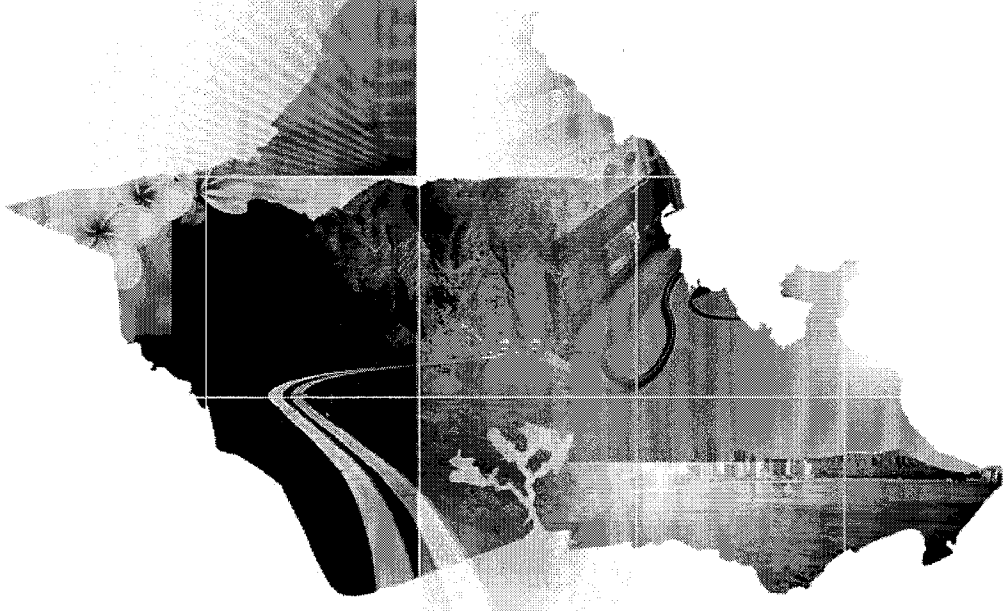
ENVIRONMENTAL JUSTICE IN THE OMPO PLANNING PROCESS: DEFINING ENVIRONMENTAL JUSTICE POPULATIONS



March 2004

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City and County of Honolulu
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EXHIBIT "A"

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The preparation of this document was financed in part through grants from the U.S. Department of Transportation, Federal Transit Administration and Federal Highway Administration, under Chapter 53 of 49 U.S.C. and 23 U.S.C.

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Acronyms

The following is a list of acronyms used throughout this report.

AIAN	American Indian or Alaska Native
CTPP	Census Transportation Planning Package
DHHS	Department of Health and Human Services (Federal agency)
DOT	Department of Transportation
DPP	Department of Planning and Permitting (City agency)
EJ	Environmental Justice
FHWA	Federal Highway Administration
GIS	Geographic Information System
GISAT	Geographic Information System Analysis Tool
MORPC	Mid-Ohio Regional Planning Commission
MPO	Metropolitan Planning Organization
MTC	Metropolitan Transportation Commission
NC	Normalized Concentration
NHOPI	Native Hawaiian or Other Pacific Islander
NHTS	National Household Travel Survey
OKI	Ohio-Kentucky-Indiana Council of Governments
OMPO	Oahu Metropolitan Planning Organization
PSRC	Puget Sound Regional Council
RC	Relative Concentration
RS	Relative Size
RTP	Regional Transportation Plan
SCAG	Southern California Association of Governments
SD	Standard Deviation
SF	Summary File
TAZ	Traffic Analysis Zone
TDFM	Travel Demand Forecasting Model
TIP	Transportation Improvement Program
WILMAPCO	Wilmington Area Planning Council

1. INTRODUCTION

In 1994, President Clinton issued Executive Order 12898 pertaining to environmental justice. The order brought to the forefront issues of discrimination that were enacted in 1964 under Title VI of the Civil Rights Act. In addition to emphasizing race and ethnicity as described in Title VI, the executive order highlighted the matter of income as it relates to the distribution of benefits and burdens to those impacted as a result of federal dollars being spent in communities.

In 1999, the United States Department of Transportation (US DOT) issued a memorandum to all federally-funded transportation agencies, including state DOTs and metropolitan planning organizations (MPO), and required such agencies to comply with Title VI and environmental justice. Noting that issues of Title VI and environmental justice were raised by concerned citizens primarily during project development phases of projects, the US DOT urged that compliance be evaluated as early as possible, specifically, in the planning stages of the transportation process.

Role of the Federal Highway Administration (FHWA)

Shortly thereafter, FHWA ramped up their efforts in providing training with respect to Title VI and environmental justice to DOTs and MPOs, and introduced their environmental justice website[1] as a resource from which to garner information regarding fulfillment of the law and executive order. FHWA defined Environmental Justice persons as anyone belonging to any of the following groups:

- **Black** - a person having origins in any of the black racial groups of Africa.
- **Hispanic** - a person of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race.
- **Asian** - a person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent.
- **American Indian and Alaskan Native** - a person having origins in any of the original people of North America and who maintains cultural identification through tribal affiliation or community recognition.
- **Native Hawaiian or Other Pacific Islander** - a person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands.
- **Low-Income** - a person whose household income (or in the case of a community or group, whose median household income) is at or below the U.S. Department of Health and Human Services poverty guidelines.

In addition, FHWA identified three fundamental environmental justice principles:

- To avoid, minimize, or mitigate disproportionately high and adverse human health and environmental effects, including social and economic effects, on minority populations and low-income populations.
- To ensure the full and fair participation by all potentially affected communities in the transportation decision-making process.
- To prevent the denial of, reduction in, or significant delay in the receipt of benefits by minority and low-income populations.

[1] http://www.fhwa.dot.gov/environment/ej2000.htm

With regard to implementation, FHWA left considerable flexibility to DOTs and MPOs. Agencies were given significant latitude as to how to identify environmental justice populations, what criteria to use to evaluate compliance, and how to measure effectiveness. To support agencies, FHWA provided examples about various ways to undertake an environmental justice evaluation with a website devoted to ten case studies of best practices.

Incorporating Environmental Justice in the OMPO Planning Process

In 2000, the Oahu Metropolitan Planning Organization (OMPO) undertook an effort to evaluate its regional transportation plan (RTP) and transportation improvement program (TIP) using the principles of Title VI and environmental justice. The region for which OMPO is responsible is the island of Oahu.

Using 1990 and 2000 Census data, OMPO identified environmental justice populations based on income and racial groups as defined by FHWA. OMPO also established seven performance measures to ascertain the effects of RTP and TIP projects on environmental justice and non-environmental justice populations. OMPO used the performance measures to evaluate the impacts of the following iterations of the RTP and TIP, including four amendments to the FYs 2002-2004 TIP:

- 2025 RTP
- FYs 2000-2002 TIP
- FYs 2002-2004 TIP
- FYs 2004-2006 TIP

As a result of the these analyses, OMPO found that two of its seven performance measures could be refined and that the areas defined as environmental justice could be updated to include 2000 US Census data. In addition, in conducting the various analyses, OMPO recognized that some of the environmental justice areas were defined as such because of the large concentration of Asian populations on Oahu.

Evolving Requirements of HDOT Subrecipients

Between 2000 and 2004, the Hawaii DOT Title VI Plan has also evolved, providing more direction for its sub-recipients[2] to follow. The 2004 HDOT Title VI Plan required that its sub-recipients collect, maintain, analyze, and use data for an expanded list of racial categories.

Recognizing that about 75% of its population is comprised of the federally-defined minority populations, the Hawaii DOT expanded two of the five racial categories to include Hawaiian/Part Hawaiian, Samoan, Japanese, Chinese, Filipino, Korean, Vietnamese, Other. The remaining three racial categories (African American, Hispanic, American Indian/Alaska Native) were kept as is, as part of the HDOT policy for which data must be sought.

Wanting to comply with the HDOT's requirements as well as updating its database, OMPO began a 6-month effort to update its geographic information systems analysis tool (GISAT) to include the HDOT requirements as well as to refine its performance measures. Because

[2] OMPO is one of a number of HDOT subrecipients.

of the high proportion of minority races on Oahu, OMPO sought to evaluate how other areas, both those with and without similar characteristics identified minority and low-income populations.

Other Areas

Significant progress has been made by DOTs and MPOs in meeting environmental justice requirements and reporting impacts of RTPs, TIPs, and individual projects on designated environmental justice populations. Many MPOs have posted on the Internet reports documenting their environmental justice processes, six of which were reviewed by OMPO:

- Metropolitan Transportation Commission (MTC)
- Mid-Ohio Regional Planning Commission (MORPC)
- Ohio Kentucky Indiana Council of Governments (OKI)
- Puget Sound Regional Council (PSRC)
- Southern California Association of Governments (SCAG)
- Wilmington Area Planning Council (WILMAPCO)

In reviewing these reports, OMPO determined that four of the six areas (e.g., MORPC, OKI, PSRC, WILMAPCO) use the average of the minority and/or low-income population and establishes this average as its threshold ("average minority threshold"). Geographic areas (e.g., TAZs or block groups) that are strictly greater than or equal to the threshold are then considered what OMPO calls "environmental justice areas". While effective and meaningful for regions whose population is comprised of a comparatively low percentage minority population, early indications from such a methodology yielded more than half of Oahu as environmental justice areas.

The experience of the other two areas, San Francisco (MTC) and Southern California (SCAG) are more meaningful to Oahu, in that their population is "majority minority" i.e., more than 50% of the area population is non-White. These two areas deviated from the "average minority threshold" methodology in two ways: (1) SCAG analyzed the minority groups individually, to avoid having the "majority minority" dominate the environmental justice identification process; and (2) MTC established a threshold of 70%, which is higher than its regional average.

Evolvement and Selection of OMPO EJ Thresholds

Recognizing that anyone can file an environmental justice complaint regardless of race or income, OMPO sought to develop a systematic and comprehensive methodology that would be valid for all racially diverse areas – Oahu as well as an increasing number of regions on the US mainland.

The OMPO process considers the nature and status of minorities in a region: (1) its numerical minority status; (2) its share of the region's aggregate household income compared against its share of the region's total households; and (3) its settlement pattern compared to all other groups. The result from this exercise concludes that (1) the federal definition of minority is valid for Oahu; (2) the unique characteristics of Asians must be taken into account; and (3) because of widely different settlement characteristics and the large percentage of Asians, minority groups should not be evaluated collectively.

Rather than relying on arbitrarily-set thresholds as the basis of identifying environmental justice populations, OMPO analyzed the underlying settlement characteristics of each of the minority races on Oahu. This yielded an understanding of the normal variation of each race among the block groups, which are not uniform in size. This, in turn, allowed the truly disproportionate concentration of the races to be found.

OMPO also placed great importance on local knowledge. That is, there is wealth of information locally, as to the location of truly disadvantaged areas. The methodology that OMPO uses must be consistent with that knowledge. It was found that this condition could be met when the disproportionality was defined as one-standard deviation from the mean of the area of concentration. Using this method resulted in 70 out of 435 block groups selected based on the federally-defined minority groups, and 17 block groups selected based on income. Of the 17 low-income block groups, nine were also selected as a result of the minority analysis. Therefore, a total of 78 block groups are considered environmental justice areas.

The process OMPO has developed for defining environmental justice areas is built on the experience of other areas in the U.S. and is transferable to DOTs and MPOs throughout the U.S. It is particularly appropriate for racially diverse areas whose population is a majority minority. It is described in depth in this report, resulting in about 18% of Oahu block groups being considered environmental justice areas. Finally, for future analyses of its RTPs and TIPs, OMPO will be using this methodology to make a determination about its compliance with Title VI and environmental justice regulations.

2. INCORPORATING 2000 CENSUS DATA

The objective of this analysis is to identify, in a systematic way, the areas on Oahu that have a disproportionate concentration of minority and/or low-income populations. The analysis was carried out based on data from the 2000 Census. In order to accurately describe the methodology used and the results obtained, it is necessary to first establish the meaning of the key terms used in the analysis.

Definition of Terms

This assessment of environmental justice pertains to the island of Oahu which, together with the Northwest Hawaiian Islands, comprises the City and County of Honolulu. Census data for the City and County of Honolulu is presented geographically as "Honolulu County". Data for Oahu is therefore obtained from the Census by taking data for Honolulu County and then excluding data for the Northwest Hawaiian Islands (Census Tract 114.98). With this understanding, the terms **Oahu** and **Honolulu** are used interchangeably in this analysis.

Because the 2000 Census allows, for the first time, respondents to choose more than one race, race data is generally summarized in two ways. When the respondents choose one race, they are identified as "Race Alone" population. The result is sometimes referred to as the "minimum" population of the race, because it gives the minimum number of people that can be associated with the race. When multiple races are selected, the respondents are counted under "Race Alone or in Combination with One or More Other Races". For similar reasons, the result is sometimes referred to as the "maximum" population, because it is inclusive of all who indicated some affiliation with the race. In this analysis, these terms "**minimum population**" and "**maximum population**" are used to refer, respectively, to the "race alone" and "race alone or in combination" population.

It should be noted that, whenever minimum population data is presented, it is always accompanied by a category called "Two or More Races", so that together they add up to 100% of the population. Note also that categories of maximum population add up to greater than the total population because they are based on tallies of races chosen by the respondents, resulting in one person being counted in multiple categories. Despite this inconvenience, maximum population is the preferred option to use when analyzing the characteristics of specific races, because minimum population involves the nonspecific "Two or More Races" category which cannot be analyzed in a meaningful way.

Depending on the geographic specificity, race data is summarized in the Census either in terms of six broad racial groups or up to 132 detailed races. The six **racial groups** are:

1. White
2. Black or African American
3. American Indian and Alaska Native
4. Asian
5. Native Hawaiian and Other Pacific Islander
6. Some Other Race

Detailed races include Chinese, Japanese, Filipino, Korean, Vietnamese, Native Hawaiian, Samoan, etc.

Another dimension of race in Census usage is **ethnicity**, which refers to whether a person is of Hispanic or Latino origin. Ethnicity is not a race because a person of Hispanic or Latino origin can be of any race. In this analysis, ethnicity and race are often presented together as mutually exclusive and collectively exhaustive categories. In this case, the race categories are understood to refer to persons who are not Hispanic or Latino, so ethnicity can be thought of as a race category. Therefore, to simplify the terminology and discussion, unless there is specific reason to distinguish race from ethnicity, the term "race' is used to refer to both.

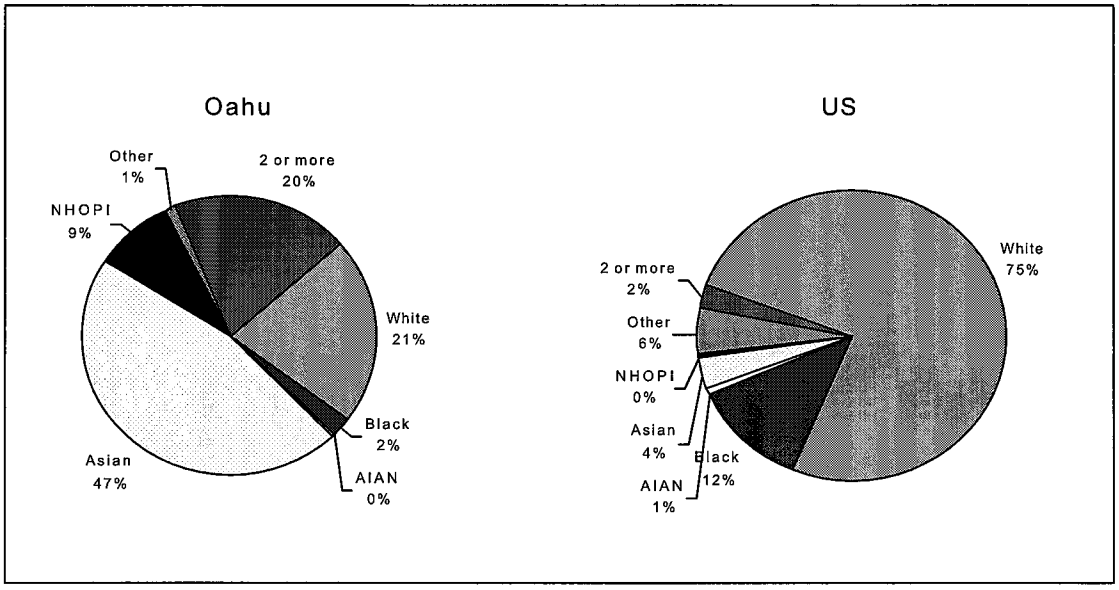
Finally, the official names for the various Census categories are often long and repetitious, making discussions long-winded and expositions boring. To avoid this, this document uses the following shorthand:

Official Name	Shorthand
White	White
Black or African American	Black
American Indian and Alaska Native	AIAN
Asian	Asian
Native Hawaiian and Other Pacific Islander	NHOPI
Some Other Race	Other
Hispanic or Latino	Hispanic

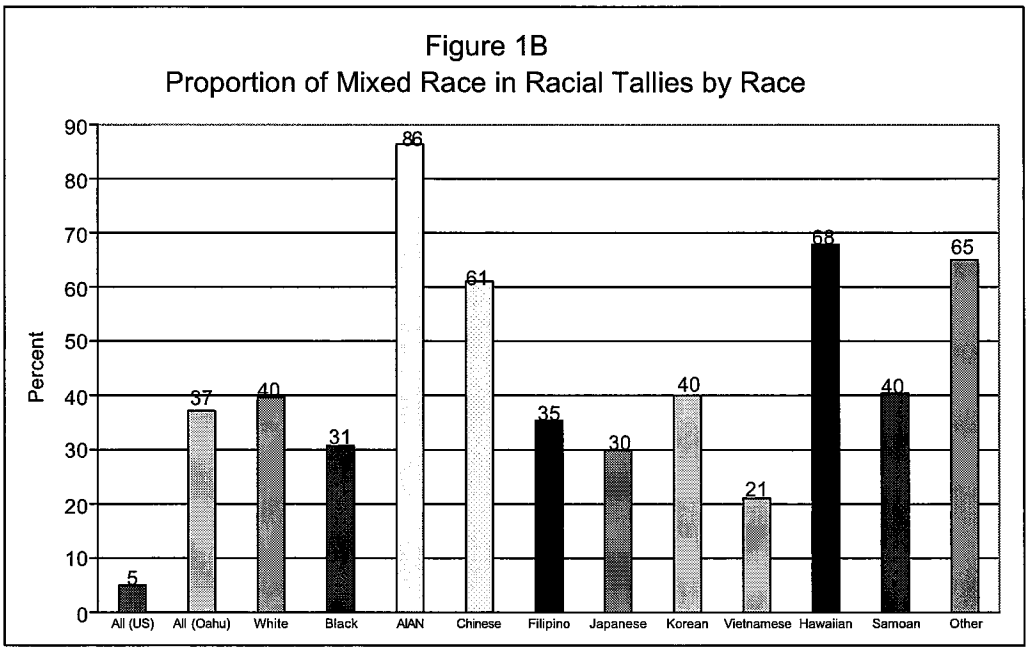
3. RACIAL DIVERSITY OF OAHU

The racial composition of the population on Oahu differs greatly from that of the US as a whole. Figure 1A summarizes the percent distribution of the minimum population (regardless of Hispanic origin) on Oahu as compared to that of the US:

Figure 1A
Comparison of Oahu and US Racial Composition
(Percent of Total Population)



Source: 2000 US Census



Source: 2000 US Census

Whites represent a clear majority in the US, accounting for over 75% of the population. In contrast, no racial group on Oahu can claim even half the population. The largest racial group on Oahu is Asian, with 46% of the island's population, followed by White with a little over 21%.

Another significant difference, and a telling measure of the diversity that characterizes the racial make-up of Oahu, lies in the proportion of the population reporting two or more races. Close to 20% reported multiple races on Oahu, while only 2.4% did so in the US. The extent of the mixing of the races on Oahu is further illustrated in Figure 1B. By comparing the minimum population with the maximum population, the percentage of mixed race in the total racial tallies was found for the US and Oahu, as well as for the individual races on Oahu. Figure 1B shows that only 5% of the races tallied in the US are mixed, while on Oahu it is 37%. Furthermore, Figure 1B shows that the high mixed race proportion applies to all races on Oahu. The highest proportion is 86% for AIAN; however, AIAN represents only 0.2% of the island's population. For the major races on Oahu, the mixed race proportions range from 21% for Vietnamese to 68% for Native Hawaiian.

These observations indicate that conclusions and methodologies applicable to the US mainland may not be appropriate or correct for Oahu. Accordingly, a unique environmental justice analysis methodology was developed and applied to better reflect the racial realities on Oahu.

4. FHWA DEFINITION OF ENVIRONMENTAL JUSTICE GROUPS

This assessment of environmental justice is based on the guidelines and definitions promulgated by the Federal Highway Administration (FHWA). FHWA defines "minority" as consisting of the following groups:

1. Black
2. AIAN
3. Asian
4. NHOPI
5. Hispanic

FHWA further defines "low-income" population as persons who live in a household whose "income is at or below the Department of Health and Human Services (DHHS) poverty guidelines". DHHS provides annual updates of the poverty guidelines that are used by the Census Bureau to calculate poverty. Table 1 provides the DHHS poverty guidelines for 1999. Note that during the 2000 Census, respondents were asked questions based on their income in the previous year, 1999.

Table 1
DHHS 1999 Poverty Guidelines

Size of Family Unit	48 Contiguous States and D.C.	Alaska	Hawaii
1	$ 8,240	$10,320	$9,490
2	11,060	13,840	12,730
3	13,880	17,360	15,970
4	16,700	20,880	19,210
5	19,520	24,400	22,450
6	22,340	27,920	25,690
7	25,160	31,440	28,930
8	27,980	34,960	32,170
For each additional person, add:			
	2,820	3,520	3,240

Source: http://aspe.hhs.gov/poverty/99poverty.htm

NOTE: Hawaii and Alaska have had separate tabulations from the contiguous 48 states since 1966. The Office of Economic Opportunity administrative practice for these two states recognized the cost of living is believed to be significantly higher than in the other states. A factor of 1.25 for Alaska and 1.15 for Hawaii is applied to the 'family of four' guideline for the 48 contiguous states; the result is then rounded to the nearest $10. These scaling factors are applied to the average difference for the 48 states to obtain average differences for the other family unit sizes.

Possible Basis for Minority Definition

The FHWA definition of minority reflects the national experience. It is instructive to point out some of the considerations that might have been used to arrive at this definition and to explore how these considerations might be relevant to Oahu.

When a race in a certain region or locale is identified as a "minority", it generally implies, at least in the environmental justice context as opposed to the broader sociological context, that the race meets one or more of the following conditions:

1. The race is a numerical minority, meaning that its share of the region's population is below 50%. Typically, there is also another race in the same region that is a numerical majority, generally defined as having a population share of greater than 50%.

2. The race's share of the region's aggregate household income is less than its share of the region's total households. For example, if 11.8% of the total number of households in the US is of a certain race, but that race only accounts for 8.3% of the aggregate household income in the US, then there is some basis for defining that race as a minority. This is, in fact, the case for Blacks.

3. The race's settlement pattern is distinctly different from the combined pattern of that of the rest of the population in the region. This is the case when immigrant groups congregate in enclaves such as Chinatown for reasons of familiarity and mutual support. Note also that when Condition 1 is true, this condition is also true and, therefore, need not be considered. But for racially diverse regions such as Oahu where there is no clear majority race, this condition will become important.

With respect to the Condition 1, Figure 1 clearly shows that, nationally, Whites constitute a numerical majority and, therefore, all other races are minorities. Oahu also meets this condition, although there is no clear majority race.

Condition 2 is illustrated in Figures 2A and 2B. They compare the number and the income of households for the six broad racial groups and independently for Hispanic origin. Based on maximum population data, two measures were obtained for the households belonging to each of these groups: 1) the group's share of the total number of households on the island, and 2) the group's share of the aggregate income of all households. The difference between income share and household share is shown in Figures 2A and 2B, where a positive value would indicate that the group has proportionately more income than its numerical share, and a negative value the opposite. Theoretically, in a perfectly fair society, the two shares should be the same; so that, for example, a race that has 10% of the households would also have 10% of the income of all the households. That, of course, is not the case in reality. Figures 2A and 2B show the reality in the US and Oahu, respectively. It can be seen that, for both the US and Oahu, all the FHWA environmental justice groups other than Asian, have income shares below their numerical shares, as required by Condition 2.

Figure 2A
Percent of Total Income in Excess of Percent of Total Households in the US

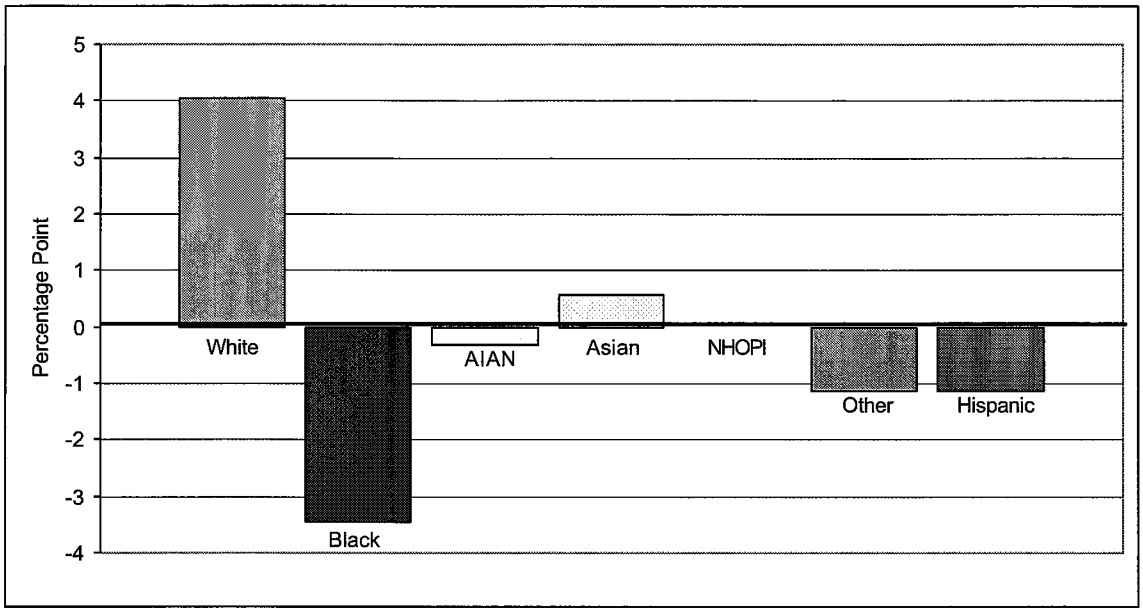
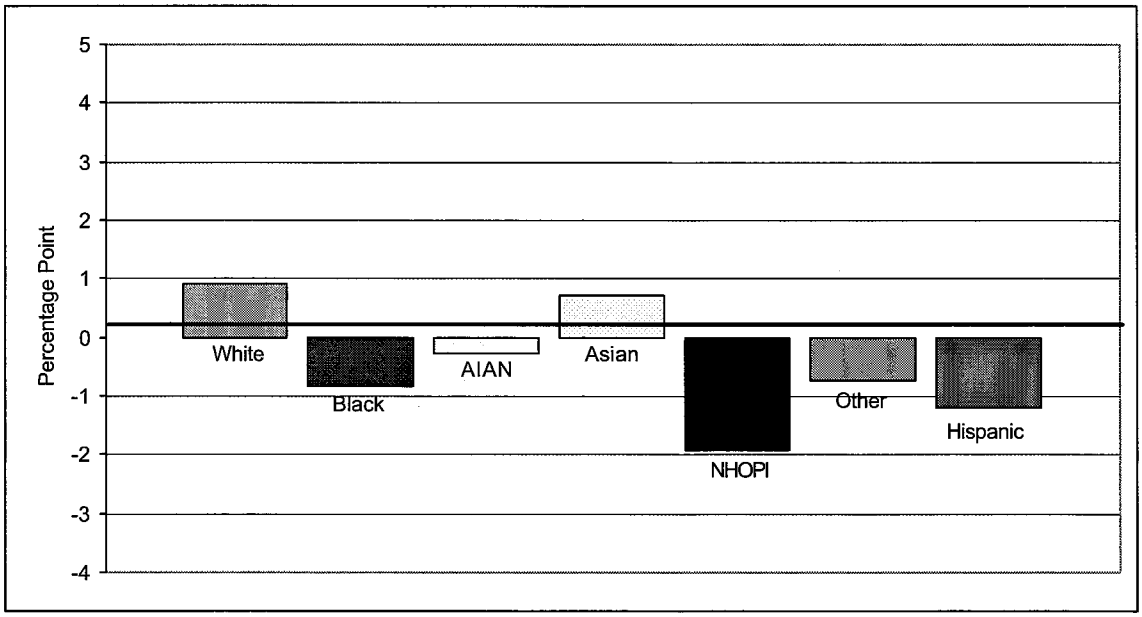


Figure 2B
Percent of Total Income in Excess of Percent of Total Households on Oahu



Source: 2000 US Census SF4
NOTES:
1. Race refers to race alone or in combination, regardless of Hispanic origin
2. Hispanic refers to Hispanic or Latino origin, regardless of race
3. AIAN = American Indian and Alaska Native
4. NHOPI = Native Hawaiian and Other Pacific Islander

Although Condition 2, with the exception noted above, apply to both the US and Oahu, there are clear differences. Nationally, the dominance of Whites stands out. The extent to which the income of White households exceeds their numbers dwarfs that of Asians – the only other group nationally with a positive income share relative to their number. Furthermore, the difference between White and Black is particularly conspicuous at the national level. Such disparities are not present on Oahu. As Figure 2B shows, the share difference of nearly all the groups, including Whites, clusters at about 1%. The only exception is NHOPI, whose household income share is shy of their numerical share by close to 2 percentage points. This condition is not unexpected, given the well-documented plight of native Hawaiians.

The clear majority of Whites implies that Condition 3 is automatically satisfied nationally. On Oahu, however, this cannot be assumed because the population is so diverse. On the contrary, the diversity requires that the settlement pattern of each of the environmental justice groups be individually analyzed so that a valid method can be developed to identify their location on the island.

5. SETTLEMENT PATTERN OF MINORITY GROUPS ON OAHU

In displaying settlement patterns, it is important to recognize that population (or household) data is almost always summarized by geographic units. For Census data, the most useful units are, in order of increasing specificity: tracts, block groups, and blocks. These units are not uniform in size. For example, the blocks are very small in dense urban areas such as Downtown Honolulu, Makiki, McCully-Moiliili, etc; they increase in size as they extend to the outlying rural areas.

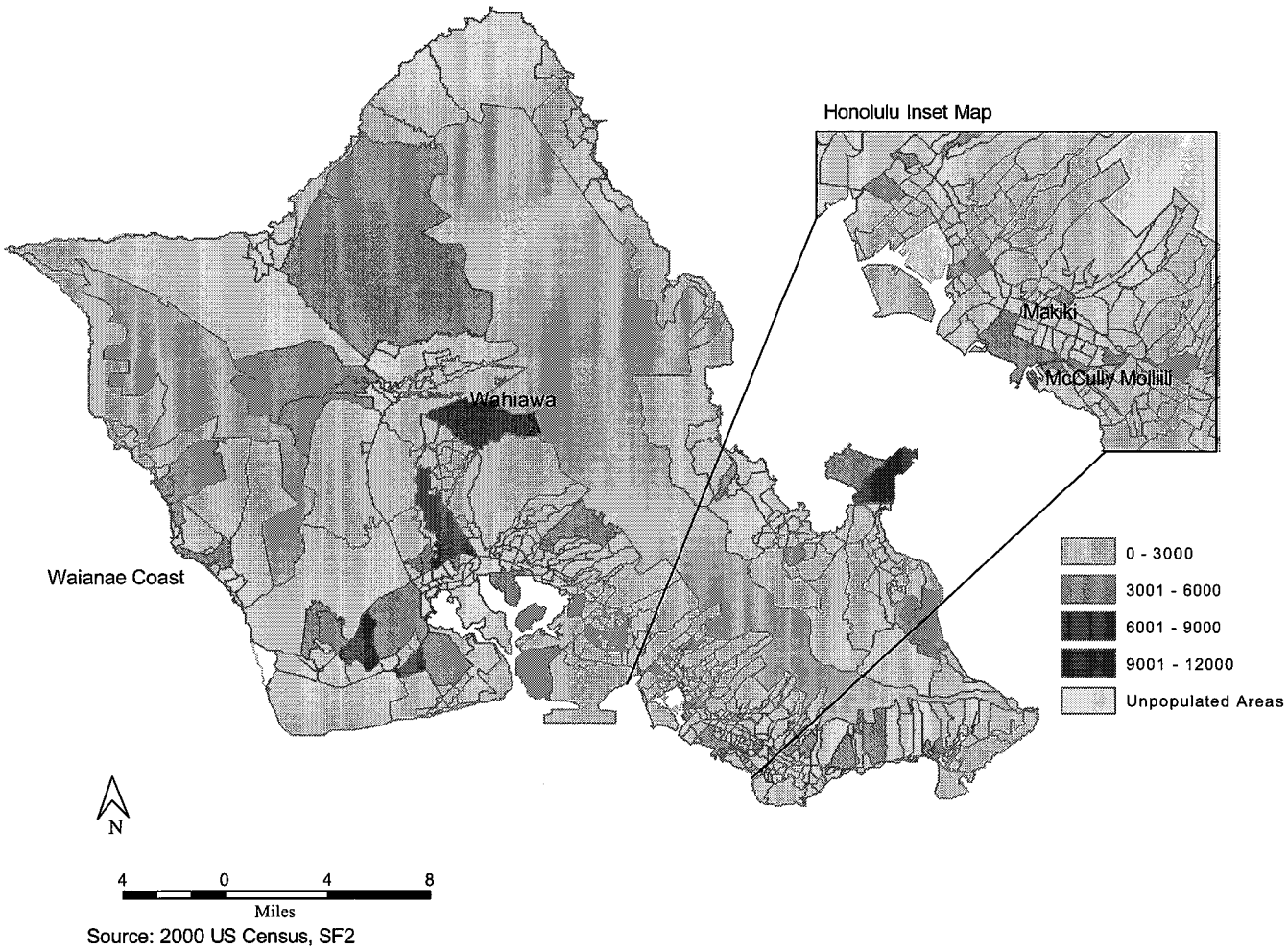
The most common way to display population settlement is to classify each geographic unit according to some population scale and then map the units with a color code that reflects the population density. Such a map of the population on Oahu by block group is shown in Figure 3. A key disadvantage of this type of map is that variations in the size of geographic units can easily lead to false impressions of population density. A typical case is a large block with a large population concentrated in a small part of the block. For example, Figure 3 could mistakenly convey the impression that the East Range area near the center of the island, by Wahiawa is a major population center because the area is large and it has a dark color. That would be a wrong conclusion because the bulk of East Range is unpopulated land used largely for military exercises, with population concentrated in the area near the H-2 Freeway.

An alternative and more realistic way of mapping population distribution is to place, within each geographic unit, a quantity of dots in proportion to its population count. Figure 4A shows the resulting dot density map for the population of Oahu by block group. Plotted with one dot equaling 100 people, the map is locationally accurate between block groups (although not within block groups, because the dots are randomly placed). The map is also accurate with respect to density, because density is indicated directly by the number of dots placed within the geographic unit. For these reasons, this analysis relied on these dot density maps to display the settlement pattern of the population.

Index of Disproportionate Settlement

Although the dot density map correctly displays the location and density of the population, it does not lend itself to the quantitative analysis of the distribution. In particular, the maps cannot directly measure how the distribution of one race compares with that of another. In other words, comparing one dot density map with another cannot easily convey the salient difference between the two distributions. The ability to measure the difference between distributions is important because this analysis must deal with the differences between the settlement patterns associated with the various environmental justice groups.

Figure 3
Population Distribution of Oahu by Block Group

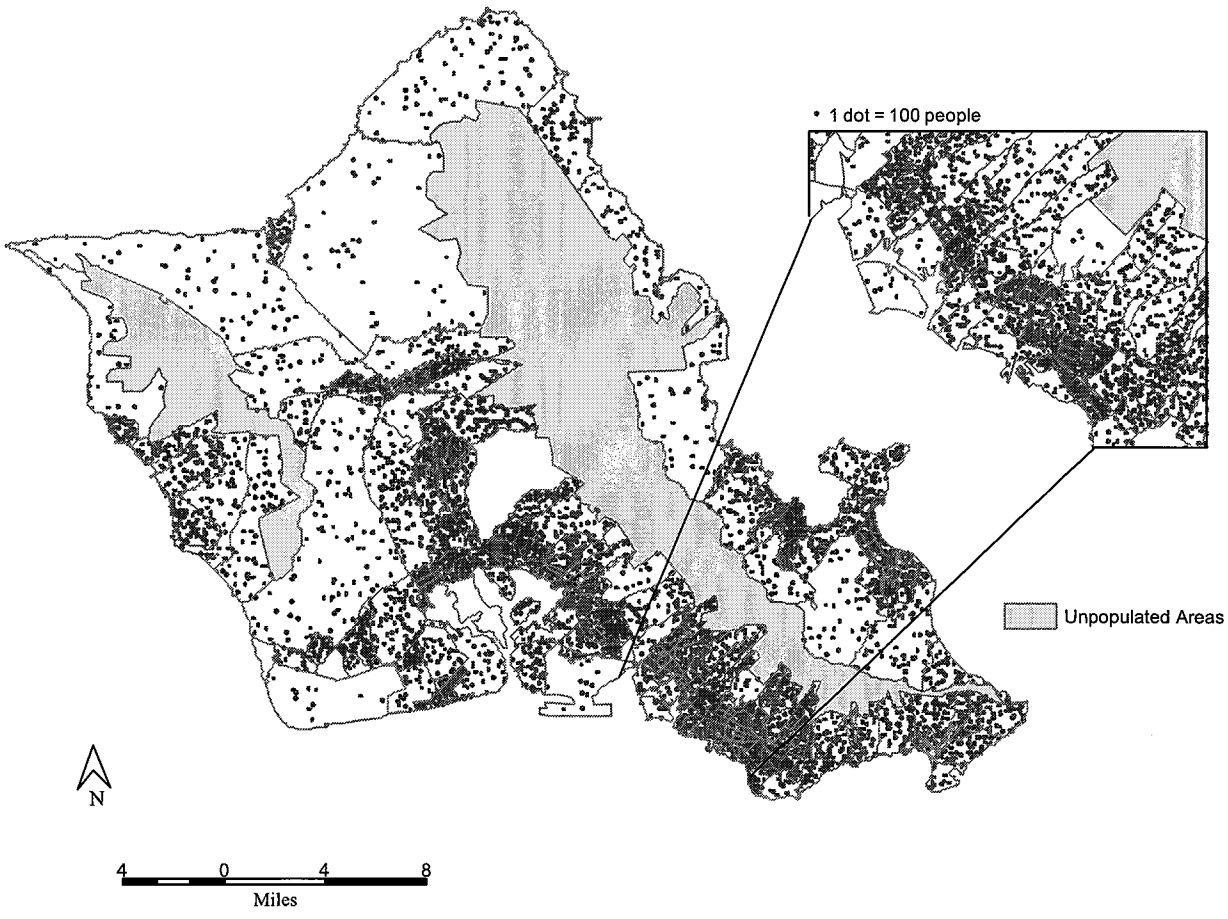


Source: 2000 US Census, SF2

To enable the settlement patterns to be compared, it is necessary to sort the underlying geographic units in some standard order and then express the distribution cumulatively so that different distributions can be compared on a common basis. For a given population distribution, this can be achieved by constructing a curve as follows:

1. Sort the geographic units in ascending order based on population;
2. Calculate the cumulative share of the population accounted for by the geographic units;
3. Express the number of geographic units involved as a percent of the total number of units; and
4. Plot the cumulative population share on the vertical axis against the cumulative share of geographic units on the horizontal axis.

Figure 4A
Dot Density Map of Block Group Population on Oahu

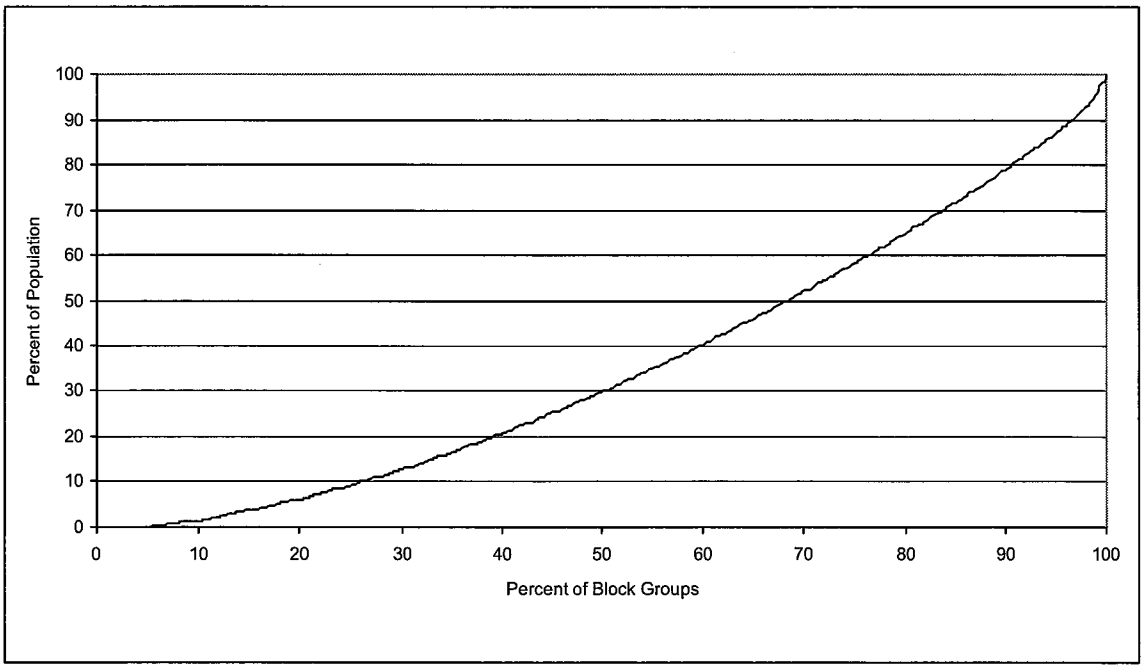


Source: 2000 US Census SF2

Figure 4B shows the resultant curve for the population distribution shown in Figure 4A. Block groups were used for reasons of data availability. The curve is referred to as the Characteristic Curve of the Block Group Population on Oahu (and is analogous to the Lorenz curve used in economic analysis to measure income inequities).

The curvature of the line reflects the fact that the block groups do not have the same population. If the block groups were the same in this respect, the line would be a straight line through the origin with a slope of one. Because they are not equal, Figure 4B shows, for example, that 20% of the block groups on Oahu accounts for 5% of the island's population; while half the block groups account for only about 30%. In general, the closer a curve is to the diagonal line, the more equal the block groups are with respect to population. Note that this means the characteristic curve of a population is always below the diagonal line.

Figure 4B
Characteristic Curve of Block Group Population Oahu (all races)



Source: 2000 US Census, City and County of Honolulu DPP

By standardizing the description of settlement patterns by means of these characteristic curves, different races can be compared on a common basis. It is important to note that the characteristic of a race must pertain to all persons claiming that racial heritage. This means that race analyses must be based on maximum population. This, in turn, implies that the races cannot be compared directly with one another because of the overlapping of the races. For these reasons, the settlement pattern of the races was compared in a pair-wise way, by comparing each race with the remaining population.

This calls for plotting the characteristic curve of each race with its "opposite" curve; i.e., a curve of the cumulative population shares of the population other than the race under consideration. Note that these "opposite" curves are not characteristic curves as defined above. When compared in this way, the area difference between the two curves is a measure of the degree of difference between the two settlement patterns and, therefore, can be viewed as an index of disproportion of the settlement pattern of the minority group. The index can range from 0 to 100 – with 0 meaning the minority group is distributed in the same proportion as the rest of the population and 100 meaning the group has nothing in common with the way the rest of the population is distributed.

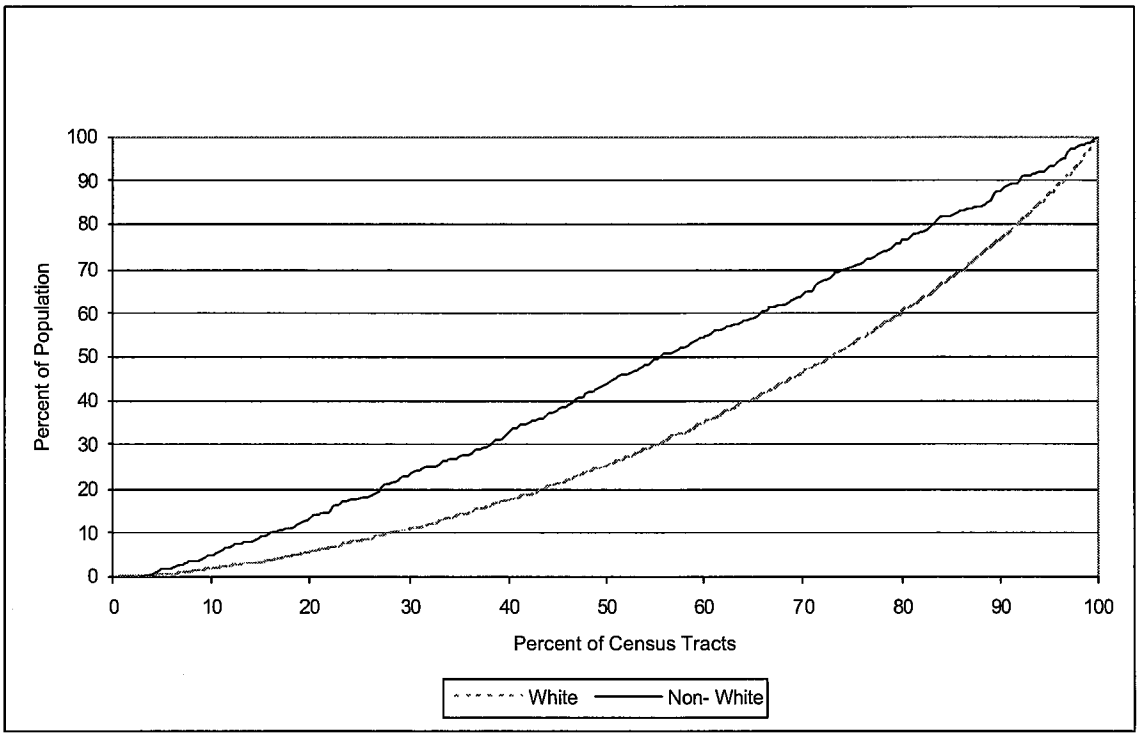
This analysis was carried out for all race categories: the FHWA minority groups, as well as Whites and a number of detailed races of local interest. The result is documented in Figures 5 through 11. Each figure consists of a dot density map depicting the settlement pattern and a graph with two curves comparing the settlement patterns of the race and its opposite. Shown below the graph is the index of disproportionate settlement for the race.

The curves were constructed using Census tracts instead of the finer block groups, as the data was obtained from Census Summary File (SF) 2. As a result, the curves are not as smooth as that shown in Figure 4B, which is based on block groups. There are also some discontinuities and flat segments on the curve because of missing data, which is common for Census data because of confidentiality thresholds. These imperfections do not detract from the essence of the message the curves convey, because the elimination of the imperfections would only improve the appearance of the curve, not its basic curvature.

Whites

Figure 5A shows the settlement curves of Whites and non-Whites. As expected, the two curves are relatively close to one another. The index of disproportionate settlement for Whites is 12.5, on a scale of 0 to100. This means there is a measurable difference between the settlement patterns of Whites and non-Whites, but the difference indicate that the patterns are relatively proportional throughout the island, as confirmed by common experience. Figure 5B shows the location of Whites on the island.

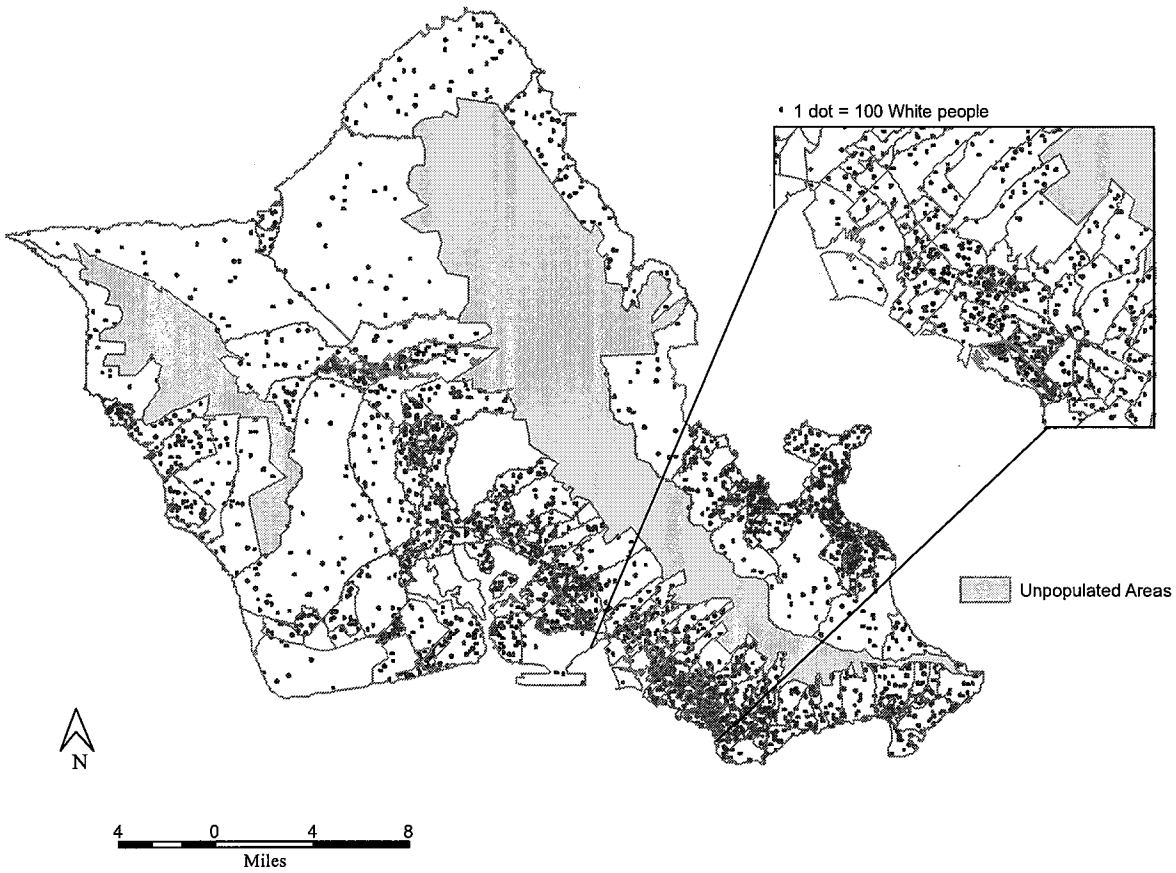
Figure 5A
Settlement Curves of White Population



Settlement Index: 12.5

Source: 2000 US Census, City and County of Honolulu DPP

Figure 5B
Distribution of White Population

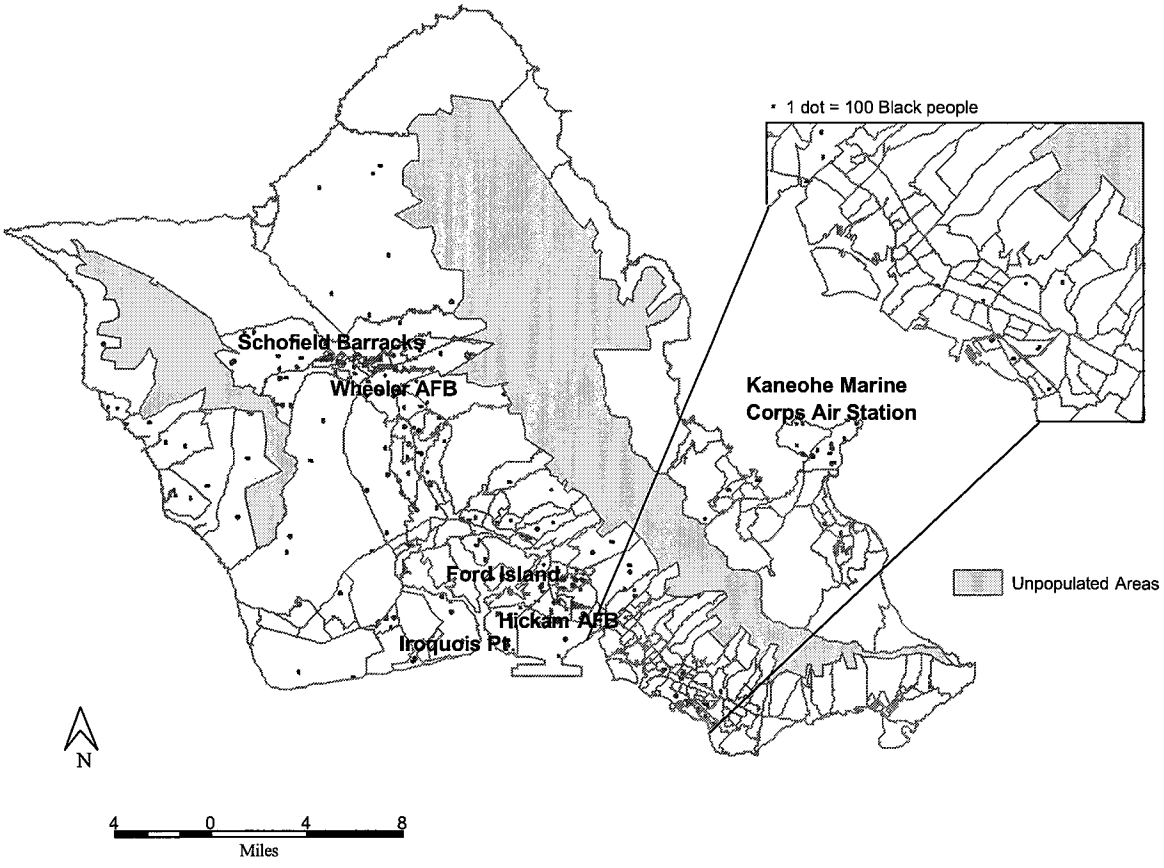


Source: 2000 US Census SF2

Black or African American

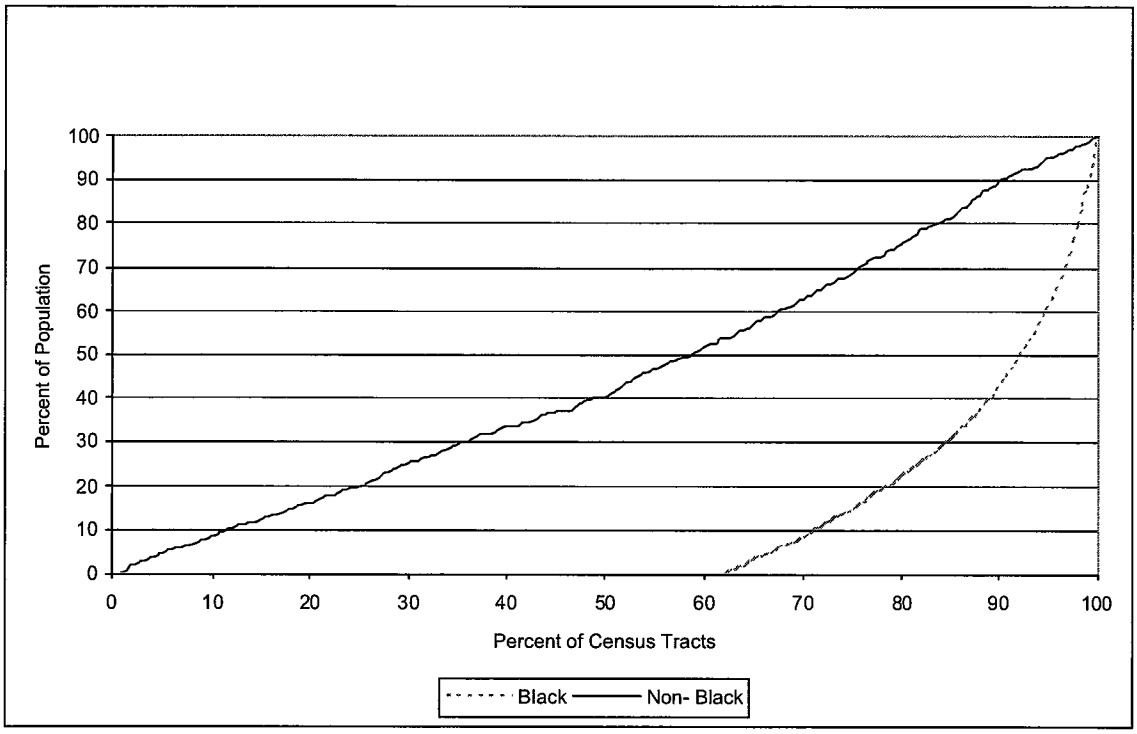
Figure 6A shows where Blacks reside on Oahu. Figure 6B shows the settlement curves for Blacks and non-Blacks. The difference between the two curves is significantly greater, compared to Whites. This indicates that Blacks on Oahu settles in a way that is very different from non-Blacks. This reflects the prevalence Blacks in and near military installations such as Kaneohe Marine Corps Base, Schofield Barracks, Wheeler Air Force Base, Pearl Harbor, Ford Island, Hickam, and Iroquois Point. The settlement index for Blacks is 34.0, as opposed to 12.5 for Whites.

Figure 6A
Distribution of Black Population



Source: 2000 US Census SF2

Figure 6B
Settlement Curves of Black Population



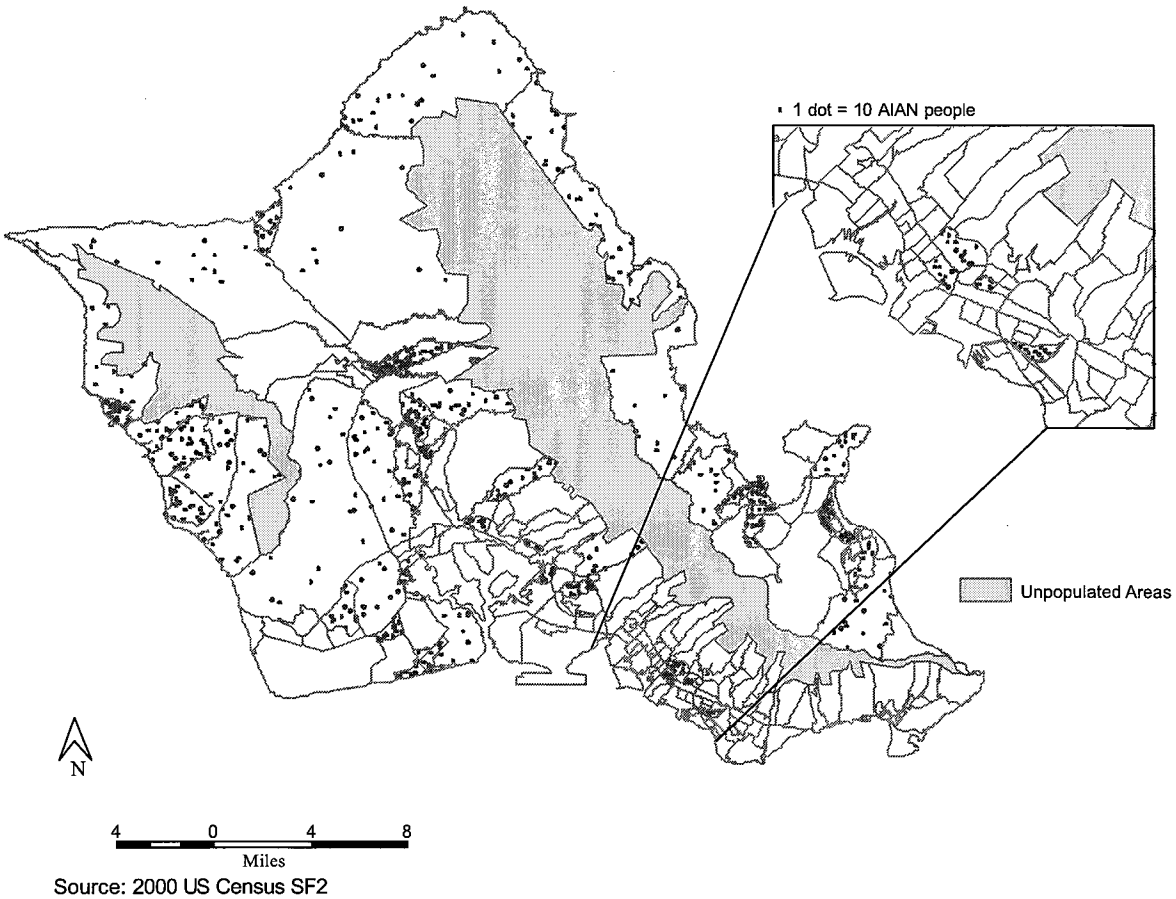
Settlement Index: 34.0

Source: 2000 US Census, City and County of Honolulu DPP

American Indian and Alaska Native (AIAN)

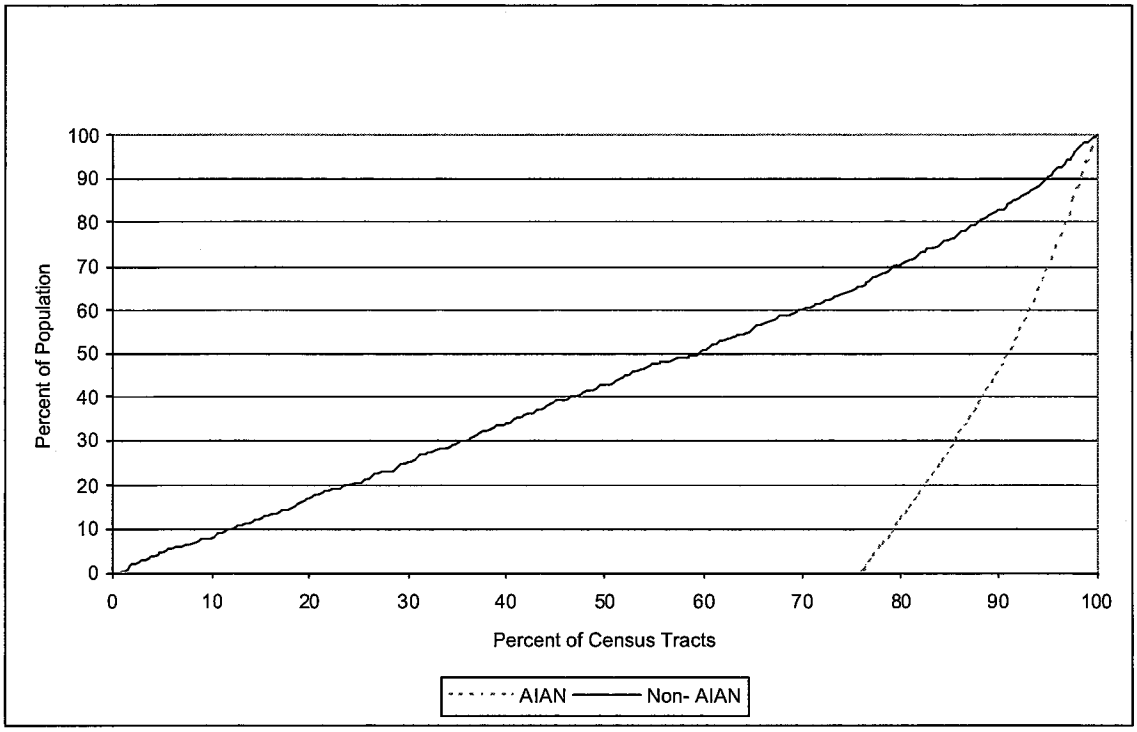
A similar analysis for AIAN finds that this minority group settles in a way that is very different from the non-AIAN population, as demonstrated by the large area difference between the two curves shown in Figure 7B. The corresponding map, shown in Figure 7A, shows the paucity of the AIAN population and their relative absence in the dense urban Honolulu area, like the Black population. They are more spread out than Blacks because of their high mixed-race rate, as shown in Figure 1B (86% as opposed to 31% for Blacks). The settlement index is 33.9, which is almost the same as that for Blacks.

Figure 7A
Distribution of American Indian and Alaska Native Population



Source: 2000 US Census SF2

Figure 7B
Settlement Curves of American Indian and Alaska Native Population



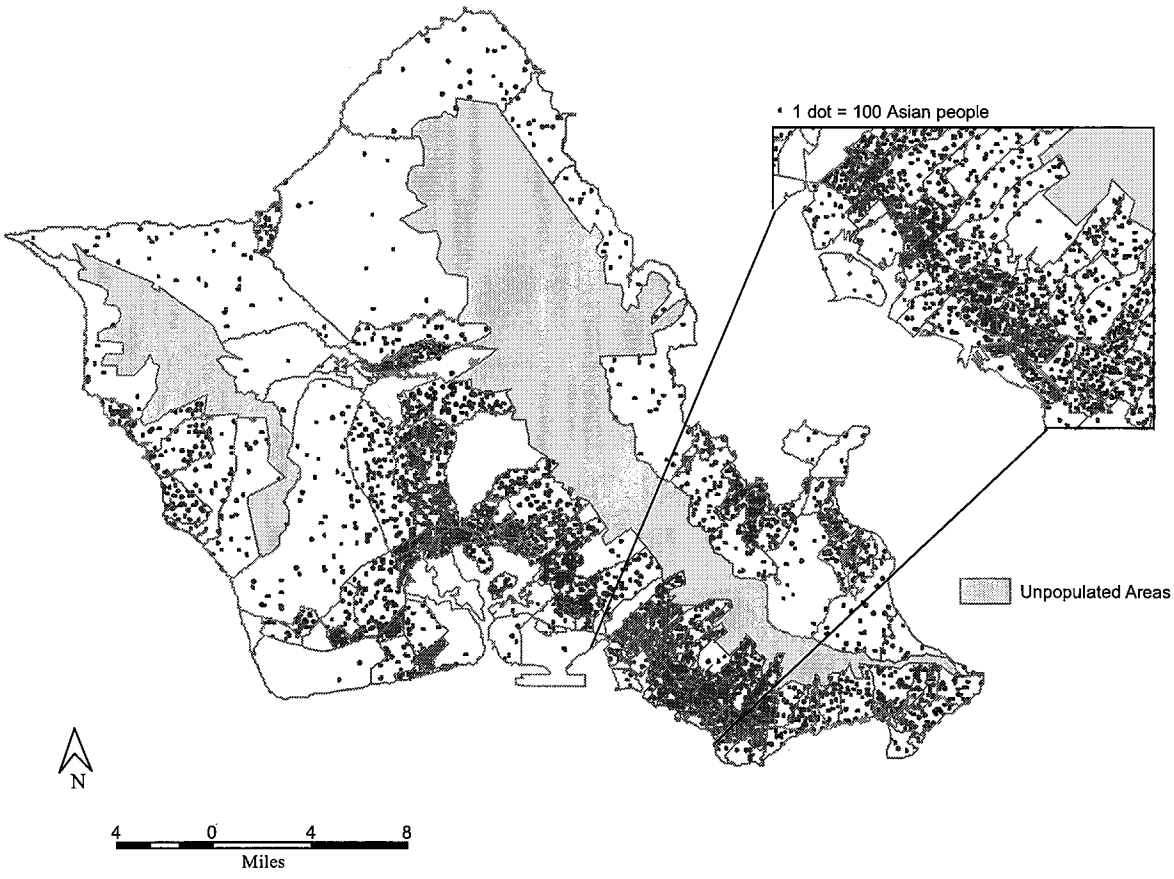
Settlement Index: 33.9

Source: 2000 US Census, City and County of Honolulu DPP

Asian

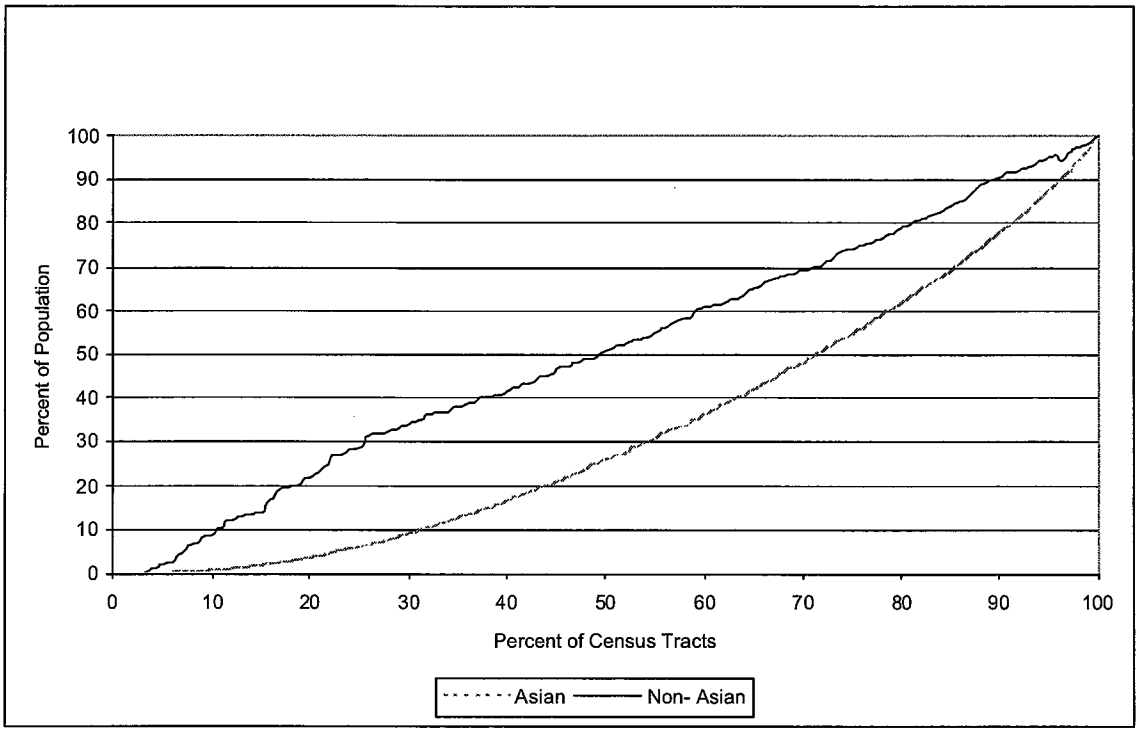
Figures 8A and 8B show the settlement pattern and curves for Asians. Like Whites, the settlement pattern of Asians tracks that of non-Asians very well, with a settlement index of 18.0, as compared to 12.5 for Whites.

Figure 8A
Distribution of Asian Population



Source: 2000 US Census SF2

Figure 8B
Settlement Curves of Asian Population



Settlement Index: 18.0

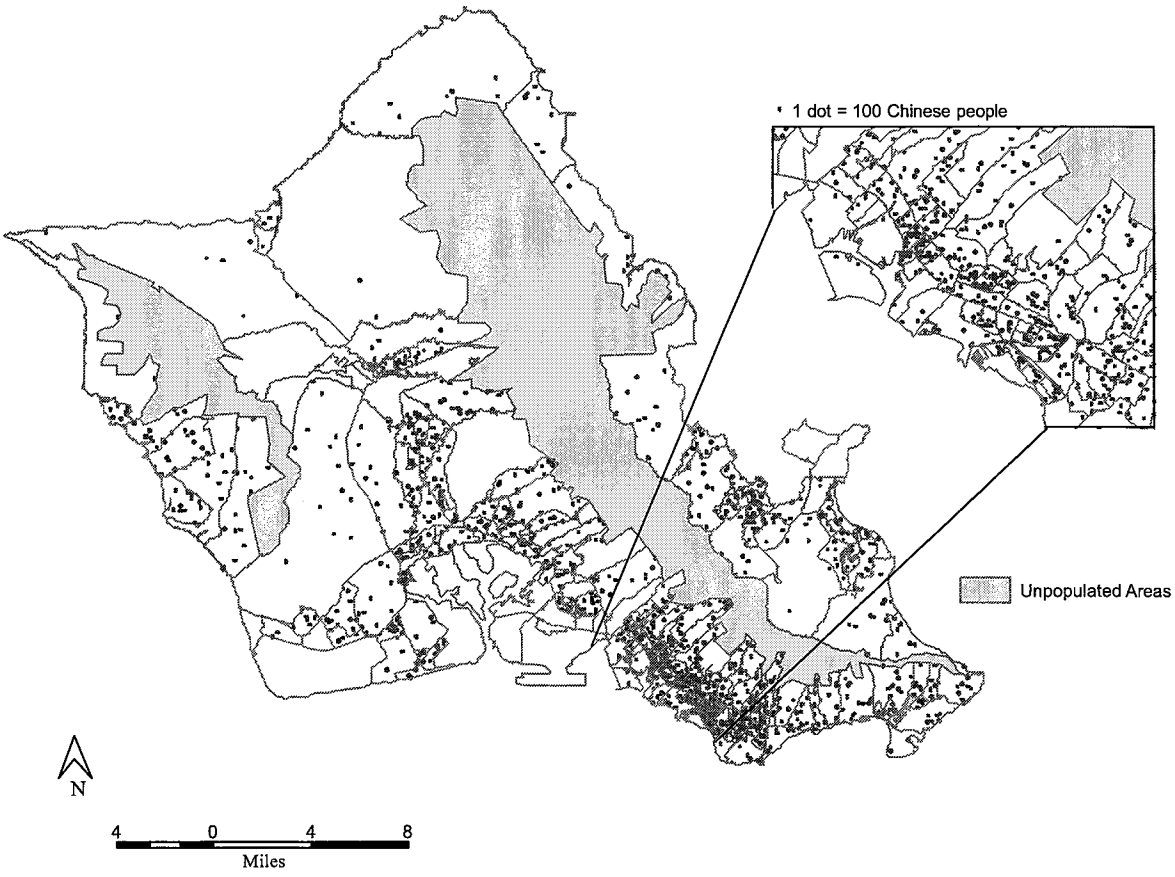
Source: 2000 US Census, City and County of Honolulu DPP

Although Asians as a group and non-Asians are very alike in their settlement pattern, further analysis is needed because of the large Asian population on Oahu. Figures 8.1 through 8.5 illustrate the settlement patterns (in part A) and settlement curves (in part B) for the following detailed races: Chinese, Japanese, Filipino, Vietnamese, and Korean. These races were selected because they are of local interest and there were sufficient data for analysis. Other smaller races such as Cambodian, Hmong, Laotian, Thai, etc. were not analyzed because data was not available.

Chinese

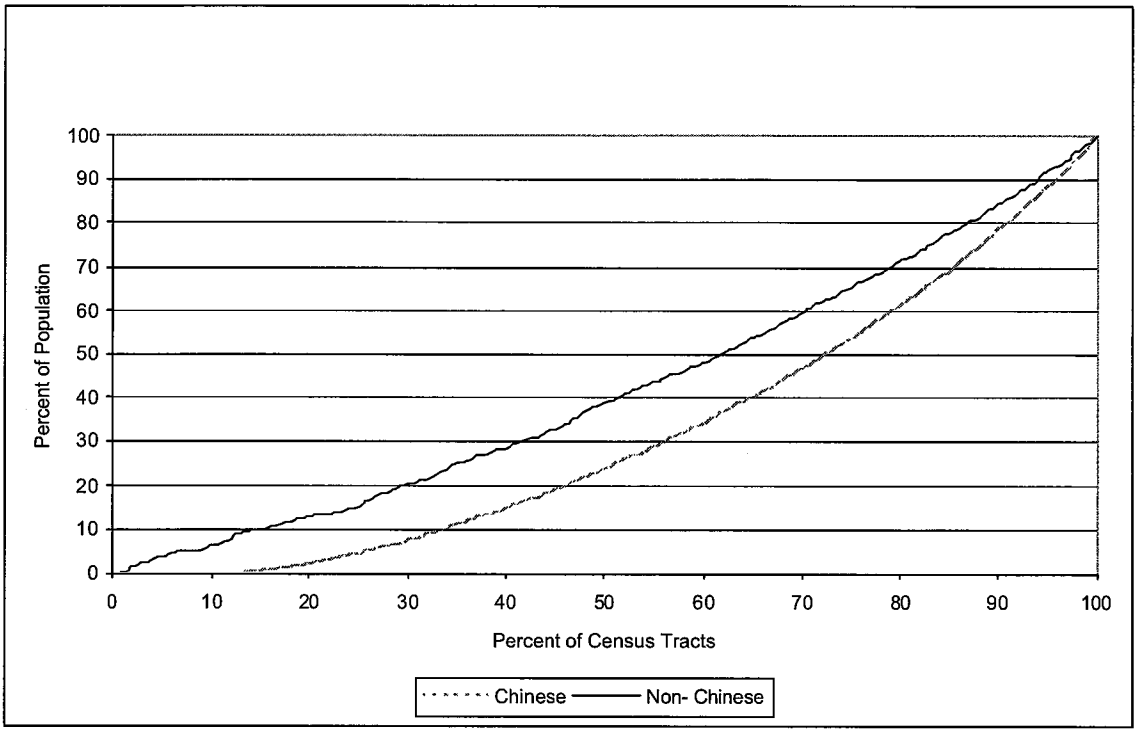
The settlement analysis for Chinese shows that they track very well with non-Chinese, as illustrated in Figures 8.1A and 8.1B. The settlement index is 10.4, which is the smallest of all the races.

Figure 8.1A
Distribution of Chinese Population



Source: 2000 US Census SF2

Figure 8.1B
Settlement Curves of Chinese Population



Settlement Index: 10.4

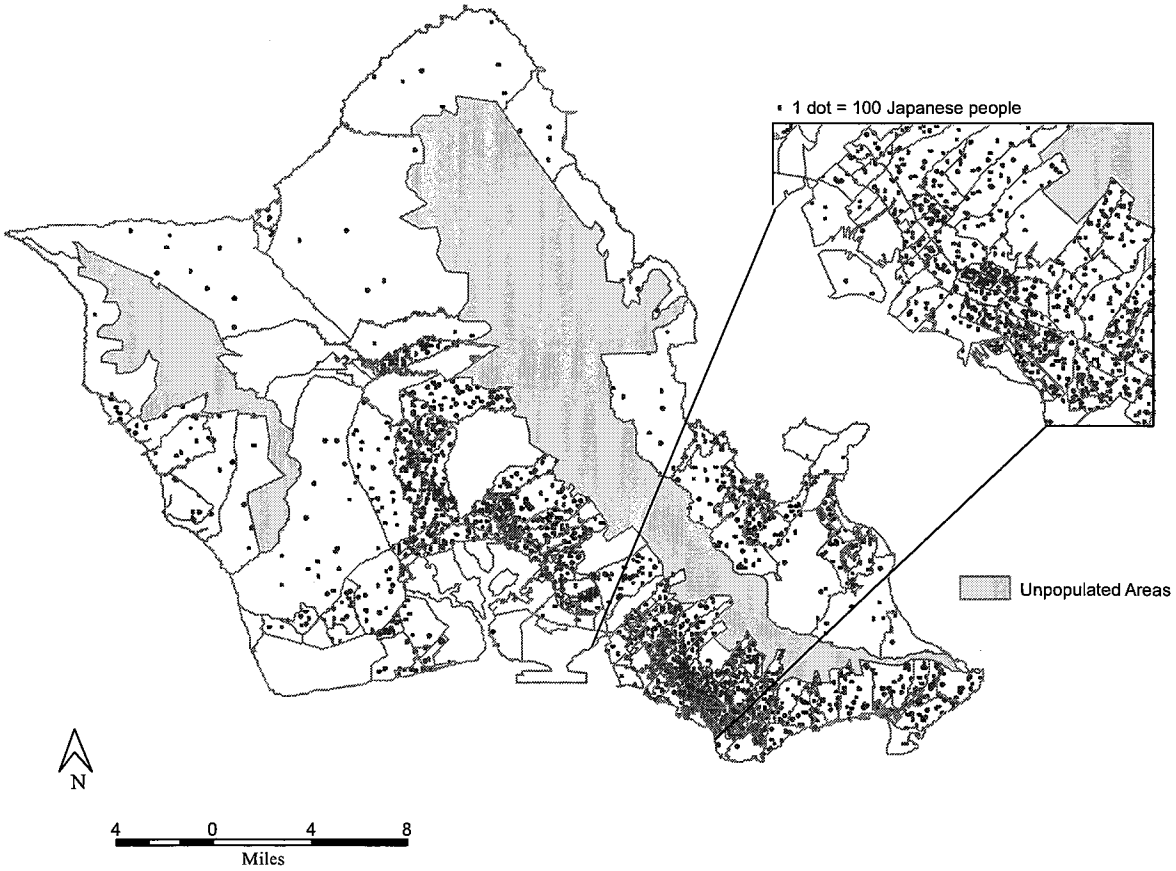
Source: 2000 US Census, City and County of Honolulu DPP

Considering that Chinese represent only about 6% of the island's population, this result requires an explanation. One possibility is that the Chinese has one of the highest mixed race rates, as measured by the mixed race proportions shown in Figure 1B. The proportion for Chinese is 61%, which is second only to the 68% for Native Hawaiians among the major races on Oahu. In contrast, the proportion for Whites is 40% and for Japanese 30%. This large mixed-race Chinese population implies a correspondingly wide range of demographic and economic characteristics, which translates to a highly varied set of locational behavior. The resultant settlement pattern is very proportional to that of non-Chinese because the diversity of the Chinese population mirrors well the range of characteristics of the general population.

Japanese

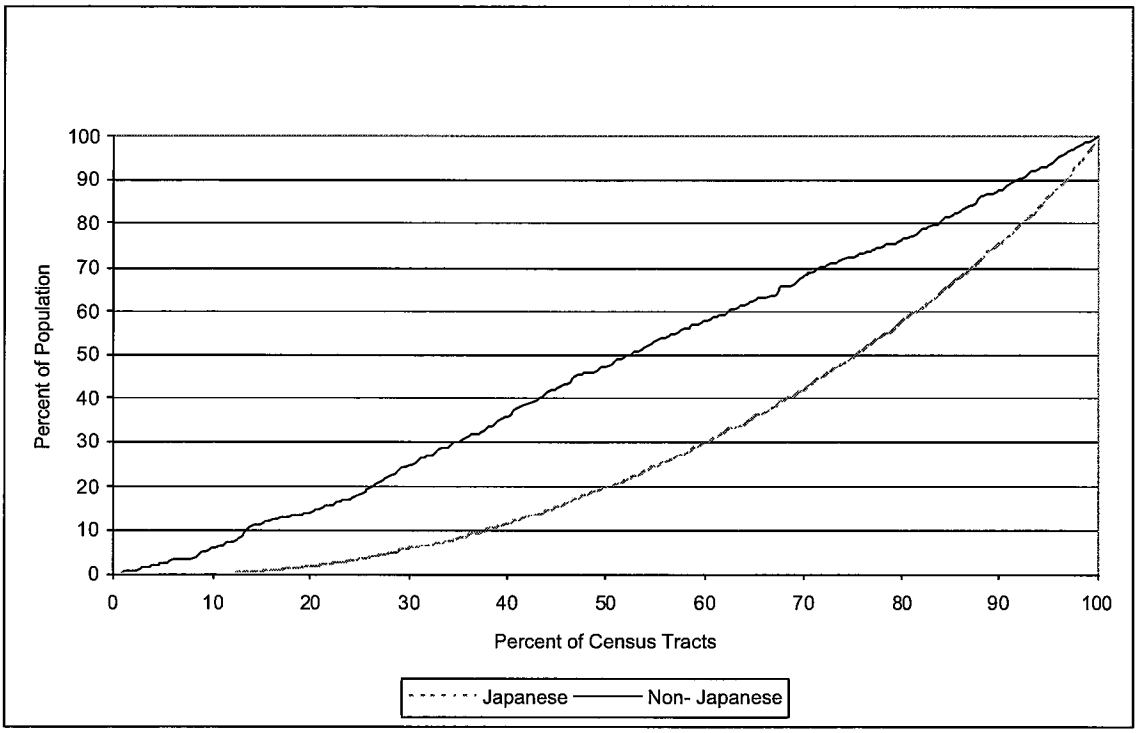
This analysis also finds that Japanese track well with non-Japanese, although not as well as the Chinese. As shown in Figure 8.2A, the Japanese are well dispersed geographically. Figure 8.2B shows the settlement index is 18.0, which equals that of Asians as a whole. This is consistent with expectation since the Japanese comprise close to 40% of the Asian population on the island. Their large population and integration into the social and economic fabric of the island help compensate for their low mixed race proportion in explaining their proportional settlement pattern.

Figure 8.2A
Distribution of Japanese Population



Source: 2000 US Census SF2

Figure 8.2B
Settlements Curve of Japanese Population



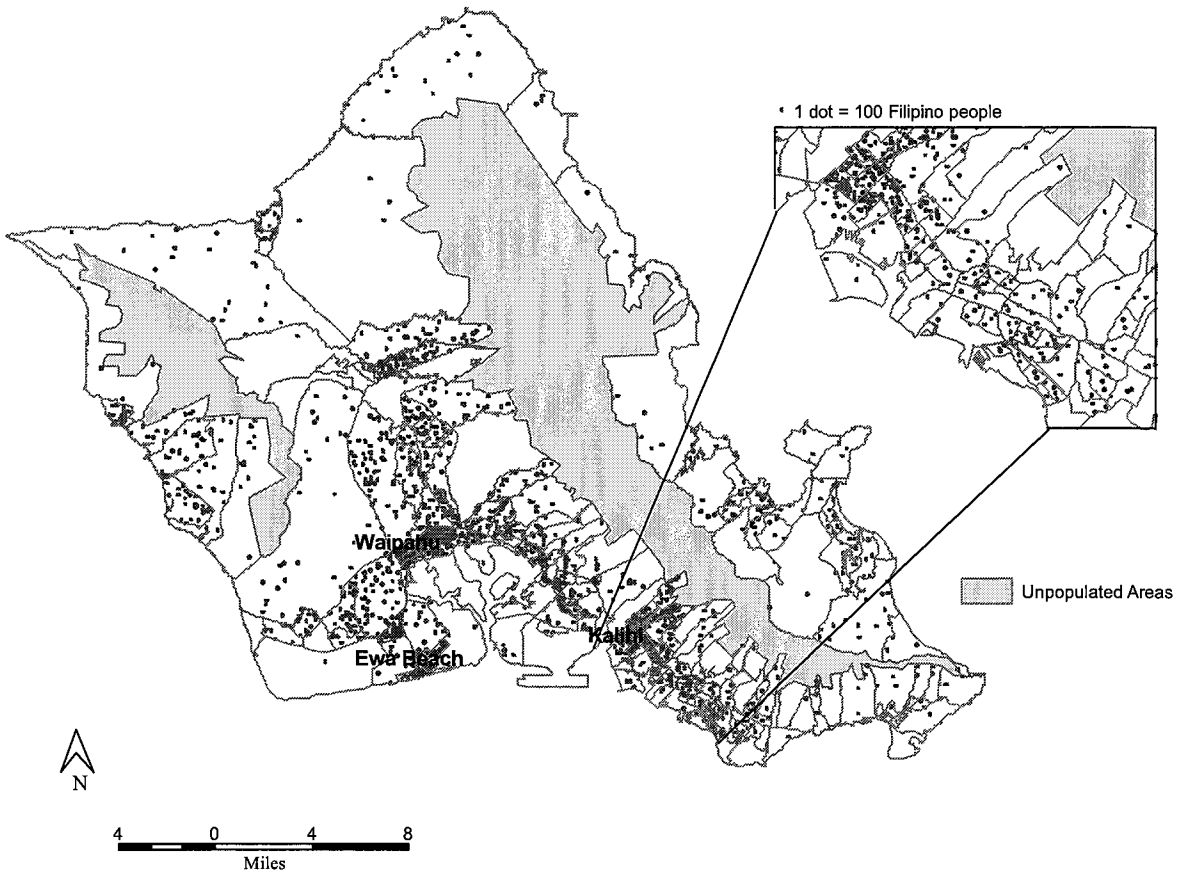
Settlement Index: 18.0

Source: 2000 US Census, City and County of Honolulu DPP

Filipino

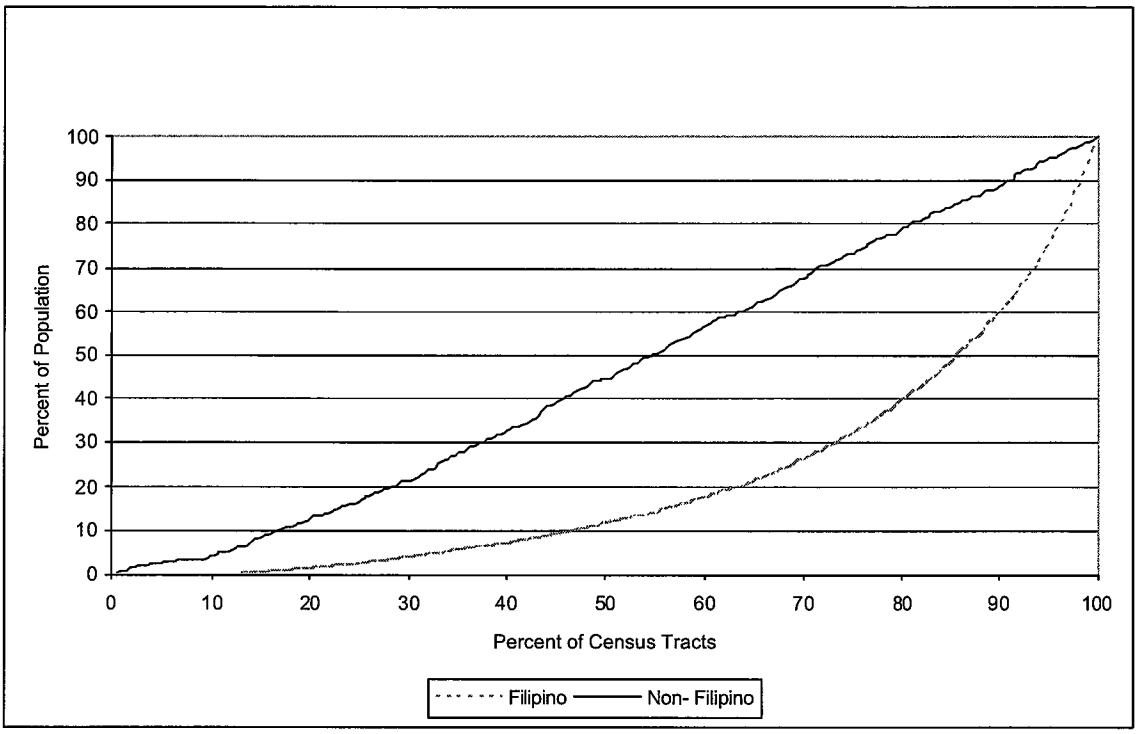
As can be seen in Figure 8.3A, Filipino populations are concentrated in pockets around Oahu, predominantly in Waipahu, Kalihi, and Ewa Beach. The analysis for Filipinos finds that their settlement pattern deviates substantially from that of non-Filipinos, as demonstrated in Figure 8.3B. Their settlement index is 24.7, which is significantly larger than that of Japanese. Like the Japanese, the Filipino population is large, representing over 30% of the island's Asian population; and the mixed race rate is low, with a proportion of 30%. The large settlement index for Filipinos is a reflection of their newer status on the island as an immigrant group.

Figure 8.3A
Distribution of Filipino Population



Source: 2000 US Census SF2

Figure 8.3B
Settlement Curves of Filipino Population



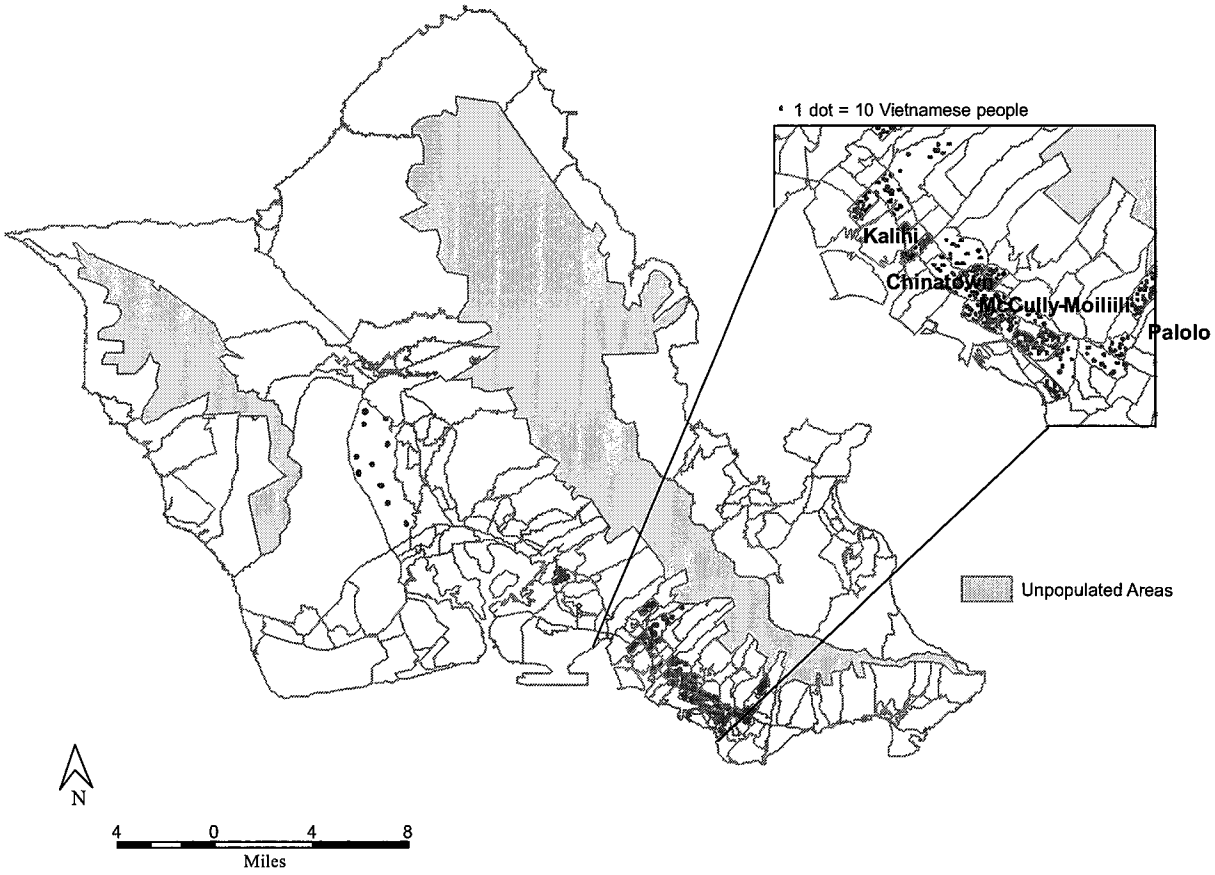
Settlement Index: 24.7

Source: 2000 US Census, City and County of Honolulu DPP

Vietnamese

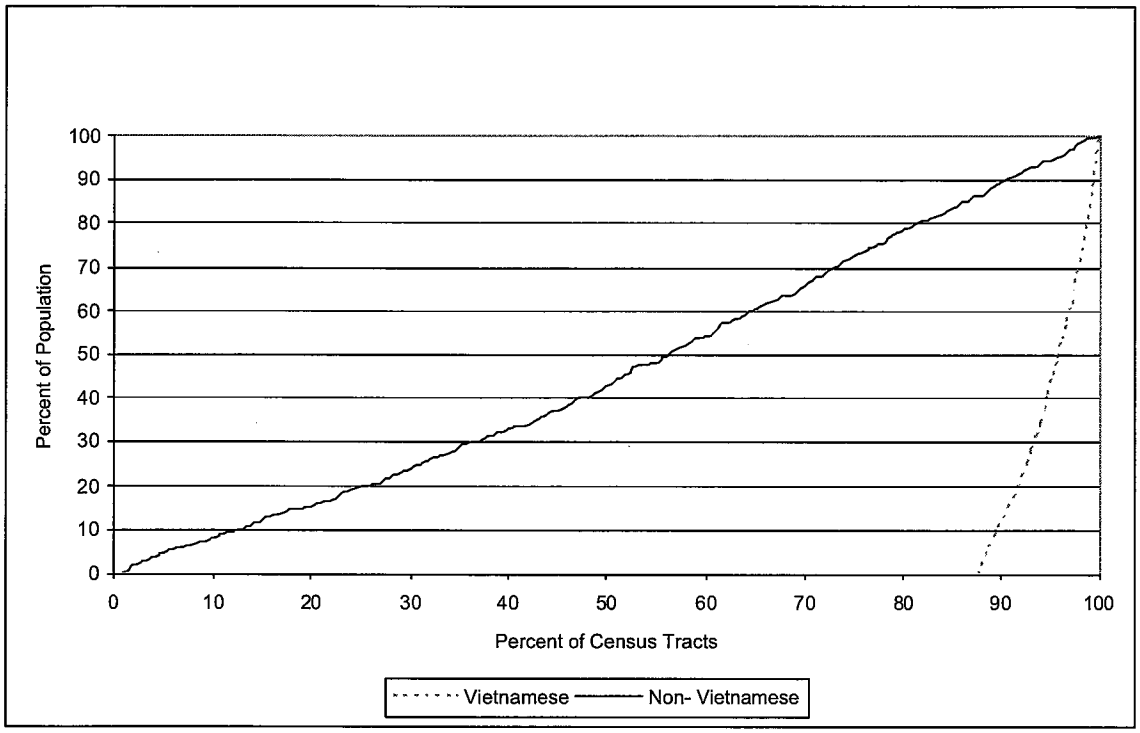
Figures 8.4A illustrates that the Vietnamese are concentrated in four areas: Chinatown, Kalihi, Palolo, and Makiki-Moiliili. The curves in Figure 8.4B show the dramatic differences in the settlement patterns of Vietnamese and non-Vietnamese. The Vietnamese settlement index of 41.5 is the largest among the races. This is due, in part, to the fact that Vietnamese constitute less than 1% of the island's population and have the lowest mixed race rate among the races.

Figure 8.4A
Distribution of Vietnamese Population



Source: 2000 US Census SF2

Figure 8.4B
Settlement Curves of Vietnamese Population



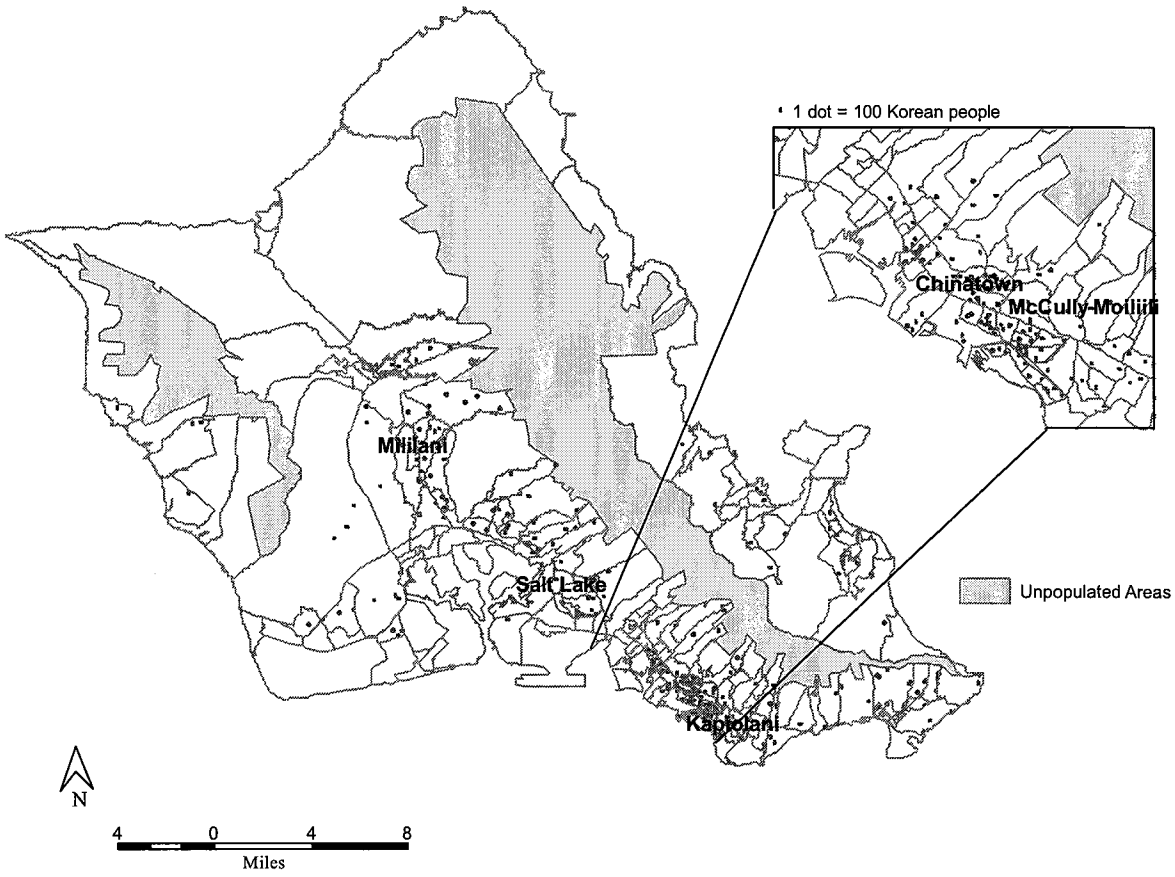
Settlement Index: 41.5

Source: 2000 US Census, City and County of Honolulu DPP

Korean

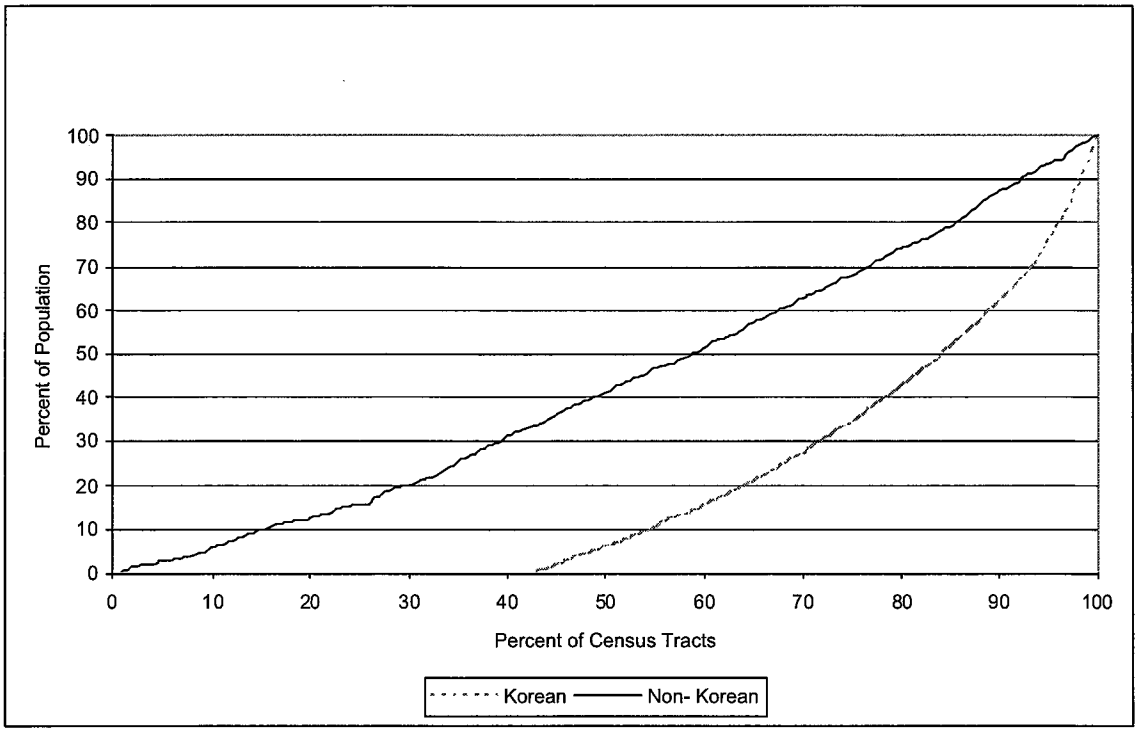
Figure 8.5A reveals that concentrations of Koreans are found in Chinatown, Salt Lake, Kapiolani, McCully-Moiliili, and Mililani-Kunia. The analysis for the Korean population finds that their settlement pattern deviates substantially from that of non-Koreans. As illustrated in Figure 8.5B, their settlement index is 23.7, which is notably higher than the 18.0 for Japanese. This reflects the fact that the Korean population is small, comprising only 2.5% of the island's population, and its mixed race proportion (40%) is low like the Japanese.

Figure 8.5A
Distribution of Korean Population



Source: 2000 US Census SF2

Figure 8.5B
Settlement Curves of Korean Population



Settlement Index: 23.7

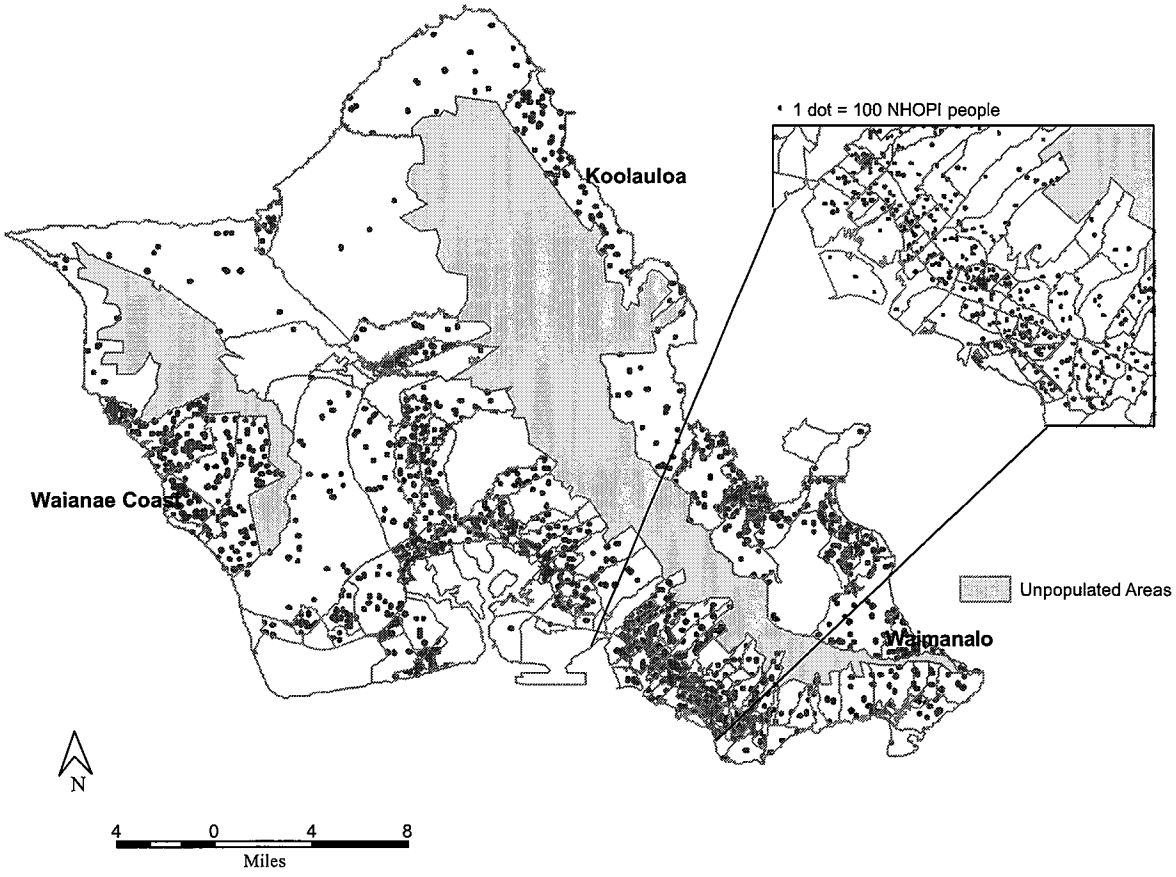
Source: 2000 US Census, City and County of Honolulu DPP

To summarize, this analysis of the detailed Asian races shows that the Chinese and Japanese settlement patterns are more proportional to their respective "opposite" races than the Filipino, Vietnamese, and Korean patterns are to theirs.

Native Hawaiian and Other Pacific Islander (NHOPI)

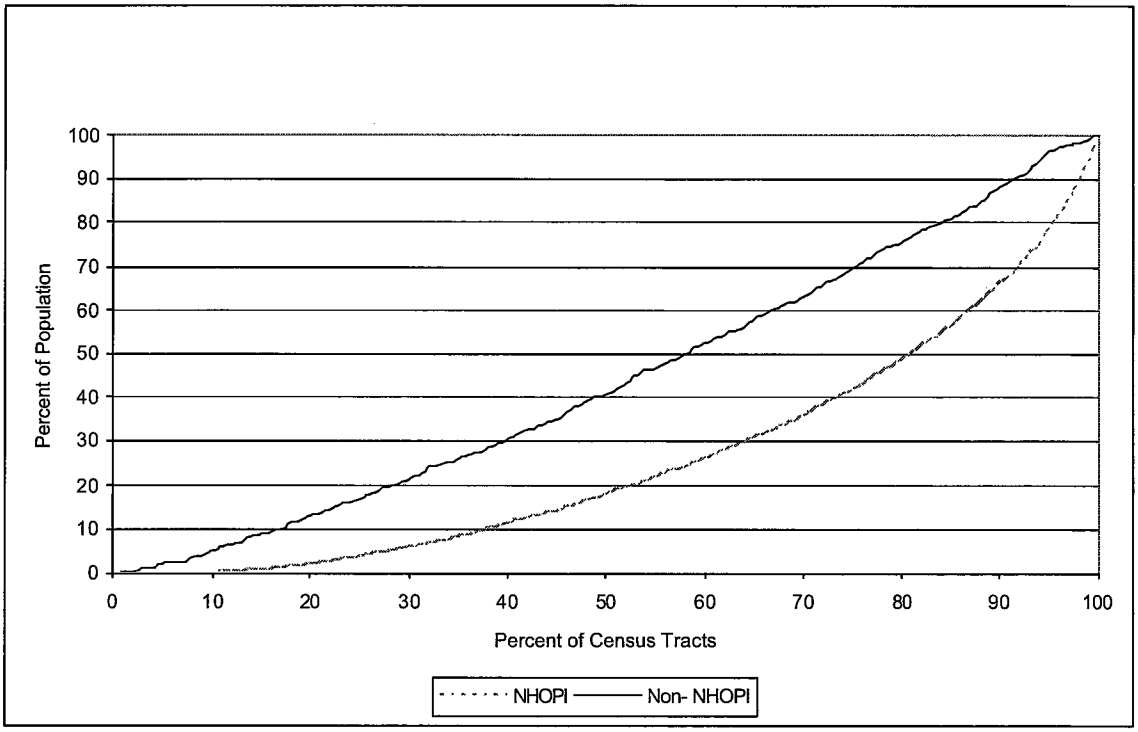
As can be seen in Figure 9A, the NHOPI populations are concentrated along the Waianae coast, in Waimanalo, and in the various rural communities in Koolauloa. The settlement curves in Figure 9B show that the NHOPI population track the non-NHOPI population well. Its settlement index of 18.2 is similar to that of Asians. This reflects the high proportion of mixed race in the NHOPI population.

Figure 9A
Distribution of Native Hawaiian and Other Pacific Islander Population



Source: 2000 US Census SF2

Figure 9B
Settlement Curves of Native Hawaiian and Other Pacific Islander Population



Settlement Index: 18.2

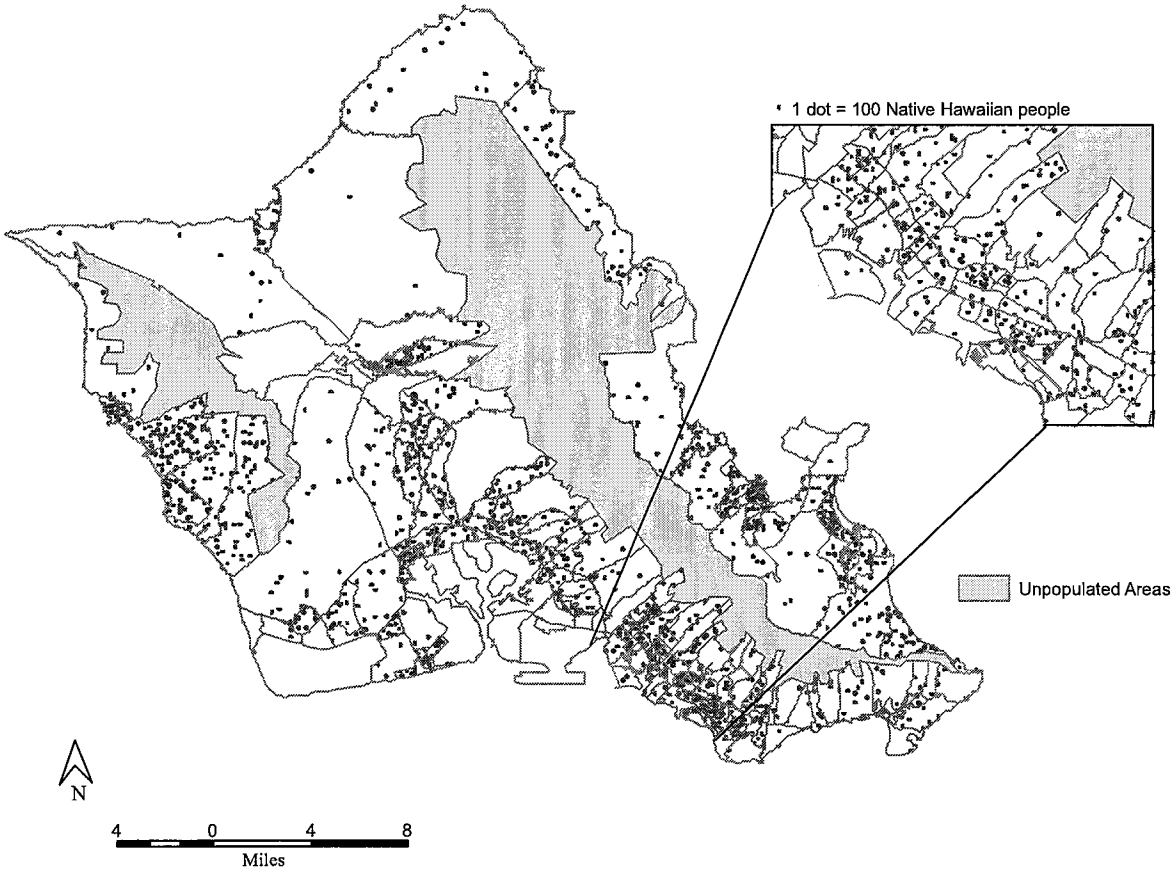
Source: 2000 US Census, City and County of Honolulu DPP

Further analysis of the detailed races within the NHOPI racial group was undertaken to identify the differences between Native Hawaiian and the other Pacific Islander groups. Native Hawaiian and Samoan were separately analyzed.

Native Hawaiian

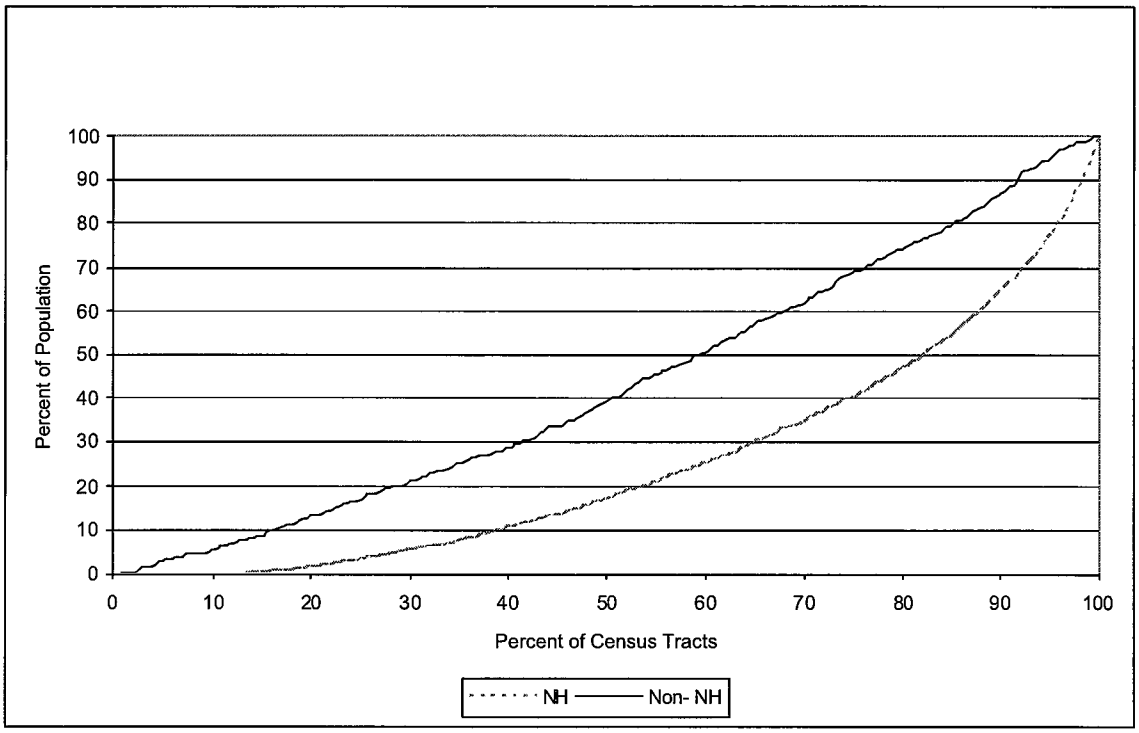
This analysis shows that the Native Hawaiian settlement pattern is very similar to that of the NHOPI group as a whole, as depicted in Figures 9.1A and 9.1B. Its settlement index is 18.3 as compared to 18.2 for NHOPI. This reflects the numerical dominance of Native Hawaiian in the NHOPI population.

Figure 9.1A
Distribution of Native Hawaiian Population



Source: 2000 US Census SF2

Figure 9.1B
Settlement Curves of Native Hawaiian Population



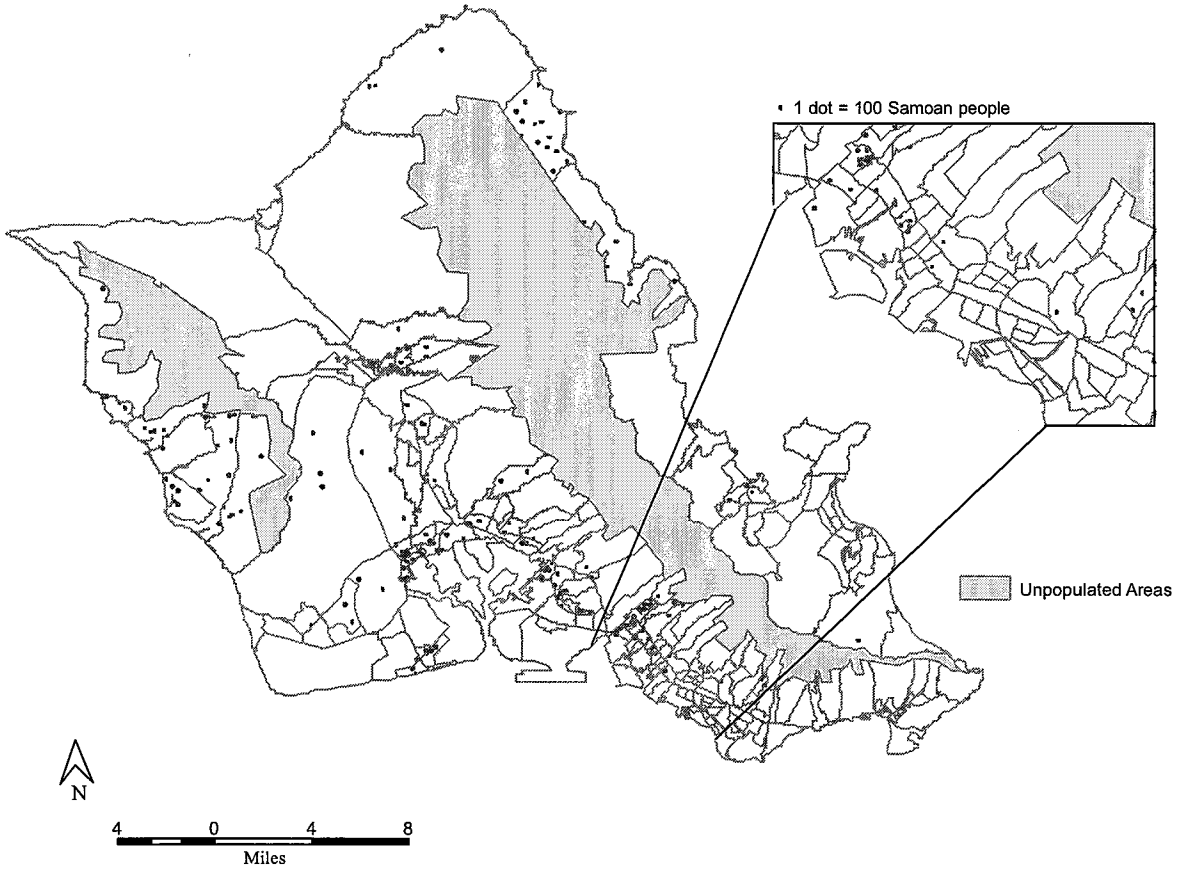
Settlement Index: 18.3

Source: 2000 US Census, City and County of Honolulu DPP

Samoan

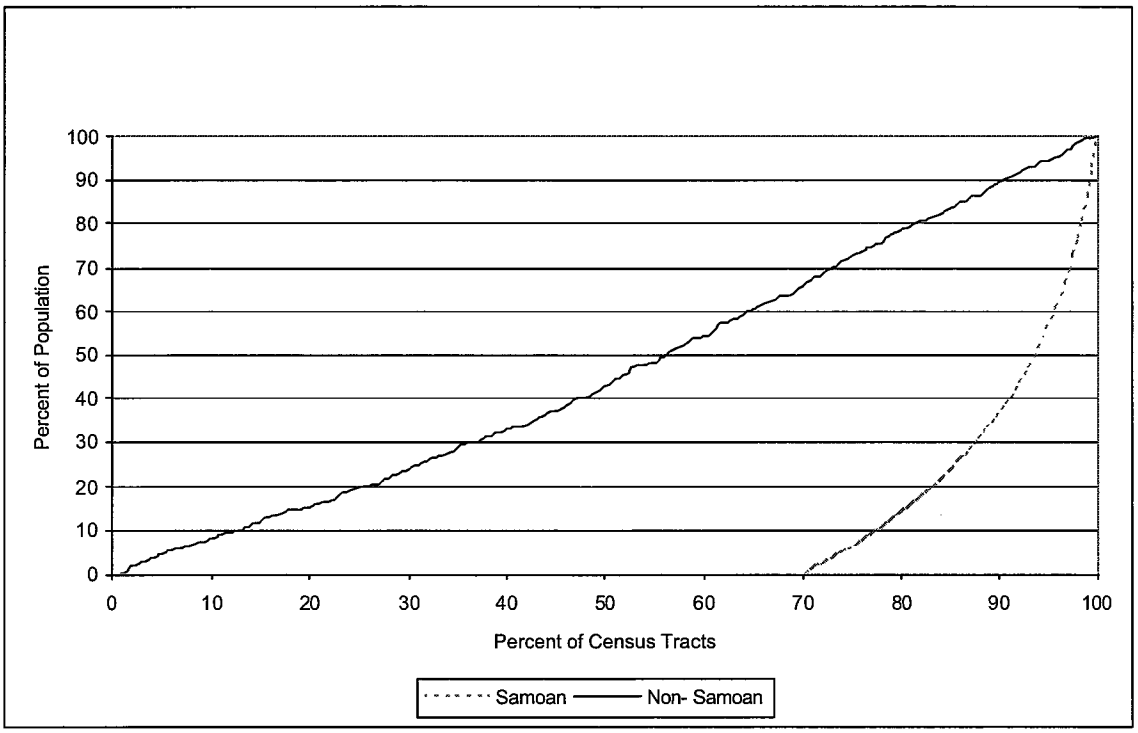
This analysis shows that Samoan deviate substantially from non-Samoans in their settlement pattern as seen in Figures 9.2A and 9.2B. Its settlement index of 36.1 is second only to Vietnamese.

Figure 9.2A
Distribution of Samoan Population



Source: US Census SF2

Figure 9.2B
Settlement Curves of Samoan Population



Settlement Index: 36.1

Source: 2000 US Census, City and County of Honolulu DPP

Some Other Race

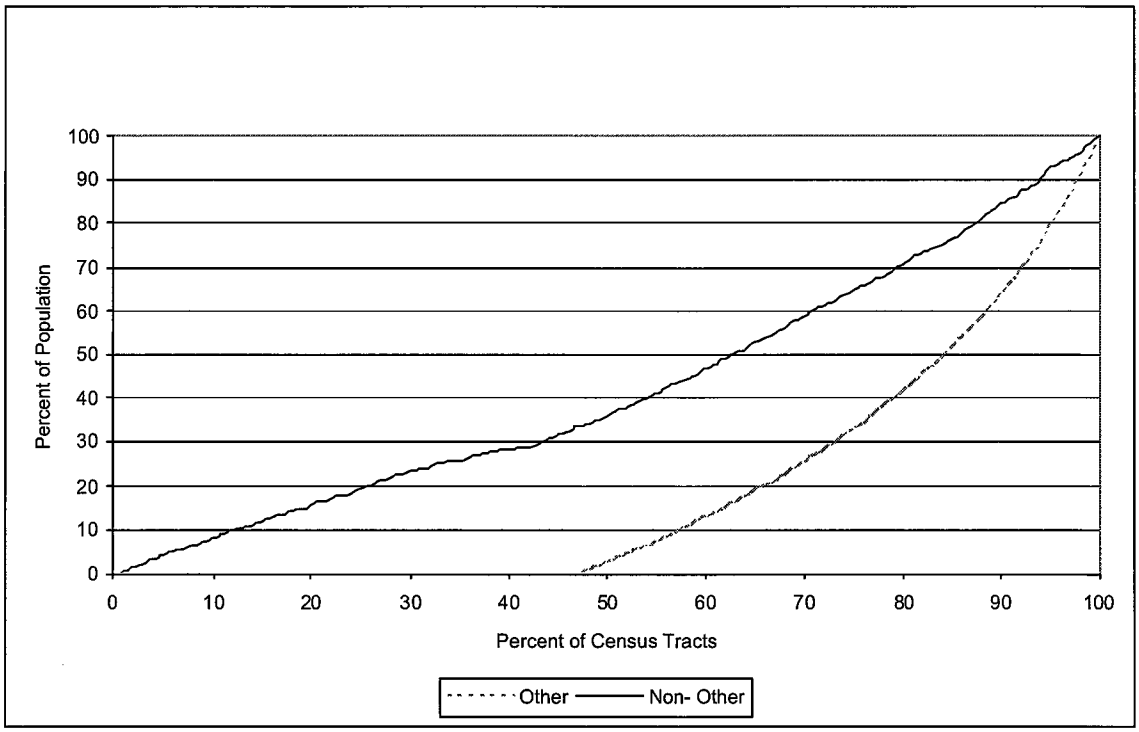
This category is not specifically identified by FHWA as a minority group. "Some Other Race" refers to races not explicitly enumerated by the Census. It consists of responses to the question "What is your race?" that could not be interpreted or imputed. Answers include "multiracial", "interracial", "mixed", etc. Other answers include Hispanic origins such as Mexican, Puerto Rican, and Cuban which are not considered races by the Census.

For completeness, "Some Other Race" was analyzed as a minority race. Figure 10A shows that the settlement pattern of "Some Other Race" is quite similar to that of "Hispanic". In fact, over 86% of the population classified as "Some Other Race" are of Hispanic origin. Figure 10B shows that there is significant deviation between the settlement patterns of "Some Other Race" and its opposite. The settlement index is 23.0, which is exceeded only by Black and AIAN.

Figure 10A
Distribution of Some Other Race Population

Source: 2000 US Census SF2

Figure 10B
Settlement Curves of Some Other Race Population



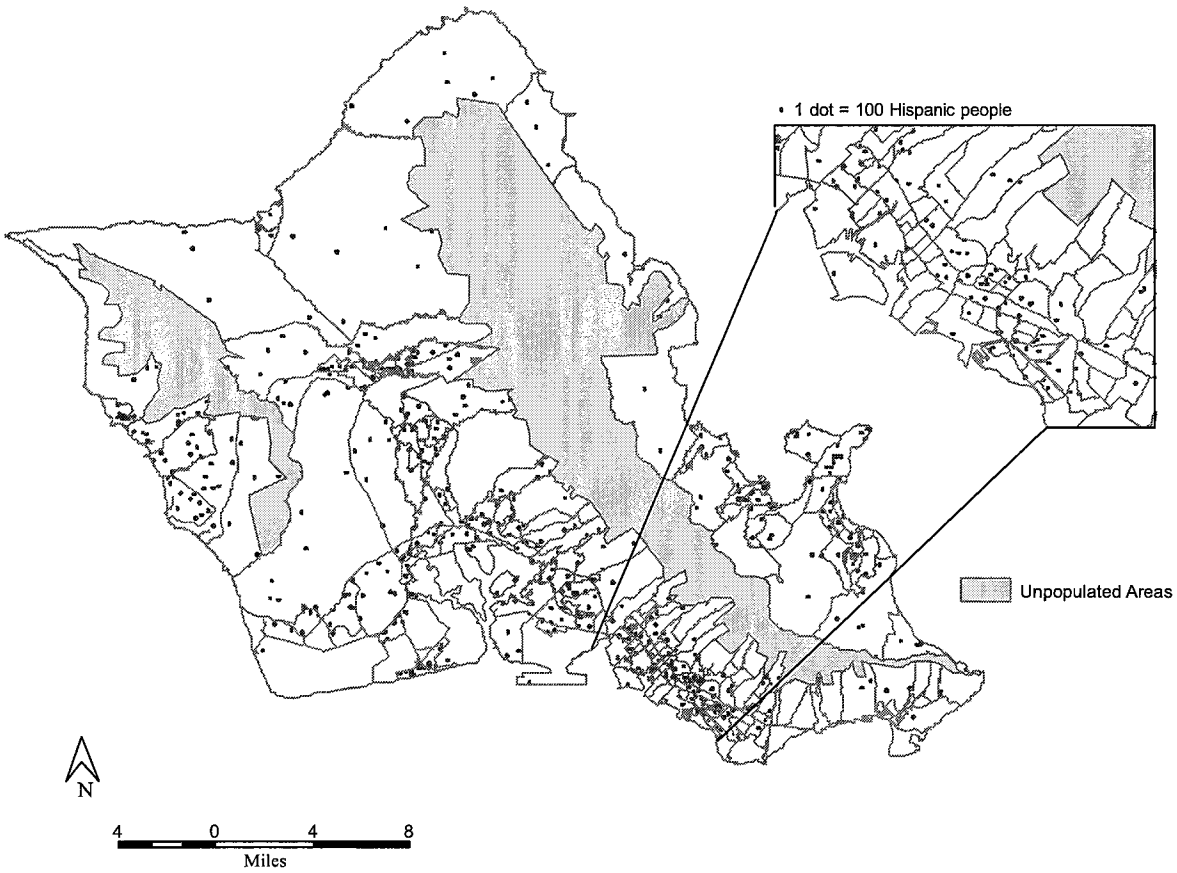
Settlement Index: 23.0

Source: 2000 US Census, City and County of Honolulu DPP

Hispanic

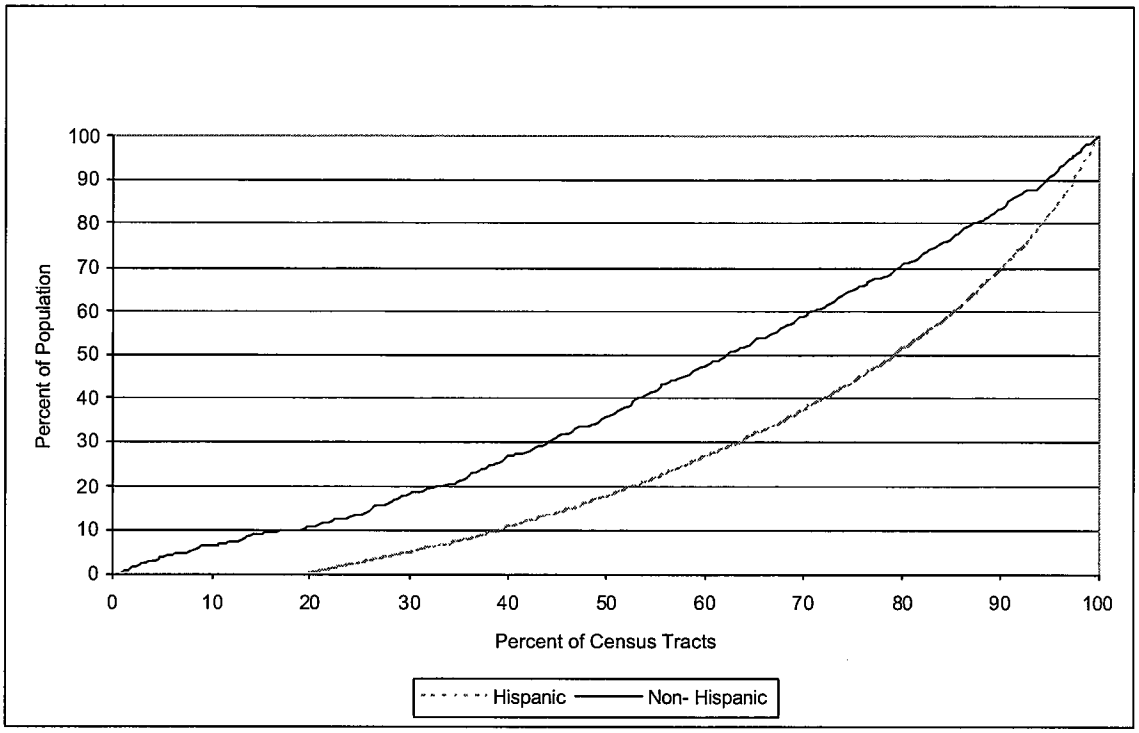
As can be seen in Figure 11A, the Hispanic population appears to be dispersed throughout the island. Figure 11B depicts the settlement curves for the Hispanic population. It shows that Hispanics track well with non-Hispanic. Its settlement index is 14.3, which lies between 12.5 for Whites and 18.0 for Asians. One reason for this result is that over half of the Hispanic population is also classified as White or Asian (e.g., Filipinos). Hispanics account for only 6.7% of the island's population.

Figure 11A
Distribution of Hispanic Population



Source: 2000 U.S. Census SF2

Figure 11B
Settlement Curves of Hispanic Population



Settlement Index: 14.3

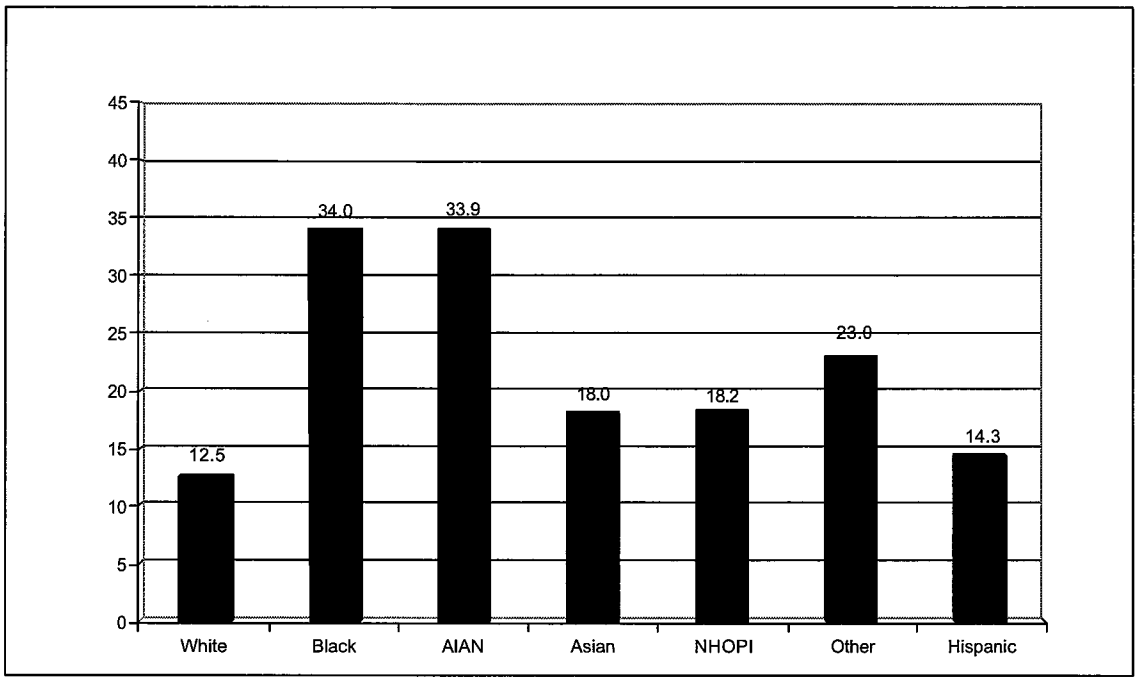
Source: 2000 US Census, City and County of Honolulu DPP

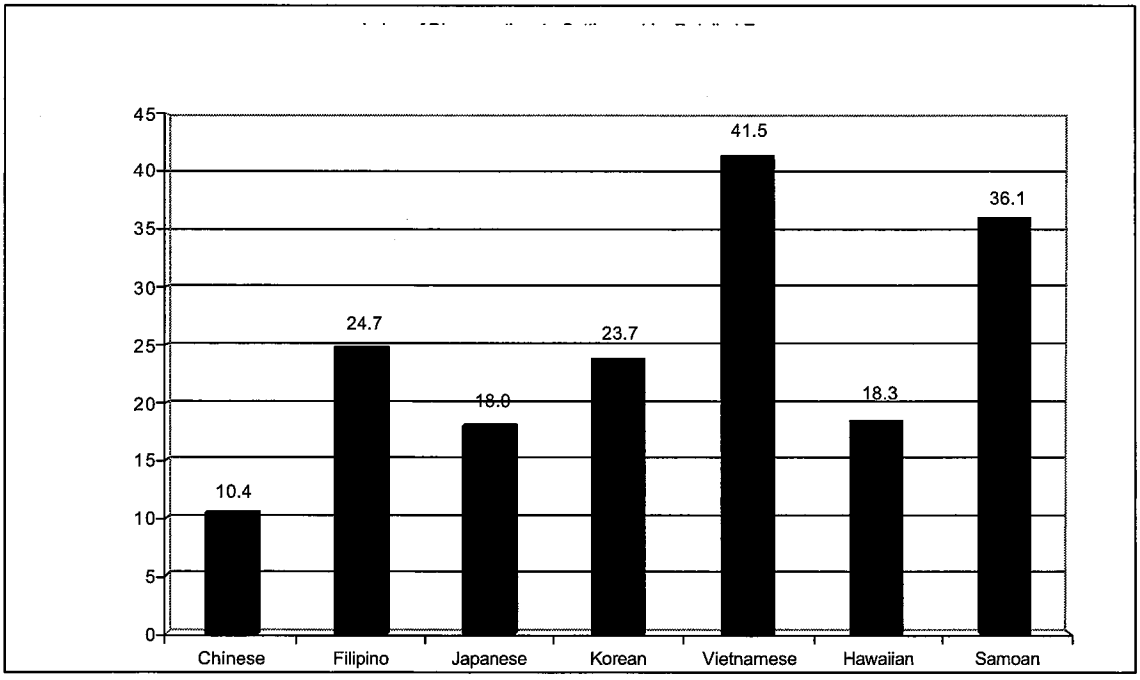
The indices of disproportionate settlement for the different races are graphed in Figure 12. They can be grouped into three general classes for comparison. Classified below are the broad racial groups along with their constituent detailed races (underlined). The races are listed in ascending order of index value.

Class	**Index**	**Races**
Low	10.4 - 14.3	Chinese, White, Hispanic
Average	18.0 - 24.7	Asian, Japanese, NHOPI, Hawaiian, Other, Korean, Filipino
High	34.0 - 41.5	AIAN, Black, Samoan, Vietnamese

This result is consistent with expectation. The diversity of the people of Honolulu is reflected in the wide range of settlement index values, from 10.4 for Chinese to 41.5 for Vietnamese. Most of the races have indices that fall in the "average" class. These "average" races account for over 60% of the island's population. A little over 30% of the population belongs to races with settlement indices that are considered "Low". The races with "High" settlement indices constitute the true minorities, in the numeric sense, since they account for only about 5% of the population.

Figure 12
Indices of Disproportionate Settlement





Source: City and County of Honolulu DPP

These index values demonstrate the wide variability of the races in terms of their settlement pattern. They, in turn, underscore the need to evaluate the minority races individually rather than collectively in order to properly identify the areas where there is a disproportionate concentration of minority population.

6. IDENTIFICATION OF MINORITY CONCENTRATION

The overriding objective of this analysis is to identify the areas on Oahu where environmental justice is a concern. After examining the rationales behind the FHWA definition of minority groups and analyzing the settlement characteristics of these groups on Oahu, it was found that:

1. The FHWA definition of minority is valid.

2. The unique characteristics of Asians on Oahu must be taken into account.

3. The minority groups cannot be evaluated collectively – because the groups have widely different settlement characteristics, and, more importantly, the Asian population would otherwise dominate the other groups.

Each minority group must, therefore, be evaluated separately. However, it is not sufficient to simply know which group qualifies as a minority and where the group settles on the island. In situations where the majority numerically overwhelms the minority, as on the US mainland, it is acceptable to identify all locations where there is some qualifying minority present as environmental justice areas. In racially diverse areas like Honolulu, however, where there is no clear majority and where one of the qualifying groups (Asian) is numerically significant, such a simplistic approach would result in close to half of Oahu being identified as environmental justice areas – a result that challenges common sense. On Oahu, therefore, it is necessary to select only those areas where the minority population is concentrated in a disproportionate way.

In this assessment of environmental justice, minority concentrations are identified in terms of block groups – as tracts are too large and complete data is not available at the block level.

Because each minority group must be separately analyzed, it is critical that the groups not be double-counted. By the nature of the data, maximum population would cause such double counting. The alternative of using minimum population is not acceptable because of the "Two or More Races" category, which accounts for 20% of the island's population. This category exists only for statistical purposes. It has no racial, social, or cultural meaning, as no one would want to be identified simply as a "Two or More Races" person. Thus, it would not be meaningful to identify the concentration of people who fall into this category.

For these reasons, a set of population figures that reflects the multiple racial character of the population, yet does not double-count the population, was derived. The method involves combining the minimum population with the maximum population. For each block group, the adjusted population of race i, AP_i, is computed as:

$$AP_i = MIN_i + \left[\frac{MAX_i - MIN}{\sum_j (MAX_j - MIN_j)} \right] * TWO_i$$

where MIN_i = minimum population of race i
MAX_i = maximum population of race i
TWO_i = population in "Two or More Races" category

The multi-race component of the maximum population tallies was used to prorate the "Two or More Races" population count. The resultant multi-race population counts were then added back in with the minimum population counts. Note, however, that because maximum population data was not available by block group, data at the tract level was used to distribute the "Two or More Races" population for the block groups. The assumption is that the tallies presented at the tract level are evenly distributed throughout that tract, and thus can be applied as a proportion in each block group contained in that tract.

In using this adjusted population to identify the minority concentrations, Hispanic was analyzed without regard to race. This means that each of the racial categories analyzed refer to those who are not of Hispanic origin.

A five-step process was used to identify the disproportionate concentrations of minority groups. For each minority group, the process can be described as follows:

1. The relative concentration (RC) of minority population in a block group is calculated by expressing its minority population as a percent of the island's total minority population. To evaluate the significance of this concentration, however, it is necessary to take into account the size of the block group, because the block groups vary greatly in size.

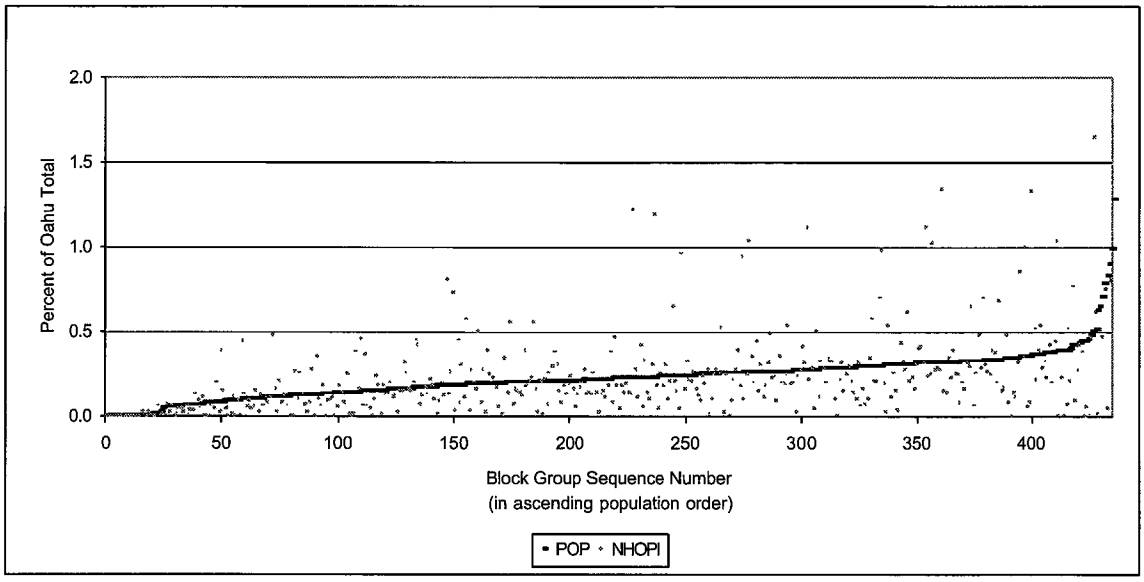
2. The size of block groups is measured in terms of population. The relative size (RS) of a block group is computed by calculating its population as a percent of the islandwide population.

3. To account for the difference in block group size, it is necessary to normalize the RC of each block group by rescaling it from the RS of the block group. This yields a normalized concentration (NC) as follows:

$$NC = RC - RS$$

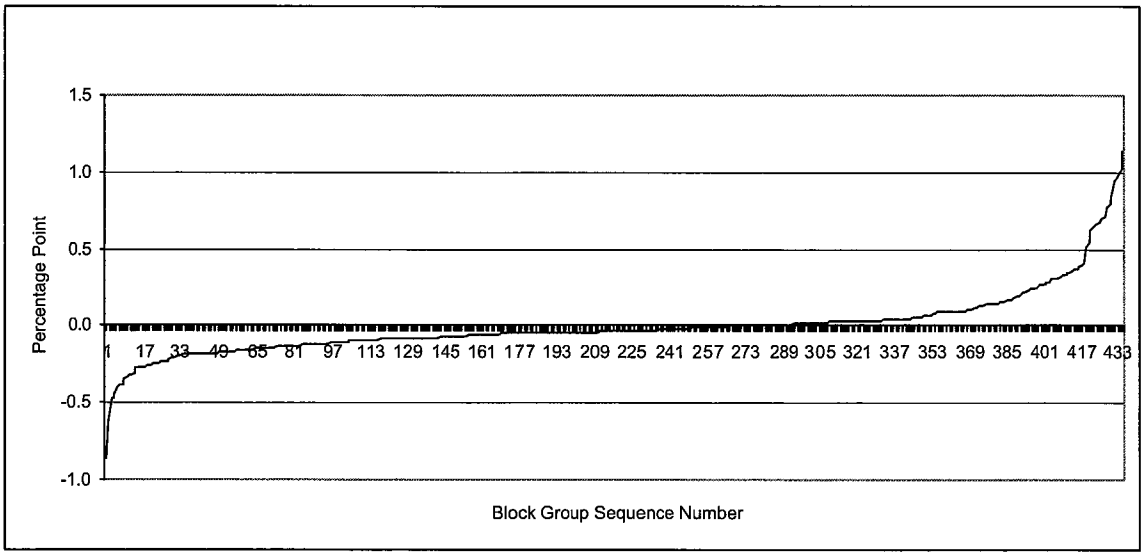
Figures 13 and 14 use the NHOPI result to illustrate the above steps. In Figure 13, RC and RS are plotted for each block group. The block groups are shown in ascending RS order so that RS appears as a smooth curve and RC as scattered points. Note that the scattering is rather symmetrical, suggesting that there is a normal range within which RC fluctuates about RS. The pattern further suggests that the environmental justice areas might be found among the block groups whose RC lies outside this normal range, since that is where the concentration is most extreme.

Figure 13
Relative Concentration of Minority versus Relative Size of Block Groups



Source: City and County of Honolulu DPP

Figure 14
Normalized Concentration of Minority in Block Groups



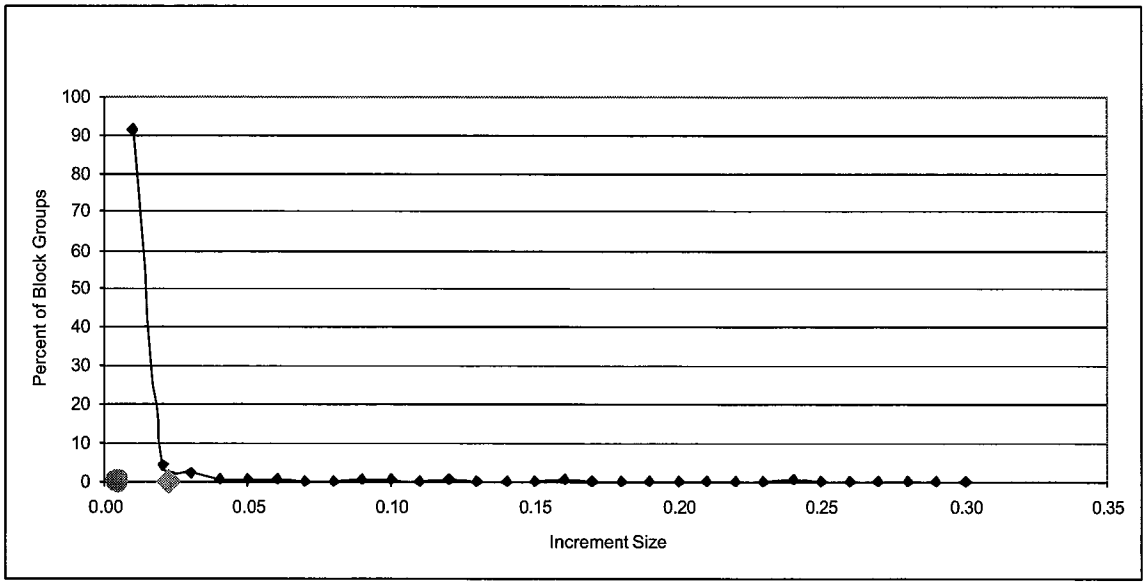
Source: 2000 US Census, City and County of Honolulu DPP

There are many ways to find this normal range. This analysis relies on an approach based on the graphical interpretation of RC and RS. The variation between RC and RS is more easily seen in Figure 14, which shows the normalized concentration, or NC, of the block groups. Since NC is graphically the distance between each of the RC points in Figure 13 and the corresponding value on the RS curve, Figure 14 directly measures the scattering or clustering behavior of RC about RS. Note that the symmetry is more obvious; and that there is a sharp break in the slope of the NC curve which can be used to demarcate the normal fluctuations from the more extreme or disproportionate concentrations of the minority population.

4. To analyze how the normalized minority concentration varies, the NC differences between successive block groups are compiled and their mean and standard deviation (SD) are computed. This is equivalent to analyzing the slope of the NC curve. The frequency distribution of these NC slope increments is shown in Figure 15, along with the mean and SD of the distribution. Note that almost all the slope increments fall within one SD of the mean.

5. The NC variations are considered normal up to the point where the slope increment of the NC curve exceeds a certain number of SDs from the mean of all the slope increments. Various numbers of SDs were tested as the threshold; and the resultant set of environmental justice areas were evaluated. The final threshold is one SD because it yielded a set of results that make sense based on local knowledge and common experience.

Figure 15
Frequency Distribution of Incremental Changes in Normalized Minority Concentration



Source: 2000 US Census, City and County of Honolulu DPP

The block groups identified by the process described above are summarized in Table 2 and shown in Figure 16. A total of 70 out of the 435 block groups on the island were selected on account of race. They were selected because they have a disproportionate concentration of at least one of the minority races.

Table 2 is organized by the eight planning regions on Oahu known as DP Areas. To facilitate the evaluation of the selected block groups, their location names are given. Also noted are block groups that are under the control of the military.

Identified in Table 2 is the selection basis for the block groups (i.e., the population in each of the minority groups that contributed toward the selection of the block groups as environmental justice areas). Note that, for block groups selected because of their AIAN population, the population basis is very small. This is because the total AIAN population on the island is very small, amounting to 1.8% of the total on a maximum population basis. In future efforts, the AIAN population should be combined with the minority group with the most similar settlement pattern.

Once a block group is selected, all of its population in groups defined as minority by FHWA is counted as minority population. This minority population is expressed as a percent of the total population in the block group and shown in Table 2. This illustrates that, when a block group is identified as minority, not all of its population is minority. Table 2 shows that the minority population ranges from 31.9% for Iroquois Point to 98% for Kamehameha IV Housing.

The selected block groups are plotted in Figure 16. The block groups are identified by their dominant selection basis (i.e., the largest minority group with a disproportionate concentration in the block group). As can be seen, block groups selected because of their concentration of Blacks are all on or near military installations. Hispanic block groups also tend to be military. NHOPI block groups are well-known Native Hawaiian areas such as Waimanalo and the Waianae coast or in Hawaiian Home Land areas such as Papakolea, in urban Honolulu. As noted earlier, block groups selected on account of the AIAN population are anomalous because of their small presence on Oahu.

Only one block group was selected because of its Asian population. The Mililani Mauka block group was selected because it has close to 65% Asian population. This is a direct consequence of including Asian as a minority group in the definition of environmental justice.

Table 2
Minority Environmental Justice Areas
(Page 1 of 2)

DP Area	Location	Military	Block Group	POP	FHWA Minority	Race or Ethnicity Selection Basis							FHWA Minority as % of POP	Selection Basis as % of	
						All	BLACK	AIAN	ASIAN	NHOPI	OTHER	HISP+		POP	Total
1	Papakolea		44001	2656	2309	1166	0	0	0	1166	0.0	0	86.9	43.9	1.7
1	Puunui		46003	1232	1086	44	0	44	0	0	0.0	0	88.1	3.6	0.1
1	Kalihi Kai		60001	3379	3013	47	0	47	0	0	0.0	0	89.2	1.4	0.1
1	Kuhio Park Terrace		62021	2034	1992	1456	0	0	0	1456	0.0	0	97.9	71.6	2.2
1	Kam IV Housing		63021	2768	2713	1329	0	0	0	1329	0.0	0	98.0	48.0	2.0
1	Fort Shafter	1	66009	1724	702	302	302	0	0	0	0.0	0	40.7	17.5	0.4
1	Tripler	1	67013	2093	1491	232	232	0	0	0	0.0	0	71.2	11.1	0.3
1	Aliamanu Military Housing	1	68041	1869	1217	552	552	0	0	0	0.0	0	65.1	29.5	0.8
1	Aliamanu Military Housing	1	68042	2364	1497	847	465	0	0	0	0.0	382	63.3	35.8	1.3
1	Aliamanu Military Housing	1	68043	1399	758	324	290	34	0	0	0.0	0	54.2	23.2	0.5
1	Radford Terrace	1	69001	1950	696	273	273	0	0	0	0.0	0	35.7	14.0	0.4
1	Catlin Naval Housing	1	70001	2051	807	244	244	0	0	0	0.0	0	39.3	11.9	0.4
1	Hickam AFB	1	71001	2270	1127	739	401	0	0	0	0.0	338	49.6	32.6	1.1
1	Hickam Housing	1	73009	5687	1817	671	671	0	0	0	0.0	0	32.0	11.8	1.0
1	Pearl Harbor Complex	1	74009	2220	833	339	339	0	0	0	0.0	0	37.5	15.3	0.5
1	Puuwai Momi Housing Complex		75041	3084	2660	1417	0	0	0	1025	0.0	392	86.3	45.9	2.1
1	Ford Island / P.C. Naval Station	1	81009	4210	1448	620	620	0	0	0	0.0	0	34.4	14.7	0.9
2	Iroquois Point	1	83019	1187	379	220	220	0	0	0	0.0	0	31.9	18.5	0.3
2	Ewa Beach		84021	2844	2470	346	0	0	0	0	0.0	346	86.8	12.2	0.5
2	Ewa Gentry		84041	8669	6817	1207	462	0	0	0	0.0	745	78.6	13.9	1.8
2	Makakilo		86032	3565	2343	477	0	0	0	0	0.0	477	65.7	13.4	0.7
2	Makakilo		86042	1641	1243	284	0	0	0	0	0.0	284	75.7	17.3	0.4
2	Lanikai Hale		86091	1703	1059	281	0	0	0	0	0.0	281	62.2	16.5	0.4
3	Waipahu		87031	1010	894	573	0	0	0	573	0.0	0	88.5	56.7	0.9
3	Waipahu		87032	1627	1450	873	0	0	0	873	0.0	0	89.1	53.7	1.3
3	Waipahu		87033	788	693	476	0	0	0	476	0.0	0	87.9	60.4	0.7
3	Mililani-Kipapa		89079	2057	1569	320	0	0	0	0	0.0	320	76.3	15.6	0.5
3	Waipahu		89141	2706	2360	740	0	0	0	740	0.0	0	87.2	27.3	1.1
3	Waipio Acres		89151	2754	2328	354	0	0	0	0	0.0	354	84.5	12.9	0.5
3	Mililani Mauka		89169	11181	8907	7175	0	0	7175	0	0.0	0	79.7	64.2	10.7
3	Mililani - Nob Hill		89181	2017	1462	307	0	0	0	0	0.0	307	72.5	15.2	0.5
3	Schofield	1	90009	2829	1207	989	616	0	0	0	0.0	373	42.7	35.0	1.5
3	Wahiawa - Mauka		92001	2256	1774	355	0	0	0	0	0.0	355	78.6	15.7	0.5
3	Wahiawa - Makai		94001	2926	2500	1305	0	0	0	837	0.0	468	85.4	44.6	1.9
3	Schofield Barracks	1	95019	3450	1664	1561	929	0	0	0	0.0	632	48.2	45.2	2.3
3	Schofield Barracks	1	95029	4035	1755	1556	875	0	0	0	0.0	681	43.5	38.6	2.3
3	Schofield Barracks	1	95039	2528	940	764	423	0	0	0	0.0	341	37.2	30.2	1.1

Table 2
Minority Environmental Justice Areas
(Page 2 of 2)

DP Area	Location	Military	Block Group	POP	FHWA Minority	Race or Ethnicity Selection Basis							FHWA Minority as % of POP	Selection Basis as % of	
						All	BLACK	AIAN	ASIAN	NHOPI	OTHER	HISP+		POP	Total
3	Schofield Barracks	1	95059	3429	1822	1694	1003	0	0	0	0.0	691	53.1	49.4	2.5
5	Ahuimanu		103051	3048	2406	402	0	0	0	0	0.0	402	78.9	13.2	0.6
5	Kahuhipa Apt/Industrial Area		105062	2981	2111	1202	0	0	0	810	0.0	392	70.8	40.3	1.8
5	Kaneohe Marine Corps Base	1	108019	3906	1334	1139	485	42	0	0	0.0	612	34.2	29.2	1.7
5	Kaneohe Marine Corps Base	1	108029	7921	2848	2244	962	106	0	0	0.0	1176	36.0	28.3	3.3
5	Kailua (Ulupaina St.)		109051	2512	1565	38	0	38	0	0	0.0	0	62.3	1.5	0.1
5	Bellows Air Station	1	113011	3102	2383	1191	0	0	0	1191	0.0	0	76.8	38.4	1.8
5	Wainamalo Beach - Homesteads		113021	2062	1814	1419	0	0	0	1419	0.0	0	88.0	68.8	2.1
5	Wainamalo Beach - Homesteads		113022	2324	1756	1235	0	0	0	1235	0.0	0	75.6	53.1	1.8
6	Kahuku		101001	2097	1714	780	0	0	0	780	0.0	0	81.7	37.2	1.2
6	Hauula		102011	2321	1732	1123	0	0	0	1123	0.0	0	74.6	48.4	1.7
6	Punaluu		102019	1666	1075	691	0	0	0	691	0.0	0	64.5	41.5	1.0
6	Laie		102021	1751	1128	667	0	0	0	667	0.0	0	64.4	38.1	1.0
6	Laie		102022	2137	1520	1145	0	0	0	1145	0.0	0	71.1	53.6	1.7
6	Laie		102023	1314	893	549	0	0	0	549	0.0	0	68.0	41.8	0.8
6	Laie		102029	897	647	528	0	0	0	528	0.0	0	72.1	58.9	0.8
6	Waihee		103031	2801	2102	376	0	0	0	0	0.0	376	75.0	13.4	0.6
7	Kawailoa - Halemano		100009	3291	1902	1073	525	0	0	0	0.0	548	57.8	32.6	1.6
7	Pupukea		101002	2243	853	48	0	48	0	0	0.0	0	38.0	2.1	0.1
8	Nanakuli-Lualualei		96011	2793	2383	1593	0	0	0	1593	0.0	0	85.3	57.0	2.4
8	Nanakuli-Lualualei		96012	1597	1393	968	0	0	0	968	0.0	0	87.2	60.6	1.4
8	Nanakuli-Lualualei		96019	2644	2112	1661	0	0	0	1338	0.0	323	79.9	62.8	2.5
8	Maili		96031	2652	2122	1250	0	0	0	835	0.0	415	80.0	47.1	1.9
8	Maili		96032	3412	2860	1752	0	0	0	1246	0.0	506	83.8	51.3	2.6
8	Nanakuli		96041	3191	2627	1968	0	0	0	1587	0.0	381	82.3	61.7	2.9
8	Nanakuli		96042	1809	1498	939	0	0	0	662	0.0	277	82.8	51.9	1.4
8	Waianae Kai		97011	2780	2239	1652	0	0	0	1216	0.0	436	80.5	59.4	2.5
8	Waianae Kai		97012	1632	1341	349	0	0	0	0	0.0	349	82.2	21.4	0.5
8	Lualualei Homestead		97021	3714	2856	1450	0	0	0	920	0.0	530	76.9	39.0	2.2
8	Lualualei Homestead		97029	4475	3787	2566	0	64	0	1963	0.0	539	84.6	57.3	3.8
8	Kaena		98019	2386	1501	375	0	0	0	0	0.0	375	62.9	15.7	0.6
8	Makaha		98021	2853	2106	1386	0	0	0	778	0.0	608	73.8	48.6	2.1
8	Makaha		98022	1687	1373	901	0	0	0	597	0.0	304	81.4	53.4	1.3
	Oahu Total			876103	131783	67119	10889	423	7175	32316	0	16316	15.0	7.7	100.0
	Block Group Count				70	70	21	8	1	32	0	36			

Source: City and County of Honolulu DPP

Figure 16
Minority Environmental Justice Areas

Source: City and County of Honolulu DPP

7. ANALYSIS OF LOW-INCOME POPULATION

Environmental justice recognizes that the availability of economic resources is an important determinant of a group's access to the decision-making process. In addition to race, therefore, the income of the population must also be analyzed. In particular, areas where the low-income population is concentrated in a disproportionate way must also be identified. For purposes of this analysis, low-income population is defined as persons in households with 1999 income below the DHHS poverty level.

Income is analyzed separately from race for two reasons. The obvious reason is that the FHWA guidelines clearly state that environmental justice is concerned with the low-income population regardless of its race, and with the minority groups regardless of their level of income.

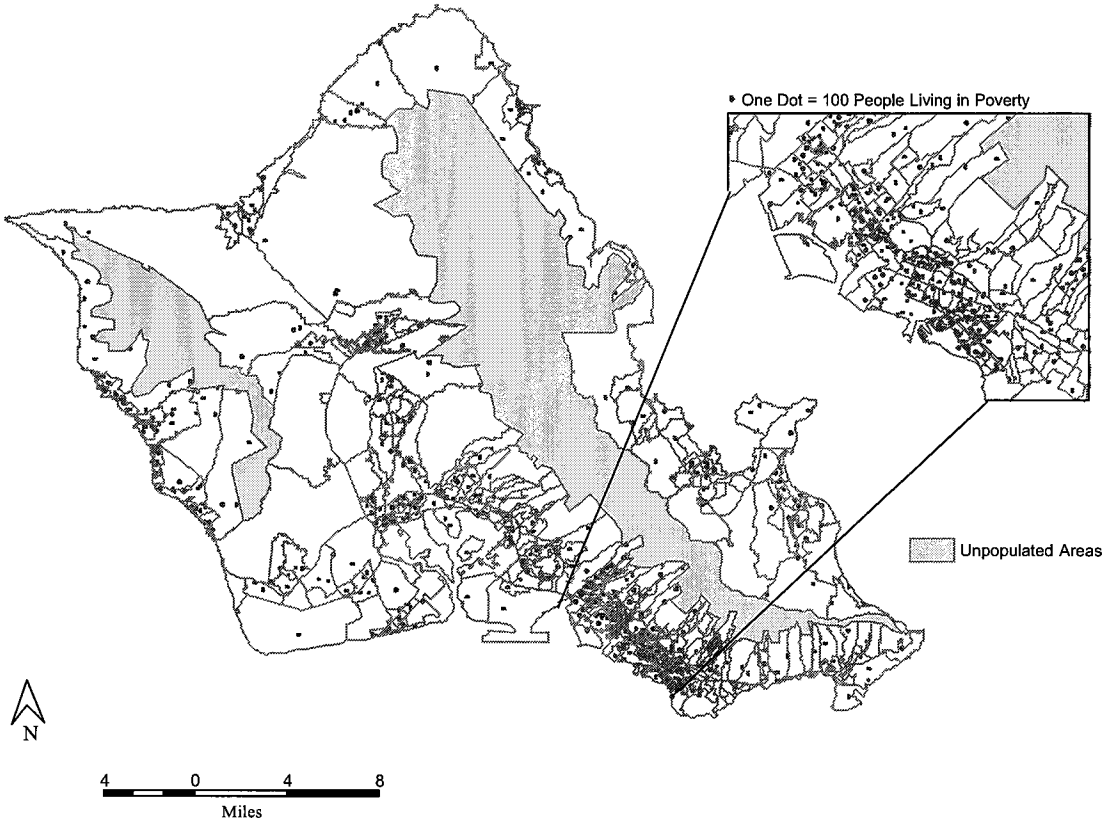
A second reason, more technical in nature, should be noted: The Census does not have data that jointly describes income and race for the geographic unit of interest, which is the block group. Rather, the Census summarizes the income distribution and race distribution separately and independently. Analyzing low-income and minority groups jointly would require using the AND logical connector in the selection criteria of block groups. This is tantamount to using marginal distributions to evaluate block groups where income conditions and race conditions must be jointly known. This is a logical fallacy that will lead to erroneous conclusions and the consequent misidentification of environmental justice areas.

The low-income population can be regarded as another minority group. Specifically, the low-income population on Oahu shares the same defining characteristics of minority groups as described previously. Households living below poverty level, for example, represent a clear numeric minority because they comprise less than 7% of the households on Oahu. It is also obvious that their income would account for far less than 7% of the island's aggregate household income.

The remaining elements of the low-income analysis are analogous to the minority analysis and can be described in a similar way. The settlement pattern of the low-income population is shown in Figure 17A. It illustrates that low-income populations are found throughout the island with concentrations along the Waianae Coast, Iwilei, Kalihi-Palama, and pockets in urban Honolulu and Wahiawa.

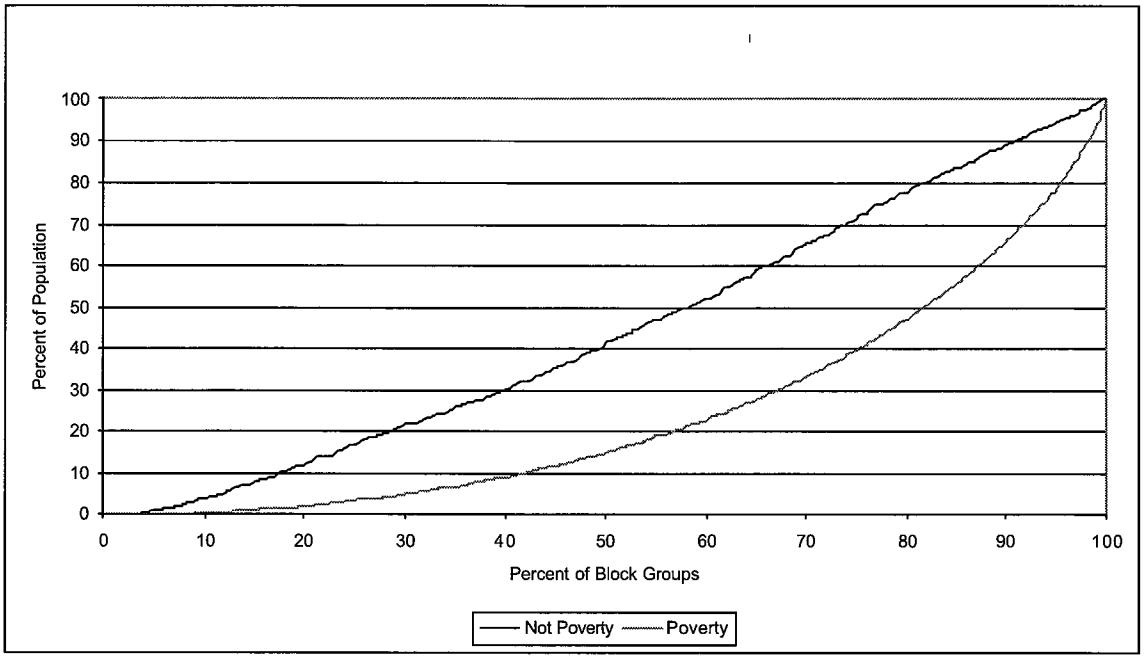
Figure 17B shows that the index of disproportionate settlement for the low-income population is 19.6. This value is considered to be in the "average" range. It is important to note that the settlement index does not compare the "poor" with the "rich", which would indeed result in a very high settlement index. Rather, it compares the "poor" with those who are not "poor". Since the low-income population represents about 11% of the population for whom poverty status has been determined, the settlement index is comparing the "poor" with the remaining 89% of the population, most of whom are far from "rich". A 19.6 settlement index means that the two settlement patterns are relatively proportional. That is, the low-income population on Oahu is <u>not</u> segregated from the rest of the population in an inordinate way.

Figure 17A
Distribution of Low-Income Population



Source: 2000 US Census, City and County of Honolulu DPP

Figure 17B
Settlement Curve of Low-Income Population



Settlement Index: 19.6

Source: 2000 US Census, City and County of Honolulu DPP

Disproportionate concentrations were found by comparing the relative concentrations of low-income population (RC) with the relative size (RS) of each block group. The normal range within which RC fluctuates about RS was then determined. Block groups whose RC lies outside this normal range were identified as environmental justice areas.

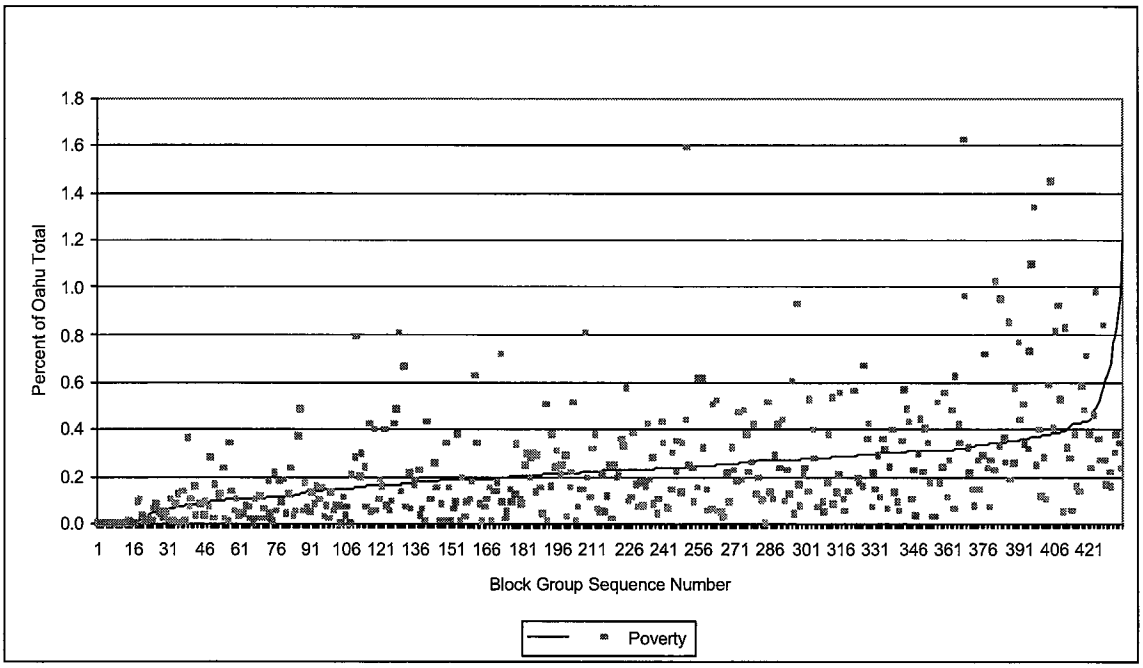
The identification process parallels the process used for minority population in every respect but one. The exception relates to the measure of relative size, RS. In the case of minority population, the Census population count was used to represent the size of the block group. In the case of low-income population, however, it was necessary to also take into account the vacant housing units in the block group. To illustrate, consider block group 37001, which is bordered by Ala Moana Blvd., Ward Ave., King St., Pensacola St., Kapiolani Blvd., Kalakaua Ave., and the Ala Wai Canal. This block group contains pockets of low-income population, such as the areas behind the Convention Center, but it is also home to some of the most upscale buildings in Honolulu, such as Yacht Harbor Tower, Uraku Tower, and the Nauru and Hawaiki Towers in Kakaako. When the Census was taken in 2000, many of the units in these upscale buildings were vacant, but those in more modest buildings were not. If the relative size of block group 37001 had been based on the population count, its relative concentration of low-income population would take on inflated import because its relative size measure did not capture the true character of the block group. This would result in the

block group being selected as an environmental justice area, which would be unreasonable. To avoid this possibility, the relative size measure RS was modified to include the effect of housing vacancy. This amounted to expressing RS in terms of potential population rather than actual population count.

In Figure 18, the low-income RC is plotted against the RS of each block group. The block groups are shown in ascending RS order so that RS appears as a smooth curve and RC as scattered points. Plotted in Figure 19 is the normalized concentration, or NC, of the block groups, which is the distance between each of the RC points and the corresponding value on the RS curve in Figure 18. The normal range within which RC fluctuates about RS is found by identifying the point on the NC curve where the slope of the curve changes sharply. To identify this break in the slope of NC, the NC differences between successive block groups are compiled and their mean and standard deviation are (SD) computed. The frequency distribution of these NC slope increments is shown in Figure 20, along with the mean and SD of the distribution. Note that almost all the slope increments fall within one SD of the mean.

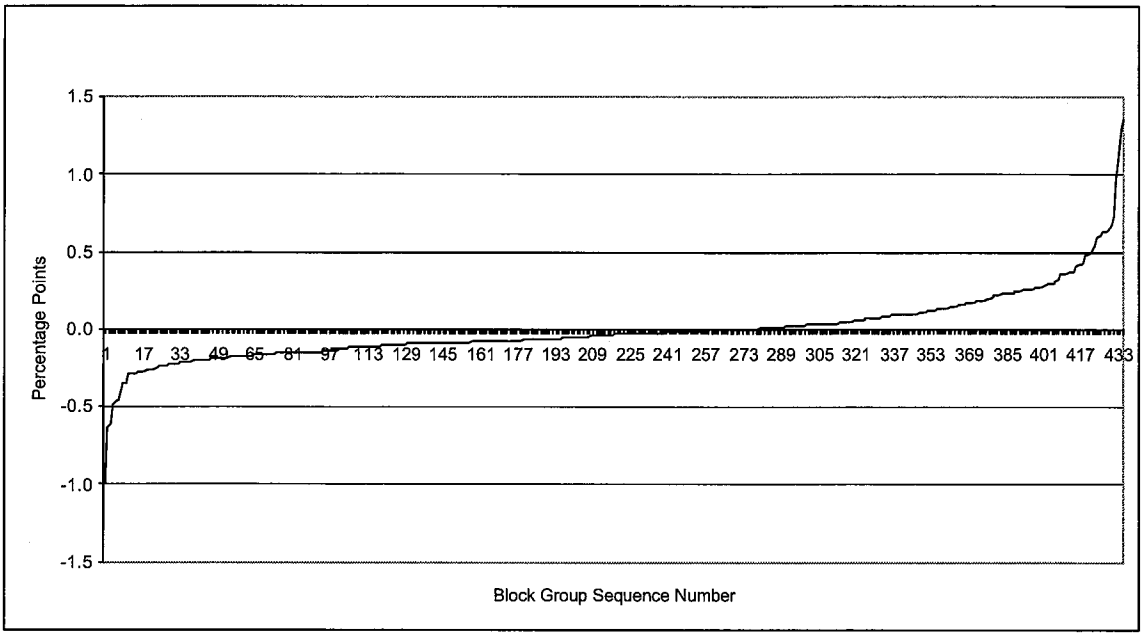
The NC variations are considered normal up to the point where the slope increment of the NC curve exceeds one SD from the mean of all the slope increments. This threshold was used because it yielded the set of low-income environmental justice areas that passed the common-sense test.

Figure 18
Relative Concentration of Low-Income versus Relative Size of Block Groups



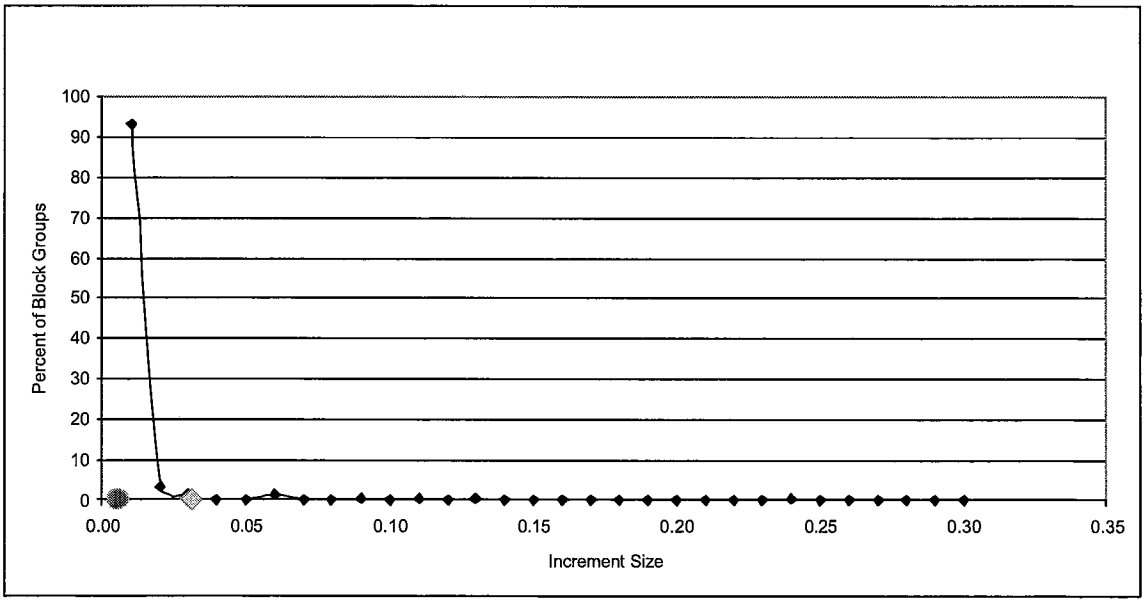
Source: 2000 US Census, City and County of Honolulu DPP

Figure 19
Normalized Concentration of Low-Income in Block Groups



Source: 2000 US Census, City and County of Honolulu DPP

Figure 20
Frequency Distribution of Incremental Changes in Normalized Low-Income Concentration



Source: 2000 US Census, City and County of Honolulu DPP

The block groups identified by the process described above are shown in Figure 21 and summarized in Table 3. A total of 17 out of the 435 block groups on the island were selected on account of low-income. They correspond to well-known poverty areas, such as public housing areas and sites of past urban renewal projects. Also shown in Table 3 are the ranking of the selected block groups in terms of their median income and per capita income, from lowest 1 to highest 435. Note that the selected areas have generally low rankings, but the rankings are not the lowest and they are not consecutive. This means measures, such as median income and capita income, can be used to confirm the selections; but they cannot be used to select the low-income areas for purposes of environmental justice. This is because of the need to account for the interplay of factors involving income distribution, race, and block group size variation.

Figure 21
Low-Income Environmental Justice Areas

Source: 2000 US Census, City and County of Honolulu DPP

Table 3
Low-Income Environmental Justice Areas

DP Area	Location	Military	Block Group	Population (Pop)	Potential (Pot) Population	Median Household Income	Median Household Rank	Per Capita Income	Per Capita Rank	Population Below Poverty (Pov)	Pov Pop as % of Pot Pop
1	Palolo Housing		11002	2050	2073	37500	96	15840	115	677	32.7
1	Kalakaua Housing		36022	2474	2627	16174	5	17987	151	781	29.7
1	Queen Emma Renewal Area		42001	3475	3609	34976	74	19845	191	1215	33.7
1	Kukui Urban Renewal Area		51001	3167	3265	33583	67	23693	270	797	24.4
1	Chinatown		52001	3056	3302	19606	9	14849	95	713	21.6
1	Mayor Wright Housing		54001	1507	1585	16136	4	6171	3	676	42.7
1	Iwilei		57002	1309	1604	16227	6	10268	17	556	34.7
1	Kam Housing		58001	1459	1494	16992	7	7702	7	664	44.4
1	Kuhio Park Terrace		62021	2034	2303	11758	2	4860	2	1336	58.0
1	Kam IV Housing		63021	2768	3060	17452	8	8381	9	1360	44.4
1	Puuwai Momi Housing Complex		75041	3083	3256	31920	56	11934	35	859	26.4
3	Waipahu - Pupupuhi		87032	1627	1880	23438	15	6806	5	601	32.0
3	Wahiawa - Makai		94001	2926	3514	25000	19	10524	20	1122	31.9
8	Nanakuli-Lualualei		96011	2793	3073	35417	79	9264	11	808	26.3
8	Maili		96032	3412	3649	31646	52	11589	33	772	21.2
8	Waianae Kai		97011	2780	3487	26188	23	11097	28	923	26.5
8	Lualualei Homestead		97029	4475	4676	45265	152	12019	39	824	17.6
	Oahu Total			876156	953063					83937	8.8

Source: 2000 US Census, City and County of Honolulu DPP

8. SUMMARY OF ENVIRONMENTAL JUSTICE AREAS

The environmental justice areas selected on the basis of minority race and low-income are combined in Figure 22 and summarized in Table 4. A total of 78, out of 435, block groups were identified. This total reflects the 70 block groups selected because of race and 17 because of low income.

There were 9 block groups that qualified as environmental justice areas on account of either race or income. This means they have disproportionate concentrations of both minority groups and low-income population. It is important to note that these block groups were selected where the race and income criteria were applied independently. All nine areas are NHOPI dominated, with four of the nine areas located along the Waianae coast, where the Native Hawaiian population is most highly concentrated on Oahu.

Figure 22
Oahu Environmental Justice Areas

Source: City and County of Honolulu DPP

Table 4
Oahu Environmental Justice Areas
(Page 1 of 3)

DP Area	Location	Block Group	Military	Poverty	POP	FHWA Minority	Selection Basis							Max Minority Pop	Max Minority Basis	FHWA Minority as % of POP	Selection Basis as % of	
							All	BLACK	AIAN	ASIAN	NHOPI	OTHER	HISP+				POP	Total
1	Aliamanu Military Housing	68041	1		1869	1217	552	552	0	0	0	0.0	0	552	1	65.1	29.5	0.8
1	Aliamanu Military Housing	68042	1		2364	1497	847	465	0	0	0	0.0	382	465	1	63.3	35.8	1.3
1	Aliamanu Military Housing	68043	1		1399	758	324	290	34	0	0	0.0	0	290	1	54.2	23.2	0.5
1	Catlin Naval Housing	70001	1		2051	807	244	244	0	0	0	0.0	0	244	1	39.3	11.9	0.4
1	Ford Island / P.C. Naval Station	81009	1		4210	1448	620	620	0	0	0	0.0	0	620	1	34.4	14.7	0.9
1	Fort Shafter	66009	1		1724	702	302	302	0	0	0	0.0	0	302	1	40.7	17.5	0.4
1	Hickam AFB	71001	1		2270	1127	739	401	0	0	0	0.0	338	401	1	49.6	32.6	1.1
1	Hickam Housing	73009	1		5687	1817	671	671	0	0	0	0.0	0	671	1	32.0	11.8	1.0
1	Pearl Harbor Complex	74009	1		2220	833	339	339	0	0	0	0.0	0	339	1	37.5	15.3	0.5
1	Radford Terrace	69001	1		1950	696	273	273	0	0	0	0.0	0	273	1	35.7	14.0	0.4
1	Tripler	67013	1		2093	1491	232	232	0	0	0	0.0	0	232	1	71.2	11.1	0.3
1	Chinatown	52001		1														
1	Iwilei	57002		1														
1	Kalakaua Housing	36022		1														
1	Kalihi Kai	60001			3379	3013	47	0	47	0	0	0.0	0	47	2	89.2	1.4	0.1
1	Kam Housing	58001		1														
1	Kam IV Housing	63021		1	2768	2713	1329	0	0	0	1329	0.0	0	1329	4	98.0	48.0	2.0
1	Kuhio Park Terrace	62021		1	2034	1992	1456	0	0	0	1456	0.0	0	1456	4	97.9	71.6	2.2
1	Kukui Urban Renewal Area	51001		1														
1	Mayor Wright Housing	54001		1														
1	Palolo Housing	11002		1														
1	Papakolea	44001			2656	2309	1166	0	0	0	1166	0.0	0	1166	4	86.9	43.9	1.7
1	Puunui	46003			1232	1086	44	0	44	0	0	0.0	0	44	2	88.1	3.6	0.1
1	Puuwai Momi Housing Complex	75041		1	3084	2660	1417	0	0	0	1025	0.0	392	1025	4	86.3	45.9	2.1
1	Queen Emma Renewal Area	42001		1														
2	Iroquois Point	83019	1		1187	379	220	220	0	0	0	0.0	0	220	1	31.9	18.5	0.3
2	Ewa Beach	84021			2844	2470	346	0	0	0	0	0.0	346	346	6	86.8	12.2	0.5

Source: 2000 US Census, City and County of Honolulu DPP

Table 4
Oahu Environmental Justice Areas
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DP Area	Location	Block Group	Military	Poverty	POP	FHWA Minority	Selection Basis							Max Minority Pop	Max Minority Basis	FHWA Minority as % of POP	Selection Basis as % of	
							All	BLACK	AIAN	ASIAN	NHOPI	OTHER	HISP+				POP	Total
2	Ewa Gentry	84041			8669	6817	1207	462	0	0	0	0.0	745	745	6	78.6	13.9	1.8
2	Lanikai Hale	86091			1703	1059	281	0	0	0	0	0.0	281	281	6	62.2	16.5	0.4
2	Makakilo	86032			3565	2343	477	0	0	0	0	0.0	477	477	6	65.7	13.4	0.7
2	Makakilo	86042			1641	1243	284	0	0	0	0	0.0	284	284	6	75.7	17.3	0.4
3	Schofield Barracks	90009	1		2829	1207	989	616	0	0	0	0.0	373	616	1	42.7	35.0	1.5
3	Schofield Barracks	95019	1		3450	1664	1561	929	0	0	0	0.0	632	929	1	48.2	45.2	2.3
3	Schofield Barracks	95029	1		4035	1755	1556	875	0	0	0	0.0	681	875	1	43.5	38.6	2.3
3	Schofield Barracks	95039	1		2528	940	764	423	0	0	0	0.0	341	423	1	37.2	30.2	1.1
3	Schofield Barracks	95059	1		3429	1822	1694	1003	0	0	0	0.0	691	1003	1	53.1	49.4	2.5
3	Mililani - Nob Hill	89181			2017	1462	307	0	0	0	0	0.0	307	307	6	72.5	15.2	0.5
3	Mililani Mauka	89169			11181	8907	7175	0	0	7175	0	0.0	0	7175	3	79.7	64.2	10.7
3	Mililani-Kipapa	89079			2057	1569	320	0	0	0	0	0.0	320	320	6	76.3	15.6	0.5
3	Wahiawa - Makai	94001		1	2926	2500	1305	0	0	0	837	0.0	468	837	4	85.4	44.6	1.9
3	Wahiawa - Mauka	92001			2256	1774	355	0	0	0	0	0.0	355	355	6	78.6	15.7	0.5
3	Waipahu	87031			1010	894	573	0	0	0	573	0.0	0	573	4	88.5	56.7	0.9
3	Waipahu	87033			788	693	476	0	0	0	476	0.0	0	476	4	87.9	60.4	0.7
3	Waipahu	89141			2706	2360	740	0	0	0	740	0.0	0	740	4	87.2	27.3	1.1
3	Waipahu - Pupupuhi	87032		1	1627	1450	873	0	0	0	873	0.0	0	873	4	89.1	53.7	1.3
3	Waipio Acres	89151			2754	2328	354	0	0	0	0	0.0	354	354	6	84.5	12.9	0.5
5	Bellows Air Station	113011	1		3102	2383	1191	0	0	0	1191	0.0	0	1191	4	76.8	38.4	1.8
5	Kaneohe Marine Corps Base	108019	1		3906	1334	1139	485	42	0	0	0.0	612	612	6	34.2	29.2	1.7
5	Kaneohe Marine Corps Base	108029	1		7921	2848	2244	962	106	0	0	0.0	1176	1176	6	36.0	28.3	3.3
5	Ahuimanu	103051			3048	2406	402	0	0	0	0	0.0	402	402	6	78.9	13.2	0.6
5	Kahuhipa Apt/Industrial Area	105062			2981	2111	1202	0	0	0	810	0.0	392	810	4	70.8	40.3	1.8
5	Kailua (Ulupaina St.)	109051			2512	1565	38	0	38	0	0	0.0	0	38	2	62.3	1.5	0.1

Source: 2000 US Census, City and County of Honolulu DPP

Table 4
Oahu Environmental Justice Areas
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DP Area	Location	Block Group	Military	Poverty	POP	FHWA Minority	Selection Basis							Max Minority Pop	Max Minority Basis	FHWA Minority as % of POP	Selection Basis as % of	
							All	BLACK	AIAN	ASIAN	NHOPI	OTHER	HISP+				POP	Total
5	Wainamalo Beach - Homesteads	113021			2062	1814	1419	0	0	0	1419	0.0	0	1419	4	88.0	68.8	2.1
5	Wainamalo Beach - Homesteads	113022			2324	1756	1235	0	0	0	1235	0.0	0	1235	4	75.6	53.1	1.8
6	Hauula	102011			2321	1732	1123	0	0	0	1123	0.0	0	1123	4	74.6	48.4	1.7
6	Kahuku	101001			2097	1714	780	0	0	0	780	0.0	0	780	4	81.7	37.2	1.2
6	Laie	102021			1751	1128	667	0	0	0	667	0.0	0	667	4	64.4	38.1	1.0
6	Laie	102022			2137	1520	1145	0	0	0	1145	0.0	0	1145	4	71.1	53.6	1.7
6	Laie	102023			1314	893	549	0	0	0	549	0.0	0	549	4	68.0	41.8	0.8
6	Laie	102029			897	647	528	0	0	0	528	0.0	0	528	4	72.1	58.9	0.8
6	Punaluu	102019			1666	1075	691	0	0	0	691	0.0	0	691	4	64.5	41.5	1.0
6	Waihee	103031			2801	2102	376	0	0	0	0	0.0	376	376	6	75.0	13.4	0.6
7	Kawailoa - Halemano	100009			3291	1902	1073	525	0	0	0	0.0	548	548	6	57.8	32.6	1.6
7	Pupukea	101002			2243	853	48	0	48	0	0	0.0	0	48	2	38.0	2.1	0.1
8	Kaena	98019			2386	1501	375	0	0	0	0	0.0	375	375	6	62.9	15.7	0.6
8	Lualualei Homestead	97021			3714	2856	1450	0	0	0	920	0.0	530	920	4	76.9	39.0	2.2
8	Lualualei Homestead	97029		1	4475	3787	2566	0	64	0	1963	0.0	539	1963	4	84.6	57.3	3.8
8	Maili	96031			2652	2122	1250	0	0	0	835	0.0	415	835	4	80.0	47.1	1.9
8	Maili	96032		1	3412	2860	1752	0	0	0	1246	0.0	506	1246	4	83.8	51.3	2.6
8	Makaha	98021			2853	2106	1386	0	0	0	778	0.0	608	778	4	73.8	48.6	2.1
8	Makaha	98022			1687	1373	901	0	0	0	597	0.0	304	597	4	81.4	53.4	1.3
8	Nanakuli	96041			3191	2627	1968	0	0	0	1587	0.0	381	1587	4	82.3	61.7	2.9
8	Nanakuli	96042			1809	1498	939	0	0	0	662	0.0	277	662	4	82.8	51.9	1.4
8	Nanakuli-Lualualei	96011		1	2793	2383	1593	0	0	0	1593	0.0	0	1593	4	85.3	57.0	2.4
8	Nanakuli-Lualualei	96012			1597	1393	968	0	0	0	968	0.0	0	968	4	87.2	60.6	1.4
8	Nanakuli-Lualualei	96019			2644	2112	1661	0	0	0	1338	0.0	323	1338	4	79.9	62.8	2.5
8	Waianae Kai	97011		1	2780	2239	1652	0	0	0	1216	0.0	436	1216	4	80.5	59.4	2.5
8	Waianae Kai	97012			1632	1341	349	0	0	0	0	0.0	349	349	6	82.2	21.4	0.5
	Oahu Total				876103	131783	67119	10889	423	7175	32316	0	16316			15.0	7.7	100.0
	BG Count	78	20	17		70	70	21	8	1	32	0	36					

Source: 2000 US Census, City and County of Honolulu DPP

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Mr. Steven Young received a Bachelor of Science degree in Electrical Engineering from the University of Hawaii and a Master of Science degree in Civil Engineering from the Massachusetts Institute of Technology. He is currently the Chief of the Planning Research Branch of the City and County of Honolulu's Department of Planning and Permitting and has been with the City for over 25 years.

Mr. Young is responsible for quantitative analyses with respect to land use, economic, population, housing, employment, and transportation. Specifically, he is responsible for the monitoring and forecasting of land use on Oahu, involving the development and application of mathematical and computer models, including geographic information systems. He has developed a computer package for application of disaggregate travel demand models with provisions for aggregation and flow equilibrium.

Mr. Young has also designed and implemented a consolidation of the processes of trip generation, distribution, modal split, and traffic assignment in the UTPS framework. He has participated in numerous traffic, parking, access, and circulation studies, as well as the development of patronage and operating cost estimates for alternative transit systems for Honolulu's transit planning programs.