7.2 METEOROLOGY AND OCEANOGRAPHY

7.2.1 Environmental Setting - Offshore Meteorology

7.2.1.1 General Weather Patterns

Weather patterns in the Southern California Bight (SCB) are dominated by the Pacific high-pressure system (Trewartha, 1954). During the summer, this high-pressure system strengthens and moves to the North Pacific creating prevailing west-to-northwesterly winds along the coast. The system weakens during the winter, moves south, and allows the Aleutian low-pressure system to spawn storms, which occasionally migrate through the Southern California area. The Pacific High, the temperature differential between land and sea, and local geography combine to produce a Mediterranean climate characterized by partly cloudy, cool summers with little precipitation and mild winters during which precipitation may fall from migrating storms (Trewartha, 1954). A more detailed discussion of general weather conditions in the SCB may be found in Bureau of Land Management (1979), Jenkins (1977), Naval Oceanography Command (1983), and Naval Oceanography and Meteorology (1977).

The general weather patterns are strongly affected by surrounding topographical features. The Santa Barbara Channel is about 60 nautical miles long and 20 nautical miles wide, oriented west-northwest to east-southeast. At the western end of the Channel near Point Arguello and Point Conception the coastline turns abruptly from an east-west to a north-south orientation. Mountain ranges parallel the shores of the Channel both to the north and to the south. The Santa Ynez Mountains rise just north of Point Conception and lie in an east-west orientation, rising to 5,000 feet north of Ventura. The Santa Monica Mountains arise from the coastal plane east of Ventura and lie in an east-west orientation rising to about 2,000 feet north of Santa Monica. The Channel Islands are also mountainous, rising from about 800 feet on San Miguel Island to 2,400 feet on Santa Cruz Island and descending to about 100 feet at Anacapa Island. The coastal ranges are marked by passes and canyons along the southern slopes. The Channel Islands have narrow ocean passages between them.

7.2.1.2 Wind Speed and Direction

The predominant wind flow pattern off the Southern California coast is west to northwesterly. This general flow of wind in the Santa Barbara Channel prevails over 50 percent of the time. The historical statistical frequency of wind direction and average speed is shown in Table 7.2-1 for the one-degree rectangle of latitude and longitude surrounding the project area. Table 7.2-1 illustrates that winds blow from the westerly quadrant about 60 percent of the time and winds from other directions occur, on average, with more or less uniformly distributed frequencies. Average speeds are 4 to 10 knots throughout the year with slightly higher averages during winter.

Table 7.2-1. Wind Direction Frequency and Mean Speed, Knots
Latitude 34° N - 35°N, Longitude 119°W - 120°W

	N		NE		E		SE		S		SW		W		NW		Overall Mean	Percent Calm
	Key																**Key**	**Key**
January	15%	6	20%	7	15%	9	3%	7	2%	5	3%	6	20%	9	14%	9	7	8%
February	15%	6	13%	7	5%	9	3%	7	2%	8	5%	8	25%	10	22%	9	7	10%
March	2%	5	4%	6	4%	7	7%	8	8%	6	7%	6	40%	11	20%	11	8	8%
April	1%	5	5%	4	6%	5	8%	6	14%	6	7%	6	36%	9	15%	10	7	8%
May	3%	4	2%	4	2%	5	5%	5	6%	4	14%	6	40%	9	15%	10	7	13%
June	2%	6	2%	4	3%	4	3%	5	6%	4	14%	6	42%	8	10%	9	8	18%
July	1%	6	1%	4	2%	5	1%	8	1%	4	12%	6	44%	8	22%	8	6	16%
August	2%	6	1%	5	1%	5	1%	6	1%	5	7%	7	44%	8	24%	8	6	19%
September	1%	5	1%	4	4%	5	1%	7	1%	6	7%	11	40%	8	30%	7	6	15%
October	2%	4	5%	5	4%	7	2%	8	7%	5	7%	5	38%	8	20%	7	5	15%
November	10%	5	12%	6	14%	7	5%	8	4%	7	3%	7	25%	8	15%	8	6	12%
December	5%	6	17%	7	17%	8	3%	10	5%	7	6%	8	20%	9	12%	10	7	15%
Annual Average	5%	6	7%	6	6%	6	4%	7	5%	6	8%	7	35%	9	18%	9	7	13%

Key: Read: During January the wind is from the north 15 percent of the time at an average speed of 6 knots. The average wind speed from all directions is 7 knots, and 8 percent of the time winds are calm.

Source: Climatic Study of the Near Coastal Zone, Southern California Operating Area. Naval Oceanography Command 1983.

Although the mean wind speed in the project area is only about 7 knots, stronger winds occur with frequency high enough to require caution at all times. Winds above 34 knots occur less than one percent of the time (Table 7.2-2). Higher wind speeds occur most often in the spring when strong northwesterly winds result from the strengthening of the Pacific High (BLM, 1979). Table 7.2-2 illustrates the statistical frequency of four categories of wind speed for the same rectangular area. Although Table 7.2-2 shows that winds greater than 21 knots occur only about 5 percent of the time, mariners recognize a windy lane parallel to and just north of the Channel Islands. They generally report that wind speeds in this lane are considerably stronger than Channel areas closer to the mainland coast. This windy lane condition appears to develop from convergence of the winds from the northwest as the air flows around the west end of the Santa Ynez Mountains, enters the Channel, and is contained by the elevated land of the Channel Islands.

Table 7.2-2. Wind Speed and Wave Height Climate, Platforms Grace and Gail, Latitude 34°N - 35°N, Longitude 119°W - 120°W

	Wind Speed in Knots				Wave Height in Feet						
	<11	**11-21**	**22-33**	**≥34**	**≥2**	**3-4**	**5-6**	**7-9**	**10-12**	**≥13**	
January	70	25	4	<1	51.1	25.9	13.8	6.9	1.7	0.6	**Percentage Frequency of Occurrence**
February	65	30	4	<1	44.9	28.4	16.5	9.1	0.6	0.6	
March	65	27	8	<1	35.4	28.8	21.7	9.6	4.0	0.5	
April	70	25	5	<1	43.8	26.8	17.5	7.7	2.1	2.1	
May	65	30	5	1	39.5	34.2	16.3	6.8	3.2	--	
June	77	20	3	<1	43.7	26.8	20.2	9.3	--	--	
July	77	20	3	<1	43.5	35.0	15.9	5.1	0.5	--	
August	78	20	2	<1	38.7	37.6	13.9	9.3	0.5	--	
September	80	17	3	<1	53.5	30.5	10.2	5.3	0.4	--	
October	80	17	3	<1	52.5	28.7	11.9	5.4	1.0	0.5	
November	80	17	3	<1	51.0	28.8	10.6	8.6	1.0	--	
December	72	25	3	<1	47.3	31.9	11.5	8.2	0.5	0.5	
Annual Average	73	23	4	<1	45.4	30.3	15.0	7.6	1.3	0.4	

Source: Climatic Study of the Near Coastal Zone, Southern California Operating Area. Naval Oceanography Command 1983.

Data obtained from an offshore point at the west end of Santa Barbara Channel (Point Arguello Buoy No. 46023) reveal higher average wind velocities, ranging from 11.8 to 15.7 knots (Table 7.2-3) (National Data Buoy Center, 2000a). The more than 11-year data record in this table captures a typical wind speed regime that could be encountered at the project site. More recently summarized data (post-1993) are not currently available; however, recent, unsummarized meteorological data from this buoy (No. 46023) can be found at http://www.ndbc.noaa.gov/historical_data.shtml (NDBC, 2000b). Additional data can be found for two closer buoys, Santa Barbara-West (No. 46054) and Santa Barbara-East (No. 46053) through the same web site. The maximum wind speeds observed at No. 46053 (located approximately 19.5 nautical miles west-northwest of Platform Grace in the eastern central Santa Barbara Channel is presented in Table 7.2-4.

Table 7.2-3. Average Wind Speeds Recorded at the Point Arguello Buoy (4/82 - 7/93)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Winds (Knots)	12.2	13.3	14.6	15.5	15.7	14.7	14.5	14.4	13.5	13.1	13.2	11.8

Source: NDBC (2000b), http://www.ndbc.noaa.gov/images/climplot/46023_ws.gif

Table 7.2-4. Maximum Wind Speed Summary Data Recorded in Eastern Santa Barbara Channel - Station 46053 (1/94-12/01)

	Jan	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*
Average and Maximum Wind Speed (Knots) by Month (Jan. 1994 - Dec. 2001)												
Mean	*9.0*	*9.3*	*9.7*	*11.5*	*9.7*	*9.2*	*9.7*	*9.6*	*8.8*	*7.9*	*8.3*	*8.0*
Max.	*41.8*	*34.0*	*36.4*	*34.4*	*32.9*	*32.1*	*25.1*	*26.4*	*27.4*	*33.4*	*32.3*	*30.1*
Peak Wind Gusts (Knots) by Month (Jan. 1994 – Dec. 2001): Highest 5-Second Average During 2 or 8-minute Period Prior to Observation Time)												
Mean	*11.3*	*11.6*	*12.0*	*13.9*	*11.8*	*11.2*	*11.7*	*11.5*	*10.7*	*9.8*	*10.3*	*10.2*
Max.	*50.2*	*41.0*	*43.4*	*41.8*	*38.7*	*37.7*	*28.8*	*30.7*	*31.9*	*41.8*	*38.5*	*37.3*
Hourly Peak Wind Gusts (Knots) by Month (Dec. 1995 - Dec. 2001): Highest 5-Second Average During Past Hour)												
Mean	*12.4*	*13.7*	*13.9*	*15.1*	*13.4*	*12.4*	*12.9*	*12.6*	*11.6*	*11.4*	*12.2*	*11.4*
Max.	*35.2*	*54.2*	*39.9*	*41.2*	*37.9*	*34.6*	*29.2*	*31.7*	*33.4*	*43.2*	*40.2*	*42.4*

Source: NDBC (2004), http://www.ndbc.noaa.gov/station_page.php?station=46053

Gale force winds, i.e., ≥ 34 knots, occasionally occur in the project area as cold fronts pass or during Santa Ana wind events. The Santa Ana winds are a reversal of the normal westerly wind patterns common to the project area. The Santa Ana's are a foehn-type,downsloping, winds forming as a result of air pressure buildup in the high-altitude deserts northeast of the project area which then travel down through the passes between the Santa Ynez and Santa Monica Mountains and out to sea south of Ventura. Foehn-type winds are characteristically strong, gusty, dry winds, caused by the adiabatic heating of air as it descends on the lee sides of mountains. Adiabatic heating refers to the increase in temperature caused by the compression of a body of air as it descends in the atmosphere. Although the Santa Ana winds are typically 15 to 25 knots, speeds of 90 knots have been observed. The Santa Ana's tend to have a relative humidity of 30 percent and temperatures at least 5°F warmer than average. Other major wind patterns are discussed below and by BLM (1979) and Jenkins (1977).

A sea breeze occurs during the day and persists until late night because of differential heating between land and sea. The opposite (land breezes) occurs during the early morning hours. Neither of these conditions produces wind speeds of high velocity, but both tend to be more intense during the summer (Jenkins, 1977). Diurnal airflow is dominated by westerly to northerly winds in the vicinity of the project area.

7.2.1.3 Precipitation

About 95 percent of the precipitation in the Southern California coastal area falls during the months of November through April. This is the result of frontal storms from the Gulf of Alaska, which are allowed to migrate through the area due to the weakening and subsequent movement of the Pacific High (BLM, 1979). Table 7.2-7 shows the percentage of time that precipitation is reported at sea. Rainfall over land and the coastal areas of the Santa Barbara Channel varies from about 4 to 41 inches and averages about 10 to 17 inches per year. The orographic effects of the coastal ranges induce a fair percentage of the rainfall. The amount of rainfall at sea over the project area is expected to be somewhat less than revealed in the records kept onshore.

Occasionally rainfall can be abundant over short periods of time. At times a deep, cold low-pressure trough in the general atmospheric circulation develops off the California coast in winter. Perturbations in the cyclonic flow around the trough produces bands of low level convergency and convection with bands of clouds and rain similar to those associated with fronts. The low-pressure troughs sometimes remain more or less stationary for up to a week or 10 days, producing repeated bands of clouds and rain every couple of days.

Other sources of rain occasionally develop during the fall in the form of tropical cyclones or hurricanes in the ocean west of Central America. Although these storms only rarely reach Southern California, they may have diameters of 300 miles or more, which is sufficient to bring rain to the Santa Barbara Channel area.

Traces of snow have been recorded, but the offshore areas are generally free of temperatures cold enough to produce such conditions as freezing rain or sleet (USGS, 1974; Jenkins, 1977). Hail may occur during the winter months in insignificant amounts.

Annual precipitation levels in the Santa Barbara area have varied from about 4 to 41 inches (10 to 105 cm) during the past 73 years, with an average of approximately 17.6 inches (44.5 cm) (Western Regional Climate Center, 2000). The most substantial rainfall occurs in the winter months from December through March (Table 7.2-5), with an average of 3.4 inches (8.7 cm) per month. While onshore rainfall may differ from that encountered offshore, these data represent the typical precipitation pattern that could be encountered within the project area.

Table 7.2-5. Average Monthly Precipitation Recorded at Santa Barbara (12/1927 - 7/2000)

Precipitation	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
cm	9.55	10.33	7.09	3.10	0.76	0.23	0.05	0.10	0.41	1.07	4.22	7.72
inches	3.76	4.07	2.79	1.22	0.30	0.09	0.02	0.04	0.16	0.42	1.66	3.04

Source: WRCC (2000), http://www.wrcc.dri.edu/summary/climsmsca.html

7.2.1.4 Temperature

Although temperature variations are also strongly influenced by topography, the range of temperatures along the coastal strip of Ventura County is fairly narrow attributed to the influence of the Pacific Ocean. In January, the long-term monthly maximum and minimum temperatures measured at the Western Region Climate Center Station (WRCC) 046569 located in Oxnard (34.11°N, -119.10°W) are 18.6°C (65.4°F) and 6.8°C (44.3°F) respectively; the corresponding

July values are 23.3°C (74°F) and 14.4°C (58°F). At the NOAA Buoy Station 46053 (34.18°N, -119.5°W) near Platform Grace the long-term monthly maximum and minimum temperatures in January were 13.4°C (56.12°F) and 8.4°C (47.12°F) respectively with corresponding July values of 20.2°C (68.36°F) and 12.1°C (53.78°F). By comparison, temperature fluctuations are generally greater onshore (NOAA, 2003a).

Table 7.2-6 illustrates the average air temperatures recorded at the NOAA Buoy Station 46053 from January 1994 to December 2001. The seven-year period of record captures a typical temperature regime for those likely to be encountered during offshore operations. Also illustrated in Table 7.2-6 are average onshore temperatures at a weather station located at 34.20°N and 119.18°W.

Table 7.2-6. Offshore and Onshore Average Air Temperatures

Month	Offshore NOAA Buoy Station 46053 1994-2001	Onshore WRCC Station 046569 1948-2003
January	13.4°C (56.12°F)	12.7°C (54.86°F)
February	13.1°C (55.58°F)	13.2°C (55.79°F)
March	13.1°C (55.58°F)	13.5°C (56.35°F)
April	12.6°C (54.68°F)	14.6°C (58.24°F)
May	13.7°C (56.66°F)	15.8°C (60.38°F)
June	14.8°C (58.64°F)	17.3°C (63.06°F)
July	15.7°C (60.26°F)	18.9°C (65.98°F)
August	16.0°C (60.8°F)	19.4°C (66.88°F)
September	16.6°C (61.88°F)	19.0°C (66.19°F)
October	16.1°C (60.98°F)	17.6°C (63.76°F)
November	14.7°C (58.46°F)	15.2°C (59.37°F)
December	13.6°C (56.48°F)	13.1°C (55.60°F)

7.2.1.5 Inversions

The project area is subject to inversion conditions which are often associated with sea-land temperature variations and compressional heating. The inversions are characterized by a layer of warmer air above the cooler air near the ground surface. Essentially three types of inversions occur in the project area including radiational (or nocturnal), marine, and subsidence inversions. These inversions act as a lid on the cooler air mass near the ground, resulting in reduced vertical mixing and pollutant dispersal.

The most prevalent inversion type in the area is the radiational inversion, which is formed overland on cloudless nights as heat radiates from the earth, cooling the lowest atmospheric layers. These inversions may be reinforced by cool air that drains down slope from the adjacent hills but is usually destroyed by surface heating during the day.

Marine inversions are formed as a result of cooling the lowest layer of the atmosphere as it passes over the cooler ocean water surface. These conditions often occur in late spring when the ocean temperatures are still cold relative to the warmer adjacent land areas.

Subsidence inversions are a result of adiabatic heating of the descending air on the outer fringes of the Pacific High pressure center. These conditions create an inversion that is essentially superimposed upon any other inversions, causing stronger resulting inversions during the warm half of the year.

The southern California coastal region has some of the lowest daytime and nighttime mixing heights in the U.S. Specifically, surface inversions such as radiational and marine inversions with mixing heights of 0 to 500 feet are most frequent during the winter and subsidence inversions with mixing heights of 1,000 to 2,000 feet generally occur during the summer (measured at Vandenberg Air Force Base located approximately 85 miles northwest of Oxnard) (County of Santa Barbara, 2000).

7.2.1.6 Sky Cover and Visibility

The most common type of cloud cover over the Southern California coast is stratus, which occurs more commonly during the summer than winter (Table 7.2-7). The combination of cold ocean current and semi-permanent sub-tropical high pressure produces the stratus. The stratus clouds generally form during the night and early morning and often push into coastal valleys and foothills. During the day the sun tends to dissipate the clouds over land, but the low stratus often remains just offshore. Ceiling heights vary from 0 to 8,000 feet with the greatest frequency between 1,000 and 4,000 feet. Fog occurs most frequently during the summer months and may markedly restrict visibility (BLM, 1979).

Table 7.2-7. Cloud Cover and Precipitation at Latitude 34° 09'N, Longitude 119° 28'W

Month	Cloud Cover		Precipitation
	Percentage of Time		
	≤2/8	≤5/8	Percentage of Time Occurring
January	52	25	5
February	52	28	6
March	50	28	3
April	48	40	3
May	50	40	2
June	40	50	1
July	40	50	1
August	40	50	1
September	50	40	1
October	56	38	2
November	54	27	3
December	55	27	4
Annual Average	50	37	3

Source: Climatic Study of the Near Coastal Zone, Southern California Operating Area. Naval Oceanographic Command, 1983.

Coastal fog and low stratus clouds associated with atmospheric temperature inversions occur during periods of light and variable winds and are most common during the summer months. Such conditions may markedly restrict visibility during project operations. Table 7.2-8 summarizes the average number of days that the project region was subject to fog with visibility ¼ mile or less.

Table 7.2-8. Heavy Fog with Visibility of ¼ mile or Less for Period of Record 1960-1990

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1.3	2.3	1.5	1.1	0.9	1.1	1.8	1.9	3.0	3.4	1.3	1.3

Source: WRCC, 2003

7.2.1.7 Severe Weather

Severe weather in Southern California is primarily caused by frontal storms, Santa Ana winds, thunderstorms, and tropical storms. However, severe weather such as thunderstorms and tropical cyclones are rare in the project area.

Thunderstorms in the project area are generally associated with active cold fronts or cold lows in winter or with the transport of moisture into the region in late summer or early fall (MMS, 2001). Winter storm centers typically originate in the vicinity of low-pressure centers in the Gulf of Alaska, move out of the Gulf and eastward, well north of Point Conception. As the front approaches, the area is subject to southeasterly winds of approximately 30 knots with locally higher gusts of 40 to 45 knots. These winds can persist for up to 12 hours. Historically, these wind events have caused wind and wave damage to unprotected coastal facilities. Following frontal passage, winds may be expected to become westerly or northwesterly and as strong as the prefrontal winds.

Severe weather conditions during the winters of 1980 to 1983 and again in 1997 to 1998 were a result of tropical storms that caused a shift in typical pressure patterns. In mid-February of 1980, and again in January of 1993 and 1998, low pressure centers from the high latitudes migrated south over the central Pacific Ocean between 30°N and 40°N latitude. Due to the northward displacement of the subtropical jet stream, warm moist air was entrained into these low pressure cyclonic systems, causing severe weather conditions and high energy storm waves that moved eastward into the Santa Barbara Channel.

The project area is also susceptible to El Niño and La Niña conditions. In normal El Niño conditions, the trade winds blow towards the west across the tropical Pacific. These winds serve to pile up warm surface water in the west Pacific, so the sea surface temperatures are about 8°C (46.4°F) higher than normal in the west and the sea surface is about 1.6 feet (0.5 m) higher at Indonesia than at Ecuador. Very Strong El Niño events have been observed in 1782-84, 1844-46, 1876-78, 1899-1900, 1940-41, 1982-83, 1991-1993, 1994-1995, 1997-1998, and

2002-2003. The 1982-83 El Niño, was widely recognized as the most severe of the 20th century, bringing numerous frontal storms, high winds, strong wave action, and above normal rainfall to the project region and caused considerable damage to coastal structures along the California coast (Environmental News Network, 1997).

Conversely, La Niña tends to bring nearly opposite effects of El Niño to the United States. During La Niña the easterly trade winds strengthen and cold upwelling along the equator and the west coast of South America intensifies resulting in unusually cold ocean temperatures in the Equatorial Pacific with sea surface temperatures falling as much as 4°C (39.2°F) below normal. Generally, La Niña produces wetter than normal conditions across the Pacific Northwest and dryer and warmer than normal conditions across much of the southern tier. Historical La Niña events have been documented in 1904, 1908, 1910, 1916, 1924, 1928, 1938, 1950, 1955, 1964, 1970, 1973, 1975, 1988, and 1995 (NOAA, 2003b).

Offshore structures in the vicinity of the project area have been constructed to withstand the maximum expected currents that are less than 50 cm/second and the 100-year storm waves that are less than 12 meters in height.

Although statistical records of weather conditions indicate a low frequency of severe weather, there are reports of singular events in the Santa Barbara Channel. Specifically, on Santa Barbara’s hottest day, a katabatic, or downsloping “simoon” wind,caused temperatures of 26.7°C (80°F) by mid morning, 45°C (113°F) at 5 p.m., and 25°C (77°F) at sundown. Simoon winds are strong, dusty or sand-laden, circular winds originating in desert regions. The name “simoon” means “poison winds” in Middle Eastern countries where desert storms are suffocating to people and livestock. In addition to rare wind events, at least one tornado touched down in the Los Angeles area in February 1983 and more were reported in the form of waterspouts in the offshore areas. Hail storms were fairly common in Southern California in early 1983, but no damage was reported.

7.2.2 Environmental Setting - Onshore Meteorology

The onshore natural gas pipelines and valve station modifications being proposed as part of the project are located in various areas of Ventura and Los Angeles Counties. Specifically, pipeline alignments being considered are located in the Cities of Oxnard, Santa Paula, Fillmore, Santa Clarita, Los Angeles and unincorporated portions of Ventura and Los Angeles Counties.

7.2.2.1 Oxnard Plain

The Oxnard Plain experiences the mild, Mediterranean climate typical of southern California. Average temperatures in the Oxnard area are a 70.7°F high, a 49.9°F low, and an overall mean temperature of 60.3°F. Precipitation averages 14.45 inches per year, with the majority of rainfall occurring from November through March. Prevailing winds along the Ventura coast and Oxnard Plain are westerly and northwesterly. During the fall, Santa Ana winds reverse the prevailing air flow and bring dry, hot gusts which often have greater air movement

7.2.2.2 Santa Paula - Fillmore

Because of its inland location, Santa Paula is often slightly warmer than the coastal communities of the Oxnard Plain. Typical summertime highs are in the 80s, with wintertime temperatures generally in the low 60s. Average annual rainfall is about 15 inches, most of which falls between November and April (City of Santa Paula, 1998). Comparatively, the average temperature in Fillmore is 77.7°F and average annual rainfall is 18.2 inches (46.2 cm) (City of Fillmore, 2006).

7.2.2.3 Santa Clarita

The following setting information was obtained from the City of Santa Clarita General Plan, Air Quality Element (City of Santa Clarita, 2000).

The strength and location of a semi-permanent, subtropical high pressure cell over the Pacific Ocean primarily controls the Santa Clarita area climate. Rainfall averages between 15 to 18 inches annually and falls mostly between the months of November and March. Summers are often completely dry, and there are frequent periods of 4 to 5 months with no rain. In the winter, occasional storms from the high latitudes sweep across the coast, bringing rain inland.

Annual average daytime temperatures range from 89.7°F in summer to 63.6°F in the winter. Predominant wind patterns in the Santa Clarita area generally follow those described for a mountain/valley regime. During the day, effects of the onshore flow reach inland and are enhanced by a localized upvalley or mountain pass wind. During the night, surface radiation cools the air in the mountains and the hills, which flows downvalley, producing a gentle “drainage wind”. The topography surrounding Santa Clarita leads to two separate valley flow patterns; distinctively different predominant wind directions in the southern and northern portions of the City and a convergence of these winds within the City.

Wind in the southern portion of Santa Clarita typically flows from the south/southeast as the effects of the regional onshore flow are modified by the upvalley flow from the San Fernando Valley through the Newhall Pass. At night, wind typically flows from the east down the Santa Clarita River Valley. Farther north, a completely different wind pattern is observed. The highest frequency of winds occurs from the west and east. The northern area of Santa Clarita receives daytime westerly winds from the Oxnard Plain by way of the Santa Clara River Valley. The return flow at night is predominantly from the east, and represents the down valley drainage pattern.

On most days, a convergence zone will exist in the Santa Clarita area as the two flow patterns meet, usually in the northern half of the valley. Where these winds meet, wind speeds accelerate. Shifts of the convergence zone lead to variations in wind speed and direction resulting in strong southeasterly to southwesterly winds. The predominant wind patterns for the Santa Clarita area are broken by occasional winter storms and episodes of Santa Ana winds. Santa Ana winds are strong northerly or northeasterly winds that originate in the desert of the Great Basin and predominantly occur from September through March. Usually warm, always very dry, and often full of dust, Santa Ana winds are particularly strong in mountain passes and at the mouths of canyons. On average, Santa Ana winds occur 5 to 10 times a year in Santa Clarita, each occurrence lasting up to several days.

7.2.3 Environmental Setting - Oceanography

7.2.3.1 Santa Barbara Channel

The offshore project area is located in the eastern portion of the Santa Barbara Channel. The Santa Barbara Channel is located at the northern edge of the Southern California Bight with an east to west orientation. It is bounded to the north by the California mainland, from Port Hueneme to Pt. Conception, and to the south by a string of four islands running from east to west: Anacapa, Santa Cruz, Santa Rosa, and San Miguel. The Channel is approximately 63 miles (100 km) long and 25 miles (40 km) wide with a maximum depth of more than 1,800 feet (300 fathoms) in its central basin. The shelf width on both sides ranges from 2 to 6 miles (3 to 10 km), the sill depths at the eastern and western entrances are 721 feet (220 m) and 1,411 feet (430 m) respectively, and the island passages are approximately 131 feet (40 m) deep (MMS, 2001).

Currents. Currents in the Channel are a superposition of large-scale flow and a cyclonic circulation characteristic to the Channel's interior. Current observations at the eastern Channel entrance indicate close agreement between direct measurements and geostrophic calculations of the flow in these areas. The large-scale surface flow is equatorward in the spring due to strong equatorward wind stress. Surface current flows reverse to the poleward direction for the remainder of the year, due to strengthening of the alongshore surface pressure gradient. Monthly averaged currents on the southern Channel shelf are eastward year-round: they reach a maximum in the spring when the large-scale flow is equatorward, and a minimum in the late fall and winter when the large-scale flow is poleward (MMS, 2001).

General oceanic circulation along the southern California coast is dominated by the California Current System (Eastern Boundary Current of the North Pacific Gyre system). The system includes four major currents including the California Current (proper), the Southern California Countercurrent, California Undercurrent, and the Davidson Current.

The California Current is southward flowing and represents the eastern limb of a large anti-cyclonic gyre that covers much of the North Pacific Basin. The broad, shallow, slow moving southerly flow of the California Current consists of relatively cold, low-salinity water that reaches to within a few kilometers of Point Conception, and generally flows outside the Santa Barbara Channel and Southern California Bight. Velocities at the core of the current (approximately 190 miles [300 km] offshore) may approach 0.5 knots (25 cm/sec) but generally are 0.1 to 0.2 knots (5 to 10 cm/sec). The California Current often exhibits high spatial and temporal variability, with eddies and jets that may include western or northern flows. Specifically, an eddy often forms south of Point Conception, resulting in a large counterclockwise gyre between the mainland and the California Current. During winter, summer, and fall, the inshore side of the gyre termed the Southern California Countercurrent, transports relatively warm saline water northward through the Southern California Bight but is essentially absent during the spring. The northwesterly countercurrent is best developed from November through January, with speeds calculated at 0.23 to 0.35 knots (12 to 18 cm/sec).

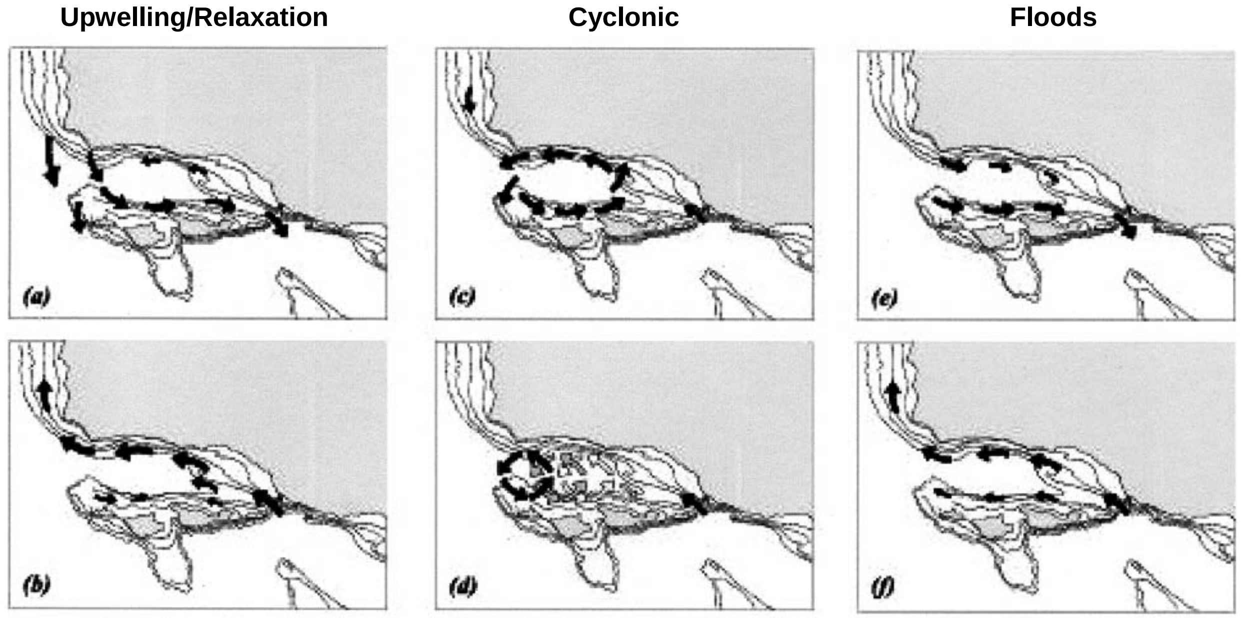
The northward-flowing California Undercurrent is a subsurface current that flows offshore, occurring beneath the shoreward side of the California Current at a depth between 330 and 980 feet (100 and 300 meters) below the surface (Hickey, 1993). The undercurrent consists of southern waters that are warmer, more saline, and less oxygenated than the California Current waters. In general, the California Undercurrent is relatively narrow, having a high-speed core located over the continental slope.

Beginning in late fall, the Pacific High pressure system weakens, lessening the forcing effects of the wind. During this period, the north winds driving the California Current are weak or absent resulting in a surface signature of the undercurrent, often termed the Davidson Current. In general, the northward-flowing waters contained in the Davidson current are warmer and more saline than those in the California Current. A rapid spring transition to strong northwesterly winds occurs between March and June when the Davidson Current weakens. These strong northwesterly winds also induce upwelling near Point Estero and Point Buchon.

The interaction of wind stress on surface water and the earth’s rotation (the Coriolis effect) causes surface currents to flow in a direction to the right of the wind in the northern hemisphere. On the California coast, the geostrophic effects of the northerly winds cause surface water to move away from the coast. As the surface water is transported offshore, it is replaced by cold, dense subsurface water from offshore. This cold upwelling water is generally nutrient rich, containing relatively high concentrations of nitrate and phosphate, which enhances local biological productivity. Such upwelling events in the Santa Barbara Channel generally occur during the spring and summer. Synoptic views of the circulation in the Santa Barbara Channel are illustrated below in Figure 7.2-1.

Tides. On the west coast, the astronomical tide is characterized as being mixed semidiurnal with two unequal high and two unequal low tides generally occurring in a 25-hour period. For a period of approximately 10 days, the 25-hour tidal cycle have two high-waters and two low-waters. This 10-day stint is then followed by a 3 to 4 day period in which the 25-hour cycle is composed of only one high-water and one low-water tide.

The tide is a long-period wave that is a combination of semidiurnal components (each having nearly 12 hour periods) and diurnal components with nearly 25-hour periods. In the eastern North Pacific Ocean, the tide wave rotates in a counterclockwise direction so that tidal extremes occur progressively later in the day northwards along the coast. As a result, flood tide currents flow up coast and ebb tide currents flow down coast.



Upwelling/Relaxation **Cyclonic** **Floods**

(a) Upwelling, (b) Relaxation, (c) Cyclonic, (d) Propagating Cyclones, (e) Flood East, (f) Flood West

Source: MMS, 2001

Figure 7.2-1. Synoptic Views of the Circulation in the Santa Barbara Channel

Higher water levels than those produced by the astronomical tides acting alone can generally be expected as the result of onshore winds and/or low barometric pressure. Storm surge and wave setup may also potentially increase water levels in shallow coastal areas by as much as 2 to 3 feet (0.61 to 0.91 m) with a recurrence interval of 100 years. However, sea level changes caused by seasonal weather patterns in the project region are probably less than 0.5 feet. The mean tide range at Port Hueneme is 3.7 feet (1.13 m) and the range between mean lower-low water and mean higher-high water is 5.4 feet (1.65 m). The highest recorded tide at Port Hueneme was 6.7 feet (2.04 m) on February 4, 1958, and the lowest recorded low tide was minus 2.4 feet (0.73 m) on January 7, 1951 (Dames and Moore, 1980).

Sea State. In Southern California, wind waves generally predominate from the northwest, although swell may originate from any direction. However, the Channel Islands act as an effective barrier against swells coming into the Santa Barbara Channel. From Ventura to Port Hueneme, swell cannot reach the area without considerable reduction by the Channel Islands or extreme refraction over the mainland shelf (MMS, 2001). Surface wave conditions inside the channel are usually mild to moderate, averaging 1 to 3 feet (0.3 to 0.9 m) in height (USGS, 1976). The eastern portion of the Channel is less sheltered by the islands and comparatively experiences higher sea states, which are generally less than 6 feet (1.8 m) (California Coastal Commission, 1981).

Extreme wave conditions in the Southern California Bight may be caused by hurricanes, tropical storms, and tsunamis. Hurricanes, originating from the Central Pacific off South

America, usually degrade to tropical storms by the time they reach California. The result is usually above average swell and high surf along south-facing exposed beaches.

Tsunamis are characterized as seismic sea waves that are generated by submarine earthquakes and volcanic eruptions. Tsunami events, although infrequent, are capable of causing severe damage in embayments and harbors. In offshore waters, tsunamis are characterized by low relief, long-period waves. In such conditions, little or no damaging effects of tsunamis have been noted. To date, two tsunami producing seismic events have been recorded in the Santa Barbara Channel. The seismic events produced moderate to large tsunamis in 1812 and 1927. Records of the 1812 tsunami indicate that the event resulted in damage to several California missions while the 1927 tsunami affected many parts of the Channel, generating a 6.6-foot (2-m) high wave (Burdick and Richmond, 1982).

The California State Lands Commission has issued estimated wave heights for projected 100 year and 500 year tsunamis along the California coast. Calculated wave heights for Port Hueneme are 11 feet (3.4 meters) for the 100-year tsunami event and 21 feet (6.4 m) for the 500-year tsunami event (CSLC, 2005). Wave height standards are significantly less offshore due to the influence of deeper water. Major damage as a result of a tsunami event is improbable in the Santa Barbara Channel unless it is funneled into and through the western opening. With current long-range warning systems, the trajectory of a tsunami can be predicted and actions taken to minimize or prevent impacts to project activity.

Table 7.2-9 displays the statistical data of the average significant wave heights and wave periods recorded at the NOAA Buoy Station 46053 near Platform Grace from 1994 to 2001. These data represent the typical wave patterns likely to be encountered in the offshore project area.

Table 7.2-9. Monthly Mean, Maximum, and Minimum Significant Wave Heights, Average Wave Periods, and Dominant Wave Periods Recorded at NOAA Buoy Station 46053 (1994-2001)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Significant Wave Height (meters)												
Mean	1.6	1.6	1.5	1.4	1.2	1.1	1.0	1.0	1.0	1.0	1.4	1.6
Max	4.7	4.6	3.6	3.2	2.9	2.9	2.2	2.0	2.3	3.1	3.8	5.6
Min	0.4	0.4	0.3	0.4	0.4	0.3	0.0	0.3	0.3	0.3	0.3	0.5
Average Wave Period (seconds)												
Mean	8.0	17.8	7.2	6.3	6.0	5.7	5.3	5.4	5.9	6.5	7.3	8.1
Max	14.5	14.2	12.7	12.7	10.3	9.4	9.4	8.2	9.9	13.2	14.6	14.9
Min	4.1	4.0	3.8	3.7	3.6	3.4	0.0	3.7	3.5	3.7	3.8	4.1
Dominant Wave Period (seconds)												
Mean	13.1	12.9	12.5	10.3	8.8	8.3	7.4	7.5	9.3	10.4	12.0	12.9
Max	25.0	25.0	25.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	25.0	25.0
Min	3.7	3.5	3.5	3.1	2.7	2.5	0.0	2.8	2.7	3.2	3.1	3.1

Longshore Transport. Longshore currents typically move sand parallel to shore and toward the heads of submarine canyons either upcoast or downcoast. When the entrance to Port Hueneme was constructed, the upcoast jetty effectively trapped or diverted the natural sand supply that was formerly available to beaches in the Ormond Beach area. The sediment that was not trapped by the jetty was lost into deep water at the head of the Hueneme Submarine Canyon. Subsequently, the Channel Islands Harbor was designed to prevent sediment loss into Hueneme Canyon. The detached breakwater at the harbor entrance provides a shadow zone that traps sediment upcoast of the northwest jetty.

Since its construction in 1960, the Channel Islands Harbor trap has been dredged once every two years with removal of about 2,500,000 yds^3 (Coastal Environments, 2000). The proposed natural gas pipeline will land onshore at the southern end of the Santa Barbara Littoral Cell that extends from Point Conception to Hueneme Submarine Canyon. Natural sources of sand for the Santa Barbara Littoral Cell are the Ventura and Santa Clara Rivers, which are 2 miles and 4 miles north (or updrift) of Mandalay Beach (pipeline onshore site). Total sand input of Santa Barbara Littoral Cell at Mandalay Beach is estimated to be 1,230,000 yds^3/yr. As determined from dredging activities of the Channel Island Sand Trap, the longshore transport rate at Mandalay Beach is 1,250,000 yds^3/yr. The quantity of sand being supplied to the cell almost exactly balances the longshore transport and ultimate losses from the cell, down the Hueneme Submarine Canyon (Coastal Environments, 2000).

Sediment Grain Size. Sediments in the nearshore project area are composed primarily of sand, with an average grain size of 141µm (fine sand). Table 7.2-10 compares mean sediment grain size parameters during summer surveys at Mandalay Beach during the period from 1980-1998.

Table 7.2-10. Comparison of Mean Sediment Grain Size Parameters During Summer Surveys, 1980-1998

Parameter	Year										
	1980	1986	1988	1990	1991	1992	1993	1994	1997	1998	Mean
% Gravel	1.2	0.1	2.9	1.7	0.4	3.2	4.4	11.1	0.9	0.1	2.6
% Sand	75.6	88.3	91.8	94.8	91.4	94.3	92.7	78.1	87.5	94.8	88.9
%Silt	19.9	11.2	4.4	3.9	7.0	2.0	3.1	10.5	10.2	4.3	7.6
% Clay	3.3	0.3	0.9	0.0	1.2	0.6	0.4	0.3	1.4	0.8	0.9
Mean Grain Size (phi)	3.46	3.22	2.68	2.66	2.60	2.50	2.26	2.44	3.12	2.83	2.78

Source: MBC Applied Environmental Sciences, 1998

7.2.4 Regulatory Setting

7.2.4.1 Federal

National Weather Service. The National Weather Service (NWS) Meteorological Services Division oversees warning and forecast operation plans, policies, and procedures. It is the primary link to the public and to those segments of the public in weather sensitive industries. Staff identify and validate service needs, mitigate weather-related disasters, and establish operational requirements for meteorological observations. The division designs, validates, and implements new products and services; establishes and maintains customer partnerships, and devises the strategic vision for meteorological services. Division staff also helps prioritize requirements-driven science and technology development to improve products and services. The Division represents the NWS at interagency, national, and international groups and forums on matters concerning meteorological policy, plans, products, and services.

The Marine and Coastal Weather Services Branch is the meteorological lead for the nation's marine and coastal weather services. Programs include warnings, forecasts, and advisories for coastal waters, offshore, high seas, and near-shore and open waters of the Great Lakes. It leads programs for tropical cyclone, coastal flood, severe convective coastal weather, and coastal hazards such as heavy surf and rip tides. The branch supports the Tsunami Warning Program. In addition, staff provides a range of weather services focused on the expanding and weather-sensitive U.S. coastal population and those responsible for its safety.

The Branch works with NOAA's National Ocean Service (NOS), the U.S. Navy and the USCG to provide ice warning and advisory services; With the U.S. Navy, the USCG, the Maritime Administration, and the USACE to operate the nations' Marine Transportation System safely; With the Department of Defense, Federal Emergency Management Agency, U.S. Geological Survey, and the American Red Cross to provide tropical cyclone services; with the USCG, Navy, Air Force, and private entities to disseminate weather to mariners; with NOS on the PORTS and TIDES programs; and with the World Meteorological Organization to provide services to the international community.

7.2.4.2 State

California Office of Emergency Services. The Governor's Office of Emergency Services (OES) coordinates overall state agency response to major disasters in support of local government. The office is responsible for assuring the state's readiness to respond to and recover from natural, manmade, and war-caused emergencies, and for assisting local governments in their emergency preparedness, response and recovery efforts.

During major emergencies, OES may call upon all state agencies to help provide support. Due to their specialized capabilities and expertise, the California National Guard, Highway Patrol, Department of Forestry and Fire Protection, Conservation Corps, Department of Social Services, Department of Health Services and the Department of Transportation are the agencies most often asked to respond and assist in emergency response activities.

OES may also call on its own response resources to assist local government. For example, four communications vans are available to send to disaster sites. Portable satellite units are available to provide voice and data transmission from remote locations. OES also maintains caches of specialized equipment, principally for use by local law enforcement agencies. One hundred and twenty OES fire engines ("pumpers") are stationed with fire districts at strategic locations throughout the state and can be dispatched when needed. OES staff members are on call 24 hours a day to respond to any state or local emergency needs.

The OES Warning Center is staffed 24 hours a day, 365 days a year. From this center, warning controllers speak with county OESs and the National Warning Center in Berryville, Virginia on a daily basis. OES also maintains a 24-hour toll-free toxic release hotline, and relays spill reports to a number of other state and federal response and regulatory agencies, as well as local governments.

OES coordinates the statewide Fire, Law Enforcement, and Telecommunications Mutual Aid Systems based on the "neighbor helping neighbor" concept. OES also coordinates the state's Urban Search and Rescue and Safety Assessment Volunteer programs. During emergencies, OES activates the State Operations Center (SOC) in Sacramento and the Regional Emergency Operations Centers (REOCs) in impacted areas to receive and process local requests for assistance. OES and other state agency public information officers staff the OES Emergency News Center to provide emergency information to the public through the news media.

OES maintains the State Emergency Plan, which outlines the organizational structure for state management of the response to natural and manmade disasters. OES assists local governments and other state agencies in developing their own emergency preparedness and response plans, in accordance with the Standardized Emergency Management System and the State Emergency Plan, for earthquakes, floods, fires, hazardous material incidents, nuclear power plant emergencies, and dam breaks.

Through its Fire and Rescue Branch's Urban Search and Rescue Task Force program, OES coordinates missions for those trapped by collapsed structures or in other high-risk situations. OES also provides search and rescue task force training for local fire personnel, governments and volunteers.

7.2.5 Significance Criteria

For the purposes of this assessment, a significant meteorological and/or oceanographic impact is considered one that would result in significant impacts to other resource categories as a result of severe meteorological and/or oceanographic conditions on the project.

7.2.6 Impact Analysis and Mitigation

The following impact analysis has been divided into five sections with project components that could be impacted by meteorological and/or oceanographic conditions in a similar manner.

7.2.6.1 Impacts Resulting from Vessel/LNG Carrier Operations

The potential exists for severe meteorological and/or oceanographic conditions to impact vessel/LNG carrier operations. Dense fog, high winds, and severe sea states are the most important factors that could impact vessel/LNG carrier operations. Precipitation, temperatures, currents, and tides are not anticipated to impact vessel/LNG carrier operations.

As discussed in Section 7.2.2 - Environmental Setting - Oceanography, the offshore project site is sheltered by the Channel Islands and experiences relatively low sea states compared to more open marine waters. It is also important to note that LNG carriers are equipped with radar systems to aid navigation and reduce potential impacts resulting from reduced visibility. Dense fog that reduced visibility to less than ¼ mile in the project region averaged between 0.9 and 3.4 days per year over a 30-year monitoring period. Because LNG carriers will be equipped with state of the art navigation systems and the occurrence of dense fog (with visibility of less than ¼ mile) is comparatively low to the number of days per year with increased visibility, fog is not anticipated to impact LNG carrier operations.

Considering that meteorological and oceanographic conditions at the project site are typically less severe than other areas with established commercial shipping activity, these conditions are not expected to impact the project. Although the size of the LNG carriers projected to be used, the state of the art navigation systems onboard each carrier, and the location of the project are anticipated to greatly reduce the probability of encountering severe weather outside a LNG carriers safe operating limits, the potential does exist for severe meteorological and/or oceanographic conditions to impact LNG carrier operations. However, a Marine Operations Manual (Appendix O.5) has been prepared and includes a safety plan to facilitate safe approach and mooring of each LNG carrier used during operation of the LNG importation facility. The Marine Operations Manual identifies meteorological and/or oceanographic conditions under which the LNG carrier is capable of safely operating. The safety plan also includes procedures to be taken in the event that conditions beyond those considered to be a safe operating environment are encountered. It is important to note that safe operating conditions may differ between LNG carriers due to varying vessel sizes anticipated to be used during project operation.

- Severe meteorological and/or oceanographic conditions could impact LNG carrier operations.

<u>Measures incorporated into the project design to reduce potential impacts.</u>

- A Marine Operations Manual will be implemented for each LNG carrier used during facility operation. These plans will provide specific criteria for allowing approach and mooring of carriers to the SSP Floating dock.
- A coastal pilot and vessel assist tugs will be used to bring all LNG carriers into and out of the mooring. Tugs will be positioned in the lee of the terminal and the moored LNG Carrier during offloading operations to support the timeliness of any response needed.
- The facilities will have all required aids to navigation to insure safe marine operations.

7.2.6.2 Impacts Resulting from Dual Mooring System, Platform Modifications and Operations, and Offshore Pipeline Installation and Operation

The potential exists for severe meteorological and/or oceanographic conditions to impact activities associated with construction and operation of the dual mooring system, platform facility, and the offshore pipeline segment. It is important to note that Platform Grace was designed to withstand a 100-year storm event. Potential impacts in extreme meteorological and/or oceanographic conditions are generally limited to personnel safety, risk of support vessels sinking/colliding, and damage to the deepwater port facilities that could result in subsequent environmental impacts. It is important to note that impacts to the offshore pipeline segment are not expected during operation of the pipeline. Dense fog, high winds, and severe sea states are the most important factors that could impact offshore project activities.

Operation of the ambient air vaporizers has the potential to produce fog as a result of condensation from surrounding, warmer air masses. Clearwater Port continues to evaluate the potential for fog creation under varying climatic conditions. The data obtained during this evaluation will be submitted to the project's lead agencies upon completion.

In order to reduce the potential for meteorological and/or oceanographic conditions to impact offshore project activities to the maximum extent possible, the Marine Operation Manual will be expanded to include a Critical Operations and Curtailment Plan (COCP) once final engineering design is completed and will be implemented during both the construction and operational phases of the project. The COCP will present a description of the conditions that are considered an unsafe working environment and will include procedures to be taken to curtail work activities if unsafe conditions are encountered. Engineering design criteria for the LNG mooring and offloading system are included in Appendix E.1.

- Severe meteorological and/or oceanographic conditions could impact offshore project activities.

<u>Measures incorporated into the project design to reduce potential impacts.</u>

- An expanded Marine Operations Manual and Critical Operations and Curtailment Plan (COCP) will be implemented during both the construction and operational phases of the project to reduce potential impacts to the degree feasible.
- A coastal pilot and vessel assist tugs will be used to bring all LNG carriers into and out of the mooring. Tugs will be positioned in the lee of the terminal and the moored LNG Carrier, during offloading operations to support the timeliness of any response needed.
- The facilities will have all required aids to navigation to insure safe marine operations
- Clearwater Port will institute a program of recording and archiving metocean data during facility operation to provide real-time data in support of operational decision-making.

7.2.6.3 Impacts Resulting from Directional Bore Beach Crossing

Severe meteorological and/or oceanographic conditions are not expected to impact activities associated with the directional bore beach crossing. The boring location will be located within the Reliant Mandalay Generating Station which is located sufficiently upland as to not be affected by oceanographic conditions. A wave resulting from a tsunami has the potential to affect boring activities, but due to the infrequency of such events and warning systems that are in place, this potential impact is considered less than significant. The HDD contractor's site specific Health and Safety Plan will include a Critical Operations and Curtailment Plan which will establish the operational constraints of the HDD operation including shut down criteria in the event extreme weather conditions (such as high winds) beyond the safe operating limit are encountered.

Precipitation at the boring location has the potential to result in polluted storm water runoff. This is considered a potentially significant impact. However, a Storm Water Pollution Prevention Plan (SWPPP) will be prepared and implemented during project construction and operation to minimize potential impacts to the maximum extent possible.

- Runoff from onshore construction sites could increase storm water pollution.

  <u>Measures incorporated into the project design to reduce potential impacts</u>

  - A SWPPP will be prepared and implemented to minimize potential runoff of polluted storm water from onshore construction sites.

  - Horizontal Directional Drilling Procedures (Appendix E.1-5) have been prepared to ensure pipeline boring operations will not be adversely impacted by meteorological or oceanographic conditions found at the site.

7.2.6.4 Impacts Resulting from Onshore Pipeline Installation and Operation

Potential Impacts Common to all Pipeline Routes (Mandalay to Center Road, Line 324 Loop, Line 225 Loop, Line 3008 Extension). Precipitation during installation of any of the evaluated onshore pipeline alignments has the potential to result in polluted storm water runoff from construction sites. As noted above, a SWPPP will be prepared and implemented during project construction. The SWPPP will include best management practices (BMPs) such as covering soil stockpiles during precipitation and/or periods of high winds and will be designed to minimize potential impacts to the maximum extent possible. The SWPPP will reduce the potential for impacts to the degree feasible. The draft BMP Manual is included is Appendix O.6 and the draft SWPPP is included as Appendix O.7.

Potential Impacts Resulting from Mandalay to Center Road Preferred Pipeline Route. As discussed in Section 7.3 (Water Quality), some flooding does occur along a portion of the Santa Clara River during the 100-year storm event. Although incorporating a SWPPP into the project design will mitigate significant impacts to water quality, the potential exists that pipeline installation activities could temporarily reduce the structural integrity of the levee.

Installation of the onshore pipeline segment along the Santa Clara River levee will be performed under all necessary permits issued by the Ventura County Watershed Protection District. Clearwater Port will install this segment of pipeline in accordance with the terms and conditions imposed by the Ventura County Watershed Protection District. These conditions may include a restricted work schedule to avoid periods of high precipitation, minimizing the length of levee disturbance at any one time, and specifications for restoration. As the permitting phase of the project is ongoing, final permit conditions will be determined through additional consultation with the Ventura County Watershed Protection District prior to permit issuance.

- Temporary disturbances to the Santa Clara River levee resulting from pipeline installation activities could impact the levees capability to withstand significant flood events.

  <u>Measures incorporated into the project design to reduce potential impacts</u>

  - Procedures to ensure the structural integrity of the levee will be included in the final project design. These procedures will be coordinated with the results of a site specific geotechnical investigation prepared for the pipeline corridor.

  - The necessary permits will be obtained from the Ventura County Watershed Protection District prior to initiating pipeline installation activities. All terms and conditions of the permit will be strictly adhered to.

Once installation of the natural gas pipelines has been completed, impacts resulting from meteorological and/or oceanographic conditions are not anticipated.

7.2.7 Summary of Meteorology and Oceanography Impacts and Mitigation Measures

Potential Impact	Resulting from Project Component	Project Incorporated Mitigation Measures
Severe meteorological and/or oceanographic conditions could impact LNG carrier operations.	Vessel/ LNG Carrier Operations	A Marine Operations Manual will be implemented for each LNG carrier used during facility operation. These plans will provide specific criteria for allowing approach and mooring of carriers to the SSP Floating dock. A coastal pilot and vessel assist tugs will be used to bring all LNG carriers into and out of the mooring. Tugs will be positioned in the lee of the terminal and the moored LNG Carrier during offloading operations to support the timeliness of any response needed. The facilities will have all required aids to navigation (Marine Operations Plan) to insure safe marine operations.
Severe meteorological and/or oceanographic conditions could impact offshore project activities.	Mooring System, Platform Operations, and Offshore Pipeline Installation and Operation	A Marine Operations Manual and Critical Operations and Curtailment Plan (COCP) will be implemented during both the construction and operational phases of the project to reduce potential impacts to the degree feasible. A coastal pilot and vessel assist tugs will be used to bring all LNG carriers into and out of the mooring. Tugs will be positioned in the lee of the terminal and the moored LNG Carrier during offloading operations to support the timeliness of any response needed. The facilities will have all required aids to navigation to insure safe marine operations. Clearwater Port will institute a program of recording and archiving metocean data during facility operation to provide real-time data in support of operational decision-making.
Runoff from onshore construction sites could increase storm water pollution.	Directional Bore Beach Crossing/Onshore Pipeline Installation	A BMP manual and SWPPP will be prepared and implemented to minimize potential runoff of polluted storm water from onshore construction sites.

Potential Impact	Resulting from Project Component	Project Incorporated Mitigation Measures
		Horizontal Directional Drilling Procedures have been prepared to ensure pipeline boring operations will not be adversely impact by meteorological or oceanographic conditions found at the site.
Temporary disturbances to the Santa Clara River levee resulting from pipeline installation activities could significantly impact the levees capability to withstand significant flood events.	Installation of Onshore Pipeline -Mandalay to Center Road Preferred Pipeline Route (Mandalay to Center Road Segment)	Procedures to ensure the structural integrity of the levee will be included in the final project design. These procedures will be coordinated with the results of a site specific geotechnical investigation prepared for the pipeline corridor. The necessary permits will be obtained from the Ventura County Watershed Protection District prior to initiating pipeline installation activities. All terms and conditions of the permit will be strictly adhered to.

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