# Appendix C: Applying Performance Measures

The process of applying performance measures to environmental justice evaluation is conceptually simple, but tends to become more complex in implementation. Conceptually, the following is needed: (1) identify a performance measure; (2) record, estimate, or compute the value of this measure for each neighborhood area defined; and (3) test whether the EJ neighborhoods were disadvantaged with respect to the Non-EJ neighborhoods, or whether the EJ neighborhoods' deficiencies were remedied at least as well as those of the Non-EJ neighborhoods. The following sections highlight some of the complexities of applying this conceptual analysis.

## Travel Demand Forecasting Model

The travel demand forecasting model output includes a number of direct measures of the performance of the current transportation system and the planned transportation system. These allow computation of the prospective improvement in performance on a number of different dimensions.

A critical feature of the travel demand forecasting model output is that most elements are tied either to the TAZ or to a network link. Standard performance tabulations may be designated by both link (to-node, from-node) identification and by the TAZ for which the value was collected. In the discussion to follow, data from the travel demand model will be referred to in terms of a TAZ, but the reader needs to recognize that complete Census and other population and performance data has not been collected on the newly-defined 762 TAZ system for Oahu. Populations have been defined at the level of the Census Block group, because that data did not require adjustment or estimation in order to determine whether an area qualified as an EJ neighborhood. Most transportation performance data generated at the TAZ level was translated to block group levels either by a geoprocessing algorithm within ArcView, or by a block-by-block translation program within the statistical system. To focus attention on the substantive environmental justice issues, the terms EJ and Non-EJ "neighborhoods" refer to the block groups which have been defined based on environmental justice guidelines (see population discussion in Chapter 2).

In cases where the travel demand model does not provide a direct performance indicator, it may provide the basis for norming a value obtained from other sources, such as translating an accident count for an area into an accidents per-vehicle-miles-traveled rate. The following section discusses the application of ORTP results to issues of mobility, accessibility, safety, equity of investments, and expressed public policy.

## Mobility

The key data files produced by travel demand forecasting models are commonly called *trip tables*. These refer, collectively, to a pair of tables which list: (a) the number of trips starting in each TAZ and ending in each other TAZ; and (b) the time that each such trip takes. Trip tables can be computed for the load factors characteristic of various times of the day. For the purposes of this analysis, the tables of interest were the morning home-to-work automobile[1] peak traffic tables. These report the trips most people make to work in the morning, and encompass some of the most congested periods in the travel day. These are trips which most people feel are important because delays have consequences at work, and planning to compensate for possible delays may require household adjustments.

Determining whether EJ neighborhoods are equitably treated in terms of mobility in a transportation plan requires three steps: (1) measure mobility with and without the implementation of the plan; (2) assign the mobility difference measures to the EJ and Non-EJ communities; (3) test the difference to determine whether it is statistically meaningful.

Steps (1) and (2) require translating information presented at the trip level (origin, destination) to information presented at the origin level only. The computation is straightforward:

1. Match the trip times to the number of trips for each plan condition (with plan, without plan) to make a trip-by-time table;
2. Match the trip-by-time tables for the with-plan and without-plan conditions to each other.
3. Compute difference in trip times (without plan - with plan);
4. Compute the total time savings on the trip, using post-plan trip frequencies;
5. Sum these total time savings over all destinations for each origin location;
6. Compute the average time savings for all the trips starting from each location;
7. Assign these values to the EJ and Non-EJ neighborhoods by one of the methods for transforming the TAZ value to a block group value; and
8. Test for the size and statistical significance of the average time difference for the EJ and Non-EJ areas.

The resulting test[2] then shows whether EJ neighborhoods show as high a level of improvement in mobility as do Non-EJ neighborhoods.

## Accessibility

Accessibility is addressed in two different contexts, transit and private automobile travel. Each of these requires substantially different measures. Following is a discussion of the measures and the approach here.

[1]The bus transit trip to work includes walking times to bus stops, waiting times, transfer times, and walking times to work destination, in addition to the actual travel time. A large portion of this time is not subject to ready manipulation by either bus system investment or by modifications of bus operations. For this reason, travel-time based measures of mobility for bus transit passengers have not been included in this analysis.

[2]The statistical test is typically a test for the difference between means, such as a t-test, Analysis of Variance (ANOVA), or General Linear Model (GLM). The formal test is necessary because all of the performance data contains error, and sometimes differences which appear to be meaningful and large are not statistically reliable, but are possibly chance effects.

**Transit Accessibility.** The travel demand forecasting model contains a pre- and post-ORTP bus route system file. This network file listed the characteristics of each road segment used by the bus system. The most stable information used was the overall length of the bus system under the no-plan and with–plan scenarios.

The length of each segment was presented in the network file, and generally attributed to a TAZ. In principle, the difference in the total length of the bus route in each TAZ[3] across the two policy scenarios is computed and assigned to the EJ and Non-EJ neighborhoods. The results are then tested.

These computations allow the evaluation of whether EJ neighborhoods received comparable quantities of bus system improvements, as indexed by the miles of bus route in the area as Non-EJ neighborhoods.

**Automobile Accessibility.** The end-result of an accessible transportation system for auto users is whether they can perform critical family functions within some limited period of time. Time is important, because it sets the ultimate boundaries on whether an activity or travel to it is feasible and practical. For many able-bodied adults it is *possible* in Hawaii's weather to walk from any point on the Island of Oahu to any other. There are no physical impediments to walking from Kailua to a job downtown. The job downtown is nevertheless not accessible from Kailua by foot, because these same able-bodied adults will not accept a two- to four-hour walk over a mountain to work.

The travel demand forecasting model creates a self-validating model of accessibility to workplaces. The morning peak home-to-work trip table reflects what the population will do under the travel demand forecasting model. Some persons in every TAZ may actually travel 45 minutes to work. Others may travel only a few minutes. For each trip from a given origin TAZ to a workplace destination, both a time to work and the number of people who go to that destination can be assigned. The trips that take 15 minutes or less from each TAZ origin are then sorted. Each of these will be to one of the 762 TAZ areas. Summing the number of people who go to each destination TAZ for an origin gives an index of the total count of the number of jobs that are actually reached in 15 minutes or less. The same process can be executed for 15- and 30-minute trips. Obviously the 45 minute trip pool contains most of the jobs on Oahu for most TAZ origin locations.[4] The 15-minute commute distance job count is smaller and more variable. It thus provides a sensitive measurement of workplace accessibility for future analysis using the travel demand forecasting model.

[3]Since the TAZ does not correspond completely to the block group, and because of certain data recording conventions in setting up the bus route diagram, it was necessary to divide some segments of the network where they crossed TAZ or block group boundary lines.

[4]The allocation procedure for job destinations involved using the statistical procedure algorithm to break down the composition of the TAZ values into blocks, then aggregating the values back into block groups.

## Safety

Safety data was tabulated by the Department of Transportation into block group totals for the years 1995-1999. In order to represent the crash frequency as a measure of relative risk, it is necessary to normalize it to a count of exposure. For the purposes of this analysis, the trip frequencies and link distances within each TAZ are used as an indicator of miles traveled within the TAZ. A ratio of crashes-to-miles traveled, then, is an index of the likelihood of being involved in a crash driving one mile within the TAZ. Of course, a one-mile risk is a very tiny number, so it is standard to present crash risks in terms of crashes per million vehicle miles traveled (VMT).

The conceptual process detailed above is implemented by determining the total miles traveled in each study area, then computing the risk of crash per million miles traveled within the TAZ. For the current study, block tabulations of crashes were transformed into block group values. In the future, it should be possible to aggregate the crash counts from blocks into the TAZ in order to compare directly with vehicle miles traveled data from the travel demand model. The crash count per million VMT can be tested across the EJ and non-EJ communities to determine whether EJ communities are disadvantaged in the transportation plan[5].

## Displacement

The logic of an environmental justice consideration of displacement is the desire to prevent or correct a pattern of running major improvements through the districts of people who had little access to the policy process. Historically, U.S. cities have often built expressways and various other urban dividers between low-income minority neighborhoods and the remainder of the city. One of the clearest indicators of potential displacement is provided by right-of-way condemnation actions.

The nature of the long-term projects in the ORTP does not allow very precise measurement of either the magnitude of the land-taking that might be involved, nor of the funds budgeted. The TIP (Transportation Improvement Program) projects, however, provide budget estimates of right-of-way costs. We use these budget allocations in the analysis.

The TIP projects are taken to have local effects as far as the acquisition of right-of-way is concerned. It is not possible to determine whether businesses or homes will be displaced, but in many areas there is little free space that would allow a highway or intersection expansion without displacing some function. The question of the proper base for the TIP right-of-way comparisons arises because there are relatively few TIP right-of-way budget allocations. The most simple base of comparison would be between the EJ and Non-EJ neighborhoods in which right-of way funds have been allocated. This test would not normally allow an assessment with respect to places in which no expenditures were made.

[5]Note that the number of crashes that each TAZ might see in the future cannot be meaningfully predicted, except by multiplying by some constant based on current crash risks.

## Equity (Distribution of Transportation Investments)

One of the common questions about the internal equity of a transportation investment program that can be raised in the context of an environmental justice discussion is whether EJ neighborhoods receive lower levels of investment than the Non-EJ areas. The most challenging projects to assess in these terms are those which span several different neighborhoods.

Projects in the ORTP were divided into network projects, which were regional in nature, and spot projects which dealt with a single bridge or some localized construction. The two classes were treated separately.

The spot projects[6] were handled by assigning the value of the improvements to the EJ or Non-EJ neighborhood where they were constructed. The test across the two classes of neighborhoods then addresses the question of whether these site-based projects were allocated equitably.

The projects which spanned multiple neighborhoods were treated by allocating the per-mile cost of each project to the neighborhoods through which the project passed. The test of differences across the EJ / Non-EJ groups is then the test of the equity of the assignment of investments.

[6]There are not very many spot projects in the ORTP (about 15). This number is too small for extensive analysis, since the average variation in the dollar values is large, compared to the averages allocated to the two classes of neighborhoods.

## Population Policy

There is a long history in Hawaii of citizens being very protective of the character of their neighborhoods. One of the persistent themes in discussions of the Oahu General Plan (1994), Development Plans and Sustainable Community Plans in many locales is the notion of “keep country country.” By this the discussants usually mean retaining some level of rural appearance, together with slow growth or population restriction efforts.

The community’s public policy on this subject is embodied in the Oahu General Plan (1994) and related regional planning documents. At this point, the General Plan is the only fully approved plan that covers the entire island. It spells out growth goals for each area of the island. The distinction between areas planned for growth and those for which growth is slowed will be used to assess the appropriateness of major projects.