Appendix O

Air Quality Study

AIR QUALITY STUDY

FOR THE PROPOSED

HONUA'ULA PROJECT

WAILEA, MAUI

Prepared for:

Honua'ula Partners, LLC

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1.0 SUMMARY

Honua'ula Partners, LLC is proposing to develop the Honua'ula Project in the Wailea area on the island of Maui. The proposed project will include 1,150 residential units, commercial space, a golf course and other associated amenities and facilities. The project is expected to be completed and fully occupied by 2022. 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 except those for nitrogen dioxide and carbon monoxide which are more stringent than the national standards.

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 elevation near sea level and by nearby mountains. Haleakala shelters the area from the northeast trade winds, and local winds (such as land/sea breezes and upslope/downslope winds) affect the wind flow in the area much of the time. Temperatures in the project area are generally very consistent and warm with average daily temperatures ranging from about 63°F to 86°F. Rainfall in the project area is minimal with an average of only about 12 inches per year.

Except for periodic impacts from volcanic emissions (vog) and possibly occasional localized impacts from traffic congestion and local agricultural sources, the present air quality of the project area is believed to be relatively good. There is very little air quality monitoring data from the Department of Health for the project area, but the limited data that are available suggest that concentrations are generally well within state and national air quality standards.

If the proposed project is given the necessary approvals to proceed, it is inevitable that some short- and long-term impacts on air quality will unavoidably 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 phase. To a lesser extent, exhaust emissions from stationary and mobile construction equipment and from the disruption of traffic may also affect air quality during the period of construction. State air pollution control regulations require that there be no visible fugitive dust emissions at the project boundary. Hence, an effective dust control plan should 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. Excess exhaust emissions from traffic disruption can be mitigated by moving construction equipment and workers to and from the project area during off-peak traffic hours and by minimizing road closures during peak traffic periods.

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 both with and without the proposed project. During worst-case conditions, model results indicated that present 1-hour and 8-hour carbon monoxide concentrations are well within both the state and the national ambient air quality standards. In the year 2022 without the project, carbon monoxide concentrations were predicted to increase at some locations in the project area, but concentrations should remain well within state and federal standards. With the project in the year 2022, carbon monoxide concentrations were estimated to increase by about 10 to 20 percent compared to the without-project case, but worst-case concentrations should remain within both national and state standards. Implementing mitigation measures for traffic-related air quality impacts is 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

Honua'ula Partners, LLC is proposing to develop the Honua'ula Project on the island of Maui near Wailea (see Figure 1 for general project location). The proposed project would include the development of 1,150 single-family and multi-family residential units (including workforce affordable homes), an 18-hole private golf course, up to 100,000 square feet of commercial and office space, and other associated facilities and infrastructure. The proposed project is expected to be completed and fully occupied by 2022.

The purpose of this study was to evaluate the potential air quality impacts of the proposed project and recommend mitigative measures, if possible and appropriate, to reduce or eliminate any project-related degradation of air quality in the area. Before examining the potential impacts of the project, a discussion of ambient air quality standards is presented and background information concerning the regional and local climatology and the present air quality of the project area is provided.

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 U.S. Environmental Protection

Agency (EPA) is currently working on a plan to phase out the national 1-hour ozone standard in favor of the new (and more stringent) 8-hour standard.

The Hawaii AAQS for sulfur dioxide were relaxed in 1986 to make the state standards essentially the same as the national limits. In 1993, the state also revised its particulate standards to follow those set by the federal government. During 1997, the federal government again revised its standards for particulate, but the new standards were challenged in federal court. A Supreme Court ruling was issued during February 2001, and as a result, the new standards for particulate were finally implemented during 2005. To date, the Hawaii Department of Health has not updated the state particulate standards. In September 2001, the state vacated the state 1-hour standard for ozone and an 8-hour standard was adopted.

During the latter part of 2008, EPA revised the standard for lead making the standard more stringent. So far, the Hawaii Department of Health has not revised the corresponding state standard for lead.

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 topography of Maui is dominated by the great volcanic masses of Haleakala (10,023 feet) and the West Maui Mountains (5,788 feet). The island consists entirely of the slopes of these mountains and of a connecting isthmus. Haleakala is still considered to be an active volcano and last erupted about 1790. The project site is located along the lower western slope of Haleakala at an elevation of about 300 feet.

Maui lies well within the belt of northeasterly trade winds generated by the semi-permanent Pacific high pressure cell to the north and east. Because the project area is located on the lower western slope of Haleakala, it is sheltered much of the time from the northeast trade winds. Local winds such as land/sea breezes and/or upslope/downslope winds also influence the wind pattern for the area. During the daytime, winds can typically be expected to move onshore because of seabreeze and/or upslope effects or because of the aerodynamic cavity caused by the trade winds flowing around Haleakala. At night, winds are often 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 lower elevation and leeward location results in warmer temperatures compared with many other parts of the island. At Puunene, which is a few miles to the north of the project area and at an elevation of about 130 feet, average daily minimum and maximum temperatures are 63°F and 86°F, respectively [1]. Temperatures at the project site can be expected to be similar to this or slightly cooler due to the slightly higher elevation.

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 Pukualani 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 nearby mountains. 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 3,000 feet (1,000 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 relatively dry due to the leeward location. Historical records from Kihei, a few miles to the north, show that this area of Maui averages about only 12 inches of precipitation per year with the summer months being the driest [1].

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 Maui for calendar year 1993. This is the most recent year for which an island-wide emission inventory is 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, most of the manmade particulate and sulfur oxides emissions on Maui originate from point sources, such as power plants and other fuel-burning industries. Nitrogen oxides emissions are roughly equally divided between point sources and area sources (mostly motor vehicle traffic). The majority of carbon monoxide emissions occur from area sources (motor vehicle traffic and sugar cane burning), while hydrocarbons are emitted mainly from point sources. Emissions today are probably higher than those shown in the table, but the proportional relationships are likely about the same.

The largest sources of air pollution in the immediate project area are most likely agricultural operations and automobile traffic using local roadways. Emissions from these sources consist primarily of particulate, carbon monoxide and nitrogen oxides. Power plants burning diesel fuel are located several miles away. These sources mostly emit sulfur dioxide, nitrogen oxides and particulate. Volcanic emissions from distant natural sources on the Big Island also affect the air quality at times during kona wind conditions. By the time the volcanic emissions reach the project area, they consist mostly of fine particulate sulfate.

The State Department of Health operates a network of air quality monitoring stations at various locations around the state, but only very limited data are available for Maui Island. The only air quality data for the project area consists of particulate measurements collected at Kihei, which is about 4 miles to the north. These data are probably at least semi-representative of the project area. Table 3 summarizes the data from the Kihei monitoring station. Annual second-highest 24-hour particulate concentrations (which are most relevant to the air quality standards) ranged from 63 to 119 $\mu g/m^3$ between 2002 and 2006. Average annual concentrations ranged from 19 to 25 $\mu g/m^3$. One exceedance of the state standard was recorded during 2005. This was reported to be due to agricultural tilling operations in the area.

Given the limited air pollution sources in the area, it is likely that air pollution concentrations are near natural background levels most of the time, except possibly for locations adjacent to agricultural operations or near traffic-congested intersections. 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 during 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 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 and from the disruption of traffic due to road construction.

Fugitive dust emissions may arise from the grading and dirt-moving activities associated with land clearing and preparation work. The emission rate for fugitive dust emissions from construction activities is difficult to estimate accurately 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 in the project area would likely be somewhere near this level or possibly lower due to the rocky nature of the soil in the area. In any case, State of Hawaii Air Pollution Control Regulations [3] prohibit visible emissions of fugitive dust from construction activities at the project boundary, and 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 oftentimes 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 and/or establishment of landscaping as early in the construction schedule as possible can also lower the potential for fugitive dust emissions.

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 standard for nitrogen dioxide is set on an annual basis and is not likely to be violated by short-term construction equipment emissions. Carbon monoxide emissions from diesel engines, on the other hand, are low and should be relatively insignificant compared to vehicular emissions on nearby roadways.

Indirectly, slow-moving construction vehicles on roadways leading to and from the project area could obstruct the normal flow of traffic to such an extent that overall vehicular emissions are increased, but this impact can be mitigated by moving heavy construction equipment during periods of low traffic volume. Likewise, road closures during peak traffic periods should be avoided to the extent possible to minimize air pollution impacts from traffic disruption. Thus, with careful planning and attention to dust control, 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. 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 30 percent per vehicle during the next 10 years due to the replacement of older vehicles with newer and cleaner 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, three scenarios were selected for the carbon monoxide modeling study: (1) year 2009 with present conditions, (2) year 2022 without the project, and (3) year 2022 with the project. To begin the modeling study of the three 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 several of the key intersections identified in the traffic study were also selected for air quality analysis. These included the following intersections:

- Piilani Highway at Kilohana Drive
- Piilani Highway at Okolani Drive
- Piilani Highway at Wailea Ike Drive
- Piilani Highway at Kaukahi Street
- Kaukahi Street at Wailea Alanui Drive
- Wailea Alanui Drive at Wailea Ike Drive

All of these intersections currently exist except for the intersection of Piilani Highway and Kaukahi Street (Piilani Highway currently ends at Wailea Iki Drive). 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 three 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.

Traffic estimates for the project indicate that traffic volumes generally are or will be higher during the afternoon peak hour than during the morning peak period. However, worst-case emission and meteorological dispersion conditions typically occur during the morning hours at most locations. Thus, both morning and afternoon peak-traffic hours were examined to ensure that worst-case concentrations were identified.

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 40.9% light-duty gasoline-powered automobiles, 46.2% light-duty gasoline-powered trucks and vans, 3.6% heavy-duty gasoline-powered vehicles, 0.2% light-duty diesel-powered vehicles, 8.5% 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.

Although CAL3QHC is intended primarily for use in assessing atmospheric dispersion near signalized roadway intersections, it can also be used to evaluate unsignalized intersections. This is accomplished by manually estimating queue lengths and then applying the same techniques used by the model for signalized intersections. Currently, only two of the six study intersections are signalized.

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 (where applicable). 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 scenarios. This implies that pedestrian sidewalks or public walkways 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 the atmospheric stability category. For these analyses, atmospheric stability category 6 was assumed for morning scenarios and stability category 4 was assumed for afternoon cases. These are the most conservative stability categories that are generally used for estimating pollutant dispersion at suburban locations for these time periods. For all cases, a surface roughness length of 100 cm was assumed and a mixing height of 300 meters was used. 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 relatively low levels. Hence, background contributions of carbon monoxide from sources or distant roadways not directly considered in the analysis were accounted for by adding a small background concentration of

0.5 ppm to all predicted concentrations for 2009. Although at least moderate development and increased traffic are expected to occur within the project area within the next several years, 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 scenarios 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 for 2009 and for each of the two future alternatives that were studied. 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 worst-case 1-hour concentration for the present (2009) scenario was 4.1 mg/m^3, and this occurred during the morning at the intersection of Kilohana Drive and Piilani Highway. Worst-case values for other locations and times ranged from 1.5 to 3.6 mg/m^3. These concentrations are well within both the national AAQS of 40 mg/m^3 and the state standard of 10 mg/m^3.

In the year 2022 without the proposed project, the predicted highest worst-case 1-hour concentration occurred again during the morning at the intersection of Kilohana Drive and Piilani Highway with a value of 4.0 mg/m^3. Other concentrations for this scenario at other times and locations ranged between 1.6 and 3.7 mg/m^3. Without the project, carbon monoxide concentrations in the year 2022 were predicted to increase somewhat at most locations in the project area compared to the existing case, but even with the increase, worst-case values would likely remain well within the state and federal standards for this scenario.

Similar to the existing and 2022 without-project scenarios, the highest worst-case concentration with the project in the year 2022 was predicted to occur during the morning at the intersection of Kilohana Drive and Piilani Highway. A worst-case 1-hour concentration of 4.8 mg/m^3 was predicted to occur at this location and time. Worst-case concentrations at other locations and times ranged between about 0.7 and 4.4 mg/m^3. In the year 2022 with the project, carbon monoxide concentrations in the project area were predicted to increase by about 10 to 20 percent compared to the without project scenario at most of the locations studied, but the predicted worst-case 1-hour concentrations for the 2022 with-project alternative at all locations studied continued to remain well within both the national and state 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 recent study based on modeling [9] concluded that 1-hour to 8-hour persistence factors could typically be expected to range from about 0.4 to 0.5. EPA guidelines [10] recommend using a value of 0.6 to 0.7 unless a locally derived persistence factor is available. Recent monitoring data for Honolulu reported by the Department of Health [11] suggest that this factor may range between about 0.35 and 0.55 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. However, it should be noted that the 8-hour concentration estimates are generally less reliable than the 1-hour values due to the prediction methodology involved.

The resulting estimated worst-case 8-hour concentrations are indicated in Table 5. For the 2009 scenario, the estimated worst-case 8-hour carbon monoxide concentrations for the study locations ranged from 0.8 mg/m^3 to 2.0 mg/m^3, with the highest concentration occurring at the intersection of Kilohana Drive and Piilani Highway. The estimated worst-case concentrations for the existing case were well within both the national limit of 10 mg/m^3 and the state standard of 5 mg/m^3.

For the 2022 without project scenario in comparison to the existing case, worst-case concentrations generally increased but remained relatively low. Concentrations ranged from 1.0 mg/m^3 to 2.0 mg/m^3 with the highest concentration occurring at the intersection of Kilohana Drive and Piilani Highway. Despite the increase, all predicted 8-hour concentrations for this scenario were well within both the national and the state AAQS.

For the 2022 with-project scenario in comparison to the 2022 without-project case, worst-case concentrations increased by about 10 to 20 percent except at the intersection of Kaukahi Street and Wailea Alanui Drive where there was no change. Worst-case concentrations ranged from 0.5 mg/m^3 to 2.4 mg/m^3 with the highest concentration occurring at the intersection of Kilohana Drive and Piilani Highway. All predicted 8-hour concentrations for this scenario were well within both the national and the state AAQS.

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 peak electrical demand of the project when fully developed is expected to reach about 9.5 megawatts [12]. Assuming the average demand is approximately one-half the peak demand, the annual electrical demand of the project will reach approximately 42 million kilowatt-hours. 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 photovoltaic systems, wind power or other alternative energy 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 project electrical demand amount to 2 percent or less of the present air pollution emissions occurring on Maui Island even 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 3,249 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 Conditions

Although very little ambient air quality data are available to characterize existing conditions, it is likely that state and federal ambient air quality standards are currently being met in the project area, except perhaps for occasional exceedances of the stringent state carbon monoxide standards within small areas near traffic-congested locations. Locations adjacent to large-scale agricultural activities may also be occasionally affected by dust.

Short-Term Impacts and Mitigation

The major potential short-term impact of the project on air quality will occur from the emission of fugitive dust during construction. Uncontrolled fugitive dust emissions from construction activities are estimated to amount to about 1.2 tons per acre per month, depending on rainfall and other factors. 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 project that have been disturbed could be controlled by mulching or chemical stabilization. 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. Establishment of landscaping early in the construction schedule will also help to control dust.

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 the disruption of normal traffic flow. Increased vehicular emissions due to the disruption of traffic can be alleviated by minimizing road closures during peak traffic hours.

Long-Term Impacts and Mitigation

With the project in the year 2022, worst-case carbon monoxide concentrations would likely increase in the project area by about

10 to 20 percent at some locations. Even with the increased concentrations, worst-case concentrations should remain well within the state and federal standards through the year 2022 with the project.

Options available to mitigate long-term, traffic-related air pollution are generally to further improve roadways, to reduce traffic and/or to reduce individual vehicular emissions. Aside from providing added roadway improvements, air pollution impacts from vehicular emissions could conceivably be additionally mitigated by reducing traffic volumes through the promotion of bus service and car pooling in the project area and/or by adjusting local school and business hours to begin and end during off-peak times. This mitigation measure is generally considered only partially successful. Reduction of emissions from individual vehicles would have to be achieved through the promulgation of local, state or federal air pollution control regulations. For example, Hawaii currently does not require annual inspections of motor vehicle air pollution control equipment. However, at the present time there is no indication that the state is contemplating adopting such rules. Due to the predicted relatively small increases in carbon monoxide concentrations and the projected compliance with state and federal standards, mitigation measures for air pollution from project-related traffic are 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.

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Figure 1 - Project Location

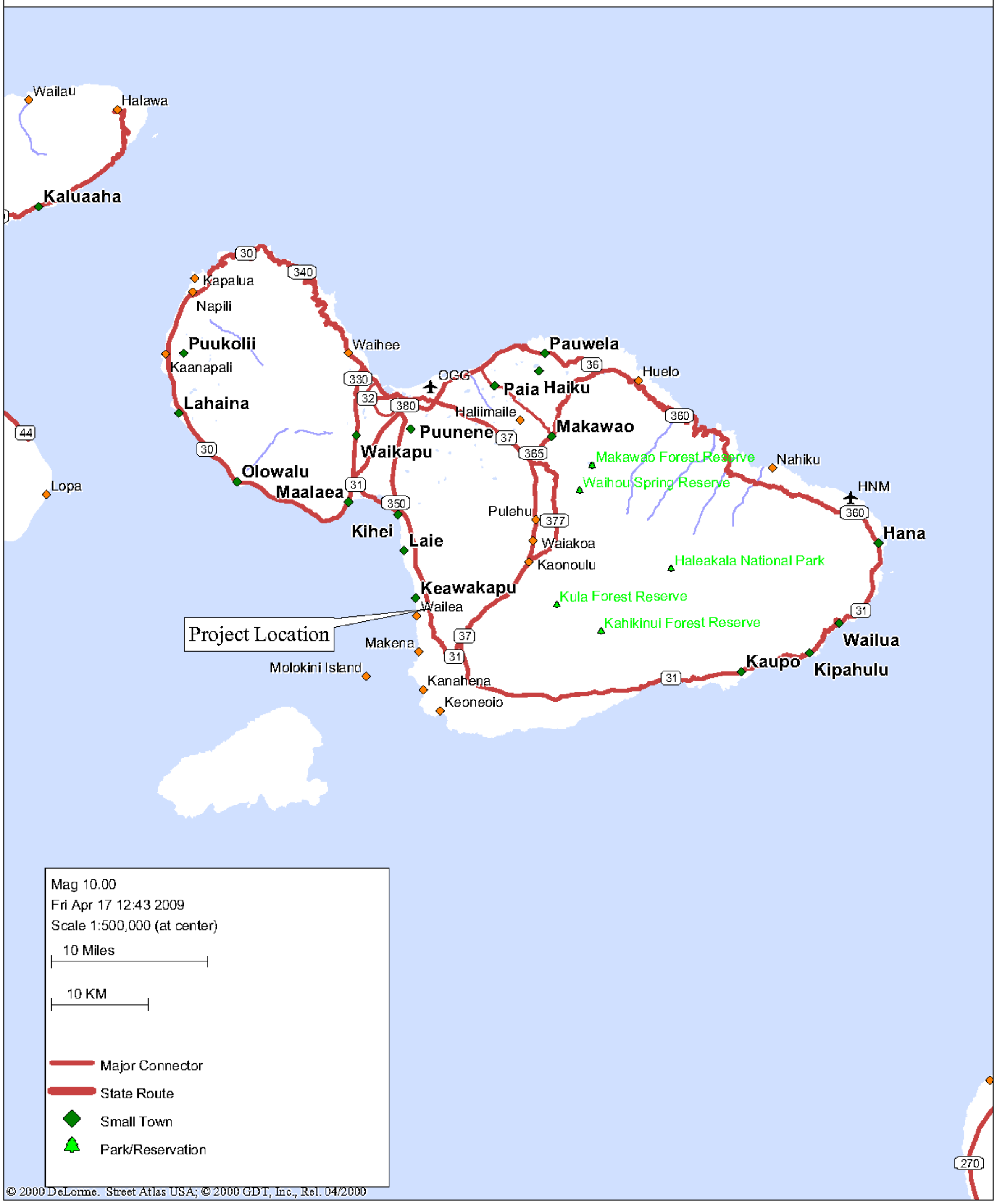

Table 1

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	μg/m³	Annual 24 Hours 3 Hours	80 365[b] -	- - 1300[b]	80 365[b] 1300[b]
Nitrogen Dioxide	μg/m³	Annual	100	100	70
Carbon Monoxide	mg/m³	8 Hours 1 Hour	10[b] 40[b]	- -	5[b] 10[b]
Ozone	μg/m³	8 Hours 1 Hour	157[e] 235[f]	157[e] 235[f]	157[e] -
Lead	μg/m³	Calendar Quarter	0.15[g]	0.15[g]	1.5
Hydrogen Sulfide	μg/m³	1 Hour	-	-	35[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 averaged over three years.
[E] Three-year average of fourth-highest daily 8-hour maximum.
[F] Standard is attained when the expected number of exceedances is less than or equal to 1.
[G] Rolling 3-month average.

Table 2

AIR POLLUTION EMISSIONS INVENTORY FOR ISLAND OF MAUI, 1993

Air Pollutant	Point Sources (tons/year)	Area Sources (tons/year)	Total (tons/year)
Particulate	63,275	7,030	70,305
Sulfur Oxides	6,419	nil	6,419
Nitrogen Oxides	7,312	8,618	15,930
Carbon Monoxide	4,612	20,050	24,662
Hydrocarbons	1,991	234	2,225

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 HONUA'ULA PROJECT

Parameter / Location	2002	2003	2004	2005	2006
Particulate (PM-10) / Kihei					
24-Hour Averaging Period:					
No. of Samples	352	340	308	337	337
Highest Concentration ($\mu g/m^3$)	95	78	65	155	72
2^{nd} Highest Concentration ($\mu g/m^3$)	80	72	63	119	66
No. of State AAQS Exceedances	0	0	0	1	0
Annual Average Concentration ($\mu g/m^3$)	20	23	19	25	22

Source: State of Hawaii Department of Health, "Annual Summaries, Hawaii Air Quality Data, 2002 - 2006"

Table 4

ESTIMATED WORST-CASE 1-HOUR CARBON MONOXIDE CONCENTRATIONS ALONG ROADWAYS NEAR HONUA'ULA PROJECT (milligrams per cubic meter)

Roadway Intersection	Year/Scenario					
	2009/Present		2022/Without Project		2022/With Project	
	AM	PM	AM	PM	AM	PM
Piilani Highway at Kilohana Drive	4.1	3.1	4.0	2.6	4.8	3.0
Piilani Highway at Okolani Drive	2.4	2.1	4.0	2.5	4.4	3.0
Piilani Highway at Wailea Ike Drive	2.4	2.0	3.1	2.2	3.8	3.2
Piilani Highway at Kaukahi Street	-	-	-	-	0.9	0.7
Kaukahi Street at Wailea Alanui Drive	1.5	1.7	2.0	1.6	2.1[a]	1.6[a]
Wailea Alanui Drive at Wailea Ike Drive	3.6	2.2	3.7	2.3	3.9	2.5

Hawaii State AAQS: 10
National AAQS: 40

[a]Includes mitigation measures given in project traffic report.

Table 5

ESTIMATED WORST-CASE 8-HOUR CARBON MONOXIDE CONCENTRATIONS ALONG ROADWAYS NEAR HONUA'ULA PROJECT (milligrams per cubic meter)

Roadway Intersection	Year/Scenario		
	2009/Present	2022/Without Project	2022/With Project
Piilani Highway at Kilohana Drive	2.0	2.0	2.4
Piilani Highway at Okolani Drive	1.2	2.0	2.2
Piilani Highway at Wailea Ike Drive	1.2	1.6	2.0
Piilani Highway at Kaukahi Street	-	-	0.4
Kaukahi Street at Wailea Alanui Drive	0.8	1.0	1.0[a]
Wailea Alanui Drive at Wailea Ike Drive	1.8	1.8	2.0

Hawaii State AAQS: 5
National AAQS: 10

[a]Includes mitigation measures given in project traffic report.

Table 6

ESTIMATED INDIRECT AIR POLLUTION EMISSIONS FROM HONUA'ULA PROJECT ELECTRICAL DEMAND[a]

Air Pollutant	Emission Rate (tons/year)
Particulate	11
Sulfur Dioxide	109
Carbon Monoxide	11
Volatile Organics	<1
Nitrogen Oxides	47

[a]Based on U.S. EPA emission factors for utility boilers [2]. Assumes demand of 42 million kw-hrs per year of electrical power use and low-sulfur oil used to generate power.