APPENDIX D1

Throughput Projection and Vessel Mix Methodology

D1

THROUGHPUT PROJECTION AND VESSEL MIX METHODOLOGY

D1.0 INTRODUCTION

D1.1 Crude Oil Demand

D1.1.1 Baker & O'Brien Projected Demand for Crude Oil Imports

Plains All American Pipeline, L.P. (Plains) retained Baker & O'Brien, Inc. (Baker & O'Brien), an independent consulting engineering firm serving the oil, gas, and related industries, to prepare a crude oil forecast for strategic planning purposes (Baker & O'Brien 2007a; Baker & O'Brien 2008). Baker & O'Brien examined publicly available data on the current sources of crude oil refined by Southern California refineries from 1996 to 2006 and predicted how those sources would change between 2007 and 2040, the projected end of the 30-year lease in the Port of Los Angeles (Port) for which Plains has applied. In addition, Baker & O'Brien projected the regional demand for crude oil in southern California through 2040 based on an analysis of current refinery capacity and estimates of likely future increases in refinery capacity. The analysis considered the effects of "refinery capacity creep" and short-term capacity additions. Baker & O'Brien based their analysis on refinery demand for crude oil rather than consumer demand for refined products (Baker & O'Brien 2008); note that this is consistent with information from the California Energy Commission (CEC), which notes that due to the limited refining capacity in California, the state must import ten percent of its refined blending components and finished gasoline and diesel to meet the growing demand (CEC 2007b). With this assumption, Baker & O'Brien project that future refinery demand for crude oil (beyond 2006) would increase at the same rate as refinery capacity (Baker & O'Brien 2008).

In addition to available data from public sources, Baker & O'Brien applied its knowledge of oil industry practices, foreign and domestic sources of crude oil, oil production operations, transportation logistics, and the operations of southern California refineries (refinery capabilities, throughput capacities, crude slates, and likely improvements that would increase capacity) in order to project future trends in the production and distribution of domestic crude oil and the likely sources of imported crude oil that will be needed to replace declining domestic production (Baker & O'Brien 2008).

As noted in Chapter 1 of the SEIS/SEIR, crude oil refined in southern California comes from three primary sources: California crude oil production; Alaska North Slope (ANS) crude oil; and imported oil (Middle East, Latin America, and West Africa, with small volumes from the Pacific Rim and Canada). Supplies of California crude oil are declining rapidly, which will lead to significant increases in imports. (Supplies of ANS crude oil are also declining rapidly, as documented by both Baker & O'Brien (2007a, 2008) and CEC (2007b, 2007c). However, ANS crude oil arrives by marine vessel, so for the purpose of assessing the need for marine import infrastructure, the more important consideration is the decline in California production, which primarily arrives in southern California by pipeline.)

Baker & O'Brien assumed that production of California crude oil would decline at 3.5% per year through 2040. This projected decline is based on recent historical production: during the three-year period between 2003 and 2006, production declined at 3.7% per year; during the five-year period between 2001 and 2006, it declined at 3.3% per year (Baker & O'Brien 2008). Baker & O'Brien also notes that these production declines occurred during a period when crude oil prices were increasing dramatically (Baker & O'Brien 2008). Although Baker & O'Brien assumed that crude production from the Los Angeles Basin and Ventura areas would continue to be directed to southern California refineries, it also assumed that crude production closer to Bakersfield and Santa Maria would be preferentially supplied to refineries in those areas first, as these areas do not have access to imports (Baker & O'Brien 2008).

Baker & O'Brien considered the potential domestic supply from the Alaska National Wildlife Reserve (ANWR). However, Baker & O'Brien note that production has not been authorized in the ANWR, would not begin for at least 10 years after approval, and would not likely affect southern California (Baker & O'Brien 2008). (In addition, like ANS production, any deliveries from ANWR production to southern California would likely be delivered by marine vessel.)

Baker & O'Brien projected refinery runs from 2007 to 2040 starting with estimates of 2006 refinery runs for each refinery, based on public sources including company annual reports, throughput capacity information, and non-proprietary industry knowledge. Baker & O'Brien estimated future refinery runs from refinery capacity creep (i.e., increase of distillation capacity due to various improvements that increase efficiency and remove bottlenecks at existing refineries, provided those improvements meet environmental and permitting requirements, and can be justified as having a sufficient economic return) (CEC 2007b; Baker & O'Brien 2008).

Baker & O'Brien developed two scenarios with different refinery capacity creep assumptions. Since consumer demand for transportation fuels is currently greater than the output of southern California refineries, and the difference is met by the importation of transportation fuels (CEC 2007b; Baker & O'Brien 2008), Baker & O'Brien assumed for their analysis that consumer demand would continue to be greater than refinery output. Therefore, in their analysis, refinery output was assumed to be the limiting factor on crude oil imports, rather than consumer demand (Baker & O'Brien 2008).

The two capacity creep scenarios include a Base Case and an Alternative Case. For both cases, Baker & O'Brien assumed an annual refinery capacity creep of 1.25% from 2007 to 2021. After 2021, the Base Case uses a lower refinery capacity creep compared to the Alternative Case (Table 1). Baker & O'Brien note that the deviation between the two scenarios is based on "the difficulty in making predictions beyond 20 years due to a variety of issues including, among other things, uncertain regulatory requirements, changing fuel economy standards, the potential impact of measures to address climate change, and political issues that could affect the availability of crude oil from certain areas of the world" (Baker & O'Brien 2008). Baker & O'Brien note further that "it is our opinion that the Base Case would be the more appropriate one to use for forecasting the period between 2022 and 2040. During this period, use of the more conservative Base Case is justified when considering the unknowable longer-term impacts of factors such as alternative fuels and conservation on refinery product requirements" (Baker & O'Brien 2008). Alternative fuels and conservation would decrease consumer demand for refined petroleum products, which would in turn decrease the potential economic returns from projects to expand refinery capacity and, therefore, the amount of refinery capacity creep.

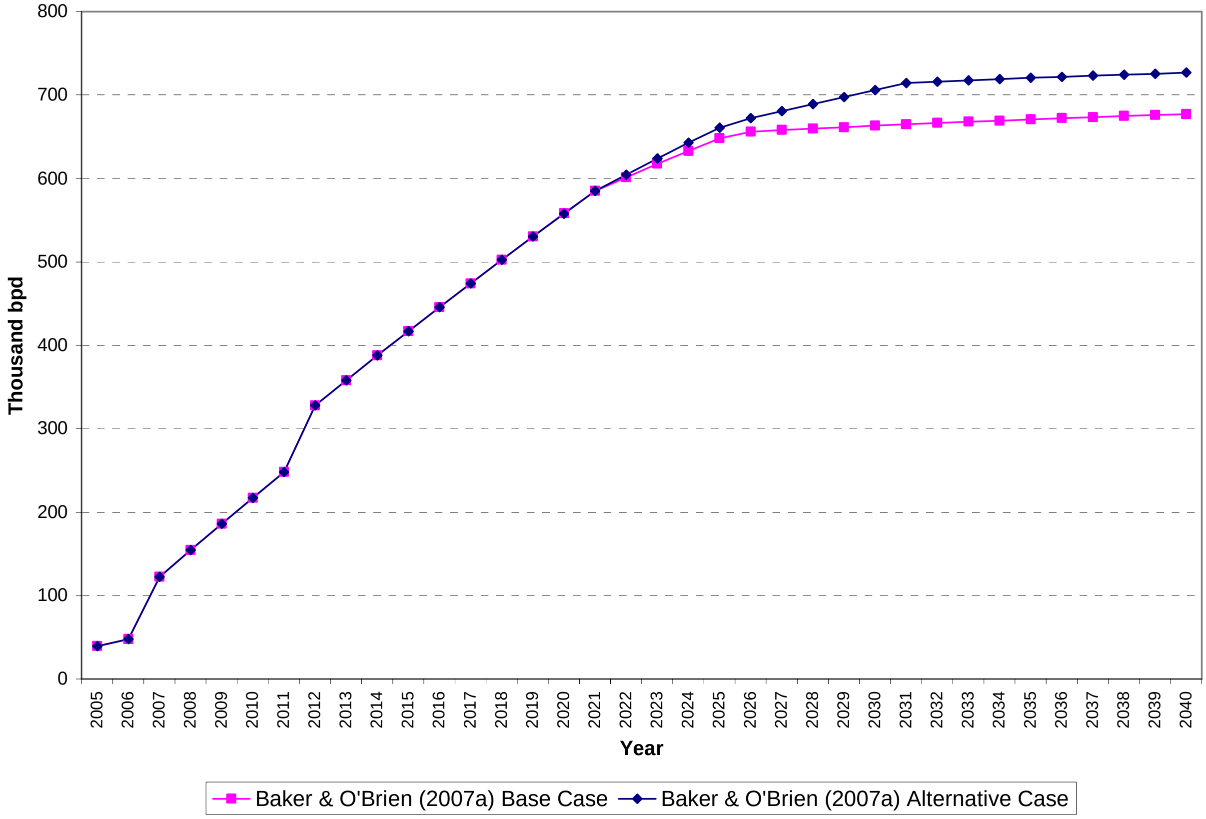
Table 1. Rates of Refinery Capacity Creep Used in Baker & O'Brien (2007a) Scenarios

Scenario	*2007-2021*	*2022-2026*	*2027-2031*	*2032-2040*
Base Case	1.25%	0.50%	0.00%	0.00%
Alternative Case	1.25%	0.75%	0.50%	0.00%
Source: Baker & O'Brien (2007a, 2008).				

On top of refinery capacity creep, Baker & O'Brien also assumed refineries would increase their distillation capacity by an additional 50,000 barrels per day (bpd), beginning in 2012, via expansion of existing refineries (over and above the capacity expansions expected from refinery capacity creep). Baker & O'Brien explain that this figure is based upon industry speculation that such a level of expansion was likely; this assumption is supported by the fact that in early 2007, two southern California refineries announced plans for capacity expansions totaling 21,000 bpd (Baker & O'Brien 2008). The Port and USACE find that the 21,000 bpd increase already announced, in combination with the forecasted rise in demand for petroleum products, suggests that a 50,000 bpd capacity increase by 2012 (over and above refinery capacity creep) is plausible.

Figure 1 provides a summary of Baker & O'Brien's projected demand, measured as incremental demand over the 2004 baseline, and including all marine deliveries (i.e., ANS as well as foreign crude). The figure shows both the Base Case and the Alternative Case. Throughout the remainder of this appendix, for simplicity, references to the Baker & O'Brien (2007a) projection imply the Base Case unless otherwise noted.

Figure 1. Baker & O'Brien Projected Demand for Crude Oil Marine Imports to Southern California (Incremental Over 2004)



Source: Baker & O'Brien (2007a).

D1.1.2 CEC Projected Demand for Transportation Fuels

The California Energy Commission (CEC) is California's primary energy policy and planning agency. Created by the state legislature in 1974, the CEC's responsibilities include forecasting future energy needs, keeping historical energy data, promoting energy efficiency, developing energy technologies and supporting renewable energy, and planning for and directing state response to energy emergencies. Senate Bill (SB) 1389 (Bowen and Sher, Chapter 568, Statutes of 2002) requires the CEC to "conduct assessments and forecasts of all aspects of energy industry supply, production, transportation, delivery and distribution, demand, and prices," and to "use these assessments and forecasts to develop energy policies that conserve resources, protect the environment, ensure energy reliability, enhance the state's economy, and protect public health and safety" (Public Resources Code § 25301[a]).

To fulfill this charge, the CEC produces and adopts an Integrated Energy Policy Report (IEPR) every two years and an update every other year. The most recent IEPR (CEC 2007a) was adopted in December 2007, and is supported by a suite of documents including the IEPR Committee Final Report (CEC 2007b), which includes more technical detail, and the Transportation Energy Forecasts for the 2007 IEPR

(CEC 2007c), which provides detailed documentation of CEC's analysis for energy needs in the transportation sector.

This section provides an overview of the major conclusions of the 2007 IEPR as they relate to the CEC's forecast for transportation fuel demand. Section D1.1.3 provides an overview of the CEC's forecast for crude oil demand, which the LAHD and the USACE used to evaluate the reasonableness of the Baker & O'Brien forecast.

As noted in Chapter 1 of the SEIS/SEIR, crude oil in California is used predominantly to make transportation fuels for consumers and businesses; no electricity in the state is generated using petroleum (CEC 2007a). Thus, the demand for crude oil in southern California is mainly a function of demand for transportation fuels: gasoline, diesel, and jet fuel. About 79 percent of California's refinery output in 2006 consisted of these fuels (CEC 2007c). Demand for transportation fuels is, in turn, a function of several factors, including population, income, vehicle purchasing and driving habits, fuel prices, rates of adoption of new technologies and alternative fuels, and greenhouse gas (GHG) reduction rules and standards. In addition to supplying southern California's transportation fuel needs, the refineries operating in southern California also supply virtually 100 percent of transportation fuels for Nevada and 60 percent for Arizona (CEC 2007b).

The California Department of Finance (DOF) predicts California's population will grow by about 30 percent between 2005 and 2030 (an average of 1.05 percent per year), and real income will grow by about 31 percent (an average of 1.08 percent per year) (CEC 2007c). From 2001 to 2005 the number of vehicles registered on California roads increased by about 3.1 percent per year. While growth in registered vehicles was fastest for hybrid vehicles (nearly doubling every year), as of 2005 hybrids were still a small proportion, just 0.3 percent, of on-road registered vehicles (CEC 2007c).

CEC's projections for fuel demand for light-duty vehicles (passenger cars, light trucks, minivans, and sport utility vehicles) take into account the following major regulations affecting fuel economy:

- AB 1493 (Pavley, Chapter 200, Statutes of 2002). As a result of this regulation, the California Air Resources Board (ARB) adopted a GHG standard for light-duty vehicles in 2004. According to the CEC (2007c), the standard requires a gradual reduction of GHG equivalent emissions beginning in 2009, which by 2016 results in approximately a 30 percent reduction in emissions per mile for the average new vehicle as compared to today's new vehicles (CEC 2007c).
- Current state mandates (amended September 2006) regarding Low Emission Vehicles (LEVs) and Zero Emission Vehicles (ZEVs) (CEC 2007c).

The CEC final staff report supporting the transportation energy forecasts for the 2007 IEPR (CEC 2007c) constructed alternative forecasts of future demand for transportation fuel, corresponding to different assumptions about the implementation of GHG standards for light-duty vehicles and the ZEV mandate. In addition, the CEC report documents alternative forecasts corresponding to different assumptions about fuel prices. CEC developed these fuel price forecasts based on the U.S. Energy Information Administration (EIA) *2007 Annual Energy Outlook High, Reference,* *and Low Case* oil price forecasts. For comparison, the CEC's Base Case starts at $2.92 per gallon for retail regular-grade gasoline in 2007, dips to $2.56 in 2014, and then rises to $2.76 by 2030, expressed as annual average inflation-adjusted 2007 dollars. The 2030 price for gasoline in the High Case is $3.96 per gallon, and in the Low Case is $2.09. In nominal dollars, or actual prices customers would see at the pump, the 2030 price for gasoline would be $6.13 per gallon in the High Case, $4.28 in the Base Case, and $3.23 in the Low Case (CEC 2007c).

Under all six alternative forecasts (Low, Base, and High Cases for fuel prices, and with or without GHG regulations under AB 1493), the CEC's transportation fuel demand model projects that vehicle miles traveled (VMT) will continue to increase through 2030, by annual average rates between 1.5% and 1.9%. The model also predicts increased numbers of on-road registered vehicles in California, by annual average rates between 1.4% and 1.5%. However, CEC predicts demand for on-road gasoline could increase or decrease, depending on fuel prices and implementation of GHG standards. Between 2005 and 2030, CEC predicts demand for on-road gasoline could increase by as much as 0.6% per year (low fuel price and no GHG standards) or decrease by as much as 0.5% per year (high fuel price and GHG standards) (CEC 2007c).

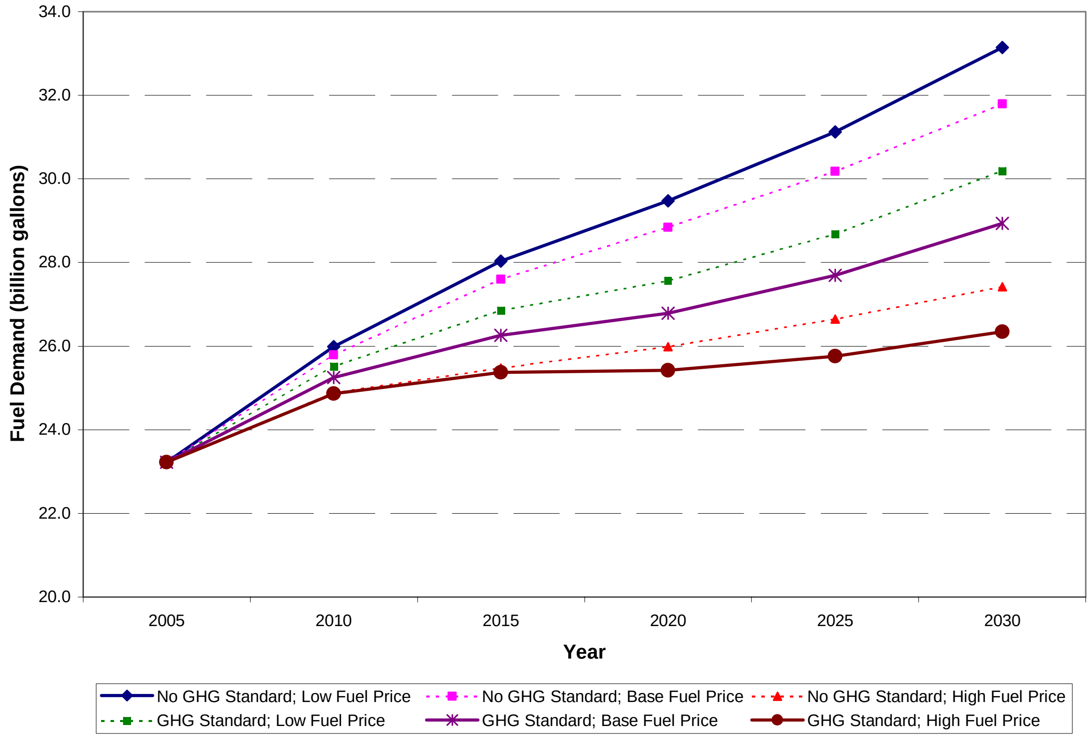
However, CEC predicts that the demand for diesel fuel will increase due to several factors, including increasing consumer purchase of light-duty diesel vehicles and truck and rail movement of imported containers from ports. The CEC's demand for diesel fuel also includes its use in off-road vehicles (mainly for construction and agriculture) as well as vehicles used for mass transit (assuming that the current proportion of mass transit vehicles using diesel fuel remains unchanged). CEC (2007c) predicts average growth in demand for diesel fuel will range between 2.1% per year (high fuel price, GHG standards) and 3.0% per year (low fuel price, no GHG standards).

CEC also predicts increasing demand for jet fuel even under alternative scenarios for fuel prices. CEC notes that the implementation of statewide GHG regulations will not affect demand for jet fuel since jet fuel is formulated to national and international, rather than state, standards. CEC predicts demand for commercial jet fuel will increase by between 2.2% per year (high fuel price) and 2.6% per year (low fuel price) (CEC 2007c).

Combining the demand for regular gasoline, diesel, and jet fuel, CEC (2007c) predicts a net increase in overall demand for transportation fuels within California, ranging from 0.5% per year to 1.4%. Table 2 shows the same info in tabular form.

Figure 2 shows the change in demand from 2005-2030 for each of the six alternative cases in the CEC (2007c) predictionforecast. Table 2 shows the same information in tabular form. Note that the report adopted by the full Energy Commission in the 2007 IEPR (CEC 2007a) adopted only the "No GHG Standard, Low Fuel Price" and "GHG Standard, Base Fuel Price" cases, and in the full Commission report the forecasts extended only to the year 2020.

Figure 2. CEC Forecast of California Transportation Fuel Demand, 2005-2030



Source: CEC (2007c), Tables 8, 9, and 10.

Note: CEC (2007a), the report adopted by the full Commission in the 2007 IEPR, adopted only the first and fourth highest cases shown in Figure 2 (i.e., the "No GHG Standard, Low Fuel Price" and "GHG Standard, Base Fuel Price" cases). Also, in the report adopted by the full Commission, the forecasts were extended only to the year 2020.

Table 2. CEC Forecast of California Transportation Fuel Demand (billion gallons)

	No GHG Standard			*GHG Standard*		
Year	*Low Fuel Price*	*Base Fuel Price*	*High Fuel Price*	*Low Fuel Price*	*Base Fuel Price*	*High Fuel Price*
2005	23.2	23.2	23.2	23.2	23.2	23.2
2010	26.0	25.8	24.9	25.5	25.2	24.9
2015	28.0	27.6	25.5	26.9	26.3	25.4
2020	29.5	28.8	26.0	27.6	26.8	25.4
2025	31.1	30.2	26.7	28.7	27.7	25.8
2030	33.1	31.8	27.4	30.2	28.9	26.3

Source: CEC (2007c), Tables 8, 9, and 10.
Note: Includes gasoline, diesel, and jet fuel. Does not include transportation fuels sold to wholesalers or retailers in other states after being refined or received within California.
Note: CEC (2007a), the report adopted by the full Commission in the 2007 IEPR, adopted only the forecasts in the first and fifth columns shown in Table 2 (i.e., the "No GHG Standard, Low Fuel Price" and "GHG Standard, Base Fuel Price" cases). Also, in the report adopted by the full Commission, the forecasts were extended only to the year 2020.

In addition to supplying California consumers, refineries in California supply transportation fuels to other states. As CEC (2007c) states:

> *"Nevada and Arizona do not have any refineries that can produce transportation fuels. As a consequence, these states must import all of their transportation fuels from refineries located outside their borders. Refineries located in California export petroleum products via pipelines that are linked to distribution terminals located in Reno, Las Vegas, and Phoenix. This network of interstate pipelines is owned and operated by the Kinder Morgan Pipeline Company (KMP). Pipelines that originate in California provide nearly 100 percent of the transportation fuels consumed in Nevada. Approximately 60 percent of Arizona's demand also is met by products exported from California. The balance of transportation fuels consumed in Arizona is delivered in a petroleum product pipeline that originates in Western Texas on a section of the KMP system referred to as the East Line.*

> *"Over the near- and long-term forecast periods, transportation fuel demand growth in Nevada and Arizona, taking into account East Line expansion plans, will place additional pressure on California refineries and the California petroleum marine import infrastructure system to provide adequate supplies of transportation fuels for this regional market."*

Based on recent trends, CEC (2007c) forecasts demand for gasoline and diesel in Nevada and Arizona will increase linearly with population, but demand for jet fuel will increase faster than population because of tourist destinations in these states (especially Las Vegas). CEC (2007c) predicts that pipeline exports from California to Arizona of gasoline, diesel, and jet fuel will increase 2.5% per year on average between 2006 and 2025 (from 133.1 thousand bpd to 211.4 thousand bpd), under both high and low population growth scenarios. For Nevada, CEC (2007c) predicts that pipeline exports from California of transportation fuels (through refined product pipelines) will increase between 2.2% and 2.6% per year, with the variation attributable to alternative scenarios for population growth. In the lower case, this represents a growth from 156.0 thousand bpd in 2006 to 234.7 thousand bpd in 2025; in the higher case, the growth would be to 255.4 thousand bpd in 2025.

D1.2 Vessel Types

D1.3 Capacity of Existing Terminals

D1.4 Assumptions for Analysis

D1.5 References

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