APPENDIX F

Single Point Mooring Evaluation

EVALUATION OF A SINGLE POINT MOORING OFFSHORE THE PORT OF LOS ANGELES AS A PERMITTING ALTERNATIVE TO PIER 400, BERTH 408 FOR CRUDE OIL IMPORT

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1.0 INTRODUCTION

Moffatt & Nichol is assisting Pacific Energy Partners (PEP) by providing professional engineering services in support of the development of a proposed crude oil import terminal on Pier 400 at Berth 408 in the Port of Los Angeles.

Several alternatives are being evaluated as part of the ongoing CEQA/NEPA environmental review process. The purpose of this report is to assess the feasibility of the alternative for an offshore mooring with an oil pipeline to Pier 400. The feasibility addresses technical, environmental, and cost aspects and is based on a high-level conceptual design, with no preliminary engineering completed.

2.0 ALTERNATIVE DESCRIPTION

This report presents the results of a preliminary evaluation of the alternative to locate a single point mooring (SPM) for oil tankers offshore of the Port and outside of the Federal Breakwater. A submerged pipeline would be constructed to transport the oil from the mooring location to Pier 400 and an above-ground pipeline would transport the oil to an inland storage tank farm on Terminal Island. It is assumed that booster pumps would be required at the Pier 400 junction due to the length of the offshore pipeline.

Three potential SPM locations were evaluated and are shown in Figure 1:

- Location 1 - due south of the Port in approximately 600 feet of water depth, with a pipeline length of 9.6 miles;
- Location 2 - upcoast, off the Palos Verdes peninsula, in approximately 300 feet of water depth, with a pipeline length of 9.8 miles;
- Location 3 - downcoast, off Huntington Beach, in approximately 200 feet of water depth, with a pipeline length of 13.6 miles.

These three locations serve as representative scenarios for evaluating cost and environmental impacts for this high-level feasibility study. There are an infinite number of mooring locations and pipeline routings possible, but the three locations listed above were deemed to be the most practical based on the objective of maintaining proximity to the Port of Los Angeles, minimizing cost (as driven by pipeline length and by water depth in which the SPM and pipeline are installed), and given the constraints listed below:

- Berthing location at a minimum water depth of 100 feet, to accommodate the design vessel draft and margin for vessel motion exposed to open ocean conditions.
- A 3000-foot radius around the mooring for the catenary of the SPM and vessel length, such that the berthed tanker does not encroach into the designated shipping lanes for the Ports of Los Angeles and Long Beach.
- Additional clearance around the mooring to allow for a ¼-mile vessel turn radius such that oil tanker approach does not encroach into the designated shipping lanes.
- Location of the SPM on a stable ocean bottom of less than 20% slope.
- Avoidance of known keep-out areas such as the Port Pilot operating areas, Shallow Water Habitat area in the inner harbor, ship wrecks and offshore fish havens.

Figure 2 shows a sketch of a representative SPM and an enlarged view of the inner harbor and landside layout.

In order to construct the offshore pipeline from the SPM to Pier 400, underground horizontal directional boring is necessary to avoid the congested and environmentally-sensitive inner harbor area. A boring of just over 5000 feet long would be accomplished from the landside at Pier 400 to a point just outside the breakwater. After setting up a boring rig area of approximately 150 feet wide by 250 feet long (150 feet minimum), a pilot hole is drilled first, to be followed by reaming, in steps, to achieve a 42 inch to 48 inch carrier tunnel. Then the 36 inch pipeline is assembled and pulled into place.

The maximum practical length of the bore is 5000 feet, although 6000 feet may be possible depending on soil conditions and other factors. Thirty-six inches is also the upper practical limit of pipeline diameter, although larger sizes may be possible depending on final design analysis. The boring can be turned directionally, but the minimum turning radius is about 3600 feet. Risks associated with a bored line include a blowout to the seabed floor which allows drilling mud to escape to the harbor. Soil test borings and analysis combined with sufficient depth below the sea floor can reduce this risk.

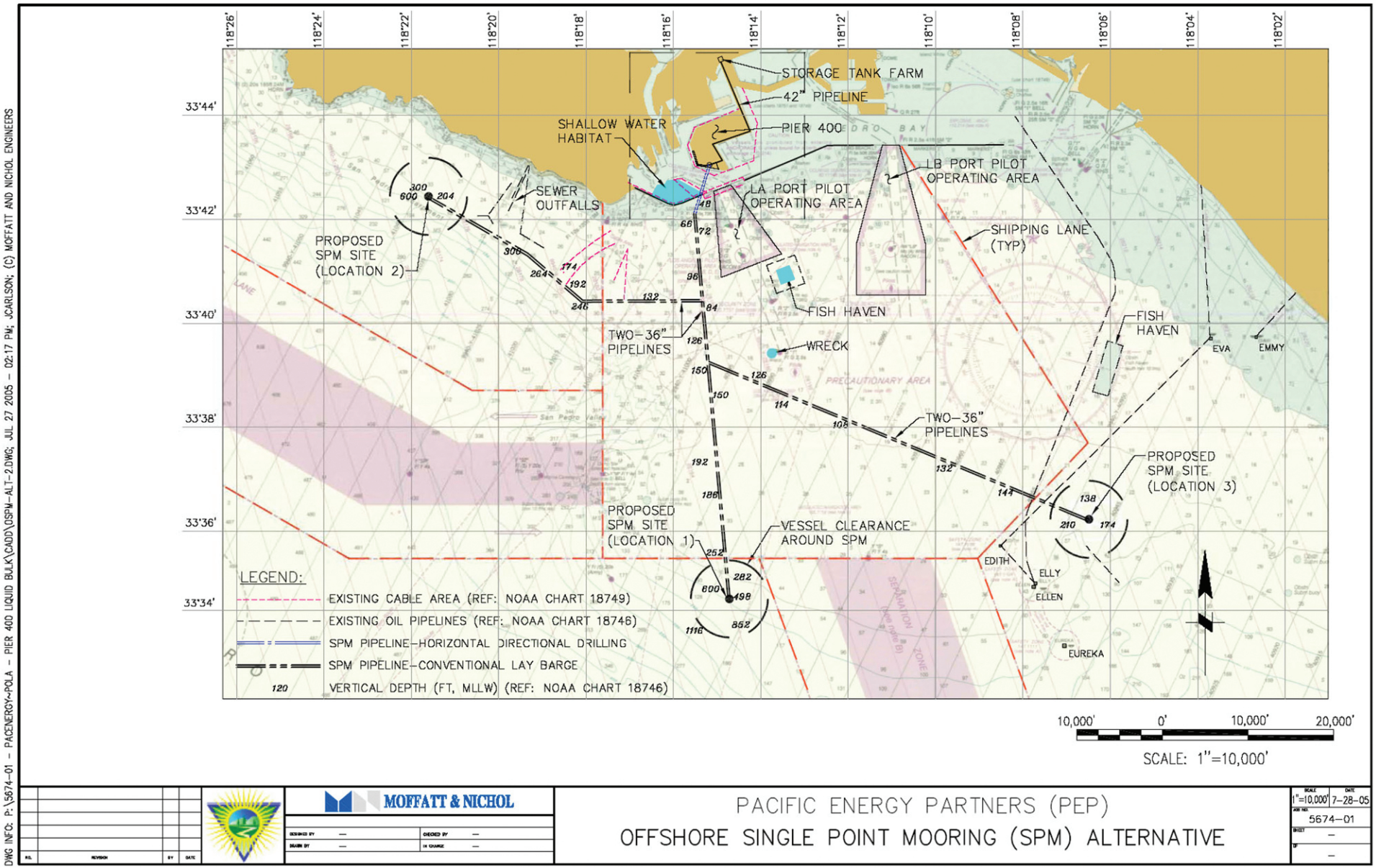

Figure 1 – Proposed SPM Locations

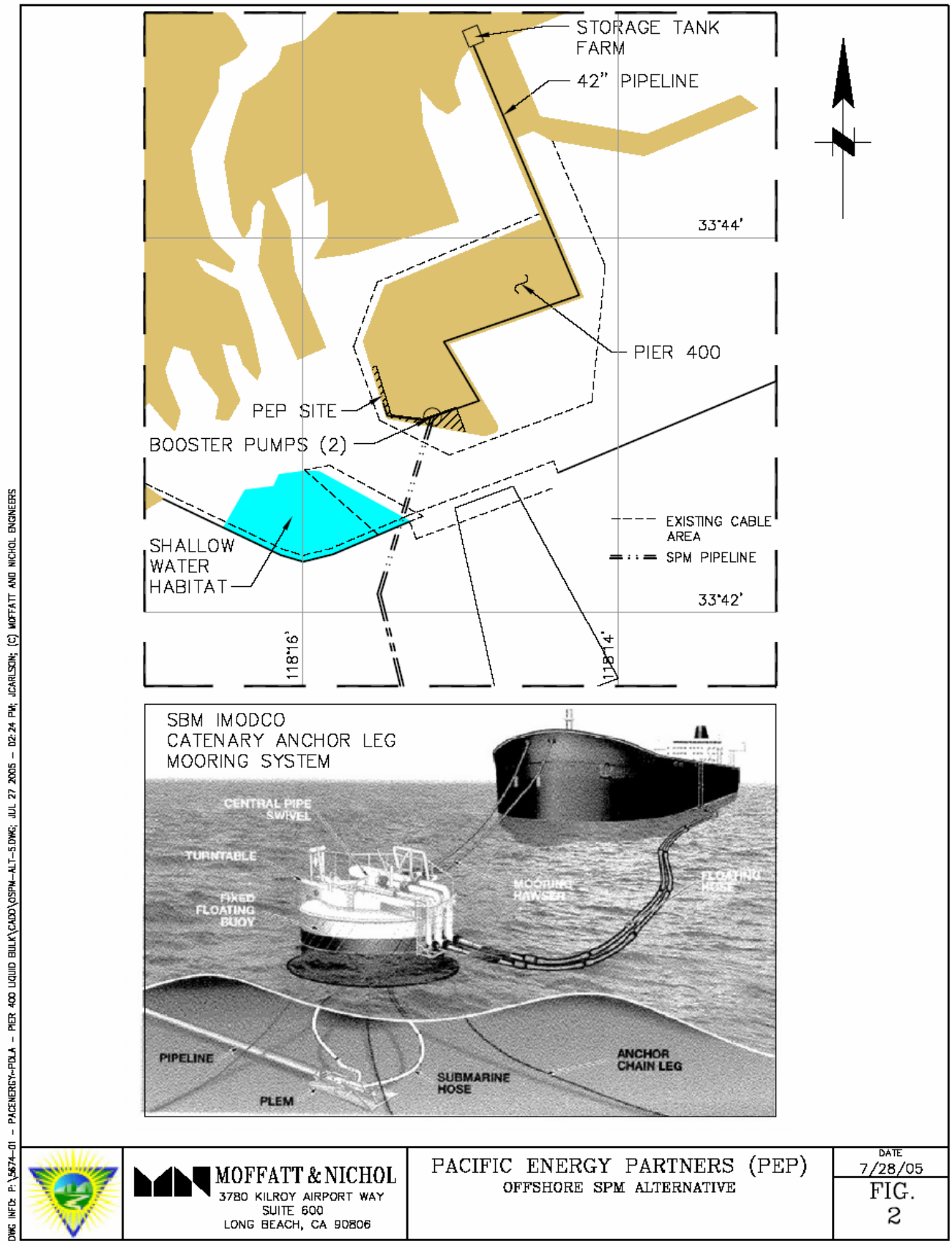

Figure 2 – Proposed SPM Alternative Concept

3.0 FEASIBILITY ASSESSMENT

The feasibility of the SPM alternative is determined primarily by environmental constraints, cost, and technical challenges. The feasibility issues relevant to all potential locations are discussed below, followed by a listing of issues unique to the three representative locations.

Environmental Impacts

- Marine Biological Resources. Impacts to biological resources occur during both construction and operations.
    - Impacts During Construction. The lay barge pipeline installation procedure requires a trough to be constructed prior to pipeline installation. This is accomplished by clam-shell dredging or high-pressure water jets. This process has the impact of destroying/disrupting bottom-dwelling (benthic) organisms, creates water turbidity and generates noise. It is expected that fish and marine mammals would avoid the project area during construction, thus resulting in potential impacts to migration, feeding or behavior. It is assumed that pipeline routing will not affect kelp beds, eelgrass beds, rocky habitat, white abalone areas, and/or designated fish havens as these will be identified during pre-project biological surveys. There is a risk of accidental discharge of drilling fluids, petroleum, hydrostatic test water, and gray water during construction that would affect water quality and thus marine biological resources.
    - Impacts During Operations. Tanker vessel berthing will generate noise in the SPM area. It is expected that fish and marine mammals would avoid the SPM area during vessel berthing, thus resulting in potential impacts to migration, feeding or behavior. There would also be a significant impact to marine resources in the event of an oil spill (discussed below).
- Oil Spill Risk. There is an increased risk of an accidental oil spill, as well as a more significant environmental impact, for the SPM alternative versus the Pier 400 – Berth 408 location. The increased risk is due to the longer oil pipeline (greater area over which a rupture could occur) and potential problems associated with the tanker vessel mooring at sea as compared to a protected harbor. The offshore location imparts a greater potential for the oil spill to spread and impact a larger area of marine habitat, including seabirds and shorebirds. Also, as occurred in the 1990 *American Trader* oil spill off Huntington Beach, an oil spill could cause closure of miles of popular local area beaches and have a grave socio-economic impact.
- Air Quality. The utilization of tanker vessel fuel replacement (i.e. Marine Diesel Oil (MDO) or Marine Gas Oil (MGO)) during tanker offloading is possible for the Pier 400 berthing location, but probably not feasible for a vessel mooring at sea. Therefore, for the SPM alternative, the tanker vessel would remain operating using Heavy Fuel Oil and emissions would be greater than if the vessel was offloading while using MDO or MGO. There would also be more emissions from running the tanker vessel's on-board equipment to pump oil over the longer

pipeline distance and there may also be more emissions during construction for the SPM alternative.

Cost.

The significant cost elements are for construction and pre-project surveys.

- Construction. Costs are driven by the length of pipeline and depth in which it and the SPM are constructed. Deeper waters (greater than 200 feet) preclude the practicality of using divers for construction and thus dictate the use of submersibles or more difficult and less precise surface installation. There is also an increased cost for the deep water SPM hardware. Longer pipelines will require installation of onshore and possibly offshore booster pumps, along with submerged cables to provide power to the offshore pumps.
- Pre-Project Surveys. Construction through or in the proximity of kelp beds, eelgrass beds, rocky habitat, white abalone areas, designated fish havens and/or buried ship wrecks must be avoided and/or minimized. This dictates the requirement for surveys at the proposed SPM site and along the entire length of the offshore pipeline for each of these entities. Longer pipelines dictate more extensive biological surveys due to the greater amount of area that is impacted by the pipeline length. And these biological surveys and bathymetric surveys become more difficult and more expensive in deeper waters.

There are additional impacts associated with the SPM alternative that are important to note, but are probably not major drivers to the overall SPM feasibility. Two significant items of note are potential impacts to local area navigation and to the project schedule due to additional regulatory compliance requirements.

- Marine Traffic / Navigation. The SPM would be located such that tanker vessel berthing does not encroach into the designated shipping lanes. However, this area of the coastline is heavily traveled by recreational boaters and thus there are potential conflicts between these boaters and the tanker vessel berthing at the SPM site. Also, the offshore submerged pipeline routing would be within the shipping lanes and thus the pipeline installation barge would be within the shipping lanes during construction. While laying a pipe, the lay barge would not be able to move out of the way of an oncoming ship. The construction time period varies according to pipeline length and depth, but could involve up to 14 months of time in which construction was occurring within the shipping lanes. The potential impacts include disruption to Port of Los Angeles and Port of Long Beach marine traffic, increase in risk of vessel collision, increased demand of Port Pilot services, and increased burden on maritime traffic tracking systems.
- Regulatory Compliance. There is a greater amount of permitting, regulatory compliance and approvals required for the SPM alternative, versus the Berth 408 location. These approving federal and state agencies include the U.S. Department of Transportation - Maritime Administration, U.S. Army Corps of Engineers, U.S. Mineral Management Service, U.S. Department of Homeland Security, U.S. Coast Guard, U.S. Office of Pipeline Safety, U.S. Fish and Wildlife Service, National Oceanic and Atmospheric Administration, California Coastal

Commission, California State Lands Commission, California Department of Fish and Game, and California State Office of Historic Preservation. Some of these agencies are unique to the SPM alternative and the others are common to the Pier 400 – Berth 408 location but involve more extensive oversight for the SPM alternative. These approvals may affect the ultimate SPM location, pipeline routing, and/or vessel design/operations and thus may influence overall feasibility of the project. Also, the length of time required to obtain these approvals may impact the overall schedule for the project.

As discussed previously, construction of the pipeline under the breakwater, via horizontal directional drilling, appears to be feasible, although there are pipeline length and diameter constraints. It is assumed that wave conditions would not present a problem to vessel mooring, oil transfer operations, and/or offshore pipeline and SPM installation as similar projects in similar wave climates and water depths have been successfully constructed and operated at other locations.

The feasibility issues associated with each of the three representative potential SPM locations and pipeline routings are as follows:

- Location 1 – Due South
  - Cost of SPM in 600 ft water depth.
  - Cost and constructability of pipeline in deeper waters.
  - Risks associated with unknown conditions in deeper waters.

- Location 2 – Off Palos Verdes
  - Aesthetics concerns of Palos Verdes residents (tanker berthing approximately one mile off coastline).
  - Popular recreational fishing area.

  It should be noted this proposed location is on the landward side of the potential offshore landslide area and thus the landslide potential was discounted as an issue.

- Location 3 – Off Huntington Beach
  - Probable need for offshore booster pump.
  - Intersection / encroachment of existing offshore oil pipelines.

  A possible variation of this alternative would be to route the SPM pipeline along the same corridor as the existing oil pipelines serving the offshore platforms, come ashore in Long Beach, and then install a landside oil pipeline to the Port of Los Angeles tank farm.

4.0 COST ESTIMATE

The cost estimate includes:

- Engineering, permitting and survey costs.
- Construction costs for offshore mooring.
- Construction costs for pipeline. Two installation methods were included: 1) horizontal directional drilling for the pipeline section for the first mile from shore; and 2) trenching via conventional barge in the deeper waters for the last section to the SPM location.
- Construction costs for landside hardware unique to the SPM alternative (i.e. shore-side booster pumps and pig launcher).

A gross estimate of the costs for the "due south" offshore SPM alternative (Location 1) is summarized in Table 1. This location was chosen because it was deemed to be the most practical of the three locations evaluated. These costs do not include the Pier 400 infrastructure (e.g. pipeline from Pier 400 inland to tank farm) that would already be a part of the Pier 400 – Berth 408 terminal location alternative. The total cost estimate for the SPM and associated offshore pipeline is just under $100,000,000. This estimate was made using order of magnitude costs without any preliminary engineering or contractor supplied estimates.

5.0 CONCLUSION

Based on the preliminary evaluation presented herein, an offshore SPM location does not appear to be feasible, primarily for cost reasons and secondarily because of environmental and technical challenges. The significant cost elements are for construction of the offshore pipeline and SPM. The primary environmental concerns are the risk of oil spill over the life of the operation and impacts to marine resources during construction.