Appendix M

Air Quality Study for the Proposed Kaloko Makai Project
B.D. Neal & Associates
October 31, 2012

Draft

AIR QUALITY STUDY

FOR THE PROPOSED

KALOKO MAKAI VILLAGE PROJECT

NORTH KONA, HAWAII

Prepared for:

Stanford Carr Development

October 31, 2012

B.D. NEAL & ASSOCIATES

Applied Meteorology • Air Quality • Computer Science

P.O. BOX 1808 • KAILUA-KONA, HAWAII 96745 • TELPHONE (808) 329-1627 • FAX (808) 325-6739
EMAIL: bdneal@bdneal.com

CONTENTS

FIGURES

TABLES

TABLES (cont.)

1.0 SUMMARY

Sanford Carr Development is proposing to develop the Kaloko Makai Village Project in the North Kona District on the island of Hawaii. The proposed 1,139-acre project will include single and multi-family housing, a hotel, commercial space, two schools, parks and other associated amenities and facilities. Development of the project is expected to occur in three phases and be completed and fully occupied by 2045. This study examines the potential short- and long-term air quality impacts that could occur as a result of construction and use of the proposed facilities and suggests mitigative measures to reduce any potential air quality impacts where possible and appropriate.

Both federal and state standards have been established to maintain ambient air quality. At the present time, seven parameters are regulated including: particulate matter, sulfur dioxide, hydrogen sulfide, nitrogen dioxide, carbon monoxide, ozone and lead. Hawaii air quality standards are comparable to the national standards, although in some cases the Hawaii standards are more stringent than the national standards, such as for carbon monoxide. For some other parameters, such as for particulate matter and sulfur dioxide, the national standards are more restrictive.

Regional and local climate together with the amount and type of human activity generally dictate the air quality of a given location. The climate of the project area is very much affected by its near coastal situation and by nearby mountains. Winds are predominantly light and variable, although kona storms generate occasional strong winds from the south or southwest during winter. Temperatures in the project area are generally very consistent and moderate with average daily temperatures ranging from about 65°F to 85°F. The extreme minimum temperature recorded at the nearby Old Kona Airport is 47°F, while the extreme maximum temperature is 93°F. Average annual rainfall in the area amounts to about 25 inches with each month typically contributing about 2 inches.

Except for periodic impacts from volcanic emissions (vog) and possibly occasional localized impacts from traffic congestion, the present air quality of the project area is believed to be relatively good. The limited air quality data that are available for the area from the Department of Health indicate that fine particulate concentrations, which are due to the vog, exceed the national air quality standards.

If the proposed project is given the necessary approvals to proceed, it may be inevitable that some short- and/or long-term impacts on air quality will occur either directly or indirectly as a consequence of project construction and use. Short-term impacts from fugitive dust will likely occur during the project construction phases. To a lesser extent, exhaust emissions from stationary and mobile construction equipment, from the disruption of traffic, and from workers' vehicles may also affect air quality during construction periods. State air pollution control regulations require that there be no visible fugitive dust

emissions at the property line. Hence, an effective dust control plan must be implemented to ensure compliance with state regulations. Fugitive dust emissions can be controlled to a large extent by watering of active work areas, using wind screens, keeping adjacent paved roads clean, and by covering of open-bodied trucks. Other dust control measures could include limiting the area that can be disturbed at any given time and/or mulching or chemically stabilizing inactive areas that have been worked. Paving and landscaping of project areas early in the construction schedule will also reduce dust emissions. Monitoring dust at the project boundary during periods of construction could be considered as a means to evaluate the effectiveness of the project dust control program. Exhaust emissions can be mitigated by moving construction equipment and workers to and from the project site during off-peak traffic hours.

After construction, motor vehicles coming to and from the proposed development will result in a long-term increase in air pollution emissions in the project area. To assess the impact of emissions from these vehicles, a computerized air quality modeling study was undertaken to estimate current ambient concentrations of carbon monoxide at roadway intersections in the project vicinity and to predict future levels with and without the proposed project. During worst-case conditions, model results indicated that present 1-hour and 8-hour carbon monoxide concentrations are within both the state and the national ambient air quality standards. Without the project, carbon monoxide concentrations can be expected to gradually increase through the year 2045 but remain within standards. With the project in the year 2025, after the first phase of the project is completed, carbon monoxide concentrations were estimated to increase moderately in the project area compared to without it, but concentrations would continue to comply with air quality standards. Increases were predicted to continue in the second and third phases of the project, but concentrations should remain within state and federal standards through the year 2045. Implementing mitigation measures for traffic-related air quality impacts is probably unnecessary and unwarranted.

Depending on the demand levels, long-term impacts on air quality are also possible due to indirect emissions associated with a development's electrical power and solid waste disposal requirements. Quantitative estimates of these potential impacts were not made, but based on the estimated demand levels and emission rates involved, any significant impacts are unlikely. Nevertheless, incorporating energy conservation design features and promoting conservation and recycling programs within the proposed development could serve to further reduce any associated impacts and conserve the island's resources.

2.0 INTRODUCTION

Sanford Carr Development is proposing to develop the Kaloko Makai Village Project on approximately 1,139 acres of undeveloped lands in the North Kona District on the island of Hawaii (see Figure 1 for project location). The project site straddles Hina Lani Street between Queen Kaahumanu Highway and Mamalahoa Highway. The proposed mixed-use development includes multi- and single-family housing, a hotel, parks, an elementary school, a middle school,

hospital/medical facilities, commercial space for stores and services, office space, fire/police facilities, a wastewater treatment plant, light industrial space and other associated facilities and infrastructure. Development is planned for three phases which are expected to be completed in approximately 10-year increments (2025, 2035 and 2045).

The purpose of this study is to describe existing air quality in the project area and to assess the potential short- and long-term direct and indirect air quality impacts that could result from construction and use of the proposed facilities as planned. Measures to mitigate project impacts are suggested where possible and appropriate.

3.0 AMBIENT AIR QUALITY STANDARDS

Ambient concentrations of air pollution are regulated by both national and state ambient air quality standards (AAQS). National AAQS are specified in Section 40, Part 50 of the Code of Federal Regulations (CFR), while State of Hawaii AAQS are defined in Chapter 11-59 of the Hawaii Administrative Rules. Table 1 summarizes both the national and the state AAQS that are specified in the cited documents. As indicated in the table, national and state AAQS have been established for particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone and lead. The state has also set a standard for hydrogen sulfide. National AAQS are stated in terms of both primary and secondary standards for most of the regulated air pollutants. National primary standards are designed to protect the public health with an "adequate margin of safety". National secondary standards, on the other hand, define levels of air quality necessary to protect the public welfare from "any known or anticipated adverse effects of a pollutant". Secondary public welfare impacts may include such effects as decreased visibility, diminished comfort levels, or other potential injury to the natural or man-made environment, e.g., soiling of materials, damage to vegetation or other economic damage. In contrast to the national AAQS, Hawaii State AAQS are given in terms of a single standard that is designed "to protect public health and welfare and to prevent the significant deterioration of air quality".

Each of the regulated air pollutants has the potential to create or exacerbate some form of adverse health effect or to produce environmental degradation when present in sufficiently high concentration for prolonged periods of time. The AAQS specify a maximum allowable concentration for a given air pollutant for one or more averaging times to prevent harmful effects. Averaging times vary from one hour to one year depending on the pollutant and type of exposure necessary to cause adverse effects. In the case of the short-term (i.e., 1- to 24-hour) AAQS, both national and state standards allow a specified number of exceedances each year.

The Hawaii AAQS are in some cases considerably more stringent than the comparable national AAQS. In particular, the Hawaii 1-hour AAQS for carbon monoxide is four times more stringent than the comparable national limit.

The national AAQS are reviewed periodically, and multiple revisions have occurred over the past 30 years. In general, the national AAQS have become more stringent with the passage of time and as more information and evidence become available concerning the detrimental effects of air pollution. Changes to the Hawaii AAQS over the past several years have tended to follow revisions to the national AAQS, making several of the Hawaii AAQS the same as the national AAQS.

4.0 REGIONAL AND LOCAL CLIMATOLOGY

Regional and local climatology significantly affect the air quality of a given location. Wind, temperature, atmospheric turbulence, mixing height and rainfall all influence air quality. Although the climate of Hawaii is relatively moderate throughout most of the state, significant differences in these parameters may occur from one location to another. Most differences in regional and local climates within the state are caused by the mountainous topography.

The site of the proposed project is located near the midpoint of the western coast of the island of Hawaii. The topography of Hawaii Island is dominated by the great volcanic masses of Mauna Loa (13,653 feet), Mauna Kea (13,796 feet), and of Hualalai, the Kohala Mountains and Kilauea. The island consists entirely of the slopes of these mountains and of the broad saddles between them. Mauna Loa and Kilauea, located on the southern half of the island, are still active volcanoes.

Hawaii lies well within the belt of northeasterly trade winds generated by the semi-permanent Pacific high pressure cell to the north and east. Nearly the entire western coast of the island of Hawaii, however, is sheltered from the trade winds by high mountains, except when unusually strong trade winds sweep through the saddle between the Kohala Mountains and Mauna Kea and reach some areas to the lee. Due to wind shadow effects caused by the terrain, winds in the project area are predominantly light and variable. Local winds such as land/sea breezes and/or upslope/downslope winds dominate the wind pattern for the area. During the daytime, winds typically move onshore because of seabreeze and/or upslope effects. At night, winds generally are land breezes and/or drainage winds that move downslope and out to sea. During winter, occasional strong winds from the south or southwest occur in association with the passage of winter storm systems.

Air pollution emissions from motor vehicles, the formation of photochemical smog and smoke plume rise all depend in part on air temperature. Colder temperatures tend to result in higher emissions of contaminants from automobiles but lower concentrations of photochemical smog and ground-level concentrations of air pollution from elevated plumes. In Hawaii, the annual and daily variation of temperature depends to a large degree on elevation above sea level, distance inland and exposure to the trade winds. Average temperatures at locations near sea

level generally are warmer than those at higher elevations. Areas exposed to the trade winds tend to have the least temperature variation, while inland and leeward areas often have the most. The project site's leeward location results in a larger temperature profile compared to windward locations at the same elevation. At the Old Kona Airport, located a few miles south of the project site, average daily minimum and maximum temperatures are 67°F and 83°F, respectively [1]. The extreme minimum temperature on record at this location is 47°F, and the extreme maximum is 93°F. Temperatures at the project site are similar.

Small scale, random motions in the atmosphere (turbulence) cause air pollutants to be dispersed as a function of distance or time from the point of emission. Turbulence is caused by both mechanical and thermal forces in the atmosphere. It is often measured and described in terms of Pasquill-Gifford stability class. Stability class 1 is the most turbulent and class 6 is the least. Thus, air pollution dissipates the best during stability class 1 conditions and the worst when stability class 6 prevails. In the Kona area, stability classes 5 or 6 typically occur during the nighttime or early morning hours when temperature inversions form due to radiational cooling or to drainage flow from the mountainous interior of the island. Stability classes 1 through 4 occur during the daytime, depending mainly on the amount of cloud cover and incoming solar radiation and the onset and extent of the sea breeze.

Mixing height is defined as the height above the surface through which relatively vigorous vertical mixing occurs. Low mixing heights can result in high ground-level air pollution concentrations because contaminants emitted from or near the surface can become trapped within the mixing layer. In Hawaii, minimum mixing heights tend to be high because of mechanical mixing caused by the trade winds and because of the temperature moderating effect of the surrounding ocean. Low mixing heights may sometimes occur, however, at inland locations and even at times along coastal areas early in the morning following a clear, cool, windless night. Coastal areas also may experience low mixing levels during sea breeze conditions when cooler ocean air rushes in over warmer land. Mixing heights in Hawaii typically are above 3000 feet (1000 meters).

Rainfall can have a beneficial affect on the air quality of an area in that it helps to suppress fugitive dust emissions, and it also may "washout" gaseous contaminants that are water soluble. Rainfall in Hawaii is highly variable depending on elevation and on location with respect to the trade wind. The climate of the project area is wetter than might be expected for a leeward location. This is due to the persistent onshore and upslope movement of marine air caused by both eddie and seabreeze or mountain slope effects. Some of the rainfall occurs during summer afternoons and evenings as a result of this onshore and upslope movement of moisture-laden marine air, and some occurs in conjunction with winter storms. At the Old Kona Airport, average annual rainfall amounts to about 25 inches with each month registering about 2 inches [1]. Rainfall at the project site is probably about the same.

5.0 PRESENT AIR QUALITY

Present air quality in the project area is mostly affected by air pollutants from vehicular, industrial, natural and/or agricultural sources. Table 2 presents an air pollutant emission summary for the island of Hawaii for calendar year 1993. This has become somewhat dated but is the latest information available. The emission rates shown in the table pertain to manmade emissions only, i.e., emissions from natural sources are not included. As suggested in the table, much of the manmade particulate emissions on Hawaii originate from area sources, such as the mineral products industry and agriculture. Manmade sulfur oxides are emitted almost exclusively by point sources, such as power plants and other fuel-burning industries. Nitrogen oxides emissions emanate predominantly from area sources (mostly motor vehicle traffic), although industrial point sources contribute a significant share. The majority of carbon monoxide emissions occur from area sources (motor vehicle traffic), while hydrocarbons are emitted mainly from point sources. Based on previous emission inventories that have been reported for Hawaii, emissions of particulate and nitrogen oxides may have increased during the past several years, while emissions of sulfur oxides, carbon monoxide and hydrocarbons probably have declined.

It should be noted that Hawaii Island is unique from the other islands in the state in terms of the natural volcanic air pollution emissions that occur. Volcanic emissions periodically plague the project area. This is especially so since the latest eruption phase of the Kilauea Volcano began in 1983. Air pollution emissions from the Hawaiian volcanoes consist primarily of sulfur dioxide. After entering the atmosphere, these sulfur dioxide emissions are carried away by the wind and either washed out as acid rain or gradually transformed into particulate sulfates or acid aerosols. Although emissions from Kilauea are vented on the other side of a mountain barrier more than 50 miles east of the project site, the prevailing wind patterns eventually carry some of the emissions into the Kona area. These emissions can be seen in the form of the volcanic haze (vog) which persistently hangs over the area.

The major industrial source of air pollution in the project vicinity is Hawaii Electric Light Company's Keahole Power Plant, which is located about 2 miles to the north. Air pollution emissions from Keahole Power Plant consist mostly of sulfur dioxide and oxides of nitrogen.

The project site is situated between Queen Kaahumanu Highway on the makai side and Mamalahoa Highway on the mauka side. Both of these highways are regional arterial roadways that often carry substantial volumes of traffic. Winds may sometimes carry emissions from motor vehicles traversing these roadways toward the project site.

The State Department of Health operates a network of air quality monitoring stations at various locations around the state. Unfortunately, very limited data are available for Hawaii Island,

and even less data are available for the Kona area specifically. During the most recent 5-year period for which data have been reported (2006-2010), the Department of Health operated an air quality monitoring site in the Kealakekua area for measuring sulfur dioxide. Particulate (PM 2.5) was also monitored at this site, but monitoring for this parameter was only initiated during 2008. As indicated in Table 3, measurements of sulfur dioxide concentrations at this location during the 2006-2010 monitoring period were consistently low with annual average concentrations of 0.004 to 0.009 ppm, which represents about 30 percent of the state and national standard. The highest annual second-highest 3-hour and 24-hour concentrations (which are most relevant to the standards) for these five years were 0.112 and 0.042 ppm, respectively; these are about 22 to 30 percent of the applicable standards. No exceedances of the state/national 3-hour and 24-hour AAQS for sulfur dioxide were recorded.

The annual average particulate (PM 2.5) concentrations for the years 2008 through 2010 ranged from 16 to 21 $\mu g/m^3$. These values exceed the national annual standard which is set at 15 $\mu g/m^3$. The 98^{th} percentile 24-hour concentration (which is most relevant to the national 24-hour standard) was reported at 37 $\mu g/m^3$ for 2008 and 2009 and at 35 $\mu g/m^3$ for 2010. These values are slightly above or equal to the national standard of 35 $\mu g/m^3$. These higher concentrations of fine particulate are primarily due to volcanic emissions.

At this time, there are no reported measurements of lead, ozone, nitrogen dioxide or carbon monoxide in the project vicinity. These are primarily motor vehicle related air pollutants. Lead, ozone and nitrogen dioxide typically are regional scale problems. Concentrations of lead and nitrogen dioxide generally have not been found to exceed AAQS elsewhere in the state. Ozone concentrations, on the other hand, have been found to exceed the state standard at times at Sand Island on Oahu. Carbon monoxide air pollution typically is a microscale problem caused by congested motor vehicular traffic. In traffic congested areas such as urban Honolulu, carbon monoxide concentrations have been found to occasionally exceed the state AAQS. Present concentrations of carbon monoxide in the project area are estimated later in this study based on computer modeling of motor vehicle emissions.

6.0 SHORT-TERM IMPACTS OF PROJECT

Short-term direct and indirect impacts on air quality could potentially occur due to project construction. For a project of this nature, there are two potential types of air pollution emissions that could directly result in short-term air quality impacts during project construction: (1) fugitive dust from vehicle movement and soil excavation; and (2) exhaust emissions from on-site construction equipment. Indirectly, there also could be short-term impacts from slow-moving construction equipment traveling to and from the project site, from a temporary increase in local traffic caused by commuting construction workers, and from the disruption of normal traffic flow caused by lane closures of adjacent roadways.

Fugitive dust emissions may arise from the grading and dirt-moving activities associated with site clearing and preparation work. The emission rate for fugitive dust emissions from construction activities is difficult to estimate accurately. This is because of its elusive nature of emission and because the potential for its generation varies greatly depending upon the type of soil at the construction site, the amount and type of dirt-disturbing activity taking place, the moisture content of exposed soil in work areas, and the wind speed. The EPA [2] has provided a rough estimate for uncontrolled fugitive dust emissions from construction activity of 1.2 tons per acre per month under conditions of "medium" activity, moderate soil silt content (30%), and precipitation/evaporation (P/E) index of 50. Uncontrolled fugitive dust emissions at the project site would likely be somewhere near that level, depending on the amount of rainfall that occurs. In any case, State of Hawaii Air Pollution Control Regulations [3] prohibit visible emissions of fugitive dust from construction activities at the property line. Thus, an effective dust control plan for the project construction phase is essential.

Adequate fugitive dust control can usually be accomplished by the establishment of a frequent watering program to keep bare-dirt surfaces in construction areas from becoming significant sources of dust. In dust-prone or dust-sensitive areas, other control measures such as limiting the area that can be disturbed at any given time, applying chemical soil stabilizers, mulching and/or using wind screens may be necessary. Control regulations further stipulate that open-bodied trucks be covered at all times when in motion if they are transporting materials that could be blown away. Haul trucks tracking dirt onto paved streets from unpaved areas is often a significant source of dust in construction areas. Some means to alleviate this problem, such as road cleaning or tire washing, may be appropriate. Paving of parking areas and/or establishment of landscaping as early in the construction schedule as possible can also lower the potential for fugitive dust emissions. Monitoring dust at the project property line could be considered to quantify and document the effectiveness of dust control measures.

On-site mobile and stationary construction equipment also will emit air pollutants from engine exhausts. The largest of this equipment is usually diesel-powered. Nitrogen oxides emissions from diesel engines can be relatively high compared to gasoline-powered equipment, but the annual standard for nitrogen dioxide is not likely to be violated by short-term construction equipment emissions. Also, the new short-term (1-hour) standard for nitrogen dioxide is based on a three-year average; thus it is unlikely that relatively short-term construction emissions would exceed the standard. Carbon monoxide emissions from diesel engines are low and should be relatively insignificant compared to vehicular emissions on nearby roadways.

Project construction activities will also likely obstruct the normal flow of traffic at times to such an extent that overall vehicular emissions in the project area will temporarily increase. The only means to alleviate this problem will be to attempt to keep roadways open during peak traffic hours and to

move heavy construction equipment and workers to and from construction areas during periods of low traffic volume. Thus, most potential short-term air quality impacts from project construction can be mitigated.

7.0 LONG-TERM IMPACTS OF PROJECT

7.1 Roadway Traffic

After construction is completed, use of the proposed facilities will result in increased motor vehicle traffic in the project area, potentially causing long-term impacts on ambient air quality. Motor vehicles with gasoline-powered engines are significant sources of carbon monoxide. They also emit nitrogen oxides and other contaminates.

Federal air pollution control regulations require that new motor vehicles be equipped with emission control devices that reduce emissions significantly compared to a few years ago. In 1990, the President signed into law the Clean Air Act Amendments. This legislation requires further emission reductions, which have been phased in since 1994. More recently, additional restrictions were signed into law during the Clinton administration, which will begin to take effect during the next decade. The added restrictions on emissions from new motor vehicles will lower average emissions each year as more and more older vehicles leave the state's roadways. It is estimated that carbon monoxide emissions, for example, will go down by an average of about 20 percent per vehicle during the next 10 years due to the replacement of older vehicles with newer models.

To evaluate the potential long-term indirect ambient air quality impact of increased roadway traffic associated with a project such as this, computerized emission and atmospheric dispersion models can be used to estimate ambient carbon monoxide concentrations along roadways leading to and from the project. Carbon monoxide is selected for modeling because it is both the most stable and the most abundant of the pollutants generated by motor vehicles. Furthermore, carbon monoxide air pollution is generally considered to be a microscale problem that can be addressed locally to some extent, whereas nitrogen oxides air pollution most often is a regional issue that cannot be addressed by a single new development.

For this project, seven scenarios were evaluated for the carbon monoxide modeling study: year 2011 with present conditions; years 2025, 2035 and 2045 without the project; and years 2025, 2035 and 2045 with the project. The years evaluated correspond to the three project phases that are planned. To begin the modeling study of the seven study scenarios, critical receptor areas in the vicinity of the project were identified for analysis. Generally speaking, roadway intersections are the primary concern because of traffic congestion and because of the increase in vehicular emissions associated with traffic queuing. For this study, the same key intersections identified in the traffic study were also selected for air quality analysis. These included the following intersections:

- Queen Kaahumanu Highway at Kaiminani Drive
- Queen Kaahumanu Highway at Hulikoa Drive
- Queen Kaahumanu Highway at Hina Lani Street
- Queen Kaahumanu Highway at Kealakehe Parkway
- Hina Lani Street at Kanalani Street
- Hina Lani Street at Kamanu Street
- Hina Lani Street at Ane Keohokalole Highway
- Hina Lani Street at Mamalahoa Highway

The traffic impact report for the project [4] describes the projected future traffic conditions and laneage configurations of these intersections in detail. In performing the air quality impact analysis, it was assumed that all recommended traffic mitigation measures would be implemented.

The main objective of the modeling study was to estimate maximum 1-hour average carbon monoxide concentrations for each of the scenarios studied. To evaluate the significance of the estimated concentrations, a comparison of the predicted values for each scenario can be made. Comparison of the estimated values to the national and state AAQS was also used to provide another measure of significance.

Maximum carbon monoxide concentrations typically coincide with peak traffic periods. The traffic impact assessment report evaluated morning and afternoon peak traffic periods. These same periods were evaluated in the air quality impact assessment.

The EPA computer model MOBILE6.2 [5] was used to calculate vehicular carbon monoxide emissions for each year studied. One of the key inputs to MOBILE6.2 is vehicle mix. Unless very detailed information is available, national average values are typically assumed, which is what was used for the present study. Based on national average vehicle mix figures, the present vehicle mix in the project area was estimated to be 34.2% light-duty gasoline-powered automobiles, 52.8% light-duty gasoline-powered trucks and vans, 3.6% heavy-duty gasoline-powered vehicles, 0.2% light-duty diesel-powered vehicles, 8.6% heavy-duty diesel-powered trucks and buses, and 0.6% motorcycles. For the future scenarios studied, the vehicle mix was estimated to change slightly with fewer light-duty gasoline-powered automobiles and more light-duty gasoline-powered trucks and vans.

Ambient temperatures of 59 and 68 degrees F were used for morning and afternoon peak-hour emission computations, respectively. These are conservative assumptions since morning/afternoon ambient temperatures will generally be warmer than this, and emission estimates given by MOBILE6.2 generally have an inverse relationship to the ambient temperature.

After computing vehicular carbon monoxide emissions through the use of MOBILE6.2, these data were then input to an atmospheric dispersion model. EPA air quality modeling guidelines [6] currently recommend that the computer model CAL3QHC [7] be used to assess carbon monoxide concentrations at roadway

intersections, or in areas where its use has previously been established, CALINE4 [8] may be used. Until a few years ago, CALINE4 was used extensively in Hawaii to assess air quality impacts at roadway intersections. In December 1997, the California Department of Transportation recommended that the intersection mode of CALINE4 no longer be used because it was thought the model has become outdated. Studies have shown that CALINE4 may tend to over-predict maximum concentrations in some situations. Therefore, CAL3QHC was used for the subject analysis.

CAL3QHC was developed for the U.S. EPA to simulate vehicular movement, vehicle queuing and atmospheric dispersion of vehicular emissions near roadway intersections. It is designed to predict 1-hour average pollutant concentrations near roadway intersections based on input traffic and emission data, roadway/receptor geometry and meteorological conditions.

Input peak-hour traffic data were obtained from the traffic study cited previously. This included vehicle approach volumes, saturation capacity estimates, intersection laneage and signal timings. All emission factors that were input to CAL3QHC for free-flow traffic on roadways were obtained from MOBILE6.2 based on assumed free-flow vehicle speeds corresponding to the posted speed limits.

Model roadways were set up to reflect roadway geometry, physical dimensions and operating characteristics. Concentrations predicted by air quality models generally are not considered valid within the roadway-mixing zone. The roadway-mixing zone is usually taken to include 3 meters on either side of the traveled portion of the roadway and the turbulent area within 10 meters of a cross street. Model receptor sites were thus located at the edges of the mixing zones near all intersections that were studied for all three scenarios. This implies that pedestrian sidewalks either already exist or are assumed to exist in the future. All receptor heights were placed at 1.8 meters above ground to simulate levels within the normal human breathing zone.

Input meteorological conditions for this study were defined to provide "worst-case" results. One of the key meteorological inputs is atmospheric stability category. For these analyses, atmospheric stability category 6 was assumed for the morning cases, while atmospheric stability category 4 was assumed for the afternoon cases. These are the most conservative stability categories that are generally used for estimating worst-case pollutant dispersion within suburban areas for these periods. A surface roughness length of 100 cm and a mixing height of 1000 meters were used in all cases. Worst-case wind conditions were defined as a wind speed of 1 meter per second with a wind direction resulting in the highest predicted concentration. Concentration estimates were calculated at wind directions of every 5 degrees.

Existing background concentrations of carbon monoxide in the project vicinity are believed to be at low levels. Thus, background contributions of carbon monoxide from sources or

roadways not directly considered in the analysis were accounted for by adding a background concentration of 0.5 ppm to all predicted concentrations for 2011. Although increased traffic is expected to occur within the project area during the next several years with or without the project, background carbon monoxide concentrations may not change significantly since individual emissions from motor vehicles are forecast to decrease with time. Hence, a background value of 0.5 ppm was assumed to persist for the future scenario studied.

Predicted Worst-Case 1-Hour Concentrations

Table 4 summarizes the final results of the modeling study in the form of the estimated worst-case 1-hour morning and afternoon ambient carbon monoxide concentrations. These results can be compared directly to the state and the national AAQS. Estimated worst-case carbon monoxide concentrations are presented in the table for seven scenarios: year 2011 with existing traffic; years 2025, 2035 and 2045 without the project; and years 2025, 2035 and 2045 with the project. The locations of these estimated worst-case 1-hour concentrations all occurred at or very near the indicated intersections.

As indicated in the table, the highest estimated 1-hour concentration within the project vicinity for the present (2011) case was 3.6 ppm. This was projected to occur during the morning peak traffic hour near the intersection of Queen Kaahumanu Highway and Kealakehe Parkway. Concentrations at other locations and times studied were 2.9 ppm or lower. All predicted worst-case 1-hour concentrations for the 2011 scenario were within both the national AAQS of 35 ppm and the state standard of 9 ppm.

In the year 2025 without the project, the predicted highest worst-case 1-hour concentration continued to occur during the morning at the intersection of Queen Kaahumanu Highway and Kealakehe Parkway with a value of 3.9 ppm. Other concentrations for this scenario ranged between 1.4 and 3.2 ppm. The predicted concentrations for 2025 without the project are slightly higher at most of the locations studied compared to the existing case, but the predicted worst-case concentrations remained within standards. As indicated by the other results shown in Table 4, this trend would continue in 2035 and 2045 without the project with worst-case concentrations tending to increase slightly, but the concentrations are projected to remain within standards.

In the year 2025 with the proposed project, the predicted highest worst-case 1-hour concentration occurred during the morning at the intersection of Queen Kaahumanu Highway and Hina Lani Street with a value of 5.4 ppm. Other concentrations for this scenario ranged between 2.1 and 5.1 ppm. With the project and assuming the roadway improvements identified in the project traffic study are implemented, carbon monoxide concentrations in the year 2025 were predicted to increase compared to the without-project case at all locations studied. However, the predicted worst case carbon monoxide concentrations remained within the state and federal standards. In 2035 with the project, this trend would tend to continue, although the location with the highest

concentration, a value of 5.8 ppm, was predicted to occur during the morning at the intersection of Queen Kaahumanu Highway and Kealakehe Parkway. In the 2045 with project scenario, worst-case concentrations generally decreased (improved) slightly or remained unchanged. For all three phases of the project, worst-case concentrations were predicted to remain within standards.

Predicted Worst-Case 8-Hour Concentrations

Worst-case 8-hour carbon monoxide concentrations were estimated by multiplying the worst-case 1-hour values by a persistence factor of 0.5. This accounts for two factors: (1) traffic volumes averaged over eight hours are lower than peak 1-hour values, and (2) meteorological conditions are more variable (and hence more favorable for dispersion) over an 8-hour period than they are for a single hour. Based on monitoring data, 1-hour to 8-hour persistence factors for most locations generally vary from 0.4 to 0.8 with 0.6 being the most typical. One study based on modeling [9] concluded that 1-hour to 8-hour persistence factors could typically be expected to range from 0.4 to 0.5. EPA guidelines [10] recommend using a value of 0.7 unless a locally derived persistence factor is available. Recent monitoring data for locations on Oahu reported by the Department of Health [11] suggest that this factor may range between about 0.2 and 0.6 depending on location and traffic variability. Considering the location of the project and the traffic pattern for the area, a 1-hour to 8-hour persistence factor of 0.5 will likely yield reasonable estimates of worst-case 8-hour concentrations.

The resulting estimated worst-case 8-hour concentrations are indicated in Table 5. For the 2011 scenario, the estimated worst-case 8-hour carbon monoxide concentrations for the seven locations studied ranged from 0.7 ppm at the Hina Lani Street at Kamanu Street intersection to 1.8 ppm at the Queen Kaahumanu Highway/Kealakehe Parkway intersection. The estimated worst-case concentrations for the existing case were well within the national limit of 9 ppm and the state standard of 4.4 ppm.

In 2025 without the project, worst-case 8-hour carbon monoxide concentrations in the project area were predicted to increase slightly or remain nearly unchanged compared to the existing case. As shown by the results given in the table, the analysis suggests this trend would continue through 2035 and 2045 without the project, and worst-case 8-hour carbon monoxide concentrations should remain within the standards through 2045.

For the 2025 with project scenario, worst-case concentrations increased at all locations studied compared to the without project case. The worst-case concentrations ranged from 1.4 to 2.7 ppm. Although concentrations were predicted to increase compared to the without project case, all predicted 8-hour concentrations for the 2025 with project scenario were within both the national and the state AAQS. In the years 2035 and 2045 with the project, worst-case 8-hour concentrations were predicted to continue to increase only slightly or remain nearly unchanged, and compliance with standards would be maintained.

Conservativeness of Estimates

The results of this study reflect several assumptions that were made concerning both traffic movement and worst-case meteorological conditions. One such assumption concerning worst-case meteorological conditions is that a wind speed of 1 meter per second with a steady direction for 1 hour will occur. A steady wind of 1 meter per second blowing from a single direction for an hour is extremely unlikely and may occur only once a year or less. With wind speeds of 2 meters per second, for example, computed carbon monoxide concentrations would be only about half the values given above. The 8-hour estimates are also conservative in that it is unlikely that anyone would occupy the assumed receptor sites (within 3 m of the roadways) for a period of 8 hours.

7.2 Electrical Demand

The proposed project also will cause indirect air pollution emissions from power generating facilities as a consequence of electrical power usage. The annual electrical demand of the project when fully developed is expected to reach a maximum of approximately 87 million kilowatt-hours [12]. The estimated annual electrical demand for each project phase is: 35 million kilowatt-hours for Phase 1, 35 million kilowatt-hours for Phase 2, and 17 million kilowatt-hours for Phase 3. Electrical power for the project will most probably be provided mainly by oil-fired generating facilities, but some of the project power may also be derived from geothermal energy, wind power or other sources. In order to meet the electrical power needs of the proposed project, power generating facilities will likely be required to burn more fuel and hence more air pollution will be emitted at these facilities. Given in Table 6 are estimates of the indirect air pollution emissions that would result from the project electrical demand assuming all power is provided by burning more fuel oil at local power plants. These values can be compared to the island-wide emission estimates for 1993 given in Table 2. The estimated indirect emissions from the full project electrical demand amount to about 2 percent or less of the present (manmade) air pollution emissions occurring on Hawaii Island if all power is assumed to be derived from oil.

7.3 Solid Waste Disposal

Solid waste generated by the proposed development when fully completed and occupied is not expected to exceed about 4,672 tons per year for Phase 1; 4,253 tons per year for Phase 2; and 2,515 tons per year for Phase 3, for a project total of about 11,440 tons per year [13]. Currently, all solid waste on the island is buried at solid waste landfills. Thus, assuming this continues to be the method for solid waste disposal, the only associated air pollution emissions that will occur will be from trucking the waste to the landfill and burying it. These emissions should be relatively minor.

8.0 CONCLUSIONS AND RECOMMENDATIONS

Existing air quality in the project area is impacted by emissions from Kilauea Volcano. Fine particulate measurements from the

Department of Health monitoring station at Kealakekua indicate that the national standards for both the 24-hour and the annual averaging periods may be exceeded. While this phase of Kilauea's eruption has been occurring for more than 25 years and it is unknown when it will end, fine particulate concentrations will go down significantly when it does.

The major potential short-term air quality impact of the project will occur from the emission of fugitive dust during construction phases. Uncontrolled fugitive dust emissions from construction activities are estimated to amount to about 1.2 tons per acre per month, depending on rainfall. To control dust, active work areas and any temporary unpaved work roads should be watered at least twice daily on days without rainfall. Use of wind screens and/or limiting the area that is disturbed at any given time will also help to contain fugitive dust emissions. Wind erosion of inactive areas of the site that have been disturbed could be controlled by mulching or by the use of chemical soil stabilizers. Dirt-hauling trucks should be covered when traveling on roadways to prevent windage. A routine road cleaning and/or tire washing program will also help to reduce fugitive dust emissions that may occur as a result of trucks tracking dirt onto paved roadways in the project area. Paving of parking areas and establishment of landscaping early in the construction schedule will also help to control dust. Monitoring dust at the project boundary during the period of construction could be considered as a means to evaluate the effectiveness of the project dust control program and to adjust the program if necessary.

During construction phases, emissions from engine exhausts (primarily consisting of carbon monoxide and nitrogen oxides) will also occur both from on-site construction equipment and from vehicles used by construction workers and from trucks traveling to and from the project. Increased vehicular emissions due to disruption of traffic by construction equipment and/or commuting construction workers can be alleviated by moving equipment and personnel to the site during off-peak traffic hours.

After construction of the proposed project phases are completed and fully occupied, carbon monoxide concentrations in the project area due to motor vehicle emissions will likely increase slightly with each phase, but worst-case concentrations should remain within both the state and the national ambient air quality standards through the year 2045. Implementing any air quality mitigation measures for long-term traffic-related impacts is probably unnecessary and unwarranted.

Any long-term impacts on air quality due to indirect emissions from supplying the project with electricity and from the disposal of solid waste materials generated by the project will likely be small based on the relatively small magnitudes of these emissions. Nevertheless, indirect emissions from project electrical demand could likely be reduced somewhat by incorporating energy-saving features into project design requirements. This might include the use of solar water heaters; designing building space so that window positions maximize indoor light without unduly increasing indoor heat; using landscaping where feasible to provide afternoon shade to

cut down on the use of air conditioning; installation of insulation and double-glazed doors to reduce the effects of the sun and heat; providing movable, controlled openings for ventilation at opportune times; and possibly installing automated room occupancy sensors. Solid waste related air pollution could likely be reduced somewhat by the promotion of conservation and recycling programs within the proposed development.

REFERENCES

1. "Climatic Summary of the United States, Supplement for 1951 through 1960, Hawaii and Pacific", U.S. Department of Commerce, Weather Bureau, Washington, D.C., 1965.

2. Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, Fifth Edition, AP-42, U.S. Environmental Protection Agency, Research Triangle Park, NC, January 1995.

3. State of Hawaii. Hawaii Administrative Rules, Chapter 11-60, Air Pollution Control.

4. KOA Corporation, Traffic Impact Study for Kaloko Makai in Kona, Hawaii, September 12, 2012.

5. User's Guide to MOBILE6.0, Mobile Source Emission Factor Model, U.S. Environmental Protection Agency, Office of Transportation and Air Quality, Assessment and Standards Division, Ann Arbor, Michigan, January 2002.

6. Guideline on Air Quality Models (Revised), Including Supplements A and B, EPA-450/2-78-027R, U.S. Environmental Protection Agency, Research Triangle Park, NC, July 1986.

7. User's Guide to CAL3QHC Version 2.0: A Modeling Methodology for Predicting Pollutant Concentrations Near Roadway Intersections, U.S. Environmental Protection Agency, November 1992.

8. CALINE4 - A Dispersion Model for Predicting Air Pollutant Concentrations Near Roadways, FHWA/CA/TL-84/15, California State Department of Transportation, November 1984 with June 1989 Revisions.

9. "Persistence Factors for Mobile Source (Roadway) Carbon Monoxide Modeling", C. David Cooper, Journal of the Air & Waste Management Association, Volume 39, Number 5, May 1989.

10. Guideline for Modeling Carbon Monoxide from Roadway Intersections, U.S. Environmental Protection Agency, EPA-454/R-92-005, November 1992.

11. Annual Summaries, Hawaii Air Quality Data, 2006-2010, State of Hawaii Department of Health.

12. Personal communication via email, Keola Cheng, Wilson Okamoto Corp, to Barry D. Neal, B.D. Neal & Associates, October 30, 2012, Electrical Estimates for Kaloko Makai Village.

13. Personal communication via email, Tracy Fukuda, Wilson Okamoto Corp, to Barry D. Neal, B.D. Neal & Associates, October 17, 2012, Solid Waste Estimates for Kaloko Makai Village

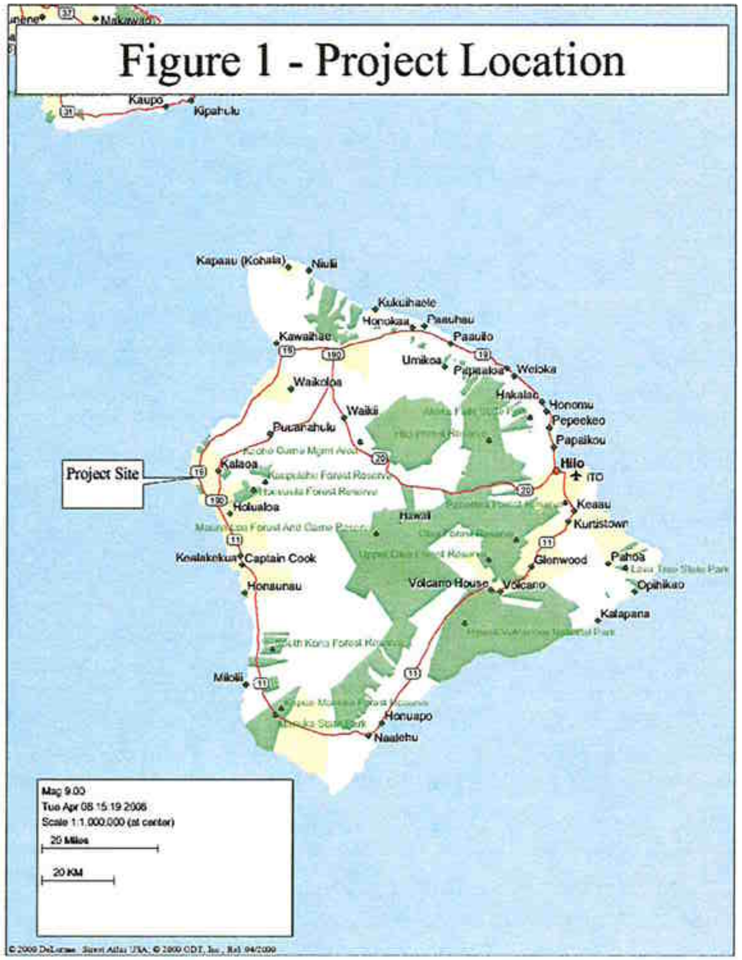

Figure 1 - Project Location

Table 1

SUMMARY OF STATE OF HAWAII AND NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Units	Averaging Time	Maximum Allowable Concentration		
			National Primary	National Secondary	State of Hawaii
Particulate Matter (<10 microns)	µg/m³	Annual 24 Hours	- 150[a]	- 150[a]	50 150[b]
Particulate Matter (<2.5 microns)	µg/m³	Annual 24 Hours	15[c] 35[d]	15[c] 35[d]	- -
Sulfur Dioxide	ppm	Annual 24 Hours 3 Hours 1 Hour	- - - 0.075[e]	- - 0.5[b] -	0.03 0.14[b] 0.5[b] -
Nitrogen Dioxide	ppm	Annual 1 Hour	0.053 0.100[f]	0.053 -	0.04 -
Carbon Monoxide	ppm	8 Hours 1 Hour	9[b] 35[b]	- -	4.4[b] 9[b]
Ozone	ppm	8 Hours	0.075[g]	0.075[g]	0.08[g]
Lead	µg/m³	3 Months Quarter	0.15[h] 1.5[i]	0.15[h] 1.5[i]	- 1.5[i]
Hydrogen Sulfide	ppm	1 Hour	-	-	0.035[b]

[a] Not to be exceeded more than once per year on average over three years.
[b] Not to be exceeded more than once per year.
[c] Three-year average of the weighted annual arithmetic mean.
[d] 98th percentile value of the 24-hour concentrations averaged over three years.
[e] Three-year average of annual fourth-highest daily 1-hour maximum.
[f] 98th percentile value of the daily 1-hour maximum averaged over three years.
[g] Three-year average of annual fourth-highest daily 8-hour maximum.
[h] Rolling 3-month average.
[i] Quarterly average.

Table 2

AIR POLLUTION EMISSIONS INVENTORY FOR ISLAND OF HAWAII, 1993

Air Pollutant	Point Sources (tons/year)	Area Sources (tons/year)	Total (tons/year)
Particulate	30,311	9,157	39,468
Sulfur Oxides	9,345	nil	9,345
Nitrogen Oxides	4,054	8,858	12,912
Carbon Monoxide	3,357	23,934	27,291
Hydrocarbons	1,477	203	1,680

Source: Final Report, "Review, Revise and Update of the Hawaii Emissions Inventory Systems for the State of Hawaii", prepared for Hawaii Department of Health by J.L. Shoemaker & Associates, Inc., 1996

Table 3

ANNUAL SUMMARIES OF AIR QUALITY MEASUREMENTS FOR MONITORING STATIONS NEAREST KALOKO MAKAI VILLAGE PROJECT

Parameter / Location	2006	2007	2008	2009	2010
Sulfur Dioxide / Kealakekua, Kona					
3-Hour Averaging Period:					
No. of Samples	2697	2756	2445	2560	2625
Highest Concentration (ppm)	0.046	0.034	0.124	0.130	0.150
2nd Highest Concentration (ppm)	0.035	0.025	0.112	0.111	0.095
No. of State AAQS Exceedances	0	0	0	0	0
24-Hour Averaging Period:					
No. of Samples	341	343	353	365	344
Highest Concentration (ppm)	0.012	0.011	0.054	0.045	0.039
2nd Highest Concentration (ppm)	0.011	0.011	0.038	0.042	0.034
No. of State AAQS Exceedances	0	0	0	0	0
Annual Average Concentration (ppm)	0.004	0.004	0.009	0.004	0.006
Particulate (PM-2.5) / Kealakekua, Kona					
24-Hour Averaging Period:					
No. of Samples	-	-	292	352	359
Highest Concentration ($\mu g/m^3$)	-	-	44	61	63
98th Percentile Concentration ($\mu g/m^3$)	-	-	37	37	35
No. Occurrences Greater than 35 $\mu g/m^3$	-	-	10	8	6
Annual Average Concentration ($\mu g/m^3$)	-	-	21	16	18

Source: State of Hawaii Department of Health, "Annual Summaries, Hawaii Air Quality Data, 2006 - 2010"

Table 4 (continued)

ESTIMATED WORST-CASE 1-HOUR CARBON MONOXIDE CONCENTRATIONS ALONG ROADWAYS NEAR KALOKO MAKAI VILLAGE PROJECT (parts per million)

Roadway Intersection	Year/Scenario					
	2025/With Project		2035/With Project		2045/With Project	
	AM	PM	AM	PM	AM	PM
Queen Kaahumanu Highway at Kaiminani Drive	2.9	2.1	4.0	3.0	4.6	2.8
Queen Kaahumanu Highway at Hulikoa Drive	3.6	2.2	3.9	2.5	3.4	2.2
Queen Kaahumanu Highway at Hina Lani Street	5.4	3.6	5.6	4.4	-	-
Queen Kaahumanu Highway at Kealakehe Parkway	5.1	3.6	5.8	3.9	5.5	3.6
Hina Lani Street at Kanalani Street	3.1	2.0	3.4	2.2	3.4	2.3
Hina Lani Street at Kamanu Street	3.3	3.0	3.7	2.9	3.6	2.9
Hina Lani Street at Ane Keohokalole Highway	2.7	2.1	4.2	2.8	4.3	3.0
Hina Lani Street at Mamalahoa Highway	3.8	2.4	4.1	2.6	4.2	2.5

Hawaii State AAQS: 9
National AAQS: 35

Table 4

ESTIMATED WORST-CASE 1-HOUR CARBON MONOXIDE CONCENTRATIONS ALONG ROADWAYS NEAR KALOKO MAKAI VILLAGE PROJECT (parts per million)

Roadway Intersection	Year/Scenario							
	2011/Present		2025/Without Project		2035/Without Project		2045/Without Project	
	AM	PM	AM	PM	AM	PM	AM	PM
Queen Kaahumanu Highway at Kaiminani Drive	2.7	1.9	2.5	1.8	3.0	2.2	2.9	2.0
Queen Kaahumanu Highway at Hulikoa Drive	2.9	1.9	3.0	1.9	3.3	2.1	3.2	2.0
Queen Kaahumanu Highway at Hina Lani Street	2.9	2.6	3.2	2.7	3.4	2.7	3.4	2.4
Queen Kaahumanu Highway at Kealakehe Parkway	3.6	2.3	3.9	2.7	4.3	2.9	4.3	2.8
Hina Lani Street at Kanalani Street	2.3	1.7	2.3	1.6	2.2	1.6	1.9	1.4
Hina Lani Street at Kamanu Street	1.4	1.5	1.7	1.6	1.5	1.5	1.3	1.5
Hina Lani Street at Ane Keohokalole Highway	-	-	1.5	1.4	2.5	2.0	2.3	1.8
Hina Lani Street at Mamalahoa Highway	2.2	1.5	2.8	1.8	2.8	1.8	2.7	1.8

Hawaii State AAQS: 9
National AAQS: 35

(continued)

Table 5 (continued)

ESTIMATED WORST-CASE 8-HOUR CARBON MONOXIDE CONCENTRATIONS ALONG ROADWAYS NEAR KALOKO MAKAI VILLAGE PROJECT (parts per million)

Roadway Intersection	Year/Scenario		
	2025/With Project	2035/With Project	2045/With Project
Queen Kaahumanu Highway at Kaiminani Drive	1.4	2.0	2.3
Queen Kaahumanu Highway at Hulikoa Drive	1.8	2.0	1.7
Queen Kaahumanu Highway at Hina Lani Street	2.7	2.8	-
Queen Kaahumanu Highway at Kealakehe Parkway	2.6	2.9	2.8
Hina Lani Street at Kanalani Street	1.6	1.7	1.7
Hina Lani Street at Kamanu Street	1.6	1.8	1.8
Hina Lani Street at Ane Keohokalole Highway	1.4	2.1	2.2
Hina Lani Street at Mamalahoa Highway	1.9	2.0	2.1

Hawaii State AAQS: 4.4
National AAQS: 9

Table 5

ESTIMATED WORST-CASE 8-HOUR CARBON MONOXIDE CONCENTRATIONS ALONG ROADWAYS NEAR KALOKO MAKAI VILLAGE PROJECT (parts per million)

Roadway Intersection	Year/Scenario			
	2011/Present	2025/Without Project	2035/Without Project	2045/Without Project
Queen Kaahumanu Highway at Kaiminani Drive	1.4	1.2	1.5	1.4
Queen Kaahumanu Highway at Hulikoa Drive	1.4	1.5	1.6	1.6
Queen Kaahumanu Highway at Hina Lani Street	1.4	1.6	1.7	1.7
Queen Kaahumanu Highway at Kealakehe Parkway	1.8	2.0	2.2	2.2
Hina Lani Street at Kanalani Street	1.2	1.2	1.1	1.0
Hina Lani Street at Kamanu Street	0.7	0.8	0.8	0.8
Hina Lani Street at Ane Keohokalole Highway	-	0.8	1.2	1.2
Hina Lani Street at Mamalahoa Highway	1.1	1.4	1.4	1.4

Hawaii State AAQS: 4.4
National AAQS: 9

(continued)

Table 6

ESTIMATED INDIRECT AIR POLLUTION EMISSIONS FROM KALOKO MAKAI VILLAGE PROJECT ELECTRICAL DEMAND[a]

Air Pollutant	Emission Rate (tons/year)			
	Phase 1	Phase 2	Phase 3	Total
Particulate	9	9	4	22
Sulfur Dioxide	91	91	44	226
Carbon Monoxide	9	9	4	22
Volatile Organics	<1	<1	<1	1
Nitrogen Oxides	39	39	19	97

[a]Based on U.S. EPA emission factors for utility boilers [2]. Assumes annual electrical demand of 35 million kw-hrs for Phase 1, 35 million kw-hrs for Phase 2 and 17 million kw-hrs for Phase 3, for a total of 87 million kw-hrs per year of electrical power use [12]. Estimated emission rates assume low-sulfur oil used to generate power.