The Brattle Group

Employment Impacts for Proposed Bay Delta Water Conveyance Tunnel Options

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INTRODUCTION

At the request of the Delta Habitat Conservation and Conveyance Program (DHCCP), *The Brattle Group* has estimated the number of direct, indirect, and induced jobs that would be created by the construction and operation of two water conveyance system options designed to deliver water to customers of the State Water Project (SWP) and the Central Valley Project (CVP). The larger option would have the capacity to deliver water at a rate of 15,000 cubic feet per second (cfs), while the smaller option would have the capacity to deliver 3,000 cfs. These systems reflect the largest and smallest size tunnel options currently under consideration by the Bay Delta Conservation Plan (BDCP). While the DHCCP process has yet to identify a conveyance alternative and a wide array of alternatives are being analyzed, this analysis is designed to provide some insight to the job creation potential of conveyance construction. The analysis attempted to use conservative assumptions, and does not include jobs created by habitat restoration and other initiatives contemplated by BDCP.

Based on our analysis, the larger tunnel option would create 129,193 (13,938 direct, 75,689 indirect, and 39,566 induced) full-time equivalent (FTE) jobs in California during an expected seven year construction period.[1] The smaller option would create 78,875 (8,130 direct, 43,109 indirect, and 22,636 induced) FTE jobs in California during the expected 7.5 year construction period. A breakdown by county for both options is presented in Tables 1 and 2.

The Metropolitan Water District of Southern California commissioned *The Brattle Group* to conduct this independent research on DHCCP's behalf.

[1] FTE or full-time equivalent is defined as the number of total hours worked divided by the maximum number of compensable hours in a work year as defined by law. For example, an FTE of 1.0 means that the position is equivalent to 1 full time worker, while an FTE of 0.5 means the position is equivalent to a half time worker.

Table 1: Impact of 15,000 cfs All Tunnel Option
Construction Period (Full-Time Equivalent Jobs)

	California (State)	Contra Costa County	Sacramento County	San Joaquin County
Direct FTE Employment	13,938	182	663	583
Indirect FTE Employment	75,689	5,157	21,665	35,893
Induced FTE Employment	39,566	1,571	8,416	13,976
Total FTE Employment	*129,193*	*6,910*	*30,744*	*50,451*

Sources: IMPLAN v3; *The Brattle Group* 2011.
Notes:
All impacts are based on cost estimates in 2010 dollars.
We assume that spending on Engineering & Design occurs outside of the three county region encompassing the facility.

Table 2: Impact of 3,000 cfs All Tunnel Option
Construction Period (Full-Time Equivalent Jobs)

	California (State)	Contra Costa County	Sacramento County	San Joaquin County
Direct FTE Employment	8,130	102	373	328
Indirect FTE Employment	43,109	3,236	13,705	19,070
Induced FTE Employment	22,636	975	5,256	7,425
Total FTE Employment	*73,875*	*4,314*	*19,334*	*26,823*

Sources: IMPLAN v3; *The Brattle Group* 2011.
Notes:
All impacts are based on cost estimates in 2010 dollars.
We assume that spending on Engineering & Design occurs outside of the three county region encompassing the facility.

The project will create additional jobs over an expected 50 year operating period. These employment impacts are presented on an annual basis in Tables 3 and 4 below. The 15,000 cfs project will generate over 500 FTEs and the 3,000 cfs project will generate over 300 FTEs annually accounting for direct, indirect, and induced impacts.

Table 3: Impact of 15,000 cfs All Tunnel Option
Operating Period (Annualized Full-Time Equivalent Jobs)

	California (State)	Contra Costa County	Sacramento County	San Joaquin County
Direct FTE Employment	100	13	46	41
Indirect FTE Employment	177	14	67	49
Induced FTE Employment	302	21	113	101
Total FTE Employment	*579*	*47*	*227*	*191*

Sources: IMPLAN v3; *The Brattle Group* 2011.
Notes:
All costs have been annualized over a 50 year operating period.

Table 4: Impact of 3,000 cfs All Tunnel Option
Operating Period (Annualized Full-Time Equivalent Jobs)

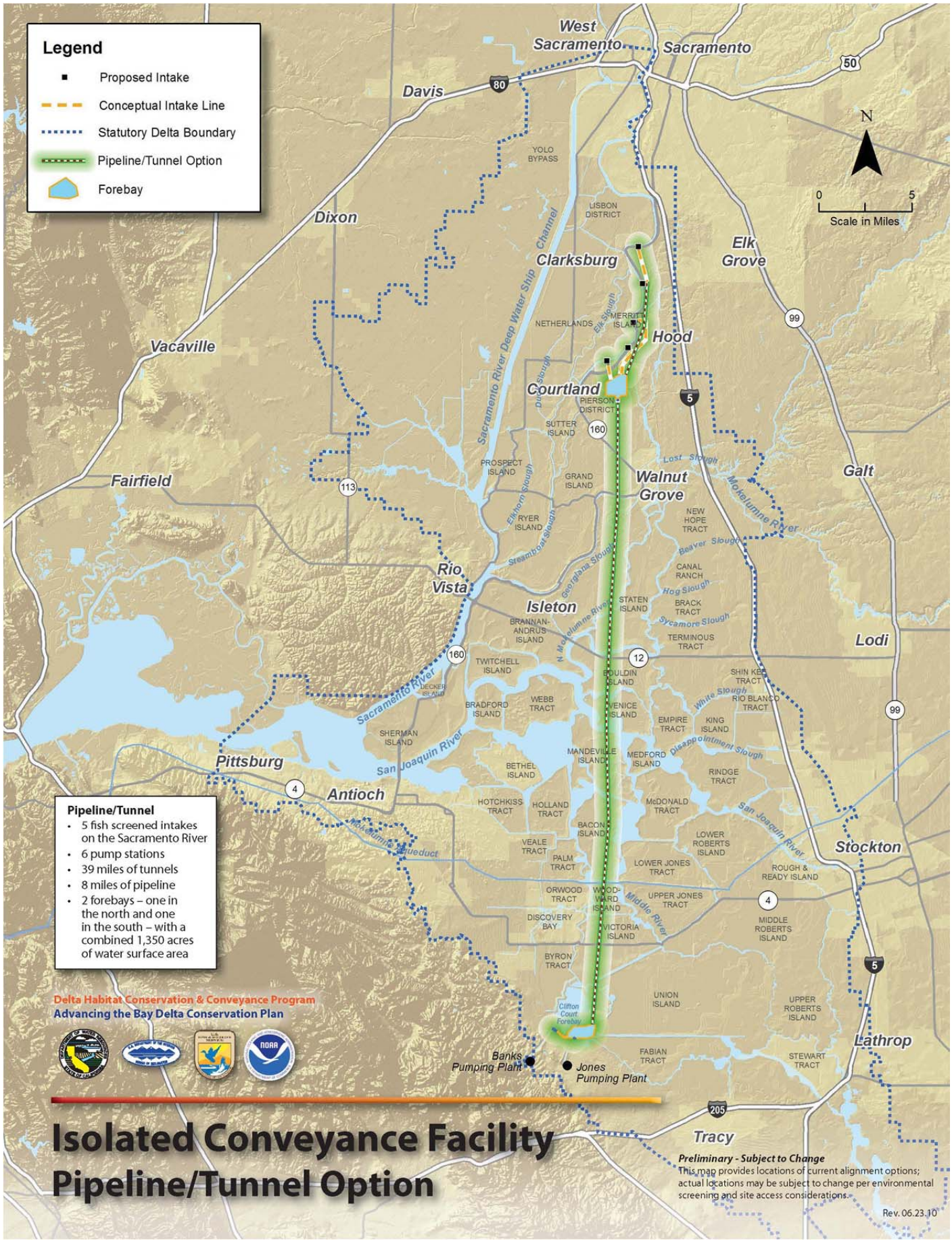
	California (State)	Contra Costa County	Sacramento County	San Joaquin County
Direct FTE Employment	75	10	35	31
Indirect FTE Employment	87	7	33	24
Induced FTE Employment	148	10	56	50
Total FTE Employment	*310*	*27*	*123*	*104*

Sources: IMPLAN v3; *The Brattle Group* 2011.
Notes:
All costs have been annualized over a 50 year operating period.

PROJECT DESCRIPTION

BDCP (the 50-year habitat conservation plan under the Endangered Species Act with comprehensive ecosystem improvements) and DHCCP (BDCP's environmental review process) are reviewing new water conveyance improvements to deliver water across the Bay Delta to the customers of the SWP and CVP. Several options are under consideration. The options include a range of tunnel systems sized from 3,000 cfs with one screened intake on the Sacramento River to 15,000 cfs with five screened intakes on the Sacramento River. The smallest system would include two 18-foot diameter tunnels. The largest system would include two 33-foot diameter tunnels. Water would be transported approximately 39 miles from intakes near Hood in Sacramento County to Byron Track forebay in Contra Costa County. This route would cross portions of three counties -- Contra Costa, Sacramento, and San Joaquin. See Figure 1.

Figure 1: Isolated Conveyance Facility – Pipeline/Tunnel Option



METHODOLOGY

The estimates presented here are based on employment multipliers generated by the IMPLAN model. IMPLAN is the most widely used model for this purpose. IMPLAN has been used by many California government agencies.[2] IMPLAN is what is referred to by economists as an input-output model. The input-output model was first specified in 1941 by Leontief for which he won the Nobel Prize in economics.[3] The core of this model is a matrix of average input (purchase) coefficients that describe the mix of goods, services and labor that are required to produce a unit of output. These coefficients represent what economists refer to as production functions. The dimensions of the matrix are determined by how many industry sectors are accounted for and whether government and household sectors are included. The basic model can be expressed in a straightforward equation: $X= (I-A)^{-1} *dY$ where (I-A) is the inverse of the Leontief matrix, dY is a change in final demand and X is output.

So-called employment and output multipliers can be derived from this equation. These multipliers describe the change in employment or output for a given change in final demand. Models are referred to as Type I and Type II depending on whether they include a household sector. Type II models, which incorporate the household sector, provide multipliers that capture direct, indirect, and induced impacts. Direct impacts refer to the direct purchases of goods, services, energy, and labor to meet a final demand. Indirect impacts refer to the purchases of goods, services, energy, and labor required to produce the directly demanded factors. Induced impacts refer to the purchases of goods, services, energy, and labor to meet the demands of households who see increased income as a consequence of additional employment. IMPLAN can be run as a Type II model providing direct, indirect, and induced job estimates.

The IMPLAN model also accounts for the trade of goods and services between jurisdictions including counties and states using what are referred to as regional purchase coefficients (RPCs). These coefficients are calculated based on observed trading of goods and services between counties and states. For example, the demand for a particular good in one California county may

[2] IMPLAN's client list includes the California Department of Finance, the California Department of Transportation, the California Department of Water Resources and the California State Water Resources Control Board. At the federal level, IMPLAN has been used by the US Army Corps of Engineers, the Bureau of Economic Analysis, the Bureau of Land Management and the Bureau of Reclamation.

[3] In 1941 Leontief published his first book on input-output economics under the title *The Structure of the American Economy, 1919-1929*.

be met in part by firms located in another California county or an out-of-state county. Consequently, both local (a county or group of counties) and state level employment impacts can be estimated.

In this analysis, employment impacts were estimated at the state level and at the county level for the three counties that would be directly affected by project construction. As described below, very disaggregate construction cost data was provided that identified equipment, materials, and labor expenses as well as expected sales tax payments. We assigned each of the cost categories provided to specific North American Industrial Classification System (NAICS) codes, which were then mapped to the IMPLAN sectoring scheme. Consideration was also given to where expenditures would be made. For example, some materials, notably tunnel drilling equipment and large pumps, are likely to be manufactured outside of California. Other cost items, in particular construction labor and equipment and materials such as concrete and steel, are more likely to be purchased locally. For the purposes of estimation, we have assumed that initial local spending will occur within the county where specific system components are anticipated. Actual spending patterns, of course, could be different. As noted above, IMPLAN will account for inter county spending patterns.

DATA

This analysis is based on preliminary project cost estimates prepared by DHCCP consultants. According to these estimates, the bulk of project spending will take place in the construction, concrete product manufacturing, architectural/engineering and fabricated metal product manufacturing sectors. The 15,000 cfs facility is estimated to cost $12.5 billion, while the 3,000 cfs facility is estimated to cost $7.2 billion.[4] The cost allocations of the 15,000 cfs and 3,000 cfs facilities (for domestic spending only) are shown in Figures 2 and 3 below.

[4] Both of these cost estimates include imported materials. The 15,000 cfs facility includes approximately $0.89 billion in boring machines, large values and pumps that are likely to come from foreign sources. The 3,000 cfs includes about $0.66 billion for similar equipment and materials.

Figure 2: Construction Period Cost Breakdown by IMPLAN Sector of 15,000 cfs All Tunnel Option

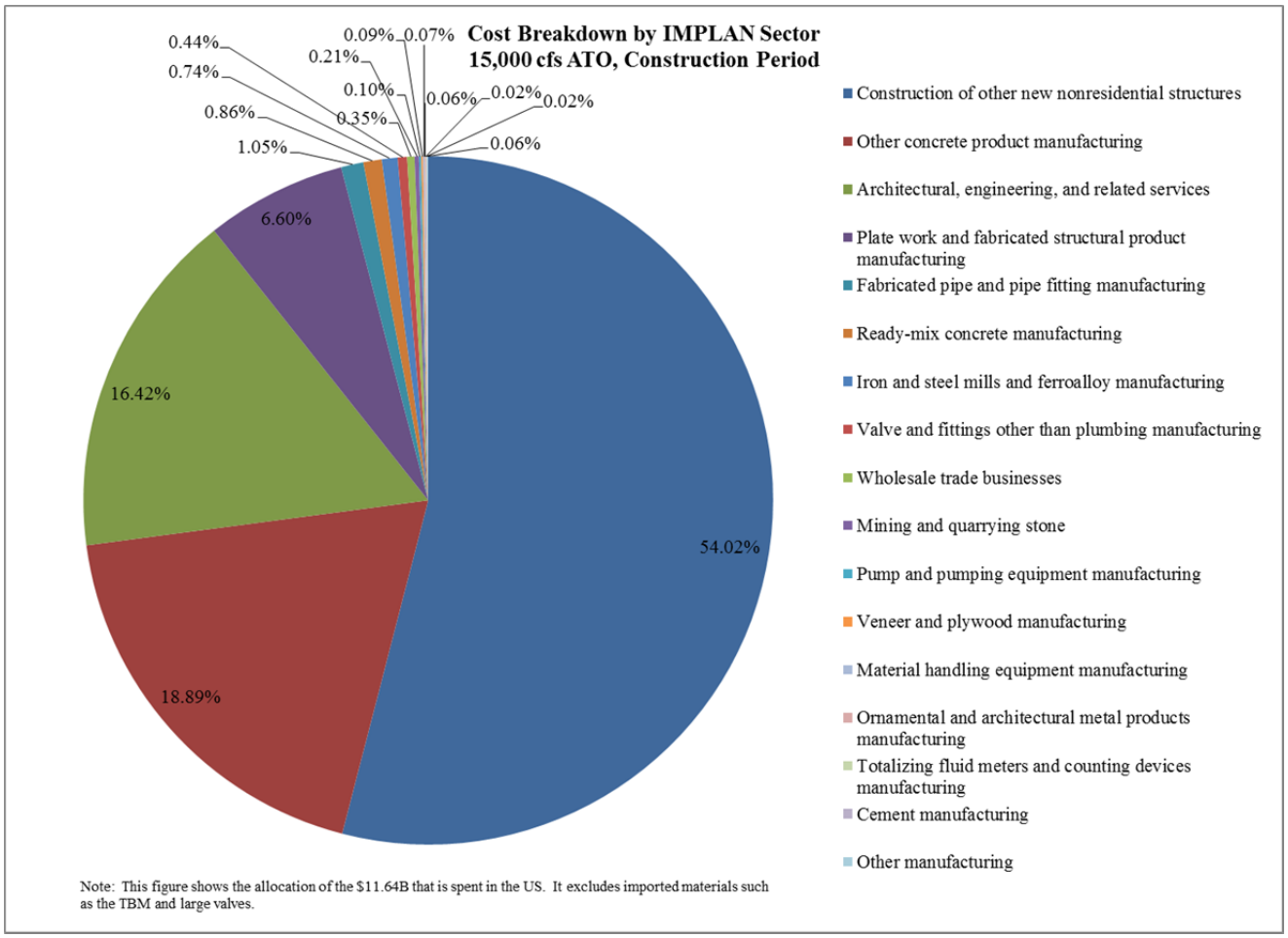
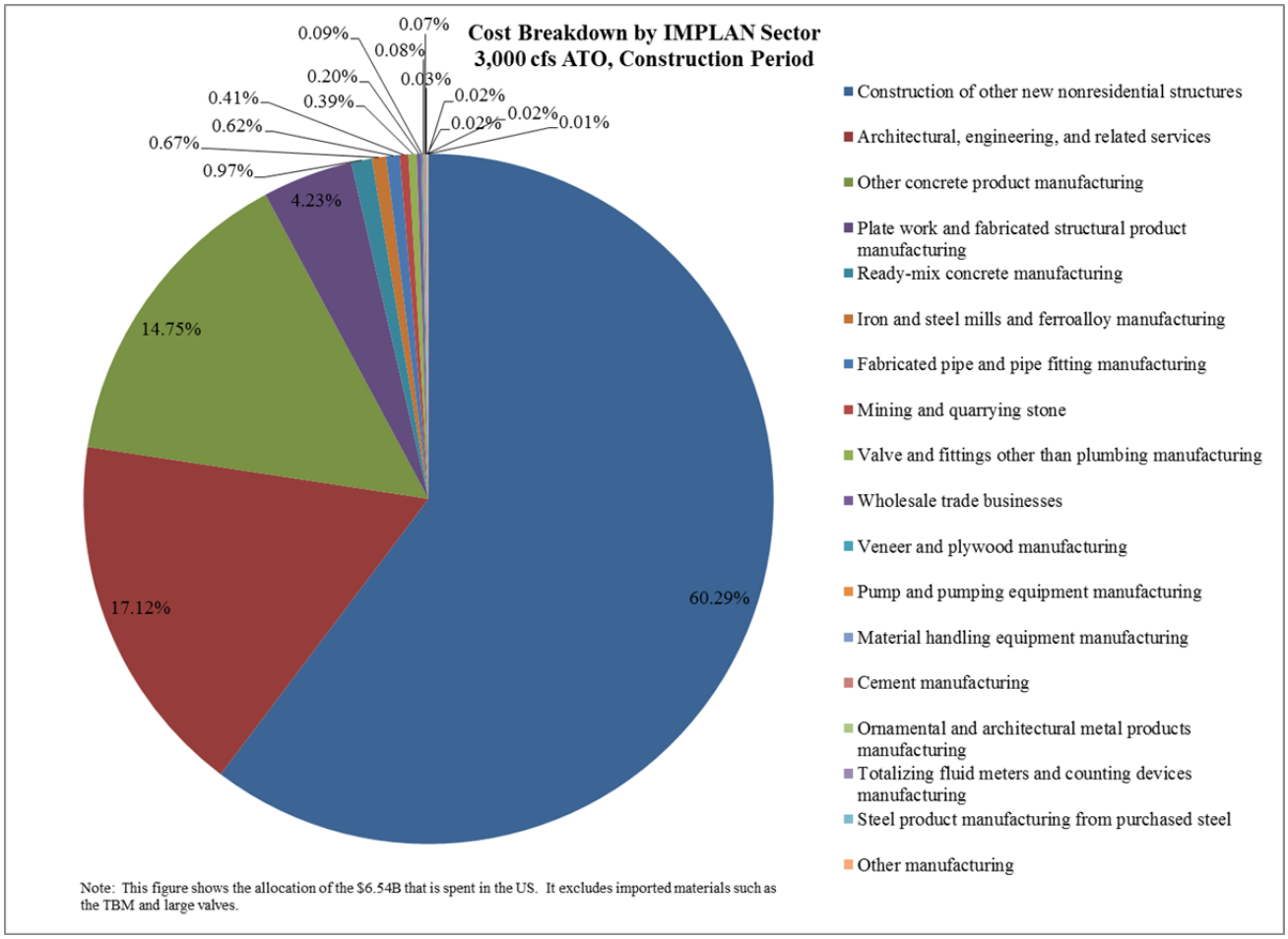


Figure 3: Construction Period Cost Breakdown by IMPLAN Sector of 3,000 cfs All Tunnel Option



Tables 5 and 6 present the construction period cost breakdowns by broad spending category. These cost allocations are based on data from several different sources and are subject to rounding error.

Table 5: Construction Period Cost Breakdown for 15,000 cfs ATO

	Item		Cost Including Imports		Cost Excluding Imports
[1]	Total Materials	$	4,333,813,058	$	3,443,587,736
[2]	Total Labor Including Eng/PM/CM & Construction	$	2,128,521,271	$	2,128,521,271
[3]	Total Equipment	$	666,077,278	$	666,077,278
[4]	Total Subcontractor	$	5,405,900,000	$	5,405,900,000
[5]	***TOTAL Construction Period Cost***	***$***	***12,534,311,607***	***$***	***11,644,086,285***

Notes
All numbers are in 2010 dollars.
Imports consist of the tunnel boring machine and large valves and pumps.
Items [1] through [4] include contingencies, assumed to be 35% for tunnel-related items and 25% for all other items.

Table 6: Construction Period Cost Breakdown for 3,000 cfs ATO

	Item		Cost Including Imports		Cost Excluding Imports
[1]	Total Materials	$	2,137,014,646	$	1,477,462,344
[2]	Total Labor Including Eng/PM/CM & Construction	$	1,253,864,097	$	1,253,864,097
[3]	Total Equipment	$	370,321,257	$	370,321,257
[4]	Total Subcontractor	$	3,438,800,000	$	3,438,800,000
[5]	***TOTAL Construction Period Cost***	***$***	***7,200,000,000***	***$***	***6,540,447,698***

Notes
All numbers are in 2010 dollars.
Imports consist of the tunnel boring machine and large valves and pumps.
Items [1] through [4] include contingencies, assumed to be 35% for tunnel-related items and 25% for all other items.

For the 15,000 cfs facility, the bulk of spending on materials and subcontractors during the construction phase is related to the tunnel component of the project, while most of the labor and equipment cost can be attributed to the construction of the intakes, pumping plants and forebays. Construction of the 3,000 cfs tunnel will require (before contingencies) roughly half the amount of expenditure required for the 15,000 cfs facility, with the bulk of the reduction coming from materials.

Over the expected 50 year operating life of the tunnel, the total annual cost of operation is expected to amount to around $82.6 million per year for the 15,000 cfs tunnel and $40.5 million per year for the 3,000 cfs tunnel. See Tables 7 and 8 for a more detailed breakdown of each of these operating cost estimates.

Table 7: Operating Period Cost Breakdown for 15,000 cfs All Tunnel Option

	Item		Cost Per Year
[1]	Energy	$	17,800,000
[2]	Operations and Maintenance	$	18,900,000
[3]	Replacement and Refurbishment	$	45,900,000
[4]	*TOTAL Annual Operating Period Cost*	*$*	*82,600,000*

Sources: November 18, 2010 Working Draft of BDCP
Notes:
All numbers are in 2010 dollars.
Spending has been annualized over a 50 year operating period.

Table 8: Operating Period Cost Breakdown for 3,000 cfs All Tunnel Option

	Item		Cost Per Year
[1]	Energy	$	8,900,000
[2]	Operations and Maintenance	$	13,230,000
[3]	Replacement and Refurbishment	$	18,360,000
[4]	*TOTAL Annual Operating Period Cost*	*$*	*40,490,000*

Notes:
All numbers are in 2010 dollars.
Spending has been annualized over a 50 year operating period.
[1] is assumed to be 50% as large as for the 15,000 cfs facility.
[2] is assumed to be 70% as large as for the 15,000 cfs facility.
[3] is assumed to be 50% as large as for the 15,000 cfs facility.

RESULTS

Based on our analysis, the 15,000 cfs facility would create 129,193 (13,938 direct, 75,689 indirect, and 39,566 induced) FTE jobs in California during an expected 7.5 year construction period.[5] The 3000 cfs facility would create 78,875 (8,130 direct, 43,109 indirect, and 22,636 induced) FTE jobs in California during the 7.5 year construction period.

Table 9 and Table 10 show construction period employment impacts for the top ten IMPLAN sectors in terms of job creation for the 15,000 cfs facility and 3,000 cfs facility, respectively. These sectors account for more than 60 percent of the estimated jobs. Most of the employment impacts are the result of direct and induced spending, with substantial job creation occurring in the construction, design and materials manufacturing sectors, as well as sectors supported by households spending their income on food, healthcare and housing.

Table 9: Construction Period Employment Impacts by IMPLAN Sector for 15,000 cfs ATO in California
Top Ten IMPLAN Sectors In Terms of Total Employment Creation

IMPLAN	IMPLAN Description	FTE Jobs
36	Construction of other new nonresidential structures	35,842
369	Architectural, engineering, and related services	13,487
163	Other concrete product manufacturing	9,838
413	Food services and drinking places	4,591
319	Wholesale trade businesses	3,878
360	Real estate establishments	3,160
186	Plate work and fabricated structural product manufacturing	2,844
382	Employment services	2,561
394	Offices of physicians, dentists, and other health practitioners	2,084
335	Transport by truck	1,727

Notes
FTE Jobs includes direct, indirect and induced employment.

[5] FTE or full-time equivalent is defined as the number of total hours worked divided by the maximum number of compensable hours in a work year as defined by law. For example, an FTE of 1.0 means that the position is equivalent to 1 full time worker, while an FTE of 0.5 means the position is equivalent to a half time worker.

Table 10: Construction Period Employment Impacts for 3,000 cfs ATO in California
Top Ten IMPLAN Sectors In Terms of Total Employment Creation

IMPLAN	IMPLAN Description	FTE Jobs
36	Construction of other new nonresidential structures	22,724
369	Architectural, engineering, and related services	7,867
163	Other concrete product manufacturing	4,337
413	Food services and drinking places	2,611
319	Wholesale trade businesses	2,107
360	Real estate establishments	1,787
382	Employment services	1,438
394	Offices of physicians, dentists, and other health practitioners	1,192
186	Plate work and fabricated structural product manufacturing	1,102
335	Transport by truck	967

Notes
FTE Jobs includes direct, indirect and induced employment.

REFERENCES

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