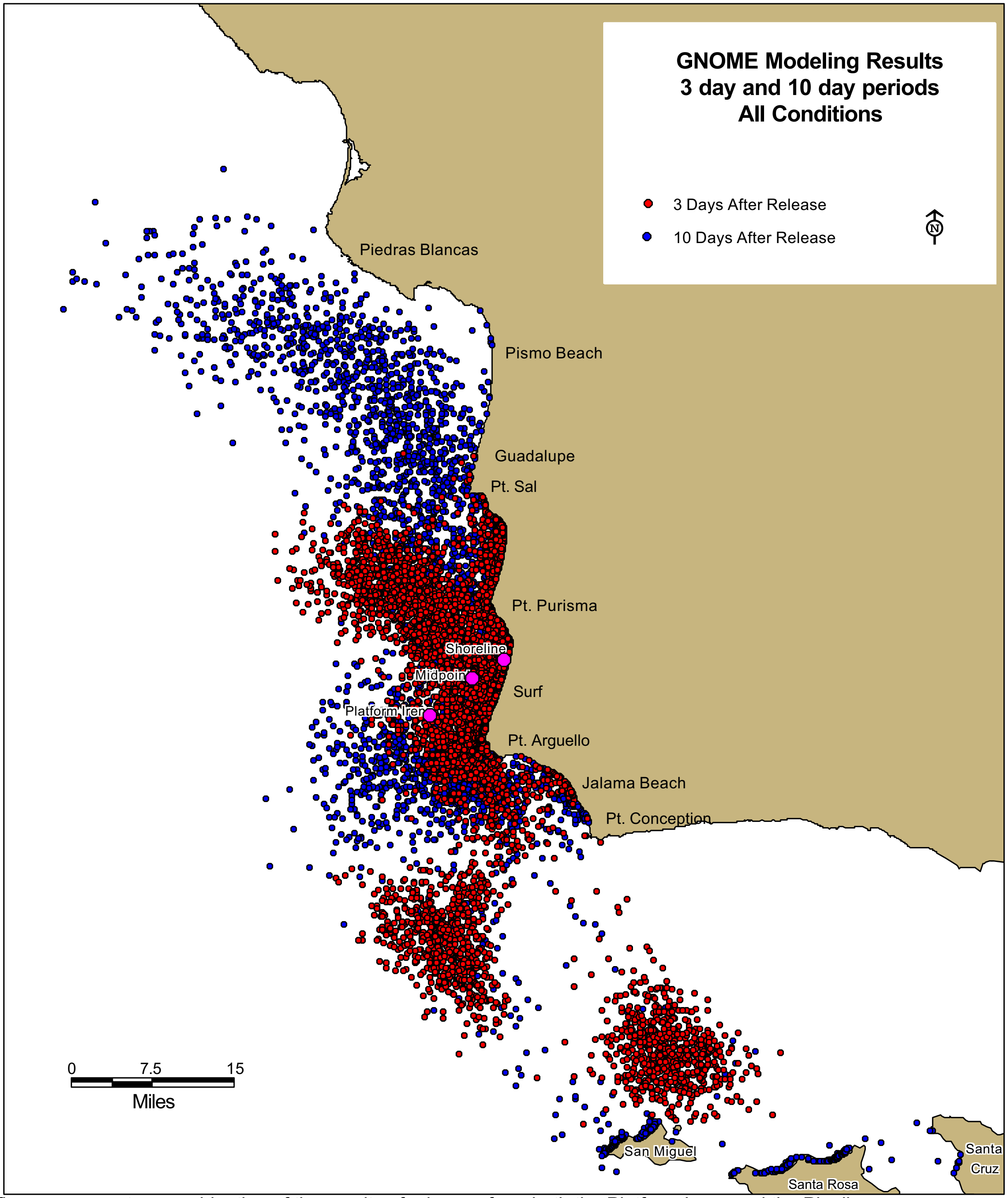
Beach Impacted Areas defined as:

PA - Point Arguello, PC - Point Conception, PP - Point Purisma, PS - Point Sal, S - Surf, P - Pismo Beach, SM - San Miguel Island, SR - Santa Rosa Island, SC - Santa Cruz Island J - Jalama, G - Guadalupe

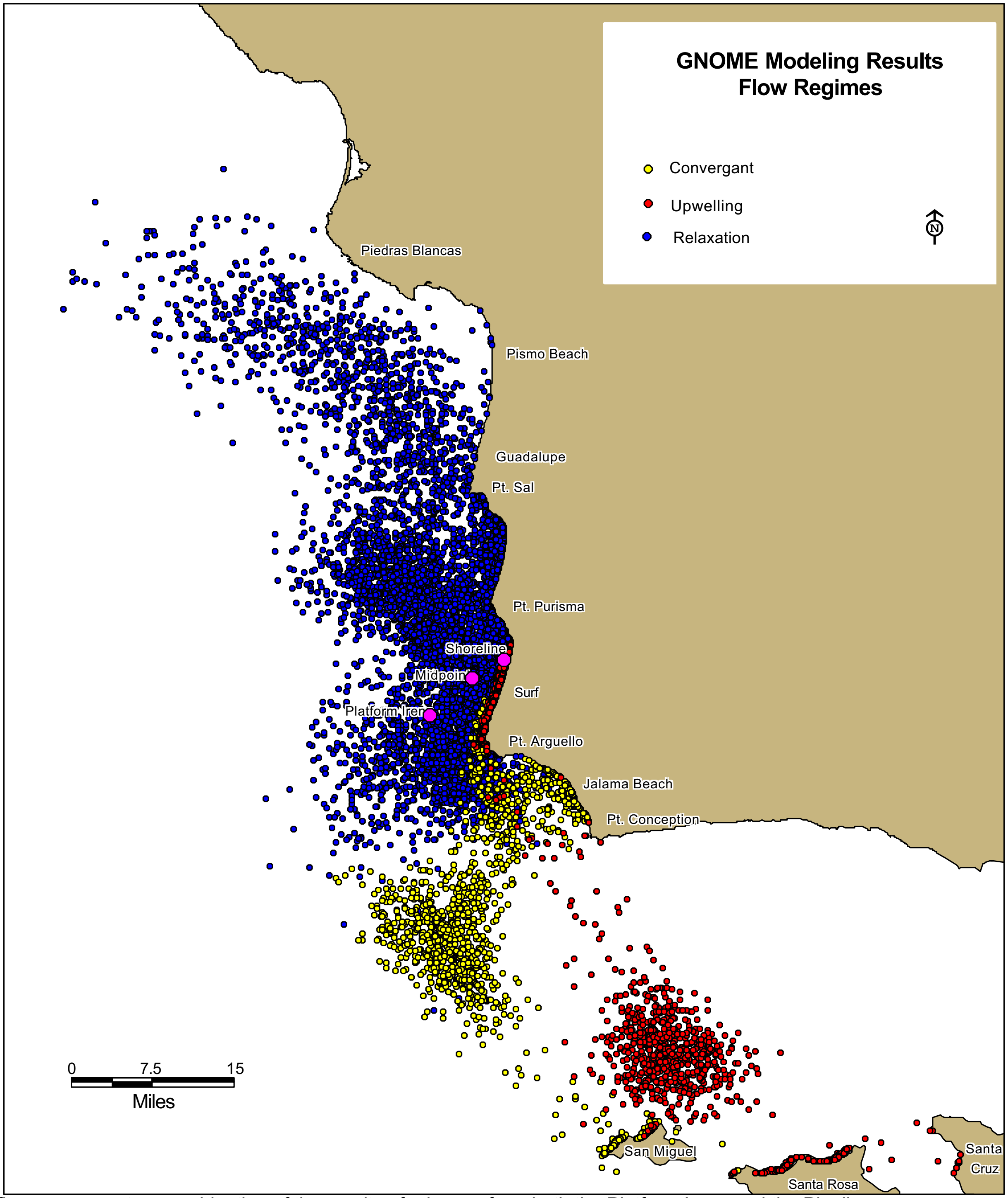
Neutral winds followed the flow regime, in this case relaxation, a moved primarily towards the north impacting the coastline from Point Arguello to north of Piedras Blancas. Wind directions between any of those modeled (such as SSW) would impact areas between the those indicated above.

Operating Scenarios and Impact Levels

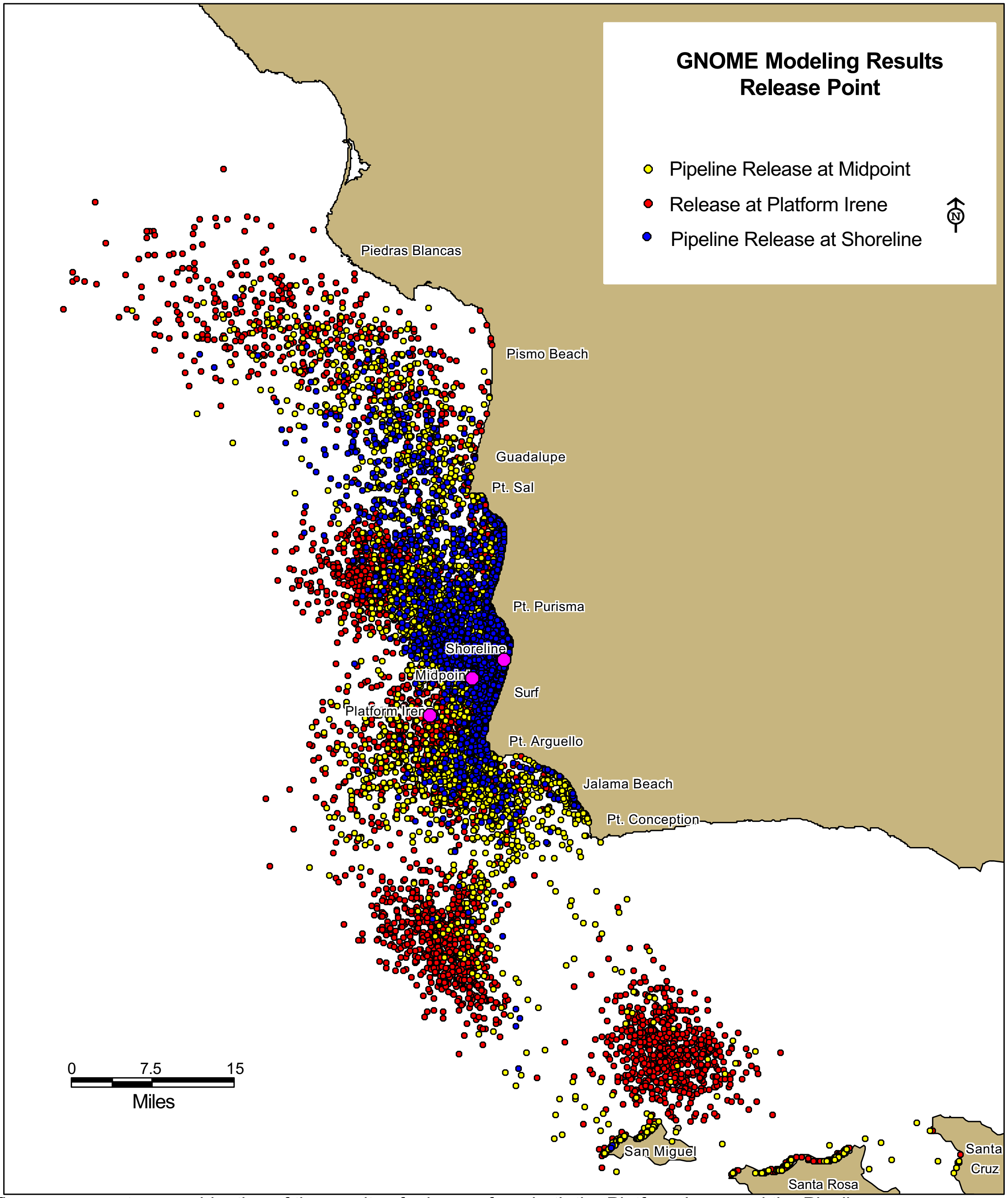
The GNOME Model produces output which allows for quantifying the amount of oil that is either beached, left on the water, weathered or that is outside the scope of the model area. Current operating scenarios have the potential to beach a maximum of about 1701 barrels of oil from current pipeline operations. The proposed project would increase this beached amount to about 3,984 barrels. This maximum amount would be associated with the pipeline shoreline release during the upwelling regime and would occur primarily at the Surf location. Worst case impacts associated with a pipeline midpoint release would occur during an upwelling regime also and would total about 996 barrels and 2090 barrels for current and proposed operations respectively. This amount would impact Surf, Point Arguello and Point Conception. Worst case impacts associated with a release at Platform Irene would occur during a relaxation regime and would total about 181 barrels and 2138 barrels for current and proposed operations respectfully. This amount would impact Point Purisma, Point Sal, Guadalupe and Pismo Beach.



This figure represents a combination of the results of releases from both the Platform Irene and the Pipeline and a range of met and regime conditions using the GNOME NOAA model.



This figure represents a combination of the results of releases from both the Platform Irene and the Pipeline and a range of met and regime conditions using the GNOME NOAA model.



This figure represents a combination of the results of releases from both the Platform Irene and the Pipeline and a range of met and regime conditions using the GNOME NOAA model.