Planning for Sustainable Tourism

Part III: Economic & Environmental Modeling Study

Volume II: Results & Recommendations

Prepared for

DBEDT
THE DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM
STATE OF HAWAII

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PLANNING FOR SUSTAINABLE TOURISM IN HAWAII
Economic and Environmental Assessment Modeling Study

MODELING STUDY REPORT

Prepared for:

The Department of Business, Economic Development, and Tourism
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Key: Notation for the Study

Visitor Expenditures	Nominal visitor expenditures on Hawaii products and imports
Real Visitor Expenditures	Visitor Expenditures deflated by Hawaii Visitor Price Index
Hawaii Consumer Price Index (CPI)	Paasche measure of consumer cost of living, 1997 base
Hawaii Visitor Price Index (VPI)	Paasche measure of visitor cost of expenditures, 1997 base
Household Expenditures	Nominal household expenditures on Hawaii products and imports
Real Household Expenditures	Household expenditures are measured as Equivalent Variation (EV) in income derived computationally Hicksian demand functions.*
Real Average Household Expenditures	Real household expenditures per labor force
Employee Compensation	Wage, salary, and other labor income
Real Employee Compensation	Employee compensation deflated by CPI
Real Average Employee Compensation	Real employee compensation divided by number of wage and salary workers
Proprietors' Income	Nominal proprietors' income
Real Proprietors' Income	Proprietors' income deflated by the CPI
Real Average Proprietor Income	Real proprietor income divided by number of proprietors
Total Output	Nominal total output
Real Total Output	Total output deflated by the CPI
Gross State Product	Nominal total value added plus Indirect Business Taxes
Real Gross State Product	Gross state product deflated by the CPI
Infrastructure Demand	Demand for infrastructure reported in physical units
Sector Output	Supply by sector, nominal output values deflated by commodity prices for 1997

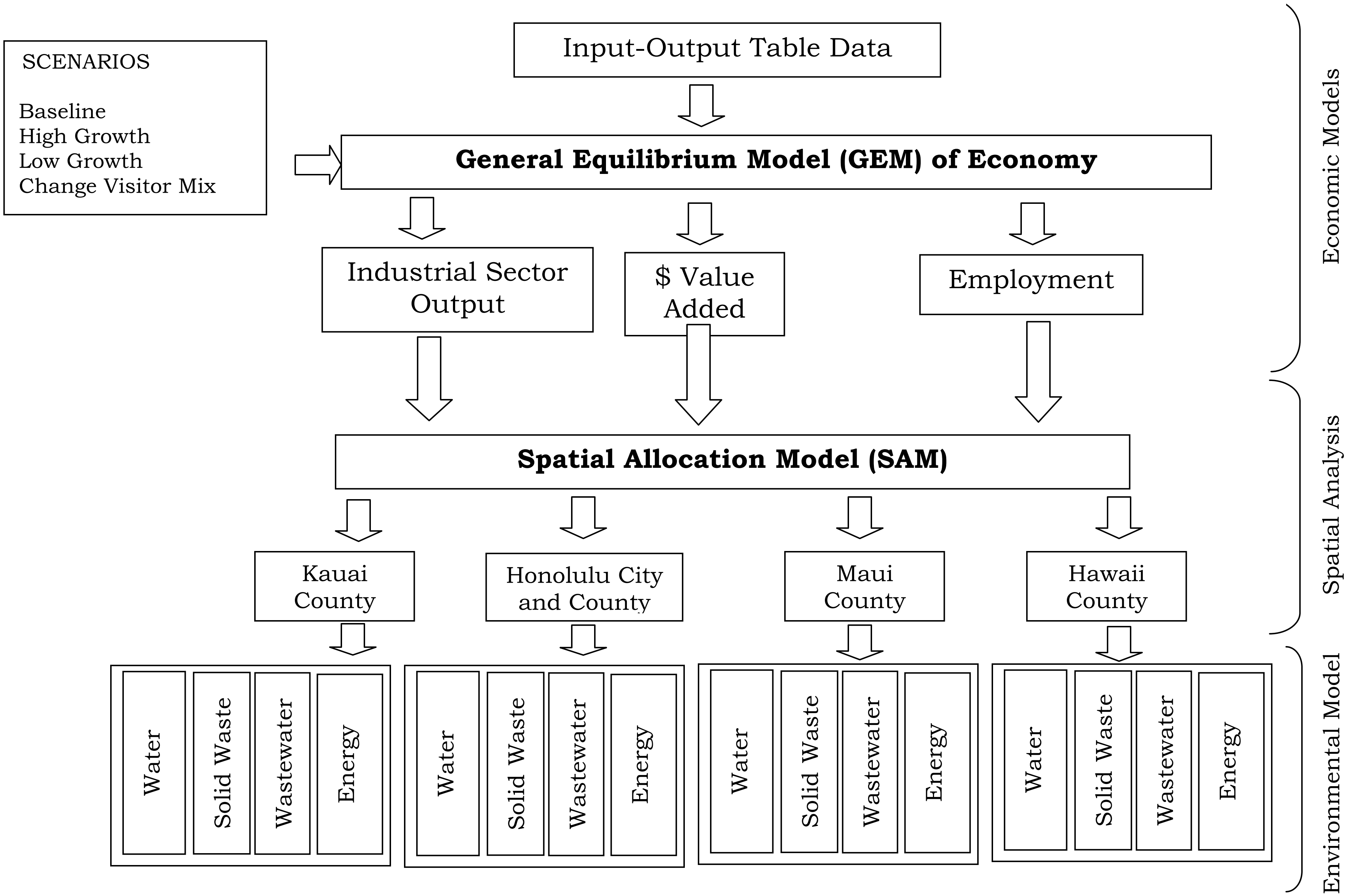
***** Note that EV is not computed by deflating nominal expenditures by a price index

I. PROJECT OVERVIEW

Compared to other sectors, tourism is distinguished both by its size and share of the state's economy and by the fact that there are few comparable opportunities for generating external sources of income for Hawaii's people. While federal and military expenditures are an important part of the local economy and there has been significant growth in the services sectors (finance, real estate, education, health, etc.), tourism is Hawaii's main export to the world. Although there are continued efforts to develop other areas of export (high tech, health care, bio-tech, media, trade, agriculture, etc.), without the visitor industry and federal spending, there would be far fewer jobs, opportunities, and dollars in our economy. The situation is complicated by the fact that tourism in Hawaii is a mature industry. Unlike other destinations in which tourism is a more recent phenomenon, poised for take-off and rapid expansion, Hawaii's tourism industry is more advanced, stable, and unlikely to see massive expansion. This raises the question of what the future of tourism in Hawaii should or could look like. This should be analyzed by looking at the impacts that tourism has on our community and our environment. Three different types of concerns are examined: economic, social, and environmental – the so-called "triple-bottom line" of sustainable development.

In this study, baseline data have been collected on Hawaii's present economic, demographic, geographic, and environmental conditions. The data have been assembled into a set of linked models. The models have been refined and calibrated so that they successfully reproduce the existing condition. The modeling structure is illustrated in Figure 1. First, a general equilibrium model (GEM) that simulates the response of the economy to changes in tourism and the environment is built. Second, a spatial allocation model (SAM) that maps Hawaii's population, tourism, and sector-level production is developed. These models are then used to estimate the human impact on Hawaii's ecosystems and provide estimates of infrastructure demand and pollution over time. The integration of economics and land use planning provides a framework for sustainable tourism policy analysis. Various tourism growth scenarios are examined.

Figure 1: Overview of Composite Model Structure



I.A. Approaches to Sustainable Tourism

Part of a larger study, under the direction of the Department of Business, Economic Development, and Tourism, this effort is focused on the interrelationships between the economy, the environment, and society as they relate to the visitor industry in Hawaii. Hawaii, which has gained a worldwide reputation as a tourist destination, has also seen significant growth in visitor arrivals, visitor spending, accommodations, and visitor-related services. Tourists are attracted to Hawaii both because of the natural and cultural assets and because of the significant public and private investment in infrastructure, hotels, businesses, and visitor-related amenities. Yet for tourism to continue to grow or even for Hawaii to maintain its competitive position within the world visitor market, there must be concerted efforts to understand and manage the interrelationships between economic forces, the environment, and society – what John Elkington coined as the "triple bottom line" in his 1998 book ***Cannibals with Forks: The Triple Bottom Line of 21st Century Businesses*** (New Society Publishers).

The definition of "sustainable tourism" originated from the more general objective of "sustainable development" that was defined in the 1987 World Commission on the Environment and Development Report, commonly known as the Brundtland Report. (World Commission on Environment and Development. (1987). *Our Common Future. (The Brundtland Report).* Oxford: Oxford University Press.) The basic idea is that development should not be concerned with just attaining maximum economic growth, but with achieving fairness, both between individuals and groups in society (intra-generational equity) but also across generations (inter-generational equity). Sustainable tourism, therefore, is concerned not just with the economic viability of the visitor industry, but also with the larger impacts on the economy, the environment, and society both now and in the future.

The term "sustainable tourism," has come to mean both sustaining tourism as a business activity and also sustaining the underlying natural and cultural resources supporting tourism. The World Tourism Organization defines sustainable tourism as, "*Meeting the needs of present tourists and host regions while protecting and enhancing opportunities for the future…"* (World Tourism Organization, Guide for Local Authorities on Developing Sustainable Tourism. Madrid. WTO. 1998.)

Another region, heavily dependent on tourism, defines sustainability as the "*optimal use of natural and cultural resources for development that is self-sustaining, provides a unique visitor experience and improved quality of life"* (Organization of East Caribbean States, http://www.jsdnp.org.jm/susTourism.htm). The Department of Business, Economic Development and Tourism, State of Hawaii, describes sustainable tourism as "*Managing tourism so as to sustain the environmental and social vibrancy of Hawaii for the people of our State."* Each of these definitions emphasizes the importance of the relationship between tourism, the environment, and community.

The Sierra Club, Hawaii Chapter, adds another important dimension to the definition of sustainability: *"ignorance-based planning is no way to sustain Hawaii's environment",* (*http://www.hi.sierraclub.org).*

The first part of the project examined infrastructure capacities and the relationships between the environment and infrastructure services. Another part of the project focused more closely on resident attitudes and the willingness of the community to experience change with regard to tourism. This part of the project, referred to as the "modeling effort of the project" integrates economic, environmental, and social data to describe baseline conditions and to evaluate alternative tourism growth scenarios. Comprehensive economic data on the structure of Hawaii's economy were used to build a CGE (computable general equilibrium) model of the interrelationships between the many sectors which make up the tourism industry as well as other key industrial sectors in the state. Using the latest available population, labor force, and visitor spending projections, a number of different scenarios are developed. Alternative growth scenarios in visitor spending and population growth are considered. The CGE model was used to project, over the long term, changes in economic performance and in social welfare associated with changes in the visitor industry and the population of Hawaii. In addition, using input-output data, and techniques of regional analysis, the direct and indirect spending of both visitors and households are estimated in the aggregate and in terms of per day, per person levels of infrastructure use. Using GIS (Geographic Information System) software and spatial databases, economic and environmental conditions are mapped and analyzed in term of the location of demand and the resulting pressure on the environment, both for existing conditions and for alternative future scenarios.

The emphasis of this component of the study is on quantitative data that could be integrated into various mathematical modeling procedures. The modeling effort can be improved as more quantitative data becomes available, especially at the County level. More details on the techniques and methodologies are contained in the Data and Methods Report and the accompanying technical appendices.

II. CURRENT CONDITIONS: HAWAII'S ECONOMY AND ENVIRONMENT

Visitors are attracted to the beauty and uniqueness of Hawaii. Yet, excessive tourism growth may pose a threat to the very environmental and cultural assets that visitors seek. According to Part I and Part III of this study, visitors contribute to congestion on our beaches, trails, and roadways. They consume water and energy and generate pollution, sewage, and solid waste. They create a demand for the expansion and development of transient accommodations. They also increase stress on public infrastructure such as parks and recreation facilities. Conservation of Hawaii's environment is critical not only to preserving the quality of life of residents but also maintaining the quality of the visitor experience. Thus, a balance is sought between prosperity for residents, preservation of the environment, and enhancing the quality of life and the visitor experience.

II.A. The Centrality of Tourism to Hawaii's Economy

The latest comprehensive data on all economic sectors in Hawaii comes from the 1997 input-output tables. A summary is presented in Table 1. Total output (including imports and inter-industry demand) amounts to $58.7 billion. In terms of final demand, household expenditures comprise approximately $19.9 billion, while the state's leading economic activity, tourism, results in annual visitor expenditures of $9.5 billion. Sectors of the economy which contribute significantly to total output include real estate ($9.0 billion), state, local, and federal government ($8.6 billion), finance and business services ($6.6 billion), retail trade ($4.2 billion), health services ($3.9 billion), construction ($3.5 billion), hotels ($3.5 billion), and restaurants ($2.3 billion). It was also determined that the total output for transportation activities (including ground, water, and air) amounted to approximately $3.6 billion, or roughly, 6% of the state's total output.

The major spending categories for households include real estate ($5.2 billion), health services ($3.9 billion), retail trade ($2.3 billion), finance and business services ($2.0 billion), restaurants ($1.6 billion), and wholesale trade ($686.6 million). Visitor spending is concentrated in areas such as hotels ($3.2 billion), air transport ($1.6 billion), retail trade ($1.0 billion), restaurants ($1.1 billion), automobile rental ($314.8 million), sightseeing transport ($285.5 million), and real estate ($239.7 million). The combined spending by visitors on performing arts, amusement, recreation, museums and golf amounts to 4.5% of their total spending. These percentage distributions are both a function of the state's industrial structure as well as the differences between residents and households. Visitors spend proportionately more on hotels, restaurants, and certain transport services (air and rental car) than residents. Residents, on the other hand, spend proportionately more on health care and financial and business services than tourists.

Table 1: Overview of the Economy, 1997 ($million)

Industry	Output	Household expenditures	Visitor's expenditures	Compensation of employees
Accommodations				
Hotels	3,456.4	170.0	3,247.4	1,282.0
Real estate	9,019.3	5,211.4	239.7	394.7
Restaurants	2,274.7	1,017.1	1,126.2	806.6
Trade				
Wholesale trade	1,939.0	686.6	190.3	750.0
Retail trade	4,179.5	2,311.7	1,087.7	1,651.6
Entertainment				
Performing arts	155.6	62.2	31.1	41.0
Amusement	157.1	27.7	129.5	41.1
Recreation	150.7	63.7	84.7	50.3
Museums historical	77.2	38.5	38.6	36.1
Sightseeing transport	303.7	15.2	285.5	131.2
Golf courses	229.8	88.5	141.3	93.2

Table 1: Overview of the Economy, 1997 ($million) – Continued

Industry	Output	Household expenditures	Visitor's expenditures	Compensation of employees
Transportation				
Air Transportation	2,044.1	338.0	1,555.2	527.0
Trucking	279.0	98.0	18.3	105.5
Water transportation	522.8	133.1	116.2	62.6
Ground transportation	128.9	34.6	76.2	41.1
Automobile rental	393.3	32.5	314.8	62.9
Parking lots	109.4	77.2	10.4	23.5
Transit	110.0	30.9	0.4	75.6
Agriculture				
Crops	393.9	56.2	15.8	142.1
Animal	212.0	41.8	1.3	59.9
Commercial fishing	69.7	24.0	1.4	11.7
Landscaping services	147.8	-	-	72.6
Manufacturing				
Food processing	1,054.5	419.5	52.3	198.8
Clothing manufacturing	209.4	39.8	18.8	55.9
Chemical manufacturing	73.9	-	-	17.7
Petroleum manufacturing	1,419.3	187.8	208.4	52.0
Other manufacturing	659.4	35.9	16.6	192.2
Services				
Construction	3,524.3	-	-	1,247.6
Information	1,940.3	776.9	33.4	504.4
Finance business professional	6,578.0	2,047.2	72.3	2,258.5
Travel reservations	456.8	148.8	191.2	179.6
Education private	477.5	307.9	7.0	308.0
Health services	3,859.3	3,642.6	83.3	1,866.2
Laundry	97.7	60.0	12.7	43.2
Other services	1,771.5	848.7	39.9	719.7
Utilities				
Electricity	1,169.1	394.6	-	175.9
Waste management private	190.4	5.7	-	52.7
Water sewer	280.3	182.2	-	93.6
Natural gas	51.2	12.8	-	23.4
Government	8,565.8	264.9	45.6	7,174.8
Total	58,732.5	19,934.2	9,493.4	21,626.2

(Source: Department of Business, Economic Development & Tourism, (2002) The Hawaii Input-Output Study. Research and Economic Analysis Division. State of Hawaii. Honolulu. See Appendix 2, Data and Methods, for further discussion of the data.)

Tourism clearly plays a major role in the state's economy. Using various methods of regional analysis, the importance of visitor spending to the economy can be quantified, both in terms of direct and indirect spending. Tourism is complicated by the fact that it is comprised of many different kinds of firms offering a broad array of goods and services. Visitor spending affects many different businesses and employees in Hawaii. Nearly one quarter of jobs in Hawaii's economy depend on tourism expenditures in sectors such as accommodations, restaurant, retail, transportation, entertainment, amusement and recreation sectors. These are important sectors in terms of both wages and salaries and in terms of proprietor's income. There are differences between the spending patterns of households and visitors (see Table 1). Visitors spend much more, proportionately, on transportation, hotels, restaurant meals, recreation and entertainment than do households. Households also support many of these same businesses. Households expend more than $170 million annually for hotel services (compared to $3.2 billion by visitors), but they annually spend almost as much ($1.0 billion) on restaurant meals as do tourists ($1.1 billion). Households spend more on performing arts ($62.2 million) than do visitors ($31.1 million). The volume of retail trade by residents ($2.3 billion) is more than double the total annual amount spent by visitors ($1.09 billion). Spending on health care, professional services, and other services by households also far outpaces that of visitors.

This analysis also helps to shed some light on the structure of the visitor economy. 131 different industries were initially examined and then for purposes of analysis, they were aggregated into 40 key industries. While there are other ways of grouping these business and economic activities, it is nonetheless revealing to note the relative share of various industries (see Table 1). For example, the hotel industry generates approximately $3.5 billion in output, compared to crops which generate only $393 million in output. The crop sector is approximately the same size in terms of output as the automobile rental industry in Hawaii. The clothing manufacturing sector generates approximately $209 million in output, which is less than the output for golf courses ($229 million). The output for the restaurant sector ($2.27 billion) is almost ten times greater than the output for golf courses. The size of the electricity sector ($1.2 billion) is about half the size of the restaurant sector, but slightly larger than the food processing sector ($1.1 billion).

II.B. The Environmental Impact of the Visitor Industry

Understanding infrastructure demand by industries is important for two reasons. First, industries need infrastructure services in order to produce various goods and services. Second, the demand for infrastructure gives a measure of the stress on the environment. There is a limited amount of fresh water and a limited capacity for wastewater treatment, solid waste disposal, electricity generation, and other crucial infrastructure services. Measuring demand thereby enables us to quantify the level of stress on infrastructure and the environment. Measuring the use of fossil fuel also provides a means of determining the amount of pollutants generated by economic activity. Table 2, Economic Activities and Infrastructure Demand in Hawaii, 1997, contains a summary of output and expenditures by households and visitors on 40 sectors. The table also summarizes estimates of the demand for water, sewer, electricity, propane, and solid waste disposal fuel for these 40 industrial sectors in Hawaii. The largest users of water on an annual basis include hotels (4.4 billion gallons), real estate (4.2 billion gallons), restaurants (3.1 billion gallons), electric companies (3.6 billion gallons), and agriculture - crops (12.8 billion gallons). Notably, industries consume approximately 40.2 billion gallons of water per year. Of this, approximately 21.9 billion gallons ends up as wastewater. The key sectors in terms of wastewater generation include hotels, real estate, restaurants, and other large water users.

The largest sectors in terms of direct electricity use include retail trade (1,136 GWh), hotels (897 GWh), petroleum manufacturing (422.6 GWh), real estate (378.1 GWh), restaurants (340.1 GWh), food processing (331.1 GWh), other services (320 GWh), and water/sewer services (302.6 GWh). Retail trade accounts for more than one-fifth of total electrical demand by industries in the state. Propane has a distinctly different distribution. The bulk of propane gas use is concentrated in two sectors, hotels and restaurants. Other large users include health services, retail trade, and government. The industries that generate the most solid waste in Hawaii include restaurants, construction, professional services, health services, and retail trade. A total of 1.49 billion pounds or more than 744,000 tons of solid waste is generated each year by industries in Hawaii. The significant sectors in terms of fossil fuel use (limited in this analysis to highway gasoline and diesel fuel), include sightseeing transportation (10.9 million gallons), trade (12.8 million gallons), construction and mining (4.5 million gallons), rental car companies (5.4 million gallons), trucking (3.9 million gallons), and other ground transportation (4.2 million gallons).

Table 2: Economic Activities and Infrastructure Demand in Hawaii, 1997

Industry	Output ($million)	Water (1000 gal)	Sewer (1000 gal)	Electricity (GWh)	Utility Gas (mmBtu)	Solid Waste (lbs)
Hotels	3,456.4	4,392,570	3,514,056	897.0	1,149,900	76,755,614
Real estate	9,019.3	4,220,882	3,376,705	378.1	41,395	17,448,355
Restaurants	2,274.7	3,102,155	2,481,724	340.1	704,600	313,157,141
Wholesale trade	1,939.0	517,582	414,066	97.4	-	41,662,660
Retail trade	4,179.5	-	-	1,136.4	153,300	148,040,690
Performing arts	155.6	206,573	165,258	4.5	-	11,314,336
Amusement	157.1	68,670	54,936	30.2	-	4,559,176
Recreation	150.7	155,794	124,635	44.0	11,770	7,626,528
Museums historical	77.2	83,844	67,075	14.1	-	3,493,800
Sightseeing transport	303.7	-	-	8.6	3,874	12,994,737
Golf courses	229.8	1,138,964	911,171	67.4	-	6,432,468
Air transportation	2,044.1	229,530	183,624	37.4	4,775	20,655,454
Trucking	279.0	86,716	69,373	15.7	3,198	11,932,766
Water transportation	522.8	44,838	35,870	19.1	4,616	3,600,255
Ground transportation	128.9	110,274	88,219	3.3	-	10,217,105
Automobile rental	393.3	571,348	457,078	7.0	-	1,593,937
Parking lots	109.4	149,095	119,276	14.8	-	2,759,326
Transit	110.0	-	-	3.3	-	3,819,400
Crops	393.9	12,834,240	-	35.7	-	17,402,579
Animal	212.0	1,357,286	1,085,829	36.3	-	8,319,363
Commercial fishing	69.7	20,806	16,645	-	-	3,868,200
Landscaping services	147.8	89,726	71,781	0.4	-	8,563,307
Construction	3,524.3	179,057	143,246	50.8	-	199,200,245
Food processing	1,054.5	511,660	409,328	331.1	-	22,462,543
Clothing	209.4	36,012	28,810	12.7	-	6,547,007
Chemical	73.9	32,839	26,271	3.8	-	776,951
Petroleum	1,419.3	1,312,188	1,049,750	422.6	-	1,119,600
Other manufacturing	659.4	138,806	111,045	38.9	-	18,558,577
Information	1,940.3	644,908	515,927	38.7	-	37,706,260
Professional services	6,578.0	942,443	753,954	141.9	-	184,041,571
Travel reservations	456.8	34,094	27,275	20.2	-	24,037,723
Education private	477.5	473,329	378,664	28.4	-	22,993,012
Health services	3,859.3	1,243,976	995,181	267.3	191,900	157,420,335
Laundry	97.7	160,881	128,705	12.4	9,205	4,277,472
Other services	1,771.5	858,924	687,139	320.0	2,086	59,083,187
Electricity	1,169.1	3,659,714	2,927,771	6.8	-	1,466,728
Waste management	190.4	156,405	125,124	0.5	-	4,169,993
Water sewer	280.3	76,365	61,092	302.6	-	1,182,600
Natural gas	51.2	859	687	2.8	-	191,993
Other government	8,565.8	401,106	320,885	144.5	75,119	6,817,913
Total Industry	**58,732.5**	**40,244,458**	**21,928,174**	**5,337.0**	**2,355,737**	**1,488,270,906**
Resident		43,299,259	22,953,795	2,665	559,900	1,709,974,454
Visitor						
State & Local Gov’t		4,305,626	3,444,501	729	359,377	
Federal Gov’t		12,519,242	10,015,394	1,278	431,721	
TOTAL DEMAND		**100,368,585**	**58,341,864**	**10,009**	**3,706,734**	**3,198,245,360**

II.C. Residents and Visitors: The Demand for Infrastructure Services

One of the most powerful uses of input-output techniques is for the estimation of direct and indirect demand by households, tourists or other final demanders. This is particularly useful for comparing the environmental impacts of tourists and others who may be purchasing infrastructure services indirectly. Direct consumption occurs when a tourist or resident pays for the good or service directly, such as the purchase of fuel at a gas station. These transactions are recorded within the input-output tables. Indirect consumption occurs when a consumer purchases a good or service in which fuel (or another resource) is used in the production of that good or service. Table 3, Direct and Indirect Infrastructure Demand, contains the estimates of direct and indirect demand for water, sewer, electricity, utility gas, and solid waste disposal services by both residents and visitors. In all categories of infrastructure service, with the exception of utility gas, the demand by residents far surpasses the demand for these services by visitors. As noted earlier, residents directly consume these infrastructure services while visitors consume them indirectly through the purchase of other goods and services, such as hotel rooms or restaurant meals. Residents purchase approximately 43.3 billion gallons of water directly compared to only 11.9 billion gallons purchased indirectly by visitors. If the indirect demand for water by residents is added to their direct demand, the total demand for water is approximately 61.4 billion gallons per year. In the aggregate, residents use approximately 5.2 times more water per year than visitors. Similarly, residents generate an estimated 33.6 billion gallons of wastewater compared to 8 billion gallons by visitors, more than a four fold difference. While the direct use of electricity by residents is about 2,665 gigawatts (GWh), compared to 1,944 gigawatts (indirectly) consumed by visitors, the total use by residents, including indirect demand is 5,253 gigawatts. In other words, residents consume 2.7 times the total amount of electricity consumed by visitors. Visitors, however, consume, in the aggregate, more propane than residents (1,521,257 mmBtu versus 1,287,940 mmBtu where an mmBtu is equivalent to 1 million Btu's). Yet in terms of solid waste disposal, residents generate far more (2,423,229,185 lbs) than visitors (421,326,645 lbs). According to these estimates, residents generate 5.75 times more waste annually than do the visitors coming to Hawaii. Similarly, the level of direct demand for highway fuel by residents, on an annual basis, amount to more than 322.7 million gallons compared to 21.6 million gallons, annually, for tourists. Residents directly consume almost 15 times the amount of highway fuel than that consumed by tourists. While the average per day tourist purchases are much higher than residents, so the indirect demand for fuel by tourists is higher, the overall aggregate annual demand (direct and indirect) is much higher for residents than tourists.

Table 3: Direct and Indirect Infrastructure Demand, 1997

	Water (m gal)	Sewer (m gal)	Electric (GWh)	Utility Gas (mmBtu)	Solid Waste (m lbs)	Hwy Gas & Diesel (Mgals)
Direct Use by Residents	43,299	22,953	2,665	559,900	1,709.9	322.7
Direct Use by Visitors	-	-	-	-		21.6
Indirect Use by Residents	18,130	10,633	2,588	728,040	713.2	31.0
Indirect Use by Visitors	11,856	8,022	1,944	1,521,257	421.3	30.4
Total Use by Residents	61,429	33,587	5,253	1,287,940	2,423.2	353.7
Total Use by Visitors	11,856	8,022	1,944	1,521,257	421.3	52.1

Another way of examining the demand for infrastructure services is estimate the per day levels, accounting for both the population size and the number of visitors (see Table 4, Average Infrastructure Demand, 1997). On a per day basis, residents use approximately 138.9 gallons of water (accounting for both direct and indirect demand). Visitors, however, use much more water, approximately 206.7 gallons per day (based on indirect demand only). Similarly, the average per day amounts of wastewater generated are much higher for visitors (139.8 gallons) than for residents (75.9 gallons). Electricity use by visitors is also much higher than for residents (33.9 KWh versus 11.9KWh). Visitors, however, use on a daily basis about nine times the amount of propane that residents use. The table also contains data on average solid waste generation. Visitors generate 7.3 pounds of solid waste per day compared to residents who generate 5.5 pounds per day. Residents consume more fuel on average than tourists. The average daily use of highway fuel by residents amounts to 0.73 gallons, compared to .38 gallons per day by tourists. But because their spending is higher, the average per day total fuel consumption by tourists is higher than for residents (0.91 versus .80 gallons per day).

Table 4: Average Infrastructure Demand, 1997

	Water (gallons)	Sewer (gallons)	Electric (KWh)	Utility Gas (mmBtu)	Solid Waste (lbs)	Hwy Gas & Diesel (gal)
Direct Use per Resident Day	97.9	51.9	6.0	0.001	3.9	0.73
Direct Use per Visitor Day	-	-	-	-	-	0.38
Indirect Use per Resident Day	41.0	24.0	5.9	0.002	1.6	0.07
Indirect Use per Visitor Day	206.7	139.8	33.9	0.027	7.3	0.53
Total Use per Resident Day	138.9	75.9	11.9	0.003	5.5	0.80
Total Use per Visitor Day	206.7	139.8	33.9	0.027	7.3	0.91

II.D. When Tourists Hit the Road: Transportation and Pollution

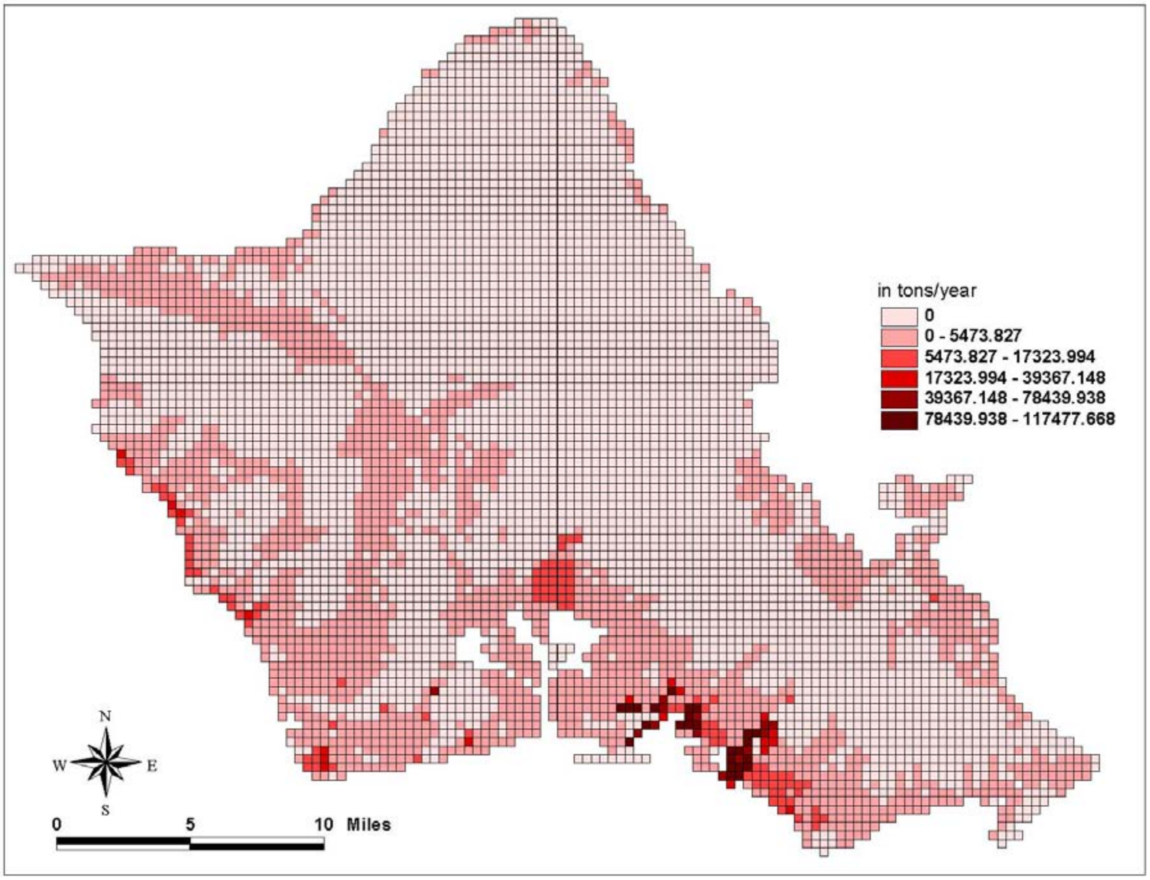
Transportation is a key component to the visitor industry. It also produces a significant impact on the environment. Motorized traffic is the single largest source of pollution in Hawaii. Traffic congestion, moreover, is an on-going concern in the community. The direct and indirect consumption of fossil fuels and other natural resources are examined. While the direct consumption of gasoline and fuel by industries in Hawaii amounts to approximately 73.4 million gallons per year, the direct consumption by residents amounts to 322.7 million gallons and the direct consumption by visitors totals 21.6 million gallons. Put another way, residents consume more than 15 times the amount consumed by tourists, and more than 4 times the amount (73.4 million gallons) directly consumed by all industries in the state. Interestingly, a large share of the indirect use, 31.0 million gallons by residents and 30.4 million gallons by visitors, totaling 61.4 million gallons can be accounted for by tracing through the purchase of fuel by businesses and apportioning it to intermediate demand. Another point is that the indirect use by visitors (30.4 million gallons) is almost the same level as the indirect use by residents (31.0 million gallons). This is, no doubt, a function of the fact that many of the services that tourists purchase (ground transportation, car rental, sightseeing tours, etc.) are heavy users of highway fuel. Totaling both direct and indirect uses of fuel shows that while in the aggregate, residents consume far more (353.7 million gallons) than tourists (52.1 million gallons), the per day total consumption (direct and indirect) for residents (0.8 gallons) and visitors (0.91 gallons) is similar.

Based on the fuel consumption patterns two additional analyses were performed: 1) estimates of the emissions (CO_2, CH_4, and N_2O) contained in Table 5, Estimates of CO_2, CH_4, and N_2O Emission, Tons, 1997; and 2) a spatial analysis of the economic structure and estimated emissions levels (Figure 2). The combined (direct and indirect) production of carbon dioxide for both residents and visitors, exceeds 3.9 million tons per year, while 57.4 tons of methane and 42.7 tons of nitrous oxide are produced annually in Hawaii. The table is also illustrative of another key finding: residents, in the aggregate generate far more pollution than visitors. Figure 2, shows the spatial distribution of the annual tons of CO_2 produced on Oahu and shows the extent to which emissions are a function of industrial structure and commuting patterns.

Table 5: Estimates of CO_2, CH_4, and N_2O Emissions, Tons 1997

	Carbon Dioxide	Methane	Nitrous Oxide
Direct Use by Residents	3,135,079	32.3	30.2
Direct Use by Visitors	210,195	2.2	2.0
Indirect Use by Residents	316,818	10.6	5.0
Indirect Use by Visitors	314,581	12.3	5.4
Total Use by Residents	3,451,897	42.9	35.2
Total Use by Visitors	524,775	14.5	7.5

Figure 2: Carbon Dioxide (CO_2) Emission Rate in Oahu



In assessing the overall impact of the visitor industry on the environment, it is quite evident that residents generate a greater impact than visitors and that the effects of residential expansion are more significant than industrial expansion. In order to estimate the visitor impact on the environment, indirect demand for infrastructure was calculated both on an aggregate basis and expressed in average visitor terms. While the total use by residents of these infrastructure services exceeds that of visitors for every type of infrastructure except propane, it is also interesting to note that the indirect use by residents also exceeds that of visitors. What this means is that in total, the purchases of goods and services by residents actually generates more environmental impact than the purchase of goods and services by visitors. Yet, at the same time, it must be noted that the average per day estimates of infrastructure demand by visitors are much higher than that of residents. Because their purchases are higher, their impact on the environment is potentially greater.

The spatial pattern of infrastructure demand is a function of the location of the resident population and various industries. While population is generally more spatially distributed, depending on the industry or business, there is more or less spatial concentration. For example, while hotels are more concentrated both in terms of economic activity and in terms of infrastructure demand and environmental impact, restaurants are more spatially dispersed. The economic and environmental impact, therefore, is also less concentrated.

The spatial analysis suggests that there may be opportunities for the planning and management of growth and development based on the relationship between the economic structure of tourism activities and the environmental impacts and infrastructure capacities present with particular locations or grid cells. As a planning tool, it may be useful to focus on those particular areas that have experienced an intensification of development and economic activity as a proxy for infrastructure demand. Knowing the type, level, and location of economic activity can be used to estimate the nature and extent of environmental impact. In addition to calculating aggregate and average levels of demand for environmental services, these data can also be used to assess the cumulative impacts of development, both over time and as the structure of the economy evolves. As more people and businesses are added to a particular location or grid cell, the resulting demand for environmental services will increase. There is, of course, the need to balance the increase in demand against either the existing and as well as future capacity of the infrastructure systems.

II.E. A Spatial View of the Hawaii Economy and Environment

Figure 3, Location of Economic Activity, shows the concentration of economic activity for the Counties of Kauai, Oahu, Maui and Hawaii. This represents the total economic output, derived from the state's Input-Output data, allocated to its location based upon matching industrial sector codes to local land use and U.S. Bureau of Census employment data. The values for the 0.1 mile grid cells range from $0 to $333 million of annual output. It is interesting to note that even in the most urbanized part of the state, economic output is concentrated in a number of key locations, primarily along the southern coast of Oahu and in a few key locations in the neighbor islands. The location of economic activity corresponds primarily to the location of heavily urbanized areas, as well as to the location of tourist resort districts such as Waikiki, the Kona Coast, Kihei, West Maui, the Southern Coast of Kauai, and other key tourism developments. In these regions, the level of economic output is quite high, approximately $178 million to $333 million per grid cell. The spatial analysis serves to illustrate that the economic activities associated with tourism and many of the resulting environmental impacts are spatially concentrated. While there are many different locations of where economic activity can occur, it is also apparent that geography of the islands constrains where this activity can occur. In addition to the natural boundary of the coastline, the interior areas contain steep mountains in which the costs of development are prohibitively expensive. The absence of roads and other critical infrastructure also limits the magnitude of economic activity.

Figure 4, shows the location of the resident population. The maps show not just the locations of urban centers throughout the state, but also the emergence of various suburban developments. In comparing Figure 3 and Figure 4, obviously there are more lands being used for economic purposes such as agriculture, industrial parks, golf courses, and uses other than for housing. The most densely populated grid cells contain between 2,614 to 3,918 persons per 0.1 mile. While there are densely populated areas in the urban centers, there are also some notably dense areas in some of the outlying areas. These areas correspond with apartment districts located in the Salt Lake and Makiki areas of Honolulu. While this figure does not depict the growth over time, it should be noted that over the past two decades, there has been continued growth in the Central and Leeward areas of the island of Oahu as well as continued growth outside of Lihue on Kauai, as well as in the central Maui and the Kona coast of the Big Island.

Figure 5, depicts the location of hotel employment in terms of the job count according to the 0.1 mile square grid structure throughout the state. The map shows quite clearly that the largest concentration of hotel jobs per 0.1 square mile is in the Waikiki district. The highest job counts per grid cell range from 1106 to 1865 for several of the cells in this area. These high job count cells also correspond with the cells that generate the greatest amount of economic output (Figure 3). It is important to note that while most of the jobs are located within Waikiki, there are also some accommodations jobs scattered in other parts of the island, matching the Ko'Olina, North Shore, as well as in other locations on Kauai, Maui, and the Big Island.

Figure 6, shows the demand for water by the hotel industry. Annual water demand is estimated to be 252.4 million gallons to 425.7 million gallons per year in several of the 0.1 mile grid cells. Of course, wastewater is estimated to be some fraction of the water demand (45% to 80%) in these areas. These maps serve to illustrate the concentration of demand for both water and wastewater infrastructure services. Figure 7, on the other hand, shows the demand for water by the restaurant industry. Here, the spatial pattern is more diffuse. While Waikiki still shows up as an area of concentrated high demand, with the bulk of the cells demanding 14.4 million to 28.5 million gallons of water for restaurant use, there are also both more restaurant locations dispersed throughout the state. Figure 8, shows the demand for water by residents. Here, the highest demand (85.7 million gallons to 128.5 million gallons per year) is located not just in urban Honolulu, but also in outlying residential communities throughout the state. The pattern of demand is far more dispersed than the demand by either hotels or restaurants. The magnitude of demand is also much greater, reinforcing the point made earlier that residents rather than visitors or businesses are most responsible for the greatest demands for water. Figure 9, which shows total water consumption, accounting for both direct and indirect demand represents the cumulative demand for water – not only by all industrial sectors (including agriculture, manufacturing, and other heavy users) and residents but also the estimated indirect demand based on the purchase of goods and services by key final demanders (residents and visitors). Here, the magnitude of demand is quite large – with many grid cells demanding 379.2 million gallons to 1.3 billion gallons of water per year. Notably the highest demand is not just in Waikiki, but rather in many of the other districts where manufacturing, oil refining, and electricity production, and other industrial activities occur.

A similar breakdown and analysis of demand for other infrastructure services can be conducted. While the nature of demand for other infrastructure services differs somewhat, a similar pattern would emerge since the estimates are based on the volume of economic activity as captured in the Input-Output tables. Figure 10, shows the total demand, statewide, for electricity consumption (direct and indirect) by industries, visitors, and residents. The cells with highest demand 100 to 242.6 gigawatt hours per year are located not just in the urban core and tourism districts, but also in industrial districts as well. Figure 11, shows the total demand (direct and indirect) for solid waste disposal services. The cells which generate the most solid waste 17.3 million pounds to 44.4 million pounds are concentrated in those areas with the greatest population densities and most economic activity, whether measured in terms of job count or economic output per 0.1 square mile.

The spatial analysis serves to illustrate the extent to which economic activity and the resulting infrastructure demand is concentrated in key locations. Figure 12, shows location for the highest concentration of industrial activity and demand for infrastructure services (water, electricity, and solid waste removal) in the state. Infrastructure demand is not only closely associated with output, but also concentrated in key locations.

Figure 3: Economic Output

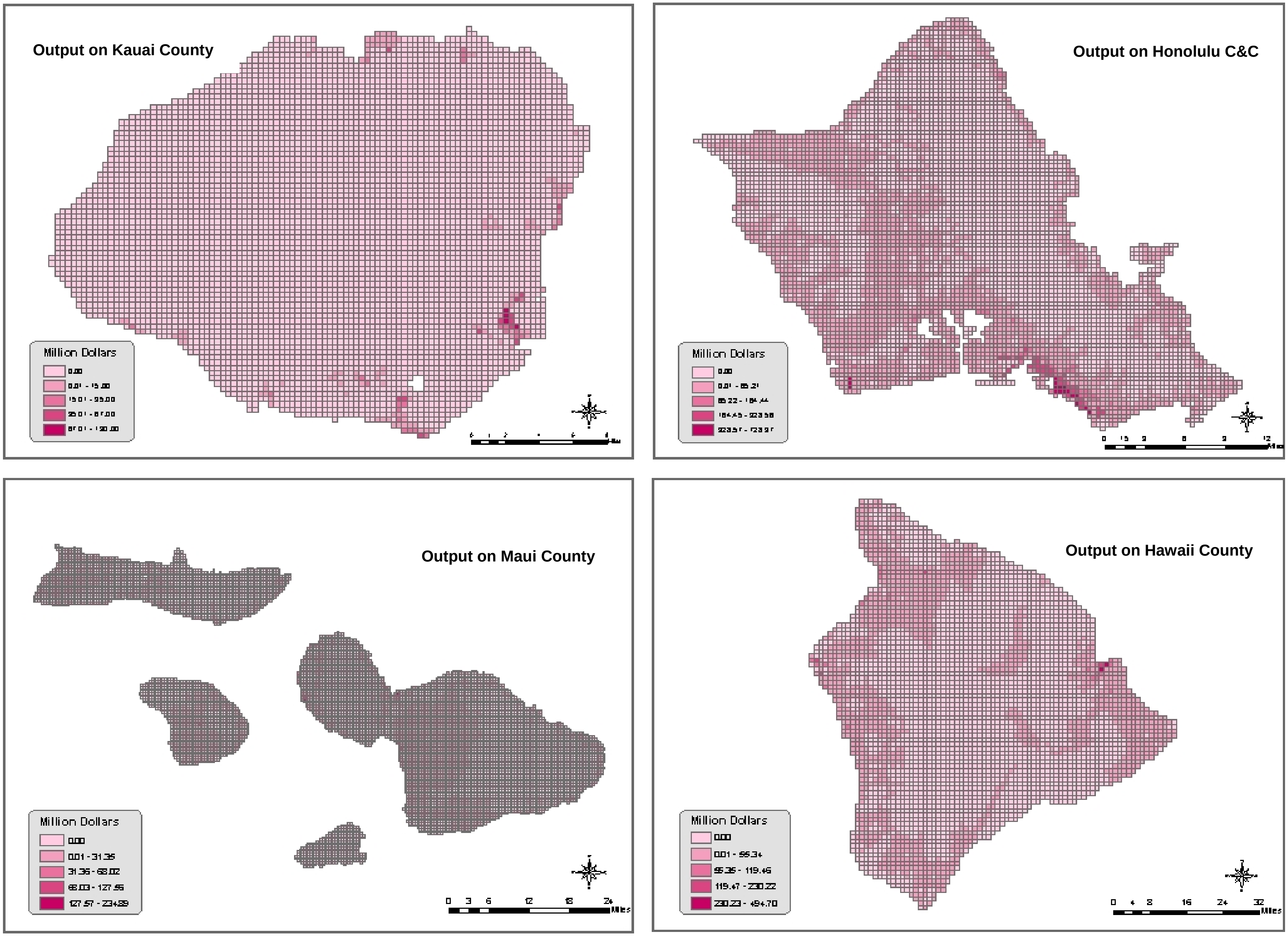


Figure 4: Baseline Population Distribution

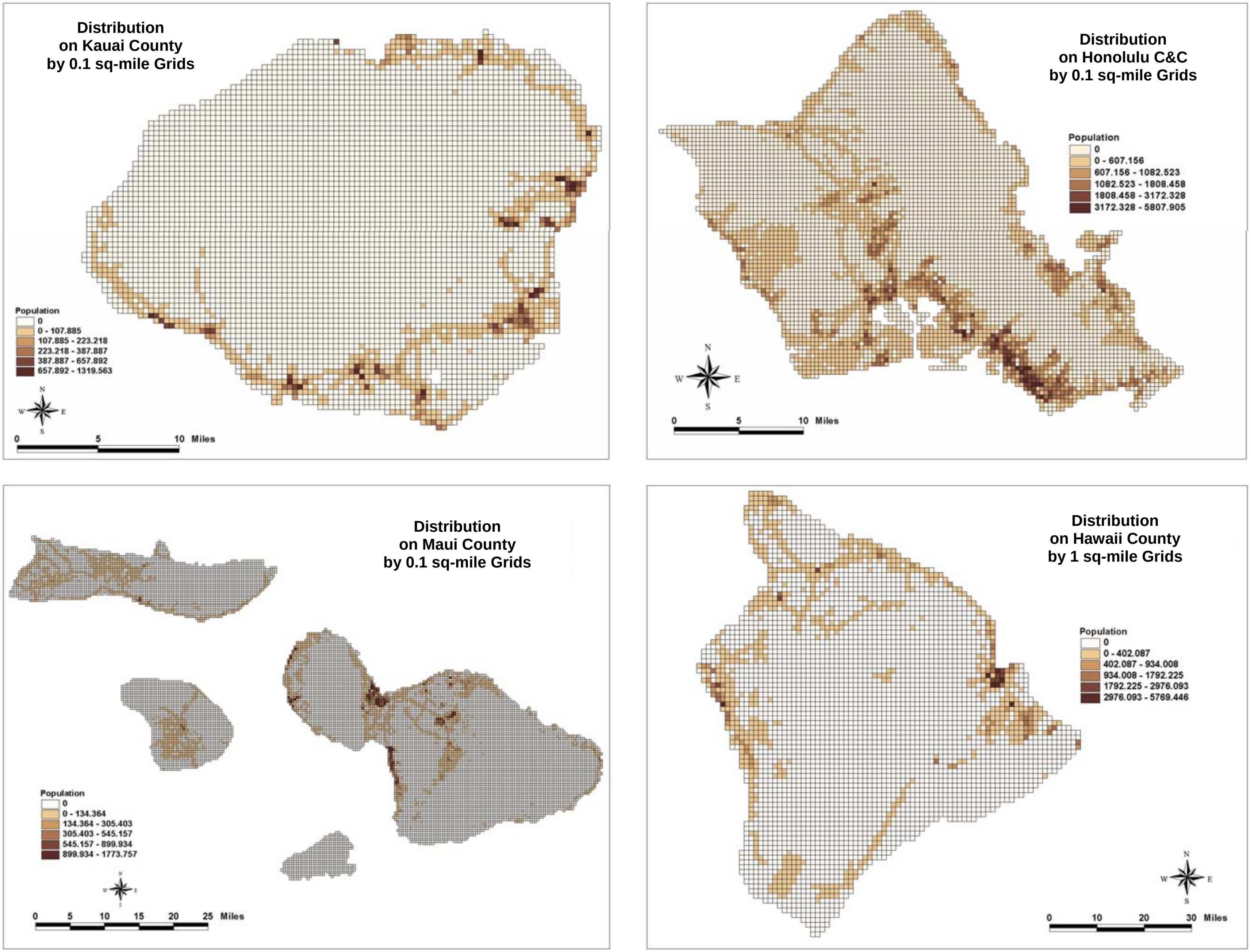


Figure 5: Employment Distribution by the Hotel Industry

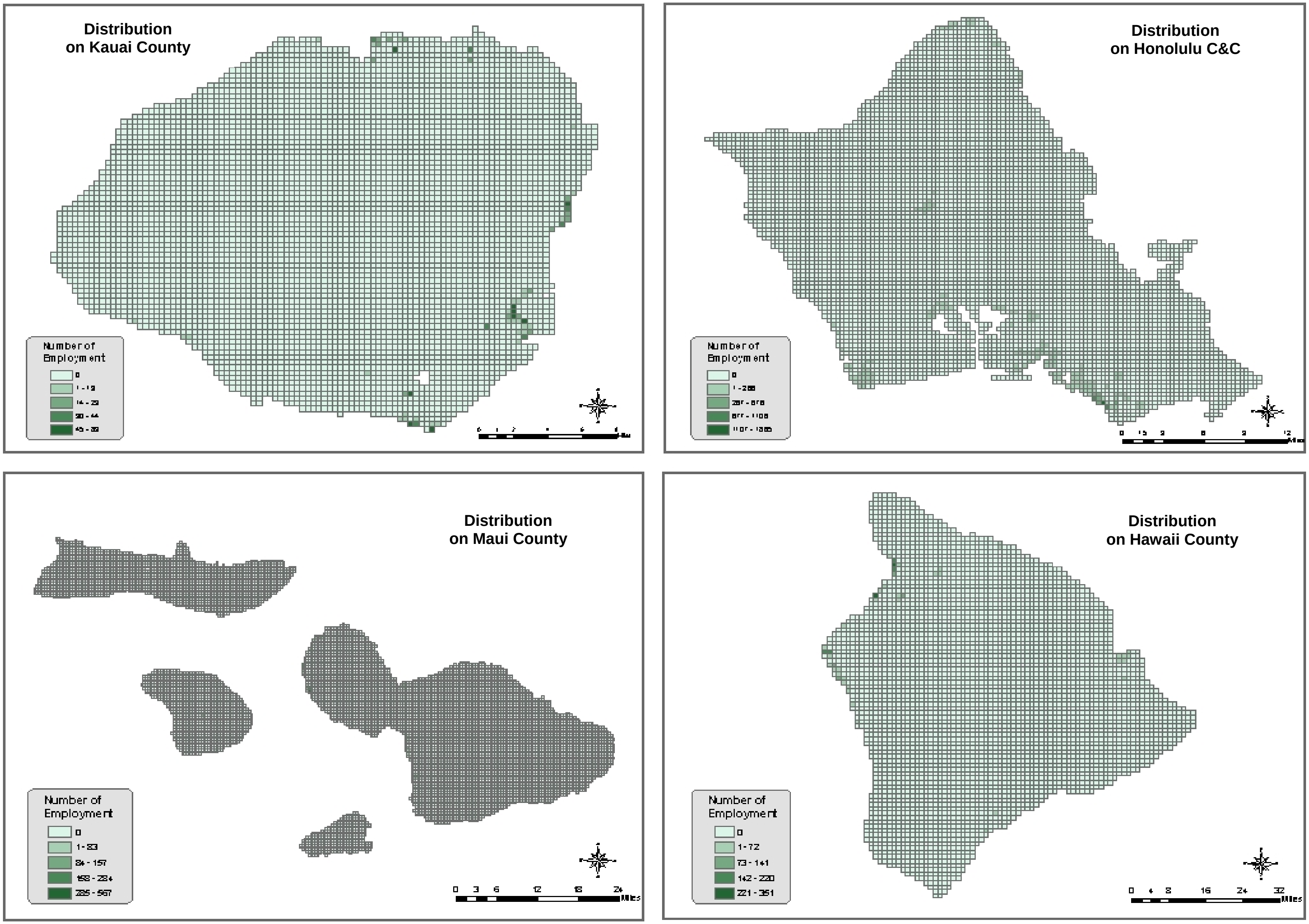


Figure 6: Water Consumption by the Hotel Industry

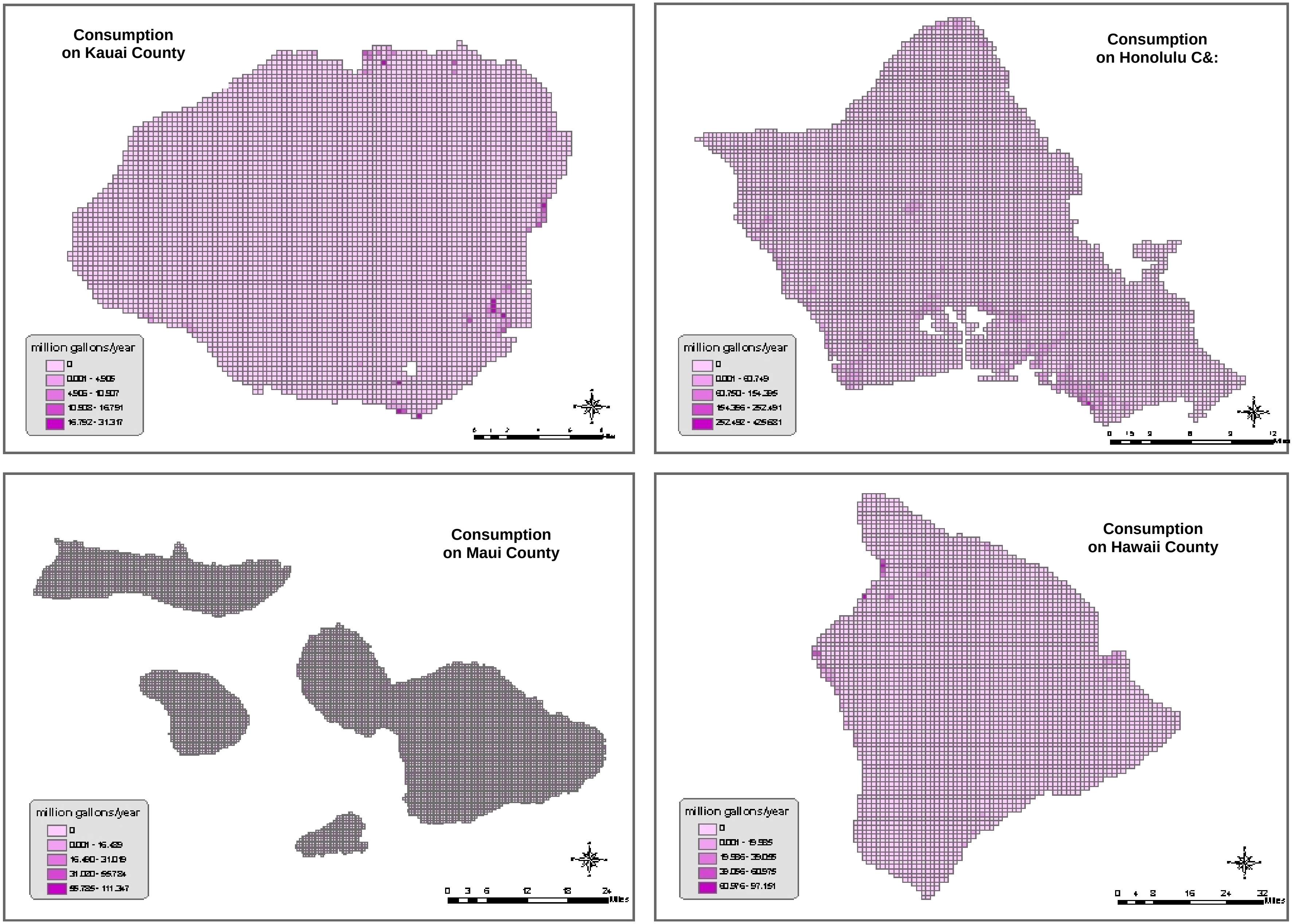


Figure 7: Water Consumption by the Restaurant Industry

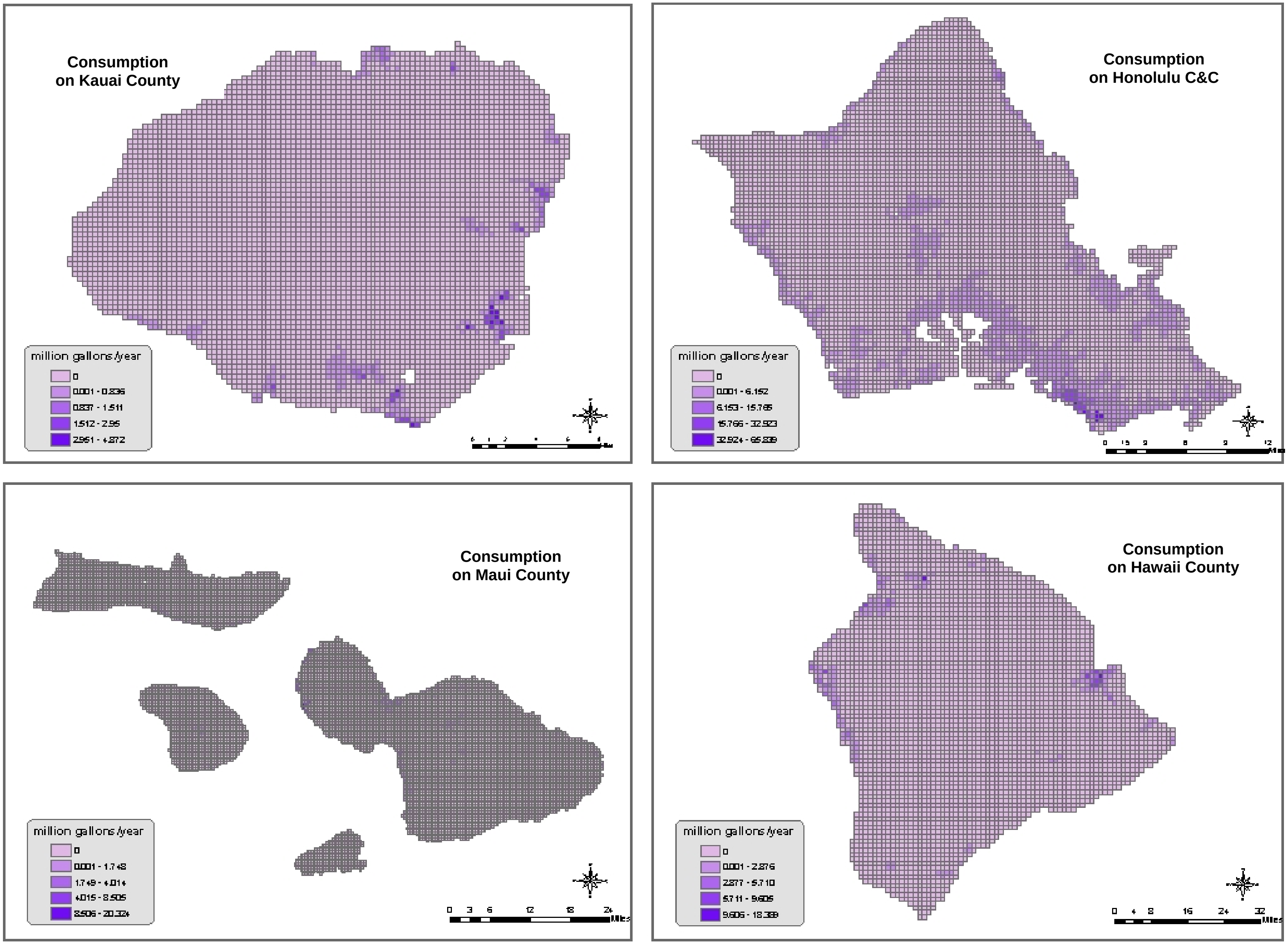


Figure 8: Water Consumption by Residential Activities

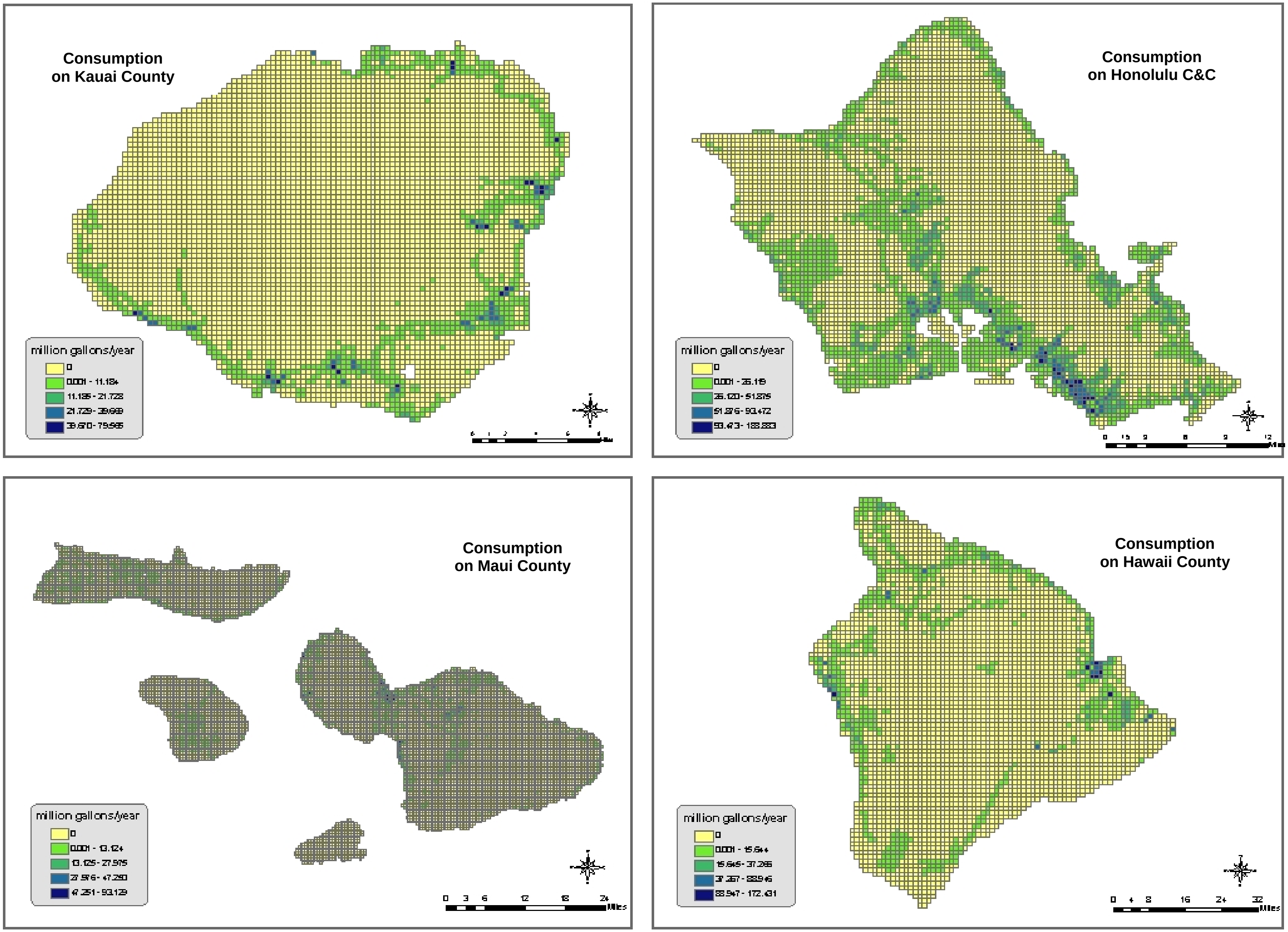


Figure 9: Baseline Water Consumption by Residents and All Industrial Sectors

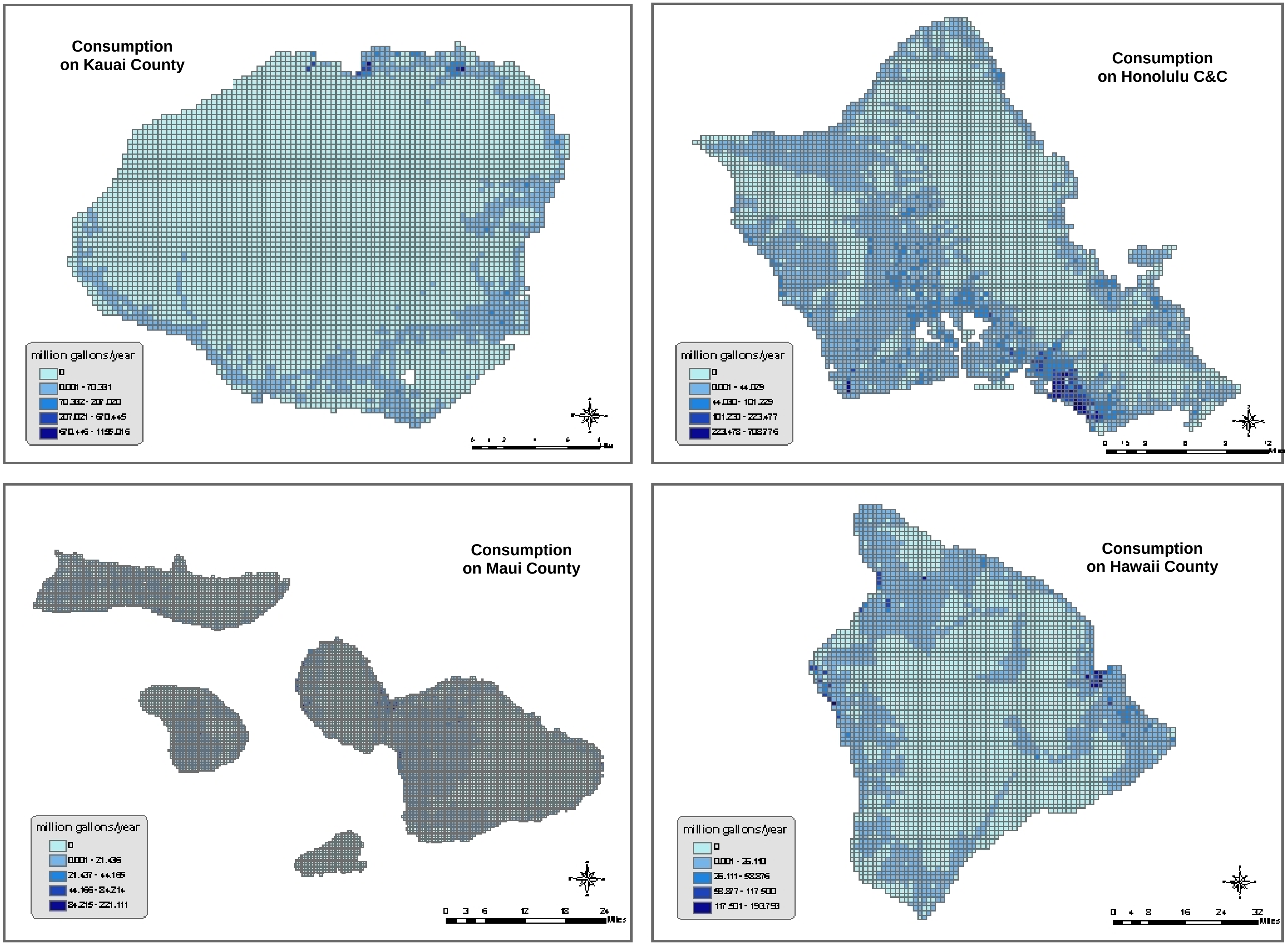


Figure 10: Baseline Electricity Consumption by Residents and All Industrial Sectors

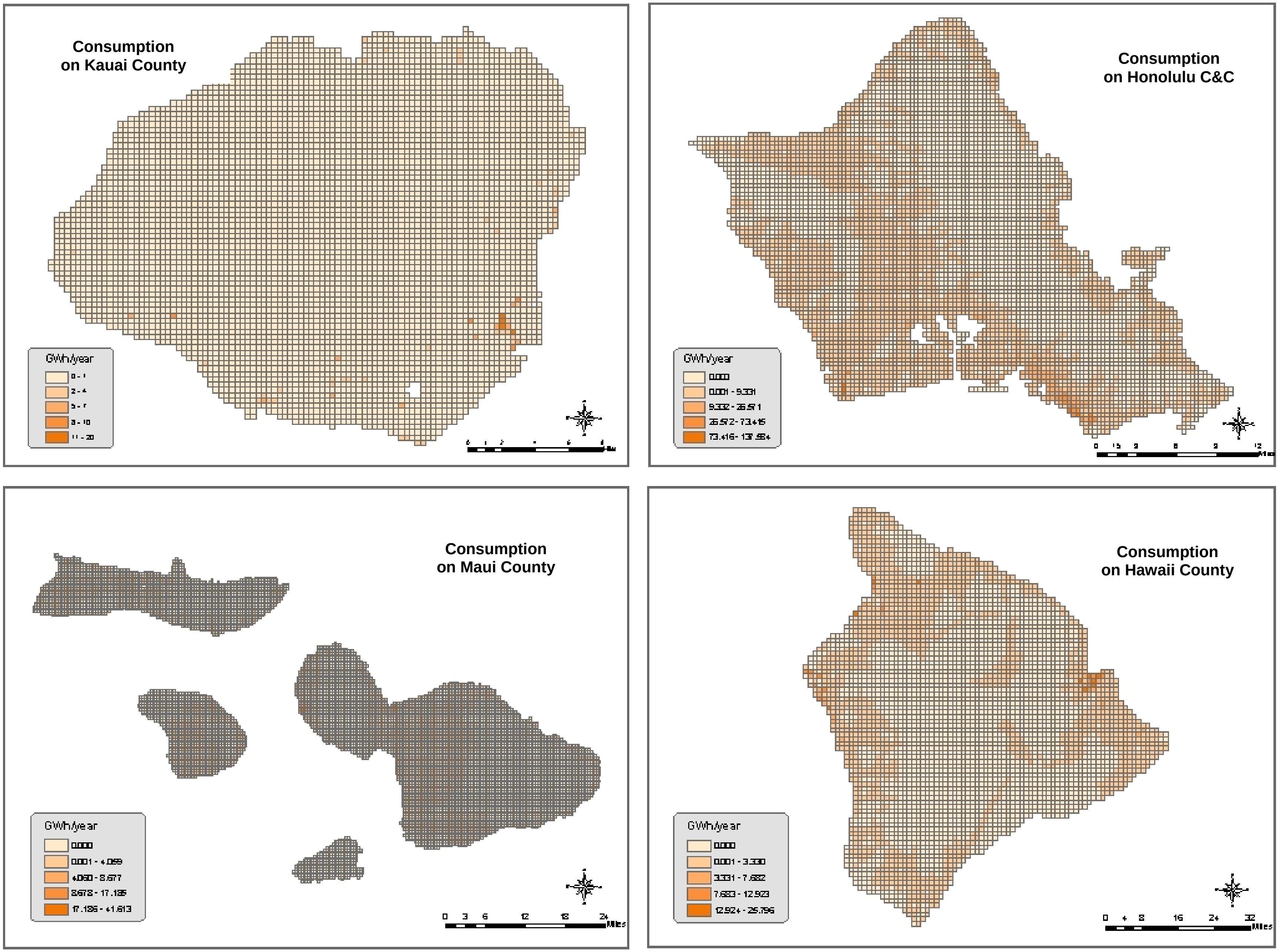


Figure 11: Baseline Solid Waste Generation by Residents and All Industrial Sectors

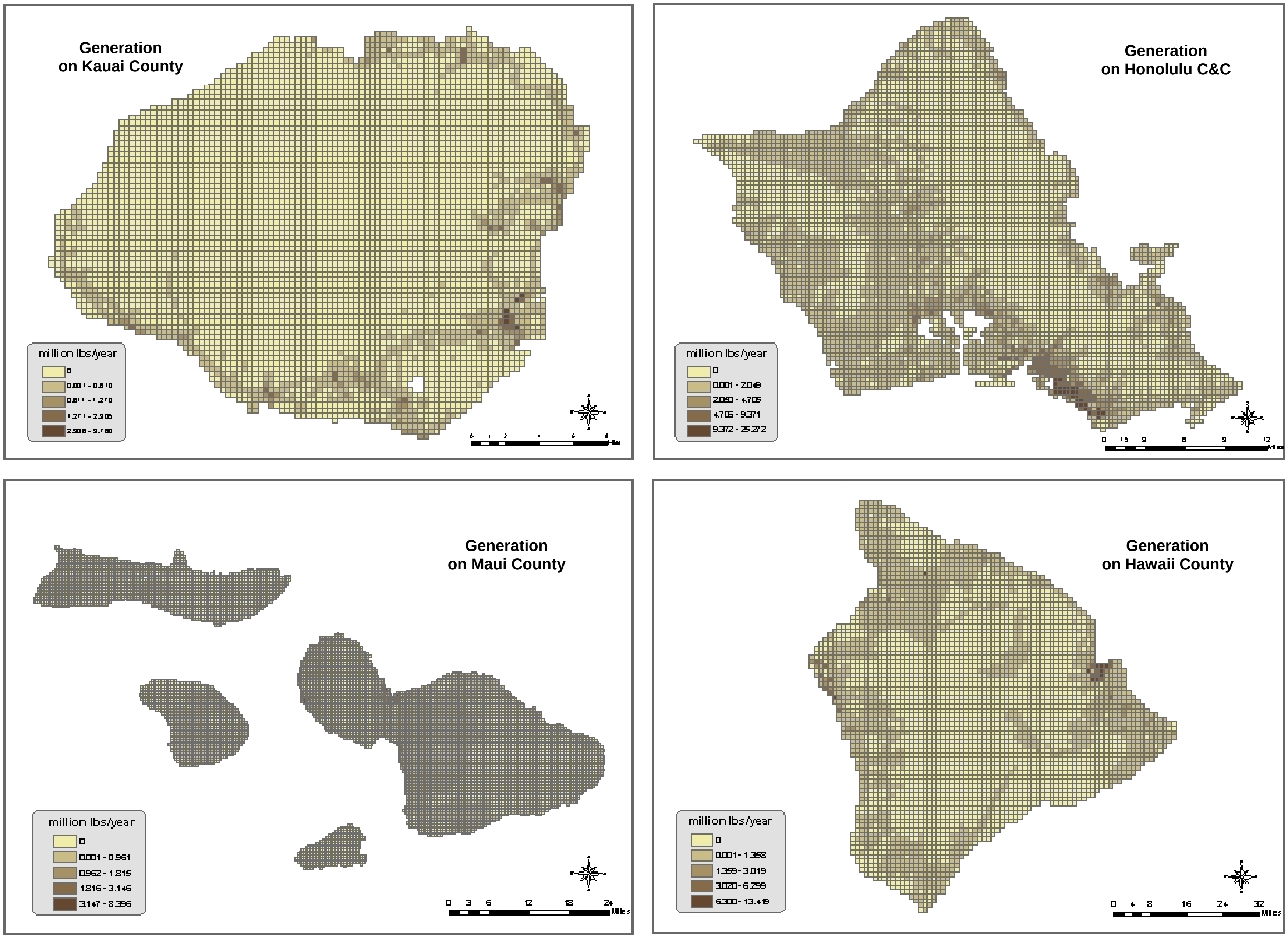


Figure 12: Infrastructures Key Locations

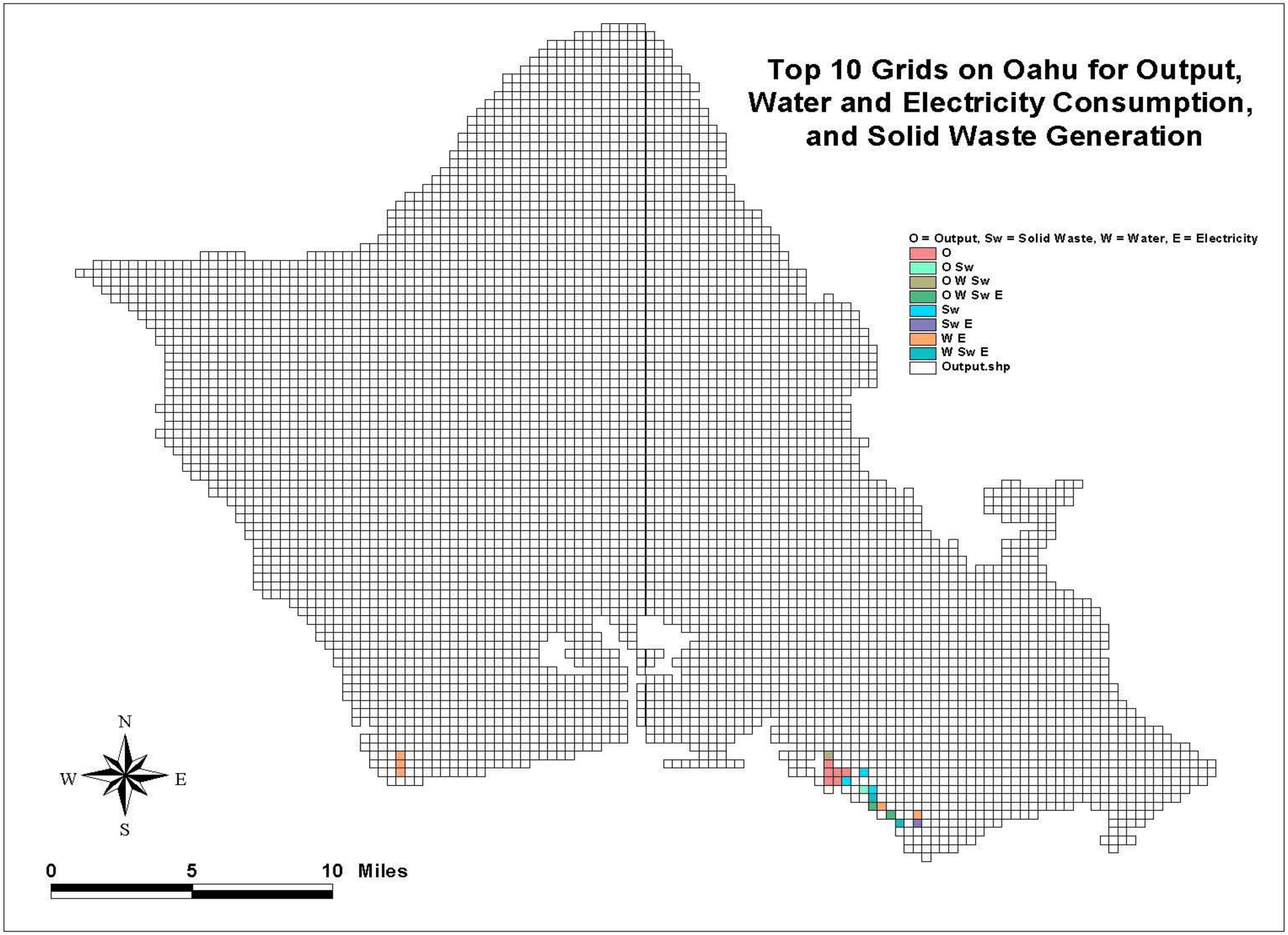
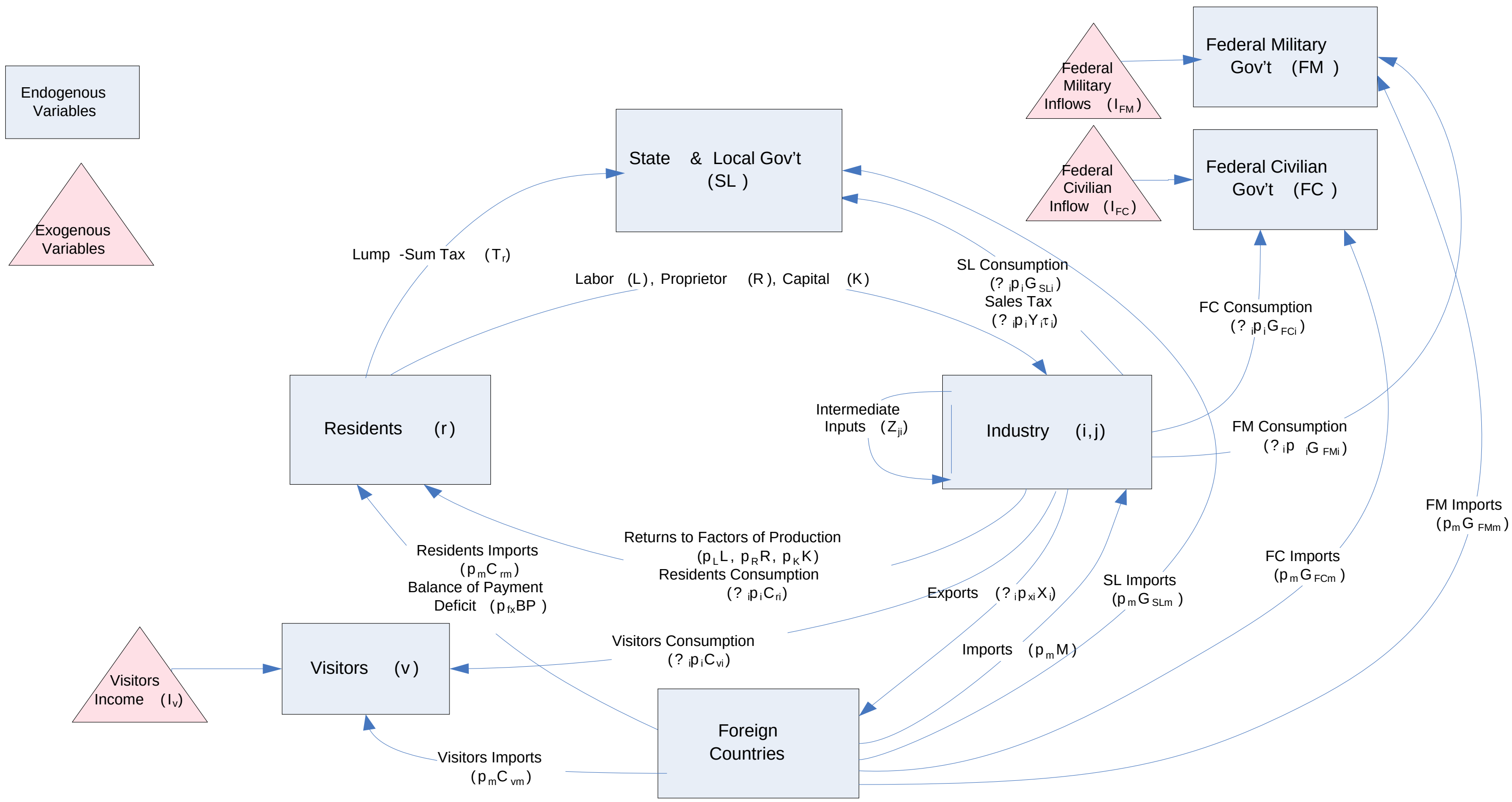


Figure 13: General Equilibrium Model of Hawaii's Economy



Computable General Equilibrium Model

III. IMPACTS OF VISITOR GROWTH

A key element of this study is the development of a model CGE of Hawaii's economy to simulate the effects of tourism growth under alternative conditions. We use it to identify the impact of growth on key economic, environmental, and quality of life measures. We seek to identify key factors influencing tourism growth, impacts of these changes over time The model allows for the estimation of effects relating to spending by visitors and households and the measurement of changes in labor, income, and other economic conditions.

Appendix 3 of the Data and Methods Report describes the modeling techniques in detail. Visitors, residents, state, local, and federal civilian government, military, and investors are all agents of Hawaii's economy. In an open economic environment, producers supply goods and services using available intermediate goods produced both locally and abroad, as well as capital, labor, land, and environmental resources such as water. The model is calibrated to detailed Hawaii data on visitor, resident, and government purchases as well as industrial technologies and purchases. The model provides estimations of supply and demand as well as the interaction between key economic sectors in terms of the purchase of goods and services throughout the local economy under various conditions. The model provides information on output, value added, prices, employment levels, returns to factors of production, and changes in welfare for key groups in the state's economy. Analysis of macroeconomic indicators as well as sector-level impacts including changes in output, employment, value added, prices, exports, and other key variables. In this section, the key findings related to the impact of visitor spending on the economy, households, labor force, and economy are presented.

III.A. What a Difference $1 Million Makes: The Impact of Visitor Expenditures

To capture the effects of tourism using the CGE model, we look at the consequences of a $1 million increase in visitor spending. This amount is large enough to trace through the effects on Hawaii, but not so large so as to create major structural changes in the local economy. As such, the analysis of the impact of increasing visitor spending by $1 million provides a reasonable measure of how, given the current structure of the economy and present supply and demand relationships, visitor spending impacts the state's economy. Other scenarios will focus on larger changes in visitor spending in order to show how some structural changes in the economy might come about with much higher levels of increased visitor spending.

Overall Economic Effects

An increase of a million dollars in visitor spending increases total output by approximately $2.1 million, with an increase in total value added of over $1.4 million. As shown in Table 6, of the $1 million, approximately $860,647 is translated into direct visitor spending on Hawaii products, with the remainder going to imports. The largest direct spending categories for tourists are hotels ($297,087), air transportation ($142,279), trade ($116,913), restaurants ($103,026). Not surprisingly, these visitor oriented sectors also experience the most growth in wages and salaries. Because of the new equilibrium, output falls in two sectors: agriculture and manufacturing. This reflects a shift in economic activity towards those sectors which benefit most from tourism.

Because of the multiplier effect and visitor dollars circulating through the local economy, a million dollar increase in visitor spending also serves to boost household spending by $1,321,493. The increased income translates into households spending significantly more on services (health, education, financial, etc.), real estate, and trade. More income means that households buy more goods and services. A million dollar increase in visitor spending yields a $281,189 increase on service spending, $275,890 on real estate spending, and $158,728 on retail and wholesale trade spending. The combined effects of both direct visitor spending and household spending mean that some sectors grow more quickly than others. This is depicted in Figure 14.

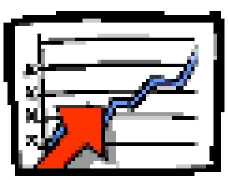
Visitor expenditures bring external dollars and foreign exchange to the economy and thus improve Hawaii's terms of trade and ability to import goods and services from abroad. That is, visitor expenditures are an 'export' of Hawaii tourism services. As local costs rise, exports of other goods and services will fall by an estimated $482,565. Hawaii's exports decline in non-visitor related services, export-oriented agriculture, and manufacturing (primarily food processing and clothing manufacturing).

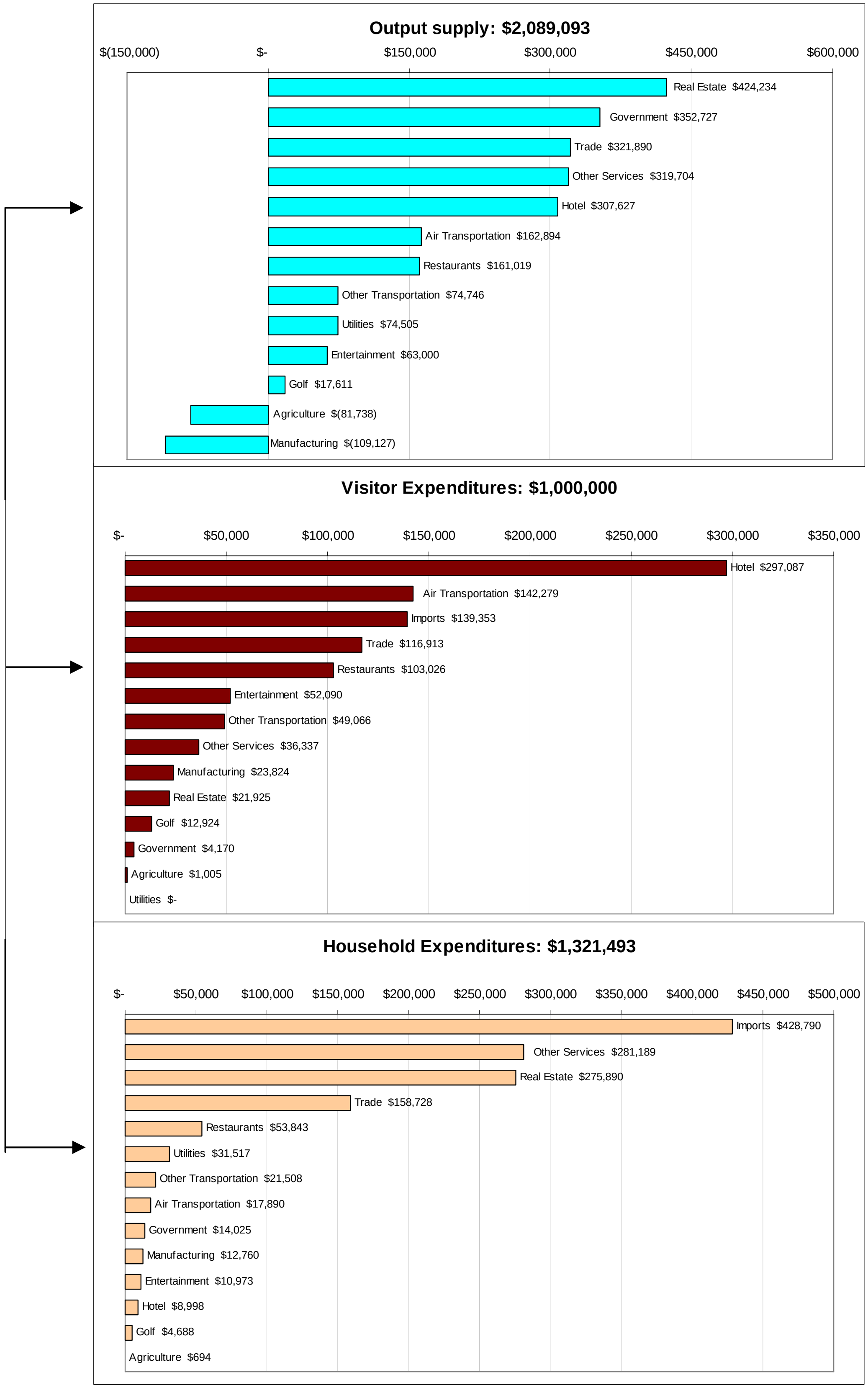
Table 6: The Impact of a $1 Million Increase in Visitor Spending

	Visitor Spending	Household Spending	Export	Output	Labor Compensation	Value Added
Agriculture	$1,005	$694	$(65,179)	$(81,738)	$(24,441)	$(38,590)
Manufacturing	$23,824	$12,760	$(163,248)	$(109,127)	$(29,942)	$(41,013)
Air Transportation	$142,279	$17,890	$(1,515)	$162,894	$48,229	$86,202
Other Transportation	$49,066	$21,508	$(10,989)	$74,746	$20,144	$34,163
Entertainment	$52,090	$10,973	$(2,910)	$63,000	$25,110	$35,665
Golf	$12,924	$4,688	$ -	$17,611	$7,613	$9,789
Hotel	$297,087	$8,998	$ -	$307,627	$119,186	$169,806
Real Estate	$21,925	$275,890	$(29,387)	$424,234	$19,265	$303,926
Restaurants	$103,026	$53,843	-(686)	$161,019	$61,973	$83,746
Trade	$116,913	$158,728	$(12,320)	$321,890	$137,138	$190,258
Other Services	$36,337	$281,189	$(187,675)	$319,704	$178,518	$217,544
Utilities	$ -	$31,517	0	$74,505	$19,348	$46,110
Government	$4,170	$14,025	$(8,655)	$352,727	$299,401	$344,985
Imports	$139,353	$428,790	$ -	$ -		
TOTAL	$1,000,000	$1,321,493	$(482,565)	$2,089,092	$881,540	$1,442,591

Figure 14: The Impact of a $1 Million Increase in Visitor Spending

A $1 million increase in visitor spending has the following effect





One of the strengths of the CGE modeling approach is that it enables the measurement of changes in various economic sectors in the state. A million dollar increase in visitor spending translates into growth for some and decline for others. Among the sectors to experience an increase in output are real estate, government, health services, retail trade, hotels, finance/business/professional services, and restaurants. Other growing sectors are those which cater to tourists (hotels, restaurants, air transport, travel reservations, automobile rental, sightseeing, and golf courses). Infrastructure and environmental services sectors (electricity, petroleum manufacturing, and water/sewer) also experience growth relative to other sectors.

The sector effects are a consequence of both the interrelationships between the visitor industry and other businesses in Hawaii and also the unique structure of the state's economy. Given the large renter population, many of whom are employed in the visitor industry or in supporting industries, it is not surprising to see that a boost in visitor spending leads to $424,234 increase in real estate output. The fact that so much of Hawaii's local economy is structured around services, trade, and government also shows up in terms of gains to those sectors resulting from a $1 million increase in visitor spending.

As noted earlier, a $1 million increase in visitor spending leads to significant gains for traditional visitor industry sectors such as air transportation, hotels, trade, and restaurants. There is also significant growth in entertainment, golf, ground transportation, and sightseeing services. A million dollar increase in visitor spending produces a $33,313 increase in Hawaii's travel reservation business as well. Clearly there are many small businesses that benefit from increased visitor spending. These benefits include not just an increase in output, but also in employment levels, prices, and income.

A million dollar increase in visitor spending leads to a $109,050 increase in construction activities, primarily repair and maintenance of existing structures. There is also an increase in landscaping services ($6,993), private waste management ($9,126), trucking ($10,852), water/sewer services ($14,306), and electricity bills ($48,658).

The biggest effect, however, of increased visitor dollars in the economy is on increased spending on services (health care, education, etc.), which no doubt contributes to a higher quality of life for residents. With a million dollar increase in visitor spending, there is also increased household spending on golf ($4,688), hotels ($8,998), entertainment ($10,973), and restaurants ($53,843). This supports, in economic terms, the notion that the presence of the visitor industry not only creates income, but also benefits in terms of expanded household consumption of visitor amenities. The enjoyment of Waikiki or other visitor amenities is not limited solely to tourists.

Employment Growth

The changes in output increases employment in some sectors. A million dollar increase in visitor spending boosts employment in hotels, with a change in wage and salary compensation of $119,186. It increases wage and salary compensation in health services by $107,913 and retail trade by $104,484. The 40 sector employment opportunities are all affected by a $1 million dollar increase in visitor spending and are shown in Table 7. These employment gains also translate into improvements in the quality of the visitor experience. The increases are a function of changes in demand for goods and services by both visitors and residents.

Table 7: Top Employment Growth Sectors

	Change in Compensation of Employees
Other government	$299,401
Hotels	$119,186
Health services	$107,913
Retail trade	$104,484
Restaurants	$61,973
Construction and mining	$49,129
Air transportation	$48,229
Other services	$35,239
Wholesale trade	$32,654
Real estate rental	$19,265
Travel reservations	$13,825
Sightseeing transport	$12,823
Electricity	$10,001
Golf courses	$7,613
Automobile rental	$5,536
Water sewer	$5,221
Recreation	$3,974
Amusement	$3,907
Petroleum manufacturing	$3,805
Trucking	$3,801
Landscaping services	$3,568
Transit	$3,451
Ground transportation	$3,351
Museums historical	$2,860
Laundry	$2,820
Waste management private	$2,765
Water transportation	$2,601
Performing arts	$1,546
Parking lots	$1,404
Natural gas	$1,361
Commercial fishing	-$484
Chemical manufacturing	-$2,138
Information	-$2,396
Other manufacturing	-$6,034
Animal	-$7,121
Food processing	-$10,800
Education private	-$11,392
Clothing manufacturing	-$14,774
Finance business professional	-$16,620
Crops	-$20,404
TOTAL	$881,540

Environmental Impacts

Even modest growth in visitor expenditures has an impact on the environment in terms of economy-wide demand for infrastructure services. Yet, because direct tourist purchases of infrastructure services are relatively small, limited mostly to gasoline purchases for rental cars, it has traditionally been very difficult to assess the impact of tourism. Our methodology provides the first estimation of the comprehensive impact of tourism expenditures.

The million dollar visitor expenditure shock generates three sources of infrastructure demand: direct demand, indirect demand, and induced demand. *Direct demand* reflects direct purchases by visitors. Much more significant is the *indirect demand* for water, energy and solid waste disposal services by the industries whose goods and services visitors purchase. Finally, tourism dollars generate income for local households, who in turn expand their consumption (both directly and indirectly) for various goods and services. This *induced demand* by households contributes significantly to the strain on infrastructure. Visitor expenditures also reduce Hawaii's reliance on exports and enhance Hawaii's ability to import goods rather than produce them locally. Thus infrastructure use is reduced as export production falls. A possibility discussed below is that large increases in visitor expenditures may also induce an in-migration of more workers. We will explore this expansionary labor force impact in more detail in a later section.

The overall impact on Hawaii is given in Table 8. Strikingly, because a small increase in visitor expenditures tends to raise costs in the agricultural sector (as workers wages rise) overall water use actually declines by 1.46 million gallons. However, municipal water use by non-agriculture sectors, notably restaurants, hotels, and golf, does rise by 1.1 million gallons.

Table 8: Increase in Infrastructure Use with $ Million Increase in Visitor Spending

	Total Water (gal)	Non-ag Water (gal)	Electric (MWh)	Utility Gas (mmBtu)	Solid Waste (lbs)	Petroleum (gals)
Total Use by Residents*	1,294,136	1,267,102	117.8	50.8	28,224	56,311
Total Use by Visitors**	991,417	969,937	174.1	138.5	35,385	77,339
Total Use by Export, Other*#	(3,745,610)	(1,113,650)	(159.0)	(82.7)	(59,427)	(91,920)
Total	(1,460,057)	1,123,389	132.9	106.6	4,181	41,730

* Includes induced effects
** Includes direct and indirect use.
# includes government, investment, and other final demand

Energy demands are significant, with electricity use expanding by 132.9 Megawatts. The sharp increase in restraint services boosts demand for utility gas by 106.6 million BTUs. The injection of a million tourist dollars leads to the generation of an additional 4,181 pounds of solid waste, and the increased consumption of 41,730 gallons of petroleum.

III.B. Visitor Expenditure Growth by Market: Changing the Visitor Mix

Declining Japanese visitor demand as well as expanding visitor demand from the US and other major markets has spurred discussions about the optimal mix of visitors coming from different markets. It is constructive to consider the economic and environmental impacts of alternative visitor types. One might extend such an analysis to other visitor categories, such as “ecotourists”, “urban sophisticates”, or the basic “sun and surf” visitors. Such an analysis, however, would require more visitor expenditure survey data than is presently available. The methodology and tools developed for this project could be applied to the analysis of other types of visitors.

Table 9 contains a comparison of spending by US-West, US-East, Japanese, and Canadian visitors. Several observations can be made from the data. First, the general patterns of spending by U.S. and other visitors are similar, while those of Japanese visitors are quite different. Japanese visitors spend proportionately less on air transport, less on accommodations, but much more on retail and wholesale trade. Their purchase of imported goods is also much higher. U.S. and other visitors spend proportionately more on rental cars than the visitors from Japan. Japanese spend almost double the volume in imports, mainly retail purchases, than other (non-U.S.) visitors.

Table 9: How Visitors Spend $1 Million

	US West	US East	Japan	Canada	Other Int’l	Average Visitor
Agriculture	$2,128	$1,385	$1,521	$2,195	$1,536	$1,716
Manufacturing	$10,064	$7,662	$12,324	$9,758	$9,190	$9,694
Air Transportation	$138,733	$197,053	$70,792	$132,503	$161,193	$144,822
Other Transportation	$54,927	$45,152	$35,707	$49,037	$76,262	$49,943
Entertainment	$47,044	$44,920	$56,798	$45,068	$93,713	$53,021
Golf	$16,141	$15,044	$6,592	$14,554	$9,729	$13,155
Hotel	$324,571	$295,681	$256,351	$441,017	$304,186	$302,398
Real Estate	$24,083	$21,992	$19,089	$30,738	$21,543	$22,317
Restaurants	$117,948	$109,191	$94,567	$74,425	$72,981	$104,868
Trade	$111,120	$115,154	$160,984	$62,906	$86,526	$119,003
Other Services	$46,953	$43,523	$30,342	$36,842	$34,223	$40,952
Utilities	$0	$0	$0	$0	$0	$0
Government	$4,826	$4,505	$3,951	$2,437	$2,392	$4,245
Imports	$101,462	$98,738	$250,983	$98,520	$126,526	$133,867
Total	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000

Estimates based on spending data provided by DBEDT – READ Division.

To examine the impact of increasing a specific visitor type, a $1 million increase in spending by various visitor groups is simulated. That is, we look at the impact of a ceterus paribus increase in Japanese spending by $1 million while holding all other elements of the economy constant. The exercise is repeated with US–East, US–West, Canadian and other international visitors. The macroeconomic results are presented in Table 10.

Japanese visitors spend approximately $248 on a given day which is more than any other visitor type. The effect of a $1 million increase in Japanese visitor spending is associated with approximately 4,027 new Japanese visitor days. Canadians, on the other hand, tend to spend less per day, approximately $117. Thus a $1 million increase in Canadian visitor spending requires 8,552 more visitor days.

While a million dollars in additional Japanese spending results in fewer people than does other visitor types it also contributes notably less to the gross state product ($1,373,783), household expenditures ($1,146,014), and consumer price inflation (0.26%) than do other visitor types. One million dollars from Canadians contribute the most to the economy, although not by a significant margin. The gap between Japanese economic contributions and those of other visitor types is due to the significantly higher levels of direct and indirect import of non-Hawaii goods and services associated with Japanese spending. As shown in Table 9, the typical Japanese visitor spends a higher share of income on imports and less on non-tradable services including accommodations and restaurants.

While Japanese visitors spend more per day and contribute less per dollar to the local economy, they also tend on average to have a lower environmental impact. Per million dollars spent, the Japanese visitor generates less water, petroleum, and electricity demand than most other visitors. Other international visitors generate a relatively low impact in terms of water and electricity. Visitors differ greatly in terms of their impact on the generation of solid waste.

TABLE 10: Impact of $1 Million Increase in Visitor Spending, by Visitor Type

	US-West	US-East	Japan	Canada	Other Int’l	Average
Visitors						
Increase # visitor days	5,910	5,313	4,027	8,552	6,250	5,342
Spending per visitor day	$169	$188	$248	$117	$160	$187
Economic Impact ($ increase)						
Gross State Product	$1,654,450	$1,638,198	$1,373,783	$1,670,052	$1,577,861	$1,583,409
Household Expenditures	$1,381,039	$1,367,441	$1,146,014	$1,394,984	$1,316,087	$1,321,493
Consumer Price Inflation	0.0031%	0.0031%	0.0026%	0.0032%	0.0030%	0.0030%
Total Environmental Impact (unit increase)						
Water (gal)	(1,440,910)	(1,558,726)	(1,302,054)	(1,413,727)	(1,565,705)	(1,460,057)
Non-ag water (gal)	1,220,282	1,147,846	932,150	1,294,676	1,058,823	1,123,389
Electricity (MWH)	140.2	132.4	125.1	148.4	120.3	132.9
Utility gas (mmBtu)	117.1	105.5	91.1	139.8	96.8	106.6
Solid Waste (lbs)	5,088	3,685	5,118	(473)	1,617	4,181
Petroleum (gal)	38,026	49,094	34,880	37,806	47,705	41,730

III.C. What if Visitors Stopped Coming? The Impact of No Visitor Growth

The incomes of Hawaii's residents are closely tied to the visitor industry. When there is no new growth of the labor force, visitor expenditure growth generates an increase in household welfare, or real household expenditures. Under these conditions, visitor growth essentially transfers income from visitors to residents through inflation of factor prices. The reverse is also true, that labor force growth without an increase visitor spending will harm Hawaii households and benefit visitors, as real incomes fall. Labor force expansion without an increase in visitors, or alternative export sectors, is not sustainable in terms of maintaining a standard of living for Hawaii residents. The CGE model is used to simulate an increase in the existing labor force with no corresponding increase in visitor expenditures.

The quality of life for residents can be gauged in part by the amount of household expenditure and the spending on various goods and services such as housing, education, health, entertainment and other amenities. The quality of the visitor experience, however, is reflected by the costs of the visit to Hawaii and the availability of labor which in turn affects the quality of service at hotels, restaurants, and other businesses used by tourists. The experience of both residents and tourists is also affected by the availability and quality of infrastructure and other support services that help to ensure a clean, safe, and attractive physical environment.

Table 11 provides the macroeconomic impact of a labor force expansion when visitor expenditures are stagnant. The growth in workers has a positive real impact on the visitor experience. The welfare of the tourist is measured in terms of real (inflation adjusted in terms of $1997) visitor expenditures, which increases from $10.93 to 10.96 billion with a 1% growth in the labor force, to $11.20 billion with a 10% labor force increase. Visitor welfare increases as the purchasing power of a nominal visitor dollar improves. The visitor price index falls from 99.7 with a 1% labor force increase to 97.4 with a 10% labor force increase.

While total household expenditures rise in real terms, the growth is less than the growth in labor force and hence average welfare declines. With a 1% increase in the labor force real expenditures increase to $25.1 billion. A 10% labor force growth results in $26.8 billion total real household expenditures and a drop in average household expenditures to $41,042. Average wage and salary compensation falls with growth in the labor force. A 10% growth in the labor force produces a drop in real average compensation to $22,103. A similar trend exists with average proprietor income. Clearly, labor force expansion without an increase in visitors (or alternative export sectors) is not sustainable in terms of maintaining a standard of living for Hawaii residents.

As labor force growth improves Hawaii's comparative advantage, export sectors such as clothing manufacturing (aloha shirts), agricultural goods, clothing, and exportable services grow disproportionately fast. Transportation, trade, finance, business, professional, health, and information services grow roughly proportional to the growth in the labor force. Visitor-related sectors including hotels, restaurants, retail, golf, and various visitor entertainment services tend to grow more slowly than the labor force.

Table 11: Labor Growth with No Visitor Growth (% change)

Scenario Parameters	Baseline	Labor Force (% change)		
Labor Force (thousands)	594.7	**1.0**	**5.0**	**10.0**
Visitor Expenditures ($ million)	10,931.0	10,931.0	10,931.0	10,931.0
Visitor Impacts				
Real Visitor Expenditures ($ million)	10,931.0	10,969.2	11,102.1	11,228.6
Hawaii Visitor Price Index (1997 = 100)	100.0	99.7	98.5	97.4
Household Impacts				
Real Household Expenditures ($ million)	24,962.0	25,141.9	25,608.9	26,848.9
Hawaii Consumer Price Index (1997 = 100)	100.0	99.8	99.0	98.3
Real Average Household Expend ($1997)	41,741.0	41,858.1	41,450.2	41,042.8
Real Compensation of Employees ($ million)	21,626.2	21,668.5	21,850.5	22,102.9
Real Average Labor Comp ($)	35,133.0	34,853.6	33,807.5	32,643.6
Real Proprietors Income ($ million)	2,088.0	2,101.4	2,155.4	2,222.9
Real Average Proprietors Income ($ thousand)	16,481.0	16,423.4	16,203.4	15,951.4
Production Impacts				
Real Gross State Product ($ million)	38,615.7	38,782.2	39,462.9	40,340.2
Real Total Output ($ million)	58,732.5	59,078.4	60,467.3	62,214.5

III.D. Visitor Expenditure Growth and the Labor Force

Fluctuations in the visitor industry clearly affect Hawaii's labor market conditions. The decade of the 1980s was characterized by a significant expansion of both tourism and the labor force. The 1990s, in contrast, witnessed a compression of growth both in tourism and the labor force. Recently, Hawaii tourism has responded to global conditions, such as the Asian financial crisis or the September 11 tragedy, and tourism jobs were severely impacted.

This section considers the impact of visitor growth under two assumptions: 1) that employment (or the number of workers) remains unchanged and 2) that workers enter freely to accommodate growth in demand. Table 12 provides a summary macroeconomic impacts of an increase in current dollar visitor expenditures of 1%, 5%, and 10% from the baseline level of $10,931 million with no growth in labor.

Table 12: Visitor Expenditure Growth with No Labor Growth

Scenario Parameters	**Baseline**	**VE Growth**		
Labor Force (thousands)	594.7	**1.0%**	**5.0%**	**10.0%**
Visitor Expenditures ($ million)	10,931.0	11,040.3	11,477.6	12,024.1
Visitor Impacts				
Real Visitor Expenditures ($ million)	10,931.0	11,003.8	11,282.3	11,602.1
Hawaii Visitor Price Index (1997 = 100)	100.0	100.3	101.7	103.6
Household Impacts				
Real Household Expenditures ($ million)	24,962.0	25,108.1	25,294.5	25,664.3
Hawaii Consumer Price Index (1997 = 100)	100.0	100.3	101.7	103.6
Real Average Household Expend ($1997)	41,741.0	42,080.8	42,533.2	43,155.1
Real Compensation of Employees ($ million)	21,626.2	21,652.2	21,763.2	21,917.8
Real Average Labor Comp ($)	35,133.0	35,175.6	35,356.0	35,607.1
Real Proprietors Income ($ million)	2,088.0	2,088.2	2,089.9	2,093.8
Real Average Proprietors Income ($ thousand)	16,481.0	16,483.3	16,496.9	16,527.1
Production Impacts				
Real Gross State Product ($ million)	38,615.7	38,663.0	38,864.4	39,143.1
Real Total Output ($ million)	58,732.5	58,769.3	58,928.6	59,154.6

Consider the impact of visitor expenditure growth on the quality of the visitor experience with no growth in labor. Visitor well-being is given by real, inflation adjusted, visitor expenditures. A 1% increase in nominal visitor expenditures results in real visitor expenditures of over $11.0 billion. As visitor expenditures grow, real visitor expenditures continue to increase This suggests that there is existing capacity for expansion of the visitor industry without a decline in the quality of service. At the same time the growth in visitor spending is associated in an increase in inflation. The visitor price index with a 10% increase in visitor rises to 103.6.

Hawaii households benefit from the increase in visitor demand. With an increase of 1% in nominal visitor expenditures, real household expenditures would increase to over $25.1 billion. This increase is attributed to real increases in labor and proprietor compensation. Household expenditures increase steadily as visitor expenditures rise. A 10% increase in visitor spending pushes real household expenditure to $25.6 billion. Finally, visitor expenditure growth has a positive effect on both real and nominal gross state product (GSP). Nominal visitor expenditure growth of 1% spurs output growth to over $58.8 billion while a 10% increase in visitor expenditure raises output to over $59.7 billion.

Table 13: Visitor Expenditure Growth with Zero Labor Wage Growth (% change)

Scenario Parameters	Baseline	VE Growth (% change)		
		1.0	**5.0**	**10.0**
Labor Force (thousands)	594.7	595.6	599.2	604.1
Visitor Expenditures ($ million)	10,931.0	11,040.3	11,477.6	12,024.1
Visitor Impacts				
Real Visitor Expenditures ($ million)	10,931.0	11,009.7	11,317.1	11,685.0
Hawaii Visitor Price Index (1997 = 100)	100.0	100.3	101.4	102.9
Household Impacts				
Real Household Expenditures ($ million)	24,962.0	25,052.0	25,423.3	25,913.7
Hawaii Consumer Price Index (1997 = 100)	100.0	100.3	101.5	103.0
Real Average Household Expend ($1997)	41,741.0	42,062.8	42,426.4	42,899.2
Real Compensation of Employees ($ million)	21,626.2	21,658.3	21,790.9	21,966.4
Real Average Labor Comp ($)	35,133.0	35,133.0	35,133.0	35,133.0
Real Proprietors Income ($ million)	2,088.0	2,090.2	2,099.8	2,113.4
Real Average Proprietors Income ($ thousand)	16,481.0	16,474.6	16,449.7	16,424.0
Production Impacts				
Real Gross State Product ($ million)	38,615.7	38,687.6	38,984.8	39,378.6
Real Total Output ($ million)	58,732.5	58,820.7	59,186.1	59,673.5

Another scenario involves the impact of an increase in nominal visitor expenditures when the labor force can expand to accommodate the growth in demand. The labor supply is assumed to be perfectly elastic and workers can move into the labor force but real wages are held constant.

As shown in Table 13, the labor force increases slightly to 595,600 with a 1% increase in visitor spending to 604,100 with a 10% increase in visitor spending. Real visitor expenditure grows to over $11 billion with a 1% nominal expenditure growth to $11.7 billion with a 10% nominal expenditure growth. The consumer price index increases to 103 and visitor price index to 102.9 with a 10% increase in nominal visitor expenditures.

Total household expenditure also increases to $25.9 billion with a 10% increase in visitor spending. This increase is driven by labor force growth and by growth in real compensation of employees, and thus real average household expenditures lag behind that of total expenditures. With visitor expenditure growth, total real compensation to employees increases at the rate of increase in the labor force. By assumption, total average compensation to labor remains fixed. Real gross state product grows to $38,687.6 million (with a 1% growth in visitor spending) to $39,378.6 million (with a 10% growth in visitor spending).

Table 14: Visitor Expenditure Growth and Perfectly Elastic Labor Force Growth

		Visitor Expenditure Percent Change		
		1%	5%	10%
Labor Force Impacts				
Labor Force (thousands)	594.7	594.8	601.4	609.2
Visitor Impacts				
Real Visitor Expenditures ($1997 m)	10,931.0	10,985.6	11,193.3	11,390.1
Visitor Price Index (1997 = 100)	100.0	100.5	102.5	105.4
Household Impacts				
Consumer Price Index (1997 = 100)	100.0	100.5	102.7	105.8
Real Avg Hshld Expenditures ($1997)	41,741	41,866.2	42,492.3	43,285.4
Real Average Compensation of Employees ($1997)	35,133.0	35,133.0	35,133.0	35,133.0
Production Impacts				
Real Gross State Product ($1997 m)	38,615.7	38,731.5	39,156.3	39,812.8

Another scenario considers the impact of an increase in nominal visitor expenditures when the labor force can expand Hawaii's productive capacity to accommodate the growth in demand but tradable Hawaii products are not easily substituted with imports. The labor supply is assumed to be perfectly elastic whereby workers move into the labor force and real wages are constant.

As shown in Table 14, the labor inflow associated with a 1% increase in nominal spending is significant (approximately 0.21% of the total labor force), and the rate of increase is slightly increasing as expenditures grow (10% expenditure increase induces approximately a 2.43% increase in labor force). Growth impacts the quality of the visitor experience. Real visitor expenditures expand to $10,985.6 million (with 1% nominal expenditure growth) to $11,390.1 million (with 10% nominal expenditure growth). The consumer price index increases by 5.8%, and visitor price index by 5.4%, with a 10% increase in nominal visitor expenditures.

Real average household expenditures increase, ranging from $41,866 to $43,285. By assumption, this increase is driven by labor force growth rather than by growth in real compensation of employees, and thus real average household expenditures lag behind that of total expenditures. With visitor expenditure growth, total real compensation to employees increases at the rate of increase in the labor force. By assumption, total average compensation to labor remains fixed. Real gross state product grows from $38,731.5 million (with a 1% growth in visitor spending) to $39,812.8 million (with a 10% growth in visitor spending).

Summary Remarks

First, while the quality of the visitor experience is dependent on the responsiveness of the labor force to tourism growth there appears to be sufficient capacity to absorb up to a 10% increase in visitor spending. Visitor welfare is measured in terms of real visitor expenditures, that is, adjusted for price inflation. When labor supply is fixed, perfectly inelastic, a nominal (dollar) increase in visitor spending results in a lower visitor welfare level with real expenditures in either case increasing slightly. In contrast, when labor supply is perfectly flexible, an expansion of nominal visitor expenditures is supported by an inflow of workers, and real expenditures increase more. Generally, visitors are better-off in an environment with a flexible rather than a fixed labor market.

Second, the more visitors spend the higher are prices, for both visitors and residents. Additionally, increases in visitor spending generate more inflation when labor markets are inelastic than when there may be in-migration. The visitor price index, as well as the consumer price index, measures the percentage change in the cost of a market basket of goods due to price changes over initial levels and is computed as a true price index.

Third, residents are better-off when visitor spending is not accompanied by a growth in the labor force. While increases in visitor spending fuels consumer price inflation, compensation to employees is increasing even faster when the labor market is price inelastic. In an elastic labor market, workers will enter up to a point where real returns to labor are unchanged. The welfare gains on a per-household basis from growth in nominal visitor spending are much more moderate (and due to increased demand for non-labor factors of production) when labor markets are flexible.

Clearly, a key limiting force in the growth of the visitor industry is the availability of labor. Without a responsive labor force, the increase in demand that tourism dollars generate are inflationary and less sustainable for the visitor industry. At the same time, tourism has traditionally been the primary export for Hawaii. Other export sectors, such as agriculture, clothing manufacturing, or intellectual property, are unlikely grow to at a rate sufficient to maintain living standards for a growing population. To provide a consistent standard of living for future generations, visitor revenues will undoubtedly play an important role.

In Hawaii, as the population and labor force expands, so goes a need for outside sources of income from industries such as tourism. Where goes tourism, so goes a demand for labor. The relationship between the standard of living of people within Hawaii, be they residents or transients, are intricately linked.

IV. PROJECTIONS FOR OUR FUTURE

An important step in planning for the visitor industry is an examination of how economic and environmental impacts accumulate over time. Thus the baseline models are extended to a dynamic framework to analyze various tourism growth scenarios over a 10, 20, and 30 year planning horizon.

The CGE model of the 1997 Hawaii economy is calibrated to key variables in the long-range forecasting model maintained by the University of Hawaii Economic Research Organization (UHERO), described in Appendix 3.4 of the Data and Methods Report. Using a time-series of data on key Hawaii, national, and international economic indicators, the UHERO model predicts inflation, employment, and output for the State and Counties. In addition to projections of county-level visitor expenditures the UHERO model forecasts growth in Federal government expenditures, both military and civilian.

Alternative growth scenarios were developed for visitor arrivals, daily census, and visitor expenditures for various categories of tourists visiting the state and each of the four counties. The scenarios are designed to reflect plausible policy goals such as low expenditures growth and high expenditures growth. The scenarios are based on assumptions regarding external forces (global population and income growth) as well as Hawaii capacity constraints.

On any given day, visitors to Hawaii account for roughly 13% of the state's de-facto population. In addition to total visitor arrivals, the state's resident population must be considered. Scenarios for resident population were developed using the cohort component method to forecast population by both age and sex, at the County-level. Baseline population projections utilize the cohort component method, described in Appendix 3.4 of the Data and Methods. This method is used by the US Social Security Administration and the US Census Bureau. Population projections from the UHERO demographic model have been integrated into the Hawaii CGE model to produce consistent scenarios for Hawaii resident population, visitor population, and visitor industry indicators.

This section provides an analysis of various visitor growth scenarios. The impacts are examined at the county level, and key infrastructure trigger points are identified.

IV.A. Baseline Projections for Growth: 2010, 2020, 2030

This section describes a baseline projection for visitor, population, and economic growth as well as the implications for quality of life and the environment. In order to base these scenarios on realistic levels of population growth and visitor spending, we develop independent projections of population, tourism, and economic growth. The methods are described in detail in Appendix 3.5 of the Data and Methods. A sequential process is used to derive visitor spending levels. Visitor arrivals are first estimated on the basis of variables such as the GDP of the origin country, the relative cost of a Hawaii vacation, exchange rates, and supply constraint factors, such as the occupancy rate. The length of stay is then determined based on ARIMA models that assume that deviations from recent average length of stay are transitory. Visitor spending is based on the application of per person per day level of spending, broken into two categories – lodging and all other expenditures. Likewise military and civilian federal government growth rates are estimated based on national trends. Population and labor force projections are made using a methodology that linked demographic changes to Hawaii's economic performance relative to the U.S. as a whole. The model used a variation of the standard cohort-component technique in which the size of each cohort declines due to mortality and either increases or decreases due to net migration. The technique uses base year populations and forecast values of age-specific fertility rates, survival rates, and migration rates.

The Economy of Hawaii 2030: Growth, Income Distribution, and Quality of Life

Baseline projections for 2010, 2020, and 2030 are provided in Figure 15 and Table 15. The labor force is projected to grow from the current (baseline) levels of 594.7 thousand to 672.5 thousand in 2010, 740.7 thousand in 2020, and 794.3 thousand in 2030. As shown in Table 15, Gross State Product (GSP) expands from $38.6 billion in 1997 to $111.8 billion in 2030; visitor expenditures grow from initial levels of $10.9 billion to over $28.5 billion in 2030 in nominal terms; and household expenditures grows from $24.9 billion to $89.0 billion in 2030. The county-level composition of visitor growth is discussed in more detail below.

Figure 15: Hawaii 2030: Projected Economic Growth

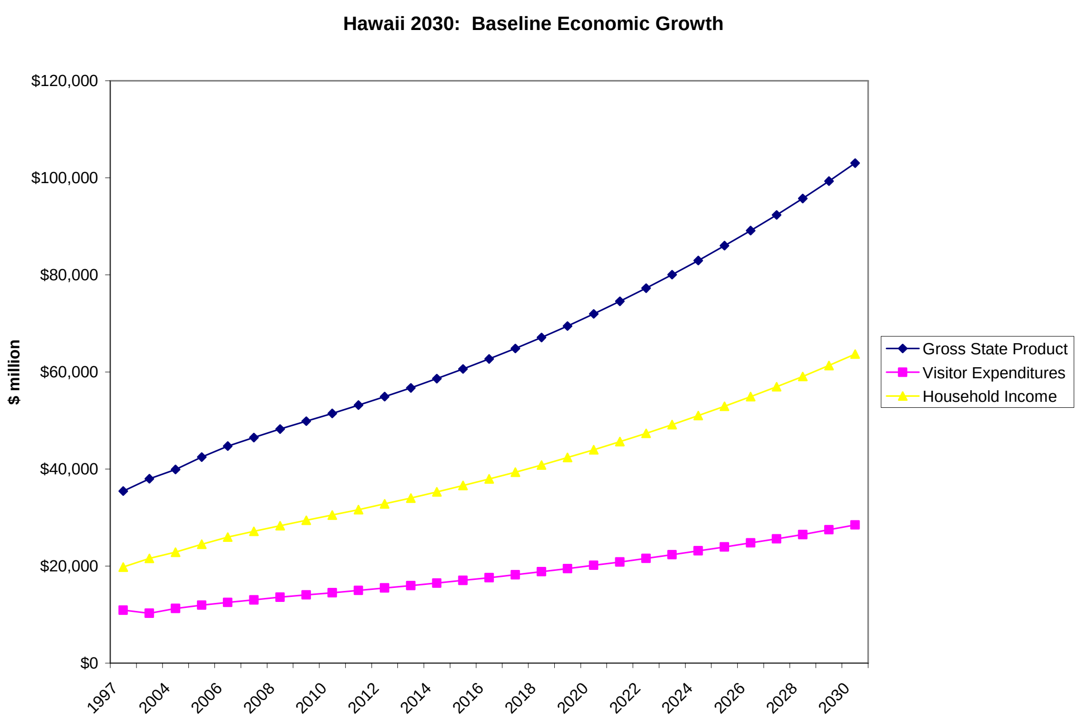


Table 15 provides macroeconomic indicators for baseline, 2010, 2020, and 2030 projections. Growth in Hawaii and the world economy generates projected inflation, with the Consumer Price Index (CPI) increasing from 100 in 1997 to 156.0 by 2030 and the Visitor Price Index (VPI) to 163.9 by 2030. Given significant price inflation, it is important to distinguish between nominal (or current dollars) and real (or inflation-adjusted using CPI or VPI) values. Whereas nominal visitor expenditures increase from $10.9 in 1997 to $28.5 billion in 2030 dollars (or 160.3%), those same expenditures evaluated at 1997 prices imply real visitor expenditures in 2030 of $17.3 billion (58.1%). Similarly total household expenditures increases from $24.9 billion to 2030 levels of $89.0 billion in nominal terms (256.7%) and $60.6 billion in real terms (143.0%). Gross state product grows in nominal terms to $111.8 billion and in real terms to $71.6 billion.

Future prospects for Hawaii residents are also provided in Table 15. The average Hawaii household (computed by dividing the total household expenditures by total labor force) will experience a projected increase in expenditure from baseline levels of $42.0 thousand to $51.3 thousand in 2010 (22.3%), $62.0 thousand in 2020 (47.6%), and $76.4 thousand in 2030 (81.9%). Income growth tends to be higher for laborers (those earning wages and salaries) than for proprietors.

The most realistic forecasts for Hawaii 2030 indicates that the State will serve as home to more residents, generate more income for residents, host more visitors from diverse origins, and supply more services to residents, visitors, government, and the military. All indications are that Hawaii's economic growth, while not overly robust, will be healthy enough to support an expanding quality of life for current residents and will attract increasingly more residents and visitors to the islands. This growth has inflationary aspects. The cost of living will rise for residents, and even more for visitors, over the next three decades. Some prices increase faster than others.

The quality of the visitor experience will be different in Hawaii 2030. In addition to a more congested environment, Hawaii prices are projected to increase. While there will be an increasing international demand for Hawaii visitor services, the cost of the Hawaii vacation will rise (by 64% in real terms over current price levels). The congestion among visitors is even more apparent when we examine impacts at the county levels. Within the next five years, most counties will begin to see a significant increase in hotel occupancies and within the decade critical visitor inventory constraints will be hit. Nonetheless, owing to the emergence of growing incomes in new Hawaii visitor markets (China, Vietnam, etc) and healthy demand worldwide, we anticipate an expanding demand for the foreseeable future.

Table 15: Hawaii 2030: Baseline Projections and Economic Impacts

Macroeconomic Indicators	1997	2010	2020	2030
Labor Force (thousands)	594.7	672.5	740.7	794.3
Consumer Price Index (1997 = 100)	100.0	116.8	132.9	156.0
Visitor Price Index (1997 = 100)	100.0	118.1	136.7	164.6
Visitor Expenditures ($m)	10,931.0	14,501.6	20,137.9	28,457.0
Real Visitor Expenditures ($1997 m)	10,931.0	12,281.8	14,732.8	17,282.7
Household Expenditures ($million)	24,962.1	40,029.0	59,511.5	89,049.6
Real Household Expenditures ($1997 m)	24,962.1	34,517.5	45,887.7	60,657.2
Real Avg Household Expenditures ($1997 th)	42.0	51.3	62.0	76.4
Compensation of Employees ($ m)	21,626.2	31,713.8	44,421.4	63,846.8
Real Comp of Employees ($1997 m)	21,626.2	27,154.0	33,421.42	40,920.5
Real Average Comp of Employees ($1997 th)	35.1	39.0	43.6	49.8
Proprietors’ Income ($ m)	2,088.0	2,887.4	3,984.9	5,618.3
Real Proprietors’ Income ($1997 m)	2,088.0	2,472.2	2,998.1	3,600.8
Real Average Proprietors’ Income ($1997 th)	16.5	17.3	19.0	21.3
Total Output ($ m)	58,732.5	81,447.0	110,934.2	154,194.6
Real Total Output ($1997 m)	58,732.5	69,736.7	83,463.2	98,826.1
Gross State Product ($ m)	38,615.7	55,873.0	78,102.9	111,778.5
Real Gross State Product ($1997 m)	38,615.7	47,839.6	58,762.0	71,640.9

Cumulative change (%)	1997-2010	1997-2020	1997-2030
Labor Force	13.1	24.6	33.6
Hawaii CPI	16.8	32.9	56.0
Hawaii VPI	18.1	36.7	64.6
Visitor Expenditures	32.7	84.2	160.3
Real Visitor Expenditures	12.4	34.8	58.1
Household Expenditures	60.4	138.4	256.7
Real Household Expenditures	38.3	83.8	143.0
Real Average Household Expenditures	22.3	47.6	81.9
Real Compensation of Employees	25.6	54.5	89.2
Real Average Compensation of Employees	11.0	24.1	41.7
Real Proprietors’ Income	18.4	43.6	72.5
Real Average Proprietors’ Income	4.7	15.3	29.1
Real Total Output	18.7	42.1	68.3
Real Gross State Product	23.9	52.2	85.5

Source: CGE: 2030 Simulations

The CGE model also demonstrates the extent to which the responses over time vary by industry, as shown on Table 16. When visitor spending increases, there are certain obvious beneficiaries, such as hotels, air transportation, entertainment, etc. Yet, the growth in population benefits other industries – rental housing, trade, services, and manufacturing. Projections for 2030 are available at the forty sector level, and for value added, employment, prices, and demand.

Table 16: Sector Output ($ million)

	1997	2010	2020	2030
Agriculture	823.5	741.1	841.4	928.2
Manufacturing	3,416.4	3,621.6	4,247.4	5,017.8
Air Transportation	2,044.1	2,796.4	3,915.4	5,584.0
Other Transportation	1,543.5	2,088.4	2,876.5	4,061.5
Entertainment	844.2	1164.4	1,644.5	2,365.2
Golf	229.8	329.2	470.7	682.3
Hotel	3,456.4	4,633.1	6,454.4	9,158.4
Real Estate	9,019.3	13,498.6	19,349.6	28,131.0
Restaurants	2,274.7	3,292.8	4,721.9	6,849.7
Trade	6,118.5	8,862.8	12,585.3	18,196.2
Other Services	18,705.3	24,331.6	31,598.1	41,595.6
Utilities	1,691.0	2,451.6	3,395.0	4,781.8
Government	8,565.8	13,635.5	18,833.9	26,789.4

Source: CGE: 2030 Simulations

Note: The values reported are not deflated by a commodity price index. The table provides levels of production at nominal values.

Hawaii 2030: Environmental Conditions

The population projections for Hawaii 2030 indicate that there will continue to be increased residential growth, expanding incomes, and global visitor demand. The growth in demand for Hawaii-made products will have an impact on environmental resources, as shown in Table 17. Most of the constraints are experienced at a local level, and we discuss county-level impacts below. Three important findings are apparent at a State-wide level.

Table 17: Hawaii 2030: Baseline Projections and Environmental Impacts

Utility Demand	**1997**	**2010**	**2020**	**2030**
Water, gallons million	100,368.6	118,074.4	139,198.6	159,616.5
Water, Non-agri, gallons million	86,156.2	109,469.6	131,998.8	153,972.2
Solid Waste, pounds million	3,198.2	3,589.6	4,017.4	4,374.9
Electricity, GWh	10,009.0	12,387.8	14,891.3	17,445.9
Utility gas, mmBtu	3,706,734.7	4,452,278.1	5,242,408.7	5,985,536.8
Petroleum, gallons million	2,030.9	2,542.6	3,195.5	3,971.1
Cumulative % change		**1997-2010**	**1997-2020**	**1997-2030**
Water		17.6.%	38.7%	59.0%
Water, Non-agricultural		27.1%	53.2%	78.7%
Solid Waste		12.2%	25.6%	36.8%
Electricity		23.8%	48.8%	74.3%
Utility gas		20.1%	41.4%	61.5%
Petroleum		25.2%	57.3%	95.5%

Source: CGE: 2030 Simulations

First, relative to 1997, municipal water use expands significantly, by 78.7.%. There will be a need to plan and accommodate for this increase in water use. It is notable that agricultural water use does not grow as much because of a decline in plantation agriculture, and thus overall water use increases by 59.0%. Relocating agricultural water to other sectors, however, is not a trivial exercise and will require significant planning. There are also significant costs associated with the maintenance and expansion of municipal water and wastewater treatment systems.

Second, the solid waste generated on an annual basis increases from 3.2 to 4.4 billion pounds per year (or 36.8%) by 2030. Unlike water quantities, which are continuously renewed, solid waste involves an accumulated impact on our land fills and environment. Here too there are significant costs associated with maintenance and expansion of solid waste management services.

Third, energy use increases over 1997 by rates of 95.5% in petroleum, 74.3% in electricity, and 61.5% in utility gas. Hawaii is highly dependent on fossil fuels for energy use. An even modest increase in worldwide crude oil prices will likely have a significant and inflationary impact on the Hawaii economy by 2030.

IV.B. Alternative Futures: Low Growth Versus High Growth

One of the main findings of this study is that the economic activity and the resulting environmental consequences generated by residents are far greater than that of visitors. Early morning traffic is further testament to this observation. While many people are commuting to work in the visitor industry, there are also many others driving to work in other sectors. While some of these sectors are important to tourism, many of the business activities in the state are oriented towards providing goods and services to an expanding population base. While many people are directly employed in visitor-related businesses, the economy that it is needed to house, feed, educate, and care for a resident population in excess of one million persons is far greater and more complex than the economy needed to sustain the 100,000 or so visitors present in Hawaii on any given day. While the daily average spending levels for residents is lower than that of visitors, the aggregate economic and environmental impacts of residents far outweighs that of visitors.

To better capture the intricacies of the relationship between the population base and the visitor industry, we develop two additional scenarios. The UHERO visitor forecasting model also provides annual projections for low and high visitor expenditures over a 30 year time horizon, Table 18 and Figure 16. These expenditures are reflective of differential income growth projections in worldwide markets (US, Japan, and other international markets), and thus the mix of visitors is also changing over time.

Table 18: Nominal Visitor Expenditure Projections to 2030

	Low Projection		Base Projection		High Projection	
	$ million	Cum. % change from 1997	$ million	Cum. % change from 1997	$ million	Cum. % change from 1997
1997	$ 10,931		$ 10,931		$ 10,931	
2010	13,773	26.0%	14,502	32.7%	15,243	39.4%
2020	17,948	64.2%	20,138	84.2%	22,541	106.2%
2030	23,891	118.6%	28,457	160.3%	33,860	209.8%

Source: UHERO Projections.

Figure 16: Low and High Visitor Expenditure Projections

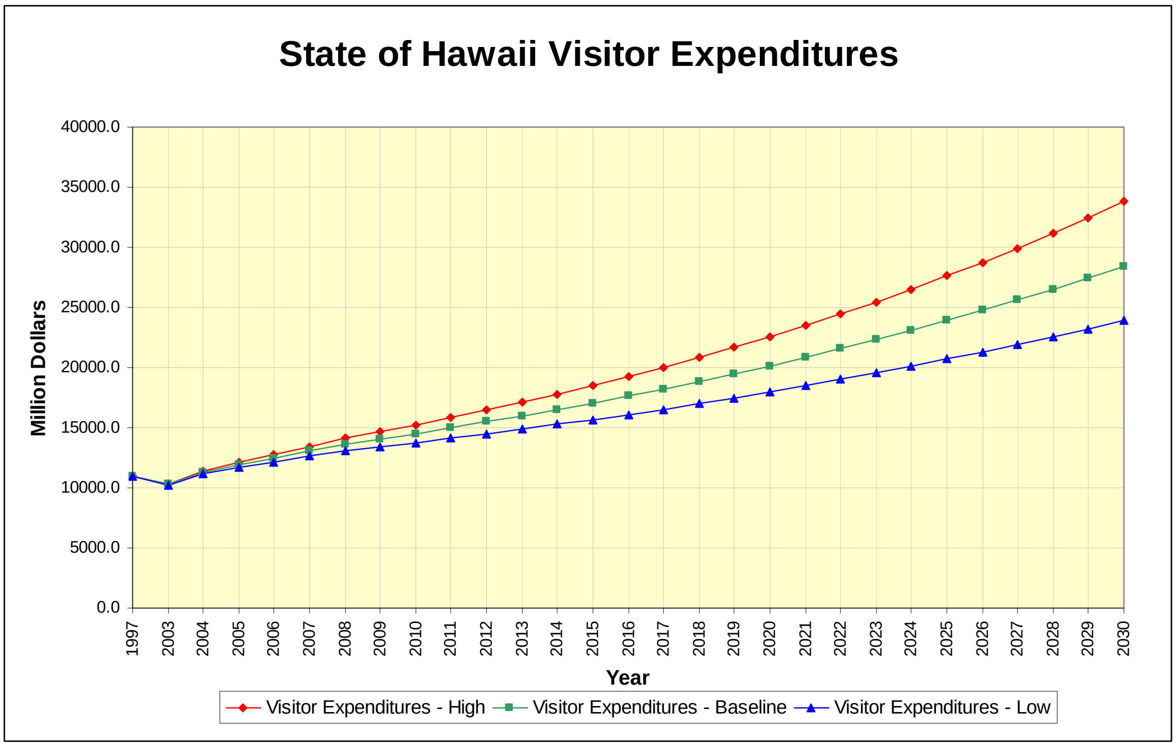


Table 19: Hawaii 2030: Low, Baseline, and High Visitor Growth Scenarios

Macroeconomic Indicators	1997	2030 low	2030 base	2030 high
Labor Force (thousands)*	594.7	692.2	794.3	858.8
Visitor Expenditures ($m)*	10,931.0	23,890.8	28,457.0	33,859.8
Real Visitor Expenditures ($1997 m)	10,931.0	14,517.4	17,282.7	19,844.8
Consumer Price Index (1997 = 100)	100.0	154.2	156.0	162.1
Visitor Price Index (1997 = 100)	100.0	164.6	164.6	170.6
Household Expenditures ($million)	24,962.0	79,848.2	89,049.6	99,668.3
Real Household Expenditures ($1997 m)	24,962.0	55,004.2	60,657.2	65,981.1
Real Avg Household Expenditures ($1997 th)	42.0	79.5	76.4	76.8
Compensation of Employees ($ m)	21,626.2	59,436.8	63,846.8	69,558.2
Real Compensation of Employees ($1997 m)	21,626.2	38,547.0	40,920.5	42,903.5
Real Avg Comp of Employees ($1997 th)	35.1	53.8	49.8	48.3
Proprietor's Income ($ m)	2,088.0	5,115.6	5,618.3	6,213.1
Real Proprietors' Income ($1997 m)	2,088.0	3,317.7	3,600.8	3,832.2
Real Average Proprietors' Income ($1997 th)	16.5	22.5	21.3	20.9
Total Output ($ m)	58,732.5	139,411.9	154,914.6	170,912.1
Real Total Output ($1997 m)	58,732.5	90,413.6	98,826.1	105,418.6
Gross State Product ($ m)	38,615.7	101,815.5	111,778.5	123,712.0
Real Gross State Product ($1997 m)	38,615.7	66,031.0	71,640.9	76,305.5

Cumulative percent change

	1997-2030 low	1997-2030 base	1997-2030 high
Labor Force*	16.4	33.6	44.4
Visitor Expenditures*	118.6	160.3	209.8
Real Visitor Expenditures	33.8	58.1	81.5
Hawaii CPI	54.2	56.0	62.1
Hawaii VPI	64.6	64.6	70.6
Household Expenditures	219.9	256.7	299.3
Real Household Expenditures	120.4	143.0	164.3
Real Avg Hsehold Expenditures ($1997 million)	89.3	81.9	83.0
Real Compensation of Employees	78.2	89.2	98.4
Real Average Compensation of Employees	53.1	41.7	37.4
Proprietor's Income	145.0	169.1	197.6
Real Proprietor's Income	58.9	72.5	83.5
Real Average Proprietor's Income	36.5	29.1	27.1
Total Output ($ million)	137.4	162.5	191.0
Real Total Output ($1997 million)	53.9	68.3	79.5
Gross State Product ($ million)	163.7	189.5	220.4
Real Gross State Product ($1997 million)	71.0	85.5	97.6

Unless otherwise noted, projections are generated by the CGE model simulations.
* indicates exogenous shocks derived from the UHERO long-range growth forecasts.

Hawaii 2030: Alternative Economic Futures

Table 19 provides an overview of macroeconomic conditions in Hawaii 2030 under low and high projections for visitor expenditure growth, as well as the baseline projections for growth discussed earlier.

One of the most significant findings relates to the labor force base that is supported under alternative assumptions for growth. UHERO baseline projections for population growth involve a 33.6% increase in the number of people employed in the 2030 labor force over 1997 levels. A significant finding is that high visitor growth would provide sufficient stimulation to the economy to attract 44.4% more workers (and hence population) to Hawaii. In contrast, low visitor growth dampens economic conditions as well as employment, with growth of only 16.4%. Thus the low growth scenario might be considered as largely supporting the existing residential population with a natural level of growth over the thirty year time horizon. Baseline and high levels of visitor growth would require that workers migrate to the State from other locations.

Under all scenarios, household spending far out-paces that of visitor spending. The highest level of visitor spending in 2030 is projected to be approximately $34 billion. Household expenditures range between a low of $79.8 billion to a high of $99.7 billion. This shows the dominance of resident spending as a key component of Hawaii's economy. Even under the most optimistic scenario of visitor spending, it is far below the level of economic impact associated with households in Hawaii.

The thirty year growth in household expenditures depends on both the level of visitor activity and the inflow of new workers. Total household expenditures is projected to expand from $24.9 billion in 1997 to low visitor growth levels of $79.8 billion ($55.0 billion real) and high visitor growth levels of $99.7 billion ($66.0 billion real). Based on an individual in labor force, however, economic quality of life conditions appear to be better the lower is visitor growth. Several indicators make evident this observation. First, real average household expenditures expands from $42.0 thousand in 1997 to 2030 projections of $79.5 thousand (89.3%) under low growth, $76.4 thousand (81.94%) under base growth, and $76.8 thousand (83.0%) under high growth scenarios. This is due two factors. First, the migration of new workers to Hawaii places downward pressure on wages and salaries to workers. This is evident in the relatively lower average returns to labor observed under the high growth scenario ($48.3 thousand) relative to the low growth scenario ($53.8 thousand). Second, the hotter is the economy the higher are consumer prices. In fact, in Part III of this project, The Socio-Cultural Public Input Component, surveys taken of Hawaii residents show that there is "very high" concern over the *cost of housing*. Over thirty years, low visitor growth generates a consumer price index of 154.2 versus 162.1 for high visitor growth. Note that the benefits of lower growth also appear to be realized by proprietors, and similar average discrepancies between low and high visitor growth scenarios are observed.

Growth in visitor expenditure has a multiplier effect on total economic output, and the value added of Hawaii producers and this impact accumulates over the thirty year planning horizon. Gross state product is estimated to increase, at minimum by 163.7% (or 71.3% in real terms) to $101.6 billion ($66 real). High projections for growth involve GSP growth of $123 billion ($76.3 billion real). This growth involves significant increase in output in key economic sectors, as well as an increasing strain on Hawaii's environmental assets.

High visitor growth has significant impact because of the increase in visitor demand for Hawaii products. Yet, a more important factor appears to be the significant growth in the labor force that would accompany more robust economic conditions. The added demand of new Hawaii residents fuels the economy and promotes higher levels of production and output. Nevertheless, as more workers join the labor force relative wages are suppressed. This dynamic population growth requires major outlays in terms of land and natural resources.

Aside from national visa policies, there are few instruments to restrict in-migration. Traditionally, a significant share of new workers to the islands comes from the U.S. mainland and is free to seek employment in the State. To mitigate negative impacts of excessive residential growth, a variety of policy instruments might be considered. One option is to slow the development of new residential housing through restrictive land use planning. While this may slow population growth, it will also exacerbate inflation in residential housing prices. There would be a mixed impact on Hawaii residents. To the degree that workforce growth is augmented with productivity growth, and enhanced capital accumulation, some of the negative impacts could be mitigated. Increasing educational opportunities for Hawaii's residents would also raise quality of life as well as returns to labor effort. In order to decompose differential impacts on Hawaii, more data would be required , including information on types of employees by sector, compensation by type, baseline union constraints on the labor force, international and national labor market conditions, and State-level migration data.

Hawaii 2030: Environmental Impacts of Alternative Scenarios

Quantitative indicators for the alternative growth scenarios were developed for infrastructure demand, as given in Table 20. In all cases, the higher are visitor expenditures, the higher is the demand for the infrastructure element. Baseline growth conditions are discussed at length above. In comparing low and high growth scenarios, the impact on infrastructure appears to be most dramatic in terms of energy demand, with high growth increasing petroleum use by 114.5% and electricity use by 84.9%, compared to low growth demand increases of 74.6% and 59.1% respectively. To better understand how growth impacts the rate at which key resources are depleted, we conduct a trigger analysis.

Table 20: Projected Infrastructure Demand for Alternative Growth Scenarios

Low Visitor Growth	**1997**	**2010**	**2020**	**2030**
Water, gallons million	100,368.6	114,566.5	130,664.4	146,962.0
Non-ag Water, gallons million	86,156.2	106,307.8	124,096.6	141,934.6
Solid Waste, pounds million	3,198.2	3,438.6	3,655.8	3,846.1
Electricity, GWh	10,009.0	11,995.4	13,906.2	15,922.0
Utility gas, mmBtu	3,706,734.7	4,272,453.9	4,784,473.9	5,266,846.3
Petroleum, gallons million	2,030.9	2,449.4	2,948.1	3,545.7

Base Visitor Growth	**1997**	**2010**	**2020**	**2030**
Water, gallons million	100,368.6	118,074.4	139,198.6	159,616.5
Non-ag Water, gallons million	86,156.2	109,469.6	131,998.8	153,972.2
Solid Waste, pounds million	3,198.2	3,589.6	4,017.4	4,374.9
Electricity, GWh	10,009.0	12,387.8	14,891.3	17,445.9
Utility gas, mmBtu	3,706,734.7	4,452,278.1	5,242,408.7	5,985,536.8
Petroleum, gallons million	2,030.9	2,542.6	3,195.5	3,971.7

High Visitor Growth	**1997**	**2010**	**2020**	**2030**
Water, gallons million	100,368.6	119,665.6	143,448.1	167,272.6
Non-ag Water, gallons million	86,156.2	111,095.5	136,248.2	161,591.2
Solid Waste, pounds million	3,198.2	3,665.2	4,214.6	4,726.3
Electricity, GWh	10,009.0	12,606.5	15,476.8	18,507.7
Utility gas, mmBtu	3,706,734.7	4,562,786.6	5,536,680.4	6,518,953.6
Petroleum, gallons million	2,030.9	2,611.2	3,392.8	4,357.0

Trigger Point Analysis

As shown in Table 21, a "trigger point" analysis is also conducted in which three levels (yellow, amber, and red) are devised. Using 1997 as the baseline demand, the "yellow" level is achieved after levels of demand increased by 10% over baseline conditions. The "amber" level is achieved when demand exceeds 125% of the baseline conditions. The critical "red" level occurs when demand reaches 150% of the quantities demanded in the baseline. From an infrastructure planning perspective, knowing when demand exceeds 125% of the baseline (amber) or150% of the baseline (red) can help identify when new systems need to be planned and brought on line. Table 21 contains a summary of the "trigger point" analysis. The low growth scenario delays the occurrence of triggers while the high growth scenario accelerates their occurrence. Demand for petroleum, electricity, and water tends to reach critical levels first, while the demand for propane and solid waste services reaches critical levels further out in time. Under the high growth scenarios, there are pressing needs ("amber" level) for petroleum, electricity, and water within the next decade. Under the low growth scenarios, the demand for these services reaches the "amber" level in 15 to 20 years. This analysis is consistent with some of the findings from Part III of this project. In the attitudinal surveys collected, "very high" concern was given to *fresh water supply running low*, as well as *air and water pollution*.

Some of the services (water, electricity, and solid waste) involve local or statewide resources produced in Hawaii. While other types of demand (propane and petroleum) will be met by imports. Each of the services is quite different in terms of its production requirements. Both water and solid waste services require local natural resources, while electricity involves importing fossil fuels.

Table 21: Trigger Point Analysis of Environmental Elements

Low Visitor Growth	Yellow	Amber	Red
Water (gal mil)	2010	2019	
Solid Waste(lb mil)	2014		
Electricity (GWh)	2007	2015	2027
Utility gas (mmBtu)	2009	2019	
Petroleum (gal mil)	2006	2011	2021
Baseline Visitor Growth			
Water (gal mil)	2008	2015	2026
Solid Waste(lb mil)	2009	2020	
Electricity (GWh)	2006	2012	2021
Utility gas (mmBtu)	2007	2013	2025
Petroleum (gal mil)	2005	2010	2017
High Visitor Growth			
Water (gal mil)	2008	2014	2023
Solid Waste(lb mil)	2008	2016	
Electricity (GWh)	2006	2011	2019
Utility gas (mmBtu)	2006	2012	2020
Petroleum (gal mil)	2005	2009	2016

IV.C. Limits To Growth: County-Level Analysis

Economic Projections

County-level visitor expenditure projections are provided in Table 22. Visitor expenditures grow throughout the State, but, over thirty years, are somewhat more concentrated on the Big Island, Maui and Kauai. Oahu’s share of Statewide visitor expenditures drops from 52% in 1997 to about 48% in 2030. Visitor arrivals from all origins are anticipated to rise in both monetary levels and in real terms. The Japanese inbound visitor market, however, is predicted to comprise a declining share of total visitors across all islands. The share of visitors from the US mainland increases from a1997 share of 39.3% to 41.6% in 2030. The most notable growth in relative terms is from other (non-Japanese) international visitors, particularly China and other rapidly growing countries in Asia. These international visitors expand from a 1997 share of 13.9% to a 2030 share of 17.4% of total visitor expenditures.

Table 22: County-Level Visitor Expenditure Projections

Oahu	Base 1997	2010	2020	2030
Visitor Expenditures ($M)	5,667.2	7,051.9	9,806.2	13,718.6
Real Visitor Expend ($1997 m)	5,667.2	5,963.0	7,152.5	8,293.9
USA Visitor Exp ($ 1997 m)	2,225.4	2,666.7	3,094.0	3,447.0
Japanese Visitor Exp ($ 1997 m)	2,655.1	2,373.1	2,901.6	3,401.9
Int'l Visitor Exp ($ 1997 m)	786.7	923.1	1,157.0	1,444.9
USA Visitor Share	39.3%	44.7%	43.3%	41.6%
Japanese Visitor Share	46.9%	39.8%	40.6%	41.0%
Int'l Visitor Share	13.9%	15.5%	16.2%	17.4%

Big Island	Base 1997	2010	2020	2030
Visitor Expenditures ($M)	1,432.0	1,973.3	2,833.1	4,111.7
Real Visitor Expend ($1997 m)	1,432.0	1,677.0	2,086.1	2,522.2
USA Visitor Exp ($ 1997 m)	993.1	1,255.0	1,546.0	1,845.7
Japanese Visitor Exp ($ 1997 m)	224.6	193.8	235.0	274.3
Int'l Visitor Exp ($ 1997 m)	214.2	228.2	305.1	402.3
USA Visitor Share	69.4%	74.8%	74.1%	73.2%
Japanese Visitor Share	15.7%	11.6%	11.3%	10.9%
Int'l Visitor Share	15.0%	13.6%	14.6%	15.9%

Maui	Base 1997	2010	2020	2030
Visitor Expenditures ($M)	2,785.8	3,931.5	5,319.6	7,519.1
Real Visitor Expend ($1997 m)	2,785.8	3,326.6	3,884.7	4,551.6
USA Visitor Exp ($ 1997 m)	2,225.7	2,611.5	3,077.4	3,524.1
Japanese Visitor Exp ($ 1997 m)	177.1	205.0	222.3	264.8
Int'l Visitor Exp ($ 1997 m)	383.0	510.2	585.0	762.6
USA Visitor Share	79.9%	78.5%	79.2%	77.4%
Japanese Visitor Share	6.4%	06.2%	5.7%	5.8%
Int'l Visitor Share	13.7%	15.3%	15.1%	16.8%

Kauai	Base 1997	2010	2020	2030
Visitor Expenditures ($M)	1,046.0	1,544.9	2,179.0	3,107.5
Real Visitor Expend ($1997 m)	1,046.0	1,315.2	1,609.5	1,915.0
USA Visitor Exp ($ 1997 m)	858.9	1,088.3	1,315.2	1,541.1
Japanese Visitor Exp ($ 1997 m)	32.3	31.0	37.2	42.5
Int'l Visitor Exp ($ 1997 m)	154.8	195.9	256.5	331.4
USA Visitor Share	82.1%	82.7%	81.7%	80.5%
Japanese Visitor Share	3.1%	2.4%	2.3%	2.2%
Int'l Visitor Share	14.8%	14.9%	15.9%	17.3%

Real Visitor Demand Projections for Hawaii Counties: 2010, 2020, 2030

Baseline projections for the composition of real visitor demand in 2010, 2020, and 2030 for each county are given in Table 23. In this analysis, key non-tradable sectors are selected. That is, the location of visitor consumption is intrinsically linked to the location of delivery of the service. For example, an Oahu-bound visitor will consume hotel and restaurant services in Honolulu. This same Oahu visitor might purchase a Maui-produced pineapple or a Hilo-made aloha shirt. Thus, Table 23 provides an overview of visitor expenditures in those sectors that are geographically-bound rather than within Statewide markets. County visitor expenditure projections are available for each growth scenario. It is important to point out that Table 23 provides projections for future visitor expenditures by sector, but evaluated at the current (1997) prices that prevail in those sectors. What is captured is the change in quantities that are demanded by visitors. Notably, output in visitor sectors do not grow at an equivalent pace. Cost differences across sectors tend to increase some prices (such as Hotels) more than others (such as Amusement), and thus visitors adjust expenditure patterns accordingly. Sector-level price projections, as well as nominal value projections, may be derived for the baseline 2030 growth scenario as well as each alternative growth scenario.

The island of Oahu, the City & County of Honolulu, stands out from the rest of the state in terms of the volume of visitor activity. By 2030, real visitor demand for hotel services alone is predicted to be approximately $2.1 billion in real terms, and restaurant expenditures top $1 billion. Waikiki remains the dominant visitor destination for the foreseeable future. Yet, visitor expenditure growth on Oahu lags behind that of the other states in key industries. Because of rising prices, the number of hotel rooms rented by visitors will rise by only 30% over a thirty year time horizon. Hence, visitors turn increasingly toward vacation rentals and their real expenditures increase on real estate by 40% by 2030. With the exception of amusement services (45% increase by 2030), visitor participation in leisure sectors such as performing arts, museums, and golf courses grows rather slowly. Cumulative growth in various transportation sectors will require county planning. By 2030, the number of trips taken by visitors is projected to notably rise in automobile rentals (38%), ground transportation (36%), and sightseeing transportation (34%). This visitor growth, coupled with significant growth in resident and industrial demand for transportation services will require significant outlays in transportation infrastructure expenditures over the coming decades.

As is the case on each of the other Hawaii Counties, the County of Hawaii will experience significant growth of the visitor industry over the coming decades. This will translate by 2030 into particularly rapid growth over 1997 levels in real visitor demand for amusement (72%), real estate (67%), automobile rentals (64%), restaurant services (64%), and ground transportation (62%). Note that hotel room prices are projected to increase significantly and thus room rentals increase by a moderate 55%.

The 2030 projections for real visitor expenditure growth in Maui reflect significant growth as well, though not quite at the level of growth on the Big Island. By 2030, demand for real estate expands by 58% and hotel rentals by 46%. Visitor transportation demand increases significantly by 2030, most notably in visitor automobile rentals (56%), ground transportation (54%), and sightseeing transportation (50%).

The most significant rate of growth in the quantity of visitor demand is projected to be within the County of Kauai. By 2030 real visitor expenditures on real estate is projected to jump (74%) and hotel room rental by 60%. Kauai will potentially witness a dramatically high accumulated growth by 2030 in the number of visitor related trips taken using ground transportation (69%), automobile rental (71%), and sightseeing transportation (66%). The number of meals served to visitors in restaurants is projected to increase by 67%.

Table 23: County-Level Real Visitor Demand Projections

Oahu	**1997**	**2010**		**2020**		**2030**	
	($m)	($m)	(cum % change from 1997)	($m)	(cum % change from 1997)	($m)	(cum % change from 1997))
Ground transportation	34.15	35.11	2.8	41.31	21.0	46.62	36.5
Automobile rental	141.09	143.72	1.9	170.67	21.0	194.85	38.1
Performing arts	16.81	16.81	-0.0	19.09	13.5	20.84	24.0
Amusement	69.96	73.81	5.5	88.23	26.1	101.41	45.0
Recreation	45.79	46.86	2.3	54.44	18.9	60.62	32.4
Museums historical	20.85	21.31	2.2	24.69	18.4	27.41	31.4
Sightseeing transport	127.95	129.73	1.4	152.06	18.8	170.85	33.5
Golf courses	76.34	77.88	2.0	90.63	18.7	101.06	32.4
Hotels	1606.85	1618.37	0.7	1878.08	16.9	2090.28	30.1
Real estate	107.41	109.27	1.7	131.17	22.1	150.65	40.3
Restaurants	758.53	795.59	4.9	930.37	22.6	1045.41	37.8
Retail trade	565.13	571.07	1.0	659.03	16.6	728.18	28.8

Big Island	**1997**	**2010**		**2020**		**2030**	
	($m)	($m)	(cum % change from 1997)	($m)	(cum % change from 1997)	($m)	(cum % change from 1997)
Ground transportation	11.02	12.64	14.7	15.32	39.0	17.90	62.4
Automobile rental	45.54	51.74	13.6	63.30	39.0	74.83	64.3
Performing arts	3.47	3.85	11.0	4.51	30.1	5.11	47.4
Amusement	14.43	16.89	17.1	20.85	44.6	24.87	72.4
Recreation	9.44	10.73	13.6	12.87	36.3	14.87	57.4
Museums historical	4.30	4.88	13.4	5.83	35.7	6.72	56.3
Sightseeing transport	41.30	46.71	13.1	56.40	36.6	65.61	58.9
Golf courses	15.74	17.82	13.2	21.42	36.1	24.78	57.4
Hotels	437.96	490.68	12.0	587.43	34.1	677.73	54.8
Real estate	34.67	39.34	13.5	48.65	40.3	57.85	66.9
Restaurants	82.81	95.71	15.6	115.92	40.0	135.52	63.7
Retail trade	153.65	172.49	12.3	205.49	33.7	235.51	53.3

Table 23: County-Level Real Visitor Demand Projections - Continued

Maui	**1997**	**2010**		**2020**		**2030**	
	($m)	($m)	(cum % change from 1997)	($m)	(cum % change from 1997)	($m)	(cum % change from 1997)
Ground transportation	21.50	25.44	18.3	29.03	35.0	33.07	53.8
Automobile rental	88.81	104.12	17.2	119.95	35.1	138.21	55.6
Performing arts	8.32	9.41	13.1	10.40	25.1	11.47	37.9
Amusement	34.60	41.31	19.4	48.08	38.9	55.82	61.3
Recreation	22.65	26.23	15.8	29.67	31.0	33.37	47.3
Museums historical	10.31	11.92	15.6	13.45	30.4	15.09	46.3
Sightseeing transport	80.54	93.99	16.7	106.87	32.7	121.18	50.5
Golf courses	37.76	43.58	15.4	49.39	30.8	55.62	47.3
Hotels	948.30	1088.68	14.8	1228.20	29.5	1380.08	45.5
Real estate	67.61	79.16	17.1	92.19	36.4	106.85	58.0
Restaurants	198.39	230.81	16.3	263.99	33.1	300.08	51.3
Retail trade	258.87	296.81	14.6	333.35	28.8	371.97	43.7

Kauai	**1997**	**2010**		**2020**		**2030**	
	($m)	($m)	(cum % change from 1997)	($m)	(cum % change from 1997)	($m)	(cum % change from 1997)
Ground transportation	9.53	11.79	23.7	14.04	47.3	16.13	69.2
Automobile rental	39.38	48.25	22.5	58.01	47.3	67.42	71.2
Performing arts	2.52	2.98	18.5	3.43	36..4	3.82	51.9
Amusement	10.47	13.09	25.0	15.87	51.6	18.60	77.6
Recreation	6.85	8.31	21.3	9.79	42.9	11.12	62.2
Museums historical	3.12	3.78	21.1	4.44	42.3	5.03	61.0
Sightseeing transport	35.71	43.55	22.0	51.68	44.7	59.11	65.5
Golf courses	11.43	13.81	20.9	16.30	42.7	18.53	62.2
Hotels	254.33	305.54	20.1	359.34	41.3	407.40	60.2
Real estate	29.98	36.68	22.4	44.59	48.7	52.12	73.9
Restaurants	86.45	105.59	22.1	125.54	45.2	144.07	66.6
Retail trade	110.00	132.06	20.0	154.54	40.5	174.01	58.2

County Hotel Capacities for Alternative Growth Scenarios

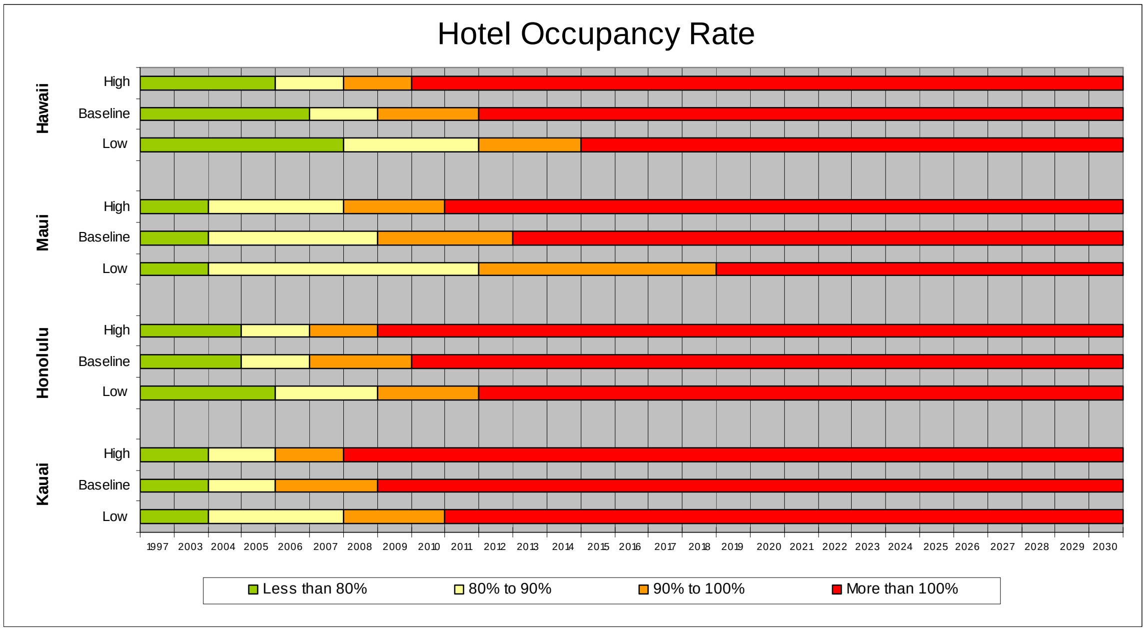
The visitor growth described above will place a strain on the visitor infrastructure in many Hawaii locations. These stresses are experienced at the local level, and spatial analyses have been conducted to illustrate these effects.

At the same time, many Hawaii communities demonstrate a reluctance to expand the capacity to handle the additional growth that increases in visitor demand would place on neighborhoods. A quintessential illustration of this tension lies in the policy choice of whether to permit new hotels to be built in a particular location. Hawaii communities vary in terms of their willingness to accommodate an expansion of hotel room capacities, with some residents being quite vocally opposed to new construction. For instance, within Part III of this project, “high” concern was given to *building/development in places that were recently “country”*, while there was “moderate” concern about *building/development near your home*, and "moderate" concern about *building/development in hotel/resort areas*. Generally, the interviews found that people doubt the government has done a good job of building infrastructure to keep up with growth, but as growth increases, people tend to think government should limit growth rather than build new infrastructure. Part III of the Sustainable Tourism study provides more in depth analysis of residential opinion regarding tourism growth and the construction of additional hotel facilities.

Figure 17 illustrates at what critical points the policy of 'no new hotels' serves to constrain the growth of tourist arrivals. Using low, base, and high projections for increases in external (US, Japan, and other international) visitor demand for hotel rooms a 'trigger point' analysis is conducted.

An annual Hotel Occupancy Rate is constructed based on the projected growth in the quantity of hotel rooms demanded, the existing stock of hotel rooms available by county, and the average annual occupancy rate of each county. While there are seasonal fluctuations in occupancy rates this annual analysis provides a snapshot of capacities over the long run. Similar to our earlier analysis, trigger points are identified for hotel room capacity thresholds for four levels (green, yellow, amber, and red). The "green" level implies 'go', and indicates years at which hotel occupancies fall below 80% and thus the hotel inventory appears to be sufficient. The "yellow" provides the first warning signal whereby hotel occupancies fall between 80-90%. Significant capacity constraints are realized when hotel occupancies hit "amber" rates of 90-100%. The "red" level indicates that there is a lost potential for growth as the visitor demand outstrips the existing stock of hotel rooms, with occupancy potentials exceeding 100% capacity.

Figure 17: Projected Occupancy Rates with Fixed Hotel Room Inventory



Within the decade, every County in the State of Hawaii is projected to have reached an "amber" warning level under even the 'low' growth projection. Because of its initial relatively small current hotel room inventory, Kauai appears to face the most pressing constraints. If worldwide demand follows 'high' visitor projections, Kauai's hotels will hit 'red' or 100% annual occupancy by 2006. Low visitor growth projections delay the 'red' indicator until only 2011. The communities of Kauai thus face immediate decisions regarding the level of tourism growth they are willing to accept. By 2030, demand for Kauai hotel rooms will exceed existing capacity by 150% (not shown).

Similarly, Honolulu faces relatively tight capacities to handle projected growth with existing hotel room stocks and lags behind Kauai by only one year for most indicators. High visitor growth would trigger 'yellow' conditions by 2005, 'amber' by 2007, and 'red' by 2009. Low visitor projections delay the threshold years only modestly, with 'red' conditions met by 2012. Again, Honolulu communities face immediate decisions regarding whether to plan for expanded visitor demand through the construction of new hotels, vacation rentals, or alternative visitor accommodations. By 2030, hotel room demand is nearly double the available stock (not shown).

While Maui will maintain healthy occupancy rates over the decade, the 'amber' trigger is not reached until 2008 under high growth, and 2012 under high growth visitor projections. Still, the 'red' trigger will be achieved by 2010 to 2019, depending on visitor growth rates. The Big Island appears to have the longest 'green' window, but when constraints are realized they also kick in rapidly, with the 'red' trigger hit by 2010 (high growth) to 2015 (low growth).

From the surveys in Part III, the residents from Maui island and Kaui appear consistently less happy with tourism growth and appear happy about the recent lack of tourism growth and change than do residents of Oahu or Hawaii. This is consistent with the hotel occupancy findings, as both Maui island and Kaui reach the yellow level sooner than do Hawaii or Oahu. Bed and breakfasts also received more "good" marks on Oahu and Hawaii than on Maui island or Kauai.

As hotel occupancy rates approach 'red' levels, visitors will increasingly seek alternatives to hotels including time-shares, condominiums, and other accommodations. They may be channelled to other Hawaii destinations, or they may select an alternative destination entirely. It is important to note that the reluctance to construct new hotels may have the unintended consequence of channelling visitors into informal accommodations, such as illegal bed and breakfast establishments, and this activity is very difficult to monitor and control. According to Part III of the study, the expanded presence of visitors into residential neighborhoods may also impose additional demands on infrastructure and transportation resources, and may alter the fabric of local neighborhoods. A full numerical analysis of the potential economic and social effects of this substitution of visitor consumption pattern would require having better data on existing alternative transient accommodations. As a great volume of this activity appears to be in informal rentals, the obstacles to data collection remain significant at the time of this writing. It is hoped that better information may be gathered in the near future.

County Environmental Capacities for Alternative Growth Scenarios

Hawaii's economy is characterized by geographic segmentation of markets in terms of visitor expenditures, labor force participation, and infrastructure. Detailed information about infrastructure capacities was collected in Part I of the study. Environmental impacts of concern are also often realized at sub-county geographic locations rather than uniformly across the State economy. Therefore, visitor activity and corresponding environmental impacts has been partitioned by county (Oahu, Maui, Kauai, Hawaii) and spatial analysis further distinguishes impacts by rural versus urban activity on each island.

Water: Projected Regional Demand and Sustainable Yields

Table 24 compares projections for annual water use under various scenarios to regional sustainable yields of 60%. The sustainable yield is defined as the maximum rate that water may be withdrawn from a source without impairing the source as determined by the Water Commission. Clearly, regional water resources are sufficient to meet projected water demand over the coming three decades. The only region that approaches 60% of sustainable yield is Oahu, which experiences a growth in the annual quantity of water demanded of 79% by 2030 under the high visitor growth scenario. Maui and the Big Island will also realize significant increases in the annual quantity of water demanded, 78% and 85% respectively by 2030 under high growth conditions, whereas annual water demand in Kauai remains relatively stable. In each case, however, there exist abundant availabilities of water.

Table 24: Projected County Water Demand and Sustainable Yields

	60% Sustainable Yield	1997	2010		2020		2030	
		(*)	(*)	% from 1997	(*)	% from 1997	(*)	% from 1997
Kauai	84,972							
High		11,140	9,886	(11%)	10,849	(3%)	11,774	6%
Base		11,140	9,790	(12%)	10,557	(5%)	11,240	1 %
Low		11,140	9,443	(15%)	9,798	(12%)	10,234	(8)%
Oahu	97,674							
High		54,532	66,149	21 %	81,824	50 %	97,820	79 %
Base		54,532	64,993	19 %	78,752	44 %	92,330	69 %
Low		54,532	62,866	15 %	73,540	35 %	84,415	55 %
Maui	123,297							
High		10,671	12,881	21 %	15,922	49 %	19,000	78 %
Base		10,671	12,659	19 %	15,336	44 %	17,959	68 %
Low		10,671	12,248	15 %	14,331	34 %	16,442	54 %

Table 24: Projected County Water Demand and Sustainable Yields – Continued

Hawaii								
	532,389							
High		7,200	8,902	24 %	11,096	54 %	13,324	85 %
Base		7,200	8,741	21 %	10,672	48 %	12,571	75 %
Low		7,200	8,456	17 %	9,969	38 %	11,498	60 %
(*)	in Million Gallons per Year							

The State is relatively rich in resources such as water and land. While also true at the County level, an analysis of a resource such as water must take into account other factors such as geography, available infrastructure and governmental regulations.

On Oahu, the Honolulu Board of Water Supply (HBWS) plans to limit the transport of water from certain regions of the island. The Sustainable Community Plans for Koolauloa and Koolaupoko suggest that there will be limited growth. Present HBWS policy is to limit the transport of water from these areas while further in-stream flow and other environmental studies are done. The Development Plan areas of the Primary Urban Core, Central Oahu and Ewa will require the most water in the future and will require transport of water from other areas of Oahu or an increase in the use of alternative sources of water. The HBWS has started a reclaimed water program for the Ewa area and is planning to use reclaimed water in Waianae and Central Oahu. The HBWS is also constructing a 5 million gallon per day pilot desalination plant in Kalaeloa that will cost approximately $40 million dollars to build and approximately $3.20 per thousand gallons to operate compared to less than a dollar for groundwater. While the island has considerable water resources, the HBWS, working with the State Commission on Water Resource Management, has elected to augment their water system with reclaimed water and desalination. This is an example of how policy decisions can create a limit to the availability of a given resource and how another decision can lead to the utilization of an alternative source of that resource. This would mean that Oahu is already at the Yellow Level for water as alternative sources are being brought on line.

The Kauai Department of Water is also constructing a new surface water treatment plant to supplement the Lihue-Hanamaulu Water System. The Department of Water operates 13 water systems which are geographically separate from each other. The Lihue-Hanamaulu water system has a connection to the Wailua-Kapaa water system but the growing demand for water in Wailua and Kapaa limits the amount of water that can be provided to Lihue. So the Department of Water has entering into an agreement to purchase water from a new private surface water treatment facility. While not as expensive as the Kalaeloa Desalination Facility, the new $8.2 million dollar 3 million gallon per day water treatment plant will greatly improve the Lihue-Hanamaulu water system. Kauai is also at the Yellow Level for water.

The County of Maui, a leader in the use of treated surface water in the State, recently announced an agreement to treat approximately 3.2 million gallons of surface water from the Wailuku Agribusiness irrigation system to relieve the water shortage in Central Maui. The County is also looking to obtain additional surface water from Hawaiian Commercial

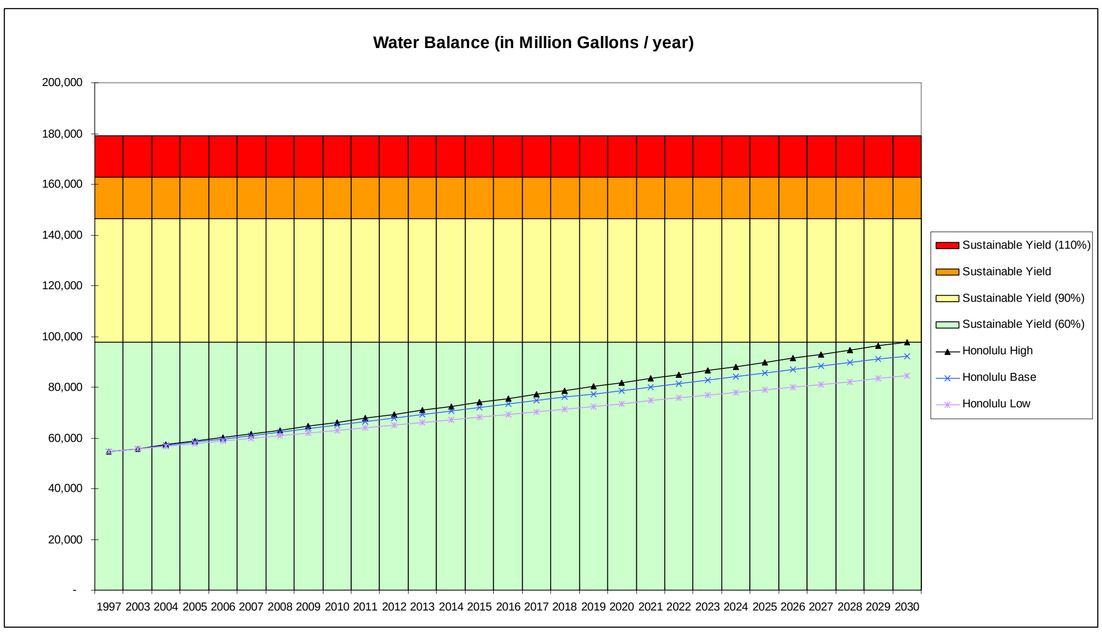
& Sugar Company and the Department of Water Supply is planning to prepare a Request for Proposals to construct a brackish water desalination plant. Central Maui is at the Yellow Level for water.

The County of Hawaii is planning new systems in Kona. New water sources and transmission mains are planned to meet the growth in North and South Kona. While the Department of Water Supply is not planning to construct a desalination facility, desalinized water is being used for several resorts along the Kohala Coast. The County of Hawaii is at the Yellow Level for water.

Case Study: Mapping the Future of Water on Oahu

This section provides a detailed spatial analysis of water supply and demand. Figure 18 illustrates the difference between projected water demand under low, base, and high growth levels as well as three thresholds for sustainable yield. Only in the year 2030 does Oahu experience moderate constraints on Islandwide water availability, 60% of the sustainable yield per annum. However, the quantity of water demanded increases significantly over the course of three decades.

Figure 18: Water Balance in Oahu



Also important is the geographic location of the change in water demand and the infrastructure capacities available for transporting water from one aquifer to another. Figure 19 maps the geographic location of current water consumption. This is the first available geographic information system for Hawaii that links water use to the underlying sector demand for water. Figure 20 provides the impact on changes in the quantity of water demanded under 2030 baseline growth conditions. It is important to note that growth is not evenly distributed across the island. Indeed, in key agricultural sectors water demand actually declines as the role of plantation agriculture recedes. However, water demand growth is also highly concentrated in the urban core as well as in new locations identified for future residential growth. While water resources may be sufficient Islandwide, there are important ecological concerns associated with moving significant quantities of water out of one natural aquifer to supply another aquifer on a long-term basis.

Figure 19: Geographic Location of Water Consumption on Oahu

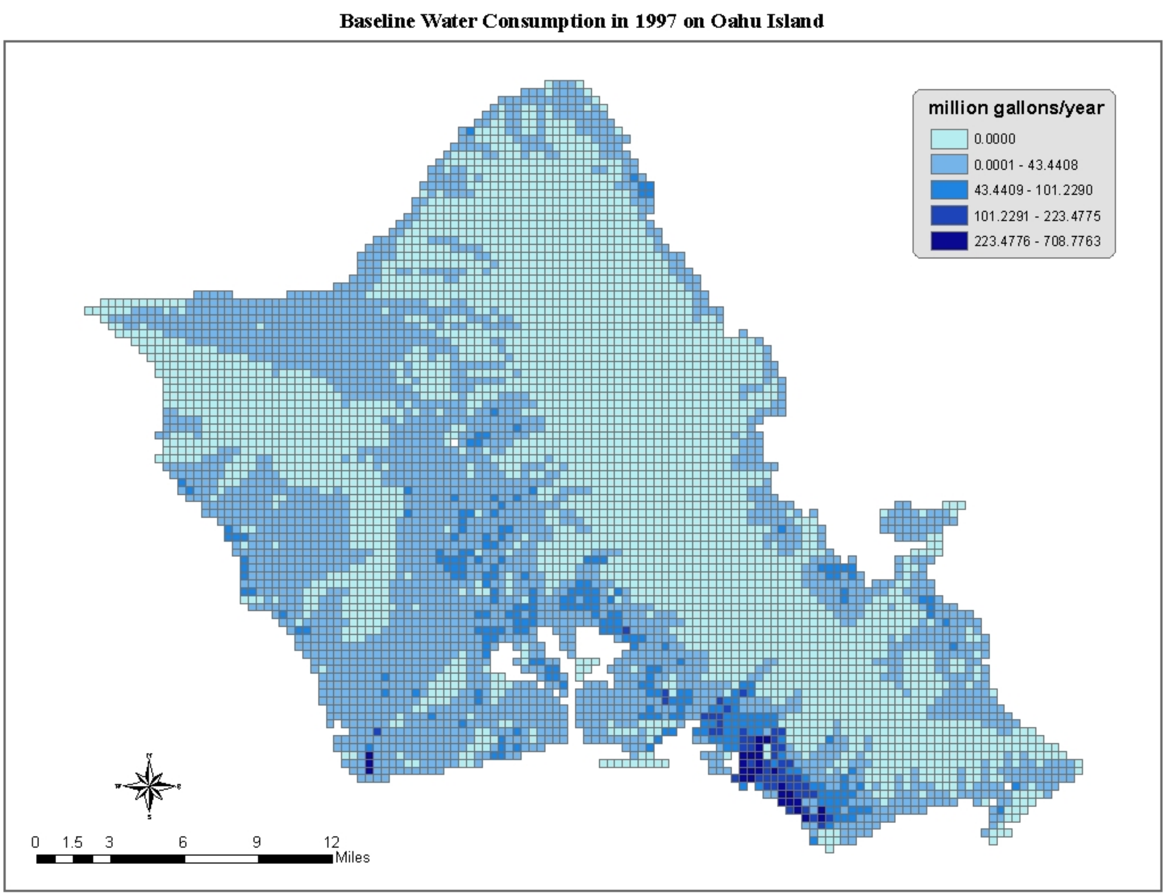
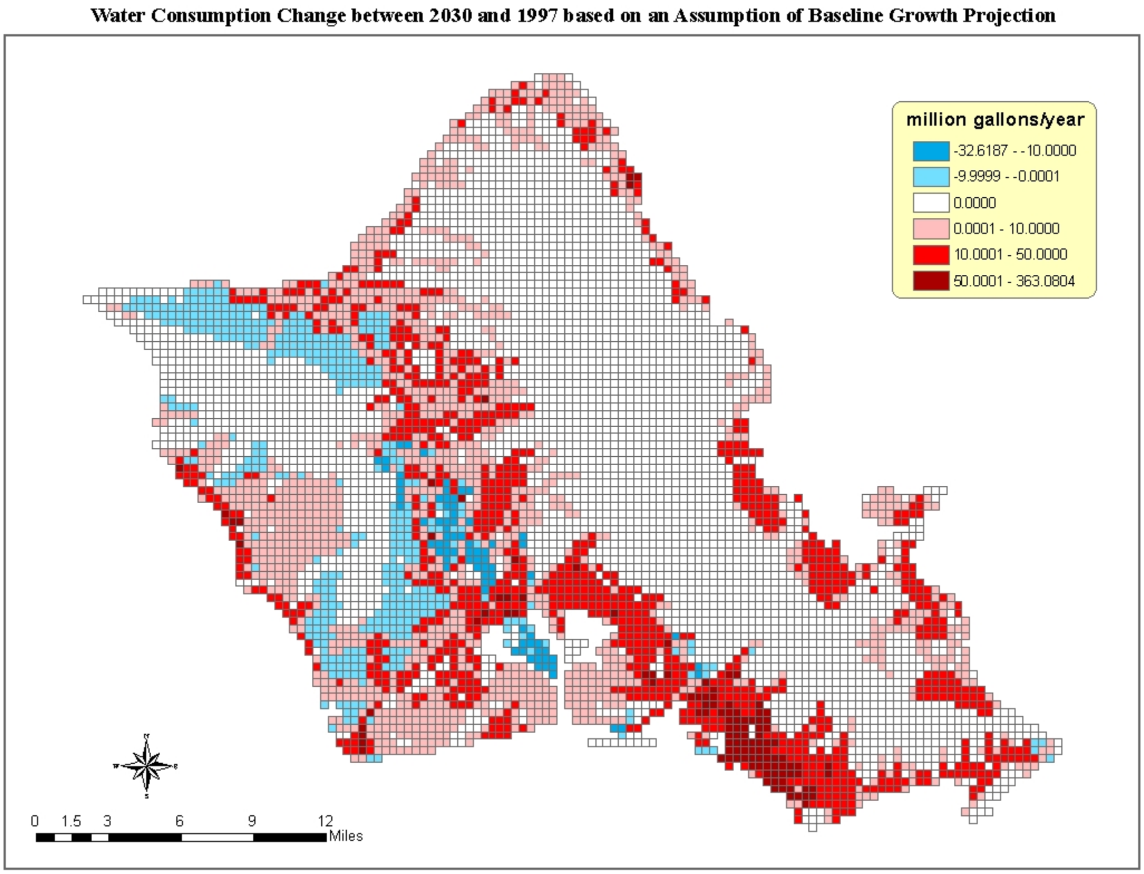


Figure 20:
Water Consumption Changes
Between 1997 and 2030 for Baseline Growth Projections



Solid Waste: Projected Regional Generation of Waste and Existing Capacities

As demonstrated above, visitors and residents alike generate significant volumes of solid waste annually. Any growth in the number of people present on a daily basis will increase the quantity of waste generated. Key Hawaii service industries generate significant volumes of solid waste, most notably restaurants, construction, retail trade, health services, and business and professional services (see Table 2.) Moreover, communities are highly reluctant to dedicate scarce land resources to the expansion of land fills. The phrase NIMBY (not in my back yard) originates from the natural tendency of residents to object to landfills being located in their neighborhood. It is not surprising that among the most pressing infrastructure growth issues facing the Hawaiian Islands is the need to dispose of rubbish.

Table 25 provides baseline estimates of remaining landfill capacities by region, as well as cumulative estimates for 2010, 2020, and 2030 of projected millions of pounds of solid waste anticipated to be generated in the region due to its residential and industrial composition. The figures are alarming. Nearly all areas hit disposal capacities within the next ten years. The notable exceptions are Hana and Maui. Oahu appears to be presently at or exceeding legal capacity limits.

Table 25: Projected Generation of Solid Waste, Pounds Million

	100% Final Disposal Capacity (*)	2003	2010	2020	2030
Hawaii	3452				
low		363	2969	6884	11016
base		363	3036	7253	11893
high		363	3070	7443	12391
Lanai	30				
low		7	61	142	229
base		7	63	150	247
high		7	63	154	258
Molokai	238				
low		17	143	332	534
base		17	146	350	576
high		17	148	360	602
Hana	208				
low		5	41	95	152
base		5	42	100	165
high		5	43	103	172
Maui	7290				
low		334	2750	6408	10292
base		334	2813	6753	11116
high		334	2846	6939	11606
Oahu	1800				
low		2401	19665	45679	73192
base		2402	20101	48076	78899
high		2402	20319	49312	82153
Kauai	293				
low		156	1281	2983	4788
base		156	1310	3142	5169
high		156	1325	3227	5391

(*) Based on calculation. Number showing available capacity starting 2003
The Low, Base, and High are cumulative number
All units are in Million Lbs / year

Figure 21: Projected Regional Trigger Points for Solid Waste Disposal

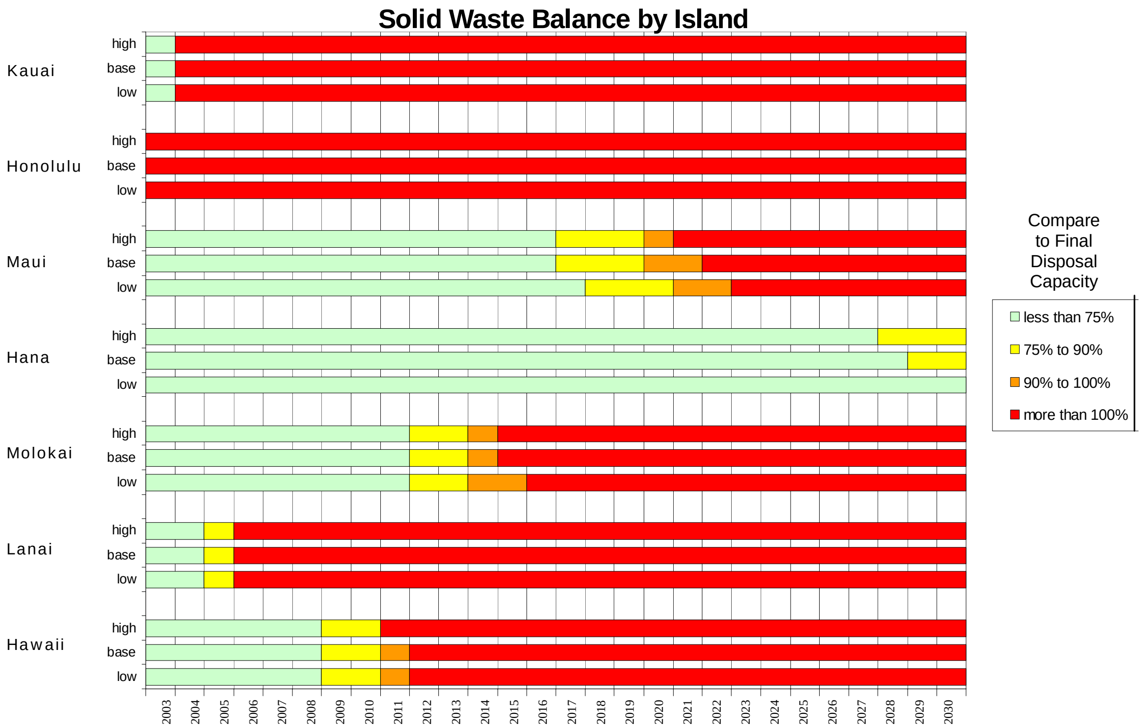


Figure 21 illustrates the projected solid waste disposal capacity constraints by utilizing a trigger analysis where four critical levels are identified (green, yellow, amber, red). "Green" indicates Disposal capacities of below 75%, "yellow" indicates capacity between 75 to 95%; "amber" indicates 90 to 100% capacity, and "red" signals that present capacity limits will be exceeded. Interestingly, the lower growth scenarios do not offer very much shelter in terms of delays in the trigger points.

The City and County of Honolulu has approximately 5 years of life at the Waimanalo Gulch Landfill. During this period, the City must select and construct a new landfill. The City is also requesting proposals for new solid waste treatment facilities utilizing alternative treatment technologies for the solid waste that is not presently treated by the H-Power Incineration Facility. These alternative technologies will augment H-Power by reducing the refuse that will go into the new landfill. The intent is to divert 100% of the refuse collected on Oahu that is not diverted through recycling programs to solid waste treatment facilities such as H-Power. While the cost refuse disposal on Oahu will increase due to the use of alternative treatment technologies, the new solid waste treatment facilities and H-Power will reduce the refuse volume by 80 to 90% prior to disposal at the new landfill. The intent is to extend the life of the new landfill so that a new landfill will not be required. Oahu is at the Yellow Level for solid waste.

The County of Kauai will soon run out of landfill space. The County is applying for a permit from the State Department of Health to extend the life of the Kekaha Landfill by allowing the County to increase the height of the landfill. The County is also searching for a new landfill site. The County of Kauai is presently bringing new systems on line and is at the Yellow Level.

The County of Maui has a new Central Maui Landfill with adequate volume to accommodate the growth of Maui. An acceleration in growth could reduce the life expectancy of the landfill and bring the County to the Yellow Level in the future.

The County of Hawaii has limited landfill capacity in Hilo and Kona. The County is planning to divert approximately 45% of the refuse collected through recycling and 35% through the use of alternative solid waste treatment technologies. The West Hawaii landfill has capacity but will require long hauls for the refuse from Hilo and Kona. The proposed plans for refuse recycling and refuse treatment will limit the expensive long hauls to the West Hawaii Landfill. The long hauling from Hilo is expected to cost approximately $90,000 a month or a little over a million dollars a year. The County is at the Yellow Level for solid waste.

Transportation

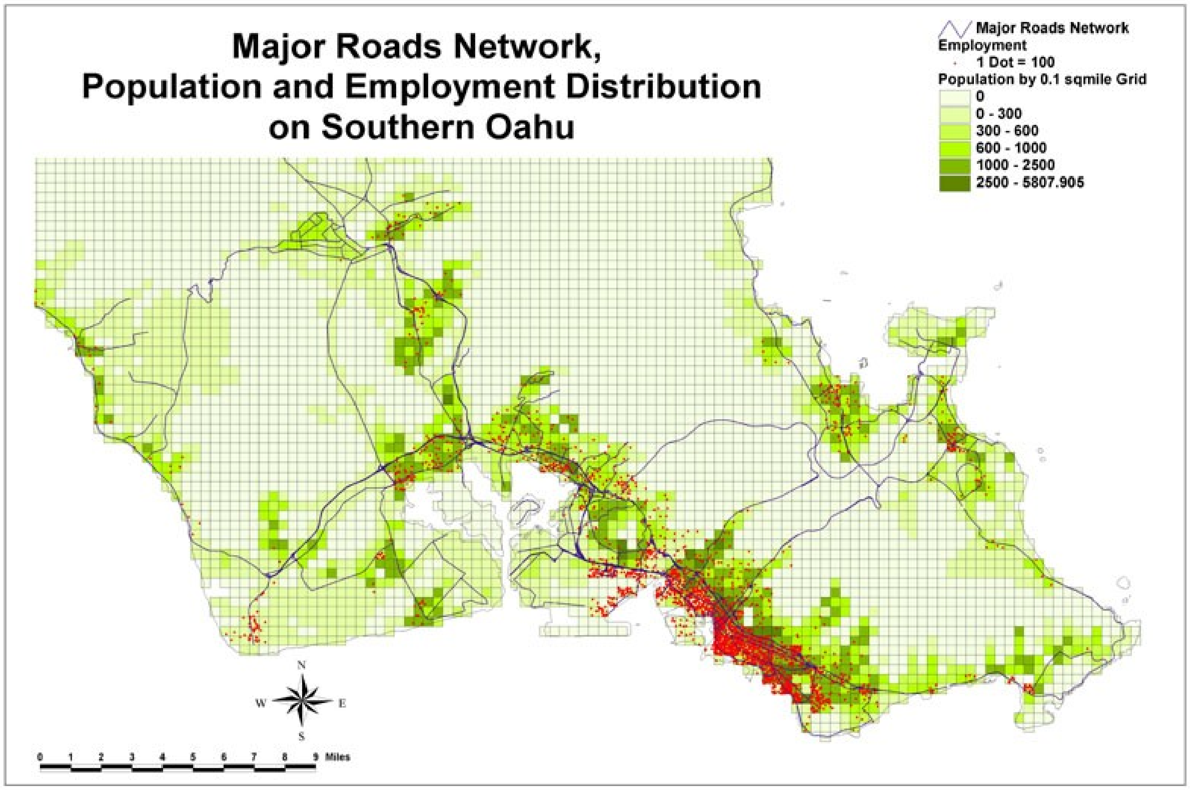
On Oahu, the State Department of Transportation (DOT) is constructing the Waimalu Viaduct Widening Project and will soon be issuing Requests for Proposals for the Fort Weaver Road Widening Project. The North-South Road Project will begin construction shortly. These projects will greatly enhance the traffic in Leeward Oahu but will not address the existing congestion along the Primary Corridor through Downtown Honolulu to Waikiki and the University of Hawaii. The City and County of Honolulu (City) is also planning improvements to alleviate congestion. The DOT and City are working together on a new plan to improve the highway system from Kapolei to Downtown Honolulu. According to Part I of this study, traffic volume on the H-2 at Kipapa is projected to increase by almost 40% by 2020, while the traffic volume at Waikele is projected to grow by over 60% by 2020. The traffic volume on the H-1 near Aiea is projected to increase by 10% over the same period.

The nature of the transportation problem is illustrated by Figure 22, which illustrates the location of both housing and jobs. The concentration of jobs and housing has contributed to roadway congestion as people travel to and from their homes and their employment locations. Congestion is particularly problematic during the peak travel hours in both the morning and afternoon/evening, especially along the Pearl City to Downtown to East Honolulu corridor. As the population continues to grow and spread to areas such as Ewa, Kapolei, and Mililani, the transportation congestion problems will continue to worsen.

As pointed out in Part I of this study, most state highways are already operating at or near capacity during peak hours. Moreover, if all tourists traveled by motor vehicle during the peak hours, the highways could not handle the additional generated traffic. Notably, 51.1% of new car registrations and 3.7% of the new truck registrations are for the rental inventory in 1999.

Another inherent problem is that many of the tourist destinations and attractions are within the urban core or involve passing through urban areas, further contributing to the congestion and traffic volume on the state and local roadways.

Figure 22



Based on the projected increase in employment over the thirty year period, even under baseline conditions, there will be 33.6% increase in total employment over 1997 levels. The high projection will result in a 44.4% increase over 1997 levels, while the low visitor growth scenario produces only a 16.4% increase over 1997 levels. Based on the CGE model estimates of county level demand for automobile rental, under baseline conditions, there is significant growth over the 30 year period. Oahu, for example will see a 38.39% increase in the demand for automobile rentals, while the projected increase on the Big Island is 64.65%, on Maui, the increase is 55.94%, and Kauai will experience a 71.55% increase in automobile rentals over the 1997 levels. These increases combined with the overall growth in employment and population suggest that the present funding strategies for highways and roads will not adequately meet demand.

The Honolulu International Airport will require additional gates and parking as air travel increases. The International Arrivals Building is near capacity and a new facility with additional gates and the space necessary to hold international visitors prior to processing by Immigrations and Customs will be required. Notably, there are no separate international passenger baggage handling capabilities on the neighbor islands. Oahu is at the Yellow Level for transportation.

The DOT and the County of Hawaii are planning to widen the Queen Kaahumanu Highway and improve the transportation corridors through Kailua-Kona. The busy highway is congested in during the afternoon peak as workers travel home from work in the resorts along the North Kona and South Kohala Coast. The Hilo and Kona Airports have no international arrival capabilities unless special arrangements are made to fly in Immigrations and Customs officials from Oahu. The Hilo and Kawaihae Harbors will require passenger handling facilities as cruise travel increases. The County of Hawaii is at the Yellow Level for transportation.

The DOT and the County of Maui are planning to widen the Mokulele Highway. The busy highway is congested in during the afternoon peak as workers travel home from work in the resorts in Kihei, Wailea and Makena. Kahului Airport has no international arrival capabilities where Immigrations and Customs processing are required. The runway will need to be extended if larger aircraft are required to land there. The Kahului Harbor will require passenger handling facilities as cruise travel increases. The County of Maui is at the Yellow Level for transportation.

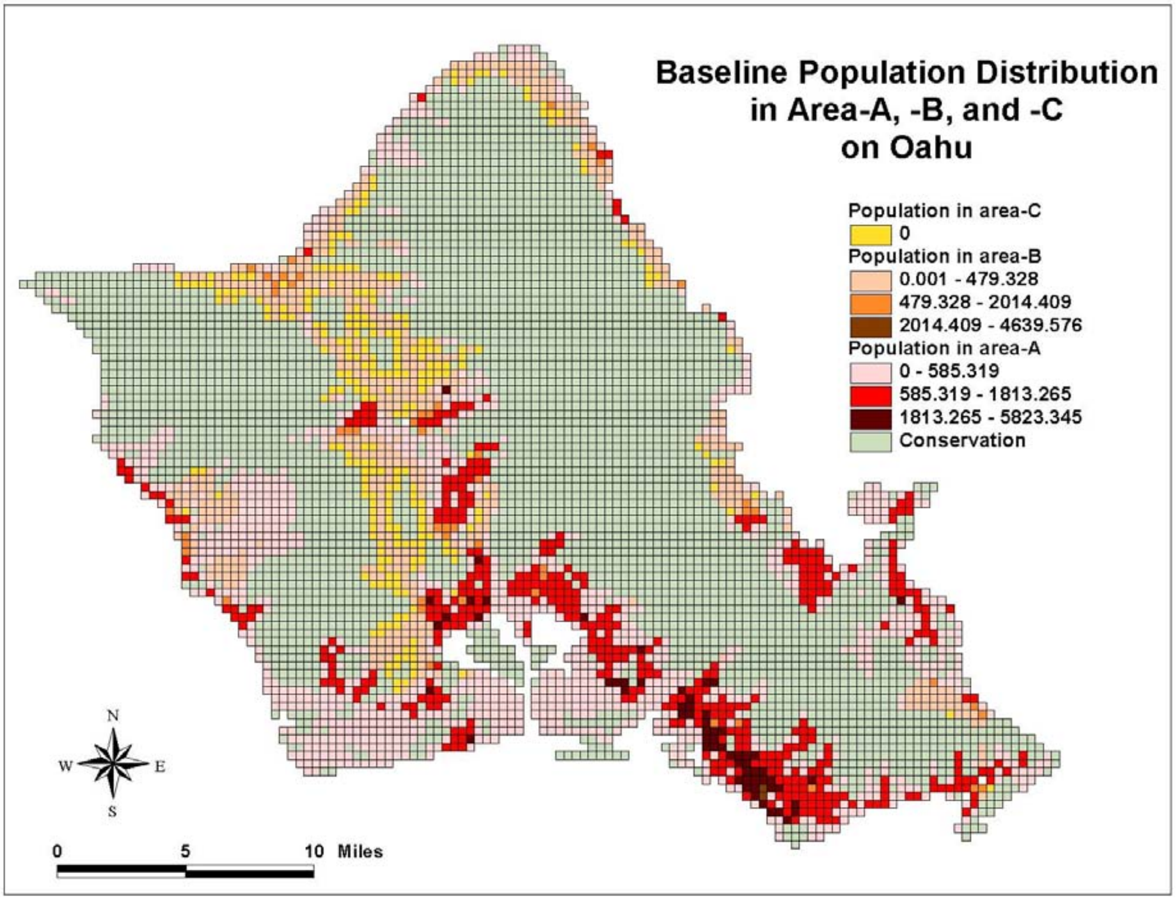
The DOT and the County of Kauai are planning to widen Kaumualii Highway from Lihue to Koloa and construct a By-Pass Road for Kuhio Highway through Kapaa Town. These busy highways are especially congested in during the afternoon peak as workers travel home from work in Lihue. The Lihue Airport has no international arrival capabilities where Immigration and Customs processing are required and will need to upgrade its baggage handling facilities, especially if the runway is extended to allow larger jets to land. Nawiliwili Harbor will require passenger handling facilities as cruise travel increases. The County of Kauai is at the Yellow Level for transportation.

IV.D. Modeling Suburban Expansion

An urban growth model has been developed to simulate patterns of residential development into the future. The model considers three different classes of land – urbanized, partially urbanized, and agricultural lands. Based on rates of population growth and other factors such as the proximity of individual zones to employment centers or adjacency to developed areas, a geographic model for estimating urbanization is developed. The densities of development are based on observed levels of development and allowable development under existing zoning and development codes. This tool is developed as a spreadsheet model linked to GIS in which the various assumptions regarding population growth, availability of land, density of development, etc. can be varied.

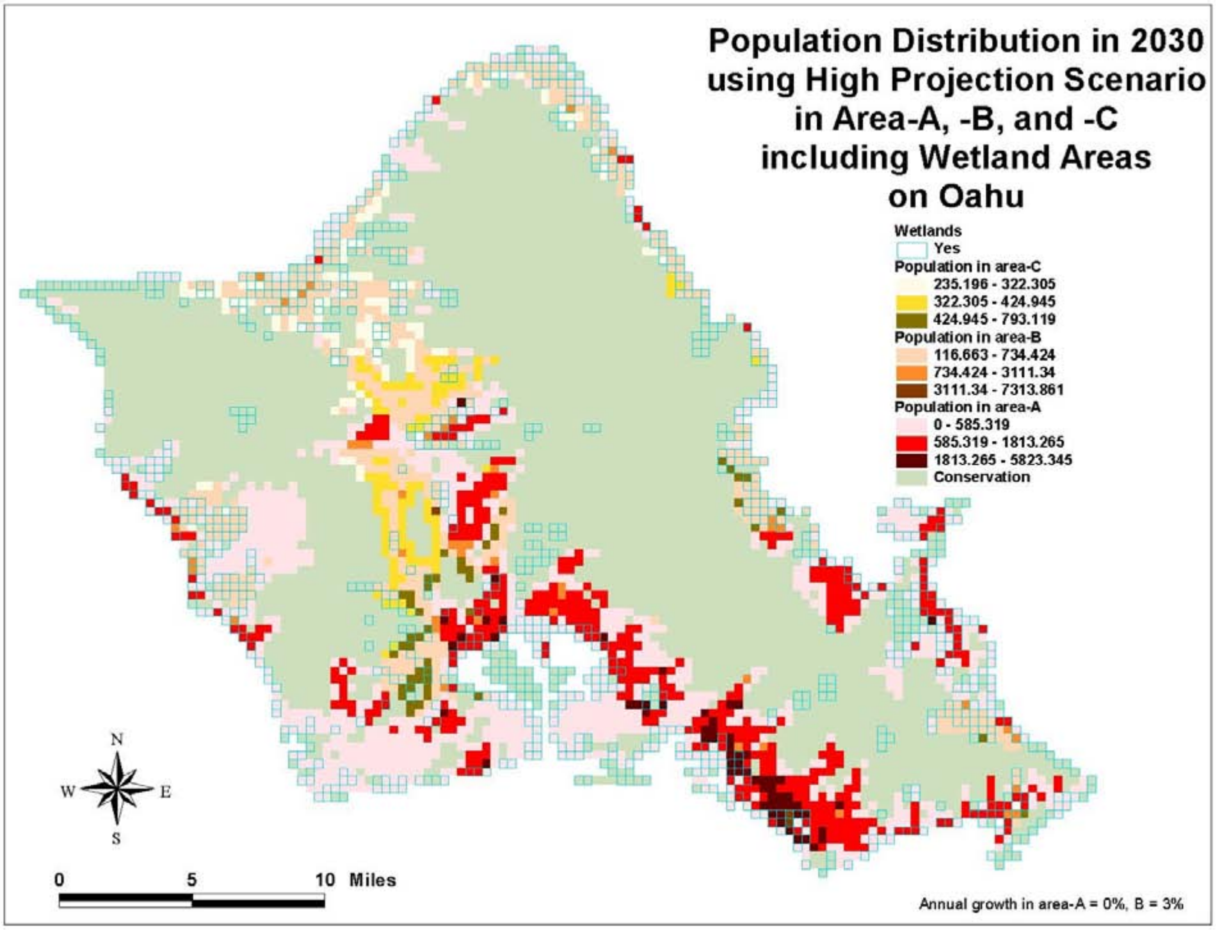
Figure 23, Baseline Population Distribution, illustrates the existing conditions allocated according to the three different categories of land. The urbanized areas (A) characterized by the colors (pink, red, dark red) have between 585 to 5,823 persons per zone. The partially urbanized are one to 4,639 persons per zone. The agricultural lands have, at present, zero people living in these zones.

Figure 23



The results of the urban growth simulation model are depicted in Figure 24. For purposes of this display, the 2030 high population growth is simulated, along with the following assumptions – that no new growth will occur in the developed zones (A) and growth of 3% will occur in the partially developed zones (B). The agricultural zones (C) will experience growth in population from 235 to 793 persons. Note that in Figure 27, wetland areas have been designated. Many of these areas overlap or are contiguous with areas of new population growth and development. These represent potential areas for closer evaluation.

Figure 24



Another strategy is to identify sensitive areas and then protect them from development. Figure 25 (bird habitat) and Figure 26 (threatened and endangered plant concentrations) show the locations of areas that may require protection from development.

Figure 25

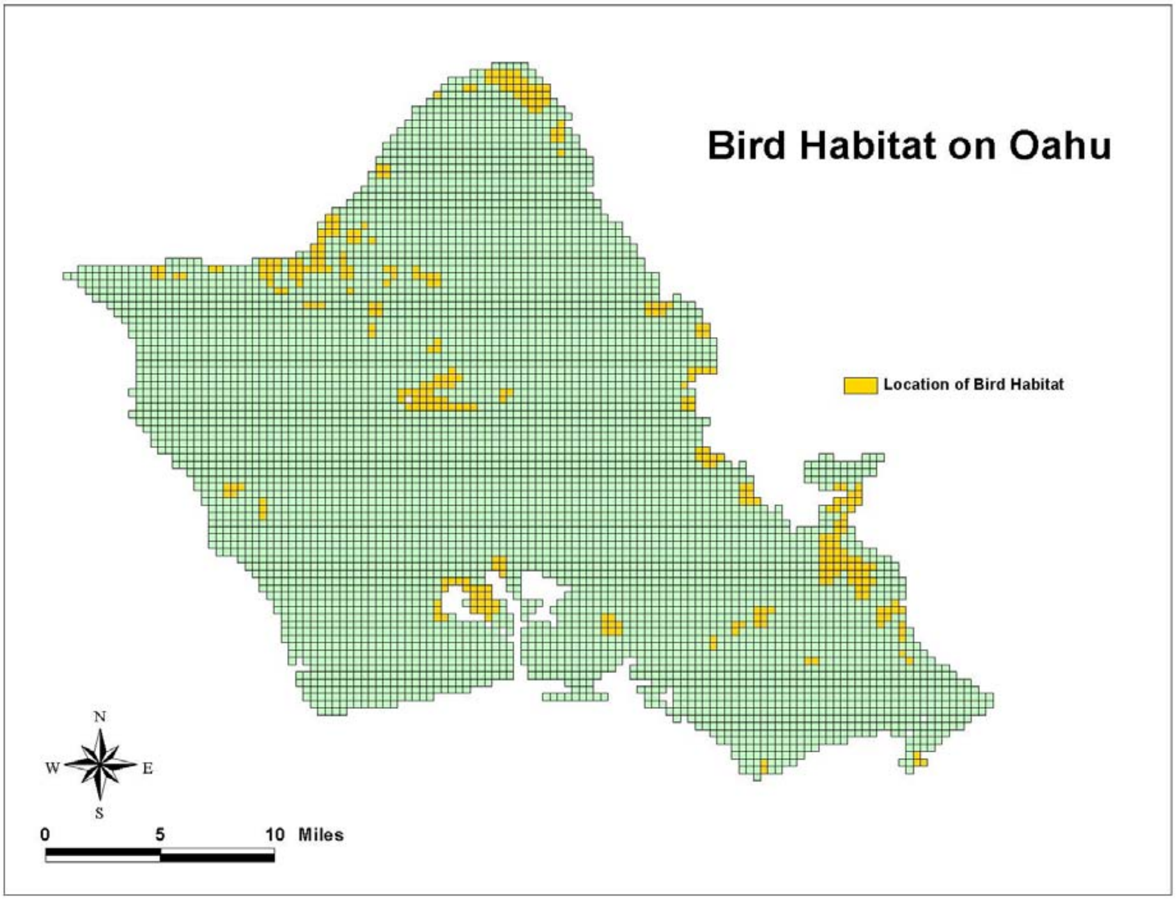
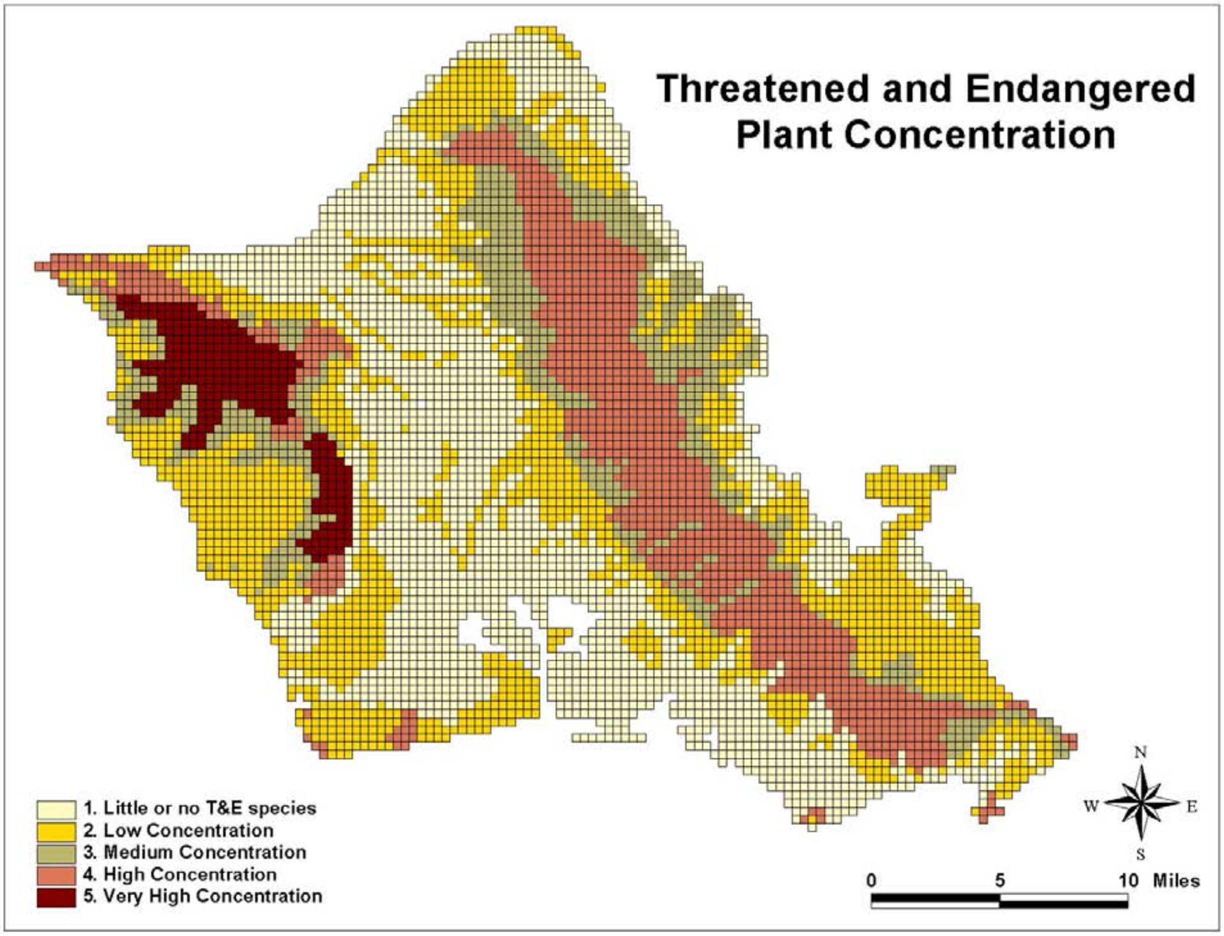

Bird Habitat on Oahu
Location of Bird Habitat
N
W
E
S
0
5
10 Miles

Figure 26


Threatened and Endangered Plant Concentration
1. Little or no T&E species
2. Low Concentration
3. Medium Concentration
4. High Concentration
5. Very High Concentration
N
W
E
S
0
5
10 Miles

IV. E. The Social Costs of Tourism

This report has focused principally on the economic and environmental aspects of tourism. Yet because tourism is so central to Hawaii's economy and such a major part of the livelihood of residents, it is also evident that there are important social and cultural impacts of tourism. In some cases, the changes brought on by increased tourism can be beneficial, in others, they may be detrimental. While some of these of these changes can be measured, others are more intangible in character. In this section, some of the issues and concerns identified in the course of the data analysis and modeling and coming from the interaction with various stakeholders and community representatives are identified.

It should be noted that an increase in tourism generally produces an increase in household income. At the same time, there are also changes in prices and the cost of living. Under some scenarios, the real purchasing power and economic welfare of households increases, while under others, there is an erosion of household real income. The expansion of this economy tends to benefit those who are employed. Those on fixed income or employed in declining industries are less likely to benefit from new growth in tourism. Also, as pointed out earlier in the analysis, changes in the level and mix of tourism expenditures produces differential effects for various types of businesses which also translates into gains for some households and declines for others. Yet, a number of general observations emerge from the modeling effort. As household wealth increases, purchasing power and expenditures on a market basket of goods and services also increases. More income means more resources to spend on housing, food, clothing, health services, entertainment, education, and other goods and services which help to improve the quality of life for Hawaii's people.

Notably, under most tourism scenarios, the volume of household spending on goods and services such as restaurant meals, entertainment, and museums exceeds the level of aggregate spending by tourists. Spending by households on these goods and services as well as on others such as health care and education are all indicators of social progress that can be attributed to growth in purchasing power resulting from increased economic activity.

One of the obvious benefits of tourism is widening of the base of consumers. More visitors mean more customers for restaurants, shops, entertainment spots, museums, golf courses, and other businesses. The added purchasing power of tourists therefore helps to sustain more diverse businesses and create a broader economic base. This in turn, benefits residents who have greater consumer choice than they would have in the absence of the visitor industry.

There is, of course, a downside to continued increased tourism. More visitors mean more traffic congestion and increased competition for space on not only the roadways but at beaches, parks, recreational facilities, shopping malls, and other locations. While on the one hand, increased traffic is a sign of a healthy economy, it also means increased travel times, longer lines, more time spent searching for parking spaces, and increased aggravation due to congestion and delay. There may be also subjective feelings that special places are being overrun by visitors. Crowding can also lead to increased litter and greater wear and tear on public facilities. Especially when the number of visitors far outnumbers residents, there can be a loss of sense of community and the perception that the area is not safe, nor desirable, to visit.

Another issue that has emerged in the course of the research and public meetings accompanying this project has been the relationship between tourism and housing. It is clear that there are two different dimensions to this problem. First, tourists compete directly with resident for the available housing stock. The large number of timeshares, resort condos, and rental properties as well as second home or vacation home properties in Hawaii means that in some areas the housing stock has been set aside for visitors rather than residents at a time when there is great demand for housing. A related problem is the problem of housing affordability. Given the wages and salaries of most of Hawaii's workers, the prospects of home ownership are limited. This is, of course, like traffic congestion and transportation issues, part of larger problems that can not, obviously, be solved by a tourism study.

Another dimension of the problem with tourism expansion is the fact that tourism and many of the supporting industries are labor intensive. As noted earlier, the labor requirements for hotels, restaurants, retail and entertainment puts tremendous upward pressure on our population. It is the increased in-migration of workers and families that put strain upon on infrastructure and contributes to the congestion, traffic, and pressures on our environment. New workers need not only housing and transportation, but also a range of other goods and services – schools, parks, emergency services, hospitals, and other facilities all of which need to be planned, developed, and built. This in turn contributes to the urbanization of land and puts further pressures on our ecosystems. As demonstrated earlier, it is the resident, not the visitors that in the aggregate consume the most water, energy and fuel and generate the greatest amounts of wastewater, solid waste and pollution. In the next section the spatial analysis of growth and development is examined.

One of the greater challenges faced by Hawaii involves not just understanding the economic, environmental, social, and cultural linkages associated with tourism, but also attempting to balance the competing needs and demands of businesses, communities, families, and government. There is, evidently, need for more deliberation among diverse stakeholders with different values, perspectives, and measures of progress in order to better manage the social and cultural dimensions of tourism into the future.

V. SPATIAL ANALYSIS OF ECONOMIC AND ENVIRONMENTAL IMPACTS

Another way of addressing the relationships between visitor spending, population growth, and environmental sustainability is to focus more closely on the question of where new growth and development should occur. To begin answering this question, this report focuses on where development has occurred and its' resulting environmental impacts.

Using GIS software, Census data, land use information and other spatial databases, we create a uniform grid structure (0.l square miles) for the entire state. This involves determining the locations and intensities of development and economic activity. The use of these databases, while the best information available, is not perfect. The Census data is mapped in census tracts that are not necessarily consistent with State land use maps. Existing land use maps may not capture all development and residential land use, as agricultural subdivisions and land uses may have changed since the existing maps were prepared. Measures of economic activity such as output or employment, both in terms of aggregate levels and of sector level activity, are determined for locations across the state. Using input-output data and the estimates of resources use described earlier, the demand for key infrastructure services is also estimated. Then, using the CGE model, the spatial impacts of changes in the economy are compared to baseline conditions. The impacts of both a simulated decrease (25%) and a simulated increase (10%) in visitor spending on employment levels are estimated.

Notably, there are both increases and declines in various industries across the state. One of the real advantages of CGE modeling approach is that a more complete picture of both the aggregate level changes as well as the sectoral responses can be simulated. This approach, combined with the uniform grid structure provides a tool in which key questions can be answered. How much economic activity is generated in a particular grid cell? How does the economic activity relate to the level of infrastructure demand? In the report, an analysis of Waikiki was performed in which the economic and environmental conditions in those grid cells corresponding to this district were compared to the rest of the state. These findings are useful in addressing questions such as, what would happen if more areas were to develop to the intensity of Waikiki? This provides another tool for the development and evaluation of other potential scenarios.

The results of the spatial analysis determined that there is, quite clearly, a concentration of economic activity in key locations. The mapping served to identify these locations, both across the state and from the perspective of individual counties. The pattern of residential location is much more dispersed. Knowing the location and densities of the resident population is important, not just in terms of planning for infrastructure but also of assessing workforce conditions. As economic changes occur and various industries expand and decline, the labor requirements will also change. The changes in the labor force will in turn affect the demand for housing and infrastructure (water, sewer, energy, solid waste disposal, etc.).

Like the analysis of the location of output, the mapping of the demand for infrastructure services shows some spatial patterns. Generally, the demand is highest in those areas with the greatest output and the largest number of employees. Offsetting this spatial pattern is the residential demand for water, electricity, and solid waste disposal services.

Mapping together the location of economic activity, population densities, and the resulting demands for infrastructure serves to illustrate the key communities and areas that experience environmental stress. Indeed the mapping exercise has shown to reveal not only the relationship between economic activity and environmental stress, but also the extent to which such tensions are concentrated in key districts, neighborhoods, and regions of the state. A surprisingly large amount of economic activity is concentrated in a relatively small area. The strain on infrastructure systems is also concentrated in key locations. It is in these locations, where the potential overloading of systems can cause increased stress on the environment. The maps and spatial analyses can be used to identify those areas that are particularly in need of environmental monitoring, remediation, and reduction of environmental stress.

A dimension that also can be integrated into this analysis involves the identification of areas or regions that need to be protected. The mapping effort has also included the location of bird habitat and threatened and endangered species. These areas may need additional protection from development.

Another important finding arising from the CGE modeling effort is that while a decrease in visitor spending results in employment losses, it also creates conditions where employment increases in some sectors. Similarly an increase in visitor spending means not just growth across all sectors, but rather that the employment in certain sectors will expand, while it will constrict in others.

While the mapping and spatial analysis can be used to identify key “hot spots” and locations were economic growth will produce increased environmental strain, the analysis also serves to point to one unmistakable pattern: while the economic activity tends to concentrate in selected locations, the real threats to the environment arise out of residential expansion. Urbanization. Sprawl. Subdivision development. The growth of the resident population creates far more strain on the environment in more locations than does the expansion of industries and businesses.

Moreover, the increase in residential population also pushes up the demand for fire protection services and other amenities such as community parks and recreational facilities. On Oahu there are 41 fire stations. Four new stations are planned in Ewa and another is planned in Koolaupoko. The increase in resident population even under baseline conditions will strain the existing and planned fire protection services. According to the Part I study, an increase in visitor population will directly affect fire and emergency medical services because many of the emergency calls are visitor related. The problems are more significant on the Big Island because of the longer travel distances. The Big Island has 14 regular fire stations and 18 volunteer stations. There are also two federal fire stations. There is but one new station planned for North Kona. According to Part I, the visitor and resident usage of fire protection and emergency services are mostly the same, except in areas of higher visitor concentration where tourist related calls dominate. The County of Maui has 13 fire stations. There are four new planned stations. Two of the planned new stations are will be located on Molokai. Kauai has seven fire stations. According to the Part I study, there is a 2 to 1 ratio of visitors to residents for rescue calls, heart attack, accidents, drowning and rescue. As the ratio of visitors to residents increases, there will be increased stress on emergency medical and rescue services. Other problems identified with regard to visitor incidents include language problems and inability to provide accurate information on the response location.

According to the Part I study, Oahu currently faces a shortage of community parks, neighborhood parks and recreational facilities for residents. The problem exists in both the coastal plain areas as well as in the older communities such as Makiki, Nuuanu, Downtown, Liliha, and Kalihi-Palama. While there are plans to acquire land and increase the amount of park space, land for these uses is limited, particularly in the Primary Urban Center. There is also a limited amount of beach and regional parks which are also heavily used by visitors as well as residents. There are six new beach parks or support beach parks planned for the North Shore where there is already heavy use of beaches by both residents and visitors. Increases in resident population above the baseline levels in 2030 will only add to the amount of additional park acreages required in Central Oahu and Ewa.

The Big Island parks are experiencing problems due to increased usage and the lack of safe swimming areas. There is crowding due to inadequate park acreage and limited parking spaces. The problems with parks on Maui include the lack of restrooms and other public infrastructure such as parking. There are also many conflicting uses between windsurfing, kite-boarding, surfing, and swimming. Maui also needs additional recreational playing fields and passive parks. All parks on Kauai experience heavy use by both residents and visitors. Due to the projected increase in motor vehicle rentals on Kauai, there is also need to expand parking at parks and recreational facilities. Parks across the state all suffer from inadequate repair and maintenance.

VI. POLICY CHOICES: SUSTAINING TOURISM IN HAWAII

This project has served to illustrate some of the challenges facing Hawaii. It is evident from Parts I, II and III of this Study that there are limits to the growth of tourism both because of internal constraints and because of external forces and competition from other destinations. On the one hand, it is somewhat tempting, given Hawaii's success in developing tourism as a global product, to simply keep doing what we have been doing and to hope that things remain as they are. On the other hand, there is need for innovation, new product development, and additional research and development if Hawaii is to remain a competitive, attractive destination.

It has been stated in Part III of the Study that the situation is further complicated by the fact that the visitor industry in Hawaii is a mature one. Unlike other places in which tourism is a more recent phenomenon, poised for take-off and rapid expansion, Hawaii's tourism product is more advanced, stable, and unlikely to see massive expansion.

Tourism is clearly the most important economic activity in Hawaii. Compared to other sectors, tourism is distinguished both by its size and share of the state's economy and by the fact that there are few comparable opportunities for generating wealth and income for Hawaii's people.

The state's economy is heavily oriented towards tourism and services. Key sectors include real estate, services (health, education, financial, etc.), government, and those catering to tourists (hotels, transportation, restaurants, etc.). Notably, however, visitor spending is approximately one-half the level of household spending. While visitors spend proportionately more on hotels, transportation, restaurant meals, and sightseeing, household spending on many of these services (retail, restaurant meals, entertainment, etc.) is also quite significant. Of course local spending on health, education, finance and other services far surpasses the level that tourists spend on these goods and services.

In this study, we also examined the environmental impacts of tourism by estimating both the direct and indirect demand for various infrastructure services by visitors and households. Direct demand results from the purchase of infrastructure services, like when a resident pays a water bill. Indirect demand occurs from purchase of a good or service from a business which in turn purchases infrastructure services, like when a tourist pays for a hotel room and the hotel, in turn, pays a water bill. As noted in this study, many of the infrastructure services used by tourists are purchased indirectly, so it was necessary to develop a methodology for tracing through these indirect effects. Induced demand was also examined. An increase in visitor spending produces income for certain households who in turn consume various goods and services that require infrastructure services. In order to fully account for the environmental impacts of changes in our economy, it is necessary to examine direct, indirect, and induced levels of infrastructure demand.

The greatest industrial demand for infrastructure services (water, electricity, sewer, solid waste etc.) comes from hotels, real estate, restaurants, and other businesses. Yet it is important to note that residential demand for these services greatly exceeds that of not only tourists, but also total industrial demand. While residents consume far more of these services, in the aggregate, on a average, per day basis, the demand for these services by tourists is greater.

The consequence of the higher average spending levels by tourists is that they generally create, on a per person, per day scale, a higher environmental impact than residents. But when the total aggregate levels of demand for infrastructure is estimated, it is clear that residents, more than visitors, are the primary source of strain on our natural resources, because of the increased levels of direct, indirect, and induced levels of demand.

Using the CGE model, the impact of visitor expenditures was also simulated. An increase of a million dollars in visitor spending produces and increase in total output of more than $2.8 million. The visitor oriented sectors such as hotels, transport, trade, and restaurants experience gains, but also, notably, the boost in household expenditures also stimulates spending on other services (health, education, financial, etc.). More income to households means more spending on real estate as well as retail trade. Not all sectors are equally affected by a boost in visitor spending. The sectors to see the greatest growth in job creation include retail, health services, restaurants, hotels, and air transport. Moreover, an increase in visitor spending also generates impacts on the environment. Direct demand results from the purchases by visitors. Much more significant is the indirect demand for water, energy, solid waste services by the industries whose goods and services are purchased by visitors. Because increased tourism generates more income for residents, their consumption (both direct and indirect) also expands. While agriculture and manufacturing sectors and the demand for water in these sectors decline by 1.44 million gallons with a $1 million increase in visitor spending, there is a significant increase in municipal water demand by residents of approximately 1.1 million gallons.

The simulations also reveal significant differences between various visitor groups and their spending patterns and their resulting environmental impacts. In this study we simulated the effects of an additional million dollars of visitor spending by various visitor types. Because Japanese visitors spend more on a per day basis than for example Canadian visitors, to earn the same amount of income will require more Canadian visitor days (8,552) than Japanese visitor days (4,027). Yet because Japanese visitors are making greater purchases of goods and services not from Hawaii, the additional million dollars in Japanese visitor spending contributes less to the economy than does the additional million dollars from Canadian visitors. The typical Japanese visitor spends much more on retail goods and less on non-tradables such as accommodations and restaurant meals. This has the added effect of also contributing notably less to the gross state product, and average household expenditures than do other visitor types. One million dollars from Canadians contribute the most to the economy, although not by a significant margin. The gap between Japanese economic contributions and those of other visitor types is due to the significantly higher levels of direct and indirect import of non-Hawaiian goods and services associated with Japanese spending.

While Japanese visitors spend more per day and contribute less per dollar to the local economy, they also tend on average to have a lower environmental impact. Per million dollars spent, the Japanese visitor generates less water, petroleum, and electricity demand than most visitors. Other international visitors generate a relatively low impact in terms of water and electricity. However, visitors differ greatly in terms of their impact on the generation of solid waste.

It is clear, given our present industrial structure, that the incomes of Hawaii's residents are closely tied to the visitor industry. A growth in visitor spending without an increase in the labor force simply transfers more income to Hawaii workers, increasing household welfare and real household expenditures. An expansion in the labor force without an increase in visitor spending tends to harm Hawaii households as real incomes fall. Labor force expansion without a growth in either tourism or another economic sector will lead to a decrease in the standard of living for Hawaii's residents. On the other hand, a increase in the labor force without growth in visitor spending will mean an improvement in welfare for visitors – because they will be getting more service for their spending.

Growth in the labor force also improves Hawaii's comparative advantage in certain export sectors such as clothing, agriculture, and exportable services. Transportation, health, trade, finance and information services grow proportionate to the increase in the labor force. Visitor related services, however, grow proportionately less than the labor force.

There is a corresponding increase in infrastructure demand. A 10% increase in the labor force, for example, leads to a 10% increase in water use, a 5.7% increase in electricity, a 5.4% increase in utility gas, a 9.5% increase in solid waste, and a 5.1% increase in petroleum.

Without increases in labor force, prices are also pushed up for both visitors and residents alike.

The quality of the visitor experience is dependent on the responsiveness of the labor force to tourism growth. Moreover, the more visitors spend, the higher prices are for both visitors and residents. Increases in visitor spending create more inflation when the labor markets are inelastic than when there is in-migration. However, residents are better off when visitor spending is not accompanied by an increase in the labor force. This transfers more income to households. But there clearly is a limit to the growth of tourism without expansion of the labor market.

Another limiting factor is the capacity of the environment to absorb more growth. To analyze this, the baseline models were extended to 10, 20, and 30 year planning horizons. A series of simulations were conducted in which the baseline conditions were compared against alternative scenarios for growth in both visitor spending and population levels. The results reveal that while the greatest increase in gross state product in 2030 occur with the highest levels of visitor spending and population growth, the high growth scenarios produce the greatest levels of inflation for both residents and visitors. The high growth scenarios also increase strain on Hawaii's environmental resources. At the same time, the addition of more residents fuels the economy and promotes higher levels of production and output.

While there is a significant increase in demand for infrastructure services associated with the high growth scenarios, and demand generally increased proportionate to the level of visitor spending and population growth, the statewide trigger analysis revealed that the low growth scenarios delay the onset of "critical" levels of increased demand. Some of the services (water, electricity, solid waste) require local or state resources while others (petroleum and utility gas) will be met by imports.

To better understand the capacity of the state to absorb more tourism, an analysis of the state's hotel room capacity was conducted, using the low, base, and high projections of visitor demand for hotel rooms. Based on this analysis, it was determined that Kauai and Honolulu already face an impending shortage of hotel rooms, followed next by Maui and then the Big Island. As occupancy rates reach more critical levels, visitors will increasingly seek alternatives to hotels including time-shares, condominiums, and other accommodations.

In terms of the analysis of environmental capacity, it is apparent from the results of Part I of the Study that there are adequate state or county land and water resources to accommodate new growth. Yet if water is to remain in certain regions and not be transported to the dryer, growing parts of the state, then there are definitely resource constraints. Moreover, there are questions regarding the development of infrastructure services and the allocation of costs for both water and wastewater facilities that are generated by the infrastructure capacities developed in Part I of the Study and the demands developed in Part II. With solid waste, the needs are more critical, especially on Kauai and Oahu.

As this report has demonstrated, there are already limits to the growth of the visitor industry. Growth is constrained by the number of hotel rooms, the number of airline seats, and other factors such as the amount of available convention and meeting space. Another obvious limiting factor is the supply of available labor to ensure the provision of a quality tourism product. We have also determined from Parts I, II and III of this Study that there are concerns regarding solid waste disposal, especially on Oahu and Kauai, but in the long-term on all islands. There are also significant issues with regard to the adequacy of various infrastructure systems with higher levels of visitor spending and population growth.

Another approach entails examining and evaluating various potential markets for tourism to Hawaii. In addition to considering the differences between east and west bound tourist, we might also consider changing the mix of business, honeymoon, convention, and other categories of tourists. Potential new mixes could include “eco-tourists,” “edu-tourists,” “health tourists” and other types of visitors to Hawaii.

Regardless of the number and type of tourists to Hawaii, there may be reason to do a better job of managing the externalities associated with tourism. Externalities are the unintended by-products of a production process, such as pollution, noise, or disruption of wildlife habitat. In the case of tourism, while visitors spend more and generate more pollution on a average, per day basis, the aggregate amounts of congestion, pollution, and environmental impacts of residents far outweighs that of both the visitor population and the industries directly supporting them. There are three basic approaches to managing externalities: tax policy, land use policy and infrastructure pricing.

Tax Policy – this approach involves changing behavior of consumers and producers by imposing taxes that raise the costs of economic activity. Revenue generated from new taxes could be used to promote sustainable development or subsidize programs that are related to reducing the environmental impacts of tourism and development. In addition to the broadly based excise tax, Hawaii currently levies a number of specific taxes directly affecting the visitor industry including the Transient Accommodations Tax (TAT) and rental motor vehicle and tour vehicle surcharge tax.

Land Use Policy – this approach involves using development plans, zoning, and other land use controls to steer growth and development. Hawaii, with its two-tiered system of zoning (state and county) has had long history of involvement in these strategies. Given the finding that development pressures are currently much more related to suburban expansion and that valuable wildlife and natural resource areas (habitat, wetlands, etc.) are at risk, the development of coordinated land use policies designed to balance growth and the natural environment are needed.

Infrastructure Pricing – this approach involves changing the price of water, wastewater treatment, solid waste, energy and other infrastructure services as a way both influencing demand and recovering revenues which can be used to expand infrastructure services or develop sustainable tourism policies. Changing the price of water or other infrastructure goods and services may influence not just demand, but also production of goods and services over time.

One of the major challenges in Hawaii and in other locations where tourism is such a pervasive part of the economy is to develop appropriate policies that do not have unintended consequences. Because so much of the economy depends on tourism and because so many people are either directly employed by the visitor industry or work in companies that provide crucial goods and services to visitor-related industries, there is hesitancy to introduce radical, sweeping change. It is, after all, the livelihoods and prosperity of companies, families, and individuals that are at stake. Hence, efforts to balance economic, environmental, and social goals need to be carefully designed and implemented to produce "win-win" solutions or, in the case of the "triple-bottom line" view of sustainability, "win-win-win."

Sustainable Development Indicators. It is evident that there is need to develop more extensive indicators pertaining to sustainable development. While measures of economic success abound, there is need to go further in terms of capturing measuring environmental quality and social vibrancy. Unfortunately, there is a tendency to monetize all of these values because of the difficulty of dealing with different measurement systems. Future work should go towards the development of appropriate measures of sustainable development that cut across different economic, environmental, and social domains.

Sustainable Tourism Database. In this project, a great amount of data has been collected from many different sources. Given the importance of tourism to Hawaii's economy and community and the need to monitor and measure the impacts (both positive and negative) of changes in tourism, there is need to both continue and expand the work that has been initiated. Further integration of Part I, Part II, and Part III of this study would be a good first step. A plan to ensure the ongoing collection and updating of vital information related to the economy, environment, and society in Hawaii should be developed.

Alternative Methods and Models. In addition to the CGE model, the use of input-output methods, GIS, and other techniques of regional analysis have been demonstrated. The work on simulating urban growth should also be expanded. Other potential models and algorithms could be incorporated to take advantage of the data that have been collected. There is a need to expand the present state-of-knowledge with regard to modeling techniques and methods of assessing the impacts of sustainable development.

County Level Analyses. Statewide economic data were used to build the initial model and then allocated down to the county and sub-county levels. Another approach would be to begin with a county level input-output table and use a more "bottom-up" approach to investigating the relationships between tourism, the economy, the environment and community. Used in tandem with the statewide model, county-level analyses might help to better understand the intricacies of not just supply and demand, but also the interactions between tourism, labor, residential development, growth, and environmental quality.

Changing the Tourism Production Process. Another strategy may involve using the data and methods created in this project as a basis for re-engineering the production of tourism in Hawaii. As noted in this study, because tourists spend more, they tend to consume more water and other infrastructure services. Perhaps more emphasis could be directed towards water savings devices, smart buildings, energy-efficiency, and other new technologies that could reduce the environmental impacts of tourism in order to create a more economically, environmentally, and socially sustainable product.

In conclusion, three major areas for future research have emerged. First, if tourism is to grow, even modestly, there is need to re-examine our policies with regard to the development of hotels and visitor accommodations. This is a concern across the state. As the number of visitors increases, more and more of the rental stock is being used for tourist accommodations (resort condos, time-shares, and unit rentals). This has served to drive up housing prices and to increase competition for a limited supply of affordable rental housing.

A second issue that has emerged in our research relates to the differential impact of various types of visitors coming to Hawaii. On the one hand, high spending tourists from Japan generate the most economic activity, yet much of that economic activity (retail purchases, etc.) leaks out of the state of Hawaii. These visitors tend to spend less on non-tradable goods and services, so the benefits to our local economy are limited. A higher proportion of what they purchase and consume is imported. Tourists from Canada, however, spend proportionately more on restaurant meals, hotel rooms, rental cars, gasoline, and stay longer than the typical Japanese visitor. Because it takes more lower spending Canadians to achieve the same levels of output and production, the impact in terms of water use, wastewater, electricity, and other infrastructure services (with the exception of solid waste generation) is proportionately greater. Clearly additional research needs to be done in terms of identifying the optimal mix of visitors from key markets in terms of economic, environmental, and social benefits and costs.

A third, broader concern relates to the question of how much additional population growth and in-migration is desirable for our state. This issue has emerged not only in terms of the increasing demand for labor in the visitor industry and in other businesses in Hawaii, but also, more fundamentally because it is the resident population that creates the greatest strain on our environment. We have demonstrated that while the daily average levels of water, sewer, electricity, propane, and solid waste generation are greater for visitors than residents, it is the residents who are most responsible for the strain on the environment. Coupled too with the larger questions regarding suburban expansion and sprawl, the changes in the structure of our economy have definite implications in terms of the demand for labor and the pressures related to growth and development of our islands.

While tourism is an essential component of Hawaii's economy and while this study was focused on the issues related to its "sustainability" defined in terms of economic, environmental and social consideration, it is clear that there are larger issues related to Hawaii's industrial structure, its population dynamics, and its patterns of growth and development over the long-term. While this project has been focused on simulating the effects of alternative tourism scenarios, it is clear that the tools, methods, and databases could be used to consider the plight and prospects for other industries (i.e. agriculture, high tech, financial services, etc.) in Hawaii in our quest to find the "triple-bottom-line."

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