APPENDIX E
DRAFT SACRAMENTO RIVER DEEP WATER SHIP CHANNEL LIMITED REEVALUATION REPORT (LRR) WITH-PROJECT ECONOMIC ANALYSIS (2011)

US Army Corps
of Engineers®

Sacramento River Deep Water Ship Channel Limited Reevaluation Report (LRR)

With-Project Economic Analysis (DRAFT)
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USACE
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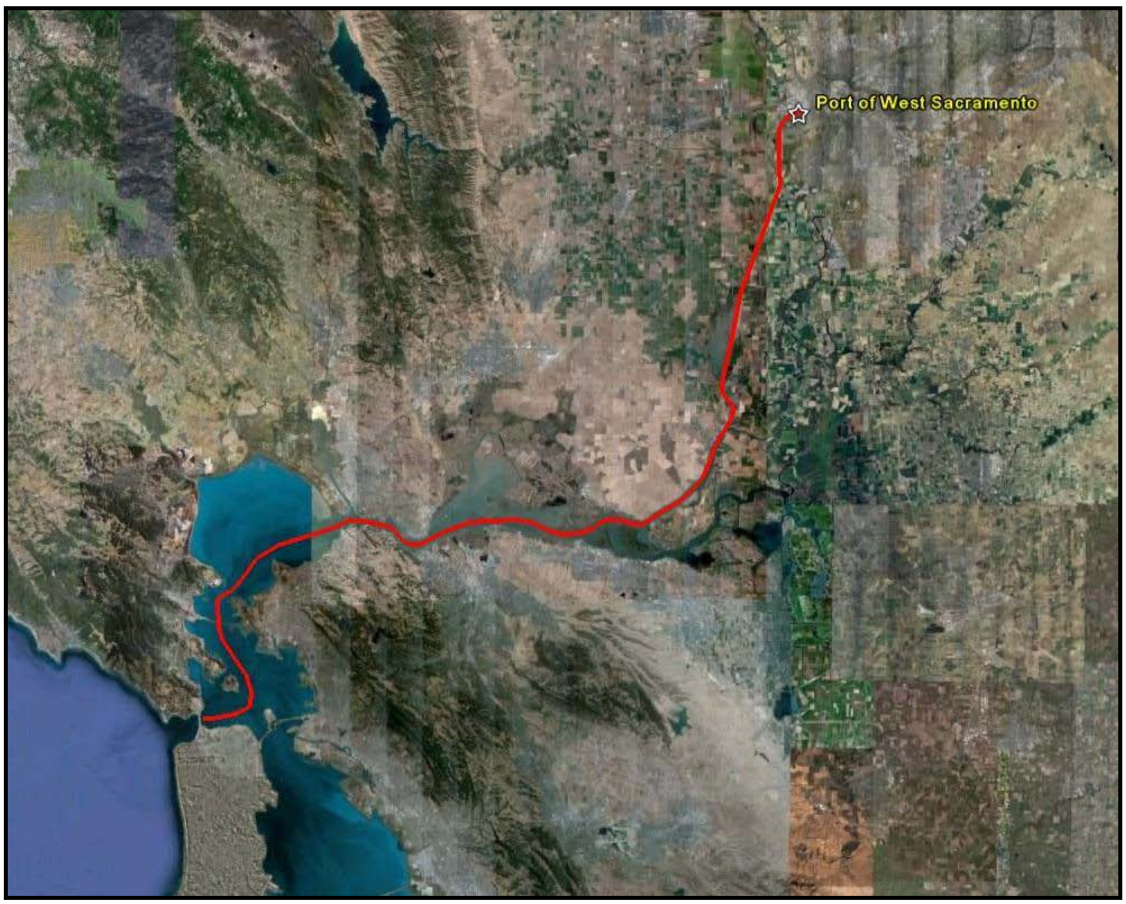

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Executive Summary

This report describes and estimates the National Economic Development (NED) impact of a deepening of the Sacramento River Deep Water Ship Channel. The economic benefit estimated is exclusively the result of anticipated transportation cost savings – a lower unit cost of moving goods as a result of shippers being able to more fully load bulk vessels and tankers.

The analysis describes recent historical throughput at the Port of West Sacramento (POWS, or the Port), and describes and displays the projected commodity tonnages expected to pass through the Port through the 50-year period of analysis (2016-2065). The future fleet mix forecasted to call at the Port is identified and discussed. Estimates of the transportation cost savings per ton of cargo for each carrier type and major trade route relevant to the Port are described, and these serve as the basis for estimating the average annual benefits expected to result from a channel deepening. The benefits have been calculated at one foot increments between the current 30' channel depth and the authorized 35' deepening. This appendix describes in detail the methodology, assumptions, data sources, and results, which include a thorough sensitivity analysis. The sensitivity analysis describes how results of this analysis – including project justification – would change given alternative commodity growth and import/export startup scenarios.

Due to particular circumstances related to the Port, the report includes a qualitative multiport analysis as opposed to a detailed quantitative analysis. First, it is important to note that the POWS continues to market itself as a primarily bulk commodity port, whereas other ports in the area – Stockton and Oakland – are either moving away from or fully disengaged from moving bulk goods. Second, several of the commodities included in the deepening benefit analysis have specialized needs (storage or transport safety restrictions) that cannot reasonably be met by other ports in the region; this is the case for two of the commodities analyzed – wood pellets and ethanol. Third, in the case of a commodity like cement that is common to several regional ports, the existence of shipper-owned facilities at the Port, and the location and size of the population centers and product markets served indicates that future competition between the region's ports is not a significant factor in the deepening benefit analysis.

Discussions with the San Francisco Bay Bar Pilots, who are responsible for the navigation of vessels down the channel to the POWS, helped to determine how important factors such as underkeel clearance, daylight restrictions, cargo density, and tidal delay should most accurately be incorporated into the analysis. The Bar Pilots confirmed that most vessels do indeed draft deeply enough to require consideration of the tide either inbound to or outbound from the Port. Given what was learned from the Bar Pilots, the analysis differentiates the assumption of average tidal delay by the major vessel types and classes.

The future vessel fleet mix is an important component of the benefit analysis. Fortunately, with its 35' channel depth and a recent historical record of bulk cargo imports and exports, the Port of Stockton's current vessel fleet mix provides an actual vessel fleet calling on a port under conditions that are very similar to the conditions that would exist following a deepening project to the POWS. Conversations with the Bar Pilots confirmed the assumption that the future vessel fleet will represent a shift within the current fleet, rather than a move to a larger class of vessels. Due to length constraints, it is not anticipated that bulk carriers much larger than the current 60,000 DWT maximum will begin calling at the POWS. Therefore, the future fleet of vessels expected at the POWS represents a re-distribution of the types of vessels currently calling – and not a shift to vessels larger than have historically called at the Port.

Future commodity movements are anticipated to come from both goods that have historically shipped through the POWS, and from goods that will be new to the POWS. The commodities that have recently moved through the POWS are rice, fertilizer, urea, anhydrous ammonia, cement, and power generating equipment. All of these goods, with the exception of fertilizer, are forecasted to continue moving through the Port into the foreseeable future. Additionally, at least four new commodities are anticipated to begin moving through the Port between now and 2016, which is the project base year for a 35' channel deepening. The new commodities anticipated to move through the POWS are: bio-fuels (ethanol and biodiesel), wood pellets, and recycled metal. Importantly, each of the commodities that have yet to begin shipping through the Port currently either has facilities constructed, facilities in design, or has a lease agreement or other financial commitment with the Port. Rice and power generating equipment (windmills) are expected to continue to move through the Port but have been excluded from the forecast of future commodity traffic because they are not anticipated to benefit from any additional channel depth. The other commodities would be expected to be able to use additional channel depth, and separate forecasts were generated for each.

These forecasts of future commodity movements to and from the Port relied on different sources of data and information, including IHS Global Insight forecasts, discussions with shippers, industry and trade reports, government agencies such as USGS and USDA, and academia. Consistent with Corps guidance, and due in large part to the uncertainty inherent in forecasting far into the future, commodity growth rates were estimated for twenty years beyond the base year, and beyond that point all volumes were simply held constant. Also, for each good expected to ship to or from the Port through the period of analysis, a sensitivity analysis was conducted in order to assess three possible future growth scenarios: a low-growth scenario, a most likely scenario, and a high-growth scenario.

The report finds that a deepening of the Sacramento River Deep Water Ship Channel would enable an increase in tonnage per shipment to and from the POWS, which would result in lower transportation costs per ton of cargo. At present, vessels of design draft greater than 30.6' must come into port "light-loaded," i.e. carrying less than vessel capacity. Deepening of the channel would enable ships to come in either fully-loaded or more fully-loaded than they currently do, which would provide the opportunity for savings in transportation costs. Given the anticipated cargos and vessels, and given the expected trade routes, the savings per ton foot of additional depth is estimated to be between $2 and $5.

The report finds that under what are considered the most likely future conditions, the annual benefits from deepening of the channel by 5' total $24.5 million, and the annual net benefits total $16.1 million. A deepening of 5' is found to have the greatest net benefits, and as such is identified as the Proposed Plan[1]. At the current NED project cost estimate of $168 million, the benefit to cost ratio (BCR) of the 5' deepening alternative is 2.93.

The sensitivity analysis shows that under the low and high commodity growth scenarios, the BCR of the 5' deepening project would be 1.82 and 6.55, respectively. In order to further understand the risk that the Federal investment would not be economically justified in the face of uncertain future commodity throughput, additional sensitivity tests were conducted. All of these tests were conducted assuming the current project cost estimate, and they revealed important information about the risk of an investment in a 5' deepening project. First, if no future commodity growth occurred, and if throughput at the Port

[1] Pending further review, receipt of data, and acquisition of a NED Categorical Exemption, the language of this appendix has been changed to reflect that a 5' deepening currently represents the "Proposed Plan," as opposed to the "NED Plan." While the analysis has shown that benefits are maximized at 35' among those depths analyzed, truncating the incremental analysis at 35' does not allow for the identification of an actual NED Plan, which by definition is the plan that optimizes net benefits.

stayed at its current level, all else equal, the BCR of the deepening project would be .86. While the result is below unity, this is an important test because it not only represents a worst case scenario, but also shows that there are currently significant inefficiencies involved in the movement of goods to and from the Port. Second, working backwards and using a weighted average of the per ton transportation cost savings, it was determined that project BCR unity would be achieved with annual throughput growth as low as 2.2% between the base year and 2035 (the year in which all commodity forecasts in the analysis are flat-lined). Finally, the sensitivity of the results to the year in which the commodities begin moving through the Port was tested. Currently, all of the new commodities are anticipated to begin shipping in 2012. Under the scenario where near-term future growth in demand is slower than currently expected, and if as a result the new commodities begin shipping in 2014 instead, the BCR of the Proposed Alternative would be 2.7. Combined, the results of the sensitivity analyses show that the Proposed Alternative has a low economic risk.

1. Introduction

1.1. Purpose

The purpose of this report is to describe the With-Project economic conditions for the proposed deepening of the Sacramento River Deep Water Ship Channel (SRDWSC). The analysis describes recent historical throughput at the Port of West Sacramento (POWS, the Port), and displays the projected commodity tonnages expected to pass through the POWS through the 50-year period of analysis. A sensitivity analysis of different scenarios relating to projected tonnages for each commodity expected to move through the Port has been conducted to address the possibility that future conditions at the Port may differ from the way in which they are projected in this analysis. Additionally, the future fleet mix forecasted to call at the Port is identified and discussed. Estimates of the transportation cost savings per ton of cargo for each carrier type and major trade route relevant to the Port are provided and help to arrive at the average annual benefits resulting from a channel deepening. The benefits have been calculated for various project depths between the current 30' channel depth and the authorized 35-foot deepening. The average annual benefits derived in this analysis were used in combination with estimated project costs, to identify the Proposed Alternative for Federal participation in constructing the project.

This analysis was conducted in accordance with ER 1105-2-100 (*Planning Guidance Notebook*) and IWR 10-R-4 (*National Economic Development Procedures Manual Deep Draft Navigation*). Data for the calculation of shipping costs was provided by the latest IWR Vessel Operating Costs (2009), Waterborne Commerce Statistics (2006), the Port of West Sacramento, interviews with various shipping companies, and the San Francisco Bay Bar Pilots' Association. Project benefits presented in this appendix are for a period of analysis of 2016 – 2065 and incorporate the FY 2010 Federal Discount Rate of 4.375%.

1.2. Study Authority

The Sacramento River Deep Water Ship Channel was originally authorized by the River and Harbor Act (Public Law 525, 79th Congress, 2nd Session) and approved for construction on July 24, 1946. The 30-foot deep channel was completed in 1963. In response to resolutions adopted on 10 July 1968 and 11 December 1969 by the House of Representatives Committee on Public Works, the Board of Engineers for Rivers and Harbors was requested to review reports pertinent to the Sacramento River Deep Water Ship Channel, and determine if any modifications to the existing navigation project should be recommended.

In July 1980, a combined Feasibility Report and Environmental Impact Statement (EIS) for Navigation and Related Purposes was completed, recommending deepening and widening of the existing channel. The Feasibility Report was transmitted to Congress in October 1983, and the Sacramento River Deep Water Ship Channel, California, channel deepening project was subsequently authorized for construction by Public Law 99-88, dated 15 August 1985. This Authorization was reiterated in Section 202(a) of Public Law 99-662, the Water Resources Development Act of 1986 (WRDA 1986).

1.3. Prior USACE Studies

The Corps of Engineers, Sacramento District completed a Feasibility Report and Environmental Impact Statement for the project in July 1980, which found the 35-foot project to be economically justified. A subsequent General Design Memorandum (GDM) and Supplemental Environmental Impact Statement was prepared in March 1986 which detailed the 35-foot project between New York Slough and the Port of Sacramento. The deepening began in 1989, but was suspended in 1990 at the request of the Port of Sacramento due to the inability to continue financing their share of the project costs. Two of the six construction contracts had been completed at that time, from River Mile 43 to 35, which is the project reach nearest the port.

In 1998 Congress directed the Corps to complete a reevaluation of the unconstructed project that would serve as the basis for a possible recommendation to resume construction. The current Limited Reevaluation Report (LRR) outlines the alternative measures screened in prior USACE studies of the Sacramento River Deep Water Ship Channel (SRDWSC) deepening study. Chapter 5 *Plan Formulation* of the LRR provides a detailed summary of the measures screened and the screening process. This analysis only addresses those alternatives that make up the final array of alternatives: future without-project conditions, deepening to the authorized depth of 35', and deepening to incremental depths shallower than 35'. The seven alternatives considered in the main report of the LRR are described below; the first three alternatives listed make up the final array.

- **Future Without-Project Conditions**: No action plan. Continuation of present shipping practices including normal channel maintenance with no improvements.
- **Channel Deepening to -35 Feet MLLW and Selective Widening**: Authorized project. First 8 miles of SRDWSC already deepened to -35 MLLW.
- **Channel Deepening to shallower than -35 Feet MLLW and Selective Widening**: Dredging to depths shallower than -35 feet MLLW.
- **Channel Deepening to deeper than -35 Feet MLLW and Selective Widening**: Dredging to depths deeper than -35 feet MLLW.
- **Intermodal**: Using of trucks and/or rail to move cargo.
- **LASH**: LASH involves carrying cargo aboard lighters or barges.
- **Locks**: Construction of a system of hydraulic locks to maintain a water depth of -35 MLLW.

2. Project Area

The SRDWSC is located in the Sacramento-San Joaquin Delta region of Central California. The study area extends from Avon, in Suisun Bay, to the Port of Sacramento, a distance of approximately 58 miles. The channel lies within Contra Costa, Solano, Sacramento, and Yolo Counties and serves the marine terminals at what is now the Port of West Sacramento. The man-made, deep-water channel was completed in 1963 – to a depth of 30 feet. The SRDWSC is divided into five reaches, which were determined by geographic settings. The Port of West Sacramento and its terminals lie within the fifth reach of the SRDWSC, which spans 8.4 miles of the channel.

Figure 1 provides an aerial view of the study area. The path taken by vessels between the Golden Gate Bridge and the Port of West Sacramento is shown in red; this includes the 43-mile deep water ship channel. In addition to the Port of West Sacramento, the Ports of Stockton, Oakland, Richmond, and Redwood City are also displayed in the image, along with their respective distances from the Golden Gate Bridge. As the point of entry to the San Francisco Bay, all vessels traveling to or from any of the aforementioned ports must pass under the Golden Gate Bridge, making it a natural reference point for distances to each port. These Ports are all included in the Multiport Analysis discussed in Section 3 of this report.

Figure 1: Study Area Overview and SRDWSC

2.1. History of The Port of West Sacramento

The Port, originally named the Port of Sacramento, has been an integral part of the West Sacramento community since its origination. Major Paul Norboe began to advocate for a deep water channel and harbor to increase commerce in the Sacramento region in 1916. In the 1930's, the "Father of the Port," William G. "Bill" Stone continued to advocate for a deep water port, which led to the initial study conducted by USACE. The Corps proposed a 43-mile long channel from the Sacramento River in Rio Vista through the Delta into Yolo County, and what is now the City of West Sacramento. The channel's construction began in 1949 and took 11 years to complete due to several halts that resulted from insufficient funding. Construction of the Port terminal began two years after the completion of the channel, in 1962. The first ship arrived at Port in 1963.

The Port's main purpose as an inland port serving the agricultural industry drove the types of imports and exports at the Port for over forty years. During that time, the Port specialized in the movement of agricultural goods, including rice, fertilizer, grains, and lumber. In 2005, after several years of declining business, the Port underwent a change in leadership and became the current Port of West Sacramento. Under the current leadership, a new business model was developed and the Port shifted its focus from mainly agricultural products to a wider mix of commodities, which are less heavily dependent on a single industry. The Port remains a facility that serves largely bulk commodity imports and exports. The types of goods shipping to and from the Port are discussed in greater detail throughout this analysis.

2.2. Facilities and Terminals

The Port of West Sacramento's facilities are located on approximately 165 acres of land in the City of West Sacramento, in Yolo County, California. Port facilities include five ship berths, three ship loaders, bulk warehouses, transit sheds, grain elevators, railways, a foreign trade zone, and outside storage areas. Undeveloped acreage on the Port's terminal is preserved for cargo generating activity. More details on the facilities are included in the following list.

- Sacramento River Deep Water Ship Channel Depth: 30 ft.
- Depth Alongside: Project Depth 35 ft.
- Five (5) berths: Each 600 ft. (183 m.) long
- Trucking: More than 50 companies provide a versatile range of services and equipment
- Railroads: A 200 railcar terminal area marshaling yard. BNSF Railway, Union Pacific, and Sierra Northern service the Port.
- Commodity handling capabilities: Bulk rice and bulk grain elevators, bulk commodities bagging facility, dry bulk cargo warehousing
- Fugitive dust, wash water, and storm water control systems
- Three (3) transit sheds
- Paved open storage area

As indicated in the list above, all berths at the POWS measure 600-feet long. Many of the dry bulk and liquid tanker vessels calling at the Port of West Sacramento measure longer than 600 feet in length. The bulk and break bulk berths at the Port are alternated such that the larger bulk and liquid tanker ships are not adjacent to each other while loading or unloading. This layout allows the line hauling (moving the ship parallel to the dock) of ships longer than 600 feet. Any neighboring break bulk ships are small enough that they can be positioned to accommodate the line hauling of larger vessels. Break bulk ships are comprised of the smaller General Cargo vessel type, discussed in greater detail in Section 6. The five ship berths and their characteristics are described briefly below.[2]

Berth 1

A pile-supported bulk cargo wharf positioned 125 feet offshore serving a 22,000 metric ton (MT)[3] capacity rice export elevator which occupies approximately 2 acres. A bulk rice ship loading gallery structure is permanently mounted on the dock.

Berth 2

[2] Berth characteristics taken from: *Port of Sacramento Maritime Demand Analysis*, Draft Report. Parsons Binckerhoff, PB Ports and Marine, Inc. September 2004.

[3] In this analysis, all cargo tonnages are in Metric Tons (MT), unless otherwise noted.

A multipurpose marginal wharf with two 86,000 square foot break bulk cargo transit sheds located alongside the berth.

Berth 5

A pile supported bulk cargo wharf positioned approximately 250 feet offshore serving a 30,000 MT bulk grain elevator and mineral bulk storage and out loading facilities. A fixed bulk grain ship loader is permanently mounted on the dock and a retractable mineral bulk ship loader is mounted on and behind the dock. The inboard side of Berth 5 and the Berth 3/4 area between Berths 2 and 5 is used as a tug base and marine service area. Berth 5 is also used for berthing visiting boats and vessels on lay status.

Berth 6

A multipurpose marginal wharf serving a 3.5-acre open storage area, and adjacent break bulk cargo transit sheds and warehouses.

Berth 7/8

A multipurpose marginal wharf (Berth 7) and 250-foot bulk cargo dolphin and trestle extension (Berth 8) serving bulk and break bulk cargo. A fixed woodchip ship loader is permanently mounted at the end of the marginal wharf and a movable bulk unloading hopper/conveyor system is located on the northern half of the marginal wharf. The Port's main reversible bulk cargo conveyor system serves Berth 7/8. An 86,000 square foot transit shed serving breakbulk cargo is located alongside Berth 7.

Figure 2 provides an aerial snapshot of the POWS facilities. The image has been diagramed so as to provide more specific information about the Port's storage and loading/unloading capabilities.

Figure 2: Aerial of Port Facilities[4]

A. **Bulk Flat Storage Warehouse -** divided into six bins with capacities ranging from 6,300-9,500 MT.
B. **Bulk Rice Pier** - Load up to 600 tons per hour. 22,000 MT storage
C. **General Cargo Wharf** - Two transit sheds, each with 86,400 square feet of storage capacity.

[4] Port of West Sacramento, August 2010

D. **Pier with grain, feed and industrial bulks** - Two ship loaders, each with 600 MT-per hour capacity. Liquid bulk terminal.
E. **General/Project Cargo Wharf** - Six acres of open wharf. Double track rail service on the dock and land sides.
F. **General Cargo Wharf** - One transit shed, with 86,400 square feet of storage. Double track rail service in the dock and land sides.
G. **General Cargo Building** - 42,000 square feet of storage.
H. **Bulk Materials Pier** - One ship loader capable of loading or discharging up to 600 MT-per hour.
I. **Open Storage** - 13 acres, paved.
J. **Wood Pellet Facility** - Flat storage for 125,000 MT of bulk cargo.
K. **Front Gate** - One quarter mile from transcontinental Interstate 80. Twenty-four hour security.
L. **Bagging Warehouse** - Pneumatic bagging of 80 and 50 pound bags.
M. **Rail Marshaling Yard** - Sierra Northern RR/UP/BNSF.
N. **Scrap Metal** - 15 acres metal export facility.
O. **Rail Car Rollover Dumper**
P. **"Dolmar" Buildings** - Two domed warehouses with 9,600 MT capacity each. Each can be used for import and export.
Q. **Wood Pellet Storage** - 30,000 MT capacity. Loads at up to 600-tons-per-hour.
R. **Biofuel Facility** - 1 million bbl import & manufacturing facility.
S. **Cement Facility** - 800,000 MT cement import terminal.
T. **Cement Facility** - 2.2 million MT cement and aggregate import terminal.

The detailed outline of facilities includes the storage and handling capacities for both current and expected future cargo at the Port. Because the growth forecasts made in this analysis predict a substantial increase in annual throughput at the Port, it is necessary to document that there exists ample storage and handling capacity to accommodate the expected increased annual tonnages. While facilities will likely change in order to meet the demands of increased cargo throughput, a detailed summary of under-utilized facilities at the Port confirms the existence of additional capacity to support projected commodity growth.

According to the POWS, six warehousing facilities currently stand unused or under-utilized. Together they can accommodate 150,000 MT of cargo storage at any one time, based upon a material density of 60 pounds per cubic foot (pcf). Storage capacities will differ for cargo of differing densities. The six warehouses are bulk cargo storage facilities, which can generally handle any free flowing dry bulk cargo.

Each warehouse is connected to a system of conveyor belts that allows for the receipt and export of cargo by truck, rail, or ship. Both the shipping and receiving conveyors are capable of moving 60 pcf cargo at a rate of 600 tons per hour (tph). The number of available trucks or railcars will affect the actual shipping and receiving rates. According to these numbers, the existing underutilized warehousing has a throughput capacity of at least 3 to 4 million MT per year given a sufficient supply of railcars and trucks. The projections made later in this analysis forecast that annual throughput at the POWS will total around 2.6 million MT from the year 2035 through the period of analysis under the most-likely future scenario. Given the estimated 3 to 4 million MT of annual capacity available at the Port, there exists ample handling and storage facilities to support the projected annual throughput under the most-likely future scenario. Section 5 of this report contains commodity forecasts and future scenarios.

In addition to the developed land described above, the Port owns undeveloped land to the North and South of the Port's harbor. This vacant land provides for the possibility of expansion of the Port's facilities, if needed to support future growth.

3. Key Assumptions of the Report

3.1. Multiport Analysis

For all deep draft navigation economic analyses, it is crucial to understand the port's role in relation to other regional ports and harbors. In order to reasonably differentiate between national benefits and regional transfers related to a potential Federal investment, an analysis must determine if port competition is expected to divert business from one port to another - either under the without or with-project condition. This type of analysis is termed a multiport analysis by the IWR Deep Draft Navigation Manual. Depending upon the extent of either existing or projected port competition, a multiport analysis may be described qualitatively for minimal effects, or can involve complex system-wide calculations and scenarios for significant competitive situations that would cause economic transfers between ports. After having looked in depth at a few commodities that may experience future multiport competition, it was concluded that this economic analysis only requires a qualitative multiport analysis. The reasons for this, in addition to a discussion of the commodities expected to be subject to competition from nearby ports, are described below.

There are four other regional ports, all included in Figure 1 on page 3, to consider for this analysis: the Ports of Oakland, Richmond, Redwood City, and Stockton. For reasons that are described below, Oakland, Richmond, and Redwood City pose little to no threat of outcompeting the POWS. The Port of Oakland is a large, container port. Its yards currently hold and process thousands of containers per month, and it is highly unlikely that its port authority would reallocate acreage to store the types of lower-revenue bulk commodities that the Port of West Sacramento services. The Port of Richmond is located approximately 10 miles from the Golden Gate Bridge, and approximately 85 miles from the POWS. The Port of Richmond is primarily a petroleum and liquid bulk facility, with petroleum comprising about 90% of its total throughput[5]. The Port currently has little or no commodity overlap with the POWS, and its location so far from the POWS makes it an unlikely future competitor for the forecasted POWS commodities. The Port of Redwood City is similar in size to POWS, its project depth is also currently 30', and the port is located in the southern area of the San Francisco Bay (see Figure 1). It has historically handled mostly sand, gravel, rock and stone, in addition to some cement imports. While cement imports are a commodity that the POWS and the Port of Redwood City have in common, the nautical distance between these two ports (approximately 120 miles), and the distance between the markets served by each makes it reasonable to assume that the ports are not and will not be in direct competition. With cement as a commodity that requires a more in-depth analysis in regards to multiport competition, further discussion as to the unlikelihood of competition between POWS and the Port of Redwood City is contained later in this section of the report.

The most competitive port to the POWS is the Port of Stockton. The Port of Stockton is, like the POWS, primarily a bulk commodity port. In 2008, the most recent year for which Stockton commodity data is available, liquid fertilizer, cement, anhydrous ammonia, molasses, and steel

[5] Source: Waterborne Commerce Statistics, CY 2007

products comprised the top five imports to the Port of Stockton, each totaling more than 125,000 MT for the year. Sulfur and rice made up Stockton's main export commodities during the same year[6]. Over the past decade, the POWS lost substantial business to the Port of Stockton. This is thought to be largely attributable to Stockton's acquisition of Rough n' Ready Island, which significantly increased the size of its port facilities and provided a one-time boost in competitiveness relative to the POWS. In 2005, shipments of grain through the POWS completely stopped, with Stockton picking up most of this business. The same dynamic occurred with wood chips in 2006. The year 2006 had the lowest throughput at the Port in more than twenty years (see Table 3). Most recently, importers of fertilizer at POWS shifted their operations to the Port of Stockton. The former fertilizer importers expressed interest in the 5' of greater depth offered at the Port of Stockton and built a new facility there, planning in advance to cease operations in West Sacramento in March 2010. The planned March 2010 exit of the fertilizer company freed up storage and other facilities for one of the new businesses expected to begin operations at the Port in the next couple of years[7]. While Stockton's acquisition of the fertilizer importer emphasizes POWS' continued vulnerability to competition from Stockton, the filling of the fertilizer facility's space with a new commodity highlights the strength of POWS' new business model (discussed below), underscoring its viability in the future.

The POWS port authority and regional political representatives implemented several changes to attempt to put the Port back on track after its downturn in business that began with the increased competition from Stockton in the early 2000s. First, the POWS fundamentally changed its business model from past decades. Rather than building and maintaining a set of facilities and attempting to attract and retain businesses, the POWS shifted to a landlord model, meaning that the POWS markets its acreage to various shippers and enters into long-term lease agreements. The individual companies develop and construct their own facilities to be used in conjunction with the infrastructure already in place at the Port. Though this does not entirely eliminate the possibility that a company will leave the POWS, it seems reasonable to conclude that companies would be substantially less likely to move to the Port of Stockton after such significant investments in buildings and/or plants have been made at the Port of West Sacramento. For example, as will be discussed further in this analysis, the Port is expected to begin exporting wood pellets to Europe and Asia in the next few years. The wood pellet facility has been permitted, and the Port is in final lease negotiations with the operator. As part of this negotiation, an Exclusive Negotiating Agreement with a $350,000 non-refundable deposit has been entered into. Construction is expected to begin in 2010, and the fully operational facility will be completed by the end of the year.[8] As will be discussed further, this business model is one reason why this analysis contends that competition between these two ports will not be a significant enough factor given future operations at the Port to warrant a quantitative multiport analysis.

Because of the new business model established at the POWS and the past loss of business to the Port of Stockton, the Ports of West Sacramento and Stockton have by and large captured niche markets at this point in time and do not appear to be in direct competition for the majority of goods expected to ship to each port. Four commodities and one other business currently overlap between the two ports: rice, cement, anhydrous ammonia, urea, and wind-power generating equipment. In each case, there are factors that greatly reduce or eliminate competition between the two ports, or

[6] Source: Port of Stockton
[7] http://www.allbusiness.com/legal/property-law-real-property-zoning-land-use-planning/13528095-1.html
[8] Source: Port of West Sacramento.

otherwise eliminate the importance of the commodity overlap to the economic analysis. Likewise, the POWS offered a prime location for several new commodities expected to come on line in the near future for several reasons, which preclude the potential relocation to the Port of Stockton as an option in the future, thus eliminating multiport competition as it relates to these new sources of business for the POWS. The factors that decrease the competition between the two ports for goods which both currently ship to each port and are expected in West Sacramento in the near future are described below.

- **Rice**

Rice is an important commodity at both the Port of West Sacramento and the Port of Stockton. According to interviews with rice exporters, current and projected rice shipment vessels generally do not need drafts of greater than 30-feet[9]. Thus, while rice represents an important source of business for both ports, and while a shift of commodities between the ports would have financial implications for each of them, such a shift is inconsequential to this deepening benefit analysis since the vessel fleet for this commodity is not expected to be able to use the additional draft that would result from a deepening project at the POWS. The historical tonnages of rice coming to the Port and its significance as a source of business are discussed and acknowledged in this report; however, rice does not factor into this NED analysis due to the lack of transportation cost savings on rice shipment as the result of a channel deepening.

- **Cement and Aggregates**

Shipments of cement and aggregates to the POWS would realize transportation cost savings from a greater channel depth. As will be explained in more detail in Section 5, most of the future growth in cement at the port is expected to be handled by a company that has recently constructed new facilities and has entered into a long-term lease at the POWS. This cement and aggregate importer has indicated that the minimum yearly tonnage that will come through these facilities at the Port totals 100,000 MT. While the construction of a new cement terminal does not guarantee any particular level of future throughput, it does mean that it is reasonable to expect that this company is committed to bringing additional future cement shipments through the POWS and will likely not leave West Sacramento for the Port of Stockton. The facility's recent construction at the Port makes this situation unique as it relates to a multiport analysis. Long-standing operations that had started to dwindle may be cause to reevaluate if cement imports have begun to or are vulnerable to move from the POWS to Stockton. A brand new facility, which expects to begin importing at a minimum level of 100,000 MT annually once cement demand rebounds from the recent recession, lends reasonableness to the assumption that these imports will arrive at the POWS (and not elsewhere) and continue to do so at a minimum of 100,000 MT through the foreseeable future.

Additionally, the facility is equipped for the importation of cement and aggregate, so that mixing of the two products for the production of concrete will take place on site. This batching function of the facility further lessens competition from the Ports of Stockton and Redwood City to the POWS. Once concrete has been mixed, its hauling lifespan is very short, limiting the number of miles it can travel post-mixing[10]. Therefore, all three ports can service specific local regions without overlap, or with negligible overlap, in the distribution of mixed concrete posing little to no threat to each other. The inability to move concrete a significant number of miles post-mixing implies that the need for

[9] As will be explained in greater detail further in the report, this is due to import quotas in Japan and South Korea.
[10] Portland Cement Association

cement and aggregate imports to the POWS will rely upon local demand and suffer little from nearby competition.

For those cement products that are not limited by a short hauling lifespan, such as bulk cement, flyash, and slag (collectively referred to as "cement" in this analysis), future competition between the surrounding ports and the POWS is expected. Despite competition in the regional cement market, the projections made in this analysis are assumed to be the same both without- and with-project. Therefore, the construction of a Federal project to deepen the SRDWSC is not expected to cause the diversion of cement imports from either the Ports of Stockton or Redwood City and the economic benefits realized by a channel deepening will not merely reflect regional transfers, but actual increased economic efficiency.

- **Wind Power Generating Equipment**

As the "green energy" industry in California and the nation has expanded, both the POWS and the Port of Stockton have begun receiving shipments of wind-power generators, which are then assembled for use throughout the Central Valley of California. This industry represents a new market for both ports and will provide revenues for continued operations. The vessels transporting this type of equipment, however, do not require deeper navigation drafts than are already available at either port. Thus, as with rice, the economic analysis does not claim nor anticipate NED benefits as a result of this industry.

- **Fertilizer Products**

Until recently, both Ports supported California's agricultural industry via the importation of agricultural fertilizers and related products, such as urea and anhydrous ammonia. As was discussed earlier, fertilizer shipments recently shifted from the POWS to the Port of Stockton and the fertilizer facilities at the Port have already been allocated for another commodity's use. Because of the heavy agricultural activity in Central California and a reliance on fertilizer products, it is possible that fertilizer imports will eventually return to the Port. However, at this juncture, it seems prudent to leave fertilizer out of the forecasts of future business at the Port.

Urea and anhydrous ammonia imports to the Port, which are counted separately from the fertilizer imports that have relocated to the Port of Stockton, have remained relatively stable for nearly twenty years and show no signs of succumbing to competition from the Port of Stockton. The business that imports these goods owns and runs an independent facility located at the POWS. Given the stable import numbers for urea and ammonia over the course of two decades, the independent ownership of the facility at the Port, and the robust agricultural activity in the region, this analysis assumes that urea and ammonia will continue to ship to POWS in roughly the same quantities through the foreseeable future. The methodology used in these forecasts is discussed in more detail in Section 5 of this analysis. Because of the uncertainty surrounding any forecast, the possibility that urea and ammonia shipments could leave the POWS for the Port of Stockton is acknowledged through the sensitivity analysis for each of these commodities.

- **Biofuels**

A new biofuels importation facility at the Port is expected to be completed for full operational use by the end of 2011. Sugar-based ethanol and biodiesel will comprise the two fuels coming to the Port. Ethanol will account for a larger percentage of the imports than biodiesel (70% versus 30%), though both will ship from South America's east coast on liquid bulk tankers.

The raw biofuels arriving at the Port will be directly imported by large oil companies intending to mix the fuels with gasoline and diesel in order to meet California's Renewable Fuel Standards (RFS) that take effect this year. After arriving at the Port facilities, the ethanol and biodiesel will be trucked to blending facilities, owned by the oil companies and located in Chico, Reno, and Fresno. At the blending facilities, the raw products will be mixed with gasoline or diesel. The blended fuels will then be distributed to retail locations, ready for purchase by consumers[11].

At present, corn-based ethanol and biodiesel are railed or trucked from the Midwest to bulk facilities located in Stockton, Selby, and Los Angeles and then trucked to the aforementioned blending terminals. Corn-based ethanol and biodiesel products are being phased out of use in California, however. California's Low Carbon Fuel Standard (LCFS) mandates a 10% reduction in the "carbon intensity" of liquid transportation fuels used in the state by 2020. A fuel's carbon intensity measures both the direct and indirect greenhouse gas (GHG) emissions associated with each step of a fuel's life cycle for each unit of energy that the fuel provides. Included in this measurement are the energy use and emissions from production of the fuel's feedstock (e.g. corn and sugarcane), manufacturing of the feedstock (e.g. conversion to ethanol), and transportation from the point of production to the point of sale (e.g. shipment from Brazil).[12] According to the EPA, the life cycle analysis of corn and sugarcane ethanols, which evaluates their carbon intensities, has concluded that sugarcane ethanol will reduce GHG emissions by around 61% when compared to traditional gasoline; corn ethanol use will result in GHG emission reductions of about 21%.[13] The findings of such analyses have made sugarcane-based ethanol an attractive substitute to corn-based ethanol in the need to comply with California regulations.

Importantly, the current infrastructure in place in Stockton is not appropriate for the importation of sugar biofuels, thus making the switch to the sugar-based products an opportunity for the construction and establishment of new infrastructure, such as that currently being put in place at the POWS. According to the importer, selection of the POWS as a site for the new biofuels facility came at the expense of ruling out the Port of Stockton. After extensive research, it was determined that the importation of biofuels at the Port of Stockton violated safety regulations there. Additionally, the Port of Richmond, the petroleum import hub of Northern California, lacks the land to accommodate the importation of biofuels. Already operating at full capacity, Richmond's land constraints rule out the building of infrastructure to facilitate the importation of biofuels to that Port. The availability of land and landlord business model at the POWS offered a close and convenient alternative to Stockton and Richmond. Because of the construction of the biofuels facility at the Port, the lack of ability to import these products at the Port of Stockton, and the long-term lease required to operate at the POWS, competition in the region does not appear to be a factor in the forecast of future imports of biofuels, therefore eliminating the need for a multiport analysis in the case of this commodity.

- **Wood Pellets**

The exportation of wood pellets from the Port is expected to begin in January 2012. Wood pellets offer an environmentally friendly substitute for coal in energy production and should not be

[11] Source: Interview with industry representative setting up operations at the POWS. April 2010.
[12] Brief for Brazilian Sugarcane Industry Association (UNICA) as Amici Curiae Supporting Respondents, National Petrochemical & Refiners Association v. Goldstene, et al., No. 10-cv-00163 (9th Cir. May 6, 2010)
[13] Ibid.

confused with the wood chips that currently ship from the Port of Stockton. Wood chips themselves can serve as the input to the production of wood pellets, which are drier, cleaner, and easier to handle than wood chips. The primary intended use of wood pellets is the co-firing of the pellets with coal in a pulverized coal fire boiler, which cannot accommodate the higher moisture content and longer burning time of wood chips. Wood pellets are specifically suited to this application, while wood chips are not. Additionally, wood pellets can be transported economically using standard equipment suited for corn kernels, plastic pellets, or other pelletized products, while wood chips require specialized conveying and unloading equipment.[14] For these reasons, the wood pellets to be produced and shipped from the POWS in the near future are not competitive with the wood chips currently shipping from the Port of Stockton.

The wood pellets produced in West Sacramento will ship from the Port to Europe and countries along the Pacific Rim, especially China, where high growth will support the demand for "green" goods such as wood pellets in the production of energy. Supply-side constraints make the POWS wood pellets competitive with those shipped from the East Coast of the United States to Europe. The supply and demand markets will be discussed more thoroughly in Section 5.

The production of wood pellets will take place in facilities currently under construction at the Port. According to company representatives, the POWS represented the only Port on the west coast that had maintained its grain silos, a vital structure for the storage of wood pellets, which require specific safety measures due to their high combustibility. The availability of these silos at the Port made it an easy choice for a location, and also is expected to minimize the possibility of relocation to other ports along the West Coast in the foreseeable future[15].

- **Scrap Metal**

A scrap metal recycling and shredding facility will begin operations at the Port in mid-2011. Given the population of California, the number of shredding facilities in the region is relatively low as compared to the availability of these types of facilities elsewhere in the nation. Scrap metal recycled in the region will be shredded and exported to China, where it will be used in the production of steel. A lack of similar facilities at other ports in the region and its construction at the POWS, in addition to the long-term lease with the Port that is currently in place, makes it unlikely that any other nearby port will represent a source of competition. The population served by this facility, which will be discussed in greater depth in the forecast of scrap metal exports, will also sustain operations at the Port into the foreseeable future.

In summary, during the investigations, data collection, and interviews for this economic analysis, for the reasons discussed, the conclusion drawn is that an in-depth, quantitatively-modeled multi-port analysis is not required. The Port of Oakland's navigational depth (50-foot) and involvement almost solely in containers make it an unlikely competitor to West Sacramento. Through interviews with shippers, it was determined that the geographical location of the ports of Richmond and Redwood City are the most important reason why they are not a substitute for POWS. With respect to the Port of Stockton, the Port of West Sacramento's new business model has greatly decreased the likelihood of transfers of the commodities associated with the new leaseholders. Also, the POWS and the Port of Stockton seemed to have reached an economical equilibrium after a time during which cargo did indeed shift from the POWS to Stockton. As discussed, despite Stockton's

[14] Source: Interview with industry representative setting up operations at the POWS. August 2010.
[15] Source: Interview with industry representative setting up operations at the POWS. August 2009.

current greater channel depth relative to Sacramento, and without any expectation of a deepening project along the Sacramento River Deep Water Ship Channel, several companies have invested in a lease and have either recently constructed or are constructing facilities at the Port in anticipation of a profitable business arrangement that involves moving commodities through the Port.

3.2. Alternate Modes

Alternate modes of transportation of the goods currently moving and expected to move through the Port of West Sacramento are not viable due to the nature of the commerce moving through the Port. All of the commodities, with the exception of cement, are either imports from abroad or exports intended for foreign destinations. For instance, biofuels will arrive from South America on liquid tankers because biofuel importers have determined that the railing or trucking of biofuels represent economically inefficient alternatives to its marine transport. Likewise, the scrap metal and wood pellets that will export from the Port to foreign countries can only reach their destinations via ship. The same holds for the fertilizer products importing to their POWS: their countries of origin make marine transport the only option for importation.

In the case of cement, imports to the Port only arrive when domestic production capacity has been reached and demand remains unmet. Therefore, it is only once the domestic cement supply requires supplements from foreign sources in order to meet demand that cement imports will arrive at the Port. That said, the cement imports arriving at the Port cannot be expected to shift to alternate transportation modes because any cement moving through the Port will originate in China and require marine transport.

In general, the international nature of the trade taking place at the POWS rules out alternate modes of transport, so that this analysis assumes no possible future shift away from marine transport.

3.3. Commodity Growth

Forecasts of commodity growth are obviously a critical part of the economic analysis. In order to make these forecasts as realistic as possible, it is important to understand whether firms have or are basing their decisions to begin new operations at the POWS and/or their growth forecasts upon a Federal channel deepening project. The findings from numerous meetings and interviews with port authority personnel and shipping companies have led the Corps analysts to believe that the various business development plans were not developed with an expectation that the channel would be deepened beyond the current project depth. The Port of West Sacramento has marketed itself based upon its current and future facilities and an advertised draft of 30-feet. None of the new businesses constructed, in construction, or in the permitting process to begin operations at the POWS have indicated during interviews that they based their business decisions or operating forecasts on the hopes or anticipation of a deeper channel. Though both the port authority and the port clients are aware that this Federal study is currently underway, they realize that there exist numerous legal, political, and financial issues that must be solved in order for channel deepening to occur. During interviews, the shippers indicated that their business is mainly dependent upon the state of the national economy—not the depth of the Sacramento channel. While the shippers indicated that lower per-ton costs could be realized by bringing in their cargo on more efficiently loaded vessels, their growth forecasts for the next five to ten years are primarily based upon historical tonnages, where applicable, and the overall health of the U.S. and world economies.

Given that the most important source of commodity import growth is the growth of the U.S. economy, it is helpful to note that since World War II waterborne commerce in the U.S. has been growing at about twice the rate of Gross Domestic Product. Additionally, world economic growth dictates the majority of export growth from the Port of West Sacramento. The growth rates developed for this analysis considered as many sources as reasonably available, including data from shippers, Federal or state agencies (such as the U.S. Department of Energy and the California Department of Food & Agriculture), industry, academia, and private consulting firms such as IHS Global Insight (Global Insight). For a port as small as the POWS, there are no readily available independent port-specific commodity forecasts. Global Insight commodity forecasts, for example, are available for the Pacific Northwest and not on the scale of the POWS. Thus, it is the responsibility of the analyst to develop a reasonable composite forecast that considers the available information for each commodity.

3.4. Vessel Operations

Vessel operations have implications for the shipping costs related to the movement of cargo. Two assumptions made in this analysis related to tidal delays and underkeel clearance requirements for the navigation of the SRDWSC affect the calculations used to determine potential project benefits. Discussions with the San Francisco Bay Bar Pilots[16], who are responsible for the navigation of vessels down the channel to the POWS helped to determine how each of these factors would be incorporated into this analysis.

Bar Pilots confirmed that high tide provides greater channel depth, and more deeply drafting vessels must sometimes wait for high tide in order to safely maneuver the channel. This "inactive" waiting time is called the tidal delay. The longest a tidal delay can be for most vessels calling at the Port of West Sacramento is 12 hours, given that there are two high tides in a 24-hour time period. Certain vessels, however, are restricted to daytime movement up the channel. Vessels measuring greater than 650' in length are restricted to daylight transits as a safety precaution. Additionally, any vessel carrying a hazardous material may only navigate the channel during daylight hours. Liquid tankers carrying anhydrous ammonia, which poses a serious threat to the surrounding population in the event of a leak, are restricted to daylight hour transit times. For daylight restricted vessels, a tidal delay can technically approach 24 hours since only one high tide is available to these vessels during the course of a day.

According to the Astronomical Tides Section 4.1.7.2 of the Alternative Formulation Briefing (AFB) Report for the SRDWSC, "Astronomical tides in the San Francisco Bay area are of the mixed, semi-diurnal type, with two highs and two lows of unequal height occurring each lunar day. The largest water-level excursion typically occurs as the tide falls from higher high water to lower low water, a process that generally requires 7 to 8 hours." The mixed, semi-diurnal tides of the San Francisco Bay make the incorporation of tidal use into the estimation of transportation costs and savings a complicated matter. Using information obtained from the San Francisco Bay bar pilots, a few simplifying assumptions were made about vessel operations as they relate to the tides in order to carry out this analysis.

San Francisco Bay Bar Pilots indicated that the average high tide in the SRDWSC approaches 3.6'. The shallowest point along the transit is referred to as the controlling depth, which is generally

[16] Discussion between San Francisco Bar Pilots and USACE San Francisco District economists took place on 9 September 2010.

about 29'. Summing the average high tide of 3.6' and controlling depth of 29', the maximum transitable depth in the channel is 32.6'. For all vessels except tankers, a mandatory 2' underkeel clearance requires that the, "vertical difference between the lowest protruding section of the hull…and the minimum actual channel depth"[17] be 2'. This safety measure helps to ensure that a vessel does not run aground while mid-channel. The minimum underkeel clearance for a liquid tanker is 3', as safety requirements for these types of vessels are generally more stringent due to the types of cargo they carry. Therefore, taking into consideration controlling depth, average high tide, and minimum underkeel clearance requirements, vessels are generally able to navigate the SRDWSC to the POWS at a maximum draft of 30.6' for bulk and general carriers, and 29.6' for liquid tankers. Of course, daylight restrictions, fog conditions, excessive shoaling and other factors will further restrict the maximum allowable draft over the course of the year. However, due to their relative rarity and the difficulty in modeling these factors, simplifying assumptions were made here.

According to the San Francisco Bay Bar Pilots, the maximum inbound vessel draft has remained fairly constant at nearly 30.6' over the past five years. The maximum outbound draft tends to be six inches lower at about 30'. Because the tide moves up the channel, it is harder for an outbound vessel to maximize the greater water depth provided by high tide, thus accounting for the shallower average maximum draft for outbound vessels.[18]

The information obtained through conversations with the Bar Pilots led to the simplifying assumptions used to carry out this analysis. The first assumption relates to the use of the tide to navigate the SRDWSC. A key driving factor behind a vessel's need to use the tide is the density of its cargo. For example, the windmills that can be carried on a ship to the POWS are not heavy enough to weigh a vessel down to the point that it requires more than the current 30' of depth available in the channel. Meanwhile, scrap metal may fill only 50% of a vessel's cargo area while weighing it down to its maximum draft. Therefore, this analysis assumes that those vessels with design drafts greater than 35', and which carry cargo with densities that are high enough to require deep water will use the tide in the same fashion both without- and with-project. The tidal delay for vessels transiting the SRDWSC is generally assumed to be the same both without- and with-project. Addendum 1 contains a table displaying the densities of each of the cargos that have been forecasted to benefit from a channel deepening in this analysis.

While tidal delays are assumed to be the same both without- and with-project, they differ across types and classes of vessels. The bulk carriers calling at the POWS in the 15,000 to 35,000 DWT classes do not exceed the length restrictions that would limit them to daylight-only transits, nor do they carry the types of cargo that may lead to the same result. Therefore, the smaller class bulk carriers are assumed to be able to use both high tides and have a tidal delay ranging from 0 to 12 hours, depending on when the ship arrives in the San Francisco Bay and whether or not it will be using the tide. Taking these factors into account, the average tidal delay for 15,000 to 35,000 DWT bulk vessels is assumed to be 6 hours. Several vessels in the 40,000 and 50,000 DWT bulk vessel classes exceed 650' in length and are daylight restricted, so that their tidal delay may range from 0 to 24 hours. To account for the daylight restricted 40,000 and 50,000 DWT bulk vessels, the proportion of vessels that measure 650' and greater in length was calculated. This percentage was used to arrive at a weighted average for the 40,000 and 50,000 DWT vessel tidal delays, resulting in average tidal delays of 8.34 and 9.48 hours for these classes of vessels, respectively. All of the

[17] NED Manual for Deep Draft Navigation
[18] San Francisco Bay Bar Pilots, discussion with San Francisco District Economists, September 2010.

tankers calling at the Port are daylight-restricted due to their cargos, leading to an assumed average tidal delay of 12 hours for the liquid tankers calling at the Port.

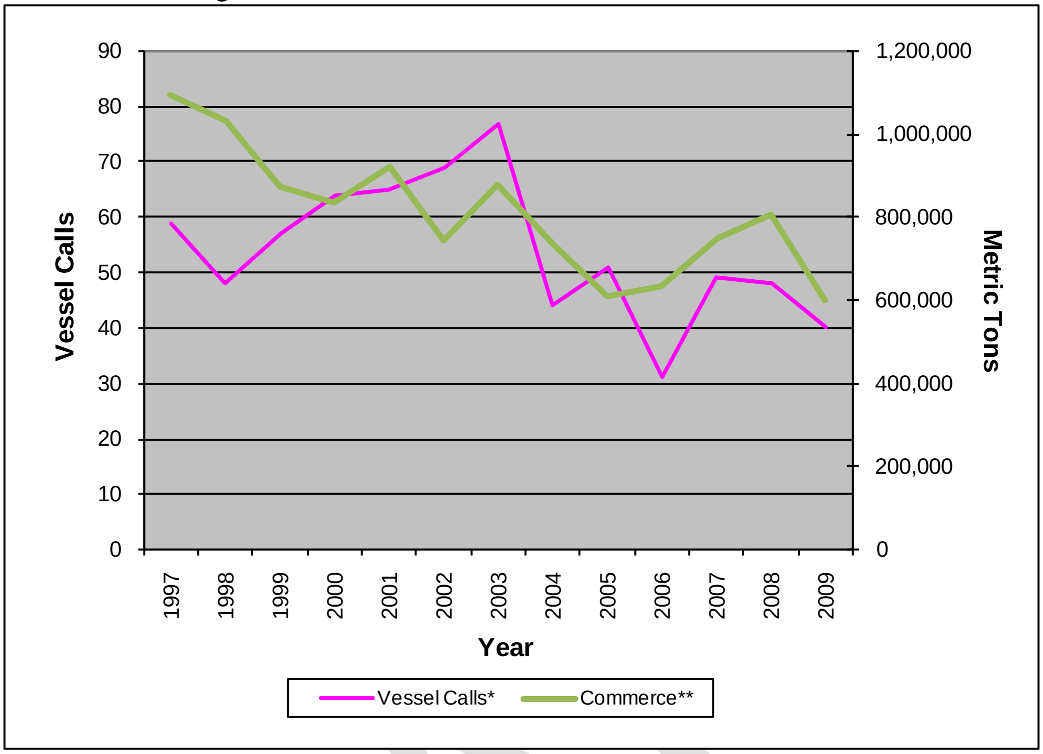
The allowable maximum transit drafts for vessels coming to and from the POWS were assumed to be 30'' and 30.6' for outbound and inbound vessels, respectively, based upon information received from the Bar Pilots. The differing maximum drafts were used to determine the amount of average lightloading across vessel classes and at incremental channel depths; the two key parameters in the calculation of transportation cost savings at different project increments. Because of the discrepancy between inbound and outbound maximum allowable drafts, inbound and outbound shipments of identical cargos would be expected to have different savings per ton, ceteris paribus. Tables 44 and 45 in Addendums 2 and 3 contain examples of total movement cost and savings per ton calculations, illustrating how tidal delays and underkeel clearance were factored into this analysis.

4. Historical Commodity Movements through the Port

The Port of West Sacramento imports and exports bulk and break bulk cargo. Bulk goods are those shipped loose and unprocessed (e.g. loose rice), while break bulk cargo includes packaged goods and project cargo (e.g. bagged rice and windmill turbines). The majority of cargo moving through the Port from 1996 through 2009 consisted of rice, cement, wood products, steel, fertilizer, and power generating equipment. Asia and Europe are the regions that traded most heavily with the Port during this time period.

The Port experienced an overall downward trend in business from 2002 through 2006, with 2006 marking its lowest point before a turn-around reflected in an increase of throughput in 2007 and 2008. The global recession that began in December 2007 resulted in a lull in activity at the Port so that overall import and export numbers in 2009 once again declined. However, the 2009 dip in movement at the Port reflects the economic contraction taking place worldwide during 2008 and 2009, whereas the downturn from 2002 through 2006 was unique to happenings at the Port. Regardless, positive growth in both 2007 and 2008 combined with several new commodities expected to start shipping through the POWS in the next few years indicate a potential return of activity to the Port following its 2002 through 2006 slump. Figure 3 illustrates business activity from 1997 through 2009, with total tons of cargo on the right axis and total vessel calls on the left axis.

Figure 3: Commerce and Vessel Calls - 1997 to 2009



Source: *Vessel and tonnage data provided by POWS; **Commerce totals for years 1997 through 2005 does not include Urea and Anhydrous Ammonia imports

Having originally positioned itself as an agriculture-centric port, many of the commodities moving through the Port of West Sacramento have historically included agricultural goods such as grains, lumber, and fertilizer. Tables 1 through 3 summarize the annual tonnages of the top 15 commodities that came to and from the Port between 1988 and June 2009, representing the most complete data available. As evidenced by the data, the majority of the fifteen major commodities that have historically shipped through the Port no longer do. However, these tables are intended to provide a general snapshot of activity at the Port over the last two decades. Of the top fifteen historical commodities, the goods that have stopped shipping through the POWS include: clay, sand, fiberboard, wheat, safflower, lumber, and wood chips.

Those commodities that have moved through West Sacramento in the past and continued to do so through 2009 (rice, fertilizer, cement, and power generating equipment) are included in bold. Each of these currently relevant commodities is discussed in more detail in the pages that follow. Figure 4 shows the historical tonnages associated with four of the important commodities that are currently still moving through the Port and are expected to in the future.

Table 1: Commodities in Metric Tons - 1988 through 1994[19]

Commodity	1988	1989	1990	1991	1992	1993	1994
Wind Turbines	0	0	0	0	0	0	0
Clay	0	0	0	0	0	35,795	25,403
Sand	0	0	0	0	0	0	0
Fiberboard	0	0	0	0	0	0	0
Wheat/Corn Storage	0	0	0	0	0	0	0
Aggregates	0	0	0	0	0	0	0
Safflower	0	0	0	60,700	18,785	51,496	44,197
Anhydrous Ammonia	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Urea	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Cement	0	0	0	0	0	0	0
Wheat	119,263	263,978	205,504	23,149	151,899	101,079	161,558
All Lumber	18,797	209,810	280,125	301,057	162,243	73,816	115,343
Fertilizer	160,320	178,981	206,852	134,746	147,591	171,169	153,088
Wood Chips	220,145	158,311	175,866	284,987	432,583	395,276	315,495
Rice	521,532	361,185	304,694	222,396	222,799	263,490	478,238
Fiscal Year Total	1,112,435	1,307,955	1,269,564	1,123,823	1,224,092	1,126,127	1,368,431

Table 2: Commodities in Metric Tons - 1995 through 2001

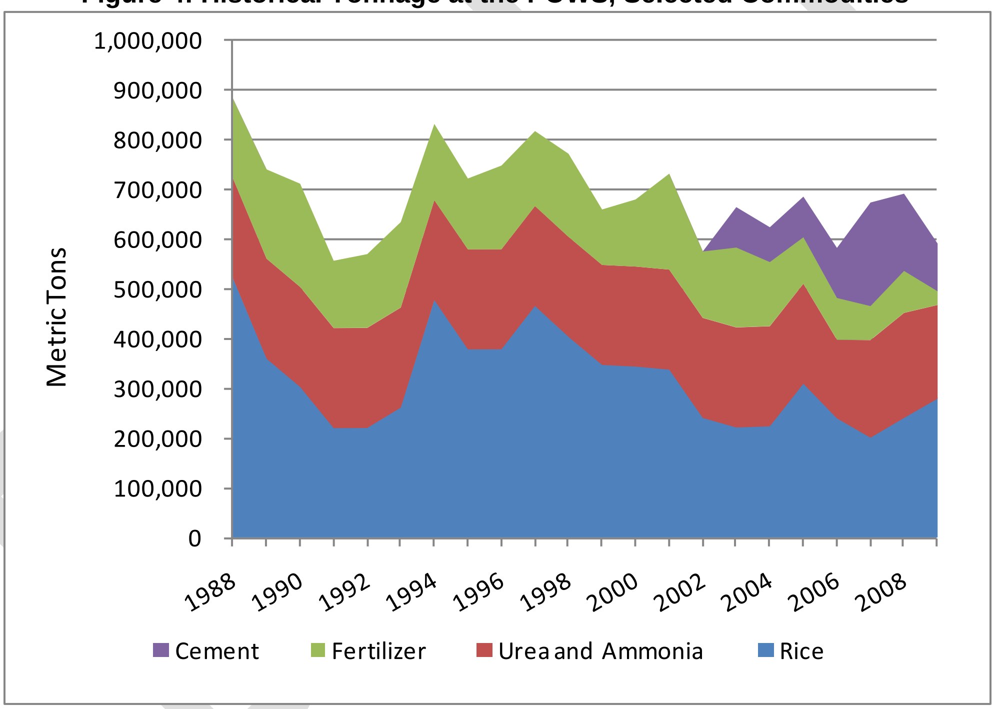
Commodity	1995	1996	1997	1998	1999	2000	2001
Wind Turbines	0	0	0	0	0	0	0
Clay	38,384	20,447	6,062	5,785	0	0	0
Sand	7,408	35,186	46,263	38,891	18,519	0	0
Fiberboard	0	0	0	0	0	0	10,187
Wheat/Corn Storage	10,367	34,169	4,246	46,650	22,983	4,509	0
Aggregates	0	0	0	0	0	0	0
Safflower	29,474	17,361	22,930	27,377	30,148	39,631	20,924
Anhydrous Ammonia	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Urea	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Cement	0	0	0	0	0	0	0
Wheat	95,477	41,273	48,666	29,762	27,558	0	41,887
All Lumber	22,078	59,078	69,419	31,746	12,189	6,314	22,518
Fertilizer	142,042	167,800	150,450	166,656	111,198	134,522	192,204
Wood Chips	266,165	369,472	276,874	276,387	224,192	226,111	253,386
Rice	379,895	380,033	466,543	404,857	348,701	345,481	339,379
Fiscal Year Total	1,009,403	1,154,288	1,091,495	1,032,620	871,826	833,421	922,081

[19] Data in Tables 1, 2, and 3 is from the Port of West Sacramento; fiscal year totals include commodities not listed, do not include Ammonia and Urea for years 1988-2005 as data is unavailable. 2000 Ammonia and Urea tonnages are estimates.

Table 3: Commodity Tonnage - 2002 through 2009

Commodity	2002	2003	2004	2005	2006	2007	2008	2009*
Wind Turbines	0	25,725	0	0	3,393	0	22,561	5,028
Clay	0	0	0	0	0	0	0	0
Sand	0	0	0	0	0	0	0	0
Fiberboard	23,327	21,982	35,459	33,034	23,832	11,409	0	0
Wheat/Corn Storage	0	31,145	0	0	0	15,657	2,325	0
Aggregates	81,853	53,674	115,290	0	0	0	89,340	0
Safflower	10,862	36,628	0	0	0	0	0	0
Anhydrous Ammonia	n/a	n/a	n/a	n/a	57,100	66,800	65,700	63,200
Urea	n/a	n/a	n/a	n/a	100,155	129,900	143,900	124,652
Cement	0	80,842	69,655	81,323	100,155	207,025	154,411	95,313
Wheat	29,763	4,409	13,570	0	0	0	0	0
All Lumber	65,701	70,146	26,375	22,637	15,743	5,784	0	0
Fertilizer	133,614	160,614	129,179	93,743	84,587	68,976	84,763	28,291
Wood Chips	147,225	159,237	109,365	51,361	0	0	0	0
Rice	242,805	223,688	226,112	311,061	241,918	203,321	242,805	281,309
Fiscal Year Total	745,052	878,803	736,117	607,678	634,916	749,677	804,846	597,792

Figure 4: Historical Tonnage at the POWS, Selected Commodities



- **Rice**

  The amount of rice shipping through the Port has remained relatively stable over the past 20 years, with an average yearly tonnage around 320,000 metric tons (MT). Nearly all rice shipping from the POWS is exported to Japan, where import facility constraints limit the size of individual shipments to just under 13,000 MT. For that reason, most of the rice shipped from the Port leaves in shipments of 13,000 MT, which do not require a vessel to load to full capacity and use more than 30’ of project depth. A small number of shipments of rice have also gone to South Korea, where the same import facility constraint limits the size of individual shipments (to 20,000 MT), which, again, do not require depth beyond the existing project depth.

Therefore, in the absence of changes at the Japanese or South Korean facilities, rice shipments out of the POWS will not incur transportation cost savings as a result of a channel deepening project. Regardless, rice has been and will remain a constant and important source of business for the Port.

Table 4 contains data from the Port of West Sacramento on rice shipments between 1988 and 2009. As indicated above, rice shipments over the 21-year period have been relatively constant, fluctuating between about 200,000 MT in the leanest business years and 520,000 MT in the Port's busiest year for rice exports.

Table 4: Rice Tonnage - 1988 to 2009

Year	Metric Tons	Year	Metric Tons
1988	521,532	1999	348,701
1989	361,185	2000	345,481
1990	304,694	2001	339,379
1991	222,396	2002	242,805
1992	222,799	2003	223,688
1993	263,490	2004	226,112
1994	478,238	2005	311,061
1995	379,895	2006	241,918
1996	380,033	2007	203,321
1997	466,543	2008	242,805
1998	404,857	2009	281,309

Source: Port of West Sacramento; complete through end of 2009

- **Fertilizer, Anhydrous Ammonia and Urea**

In the context of this analysis, when referring to "fertilizer" imports, "urea" and "ammonia" imports should be considered as separate commodities. Finished product bulk and bagged fertilizer imports have a very different historical record and future forecast than urea and ammonia imports. The following discusses historical fertilizer, urea, and ammonia import tonnages, while Section 5 addresses their projections.

The Port imported dry bulk and bagged fertilizer for over 20 years, with average throughput totaling more than 135,000 MT annually. Fertilizer imports began to decline in the early 2000s and have dropped off steadily since 2003, reaching the lowest level of less than 30,000 MT in 2009. Table 5 below contains the fertilizer data provided by the Port. Because the Port's main fertilizer importer relocated away from POWS in 2010, bulk and bagged fertilizer will not factor into the analysis of the future without-project condition.

Table 5: Fertilizer Tonnage - 1988 to 2009

Year	Metric Tons	Year	Metric Tons
1988	160,320	1999	111,198
1989	178,981	2000	134,522
1990	206,852	2001	192,204
1991	134,746	2002	133,614
1992	147,591	2003	160,614
1993	171,169	2004	129,179
1994	153,088	2005	93,743
1995	142,042	2006	84,587
1996	167,800	2007	68,976
1997	150,450	2008	84,763
1998	166,656	2009	28,291

Source: Port of West Sacramento; complete through end of 2009

In addition to the fertilizer imported by the Port, an independent operator has imported urea and anhydrous ammonia for the production of fertilizer since 1982; these commodities continue to ship to the Port and are forecasted to continue doing so throughout the period of analysis. Table 6 shows the amounts of urea and anhydrous ammonia that were imported in the years 2006 through 2008, which are the only years for which data is available. According to the importers at the Port, these years of data are a good representation of the volumes of urea and ammonia that have been coming to the Port since 1982, as the tonnages of each have been roughly the same from year to year. Urea is shipped on dry bulk carriers, while liquid anhydrous ammonia arrives at the Port in tankers.

Table 6: Urea and Anhydrous Ammonia Tonnage - 2006 to 2008

Urea		Anhydrous Ammonia	
Year	Metric Tons	Year	Metric Tons
2006	100,155	2006	57,100
2007	129,900	2007	66,800
2008	143,900	2008	65,700

Source: Importers

- **Cement and Aggregates**

The Port started receiving cement imports in 2003. Given the relatively few years of data for cement imports, it is not possible to establish a growth trend based upon Port data alone. It is safe to say, however, that cement imports increased overall from 2003 to 2008 before a contracting economy negatively affected international trade. Additionally, a new cement importer has come on line at the Port since the 2003 through 2009 data was compiled, representing an eventual source of growth in imports that will be reflected in the forecasts discussed in Section 5. Table 7 provides the cement data currently available. It should be noted that 2009 tonnages are lower than those of the previous few years due to the recent recession.

Table 7: Cement Tonnage - 2003 to 2009

Year	Metric Tons
2003	80,842
2004	69,655
2005	81,323
2006	100,155
2007	207,025
2008	154,411
2009	95,313

Source: POWS; complete through end of 2009

- **Power Generating Equipment**
  The importation of wind power generating equipment to the Port began in 2003. For the years that data on windmill shipments is available, tonnages have ranged from less than 3,500 MT to greater than 25,000 MT, with no discernible trend in growth. Table 8 contains this data.

Table 8: Power Generating Equipment - 2003 to 2009

Year	Metric Tons
2002	0
2003	25,725
2004	0
2005	0
2006	3,393
2007	0
2008	22,561
2009	5,028

Source: POWS; complete through the end of 2008

The amount of windmill equipment that can fit on a vessel is not heavy enough to cause the vessel to require more depth, indicating that a deeper channel will not lead to transportation cost savings in the shipment of wind power generating equipment. As with rice, due to the lack of a need for greater channel depth in the shipment of this commodity, power generating equipment is not considered in the benefit analysis.

5. Future Commodity Movements through the Port

As discussed above, rice, fertilizer, urea, anhydrous ammonia, cement, and power generating equipment are the recent historical commodities moving through the Port; all of these goods, with the exception of fertilizer, are forecasted to continue moving through the Port into the foreseeable future. Additionally, at least four new commodities are expected to begin moving through the Port between now and 2016, which is the project base year[20] for a 35' channel deepening. The project base year varies among the alternative channel depths due to differing lengths of the construction period. The new commodities expected at the POWS are: bio-fuels, wood pellets, slag, and recycled metal. The future movement of each of these commodities is discussed in detail below. Rice and power generating equipment have been excluded from the forecast of future commodity traffic due to the aforementioned lack of benefits realized in the shipment of these two goods due to a channel deepening.

Forecasts of future commodity movements to and from the Port relied on different sources of data and information, dependent upon resources available and commodity specific history at the Port. For those businesses that have yet to go on line in West Sacramento, the use of growth trends over the years was not always possible in projecting future growth rates because some of these industries are not only new to West Sacramento, but relatively new both nationally and globally. Conversations with importers and exporters of specific goods that have yet to start using the Port, but have – importantly – reached contractual agreement to start doing so within the next couple of years, and industry-wide data were used to establish expected initial tonnages of these goods. Growth rates were established using independent, commodity specific studies and IHS Global Insight forecasts. Growth rates and sources will be addressed more thoroughly in the subsequent section, discussing each commodity and its projected movement. Consistent with Corps guidance, and due in large part to the uncertainty inherent in forecasting far into the future, commodity growth rates were estimated for twenty years beyond the base year, and beyond that point all volumes were simply held constant (zero growth beyond 2035).

Corps guidance also requires that a sensitivity analysis be conducted in the forecasting of future commodity movements. For each good expected to ship to or from the Port through the period of analysis, a sensitivity analysis was conducted in order to assess three possible future growth scenarios: a low-growth scenario, the most likely scenario, and a high-growth scenario. The forecasts presented in this section of the report represent what the Corps analysts have deemed to be the most likely future scenario for commodities moving through the Port. In order to carry out the NED analysis, it was necessary to identify the most likely future condition in order to complete a benefit-cost analysis with a definitive conclusion. For that reason, commodity sensitivity analyses are discussed distinctly from the forecasts presented below. Sensitivity analyses can be found in Section 6 of this report.

[20] 'Base year' is defined as the most likely year that benefits of a Federal project will begin to accrue. In this case the benefits will only begin accruing once the deepening project is physically complete.

5.1. Commodities Analysis

- **Anhydrous Ammonia and Urea**

  A single business with facilities at the Port has independently imported anhydrous ammonia (ammonia) and urea as inputs to the production of fertilizer since 1982. Unlike finished-product fertilizer imports, annual import volumes of both ammonia and urea to the Port of West Sacramento have been roughly the same for over 25 years. Urea and ammonia imports originate in South America, Europe, India and Southeast Asia and are distributed throughout California's Central Valley farming region.

  Shippers of ammonia and urea only provided three years (2006-2008) of import data for this study. Upon request for more data, they informed the Corps economists that the three years provided are very representative of the volumes of each good that have come to the Port since 1982 and declined to furnish additional data, indicating that current and future tonnages can be expected to be roughly the same.

  This study's forecasts of future ammonia and urea imports are dependent upon the United States Department of Agriculture (USDA) data and the local importer's indication that import volumes to the facilities at the POWS have remained stable since 1982.

  Using a previous USACE navigation study[21] as a methodological guide, a base tonnage was derived from the weighted average of import volumes from 2006-2008[22]. This approach generated estimates of 2009 import tonnages of anhydrous ammonia and urea equal to 63,200 MT and 124,652 MT, respectively. Considering the trend indicated by importers at the Port, a 0% growth rate has been assumed for this forecast, signifying a constant volume of ammonia and urea imports into the foreseeable future. Table 9 below summarizes the ammonia and urea projections derived.

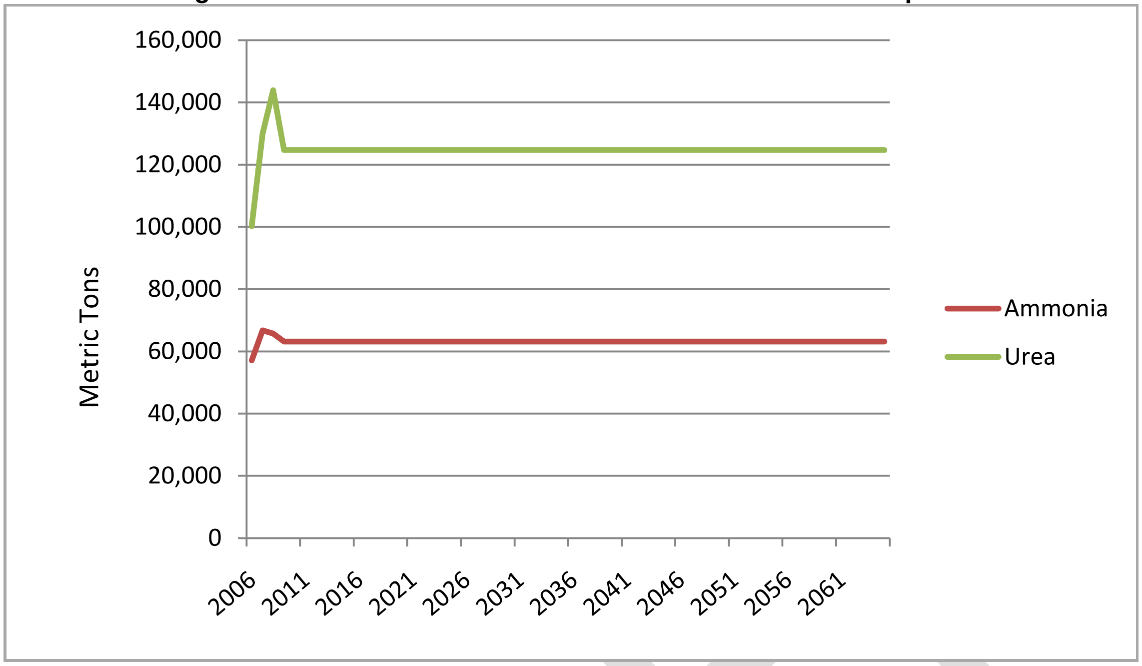
Table 9: Forecasted Ammonia and Urea Imports

Anhydrous Ammonia		Urea	
Year	**Metric Tons**	**Year**	**Metric Tons**
2010	63,200	2010	124,652
2016	**63,200**	**2016**	**124,652**
2021	63,200	2021	124,652
2026	63,200	2026	124,652
2036	63,200	2036	124,652
2065	63,200	2065	124,652

[21] IWR. *Savannah Harbor Expansion Project, Transportation Cost and Savings Model: Model Documentation*. 22 October 2009.

[22] The average was weighted 50% for the most recent year of data (2008), and 30% and 20% for 2007 and 2006, respectively.

Figure 5: Historical and Forecasted Urea and Ammonia Imports

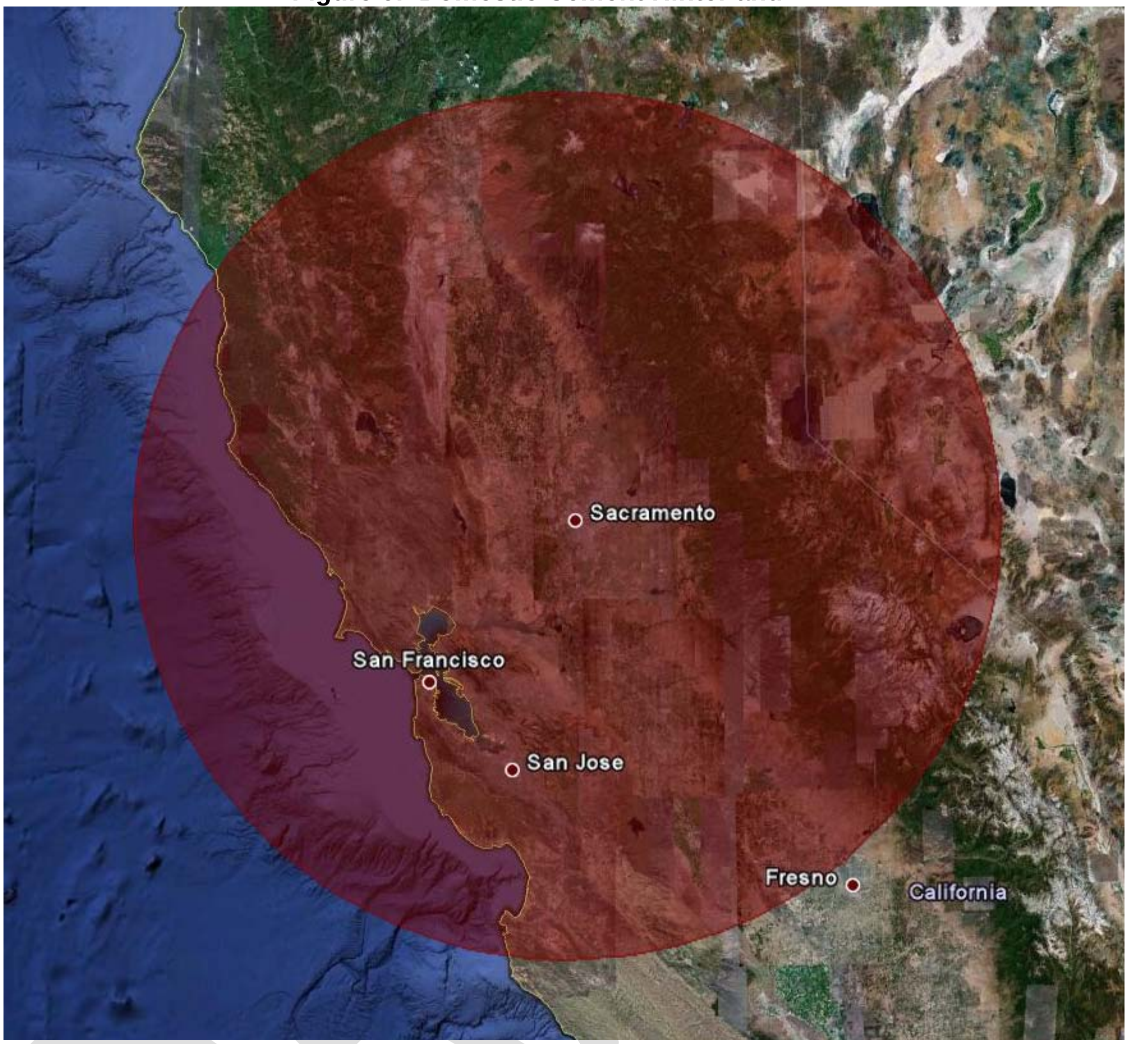


- **Cement and Aggregates**

  Cement imports to the Port began in 2003. Imported from China, a portion of the cement arriving at the Port is mixed for use on site and distributed to the local region. As discussed in the multiport analysis section of this report, the mixing of cement and aggregates to form concrete limits the number of miles the product can travel. Therefore the domestic distribution network for mixed concrete covers an area within a fifty mile radius of the Port. The domestic hinterland for the other dry bulk cement products expected at the Port spans an area within a 150 mile radius. Forty-two counties, with a total population of over 13 million people, lie within the bulk cement distribution area.[23] Figure 6 displays the domestic hinterland for cement imports to the POWS and highlights the major cities lying within the area of distribution. Though it does not appear on the map, Reno, NV also falls within the domestic cement hinterland.

[23] California State Association of Counties, 2009.

Figure 6: Domestic Cement Hinterland



As with all of the cargo imported at the POWS, cement products are not expected to be distributed beyond the Sacramento and Northern California region.

Since cement imports first arrived at the Port in 2003, annual tonnages have fluctuated between 70,000 MT and 200,000 MT annually. An estimate of 2010 import volumes was derived by applying a yearly growth rate of 2.5% to the 2009 import tonnage of 95,313 MT. Using this methodology, the 2010 volume expected in Sacramento equals approximately 97,700 MT.

For the determination of the rate of growth of cement imports, a range of historical annual growth rates was first established. These growth rates were arrived at using 100 years of cement consumption data from the U.S. Geological Survey (USGS) and input from cement industry representatives specific to the Port of West Sacramento. USGS data indicates that the average national historical growth rate of cement consumption ranges from 3.7 to 4.3%.[24] In order to confirm this growth rate at the regional level, discussions with local industry representatives were conducted. Industry representatives indicated that annual cement imports have historically

[24] USGS, Cement Statistics, November 2009

grown by between 3 and 4.5% per year. With the USGS national rates falling within this range, the initial best approximation of an annual rate used in the forecast of cement imports to the Port of West Sacramento was an average of the minimum and maximum cited by industry representatives, which yields an annual growth rate of 3.75%.

In order to better understand how realistic this growth rate is for application to a twenty-year growth forecast, IHS Global Insight projections of stone, clay, and other crude mineral imports to the Pacific Northwest were considered to serve as a proxy for projected cement import growth. According to IHS Global Insight estimates, stone, clay, and other crude mineral imports will increase between 2% and 6% over the next four years before leveling off at 1% through 2028.[25] Because these rates average to less than the 3.75% annual growth rate originally considered, an average of the IHS Global Insight and industry data has been used in this analysis to represent the most likely future rate of growth for cement imports to the POWS, resulting in projected annual growth around 2.5%.

The application of a growth rate to the 2010 cement import tonnage of 97,700 MT alone, as discussed above, does not accurately reflect the most-likely future conditions for cement imports to the Port. A new cement facility recently constructed at the Port, which currently sits idle and expects to begin importing cement and aggregates in 2012, will provide a boost in import amounts that is significant to the POWS and cement forecasts in this study. The owner of this plant also owns a cement production and distribution facility in Southern California, and has indicated that imports to the POWS will commence once their domestic production capacity has been reached – when the Southern California facility is operating at full capacity. According to representatives of this facility the minimum amount that the facility will import to POWS on an annual basis is 100,000 MT of cement and aggregates.

To give an idea of how much 100,000 MT of cement and aggregates represents relative to statewide consumption of cement and concrete, data from the Portland Cement Association (PCA) was evaluated. The most recent year for which PCA had a cement consumption profile for California was 2007. After having peaked in 2005, cement and concrete consumption fell by 6.6% in 2006 and another 13.6% in 2007. The numbers for 2007 therefore represent cement consumption in a contracting market. During that year, Californians consumed over 12.3 million MT of cement and 54.4 million MT of concrete. State cement production capacity fell just below consumption at 12.1 million MT in 2007[26], indicating that consumption would have to total about what it did in 2007 for demand to require imports from foreign sources (concrete capacity figures are unavailable). Given these numbers, the 100,000 MT annual minimum required for operation of this facility at the POWS represents about .125% of total state consumption in a year in which state capacity has just been met; in other words, even in a contracting or low growth economy, the amount expected to import to the POWS does not represent a proportion so large as to be unrealistic.

Importantly, before the recession, the company expected that imports to the POWS would have already begun. However, domestic demand for cement fell to the point that this distributor has not required foreign cement imports to supplement the domestic supply in order to meet demand. Once the economy rebounds and demand for cement returns, importation will begin at

[25] IHS Global Insight, US North Pacific Region Seaborne Trade Forecast, December 2009
[26] PCA Economic Research, Summary of Cement Based Products Industry Statistics for California, December 2009

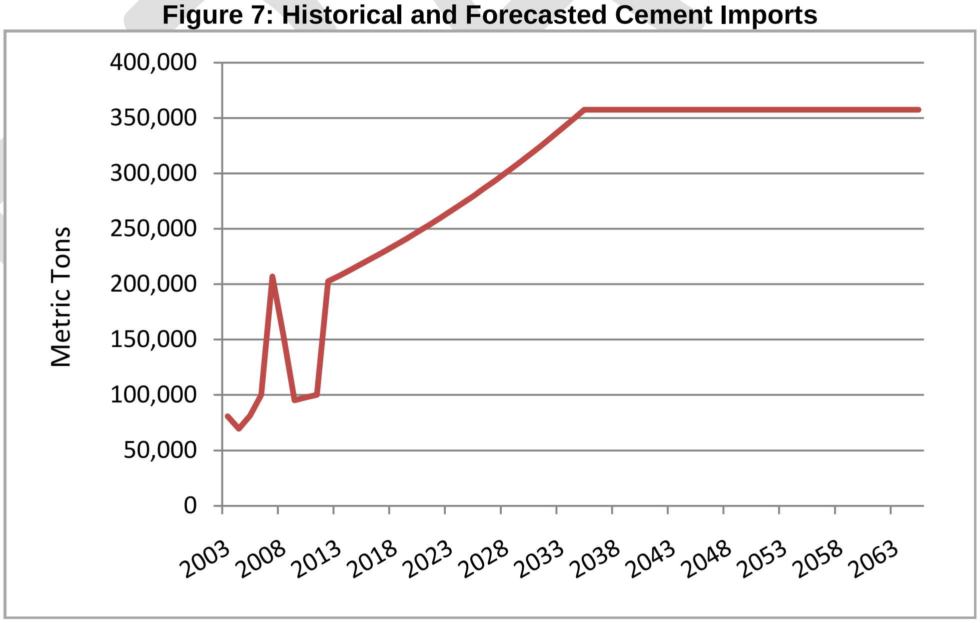
the POWS facility in the amount of at least 100,000 MT annually, which would place cement imports in 2016 just slightly higher than their 2007 level, before the economy began to contract. As is the case for all of the forecasted new commodities at the Port, there is a lot of uncertainty around when the West Sacramento facility will begin operating. This uncertainty is important to recognize and is, therefore, addressed in the sensitivity analysis of the cement forecast.

Table 10 contains the cement forecast derived for this analysis that is considered to represent the most likely future scenario. This forecast assumes that the facility begins importing its minimum amount in 2012, which is the year IHS Global Insight projects the U.S. economy to return to a pre-recession annual growth rate exceeding 4%.[27]. The forecast presented in Table 10 assumes a 2.5% annual growth rate.

Table 10: Forecasted Cement Imports

Cement	
Year	**Metric Tons**
2010	97,696
2016	**223,678**
2021	253,072
2026	286,327
2036	357,584
2065	357,584

Figure 7: Historical and Forecasted Cement Imports



[27] IHS Global Insight. Long-term U.S. Economic Forecast. August 2009.

- **Biofuels**

  Construction of a new alternative fuels facility at the Port is expected to begin in 2010, and to be completed for full operation by the end of 2011. All permits for the construction and operation of this facility have been obtained, including a conditional use permit and the completion and approval of a CEQA Mitigation Negative Declaration. The operators and owners of the facility have already signed a long-term lease for the Port land on which they are permitted to construct.[28]

  Sugarcane-based ethanol and biodiesel will be shipped to the facility from South America's east coast. From the POWS, the ethanol and biodiesel will be trucked to blending facilities owned by oil companies, where they will be combined with traditional gasoline and diesel fuels to produce blended fuels that will meet California's strict carbon regulations. The blending facilities most likely to receive the raw materials are located in Reno, Chico, and Fresno. Once combined, the fuels will be sold at retail locations throughout Northern and Central California. The total market area to be served by the blending facilities will be California's Central Valley, which spans from Bakersfield to the Northern California border and into Western Nevada. The primary distribution area in California covers about 81,000 square miles and is represented by the red shaded area in Figure 8.

[28] Source: Port of West Sacramento

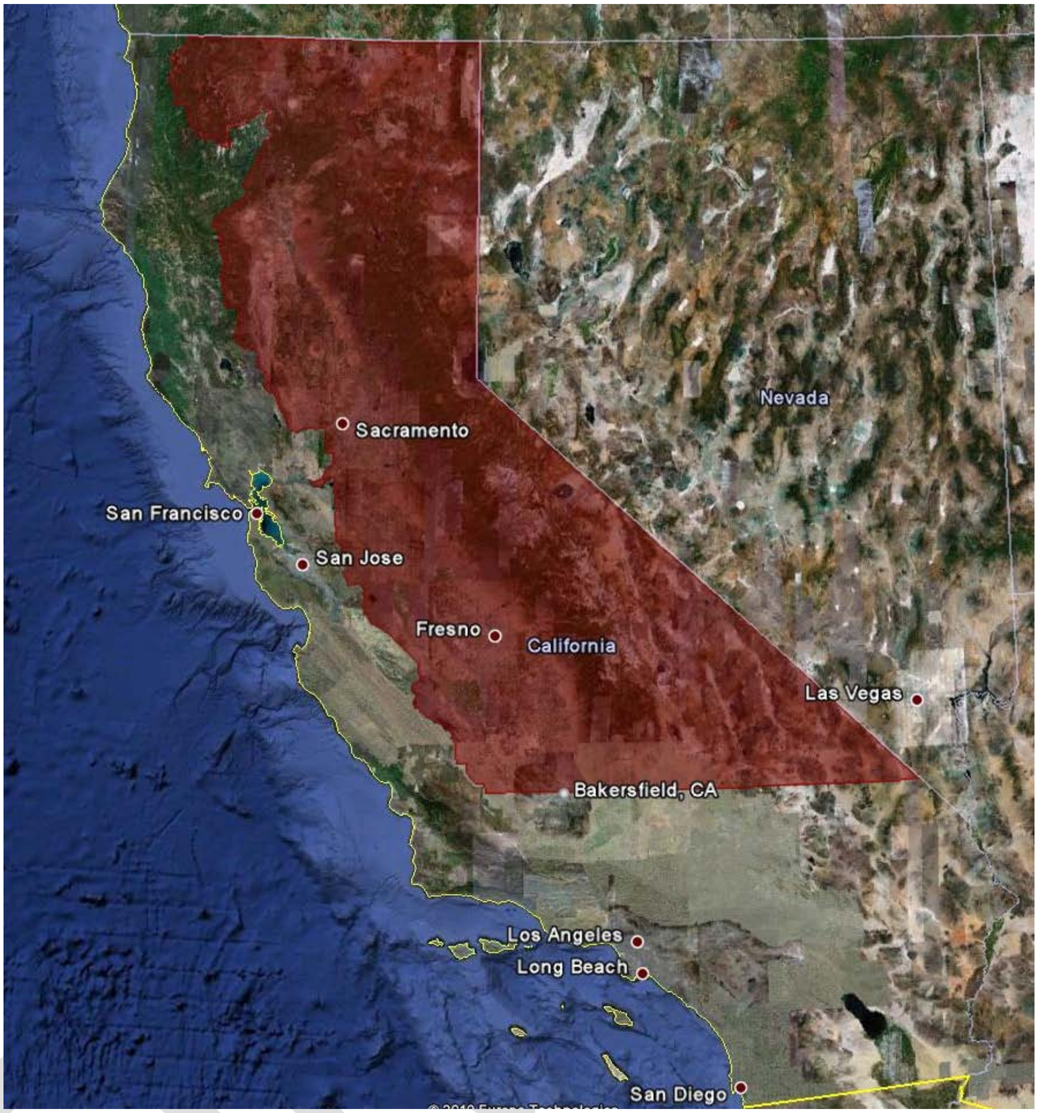


Figure 8: Biofuels Domestic Hinterland

Current permitting of the biofuels production facility allows for a maximum of 540,000 tons of throughput per year. The biofuel producers expect that the facility's first year of operation, anticipated to be 2012, will result in the importation of roughly half of the total currently permitted capacity, or 270,000 MT. This amount represents the initial tonnage from which the biofuels future forecast is based.

For the deepening benefit analysis, forecasts of biofuel growth derived in a University of California (UC) study[29] were used to help forecast import tonnages of biofuel inputs for use at the Port through the period of analysis.[30] The UC study forecasted three ethanol demand scenarios:

1) A continuation of current 5.7% statewide average (known as E5.7),

[29] Gildart, M.C., B.M. Jenkins, and R.B. Williams. *California Biofuel Goals and Production Potential*. European Biomass Conference and Exhibition, 7-11 May 2007.

[30] According to a conversation with a representative from IHS Global Insight, there are currently no reports available that contain relevant forecasts of biofuel demand.

2) A 10% Renewable Fuel Standard (RFS), which assumes some combination of ethanol-gasoline blends such that the overall average is E10, and
3) A 20% RFS (E20 overall average).

The same approach for forecasting ethanol demand statewide was used for the forecast of statewide biodiesel demand, using renewable blend scenarios of 2%, 5%, and 20% (B2, B5, and B20) respectively.

Using an average of gasoline and diesel demand projections, the study forecasted statewide biofuels demand for each scenario. Table 11 below shows the study's demand forecasts through 2050. The units of measure used in the forecasts of ethanol and biodiesel demand are gigalitres (Gl y^{-1}); one gigalitre is the equivalent of 274,172,052 gallons.

Table 11: University of California Forecasts - Ethanol and Biodiesel Demand (Gigalitres)

Ethanol - Statewide Demand				Biodiesel - Statewide Demand			
Year	**E5.7**	**E10**	**E20**	**Year**	**B2**	**B5**	**B20**
2010	3.5	6.2	12.8	**2010**	0.05	0.12	0.49
2020	3.7	6.5	13.5	**2020**	0.13	0.33	1.3
2050	4.4	7.9	16.4	**2050**	0.56	1.41	5.65

Currently, nearly all gasoline in California contains 5.7% ethanol, which is represented by the E5.7 demand forecast. Given California's Low Carbon Fuel Standard, which calls for the reduction of the carbon intensity of the State's passenger vehicles by at least 10% by the year 2020, demand for alternative fuels in California will likely change between the scenarios depicted in Table 11. In other words, because the State is currently operating under scenario E5.7 conditions, and because fuel standards are calling for further reductions in carbon intensity, it is likely that the scenario will shift to E10 by 2020 and, potentially, E20 by the year 2050. Therefore, changes in demand for ethanol and biodiesel, for this analysis, assume a shift towards fuel combinations containing greater percentages of renewable components (ethanol and biodiesel) over time.

A 2007 report by the California Energy Commission entitled '*Transportation Energy Forecasts for the 2007 Integrated Policy Report*' forecasts the volume of ethanol imports that will be demanded in California at year 2012, 2015, and 2025. According to the report:

> "California ethanol demand is forecast to increase primarily from revisions to California's gasoline regulations and other efforts to increase the use of alternative fuels. Staff believes the majority of California's gasoline market will contain E-10 by 2012. As such, ethanol demand in the state is forecast to increase from 951 million gallons in 2006 to approximately 1.68 billion gallons in 2012 (under the Base Case gasoline demand scenario), a 77% increase. The additional imports needed to meet this anticipated growth will depend on how many additional California ethanol production facilities are constructed over the next couple of years."[31]

The report goes on to calculate that, given their estimates of the ethanol production capability of the state in the near future, under the base case scenario the State will need to import

[31] Can be found on page 52 of the report

approximately 500 million gallons per year to meet demand. Much of this demand is expected to be met by additional rail car imports from the Midwest, but under the base case scenario where the additional future import demand is met by marine vessels, the annual additional number of 35,000 MT tankers needed to bring in this amount of ethanol would be greater than 400. The report does not speak to which California ports are expected to receive the future ethanol imports, but the report does provide support for a forecast of a significant increase in ethanol demand and ethanol imports. The report summarizes some of its findings with the following: "The forecasts and analysis indicate a growing need for expanded import infrastructure, particularly marine import facilities, to offset declining in-state oil production and growing demand in California, Nevada, and Arizona for transportation fuels." Additionally, of the 1.68 billion gallons of ethanol demand expected in the state in 2012, over 300 million gallons of that is expected to be required by California's Central Valley, the area to be served by the POWS facility.[32]

A shift in the State RFS equal to the UC forecast would imply a range of annual growth rates of biofuel input imports between 8.6% and 16% until 2020, and 5.1% and 11% from 2020 to 2050. Given the uncertainty of the future demand, the potential transportation cost savings were calculated using the lower bounds of the ranges – 8.6% growth until 2020 and 5.1% growth until 2035. As with all other commodities included in this analysis, tonnages are held constant beyond year twenty of the period of analysis.

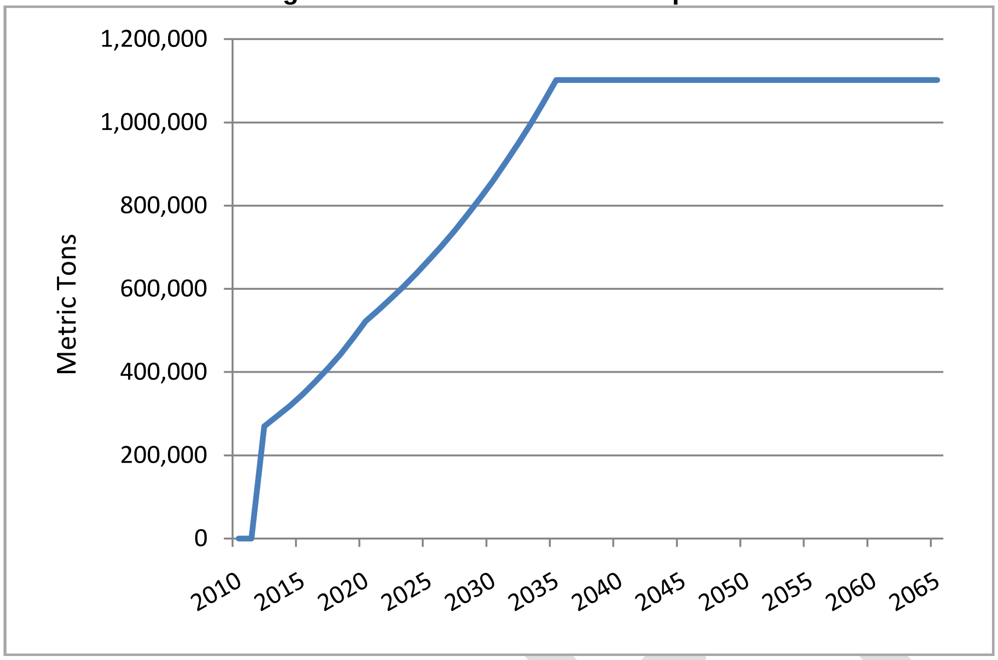
An additional consideration for this commodity is that the new biofuel facility is currently only permitted to import 540,000 MT per year. According to the forecasts, this would mean that biofuel import growth would stop in 2021. Because a decrease in carbon intensity has been mandated by the State and is driving the increased demand for biofuels, strict limits on the importation of fuels that will help to meet these standards seem unlikely. Therefore, this analysis assumes that the most-likely scenario for biofuel imports to the POWS will be a re-permitting of the biofuels facility to allow annual import tonnages beyond the current maximum. Table 12 and Figure 9 below display the projection of biofuel imports to the Port through the year 2065.

Table 12: Forecasted Biofuel Imports

Biofuels	
Year	**Metric Tons**
2010	0
2016	**375,563**
2021	549,041
2026	704,075
2036	1,101,649
2065	1,101,649

[32] Source: Interview with industry representative setting up operations at the POWS. August 2010.

Figure 9: Forecasted Biofuels Imports



- **Scrap Metal**

  A metal recycling and shredding facility is expected to begin operating at the Port in June 2011. The CEQA approval process for the facility has begun and business operators have engaged in an Exclusive Negotiating Agreement (ENA) with the Port, which required a $200,000 non-refundable deposit, and essentially serves as a placeholder until the official lease has been signed. Additionally, acquisition of all necessary permits for construction and operation is underway.[33]

  The facility will use Northern California's metal waste and grind it into scrap for exportation to the BRIC Countries (Brazil, Russia, India, and China), where it will be used in the production of steel. Currently, only two metal recycling and shredding facilities serve all of Northern California, home to some 20 million residents. For comparison's sake, Texas' population of 24 million is serviced by 20 shredding operations.[34] The 20 counties in the greater Sacramento area that will be served by the facility at the Port have combined populations totaling more than 4.3 million according to 2009 population data[35]. The shaded area in the figure on the following page represents the 20 counties that make up the domestic hinterland for scrap metal. These numbers indicate that a market for scrap recycling exists in the Northern California region, providing support for the viability of this facility and its growth over time as the State's population grows and the global movement towards sustainability continues to encourage recycling among the growing population.

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[33] Source: Port of West Sacramento

[34] *Sacramento Business Journal*. http://sacramento.bizjournals.com/sacramento/stories/2008/10/13/story4.html, 10 October 2008.

[35] California State Association of Counties, http://www.counties.org/default.asp?id=399, 2009.

Figure 10: Scrap Metal Domestic Hinterland

Representatives of the facility stated that a typical cargo is about 32-35,000 MT and that the first year of operation will yield one shipment of this size every six weeks, resulting in an estimated initial tonnage of 270,000. Under current channel constraints, a lightloaded 60,000 DWT bulk vessel would be capable of hauling a shipment of scrap metal of this magnitude from the POWS. A five-foot channel deepening would enable bulk vessels in the 40,000 to 60,000 DWT classes to transport 32-35,000 MT shipments of scrap metal from the Port with less lightloading than is required with the current channel depth.

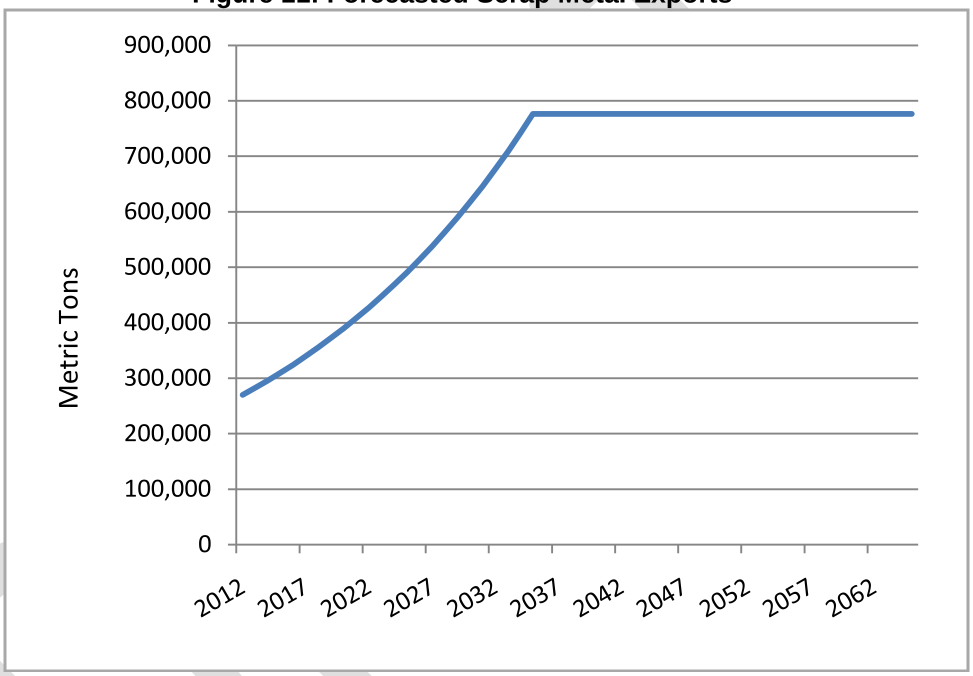
IHS Global Insight provides forecasts of scrap metal exports from the Pacific Northwest through the year 2028. Annual growth rates derived from the Global Insight projections yield an average of 4.7%.[36] For this analysis, in order to forecast scrap metal exports from the Port of West Sacramento to steel-producing BRIC countries, Global Insight's 4.7% annual average growth rate has been applied from 2012 through 2035, after which the tonnage is held constant. Table 13 and Figure 11 display the scrap metal export forecast.

[36] IHS Global Insight, US North Pacific Region Seaborne Trade Forecast, December 2009

Table 13: Forecasted Scrap Metal Exports

Scrap Metal	
Year	**Metric Tons**
2010	0
2016	**324,452**
2021	408,210
2026	513,591
2036	776,493
2065	776,493

Figure 11: Forecasted Scrap Metal Exports



To provide some perspective on the amount of scrap metal forecasted to move through the Port, as of 2008 the amount of recycled metal in the United States totaled over 95 million MT[37]. The growth of exports from POWS to a constant level of 776,493 MT in 2035 represents less than 1% of the total tonnage of recycled metals nationwide in 2008. As the amount of recycled metal is expected to increase significantly by 2035, the percentage of the total exporting from the Port will represent a far smaller proportion than the less than 1% it currently equals. These figures serve as a basis for concluding that the estimates for growth of scrap metal exports through the Port represent both a realistic and conservative trend.

- **Wood Pellets**

  A new wood pellet production plant, the first on the United States' West Coast, is set to begin operations at the Port in 2012. The facility's permit has been approved and the acquisition of air permits is currently in progress. Additionally, an Exclusive Negotiating Agreement with a

[37] Institute of Scrap Recycling Industries, Inc. "Scrap Recycling Industry Facts."

$350,000 non-refundable deposit has been entered into while final lease negotiations take place. Preparation of the CEQA Mitigation Negative Declaration has also begun. Construction is expected to begin in 2011, and the fully operational facility will be completed by 2012.[38]

The facility will use wood waste to produce wood pellets for exportation to Europe and, potentially, Asia. Wood pellets are made from sawdust, shavings, bark, and chips, which are the by-products of wood processing and forest industry activities. The supply source for the wood pellets to be produced at the POWS will be slash piles, consisting of tree tops and limbs left by the logging and timber industry, from the Sierra Foothills and orchard biomass from Central Valley orchards. The timberland wood supply will come from within 60 miles of the facility at the Port (illustrated in Figure 12). Slash piles result from the thinning that government agencies and private forest owners must do to reduce fire risk. The wood collected in slash piles is also known as "white wood." In the past, "white wood" has been dried in biomass electric generating plants, which require a significant amount of burned biomass to generate electricity. Many of the more than 50 biomass electric generating plants in California are being retired and dismantled due to an inability to meet stricter air quality requirements.[39] Because the practice of drying the slash pile wood in biomass generators is becoming less prevalent, but forest thinning continues, a growing supply of "white wood" exists throughout the state for the production of wood pellets.

In California, wildfire prevention measures have led to Federally and State subsidized programs to help forest landowners manage their land and reuse the resulting slash piles and biomass waste in a sustainable fashion. The California Department of Forestry and Fire Protection (CAL FIRE),

> …administers state and federal forestry assistance programs with the goal of reducing wildland fuel loads and improving the health and productivity of private forest lands. California's Forest Improvement Program (CFIP) and other federal programs that CAL FIRE administers, offer cost-share opportunities to assist individual landowners with land management planning, conservation practices to enhance wildlife habitat, and practices to enhance the productivity of the land.[40]

Additionally, upon order from Congress, the USDA established a Biomass Crop Assistance Program (BCAP) in 2008. "BCAP was designed to spur new energy and economic developments in rural America by reducing the financial risk for farmers, ranchers and foresters who invest in the establishment, production, harvest and delivery of biomass crops to displace fossil feedstocks used for biofuels and renewable energy."[41] The different agencies working to ensure wildfire prevention in the State of California, in combination with incentive programs such as the USDA's BCAP, have heavily subsidized the wood pellet input supply in California. The demand for wood pellets in Europe exceeds their forest production capacity, and significant volumes of pellets are shipped from the US and Canadian East Coasts. However, the wood removal for fire prevention that is necessary in California is neither needed nor susbidized on

[38] Source: Port of West Sacramento.
[39] Source: Interview with Industry Representative, August 2010.
[40] http://www.fire.ca.gov/resource_mgt/resource_mgt_forestryassistance.php
[41] Politsch, Kent. "Farmers and Foresters Help Create Biofuels Through BCAP." USDA Farm Service Agency. April 2010.

the East Coast, thus leading to higher overall production costs of east coast pellets, therefore negating what otherwise would have represented a comparative advantage due to location. The relatively cheaper wood pellet production in California and shortage in Europe makes the POWS wood pellets competitive with those produced on the East Coast.

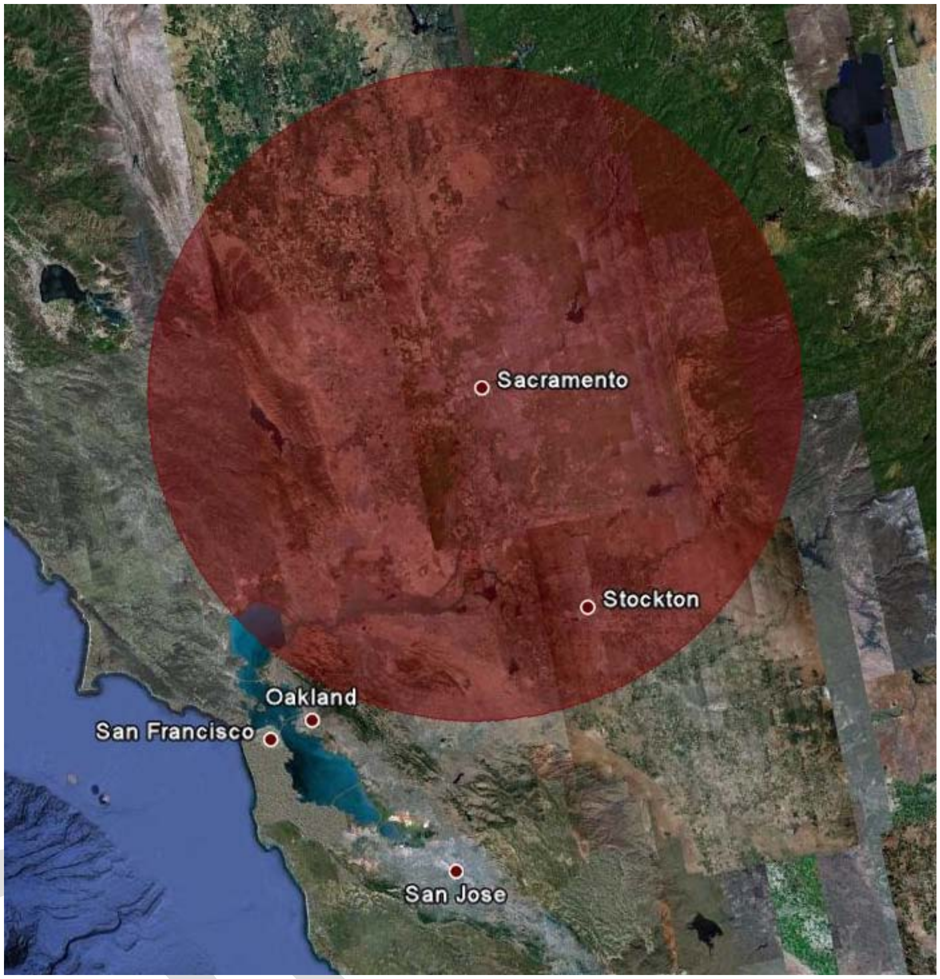


Figure 12: Wood Pellets Domestic Hinterland

For the production of wood pellets, raw materials must be thoroughly dried before further processing. After drying, the materials are ground to a uniform dust and pressed into 6 to 8 millimeter pellets[42]. Once distributed, pellets serve as an environmentally friendly substitute for coal in the regions of importation, which are expected to be mainly European and some Asian countries. World wood pellet demand is driven by compliance with the Kyoto Protocol to reduce greenhouse gas emissions.

The POWS wood pellet facility has a total annual production capacity of 150,000 MT. Representatives stated that there will likely be a 3-6 month "ramp up" period during the first year of operation and total capacity will not be reached until the second year of operation, after which the facility is expected to produce and export at maximum capacity on an annual basis.. Several independent publications have estimated the global wood pellet market to grow at a rate

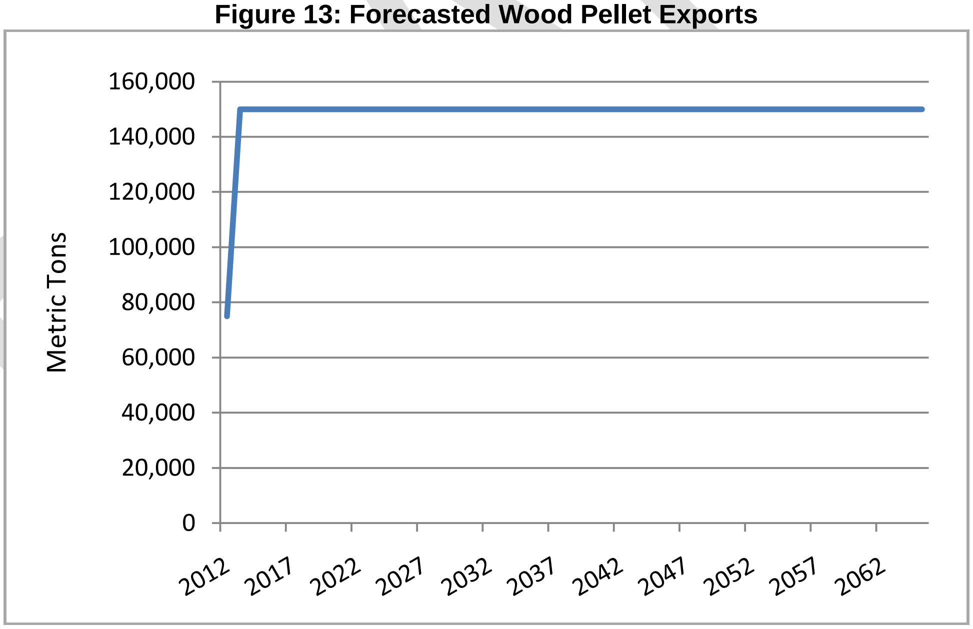
[42] *Global Wood Pellets Market and Industry: Policy Drivers, Market Status, and Raw Material Potential*. IEA Bioenergy Task 40. November 2007.

of between 25% and 30% over the next 5 years[43]; growth rates specific to the European market are expected to average between 8-10%[44]. Given that the POWS facility's wood pellet exports are competitive on both the European and Asian markets, this report's most-likely forecast assumes that the wood pellet facility operates at full capacity from 2013 through the period of analysis, for a yearly tonnage of 150,000 MT. Alternative growth rates are considered in the sensitivity analysis of this commodity's projected annual export tonnages from the Port. Table 14 and Figure 13 display the projected most-likely estimates of wood pellet exports over the period of analysis.

Table 14: Forecasted Wood Pellet Exports

Wood Pellets	
Year	**Metric Tons**
2010	0
2016	**150,000**
2021	150,000
2026	150,000
2036	150,000
2065	150,000

Figure 13: Forecasted Wood Pellet Exports



- **Slag**

The most recent business to consider entering into a contractual agreement with the Port is an importer of raw and crushed slag for the production of an environmentally friendly cement alternative. If the business takes up residence at the Port, slag, which is a byproduct of steel production, will be imported primarily from Asia, though Latin America has been cited as a

[43] Ekstrom, Hakan. "Global Wood Pellet Market 2008." Wood Resources International. February 2009.
[44] *Wood Pellets Lead Biomass Energy Rise*. Carbon Positive. November 2009.

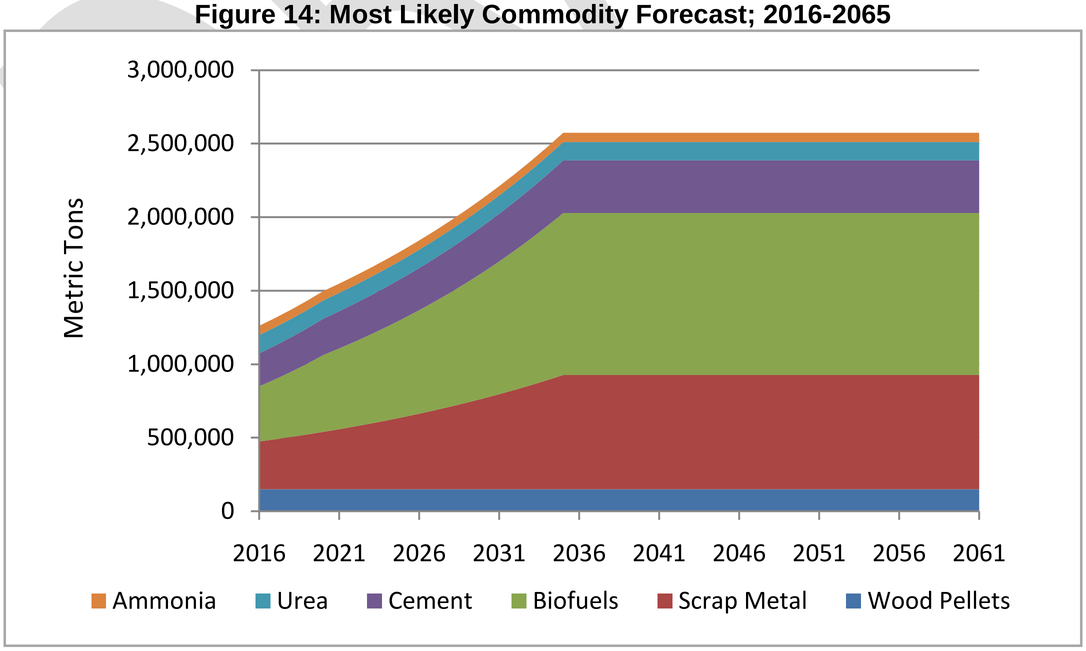
potential secondary source of the material. Although the facility's construction has not been confirmed, business representatives have indicated that the Port of West Sacramento's existing infrastructure, location, and permitting process make it an attractive choice. The two year permitting process makes 2012 the earliest year that operations could begin. If constructed, the facility will have a maximum capacity of 750,000 MT of throughput per year. While the future of this facility is not yet certain, it represents an important source of potential extra business at the Port and highlights the fact that the Port remains a viable and appealing option for businesses seeking deep water port locations. At this juncture, the potential slag importer is still evaluating its preferred location and facilities at the Port. Due to the lack of any formal agreement to begin conducting business at the POWS, no commodity forecast will be made at this time, and the possible future importation of slag will not factor into the current analysis.

5.2. Summary of Most-Likely Future Forecasts

With the addition of several new commodities, Port throughput is expected to grow significantly over the next two decades. These new commodities are the largest source of growth expected at the Port – especially wood pellets, biofuels, and scrap metal. Also, since wood pellets and scrap metal are exports, over the next several decades the ratio of exports to imports is expected to increase compared to the recent historical trade balance. As stated throughout the report, there is undoubtedly uncertainty over the year when these new commodities will begin moving through the Port, and over how the throughput of each of these commodities grows over time. The uncertainty associated with the forecasts is addressed in the sensitivity analysis in Section 6.

Figure 14 provides a visual snapshot of the overall expected throughput at the Port from the project base year of 2016 through the period of analysis, ending in 2065. Given the most-likely future forecasts identified in this analysis, the total tons of goods moving through the Port in 2016 is expected to exceed 1.2 million MT. According to Corps forecasts, this amount will grow to over 2.5 million MT before leveling off in 2035.

Figure 14: Most Likely Commodity Forecast; 2016-2065



5.3. Commodity Forecast Sensitivity Analysis

Corps analysts conducted sensitivity analyses of the growth forecasts presented in Section 5 to understand how the results of this analysis would change given alternative growth scenarios. The forecasts discussed in Section 5 represent the expected future condition at the Port. However, all forecasts have an element of uncertainty and it is important to recognize that though the most likely scenario has been identified, uncertain variables may lead to alternative future scenarios. Therefore, for each commodity, low-growth and high-growth scenarios have been identified in order to represent other possible future conditions at the Port of West Sacramento, but are not considered in determination of the recommended project channel depth. The discussions of the sensitivity analyses contained within this section of the report include an identification of data sources and growth rates relevant to each commodity's low- and high-growth scenarios. The results of the benefit analysis will include a description of how the benefits from deepening change when considering the alternative forecasts.

In addition to the low- and high-growth scenarios detailed in this section of the analysis, further consideration is given to the sensitivity of the forecasts to changes in uncertain parameters in the Net Benefits and Benefit-to-Cost Ratio Analysis in Section 9.

- **Anhydrous Ammonia and Urea**

As the two commodities expected to arrive at the Port in the future that have been imported for the longest amount of time, identification of the most-likely future imports of anhydrous ammonia and urea relied upon historical trends and information from importers. According to the importers of these two goods, they have arrived at the Port in roughly the same quantities for nearly twenty years and are expected to remain doing so. Therefore, the most-likely future scenario for both anhydrous ammonia and urea assumed a 2009 import tonnage equal to a weighted average of the three most recent years' tonnages and a 0% annual growth rate. The assumption of 0% growth seemed both realistic and prudent given the information provided by the importers and Global Insight projections regarding the growth of fertilizers over the next 20 years, which provided a basis for the high-growth scenario for ammonia and urea imports at the Port.

Global Insight's projected average annual growth rate of liquid fertilizer imports to the Pacific Northwest from 2010 to 2028 equals 1.44%; that for dry bulk fertilizer imports is nearly the same at 1.43% per year. As a liquid fertilizer input, the growth rate for liquid fertilizer imports was applied to ammonia for its high-growth future forecast, while the dry bulk fertilizer import projection was applied to urea. Both imports were grown from their estimated 2009 import tonnages of 63,200 MT and 124,652 MT and assumed to level out in 2035, as is the case with all projections in this analysis.

For the low-growth case of ammonia and urea imports, which are not predicted to grow under the most-likely scenario, but are expected to continue importing in roughly the same quantities as they do today, a negative growth rate was assumed. Given the loss of fertilizer imports to the Port of Stockton, it is possible and necessary to consider that the same fate may befall ammonia and urea imports to the Port of West Sacramento. Fertilizer imports to the POWS totaled over 160,000 MT in the first year for which data is available, 1988. Since fertilizer stopped shipping to the POWS in March 2010, the first year of zero imports will be 2011. Using these figures to determine an average annual rate of decline in fertilizer imports resulted in the calculation of a -40% average annual growth rate over the 23 years that fertilizer imported to the Port. Obviously, fertilizer imports increased for a time before beginning their eventual decline to zero. However, this figure provides an estimate for the rate at which ammonia and urea imports might stop shipping to the Port under the low-growth scenario. Applying a -40% annual rate of growth to the 2009 estimated tonnage established a low-growth forecast for these two goods.

Table 15 contains the low-growth and high-growth scenario tonnages for anhydrous ammonia and urea shipments to the POWS. These figures, in addition to the most-likely scenario forecast used in the NED analysis, are displayed in the graphs in Figures 15 and 16.

Table 15: Low-Growth and High-Growth Ammonia and Urea Imports (MT)

Year	Anhydrous Ammonia		Urea	
	Low-Growth	High-Growth	Low-Growth	High-Growth
2010	37,920	64,110	74,791	126,434
2016	**1,769**	**69,852**	**3,489**	**137,678**
2021	138	75,029	271	147,807
2026	11	80,589	21	158,682
2036	0	91,655	0	180,312
2065	0	91,655	0	180,312

Figure 15: Historical and Potential Future Ammonia Import Scenarios

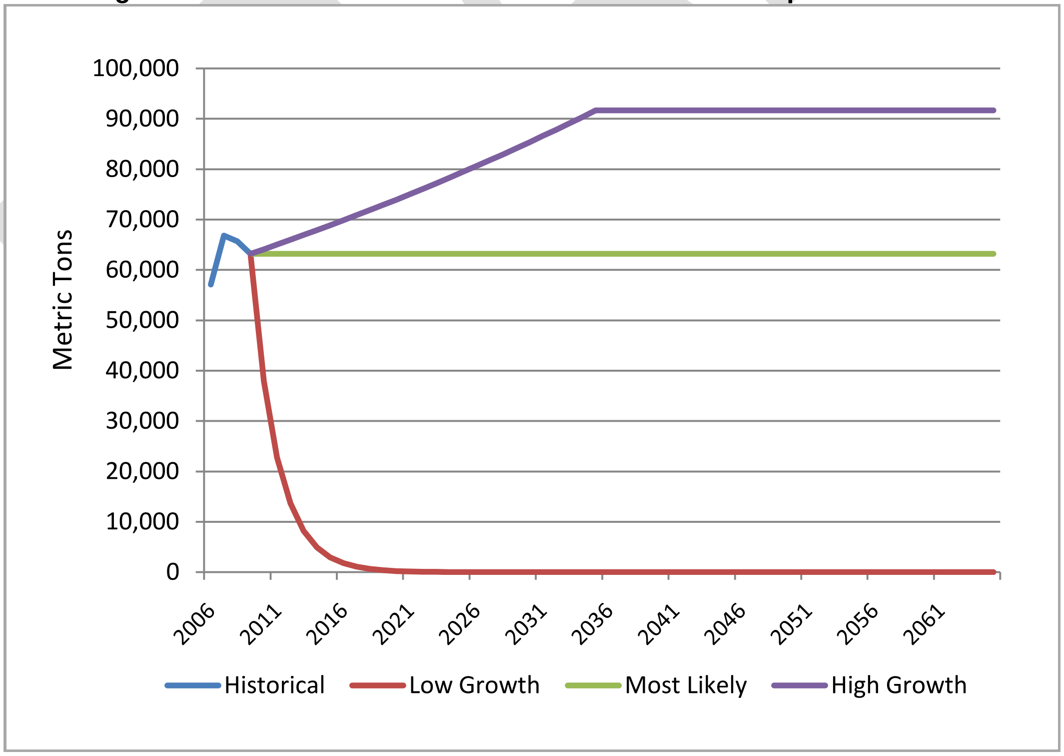
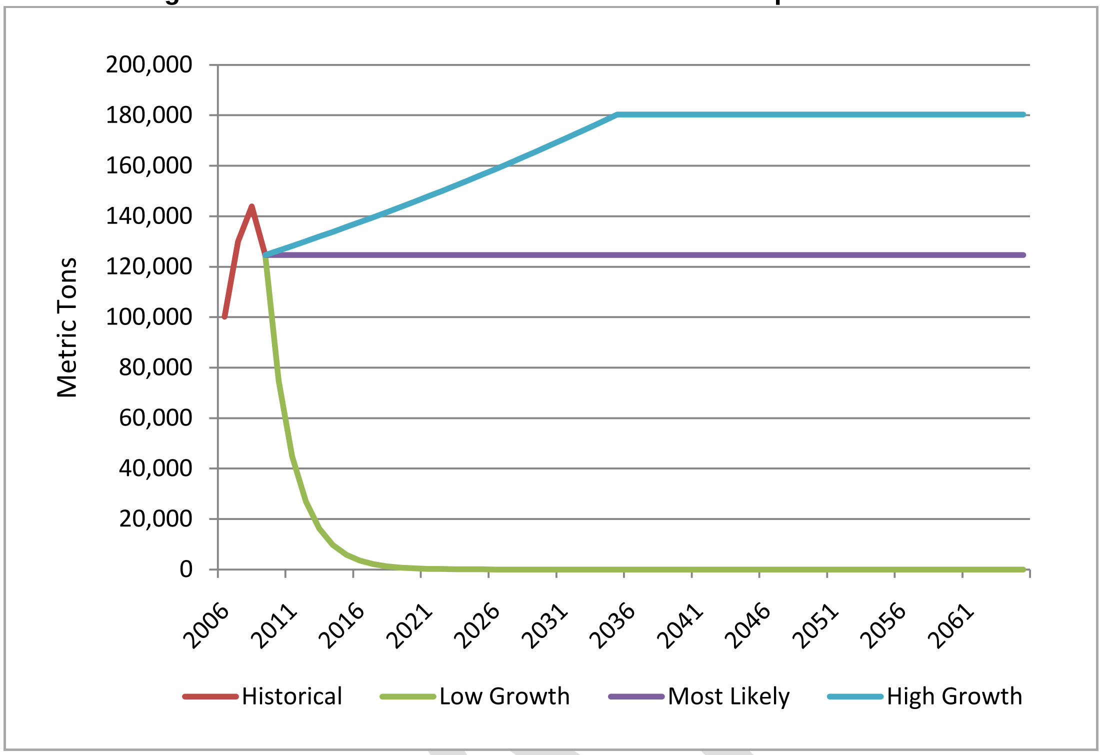


Figure 16: Historical and Potential Future Urea Import Scenarios



- **Cement and Aggregates**

As discussed in the forecast of the most-likely future scenario for cement imports to the POWS, several growth rates related to cement imports and consumption were identified during the initial research conducted to determine the most realistic future import tonnages of cement. USGS data provided historical growth rates of national cement imports and consumption between 3.7 and 4.3% annually. Industry representatives of cement importers operating at the Port corroborated these rates by indicating that annual growth rates fluctuate between 3 and 4.5%. Because USGS data covers the national economy, as opposed to the economy of the region of interest, it was necessary to find a way to substantiate cement import growth rates by finding a local proxy from an independent source. To this end, the IHS Global Insight projections for stone, clay, and other crude minerals were used, which provided a forecast that is specific to the Pacific Northwest and serves as a proxy for cement imports. Because the forecast is not for cement and aggregates themselves, the most-likely future annual growth of cement imports identified in this analysis relies upon an average of the USGS and industry growth rates and the growth rate provided by Global Insight. However, the USGS data and industry representatives enabled the identification of a high-growth scenario forecast for cement and aggregate imports to the POWS through the period of analysis. An average of the 3 to 4.5% annual growth rate provided by the Port importers, which is equal to 3.75% and falls within the 3.7 to 4.3% national historical rates derived from USGS data was used to forecast a high-growth scenario for cement imports.

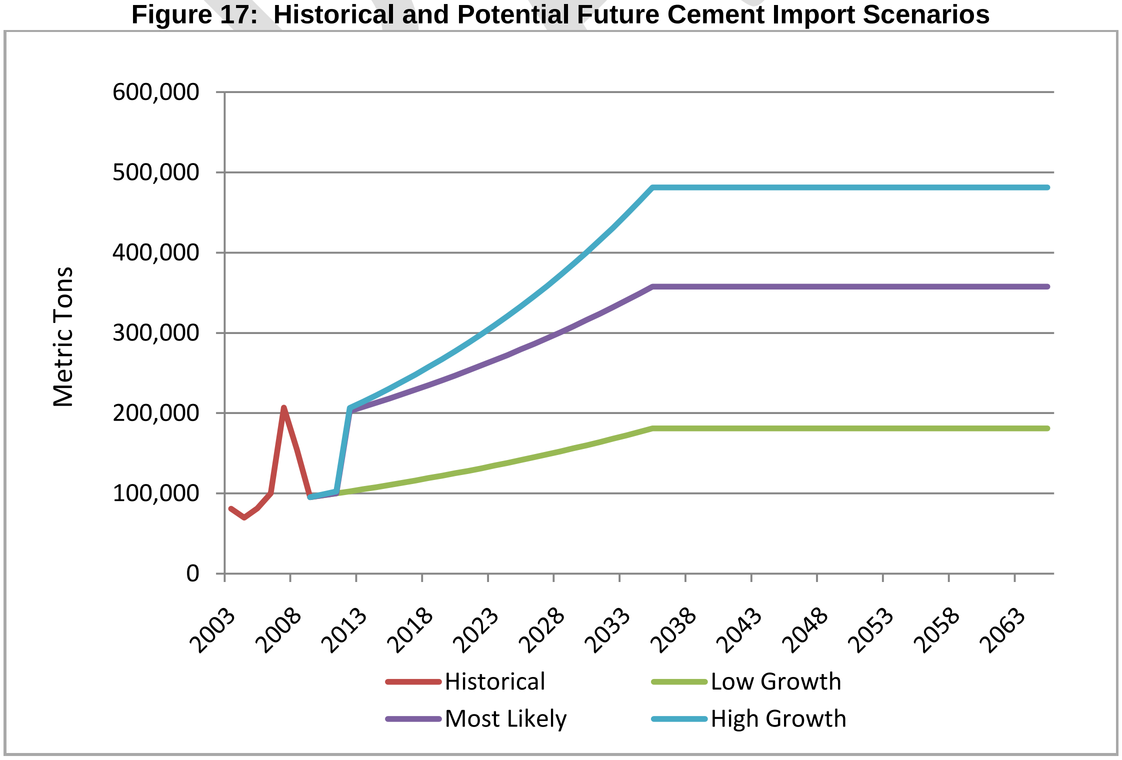
Having identified most-likely and high-growth future scenarios related to cement and aggregate importation at the Port, Corps analysts required a low-growth scenario to round out the sensitivity analysis of cement imports. Given the conservative approach of tempering the high-growth rate by averaging it with a Global Insight proxy to arrive at a most-likely annual growth rate of 2.5%, the approach to identifying a low-growth scenario did not involve a lowering of the expected annual growth rate of imports. Rather, the low-growth scenario for cement imports assumes that, over the period of analysis, economic growth in California does not reach a level that requires the idle cement import and mixing facilities to begin importing foreign cement. Therefore, in the low-growth scenario for cement imports, the 2009 import tonnage of 95,313 MT grows annually by 2.5% until 2035, at which point it levels off.

Table 16 below contains the forecasted low-growth and high-growth cement imports using the growth rates and base tonnages just discussed. Figure 17 displays the three possible future scenarios for cement imports to the POWS. As is made evident by the graph, the low-growth scenario projects cement imports to grow at a rate that prevents imports from ever reaching their 2007 level of over 200,000 MT.

Table 16: Low-Growth and High-Growth Cement Imports (MT)

Cement		
Year	**Low-Growth**	**High-Growth**
2010	97,696	98,887
2016	**113,297**	**239,195**
2021	128,185	287,536
2026	145,030	345,647
2036	181,123	481,422
2065	181,123	481,422

Figure 17: Historical and Potential Future Cement Import Scenarios



- **Biofuels**

The most-likely future scenario for biofuel product imports to the POWS takes into account both current and future California Renewable Fuel Standards (RFS). Doing so results in the application of a graduated annual growth rate, as discussed in the commodity forecasts identified in Section 5 of this analysis. To briefly reiterate, the most-likely growth forecast for biofuel imports assumes an 8.6% annual growth rate from 2012 to 2020, and 5.1% from 2021 to 2033, at which point the forecast levels off to zero growth. The 8.6% growth rate accounts for a shift in the ethanol-gasoline blend from the current mixture that contains 5.7% ethanol, to the projected mandated 10% blend in 2020, which would prompt in increase in ethanol needs statewide. This ethanol demand is captured by the 8.6% annual growth rate. Between 2020 and 2050, California CFS will increase the mandated amount of ethanol in gasoline to 20%, creating an average annual growth of 5.1% in statewide ethanol demand during that time period. Therefore, the most-likely forecast of future ethanol imports to POWS considers the California CFS and its influence on ethanol demand in the state in its use of two growth rates.

High-growth and low-growth scenarios for biofuel import forecasts take into account different factors in the California biofuels market and factors specific to the Port. Currently, most biofuel consumption includes the use of a gasoline-ethanol blend. However, diesel requires biodiesel, as opposed to ethanol, in the blending process and biodiesel accounts for a significant percentage of the biofuels imported to the POWS. Industry representatives indicated that about 70% of the biofuels importing to the Port will be ethanol and the remaining 30% will be biodiesel, reinforcing the greater consumption of ethanol over biodiesel. In the UC study[45] used to derive the most likely growth forecast for biofuels, demand for biodiesel is projected to grow at a faster rate than that of ethanol. The growth rates used in the most-likely forecast for biofuel imports are those projected for ethanol consumption, which makes up a greater proportion of expected imports, though does not account for all expected POWS biofuel imports. Using ethanol demand growth rates helped to establish a conservative estimate of the most-likely future forecast for this reason. Therefore, in conducting a high-growth scenario, growth rates for statewide biodiesel demand have been applied. Assuming that biodiesel begins to make up a larger percentage of imports to the Port and the California biofuels market, which seems like a possibility, this can be captured by the application of the biodiesel growth rates projected in the UC study. Doing so results in the application of a 16% annual growth rate from 2010 to 2020, which falls to 11% annually from 2020 to 2035, after which point the projections for biofuel imports are leveled off.

The potential for a low-growth scenario is based more upon limitations at the Port rather than a lack of demand for biofuels. Implementation of California's CFS essentially guarantees an increase in demand for sugar-based ethanol and biodiesel. Likewise, the lack of existing infrastructure for the importation of sugar-based biofuels to the region highlights the opportunity for this sort of marine transport to grow robustly once it has been established at the Port. Currently, however, the permitting of the facilities located at the Port, which are being constructed to enable the importation of these biofuels, limits the maximum tonnage that can arrive at the POWS annually. The likelihood of a re-permitting that will increase the allowed yearly throughput seems quite high; however, it is important to at least acknowledge the potential that imports to the POWS may be capped at the currently permitted amount of 540,000 MT annually into the foreseeable future. Therefore, the low-growth scenario considered in this analysis is not one of a lack of demand or

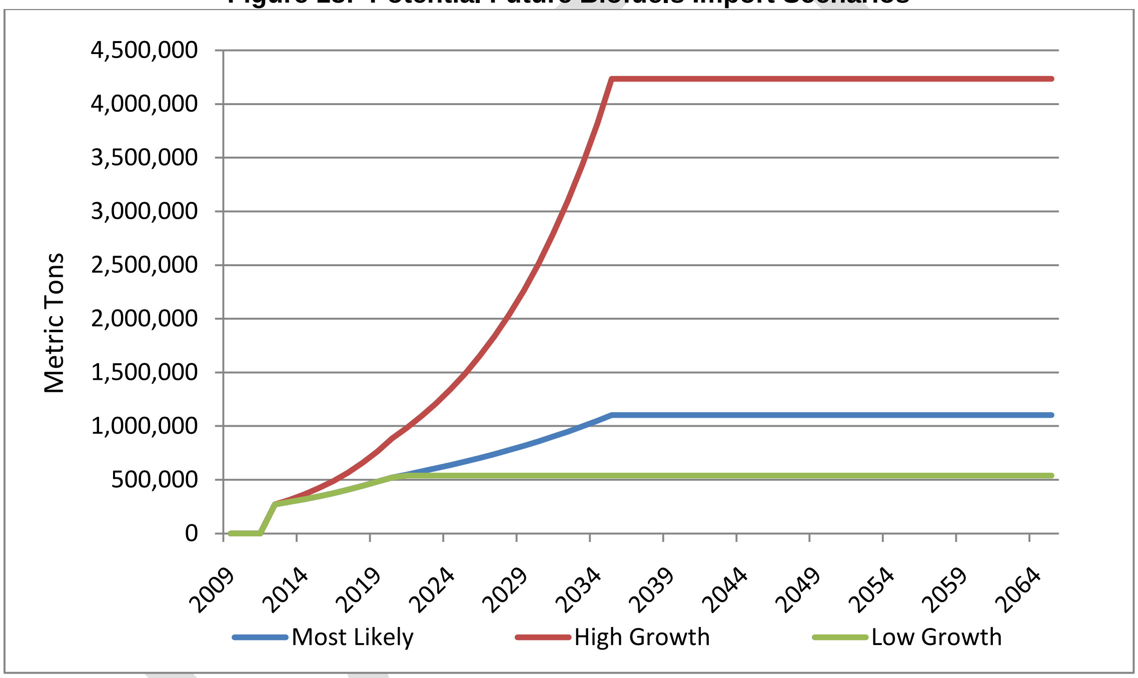
[45] Gildart, M.C., B.M. Jenkins, and R.B. Williams. *California Biofuel Goals and Production Potential*. European Biomass Conference and Exhibition, 7-11 May 2007.

growth to support an increase in annual imports, but a lack of currently permitted capacity. The low- and high-growth forecasts for biofuel imports are contained in Table 17 and Figure 18.

Table 17: Low-Growth and High-Growth Biofuels Imports (MT)

Biofuels		
Year	**Low-Growth**	**High-Growth**
2010	0	0
2016	**375,563**	**488,873**
2021	540,000	982,541
2026	540,000	1,655,639
2036	540,000	4,235,185
2065	540,000	4,235,185

Figure 18: Potential Future Biofuels Import Scenarios



- ## Scrap Metal

The sensitivity analysis for scrap metal exports from the Port of West Sacramento considered data from the USGS related to historical scrap metal exports and their growth in order to identify low- and high-growth scenarios. The most-likely forecast was fairly easy to assess due to the availability of scrap metal export projections specific to the Pacific Northwest from Global Insight. Using the initial expected tonnage of exports provided by industry representatives, who expect to begin operations at the Port in 2012, the growth rate used in the Global Insight projections of 4.7% per year was applied to arrive at a forecast of the most-likely future tonnages shipping from the Port through the period of analysis. USGS historical trends, while providing information off of which to base low-growth and high-growth scenario analysis, reflect the national scrap metal export market and are, therefore, less likely to reflect the future of POWS as accurately as those projections calculated using Global Insight forecasts as a guide.

The USGS has data related to iron and steel scrap exports dating back to 1934. Because international trade has changed drastically since the early 1930s, with rapidly developing countries like China entering the world stage and making up an increasingly large percentage of the world economy over the last two decades, a trend extrapolated from data from 1934 to 2008 serves as the growth rate used in this sensitivity analysis to forecast a low-growth scenario. If the growth of rapidly expanding developing economies is to slow significantly, future world scrap metal demand can be expected to look more like the long-term historical average. From 1934 through 2008, scrap metal exports from the U.S. grew an average of 3.35% annually.[46]

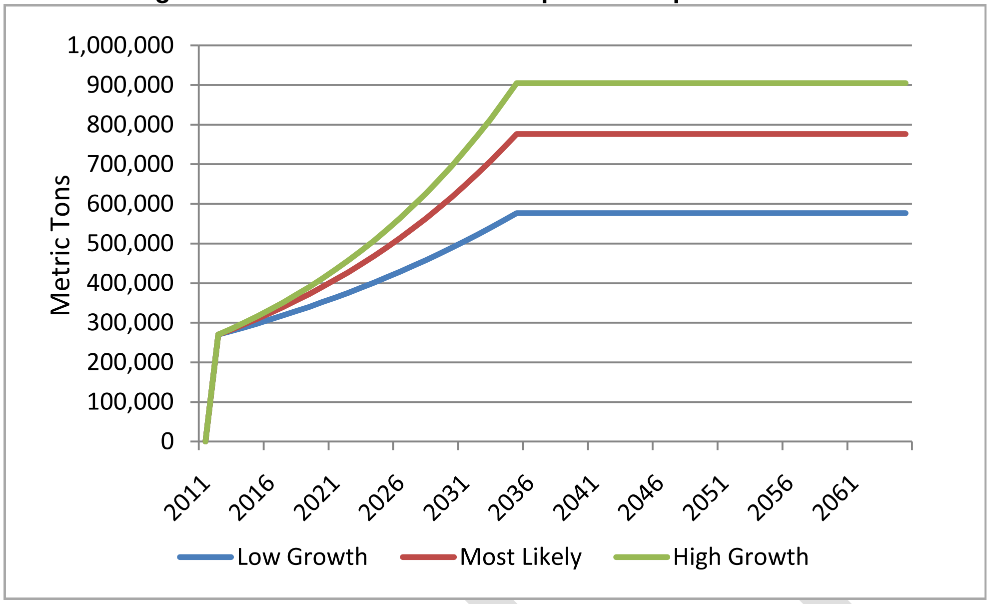
Growth rates extrapolated from more recent years of USGS iron and steel scrap export data represent a high-growth scenario, however. Given the rapid growth of China and India, two major scrap importers, over the last decade and an overall increase of international trade, coupled with a robust U.S. economy leading up to the recent recession, the last 10 years of data provide a snapshot of the international scrap market during a period of high-growth. From 1999 to 2008 (the most recent year of available data), scrap exports from the United States grew annually at an average rate of 5.4%.[47]

Table 18: Low-Growth and High-Growth Scrap Metal Exports (MT)

Scrap Metal		
Year	**Low-Growth**	**High-Growth**
2010	0	0
2016	**308,099**	**333,216**
2021	363,368	433,440
2026	428,553	563,809
2036	576,751	905,103
2065	576,751	905,103

[46] USGS. Historical Statistics for Mineral and Material Commodities in the United States. Iron and Steel Scrap. December 2009.
[47] Ibid.

Figure 19: Potential Future Scrap Metal Export Scenarios



- **Wood Pellets**

As a relatively new commodity on the international market, there is no historical data to inform the forecasts of wood pellet export growth from the POWS. Initial conversations with the representative that will be exporting wood pellets from the Port helped to establish that there is an expectation of rapid global growth for this commodity from its first year forward, but that Port capacity is limited at 150,000 MT annually. Therefore, the rapid expansion of the global wood pellet market is expected to require full annual production at the Port facilities, supporting the most-likely scenario that the wood pellet facility operates at full capacity after its start-up year.

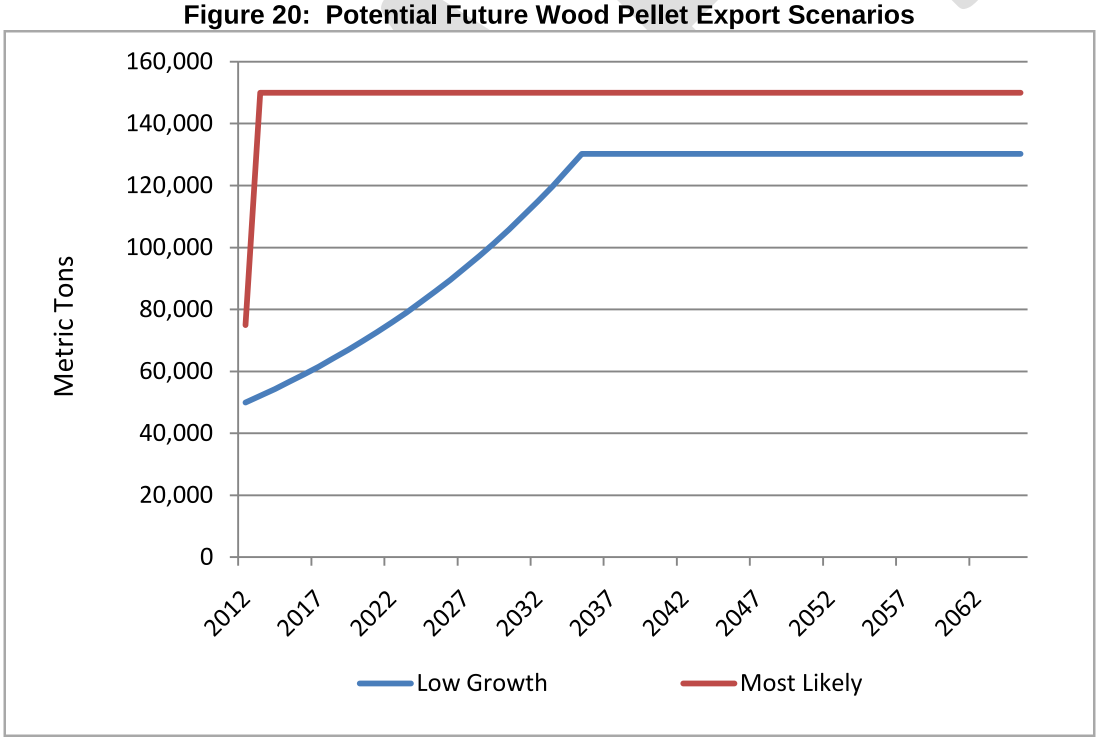
Because the capacity limits at the Port are expected to be reached under the most-likely future scenario, projecting a quantitative high-growth scenario was hampered by the fact that output cannot physically exceed the amounts forecasted under the most-likely scenario. European wood pellet imports are expected to increase 8 to 10% annually, while global growth rates range from 25 to 30% per year. Given the robust growth of the wood pellet market, expansion of Port capacity beyond its current maximum may eventually take place in order to accommodate some of the global demand, which would represent the high-growth scenario for wood pellet export growth at the POWS. Without any solid evidence to substantiate this possibility, this analysis forecasts only the most-likely and low-growth scenarios for the sensitivity analysis of wood pellet growth, while acknowledging that a high-growth scenario may eventually unfold at the Port.

Despite the expectation for rapid growth in the wood pellet industry, it is still necessary to consider a low-growth forecast for wood pellet exports. The U.S. Department of Energy (DOE) provides an International Energy Outlook on a yearly basis. Average annual growth rates of renewable energy consumption in China and OECD Europe provided a growth rate on which to base the low-growth forecast for this analysis. Applying the DOE forecast results in an annual average growth rate of 4.25%. While wood pellet use is generally expected to grow at a faster rate than the broader renewable energy industry, a reasonable low-growth scenario for wood pellets is that the market growth is simply in line with the lower forecasted growth of renewables. The initial tonnage under the low-growth scenario is also expected to be lower than those under the most-likely and high-growth scenarios, which assume production at 50% of capacity during the first year of production. Under the low-growth scenario, first year output tonnage is forecasted to be 1/3 of production capacity at 50,000 MT. Table 19 displays the results of the low-growth scenario analysis and Figure 20 graphs the low-growth and most-likely scenarios considered in this sensitivity analysis of wood pellet exports from the Port.

Table 19: Low-Growth Wood Pellet Exports (MT)

Wood Pellets	
Year	**Low-Growth**
2010	0
2016	**59,057**
2021	72,720
2026	89,544
2036	130,233
2065	130,233

Figure 20: Potential Future Wood Pellet Export Scenarios



6. Vessel Calls & Fleet Mix

6.1. Historical

The Port of West Sacramento vessel fleet mix was determined using vessel call data from the years 1997 through 2009. All data came directly from the Port and Waterborne Commerce Statistics.

Vessel characteristics not included in either data set were obtained through online ship tracking websites, which record vessel types and dimensions. Given the number of years of vessel data used to determine the fleet mix and the varying levels of activity at the Port during those years (i.e. some economically prosperous years and some recessionary), the mix of vessels during the years for which data was obtained provides an accurate representation of the overall vessel fleet using the Port.

At present, the types of vessels calling at the Port of West Sacramento include Bulk Cargo Carriers, General Cargo Carriers, and Tankers. Bulk Carriers, which ship the unpackaged, raw materials identified as bulk cargo above, tend to be larger and draft more deeply than General Carriers, which transport smaller shipments of the break bulk cargo consisting of packaged goods and project cargo. Tankers are used to transport bulk liquid materials and those calling at POWS tend to fall within the same range of sizes as the Bulk Carriers. In the case of West Sacramento, only ammonia currently arrives at the Port via Tanker vessels; biofuels represent a commodity that will ship to the Port on Tankers in the future. In this analysis, “Bulk Carriers” refer to vessels that transport solely dry bulk material, while “Tankers” comprise the fleet of vessels carrying liquid bulk.

Tables 20 through 22 below present the classes (sizes) of the three types of vessels calling at the Port by deadweight tonnage (DWT) and their maximum design drafts. As the data shows, vessels in all but the smallest class of General Carriers (highlighted in blue) have maximum design drafts greater than the existing 30’ channel constraint. For this analysis, the under-keel clearance for all vessels using the SRDWSC is assumed to be 2’. That is to say, any vessel operating along the channel or at the Port must have two feet of clearance between its keel and the Port or channel bottom. Therefore, given a tide of 3.6’ and controlling depth of 29’, even a 32.6’ draft vessel must light-load by two feet to meet this safety requirement. The maximum design drafts recorded for each vessel class indicate that the majority of vessels calling at the Port have been light-loaded in order to do so.

Table 20: Tanker Carriers

Vessel Design Draft (feet)	Vessel Size (DWT)
n/a	20,000
39	25,000
33	35,000
n/a	50,000
n/a	60,000

Table 21: Bulk Carriers

Vessel Design Draft (feet)	Vessel Size (DWT)
32	15,000
38	25,000
39	35,000
41	40,000
44	50,000
43	60,000

Table 22: General Carriers

Vessel Design Draft (feet)	Vessel Size (DWT)
29	11,000
32	14,000
32	16,000
32	20,000
33	24,000
34	30,000

The fleet of vessels calling at the Port since 1997 is heavily weighted towards Bulk Carrier Vessels with design drafts greater than 30'. Of the 684 vessel calls made during the years for which data was available[48], Bulk Carriers accounted for 559. Table 23 below includes information on the fleet of Bulk Carriers using the Port. Table 24 provides more detailed data related to the dimensions of each class of Bulk Carrier calling at the Port from 1997 to 2009.

Table 23: Bulk Carrier Calls and Characteristics - 1997 to 2009

DWT	15,000	25,000	35,000	40,000	50,000	60,000	TOTAL
# Vessel Calls	16	203	49	204	85	2	559
Percentage of Calls	3%	36%	9%	36%	15%	<1%	100%
Max Draft	32	38	39	41	44	43	44
Average Length	491	532	571	625	640	681	590

Table 24: Bulk Carrier Dimension Ranges

DWT	Draft		LOA		Beam	
	Min	Max	Min	Max	Min	Max
15,000	23.3	32.0	456.0	524.9	72.3	84.6
25,000	28.2	38.0	488.8	646.3	75.0	90.4
35,000	31.2	39.0	561.0	641.4	83.0	98.4
40,000	29.5	41.0	557.7	659.4	93.3	333.7
50,000	31.7	44.4	600.4	685.0	99.7	106.0
60,000	42.0	43.0	623.3	623.3	105.0	105.0

As Table 23 shows, 36% of Bulk Carriers fell in the 40,000 DWT class of vessels; among them the maximum draft was 41'. Graphs of the distribution of Bulk Carriers by year and DWT, shown in Figures 21 and 22, provide a visual representation of the vessel fleet calling at the Port since 1997. The general snapshot that this provides illustrates the frequent use of 25,000 and 40,000 DWT vessels in shipments to and from the Port. These two vessel classes almost always make up the two largest percentages of vessel calls in any given year.

[48] Tanker vessel data was only available for 2006-2008; therefore, the total vessel calls do not include any tankers that called at the Port in the years 1997-2005, and 2009.

Figure 21: Percentage of Bulk Vessel Calls by DWT - 1997 to 2002

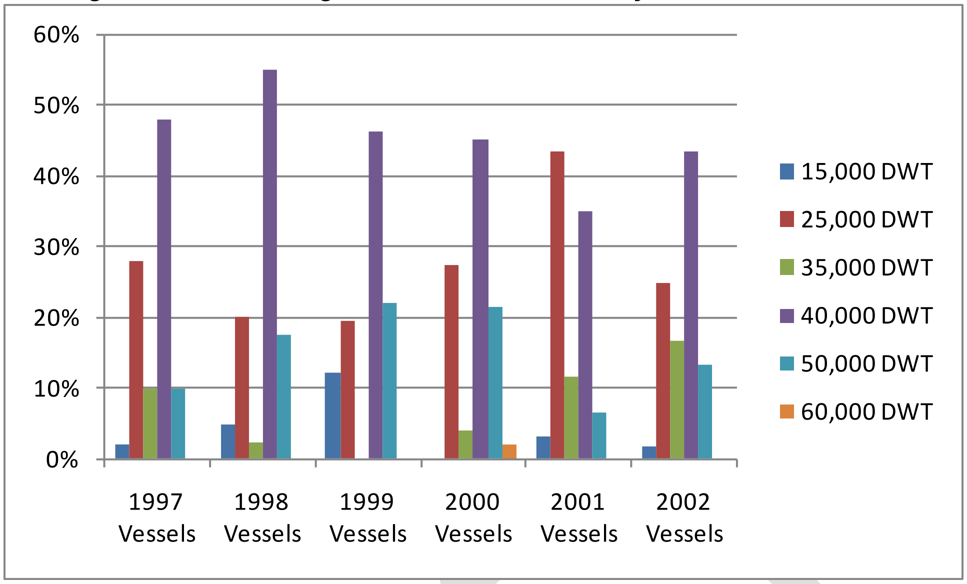
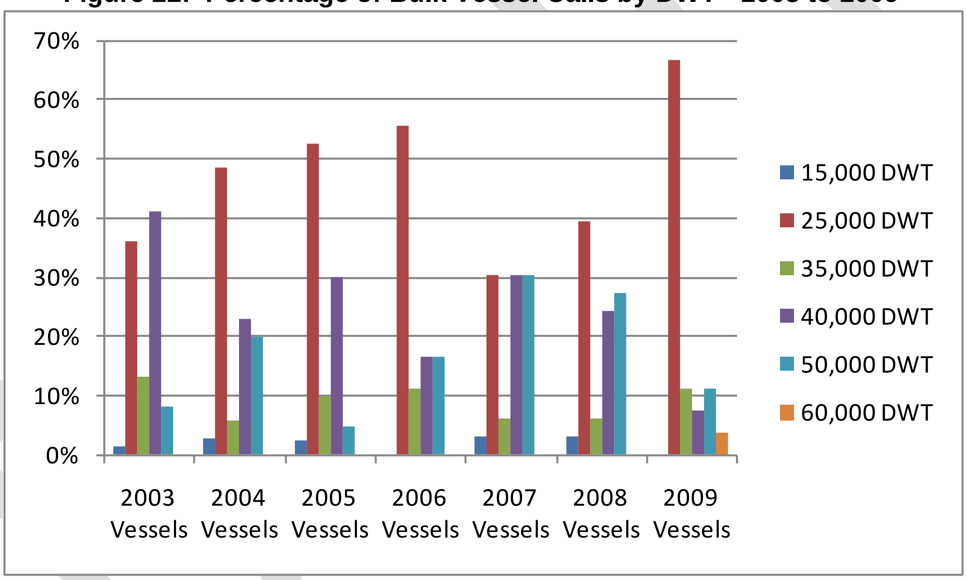


Figure 22: Percentage of Bulk Vessel Calls by DWT - 2003 to 2009



General Cargo Carriers accounted for the next largest proportion of vessel calls over the period 1997-2009, with 106 total calls over the thirteen years of data. As mentioned before, General Carriers are smaller than Bulk Carriers, topping out around 30,000 DWT and drafting less deeply than Bulk Carriers.

Figure 23: Percentage of General Vessel Calls by DWT - 1997 to 2002

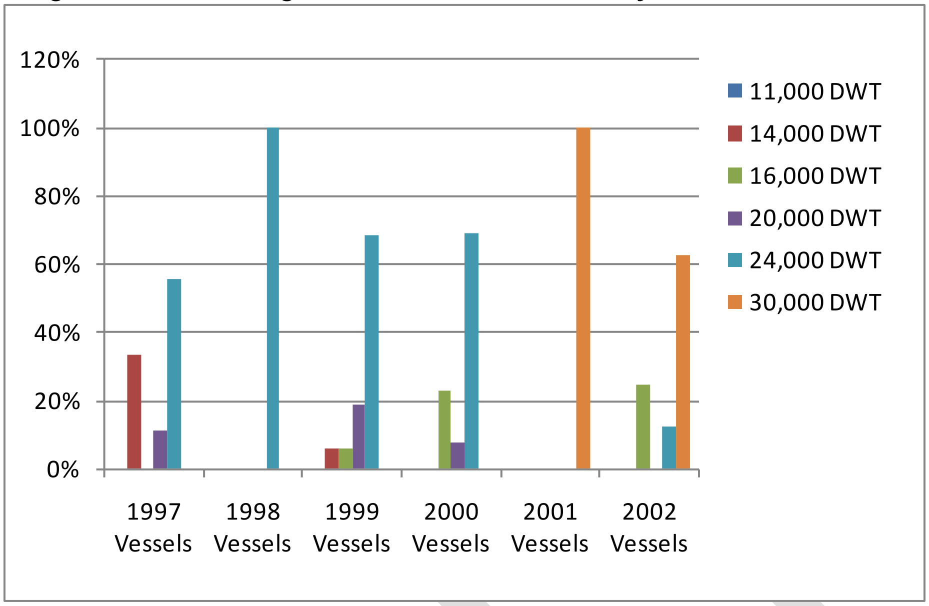
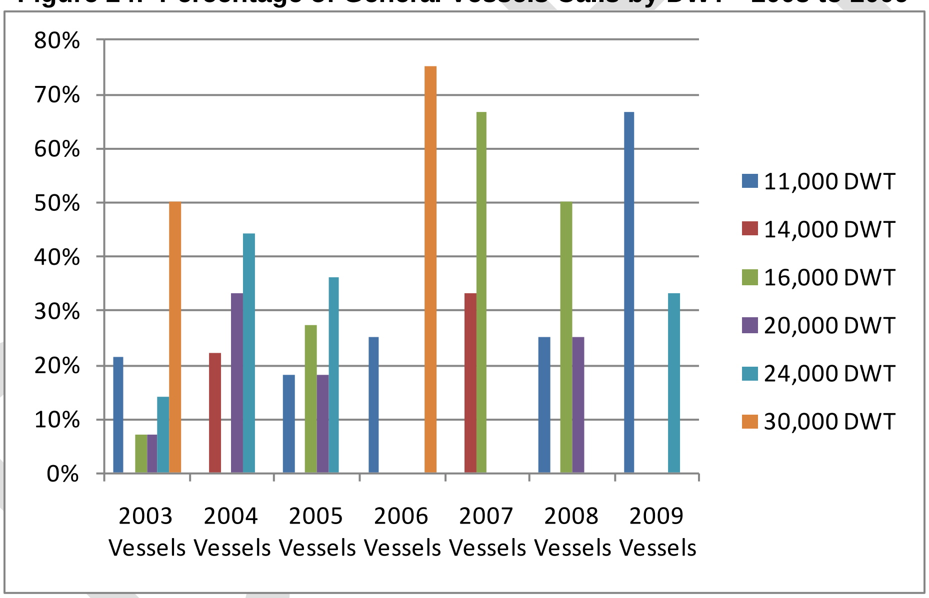


Figure 24: Percentage of General Vessels Calls by DWT - 2003 to 2009



In order to give a sense of the dimensions of the General Carriers calling at the Port, Tables 25 and 26 summarize some general characteristics of the fleet.

Table 25: General Carrier Calls and Characteristics - 1997 to 2009

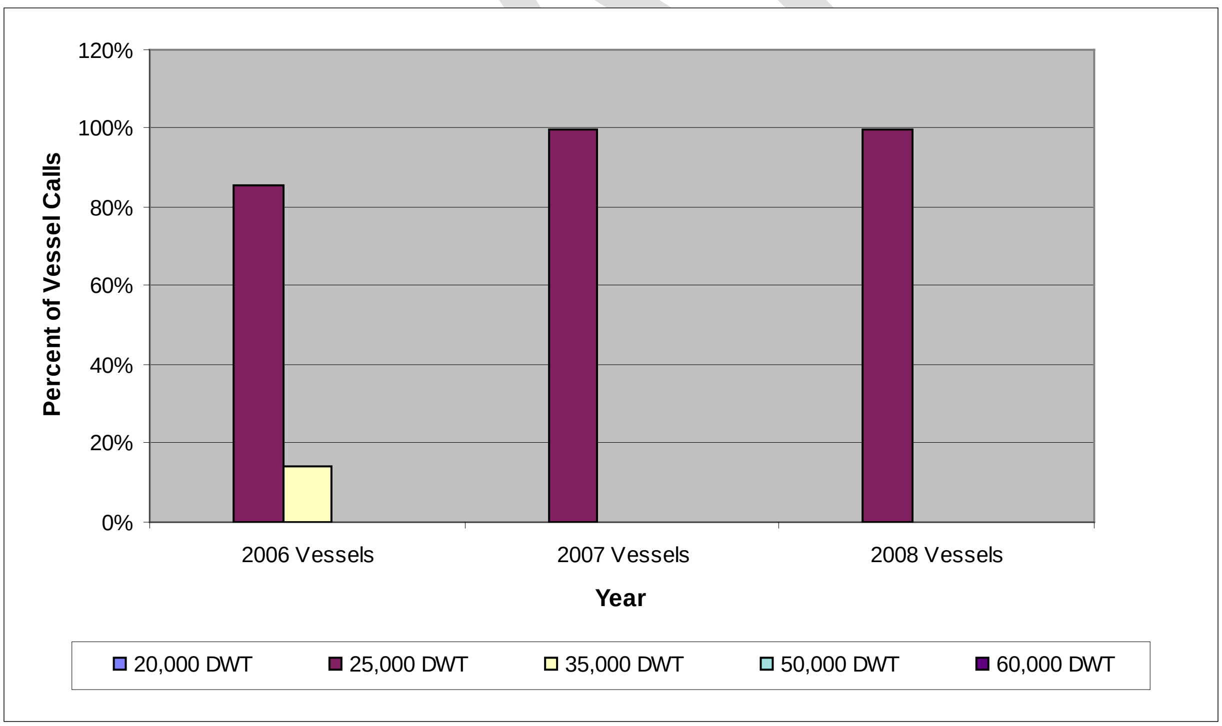
DWT	11,000	14,000	16,000	20,000	24,000	30,000	TOTAL
# Vessel Calls	9	8	16	12	45	16	106
Percentage of Calls	8%	8%	15%	11%	42%	15%	100%
Max Draft	28.9	31.8	32.0	32.2	33.0	34.0	34.0
Average Length	350.7	451.0	482.3	512.9	511.1	554.0	477.0

Table 26: General Carrier Dimension Ranges

DWT	Draft		LOA		Beam	
	Min	Max	Min	Max	Min	Max
11,000	21.0	28.9	328.1	426.5	54.5	68.9
14,000	27.9	31.8	446.2	469.7	62.0	74.8
16,000	23.3	32.0	439.6	520.0	70.5	84.6
20,000	30.4	32.2	492.1	518.0	71.6	75.8
24,000	30.9	33.0	484.9	520.0	84.6	84.6
30,000	20.3	34.0	554.5	593.8	85.3	92.0

Tankers, for which there exists only three years of data, comprise the smallest number of vessel calls to the Port. With ammonia as the only good shipped to the Port via Tanker, the low number of calls and lack of data is not surprising. The limited number of years of data results from the relatively recent startup of ammonia shipments. In projecting the future mix of vessels, data from the Port of Stockton was used to construct a more comprehensive mix of Tankers because, as shown in Figure 25, the current fleet calling at the Port of West Sacramento is comprised almost entirely of 25,000 DWT ships.

Figure 25: Percentage of Tanker Vessel Calls by DWT - 2006 to 2008



As shown, all but one Tanker calling at the Port was a 25,000 DWT vessel. The lone 35,000 DWT tanker happened to have a shallower draft than the maximum draft of the 18 other vessels that called, which further necessitated the use of data from the Port of Stockton in projecting a future vessel fleet mix. Tables 27 and 28 contain information on characteristics of tankers calling at the Port from 2006 through 2008.

Table 27: Tanker Calls and Characteristics - 2006 to 2008

All Tanker Vessels - 2006 to 2008						
DWT	**20,000**	**25,000**	**35,000**	**50,000**	**60,000**	**TOTAL**
# Vessel Calls	0	18	1	0	0	19
Percentage of Calls	0%	95%	5%	0%	0%	100%
Max Draft	n/a	38.5	33.3	n/a	n/a	38.5
Average Length	n/a	568	607	n/a	n/a	588

Table 28: Tanker Vessel Dimension Ranges

DWT	Draft		LOA		Beam	
	Min	Max	Min	Max	Min	Max
20,000	n/a	n/a	n/a	n/a	n/a	n/a
25,000	32.8	38.5	543.5	629.9	87.0	98.4
35,000	33.3	33.3	607.0	607.0	90.2	90.2
50,000	n/a	n/a	n/a	n/a	n/a	n/a
60,000	n/a	n/a	n/a	n/a	n/a	n/a

6.2. Projected Future Vessel Fleet

Because larger vessels generally have lower transportation costs per ton of shipped cargo, the primary determinants of shipping costs for a given trade route and commodity are the size of the vessel and whether the vessel sails fully-loaded or light-loaded. Therefore, given the current mix of vessels, which is heavily weighted towards larger carriers with drafts constrained by the 30' channel depth, channel deepening presents the opportunity to more fully load larger vessels, resulting in transportation cost savings.

The tables below display the anticipated shift in vessel fleet sizes under various project depths. The forecast distributions result from computations using the 2009 IWR Vessel Operating Costs and use of the current Port of Stockton vessel fleet mix as a benchmark. The general rule is that once a per-ton cost for the next-size ship falls below the previous smaller class vessel, then shippers will tend to hire the larger vessel. In order to ensure the reasonableness of the forecasted fleet, Port of Stockton data was used as a basis for comparison. With its 35' channel depth and a large quantity of bulk cargo imports and exports every year, the Port of Stockton's current vessel fleet mix provides an actual vessel fleet using a port under conditions that are very similar to the POWS with-project condition. Conversations with the bar pilots confirmed the assumption that the future vessel fleet will represent a shift within the current fleet, rather than a move to a larger class of vessels. Due to length constraints, it is unrealistic to assume that Bulk Carriers much larger than the current 60,000 DWT maximum will begin calling at the POWS. Therefore, the future fleet of vessels expected at the POWS represents a re-distribution of the types of vessels currently calling. The two tables below display the anticipated fleet distribution shift for the Port of West Sacramento.

The two goods that ship to the Port on General Carriers, rice (on occasion) and wind generating equipment, are not expected to benefit from a channel deepening. The commodities included in the benefits analysis will ship solely on Bulk and Tanker vessels. Therefore, a forecast of the future General Carrier fleet has not been carried out for this analysis, as those goods expected to incur transportation cost savings from a project will not ship on General Carriers.

Table 29: Bulk Carriers - Forecasted Fleet

Project Depth	15,000	25,000	35,000	40,000	50,000	60,000
30	3%	35%	9%	38%	15%	0%
32	2%	34%	9%	34%	20%	1%
33	1%	32%	9%	30%	25%	3%
34	0%	30%	10%	25%	30%	5%
35	0%	25%	15%	20%	35%	5%

Table 30: Liquid Tankers - Forecasted Fleed

Project Depth	20,000	25,000	35,000	50,000	60,000
30	0%	95%	5%	0%	0%
32	0%	90%	10%	0%	0%
33	0%	85%	15%	0%	0%
34	0%	80%	20%	0%	0%
35	0%	75%	20%	5%	0%

While the tables above display the current expectations for the shift in vessel fleet mix that would occur at each increment of channel deepening, it is also important to note that some future shift in the vessel fleet mix may occur in the absence of a federal project. The San Francisco Bay Bar Pilots indicated that the SRDWSC was designed for vessels that were generally smaller than those that currently call at the Port due to a natural trend towards the use of larger vessels, thus resulting in a greater proportion of vessels that are restricted to daylight transits due to their dimensions.[49] It can only be assumed that as the world fleet of vessels becomes larger, the trend within the fleet of vessels calling at the POWS will follow suit, thus accounting for some future shift in the future vessel fleet with- and without-project.

[49] Conversation with SF Bay Bar Pilots, September 2010.

7. NED Benefits from Deepening

7.1. Methodology & Key Assumptions

Estimation of transportation cost savings begins with the identification of the current fleet of vessels that uses the Port of West Sacramento. Once the mix of vessels has been identified and broken down into the tonnage classes listed above, total movement costs are calculated for each vessel class and trade route using "at sea" and "in port" cost estimates provided by IWR and data from individual shipping agencies, which provide estimates as to the port and harbor fees accrued both at a vessel's origin and destination. The distances for each trade route came from the NED Deep Draft Navigation Procedures Manual (2010). As was discussed in the "Key Assumptions" Section of this report, a tidal delay of 6 hours was assumed for all but the smallest class of vessels. The tidal delay adds to a vessel's total time at sea and thus factors into its total cost at sea.

Vessels are assumed to carry between 90% and 92% of their total DWT in cargo when loaded to full capacity; this amount is referred to as a vessel's "payload". The actual percentage is dependent upon vessel type (Bulk, General, or Tanker) and size. Because most vessels are arriving at Port light-loaded, the immersion factor (tons per inch) provided by IWR is then used to calculate the per ton cost for each foot a vessel has been light-loaded, which also factors in the underkeel clearance requirement for navigating the SRDWSC. A weighted average of the per-ton cost is calculated for the without-project condition based upon the vessel mix that has been previously identified. For example, because 30% of Bulk Carriers calling at the Port fall in the 40,000 DWT class, the cost per ton for a 40,000 DWT vessel will account for 30% of the average for Bulk Carriers overall. As an example, the steps for calculating the per ton cost for a 40,000 DWT Bulk Carrier from Asia have been included in Addendum 1. Since the example pertains to a 40,000 DWT carrier, the per ton cost does not amount to the weighted average used in the actual analysis, but is meant to provide information as to how the calculations were carried out for the study's transportation cost estimates.

Because channel deepening will enable ships to load more fully, leading to lower expected transportation costs per ton, larger vessels should become more cost competitive under the with-project condition. Therefore, following channel deepening, at least some shift in vessel fleet composition towards larger vessels is expected to take place. Estimates of with-project transportation cost savings are based upon the assumption that larger vessels will make up an even larger portion of the vessel fleet, as demonstrated in the fleet forecasts identified in Section 6.

In deep draft navigation improvement projects, project alternatives can consist of either alternate types of improvements (e.g. widening, deepening, or a combination of both) or simply an incremental scale of improvement. In the case of the POWS, incremental project depths make up the five with-project alternatives analyzed in this study as channel widening, other than to support a deeper channel depth, is not being considered as an alternative. Therefore, the five with-project alternatives assessed here are a 31', 32', 33', 34' and 35' channel deepening.

7.2. Economic Benefits

The economic benefits that are expected to result from the deepening of the Sacramento River Deep Water Ship Channel consist of transportation cost savings. Cost reduction benefits result from a decrease in the cost of shipping commodities that reflect the same origin-destination pattern and harbor in all project conditions. Cost reduction benefits generally take one of three forms:

- Increased loads for existing vessels reduce unit costs
- Use of larger vessels
- Enhanced vessel maneuverability

For the Sacramento River Deep Water Ship Channel, deepening would enable an increase in tonnage per shipment, which would contribute to lower transportation costs per ton of cargo. At present, vessels of design draft greater than 30.6' must come into port "light-loaded," i.e. carrying less than vessel capacity. Deepening of the channel would enable ships to come in either fully-loaded or more fully-loaded than they currently do, which would provide the opportunity for savings in transportation costs.

The transportation cost savings that result from more fully-loaded ships are derived from lower per ton movement costs. For example, a 33'-draft vessel carrying scrap metal to Asia must leave the Port light-loaded due to the 30' channel depth constraint. However, after the proposed deepening, the same vessel could potentially leave the Port fully-loaded. Both vessel trips to Asia would have roughly the same overall costs. Therefore, the greater amount of cargo delivered by the fully-loaded vessel at the same cost as the cargo delivered by the light-loaded vessel results in the potential transportation cost savings per ton of cargo.

Vessels larger than the ones that have sailed the Sacramento River Channel over the past few years are not expected to use the channel even with a deepening project of up to five additional feet of draft. The primary constraint is the bar pilots' ability to navigate long vessels through some of the curves that are in the channel. At present, there is no proposal to substantially straighten these curves, although slight modifications are planned to meet safety standards for a deeper navigation trench. Tables in Section 6 showed that there is expected to be a shift of the forecast vessel fleet, where the smallest class vessels will in all likelihood be phased out as commerce shifts more tonnage onto Panamax-sized ships. However, and importantly, this analysis does not claim NED benefits resulting from an introduction of larger class vessels than are already using the POWS.

7.3. Potential Savings per Ton

The following summarizes the estimates of cost savings per ton for relevant trade routes given a five foot deepening of the SRDWSC by commodity. It should be noted that the greater savings per ton for Liquid Tanker vessels are consistent with the notion that shipping on Liquid Tankers is more expensive overall because of increased costs due to safety requirements. Therefore, as costs are greater, savings per ton will also be greater. As mentioned previously, most vessels calling at the Port are Bulk Carriers. Starting on the next page, tables 31 through 36 display, for each commodity, the most-likely tonnage forecast, the savings per ton for a five foot deepening, and the present value of these transportation cost savings estimates at each of the selected years.

Table 31: Potential Biofuels Transportation Savings - 5' Deepening

Biofuels - Liquid Tankers*						
Year	**2010**	**2016**	**2021**	**2026**	**2036**	**2065**
Tonnage	0	**375,563**	549,041	704,075	1,101,649	1,101,649
30' Cost per Ton	$68.19	$68.19	$68.19	$68.19	$68.19	$68.19
35' Cost per Ton	n/a	$48.09	$48.09	$48.09	$48.09	$48.09
Savings per Ton	-	$20.10	$20.10	$20.10	$20.10	$20.10
Expected Savings	-	$6,638,801	$7,834,824	$8,110,738	$8,270,275	$2,389,031

*Imports come from S. America

Table 32: Potential Cement Transportation Costs and Savings - 5' Deepening

Cement - Dry Bulk						
Year	**2010**	**2016**	**2021**	**2026**	**2036**	**2065**
Tonnage	97,696	223,678	253,072	286,327	357,584	357,584
30' Cost per Ton	$26.45	$26.45	$26.45	$26.45	$26.45	$26.45
35' Cost per Ton	n/a	$18.89	$18.89	$18.89	$18.89	$18.89
Savings per Ton	**-**	$7.56	$7.56	$7.56	$7.56	$7.56
Expected Savings	**-**	$1,487,156	$1,358,293	$1,240,596	$1,009,672	$291,663

*Imports come from Asia

Table 33: Potential Anhydrous Ammonia Transportation Costs and Savings - 5' Deepening

Anhydrous Ammonia - Liquid Tanker						
Year	**2010**	**2016**	**2021**	**2026**	**2036**	**2065**
Tonnage	63,200	**63,200**	63,200	63,200	63,200	63,200
30' Cost per Ton	$74.03	$74.03	$74.03	$74.03	$74.03	$74.03
35' Cost per Ton	n/a	$52.21	$52.21	$52.21	$52.21	$52.21
Savings per Ton	-	$21.82	$21.82	$21.82	$21.82	$21.82
Expected Savings	-	$1,212,781	$979,039	$790,346	$515,054	$148,783

*Imports come from S. America, Europe, India, SE Asia

Table 34: Potential Urea Transportation Savings - 5' Deepening

Urea - Dry Bulk						
Year	**2010**	**2016**	**2021**	**2026**	**2036**	**2065**
Tonnage	124,652	**124,652**	124,652	124,652	124,652	124,652
30' Cost per Ton	$36.80	$36.80	$36.80	$36.80	$36.80	$36.80
35' Cost per Ton	n/a	$26.23	$26.23	$26.23	$26.23	$26.23
Savings per Ton	-	$10.57	$10.57	$10.57	$10.57	$10.57
Expected Savings	-	$1,158,734	$935,408	$755,125	$492,101	$142,153

Table 35: Potential Scrap Metal Transportation Savings - 5' Deepening

Scrap Metal - Dry Bulk						
Year	**2010**	**2016**	**2021**	**2026**	**2036**	**2065**
Tonnage	0	**324,452**	408,210	513,591	776,493	776,493
30' Cost per Ton	$37.69	$37.69	$37.69	$37.69	$37.69	$37.69
35' Cost per Ton	n/a	$25.76	$25.76	$25.76	$25.76	$25.76
Savings per Ton	-	$11.93	$11.93	$11.93	$11.93	$11.93
Expected Savings	-	$3,404,093	$3,457,422	$3,511,587	$3,459,861	$999,449

*Exporting to BRIC Countries

Table 36: Potential Wood Pellet Transportation Savings - 5' Deepening

Wood Pellets - Dry Bulk						
Year	2010	**2016**	2021	2026	2036	2065
Tonnage	0	224,481	329,836	484,637	968,792	968,792
30' Cost per Ton	$38.79	$38.79	$38.79	$38.79	$38.79	$38.79
35' Cost per Ton	n/a	$27.10	$27.10	$27.10	$27.10	$27.10
Savings per Ton	**-**	$11.69	$11.69	$11.69	$11.69	$11.69
Expected Savings	**-**	$2,307,831	$2,737,413	$3,246,958	$4,229,856	$1,221,877

*Exporting to Europe (80%) and likely Asia (20%)

Tables 31 through 36 intend to give an idea of the yearly transportation cost savings to be expected for each commodity given a five foot deepening. This analysis takes into account the possibility of five different project depths: 31', 32', 33', 34', and 35'. Therefore, transportation cost savings per ton have been evaluated for each commodity at the specified potential project depths. Table 37 contains savings per ton by project depth.

Table 37: Potential Transportation Savings per Ton at Incremental Project Depths

Project Depth	Biofuels	Cement	Ammonia	Urea	Scrap Metal	Wood Pellets
31'	$4.75	$1.74	$5.16	$2.42	$2.66	$2.73
32'	$9.30	$3.39	$10.10	$4.72	$5.14	$5.29
33'	$13.31	$4.92	$14.45	$6.96	$7.46	$7.69
34'	$16.51	$6.32	$17.92	$8.83	$10.17	$9.81
35'	$20.10	$7.56	$21.82	$10.57	$11.93	$11.69

7.4. Average Annual Benefits

In order to identify the Proposed Plan, estimates of average annual benefits were calculated for each of the potential project depths using the cost savings per ton displayed in Table 37 and most-likely tonnage forecasts of each commodity through the 50-year period of analysis, from 2016 through 2065. Average annual benefits were discounted using the 2010 discount rate of 4.375%. The results of the analysis are contained in Table 38.

Table 38: Total Average Annual Savings at Incremental Project Depths

Project Depth	Total Expected Annual Benefits
31'	$5,603,127
32'	$11,024,201
33'	$16,053,594
34'	$19,900,582
35'	$24,449,819

As is to be expected, total average annual benefits increase as the depth of the project increases. Project cost estimates, however, are necessary to determine whether the net benefits from increasing the project depth become larger from one increment to the next. The net benefits portion of the analysis is contained in Section 9 of this report.

7.5. Sensitivity Analysis of Average Annual Benefits

The commodity forecasts generated for the low- and high-growth scenarios identified in Section 6 of this analysis help to evaluate the potential benefits of a channel deepening given an alternate scenario to the most-likely scenario summarized above. In the case of a 5'channel deepening, the following annual benefits will result given a low-growth or high-growth scenario. The same methodology used in the calculation of the most-likely expected annual benefits was used in this portion of the sensitivity analysis. The results of the most-likely average annual benefits are contained in the table for comparison's sake.

Table 39: Total Expected Annual Savings - Sensitivity Analysis

Growth Scenario	Total Expected Annual Benefits
Low-Growth	$15,146,967
Most Likely	$24,449,819
High-Growth	$54,546,844

The results of the sensitivity analysis of the average annual benefits of a 5' channel deepening confirm that the magnitude of the benefits of a project is highly dependent upon the amount of cargo shipping to and from the Port. Nonetheless, even under the low-growth scenario, average annual benefits from a 5' deepening total more than $15 million. Because the ability to calculate the net benefits of a potential project relies on both benefit and cost estimates, the meaning of these results is dependent upon the estimated project costs.

8. NED Costs of Deepening

In the evaluation and comparison of project depth alternatives, which is necessary to arrive at the selected plan, NED costs play a critical role. NED costs include both the financial and economic costs associated with a project throughout its lifecycle. Each of these types of costs and their sources are discussed in this section of the report. Additionally, the NED costs for the depth alternatives being considered in this analysis will be identified.

8.1. NED Costs – Financial

Financial costs of the proposed project consist of the construction and mitigation costs accrued during construction of the project and over its lifecycle. More specifically, and in the case of the SRDWSC, these costs include:

- Land Construction Costs
- Dredging Costs
- Planning, Engineering, and Design Costs (PE&D)
- Supervision and Administration Costs (S&A)
- Contingency Costs
- Supervision, Inspection, and Overhead Costs (SIOH)
- Mitigation Costs

San Francisco district cost engineers estimated the financial costs of the SRDWSC deepening project listed above for use in this NED analysis. The sum of these costs is used to determine Interest During Construction (IDC), which represents the economic cost of building a project. The following section defines IDC and provides an explanation as to how it is calculated and included in the analysis. Together, these costs represent the estimated first cost of construction.

Another financial cost not included above is the annual cost accrued over the life of a project due to Operation, Maintenance, Repair, Replacement, and Rehabilitation (OMRR&R) activities that represent an increase over the current OMRR&R costs to maintain the 30' channel. OMRR&R was excluded from the list of financial costs above because it is not included in the calculation of IDC.

IDC takes into account only those costs incurred during construction. Currently, cost engineers agree that a channel deepening will not result in increased OMRR&R costs. Therefore, this analysis assumes OMRR&R costs equal to zero.

Mitigation costs can be incurred prior, during, and after project construction. There are no current mitigation cost estimates available for inclusion in this analysis. Environmentalists have indicated that the mitigation costs associated with a channel deepening are expected to be marginally higher than without-project mitigation costs. For now, mitigation costs have been left out of the NED analysis, so it is important to note that the overall NED costs for each project increment may increase in the future. However, given the results of the analysis, discussed in Section 9, inclusion of mitigation costs is not expected to impact the outcome of this analysis.

8.2. NED Costs – Economic

Interest During Construction (IDC) represents an economic cost of building a project that is considered in the selection of the recommended plan, but does not factor in as a paid cost. IDC is the cost of the foregone opportunity to invest the money required to construct a project for another use. The hypothetical return on another investment, measured as IDC, is counted as an NED cost. As an economic, rather than a financial, cost, IDC is not considered in the determination of cost-sharing responsibilities.

IDC reflects that project construction costs are not incurred in one lump sum, but as a flow over the construction period. This analysis assumes that construction expenditures are incurred at a constant rate over the period of construction, an assumption which is supported by the *NED Manual for Deep Draft Navigation*.

The calculation of IDC is summarized in the *NED Manual for Deep Draft Navigation* as follows.

> If B is the project base year (the year in which construction costs end and the project begins to derive benefits), then the total cost incurred during construction, including actual expenditures and implicit interest payment, is the equivalent lump-sum expenditure in the base year, C_B, which is computed as:
>
> $C_B = \sum_{i=1}^{t} C_i (1+r)^{t-1}$; where
>
> C_i construction expenditures in period i
>
> r per unit interest rate; and
>
> t number of construction periods up to the year that the project is implemented, which is the start of the period of analysis
>
> Therefore, IDC = C_B – Estimated First Cost of Construction

In this analysis, the IDC is evaluated using a flow of constant monthly construction expenditures. Calculating the hypothetical interest earned on each monthly construction payment and summing them to arrive at the total construction investment cost (C_B) enables the calculation of IDC by taking the difference between C_B and estimated construction cost discussed in Section 8.1. IDC is, therefore, a function of both estimated total construction cost and construction time. The longer it takes to construct a project, the larger the hypothetical alternative investment grows. The implication behind this fact is that IDC accounts for a larger proportion of NED Costs the larger the project and the longer it takes to construct. IDC figures calculated for the alternative channel depths evaluated in this analysis illustrate this point; these figures can be found in Table 37 in Section 8.3.

8.3. SRDWSC Deepening NED Costs

Table 40 contains the NED costs associated with each project depth evaluated in this analysis. As stated before, all costs, with the exception of IDC, were provided by the San Francisco District cost engineers working on this study.

Table 40: NED Costs of Alternative Channel Depth

Project Depth	Estimated Construction Cost	IDC	OMRR&R	Total NED Cost
31'	$69,231,035	$3,708,856	$0	$72,939,891
32'	$92,834,574	$6,407,194	$0	$99,241,768
33'	$111,150,575	$8,980,714	$0	$120,131,289
34'	$133,949,920	$12,962,631	$0	$146,912,551
35'	$151,583,306	$16,516,090	$0	$168,099,396

Detailed estimated first costs for each incremental depth are contained in Addendum 4 of this report. As was stated previously, mitigation cost estimates are not yet available for inclusion in the total NED costs.

9. Net Benefits and Benefit-to-Cost Ratio Analysis

Having identified the NED benefits and costs associated with the deepening of the SRDWSC, identification of the Proposed Alternative requires a comparison of the net benefits resulting from each project depth. By definition, the NED Alternative is the alternative that maximizes net benefits. This analysis identifies a Proposed Plan, which achieved the NED objective among the alternatives considered. Table 41 below contains the NED Costs and Benefits for incremental channel depths and the resulting net benefits and benefit-to-cost ratios.

Table 41: NED Benefits and Costs, Net Benefits, and Benefit-to-Cost Ratio by Alternative

Project Depth	Annual Costs	Annual Benefits	Net Benefits	BCR
31'	$3,616,156	$5,603,127	$1,986,971	1.55
32'	$4,920,129	$11,024,201	$6,104,072	2.24
33'	$5,955,773	$16,053,594	$10,097,821	2.70
34'	$7,283,513	$19,900,582	$12,617,069	2.73
35'	$8,333,897	$24,449,819	$16,115,922	2.93

According to the definition of the NED Alternative, a 35’ channel deepening has been selected as the Proposed Plan for this study because it is the alternative that results in the highest net benefits among the five incremental depths that have been analyzed. With net benefits exceeding $16 million, a 35’ channel deepening also has a Benefit-to-Cost Ratio (BCR) equal to 2.93.

Calculating the net benefits associated with each of the scenarios derived in the sensitivity analysis provides a measure of the 35’ channel deepening alternative’s viability by indicating whether or not a project is sustainable given the possibility that the most-likely projections used in this analysis are incorrect. Table 42 contains the results of the net benefit and BCR analyses of the low-growth and high-growth scenarios using the benefits calculated and displayed in Table 39. The most-likely scenario is displayed for comparison’s sake. To reiterate, these results were calculated for a 35’ deepening project.

Table 42: Sensitivity Analysis Results - Net Benefits and Benefit-to-Cost Ratios

Scenario	Annual Costs	Annual Benefits	Net Benefits	BCR
Low-Growth	$8,333,897	$15,146,967	$6,813,070	1.82
Most Likely	$8,333,897	$24,449,819	$16,115,922	2.93
High-Growth	$8,333,897	$54,546,844	$46,212,947	6.55

Because the most-likely scenario for a 35’ deepening yields positive net benefits and a BCR of 2.93, the yet higher net benefits and BCR resulting from the analysis of a high-growth scenario are unsurprising. The important result to note here is that even under the low-growth scenario, annual net benefits of a 35’ channel deepening exceed $6.8 million dollars and generate a BCR of 1.82. These results support the identification of a 35’ channel deepening as the Proposed Alternative.

In the interest of further testing the sensitivity of project justification to uncertainty in parameters, a few additional scenarios have been briefly considered to illustrate the effect of changes in different parameters on project benefits and are displayed in Figure 26.

Figure 26: Comparison of Growth Scenarios at the POWS

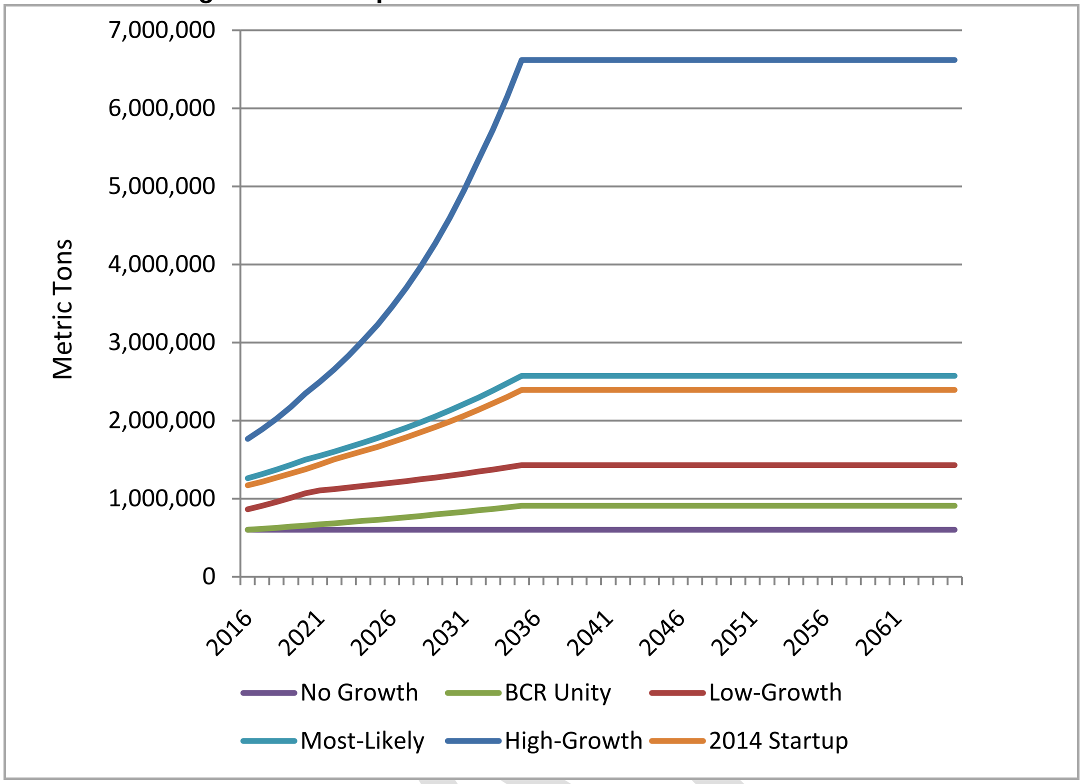


Figure 26 serves to provide a snapshot of five possible growth scenarios and the BCR Unity scenario for the SRDWSC deepening study. In 2009, the movement of goods through the POWS totaled 597,000 MT. The no-growth scenario displayed above depicts a scenario under which the POWS experiences no overall growth in imports and exports, so that yearly throughput remains constant at the 2009 level of nearly 600,000 MT through the period of analysis. The BCR Unity Scenario represents the minimum level of annual throughput necessary to justify a 35' channel deepening. As the graph shows, the no-growth scenario does not achieve BCR unity; if no growth occurs at the Port and a deepening takes place, the BCR will be .86 given current construction cost estimates. The no-growth scenario BCR was arrived at by taking a weighted average of the savings per ton using the expected distribution of goods moving through the Port in 2016 under the most-likely scenario. Using this weighted average of the savings per ton, annual savings were calculated over the period of analysis and then discounted using the 2010 federal discount rate. From this benefit stream, it was possible to calculate average annual savings under the no-growth scenario. The cost estimates used to calculate the no-growth BCR are the same as those identified in Table 40 for a 35' deepening.

The BCR Unity scenario illustrates that annual tonnages required to support a channel deepening fall below even the low-growth scenario tonnages forecasted in this analysis. The BCR Unity scenario was arrived at by using the 600,000 MT throughput from 2009 as a base year tonnage (base year being 2016), and applying a 2.22% annual growth rate until 2035, after which uncertainty requires projections to stagnate. The annual population growth rate projected for the domestic hinterland of the Port of West Sacramento from 2010 through 2050 is 1.22%.[50] Using this percentage as a base support for growth in imports to the Port, in the absence of any other source of economic growth, it is not high enough to support the necessary 2.2% average annual growth through 2035 necessary to achieve BCR unity. However, because two of the new commodities are exports from the Port, international economic growth rates should also be considered in the BCR Unity scenario. With scrap metal expected to account for a larger percentage of exports than wood pellets, and wood pellet export quantities constrained by annual production capacity, the BRIC country economic growth rates are more important to growth at the Port. A Goldman Sachs publication projects the BRIC countries to grow an average of more than 5% annually over the next 20 years and close to 5% by 2050.[51] Between population growth in the POWS domestic hinterland and projected BRIC economic growth, the BCR Unity scenario's 2.22% annual growth rate does not seem to be unreasonably high even under relatively low domestic economic growth conditions.

Additionally, under the BCR Unity scenario maximum annual throughput levels out at just over 900,000 MT. Historical throughput at the Port exceeded 900,000 MT in all but two years from 1988 through 2001, so that even if the Port merely returns to its historical level of activity, BCR Unity will be achieved. The most-likely, low-growth, and high-growth scenarios displayed above are discussed in detail in Section 5.

Another source of uncertainty is the assumption that new commodities will start shipping through the Port in 2012, a hypothesis derived from shippers' expectations regarding economic growth and completion of new facilities at the POWS. It seems prudent to consider that the economy may fail to expand as rapidly as originally expected and/or construction and permitting processes may take longer than estimated. The expected start-up date of new commodities moving through the Port was changed to 2014 under the "2014 Startup" scenario in order to see how dramatically a shift in initial operations of new commodities changes the outcome of the analysis. The graph illustrates that while projections under the 2014 Startup scenario result in somewhat lower annual tonnages than under the most-likely scenario, BCR unity is still achieved even when new growth at the Port occurs later than the expected 2012 startup date. The BCR under the 2014 Startup scenario is 2.71 and average annual benefits total more than $22.5 million.

The sensitivity analyses performed here are intended to illustrate a "worst case" scenario and demonstrate that even if the economy performs less robustly than expected, the economic risk of constructing the SRDWSC deepening remains relatively low.

[50] State of California, Department of Finance, *Race/Ethnic Population with Age and Sex Detail, 2000–2050.* Sacramento, CA, July 2007.
[51] Goldman Sachs. *Dreaming with BRICs: the Path to 2050*. Global Economics Paper No. 99. October 2003.

Addendum 1

Table 43: Key Commodity Densities

Commodity	Density (lb. per cubic ft.)
Biofuels	49.3 to 60.7
Cement	80.5 to 135
Concrete	140.0 to 150.01
Slag	60 to 132
Steel	>437
Wood Pellets	42

Addendum 2

Table 44: Example of Total Movement Cost Calculation

Bulk Carrier - Asia Trade Route							
	Source/Calculation	**Average Vessel Class**					
DWT	IWR 2009	15,000	25,000	35,000	40,000	50,000	60,000
Payload (metric tons)	NED Manual for Deep Draft Navigation	13,500	23,000	32,200	36,800	46,000	55,200
Load Factor (tons/in)	IWR 2009	64.7	88.9	109.7	119.2	137.0	153.5
	Source/Calculation	**Operating Cost in Port**					
Total Time in Port (hrs)	POWS	54	75	96	120	144	168
Total Hourly Cost in Port ($/hr)	Weighted Average of IWR 2009 Costs	$327	$383	$434	$459	$513	$544
Total Cost in Port ($)	= Time in Port x Cost in Port	$17,666	$28,727	$41,647	$55,029	$73,894	$91,333
	Source/Calculation	**Operating Cost at Sea**					
Distance (naut. mi.)	NED Manual for Deep Draft Navigation	5,750	5,750	5,750	5,750	5,750	5,750
Ballast Factor (BF)	Assumes vessel reloads at some point after the POWS	1.2	1.2	1.2	1.2	1.2	1.2
Distance with BF (naut. mi.)	= Distance x Ballast Factor	6,900	6,900	6,900	6,900	6,900	6,900
Speed (knots)	IWR 2009	14	14	14	14	14	14
Time at Sea (hrs)	= Distance / Speed	$493	493	493	493	493	493
Tidal Delay	SF Bay Bar Pilots	0	6	6	8.34	9.48	10
Total Time at Sea (hrs)	= Time at Sea + Tidal Delay	$493	$499	$499	$501	$502	$503
Cost at Sea per Hour ($/hr)	IWR 2009	$600	$677	$748	$783	$857	$908
Total Cost at Sea ($)	= Cost at Sea x Time at Sea	$295,714	$337,726	$373,145	$392,437	$430,503	$456,594
	Source/Calculation	**Harbor Fees**					
Origin ($)	POWS	$27,750	$27,750	$27,750	$27,750	$27,750	$27,750
Destination ($)	POWS	$37,000	$37,000	$37,000	$37,000	$37,000	$37,000
Total Harbor Fees ($)	= Origin Fees + Destination Fees	$64,750	$64,750	$64,750	$64,750	$64,750	$64,750
		Total Movement Cost					
Total Trip Cost ($)	= Cost at Sea + Cost at Port + Harbor Fees	$378,130	$431,203	$479,542	$512,216	$569,147	$612,677

Addendum 3

Table 45: Example of Transportation Cost and Savings per Ton
40,000 DWT Bulk Carrier from Asia

Measurement	Notes and Explanations	Calculation Steps	Results
DWT	n/a	n/a	40,000
Fully-Loaded Payload	Percentage of total DWT that is cargo = 92%	.92*40,000 =	36,800
Maximum Draft	POWS Vessel Data 1997-2009	n/a	41'
Total Movement Cost	Derived from IWR 2009 VOC and individual port and harbor fees	n/a	$512,216
Load Factor (tons/inch)	IWR 2009 data. Measures tons of cargo per inch of draft.	n/a	119.2
30' Channel Light Loading	Requires 2' underkeel clearance. Vessel light loads the difference between the maximum draft and 30.6' (Maximum allowable draft in channel – using 3.6' of tide)	41'-30.6' =	~10'
30' Channel Payload	Light loaded payload is equal to the total payload minus the tons per inch times the number of feet (in inches) the vessel has been lightloaded	36,800 - (119.224*10*12) =	22,493
Cost per ton	Total Movement Cost divided by 30' payload	$512,216/22,493 =	$22.78
35' Channel Light Loading	Requires 2' underkeel clearance. Vessel light loads the difference between the maximum draft and 35.6' (Maximum allowable draft in channel – using 3.6' of tide)	41'-35.6' =	~5'
35' Channel Payload	Light loaded payload is equal to the total payload minus the tons per inch times the number of feet (in inches) the vessel has been lightloaded	36,800 - (119.224*5*12) =	29,647
Cost per ton	Total Movement Cost divided by 35' payload	$512,216/29,647 =	$17.28
Savings per ton	Difference between 30' Channel Cost per Ton and 35' Channel Cost per Ton	$22.78 - $17.28 =	**$5.50**

Addendum 4

Table 46: Estimated First Cost of Project Construction for All Project Depths

Cost	31' Project Depth	32' Project Depth	33' Project Depth	34' Project Depth	35' Project Depth
Total Land Construction cost	$39,759,656	$41,511,079	$43,580,948	$46,066,594	$48,491,909
Dedging Cost for Project Depth	$21,050,985	$36,659,639	$48,264,019	$62,773,804	$73,636,712
Planning Engineering & Design (PE&D)	$1,473,569	$2,566,175	$3,378,481	$4,394,166	$5,154,570
S&A Costs	$1,473,569	$2,566,175	$3,378,481	$4,394,166	$5,154,570
Contingency Cost	$4,210,197	$7,331,928	$9,652,804	$12,554,761	$14,727,342
SIOH (Supervision Inspection and Overhead)	$1,263,059	$2,199,578	$2,895,841	$3,766,428	$4,418,203
Total Cost	**$69,231,035**	**$92,834,574**	**$111,150,575**	**$133,949,920**	**$151,583,306**
Project Duration Time	29.1 months	37.2 months	43.2 months	50.7 months	56.7 months