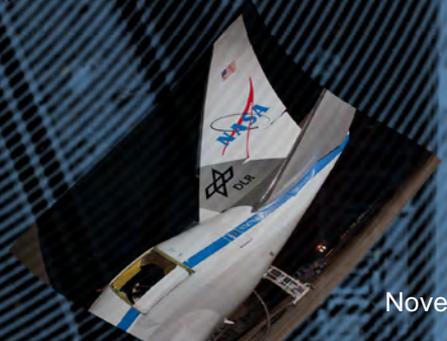
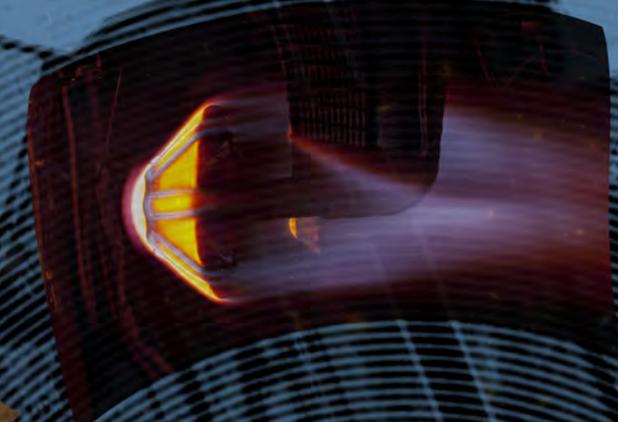
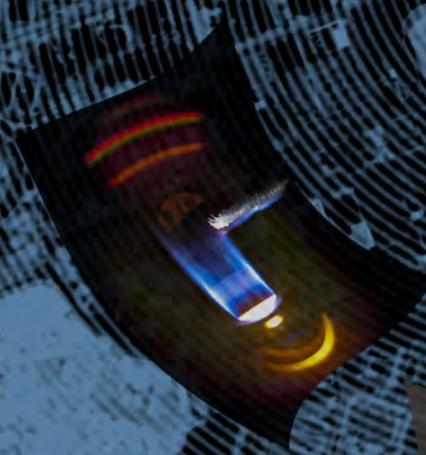
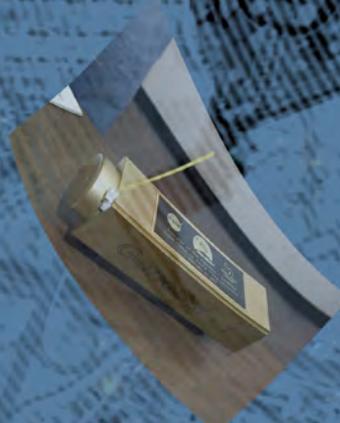


# ECONOMIC BENEFITS STUDY

## 2015 Economic Activities Update

*NASA Ames Research Center  
and NASA Research Park in Silicon Valley*



## Structure of the Update

As with the 2009 EBS, this 2015 update estimates the economic impacts of:

- ▶ NASA Ames Research Center
- ▶ NASA Research Park Construction Activity
- ▶ NASA Research Park Ongoing Operations

For each set of economic activities, BAE estimates the direct, indirect, and induced economic benefits; as measured by jobs and dollar value of economic output. To make these estimates, BAE has utilized IMPLAN, a PC-based computer software package that automates the process of developing input-output models for regions within the United States. Refer to Attachment A for a full description of IMPLAN, as well as definitions for the terms “direct,” “indirect,” and “induced” impacts.

To prepare this update, BAE obtained the most recent California data set offered by IMPLAN at the county and state level. The data used was current as of 2013. BAE made consumer price index-based adjustments to bring the IMPLAN output to 2015 dollars.



The Lunar Crater Observation and Sensing Satellite (LCROSS) in Ames clean room N-240 - mission staff cleaning for shipment to Northrop Grumman, Redondo Beach, CA



Aerial imagery of NASA Ames Research Center

## Geographic Scope of Analysis

This update is limited to estimating the economic benefits for the San Francisco Bay Area region as well as the entire state of California..

In the 2009 EBS, BAE had prepared estimates at the national level. Due to limitations in available data regarding the scope and value of NASA Ames contracts performed outside of California, BAE was unable to prepare updates at the national level for this updated analysis.

Also in the 2009 EBS, BAE obtained data in a form that permitted the same economic benefits analysis of NASA Ames Research Center's activities on the nine-county Bay Area region. Again, due to data limitations encountered for this 2015 update, the analysis presented herein for NASA Ames' is limited to the California scale.

## Economic Benefits: Ames Research Center

As established by the findings in previous EBS reports, the NASA Ames campus generates significant economic stimulus, or benefits, to the regional and state economy. Employment and economic output, associated with employee spending patterns and productivity, are primary drivers of this "benefit."<sup>1</sup>

The following analysis presents quantitative employment and economic output associated with the traditional NASA Ames campus for the State of California.<sup>2</sup>

Employment and economic factors measured include:

- ▶ NASA Ames Budget and Expenditures
- ▶ Contracts Awarded (amount, recipients, and geography)
- ▶ Employment and Compensation
- ▶ Direct, Indirect, and Induced Economic Benefits

<sup>1</sup> Output is defined by the U.S. Bureau of Economic Analysis as sales or receipts and other operating income, commodity taxes, and inventory change.

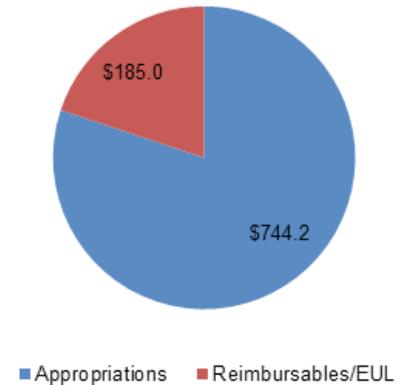
<sup>2</sup> The analysis excludes economic benefits generated by NASA Research Park; these additional benefits are presented in a separate section of this memorandum report.

### Budget and Expenditures

In Fiscal Year 2015, the operating budget for NASA Ames was approximately \$929 million. Of this total, NASA Ames received approximately \$744.2 million through NASA’s overall federal appropriation. In addition, NASA Ames obtained \$185.0 million of its FY 2015 operating budget through reimbursements from other government agencies and private entities (see Figure 1). NASA Ames’ revenue from reimbursable services also has increased in recent years, attributed to increased enhanced use leasing (“EUL”) and partnership activities.

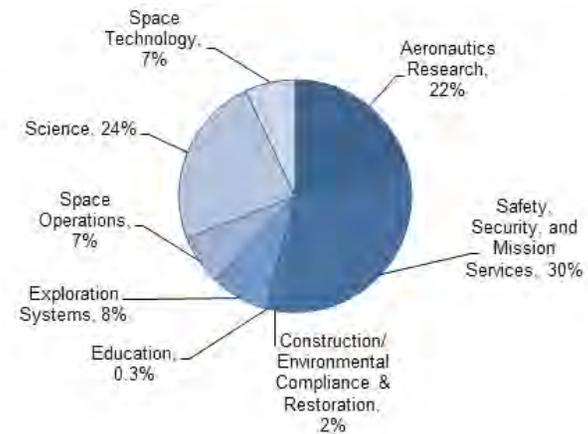
Funding for NASA Ames supports core enterprises such as Aeronautics Research, Education, Exploration Systems, Safety, Security, and Mission Services, Science, Space Technology, and Space Operations. Figure 2 provides a breakdown of the percent of appropriations budget that were allocated to each program in Fiscal Year 2015.

**Figure 1:** NASA Ames Operating Budget, FY 2015 (millions of dollars)



Source: NASA Ames Research Center 2015; BAE, 2015

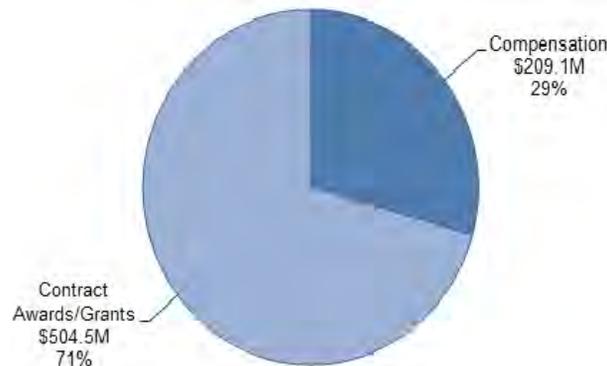
**Figure 2:** NASA Ames Appropriations Budget by Mission, FY 2015



Source: NASA Ames Research Center 2015; BAE, 2015



**Figure 3: NASA Ames Appropriations Budget by Mission, FY 2015**



Source: NASA Ames Research Center 2015; BAE, 2015

**Table 1: California Contract Awards by County, Place of Performance, FY 2015**

Place of Performance	FY 2015	Percent
<b>Bay Area Counties</b>		
Santa Clara	\$397,124,001	92.7%
San Mateo	\$835,149	0.2%
Alameda	\$543,670	0.1%
Other Bay Area Counties	\$249,683	0.1%
<b>Bay Area Subtotal</b>	<b>\$398,752,503</b>	<b>93.1%</b>
<b>Other California Counties</b>		
Los Angeles	\$23,709,540	5.5%
Orange	\$2,130,872	0.5%
San Diego	\$1,741,367	0.4%
Monterey	\$1,223,684	0.3%
Other California Counties	\$659,153	0.2%
<b>Other Counties Subtotal</b>	<b>\$29,464,616</b>	<b>6.9%</b>
<b>California Total</b>	<b>\$428,217,119</b>	<b>100.0%</b>

Source: Federal Procurement Data System – Next Generation (FPDS – NG), 2015; BAE, 2015

## Compensation

Within the operating budget of NASA Ames, there are two major categories of spending. This includes performance awards to contractors and grantees, and compensation to NASA Ames' own civil servant employees. Figure 3 presents the spending breakdown of Fiscal Year 2015 budget for these two categories at NASA Ames. Approximately \$504.5 million, or 71 percent of the NASA Ames Fiscal Year 2015 budget, was spent through contracts and grants that were awarded to businesses, universities, non-profits and other government entities in the California Bay Area and throughout the entire United States. The remaining 29 percent, or \$209.1 million, was comprised of compensation to civil servant employees at NASA Ames. Note that this compensation break down is based on total direct appropriations (\$744.2M). Reimbursable dollars, travel, and other small purchases are excluded.

## Geographic Distribution of Contract Awards in California

Of the \$503 million awarded to NASA Ames in Fiscal Year 2015<sup>3</sup> approximately \$428 million was received by contractors and grantees in California. This distribution is illustrated in Table 1. The San Francisco Bay Area received approximately \$399 million in Fiscal Year 2015<sup>4</sup>, representing 93.1 percent of the NASA Ames contract awards in California.

Contractors and grantees located in Santa Clara County (the same county as NASA Ames) received \$397.1 million in NASA Ames contracts. Contractors and grantees in other Bay Area counties received approximately \$1.6 million worth of NASA Ames awards in Fiscal Year 2015. The majority of the work that is performed under these contracts and grants occurs at NASA Ames or within Santa Clara County. Due to the high level of investment in the surrounding area, NASA Ames attracts a wide range of research and development activity into the Bay Area.

<sup>3</sup> Note that the data provided on a geographic basis is \$1.5 million less than the total contract awards and grants reported in Figure 3.

<sup>4</sup> San Francisco Bay Area includes nine counties: Alameda, Contra Costa, Marin, Napa, San Francisco, Santa Clara, San Mateo, Solano, and Sonoma.



NASA Ames also has a smaller number of contract awards in Fiscal Year 2012 that were performed in California counties outside of the Bay Area. This includes Los Angeles County (\$23.7 million), Orange County (\$2.1 million), and San Diego County (\$1.7 million). Figure 4 illustrates the geographic distribution of the NASA Ames awards to contractors and grantees in Fiscal Year 2015.

### Distribution of Small Business Contract Awards

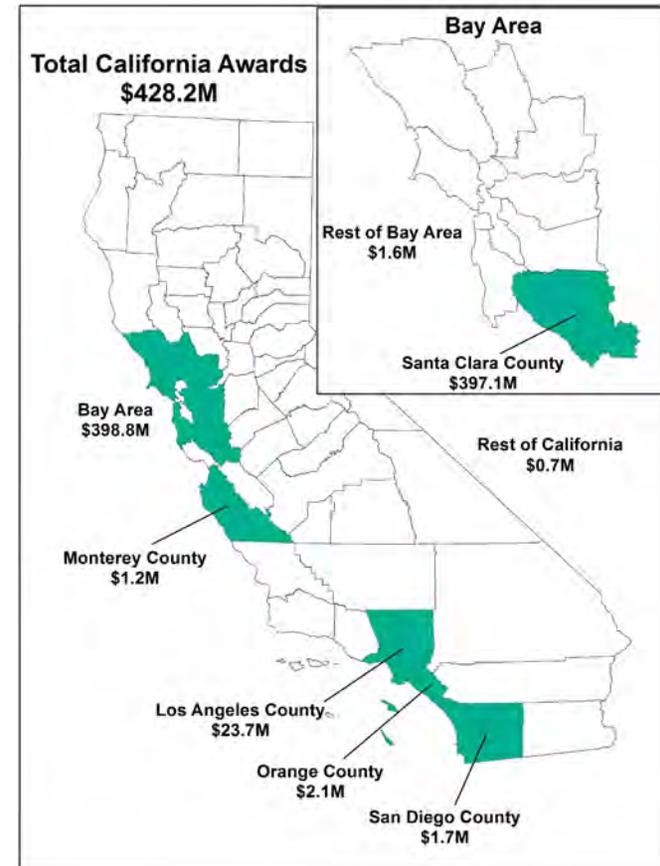
Of its \$428 million in contract awards in California, NASA Ames awarded over \$190 million to small businesses in Fiscal Year 2015. As shown in Table 2, the largest category of these contract awardees were classified as Small Business Administration (SBA) Certified Small Disadvantaged Businesses, followed by Minority Owned Businesses and SBA Certified 8(a) Program Participants.

**Table 2:** Categorization of Small Business Contract Awards by Socio-Economic Group, FY 2015

<u>Socio-Economic Group</u>	<u>Award Amount (Millions)</u>	<u>Percentage of Total</u>
SBA Certified Small Disadvantaged Business	\$91.5	48%
Minority Owned Business	\$77.1	40%
SBA Certified 8(a) Program Participant	\$50.0	26%
Veteran Owned	\$48.8	26%
Alaskan Native Owned	\$46.3	24%
Non Profit Organizations	\$29.7	16%
Woman Owned	\$18.1	10%
Black American Owned	\$9.8	5%
Hispanic American Owned	\$8.0	4%
Subcontinent Asian (Asian-Indian) American Owned	\$7.7	4%
SBA Certified Hub Zone Firm	\$4.8	3%
Asian-Pacific American Owned	\$2.4	1%
Service Disabled Veteran Owned	\$1.7	1%
Native American Owned	\$1.3	1%

Source: Federal Procurement Data System – Next Generation (FPDS – NG), 2015; BAE, 2015

**Figure 4:** Contract Awards to Contractors and Grantees by Place of Performance, FY 2015



Source: NASA Ames; BAE Urban Economics





Commercial Orbital Transportation Services Program (COTS).  
Illustration of Low Earth Orbit spacecraft provided by Silicon Valley  
Space Club

## Contracts and Awards Link NASA to California Private Industry

Grant recipients and contractors in Santa Clara, the Bay Area, and California connect NASA Ames to a wide range of businesses, educational institutions, non-profit organizations, and governmental entities. Table 3 shows that within the Bay Area, private-sector businesses performed 79.5 percent of all contract awards. Following private sector businesses, educational institutions performed 6.8 percent; non-profits performed 6.7 percent; and other government entities performed 6.8 percent of contract awards in Fiscal Year 2015.

**Table 3:** California Contract Awards by County, Place of Performance, FY 2015

<u>Bay Area Counties</u>	<u>Businesses</u>	<u>Education</u>	<u>Non-Profit</u>	<u>Other Gov't</u>	<u>Totals</u>
Alameda	\$522,899	\$20,771	\$0.00	\$0.00	\$543,670
Contra Costa	\$143,720	\$0.00	\$0.00	\$0.00	\$143,720
San Francisco	\$(8,000)	\$0.00	\$0.00	\$0.00	\$(8,000)
San Mateo	\$19,080	\$0.00	\$816,069	\$0.00	\$835,149
Santa Clara	\$316,079,024	\$27,159,960	\$26,900,057	\$26,984,960	\$397,124,001
Sonoma	\$113,963	\$0.00	\$0.00	\$0.00	\$113,963
<b>Bay Area Subtotals</b>	<b>\$316,870,686</b>	<b>\$27,180,731</b>	<b>\$27,716,127</b>	<b>\$26,984,960</b>	<b>\$398,752,503</b>
Percent	79.5%	6.8%	7.0%	6.8%	100.0%
<b>Other California Counties</b>					
Los Angeles	\$22,568,871	\$0.00	\$1,140,669	\$0.00	\$23,709,540
Monterey	\$1,223,684	\$0.00	\$0.00	\$0.00	\$1,223,684
Orange	\$2,130,872	\$0.00	\$0.00	\$0.00	\$2,130,872
Sacramento	\$83,850	\$0.00	\$0.00	\$0.00	\$83,850
San Diego	\$1,728,032	\$13,335	\$0.00	\$0.00	\$1,741,367
San Joaquin	\$477,396	\$0.00	\$0.00	\$0.00	\$477,396
Santa Cruz	\$(5,450)	\$0.00	\$15,000	\$0.00	\$9,550
Stanislaus	\$19,530	\$0.00	\$0.00	\$0.00	\$19,530
Ventura	\$18,228	\$0.00	\$0.00	\$0.00	\$18,228
Yolo	\$50,599	\$0.00	\$0.00	\$0.00	\$50,599
<b>Other California Subtotals</b>	<b>\$28,295,612</b>	<b>\$13,335</b>	<b>\$1,155,669</b>	<b>-</b>	<b>\$29,464,616</b>
Percent	96.0%	0.0%	3.9%	0.0%	100.0%
<b>Grand Totals</b>	<b>\$345,166,298</b>	<b>\$27,194,066</b>	<b>\$28,871,796</b>	<b>\$26,984,960</b>	<b>\$428,217,119</b>
Percent	80.6%	6.4%	6.7%	6.3%	100.0%

Source: Federal Procurement Data System – Next Generation (FPDS – NG), 2015; BAE, 2015



### Employment and Economic Stimulus

NASA Ames generates quantifiable financial benefits in California as a result of its activities.

Table 4 shows the direct, indirect, and induced statewide impacts of annual operations<sup>5</sup> from NASA Ames. NASA Ames operating activity provides the state with \$1.65 billion in annual economic benefits and supports approximately 9,400 permanent jobs. As noted previously, contract data broken down by nature of activity was not available at the county level; therefore, impacts for only the State of California are presented here.

### Multiplier Effect

Dividing the total output by direct output indicates the economic multiplier that measures the economic activity of every dollar spent. Thus, every dollar of economic activity that occurs from the operation of NASA Ames generates approximately \$2.03 in total economic activity in California. A detailed explanation of the multiplier effect is included in the Appendix, which outlines the IMPLAN model.

### Tax Impacts

In addition to estimating the direct, indirect, and induced impacts from operations, IMPLAN also provides estimates of local, state, and federal tax impacts. The results here are statewide tax impacts, including county and local taxes. According to IMPLAN, economic activity at NASA Ames will result in total state and local tax collection of approximately \$74.5 million per year. This total is captured in Table 5.

<sup>5</sup> Direct benefits are NASA Ames' direct spending, net of tax payments; indirect benefits represent economic activity generated by business-to-business spending; induced benefits represent economic activity generated by employee household spending. A complete description of these concepts is presented in Attachment A.

**Table 4: NASA Ames Research Center Economic Benefits, FY 2015**

	Direct Benefits	Indirect Benefits	Induced Benefits	Total Benefits
Output	\$813,429,683	\$258,749,440	\$582,443,430	<b>\$1,654,622,553</b>
Employment	4,043	1,600	3,764	<b>9,408</b>

Source: IMPLAN; BAE, 2015.

**Table 5: NASA Ames Research Center Tax Impacts, FY 2015**

<b>Tax Recipient/Tax Category</b>	<b>California Total</b>
<b>State/Local Govt NonEducation</b>	
Corporate Profits Tax	\$3,739,730
Dividends	\$210,189
Indirect Bus Tax: Motor Vehicle Lic	\$422,213
Indirect Bus Tax: Other Taxes	\$2,771,621
Indirect Bus Tax: Property Tax	\$15,066,190.00
Indirect Bus Tax: S/L NonTaxes	\$541,218
Indirect Bus Tax: Sales Tax	\$17,170,976
Indirect Bus Tax: Severance Tax	\$9,713
Personal Tax: Income Tax	\$26,125,973
Personal Tax: Motor Vehicle License	\$986,604
Personal Tax: NonTaxes (Fines- Fees)	\$4,678,298
Personal Tax: Other Tax (Fish/Hunt)	\$223,107
Personal Tax: Property Taxes	\$329,360
Social Ins Tax- Employee Contribution	\$767,870
Social Ins Tax- Employer Contribution	\$1,484,548
<b>Total: State/Local Government</b>	<b>\$74,527,610</b>

Source: IMPLAN; BAE, 2015.





GeneSat tracking dish at Stanford University in Northern California; a collaboration between NASA Ames and Santa Clara University CREST Program

## ***Measuring the Economic Benefits of NASA Research Park***

As NASA Research Park (NRP) continues to build out, it will generate major economic benefits for the Bay Area and California. This section presents a detailed analysis of the NRP Development Plan, and estimates both construction benefits stemming from current development plans, as well as the ongoing operational impacts.

### **NASA Research Park**

The NRP at NASA Ames is a shared-use R&D and education campus for industry, academia, non-profits, and government. NRP provides a physical place for innovation and entrepreneurship and serves as a technology accelerator by fostering both informal and formal collaborations. The NRP houses over 70 industry and university partners that are collaborating with NASA on a variety of technologies and disciplines.

### **NRP Development Plan**

Adopted in late 2002, the NASA Ames Development Plan (NADP) envisions developing six million square feet in the NRP for future use as office, R&D, university classrooms and labs, housing, museums, and a conference and education center. Much of this development will be new construction, but a portion will include the renovation of historic structures in the Shenandoah Plaza Historic District, located within the NRP. The NADP also calls for the development of 1,930 residential units. Approximately 1.8 million square feet of the total NRP area would be developed into residential units. Integrating a residential component would support a balance of jobs and housing as other development of the NRP moves forward.

The phasing of this construction is assumed to occur over a 15-year period, based upon information provided. Total envisioned NRP construction is valued at approximately \$3.2 billion in 2015 dollars.

BAE's analysis of the economic impacts attributed to planned development in the NRP is based on estimates of development phases given to NASA by NRP partners, notably



Planetary Ventures, LLC (a wholly owned subsidiary of Google, Inc.). Planetary Ventures, LLC has leased approximately 42 acres of land in the Bay View Planning District and 1,000 acres in the Eastside Airfield District. Estimates also take into consideration the University Associates-Silicon Valley LLC, which has leased approximately 77 acres of land in the South Campus Planning Area. Additional data regarding construction assumptions are presented in Attachment A.

### Employment and Economic Stimulus of NRP from Construction

Table 6 shows the direct, indirect, and induced regional and statewide impacts from the construction phase of proposed development at NRP. As indicated, construction activity will provide the region with just over \$5.6 billion in economic benefits, and support approximately 1,970 new jobs over the 15-year construction period (i.e., 1,970 jobs provided annually for 15 years). Statewide, construction will generate approximately \$6.7 billion in economic activity and 2,430 jobs.

### NRP Construction Multiplier Effect

Dividing both Bay Area and California total output by its direct output indicates the economic multiplier that measures the economic activity of every dollar spent. Thus, every dollar attributed to construction, would generate, or equate to economic activity worth approximately \$1.73 in the Bay Area and \$2.07 in the State.

### Employment and Economic Stimulus of NRP at Full Operation (2024)

Ongoing annual operations at NRP also contribute to the regional and statewide economies. This section estimates ongoing annual NRP operation impact using employment estimates for NRP on full build-out and occupancy. Full build-out and occupancy is estimated to occur in 2024. Based on assumed employment densities per land use, at full operation, NRP will be the location of approximately 14,100 employees (see Table 7).

**Table 6: NRP Construction Impacts (2015 \$)**

Geography	Direct Impacts	Indirect Impacts	Induced Impacts	Total Impacts
<b>Bay Area</b>				
Output	\$3,239,592,000	\$1,101,001,000	\$1,260,982,000	<b>\$5,601,575,000</b>
Employment	1,077	369	518	<b>1,965</b>
<b>California</b>				
Output	\$3,239,592,000	\$1,640,866,000	\$1,811,946,000	<b>\$6,692,404,000</b>
Employment	1,077	570	781	<b>2,427</b>

Notes: All impacts reported in 2015 dollars. This includes impacts from Planetary Ventures LLC (Google Inc.), NRP Tenants, and UA-SV LLC. Bay Area nine-county region includes counties of: Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma. Table assumes a construction phase of 15 years.

Sources: IMPLAN, BAE, 2015.

**Table 7: NRP Economic Impacts at Full Operation (2015 \$)**

Geography	Direct Impacts	Indirect Impacts	Induced Impacts	Total Impacts
<b>Bay Area</b>				
Output	\$6,610,214,405	\$2,816,056,370	\$2,418,823,297	<b>\$11,845,094,072</b>
Employment	14,130	12,937	14,918	<b>41,986</b>
<b>California</b>				
Output	\$6,610,214,405	\$3,345,210,865	\$3,345,551,447	<b>\$13,300,976,717</b>
Employment	14,130	18,083	21,620	<b>53,833</b>

Notes: The nine-county Bay Area region includes the following counties: Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma.

Sources: IMPLAN; BAE Urban Economics, 2015



**Table 8: NRP Tax Impacts, Santa Clara County and State of California**

<u>Tax Recipient/Tax Category</u>	<u>Santa Clara County</u>	<u>California Total</u>
<b>State/Local Govt NonEducation</b>		
Corporate Profits Tax	\$25,271,455	\$33,349,802
Dividends	\$1,420,363	\$1,874,400
Indirect Bus Tax: Motor Vehicle Lic	\$1,943,815	\$3,279,403
Indirect Bus Tax: Other Taxes	\$12,760,198	\$21,527,691
Indirect Bus Tax: Property Tax (a)	\$52,059,677	\$99,718,674.44
Indirect Bus Tax: S/L NonTaxes	\$2,491,702	\$4,203,743
Indirect Bus Tax: Sales Tax	\$79,053,040	\$133,370,127
Indirect Bus Tax: Severance Tax	\$44,719	\$75,446
Personal Tax: Income Tax	\$106,034,547	\$149,751,164
Personal Tax: Motor Vehicle License	\$4,000,839	\$5,655,105
Personal Tax: NonTaxes (Fines- Fees)	\$18,799,319	\$26,815,482
Personal Tax: Other Tax (Fish/Hunt)	\$1,152,972	\$1,278,825
Personal Tax: Property Taxes	\$1,318,866	\$1,887,857
Social Ins Tax- Employee Contribution	\$1,459,894	\$4,489,812
Social Ins Tax- Employer Contribution	\$2,822,461	\$8,680,303
<b>Total: State/Local Government</b>	<b>\$310,633,867</b>	<b>\$495,957,834</b>

(a) Direct property tax revenues estimates have been adjusted to exclude space in Federal enclave.

Sources: IMPLAN; BAE, 2015.

NRP tenant employees, or employees working in future development at NRP, generate output that flows through the local economies. Table 7 shows the direct, indirect, and induced benefits from NRP annual operation at full operation. At full operation, the NRP is expected to provide the region with \$11.8 in total annual economic impacts, and support approximately 42,000 jobs. California as a whole would expect to gain \$13.3 billion in total annual economic activity and 53,800 jobs.

### NRP Operations Multiplier Effect

Dividing the Bay Area and California total output by their direct output provides a measure of the economic activity generated from each dollar spent. Thus, for every dollar attributed to operations, NRP will generate total economic activity valued at approximately \$1.79 within the region and \$2.01 statewide.

### NRP Tax Impacts

According to IMPLAN, NRP economic activity within Santa Clara County will generate annual total state and local taxes of approximately \$311 million. Economic activity within the State would result in annual total state and local taxes of approximately \$496 million (including economic activity generated within Santa Clara County). Table 8 shows the estimated tax impacts from county and state models.



## ***Attachment A: Overview of IMPLAN Input-Output Model***

### **IMPLAN Input-Output Model**

Regional and national input-output models have been used for years by economists as a tool to understand the extremely complex interactions among the various parts of an economy. There are two basic types of models available to assess the economic impacts of an activity including regional input-output models and customized dynamic econometric models. The economic model used in this analysis, IMPLAN, is a PC-based computer software package that automates the process of developing input-output models for regions within the United States. The IMPLAN model is well respected as the industry standard for projecting economic impacts resulting from existing economic activities or future “events.” In this study, the projected construction budget and operating employment make up the “events” in the IMPLAN model.

### **What is IMPLAN?**

In 1976, the USDA Forest Service in conjunction with the University of Minnesota developed the IMPLAN model in response to the National Forest Management Act. The National Forest Management Act required the USDA Forest Service to create five-year management plans that estimated the local socio-economic impacts associated with various land use alternatives. In 1988, the University of Minnesota began offering the use of the IMPLAN model to non-Forest Service users. Through a technology transfer agreement in 1993, the Minnesota IMPLAN Group (a private enterprise) was formed with the purpose of maintaining and distributing the IMPLAN software and databases.

At the heart of the model is a national input-output dollar flow table called the Social Accounting Matrix (SAM). Unlike other static input-output models which just measure the purchasing relationships between industry and household sectors, SAM also measures the economic relationships between government, industry, and household sectors. This allows IMPLAN to model transfer payments such as unemployment insurance. Thus, for the specified region, the input-output table accounts for all of the dollar flows between different sectors within the economy.

### **National Industry Data**

The model uses national production functions for 536 industries, including government and households. These national production functions are used to determine how an industry spends its operating receipts to produce its commodities. Using construction as an example, IMPLAN uses a production function based on the average national construction firm to determine how a firm in the construction industry spends “each dollar of outlay on goods and services to produce a dollar of output.” The model also uses a national matrix to determine the byproducts that each industry generates. IMPLAN couples the national production functions with a variety of county-level economic data to determine the impacts of an economic “event.”

### **County-Level Economic Data**

To estimate the county-level impacts, IMPLAN combines national industry production functions with county-level economic data. IMPLAN collects data from a variety of economic data sources to generate average output, employment, and productivity for each of the industries in a given county. It also



collects data containing the average prices for all the goods sold in the local economy. In a county and a regional model, IMPLAN uses average county data to estimate the impacts to the county, and averages all of the economic data across the region's counties to estimate the impacts to the region. In addition, IMPLAN gathers data on the types and amount of output that each industry generates within the county. This allows the model to determine how much of each production input (e.g., wood, steel, labor, etc.) the firm can buy locally within the county, or within the region. In the case of labor, the model accounts for county and regional commute patterns, so as not to overestimate the impacts from labor spending its income in the local economy. Finally, the IMPLAN model uses county-level data on the prices of goods and household expenditures to determine the consumption functions of county households and local government, taking into account the availability of each commodity within the specified geography.

## Multipliers

IMPLAN combines this data to generate a series of multipliers for the local economy. The multiplier measures the amount of total economic activity that results from an industry (or household) spending an additional dollar in the local economy. IMPLAN uses the national and county-level data to generate SAM multipliers, which include the direct, indirect, and induced impacts to the local economy.

- ▶ **Direct Impacts:** Direct impacts refer to the dollar value of economic activity available to circulate through the economy. The direct impacts may equal the operating budget (or revenues) of an industry, or less, depending on several factors. First, the direct impacts do not include payments to capital, inventory, federal taxes, or state and local taxes, as payments of these types do not circulate through the economy.
- ▶ **Indirect Impacts:** The indirect impacts refer to the “inter- industry impacts of the input-output analysis.”<sup>6</sup> In the construction example, this would include payments for construction inputs such as wood, steel, office supplies, and any other non-labor payments that the construction firm would pay in the building process. Indirect impacts vary between the county and region based on the availability of goods within the two geographies. For example, if the construction firm buys some inputs from a firm in a different county but still within the region, those expenditures would be represented in the regional model, but not in the county model. As such, the indirect impacts will always be larger for the larger geography (region) that includes the smaller geography (county).
- ▶ **Induced Impacts:** The induced impacts refer to the impacts of household expenditures in the model.<sup>7</sup> When households earn income, they spend part of that income on goods and services. The model treats households as an “industry” in determining their local expenditure patterns. In the construction example, the induced impacts include the expenditures of construction laborers' incomes, as well as the expenditures of the incomes of persons who work in industries represented in the indirect impacts. First, the model accounts for local commute patterns in the geography. If 20 percent of construction workers who work in the county live outside of the county, the model will allocate 80 percent of labor's disposable income into the model to generate induced impacts. In addition, as with industries, the model excludes payments to federal and state taxes and savings based on the geography's average local tax and savings rates. Thus, only the disposable incomes from local workers' households are included in the model.



<sup>6</sup> IMPLAN Pro User's Guide, 2000.

<sup>7</sup> Ibid.

### Summarizing the Impacts

Once the model is applied, IMPLAN generates a series of output tables to show the direct, indirect, and induced impacts within each of the model's 536 sectors. IMPLAN generates these tables for two types of impacts: output and employment. These are defined as follows:

- ▶ Output refers to the total economic value of the project in the local economy.
- ▶ Employment shows the number of employees needed to support the economic activity in the local economy. It should be noted that for annual impacts of ongoing operations, the employment figure shown represents the amount of employment needed to support that activity for a year. Thus, IMPLAN reports the total number of workers required to support the economic activity over the course of a year. In the case of a construction project, IMPLAN reports the number of workers needed to support the economic activity over the life of the project and, thus, it is necessary to divide the total number of employees who would be required to support the project by the estimated duration in years that the project would last. Furthermore, IMPLAN reports the number of jobs based on average output per employee for a given industry within the geography. This is not the same as the number of full-time positions.

### IMPLAN Analysis Assumptions

**Table 9: NRP Construction Costs through Buildout**

Land Use	Square Feet	Cost per Sq. Ft. (a)	Total Cost
<b>Commercial</b>			
Office/R&D Dry Lab	1,755,000	\$519.11	\$911,100,000
Technical - Wet Lan/Manufacturing	125,000	\$519.11	\$64,900,000
Education - Training/Classroom	614,700	\$601.40	\$369,700,000
Industrial and Commercial Complexes	780,613	\$416.85	\$325,394,704
Commercial and Services	156,200	\$482.75	\$75,500,000
Public Assembly/Recreational/Entertainment	440,000	\$478.36	\$210,500,000
Hotel Conference and Training (b)	250,000	\$462.93	\$115,800,000
<b>SUBTOTAL: Commercial SF</b>	<b>4,121,513</b>		<b>\$2,072,894,704</b>
<b>Residential</b>			
Townhome (1,300 SF) (c)	390,000	\$338.38	\$132,000,000
Apartment (1,000 SF) (d)	825,000	\$338.38	\$279,200,000
Apartment (800 SF) (e)	520,000	\$338.38	\$176,000,000
Apartment (800 SF) (f)	108,000	\$338.38	\$36,500,000
<b>SUBTOTAL: Residential SF</b>	<b>1,843,000</b>		<b>\$623,700,000</b>
<b>Infrastructure</b>			
Parking	3,019,144	\$179.85	\$542,997,000
<b>SUBTOTAL: Infrastructure/Parking</b>	<b>3,019,144</b>		<b>\$542,997,000</b>
<b>TOTAL SF (ex. Parking)</b>	<b>5,964,513</b>		<b>\$3,239,591,704</b>

Notes:

- (a) From AECOM, cost indexed to July 2015
- (b) Based on a 250 unit hotel.
- (c) Represents 300 units.
- (d) Represents 825 units.
- (e) Represents 650 units
- (f) Represents 180 units.

Sources: AECOM; BAE, 2015.

**Table 10: NRP Employment at Full Operation**

Land Use	Square Feet	Employment Density	Total Existing/New Employment
<b>Commercial</b>			
Office/R&D Dry Lab	1,755,000	250	7,020
Technical - Wet Lan/Manufacturing	125,000	420	298
Education - Training/Classroom	614,700	178	3,453
Industrial and Commercial Complexes	780,613	300	2,599
Commercial and Services	156,200	500	312
Public Assembly/Recreational/Entertainment	440,000	3,826	115
Hotel Conference and Training (a)	250,000	0.75	333
<b>SUBTOTAL: Commercial SF</b>	<b>4,121,513</b>		<b>14,130</b>

Sources: AECOM; BAE, 2015.



# Acknowledgements

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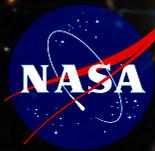
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