4.5 AIR QUALITY

4.5.1 Impact Methodology

Air quality impacts from the proposed alternatives have been evaluated in terms of emissions associated with the project alternatives. Emission sources associated with the Proposed Action include emissions from construction activities, ordnance use, engine emissions from military vehicle use, fugitive dust from vehicle travel on unpaved roads, wind erosion from areas disturbed by off-road vehicle maneuvers, and engine emissions from personal vehicle use associated with added personnel.

Construction emissions analyses used USEPA emissions data for off-road engines and vehicles (USEPA 1991), and generalized data for fugitive dust emissions from construction activity (USEPA 1995; California Air Resources Board 1997). Engine emissions from military vehicles have been estimated from USEPA data for off-road vehicles and engines (USEPA 1991). Fugitive dust emissions associated with tactical vehicle use have been based on USEPA methodologies for vehicle travel on unpaved roads (USEPA 1998). Fugitive dust emissions are those that do not pass through a confining pipe or stack. Emissions of wind-blown fugitive dust from areas disturbed by off-road vehicle maneuvers have been estimated using a proprietary wind erosion rate model and wind speed data from on-post meteorological stations. Emissions from personal vehicles have been estimated using an USEPA vehicle emission rate model. Because the number, size, duration, and intensity of accidental wildfires cannot be predicted with any accuracy, generalized estimates of emissions from wildfires are provided using USEPA data (USEPA 1995). Sections 5.5, 6.5, 7.5, and 8.5 provide more detailed emissions analyses that the summaries presented in this section. Further details are presented in Appendix G.

Particulate matter emissions analyses prepared for this EIS are presented as PM_{10} estimates because that is the most appropriate size fraction to address for fugitive dust issues. PM_{10} estimates presented for military and private vehicle engine emissions can be interpreted as also being a conservative estimate of $PM_{2.5}$ emissions. Visible dust is a clear indication of airborne PM_{10} concentrations that are typically in the range of several thousand micrograms per cubic meter. It takes only a few hours of such concentrations to produce a 24-hour average that exceeds the state and federal 24-hour average PM_{10} standard of 150 micrograms per cubic meter. PM_{10} emissions are important because the PM_{10} size fraction represents airborne particles small enough to be inhaled into the lower respiratory tract, where they can have adverse health effects.

In response to USEPA and public comments, the Army conducted a more detailed modeling and analysis of fugitive dust issues.[1] The intent of the modeling was to better

[1]Dispersion modeling analyses have been performed to better evaluate the potential for violations of the federal PM_{10} standard due to fugitive dust emissions associated with military vehicle use. The modeling analyses used the CALINE4 line source model was used (Benson 1984) as an area source model. Five particle size categories were used to account for particle settling and deposition. The particle size categories used in the analysis are equivalent to the conventional soil survey categories of clay, very fine silt, fine silt, medium silt, and coarse silt. Meteorological conditions assumed in the modeling analysis included Class D (neutral) and Class E (mild temperature inversion) conditions. Given the minimal

determine the potential degree of impact and the geographic extent of the impact. The model the Army used is a widely used standard dispersion model (see Appendix G for further detail). Emission rate, traffic activity, and weather condition factors considered in the modeling included the following:

- Soil type;
- Particle settling and deposition based on particle size and density;
- Soil moisture;
- Climatic conditions including wind speed, wind direction, rainfall frequencies, and atmospheric stability;
- Vegetation cover;
- Vehicle traffic conditions, including the types of vehicles, their weight, number of wheels, and hourly traffic volumes; and,
- Geographic size of the disturbed area.

The dispersion modeling results obtained for evaluating a brigade level vehicle maneuver exercise on a 10,000-acre portion of WPAA were used to extrapolate potential PM_{10} concentrations from wind erosion conditions. The extrapolation procedure adjusted the maneuver exercise modeling results to account for wind erosion emission rates at different wind speeds and the effect of variable wind speeds on dispersion and dilution of the resulting emissions. The extrapolated modeling results were evaluated in the context of wind speed frequency data from the Army's West PTA automated weather station.

4.5.2 Factors Considered for Impact Analysis

Major factors considered in determining whether a project alternative would have a significant impact on air quality include the following:

- The amount of net increase in annual emissions of criteria pollutants on a given Island. The 100 tons per year Clean Air Act conformity de minimis threshold does not apply to Hawai'i because it is an attainment area but was used as a basis of comparison in analyzing air quality impacts;
- Whether or not dispersion modeling analyses indicated a potential for violation of federal and state PM_{10} standards at off-post locations;
- Whether or not relatively high emissions would occur on a continuing basis for periods longer than the time frame of relevant ambient air quality standards (e.g., 8-hour periods for ozone precursors, 3-hour and 24-hour periods for sulfur oxides, 24-hour periods for PM_{10});

diurnal and seasonal variations in air temperature and the predominance of high humidity levels, these atmospheric stability assumptions provide a conservative analysis. Wind speed assumptions used in the modeling analyses were based on site-specific estimates of the wind speed exceeded 75 percent of the time. Emission estimates used in the dispersion modeling assumed a dry surface. Additional details regarding the modeling procedures are presented in Appendix G-7.

- Whether or not emissions of precursors to ozone or other secondary pollutants would occur in such quantities and at such locations as to have a reasonable potential to cause or contribute to a violation of federal or state ambient air quality standards; or
- Whether or not emissions of hazardous air pollutants could exceed state standards or other hazardous air pollutant exposure guidelines at locations accessible to the general public.

During the scoping process for this EIS, the public expressed general concerns regarding the potential for hazardous air pollutant emissions (primarily in connection with ordnance use), fugitive dust from vehicles traveling on unpaved roads and in maneuver areas, and the potential for wind erosion from areas disturbed by vehicle maneuvers.

4.5.3 Summary of Impacts

Table 4-4 lists the types of air quality impacts associated with the Proposed Action, Reduced Land Acquisition, and No Action at the relevant installations.

Proposed Action (Preferred Alternative)

The Army identified in the EIS a potential significant impact from fugitive dust. The EIS separated the fugitive dust impacts into two components: dust generated directly by vehicle travel on unpaved roads or off-road maneuver areas, and dust generated by wind erosion from areas disturbed by off-road vehicle activity. In response to agency and public comments the Army conducted additional modeling which provided a better understanding of the onsite conditions and potential adverse impacts from fugitive dust. The Army developed additional mitigation programs that are known to be effective for controlling fugitive dust, reducing the severity of the potential impacts. We believe that implementation of these measures will avoid exceeding the PM_{10} standards and will avoid unacceptable impacts to human health and visual resources. The Army acknowledges and has considered the public's concern that annoying dust will be intermittently produced by training and convoy activities at PTA. The Army also recognizes that the potential magnitude of fugitive dust impacts from wind erosion at WPAA are sensitive to the amount of vegetation cover that can be maintained on the area. There is significant uncertainty about the extent to which vegetation cover will be reduced by vehicle maneuver activity at WPAA. Consequently, the Army has retained the significant impact designation for this impact in this Final EIS, even though the Army believes that wind erosion will not result in violations of state or federal air quality standards at off-post locations. Based on the additional modeling and mitigation measures, the impact of fugitive dust from vehicle activity on unpaved areas has been changed from a significant impact to significant but mitigable to less than significant.

Significant Impacts

Impact 1: Wind erosion from areas disturbed by military vehicle use. Off-road vehicle activity can reduce or eliminate vegetation cover in affected areas, resulting in increased susceptibility to wind erosion. The amount of project-wide off-road vehicle activity would increase

Table 4-4
Summary of Potential Air Quality Impacts

Impact Issues	SBMR			DMR			KTA			PTA			Project-wide Impact		
	PA	RLA	NA	PA	RLA	NA	PA	RLA	NA	PA	RLA	NA	PA	RLA	NA
Emissions from construction activities	⊙	⊙	○	⊙	⊙	○	⊙	⊙	○	⊙	⊙	○	⊙	⊙	○
Emissions from ordnance use	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙
Engine emissions from military vehicle use	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙
Fugitive dust from military vehicle use	⊘	⊘	⊙	⊘	⊘	⊙	⊘	⊘	⊙	⊘	⊘	⊙	⊘	⊘	⊙
Wind erosion from areas disturbed by military vehicle use	⊙	⊙	⊙	⊙	⊙	⊙	⊘	⊘	⊙	⊗	⊗	⊙	⊗	⊗	⊙
Emissions from increased aircraft operations	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙
Emissions from wildfires	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙
Other emissions from personnel increases	⊙	⊙	⊙	○	○	○	○	○	○	○	○	○	⊙	⊙	⊙

This table summarizes project-wide impacts. For installation-specific impacts see Chapters 5– 8.
In cases when there would be both beneficial and adverse impacts, both are shown on this table. Mitigation measures would only apply to adverse impacts.

LEGEND:

⊗ = Significant
⊘ = Significant but mitigable to less than significant
⊙ = Less than significant
○ = No impact
\+ = Beneficial impact
N/A = Not applicable
PA = Proposed Action
RLA = Reduced Land Acquisition
NA = No Action

substantially under the Proposed Action. In addition, the area available for off-road vehicle maneuvers would increase from 8,843 acres (3,579 hectares) to 31,518 acres (12,755 hectares) at PTA. Most of the additional land that would become available for off-road vehicle maneuvers has a very high potential for wind erosion if vegetation cover is reduced. The introduction of off-road vehicle maneuver activity into areas currently used for cattle grazing would be expected to reduce vegetation cover and increase the extent of ground disturbance. Wind speed patterns at KTA and PTA provide considerable opportunity for wind erosion to occur at these installations. The project-wide net increase in PM_{10} emissions from wind erosion would average 1,796 tons (1,629 metric tons) per year. Net increases in wind erosion would be small at SBMR and DMR, and most of the increase would occur at KTA and PTA. Wind erosion issues are of particular concern near the WPAA because soils in that area are derived from very low-density volcanic ash. In July 1999, a severe dust storm resulted from wind blowing over areas denuded of vegetation by a recent fire. The result was fugitive dust emissions at high enough levels to require temporary evacuation of residences at Waiki'i Ranch.

The potential magnitude of wind erosion is strongly dependent on the extent of vegetation cover that can be maintained on areas subject to vehicle maneuver activity. Vegetation cover would be the major factor controlling potential wind erosion at WPAA. An equally important consideration at KTA is the moisture content of exposed soils. High soil moisture levels effectively prevent wind erosion even in the absence of significant vegetation cover. Rainfall frequency is too low at WPAA for soil moisture conditions to be a major control on wind erosion conditions at that location.

Vehicle maneuver activity at WPAA is expected to be widely dispersed over large portions of the area, and thus would minimize the extent of vegetation damage resulting from the maneuver exercises. The specific PM_{10} increments generated by wind erosion would vary with distance from the WPAA and with the number of hours per day when average hourly wind speeds exceed 12 mph (5.4 meters per second). Wind erosion emission rates increase rapidly when the average hourly wind speed reaches or exceeds 20 mph (8.9 meters per second). Based on three years of meteorological data from the Army's West PTA automated weather station, wind speeds at WPAA would be expected to reach or exceed 20 mph (8.9 meters per second) for 216 hours in a typical year. Wind speeds above 30 mph (13.4 meters per second) occur at WPAA about 24 hours per year. Wind speed frequency distributions for the west side of PTA indicate that days with persistent wind speeds above 20 mph (8.9 meters per second) are uncommon.

As long as high levels of vegetation cover are maintained on the WPAA, only extreme periods of very strong winds would have the potential to generate off-post PM_{10} levels above the value of the state and federal 24-hour PM_{10} standards. If hourly average wind speeds stayed above 25 mph (11.2 meters per second) and blew in the same direction for an entire calendar day, then the federal 24-hour PM_{10} standard could be exceeded at distances of up to 3,200 feet (975 meters) from the WPAA. However, it is very unlikely that a day of such extreme high wind speed would occur. Historically, a more realistic but still unlikely high wind speed scenario would be a day with 12 hours of wind speeds above 25 mph (11.2 meters per second) and 12 hours with wind speeds of 20 to 25 mph (8.9 to 11.2 meters per second). This would limit the occurrence of dust levels above the value of the state and federal 24-hour PM_{10} standards to locations within about 500 feet of the wind erosion source area. The low probability of such extreme high wind conditions indicates that wind erosion at WPAA would be unlikely to generate off-post PM_{10} levels above the value of the state and federal 24-hour PM_{10} standards.

The evaluation of PM_{10} levels associated with wind erosion suggests that state and federal 24-hour PM_{10} standards would not be violated at off-post locations. That conclusion, however, depends in part on maintenance of a high level of vegetation cover at WPAA. The Army's DuSMMoP and ITAM program would substantially mitigate potential wind erosion problems by providing a management tool that would help limit damage to vegetation from off-road vehicle maneuver activity. Although violation of air quality standards is not likely, the overall level of PM_{10} generated by wind erosion would increase as a result of the Proposed Action. Given the resulting increase in overall PM_{10} levels, the uncertainties associated with any estimate of potential wind erosion conditions, and public perceptions of the potential magnitude of this impact, the Army considers wind erosion from the WPAA to be a significant air quality impact under the Proposed Action.

Regulatory and Administrative Mitigation 1. The Army will develop and implement a Dust and Soils Management and Monitoring Plan (DuSMMoP) for the training area. The plan will address measures such as, but not limited to, restrictions on the timing or type of training during high risk conditions, vegetation monitoring, dust monitoring, soil monitoring, and buffer zones to minimize dust emissions in populated areas. The plan will determine how training will occur in order to keep fugitive dust emissions below CAA standards for PM_{10} and soil erosion and compaction to a minimum. The Army will monitor the impacts of training activities to ensure that emissions stay within the acceptable ranges as predicted and environmental problems do not result from excessive soil erosion or compaction. The plan will also define contingency measures to mitigate the impacts of training activities which exceed the acceptable ranges for dust emissions or soil compaction.

The Army will continue to implement land restoration measures identified in the INRMP. Mitigation measures include, but are not limited to, implementation of the ITAM program to identify and inventory land condition using a GIS database; coordination between training planners and natural resource managers; implementation of land rehabilitation measures identified in the INRMP; monitoring of the effectiveness of the land rehabilitation measures; evaluation of erosion modeling data to identify areas in need of improved management; and implementation of education and outreach programs to increase user awareness of the value of good land stewardship.

Significant Impacts Mitigable to Less Than Significant

Impact 2: Fugitive dust from military vehicle use. The PM_{10} emissions in fugitive dust generated by the increased vehicle traffic would be about 1,736 tons (1,575 metric tons) per year, representing an 81 percent increase over No Action conditions. Net increases in fugitive dust from vehicle use would be 780 tons (708 metric tons) per year at SBMR, 211 tons (191 metric tons) per year at DMR, 315 tons (286 metric tons) per year at KTA, and 429 tons (390 metric tons) per year at PTA. Sources of fugitive dust associated with military vehicle traffic include vehicle convoys on military vehicle trails, vehicle maneuver training on gravel or dirt roads inside military installations, and off-road military vehicle maneuvers inside military installations.

Without mitigation, if unpaved road surfaces are dry and winds are light, even relatively modest numbers of vehicles can create sufficient dust to cause downwind PM_{10} concentrations that exceed the federal 24-hour standard of 150 micrograms per cubic meter. In the absence of any dust control measures, daily traffic volumes of about 100 vehicles per day have the potential for causing PM_{10} problems at locations within 2,000 feet (610 meters) of the roadway. Lower daily traffic volumes could cause PM_{10} problems over shorter distances, and higher daily traffic volumes could cause PM_{10} problems over longer distances. Maximum traffic volumes on proposed military vehicle trails would be slightly over 100 vehicles per day on the DMR Trail, about 300 vehicles per day on the Helemanō Trail, and about 500 vehicles per day on the PTA Trail. Potential PM_{10} problems from vehicle traffic on military vehicle trails can be reduced substantially by a combination of feasible mitigation measures, including the use of washed gravel for surfacing the trails and implementing a dust management program that may include road paving or periodic application of chemical dust suppressants. Alternative chemical dust suppressants include hygroscopic salts (such as calcium chloride or magnesium chloride solutions) and synthetic polymer compounds (such as polyvinyl acetate and vinyl acrylic). If properly applied, dust control measures for unpaved roads would achieve at least 90 percent control of fugitive dust under the weather conditions and roadway use levels prevalent at USARHAW installations. Although fugitive dust from vehicle travel on unpaved roads would be a significant impact in the absence of mitigation, the Army will implement mitigation programs sufficient to avoid violating the federal PM_{10} standard or substantial adverse health consequences for the public.

Because soil conditions, precipitation patterns, and the geographic distribution of areas suitable for off-road vehicle maneuver activity vary widely among USARHAW installations, potential fugitive dust concentrations downwind of vehicle maneuver training areas also show substantial variation among the different installations. Available vehicle maneuver areas are limited at SBER, DMR, and KTA, placing practical limitations on the size and type of vehicle maneuver training that can occur at these installations. DMR is used primarily for logistics activity training, rather than tactical maneuver training. Consequently, dispersion modeling analyses were not performed for DMR. SBER would support small unit and company level maneuver exercises, while KTA would support small unit, company, and battalion level exercises. PTA would support small unit, company, battalion, and brigade level maneuver exercises. Small unit exercises were not modeled because those exercises involve too few vehicles to create significant fugitive dust problems.

If a full company level exercise were conducted at SBER when ground surface conditions were dry, there would be a strong probability that PM_{10} concentrations would exceed the level of the state and federal PM_{10} standards in nearby off-post residential areas. The Army will mitigate this potential impact by developing a Dust and Soil Management and Monitoring Plan (DuSMMoP) in coordination with appropriate state and federal agencies. The DuSMMoP will include a program for monitoring PM_{10} levels at representative locations near installation boundaries. Based on monitoring results, the Army will implement one or more of the following measures:

- Applying dust control agents to unpaved trails and roads;
- Developing management programs that adjust the size and design of vehicle maneuver training at SBER based on prevailing soil moisture conditions;
- Applying the ITAM program to accommodate continued training; and
- Deferring or moving full company level training exercises to other installations.

Implementing such mitigation measures would reduce fugitive dust impacts from vehicle maneuver training exercises to a less than significant level.

High PM_{10} concentrations from a company level exercise at KTA would be limited to on-post locations even if such an exercise were conducted when ground surface conditions were dry. Battalion level exercises at KTA, on the other hand, have the potential for creating PM_{10} concentrations that would exceed the level of the state and federal PM_{10} standards at off-post locations. For exercises that include a total of six hours of significant vehicle activity in a single day, PM_{10} concentrations might exceed the federal 24-hour standard at locations within 1.2 miles (1.9 kilometers) of the maneuver area. However, high PM_{10} concentrations from battalion -level exercises at KTA would occur only if the ground surface were dry. The impact of fugitive dust emissions from vehicle maneuver exercises would be reduced to a less than significant level through application of the mitigation measures described above.

Most vehicle maneuver exercises at PTA would occur on WPAA, which provides a much larger area for maneuvers than is available at SBER or KTA. While company and battalion exercises at SBER or KTA are severely constrained by available area, that would not be the case at WPAA; consequently, vehicle activity during maneuver exercises at WPAA would be widely dispersed rather than concentrated in small areas. The dispersed pattern of vehicle activity would result in much less intense ground disturbance at WPAA than at SBER or KTA. Company level vehicle maneuver exercises at WPAA would typically be spread over 2,000 to 5,000 acres (809 to 2,023 hectares). A 2,500-acre (1,012-hectares) activity area was assumed for modeling company level exercises. Because vehicle activity and resulting fugitive dust emissions would be widely dispersed, individual downwind locations would experience only low concentrations of PM_{10}. The federal and state 24-hour PM_{10} standards would not be exceeded at either on-post or off-post locations during company level exercises at WPAA.

Battalion level exercises at WPAA normally would be spread over a large portion of the WPAA. To provide a conservative analysis, the modeling evaluation assumed that a battalion level exercise would be concentrated on a 6,000-acre (2,428-hectare) area. Even with the conservative modeling assumptions, vehicle activity and resulting fugitive dust emissions would be well dispersed. Although moderate PM_{10} concentrations could occur within a few hundred feet of the exercise area, the federal and state 24-hour PM_{10} standards would not be exceeded at either on-post or off-post locations during battalion level exercises at WPAA.

Brigade level exercises normally would make use of the entire 23,000-acre (9,308-hectare) WPAA. To provide a conservative analysis, the modeling evaluation assumed that a brigade level exercise would be concentrated on a 10,000-acre (4,047-hectare) area. Without mitigation, for a concentrated activity scenario such as the one analyzed, vehicle activity and resulting fugitive dust emissions would produce relatively high PM_{10} concentrations at downwind distances that would be likely to reach off-post locations. The geographic extent of high PM_{10} concentrations would depend partly on weather conditions and partly on the duration of periods with significant vehicle activity. Events with only four hours of significant vehicle activity in a day could create high PM_{10} concentrations as far as 3,000 feet (914 meters) from the edge of the activity area. Events with six hours of significant vehicle activity in a day could create high PM_{10} concentrations as far as 1.5 miles (2.4 kilometers) from the edge of the activity area. Events with eight hours of significant vehicle activity in a day could create high PM_{10} concentrations at distances of more than two miles (3.2 kilometers) from the edge of the activity area. PM_{10} impacts from brigade level vehicle maneuver exercises could be significant but could be reduced to a less than significant level through the proposed mitigation program.

Each of these levels of exercise use aviation support with varying amounts of low altitude helicopter and aircraft flight activity. The Army received comments expressing concerns over dust from helicopter flight activity. The Army reviewed this issue and determined that typical helicopter flight activity would not result in noticeable dust generation because the aircraft would be too high above the ground. Helicopter landings will generate dust, however, landings will be brief and limited in number and the dust effects would be very localized (limited to 200 feet or less).

The Army will mitigate potential fugitive dust problems from brigade level vehicle maneuver exercises with measures discussed above under SBER and with the development and implementation of the DuSMMoP. Through the development of DuSMMoP, brigade level maneuver exercises may be dispersed over most of the available maneuver area to avoid concentrating sources of fugitive dust emissions. Spreading a brigade level exercise over 20,000 acres (8,094 hectares) would reduce the expected downwind concentrations by 50 percent, compared to the scenario with activity concentrated on 10,000 acres (4,047 hectares). The Army prefers to train over large areas, so this requirement would have minimal effect on the planning for most brigade level exercise events. Implementing such a management program would reduce fugitive dust impacts from vehicle maneuver training exercises to a less than significant level.

The Army is considering several measures to control dust on vehicle trails. Following is a discussion of some of the measures the Army will consider. Providing a gravel cover to dirt roads and other open dirt areas reduces fugitive dust generation. Gravel produced by crushing local lava-derived rocks would have a moderate dust content unless washed sufficiently to reduce the amount of fine material in the gravel. In addition, lava-derived gravel weathers relatively rapidly and is likely to fragment and crumble more readily than gravel produced from harder rocks. Thus, the resulting gravel surface would be expected to generate noticeable quantities of fugitive dust. Dust generation could be reduced by washing gravel after it is produced by rock crushing operations. The extent of washing for dust reduction would need to be balanced against the engineering requirement to have sufficient fine material to provide a stable gravel surface. Either fresh water or seawater would be appropriate for such gravel washing operations, with the water being recycled for repeated washing operations. Gravel washing treatments by themselves are unlikely to reduce dust generation to less than significant levels, but could nevertheless be an important part of an overall dust control strategy.

Water application whenever road surface materials become dry would be expected to reduce fugitive dust emissions by 75 to 90 percent while the road surface retains moderate moisture levels, but dust control levels would drop rapidly as the road surface dries. Frequent water spray applications (often at least once per day) are required to maintain a high level of dust control. The use of seawater rather than potable water would reduce concerns over the use of limited water supplies. However, water evaporates too rapidly to provide effective dust control for any extended period of time. The necessity for frequent repeat treatments often makes water application for on-going dust control an impractical option in warm climates.

Thus, simple water sprays are not recommended for dust control on unpaved roads at USARHAW installations.

Synthetic dust control chemicals are widely used for on-going dust control on unpaved roads. When properly matched to road surface, traffic, and weather conditions, synthetic dust control products can achieve high levels of dust control. EPA estimates an 80 percent emission reduction as being typical for properly used synthetic dust control products (U.S. EPA 1998). Major categories of dust control products include hygroscopic salts (primarily calcium chloride and magnesium chloride solutions), various synthetic polymers (polyvinyl acetate and vinyl acrylic), lignosulfonate compounds (derived from pulp and paper processing), vegetable oil products, and petroleum products (various asphalt emulsions and mineral oils). Bolander and Yamada (1999) and USAEC (1999) provide summaries of dust control product characteristics and suitability under various conditions.

Bolander and Yamada (1999) provide a summary of environmental risks for various types of dust control products. Petroleum products used for dust control pose the greatest risk of producing environmental impacts due to toxicity and water quality effects. Vegetable oil products also can cause water quality problems, and may not work well on graveled surfaces. Lignosulfonate compounds have low direct toxicity, but can cause water quality problems due to oxygen depletion from biochemical oxygen demand. Lignosulfonate compounds may not work well on graveled surfaces. Synthetic polymers have very low toxicity and pose no water quality concerns under normal circumstances of use, but may not perform well on graveled surfaces. Hygroscopic salts have very low toxicity and pose no water quality concerns under normal circumstances of use. Synthetic polymers and hygroscopic salts pose the fewest potential environmental concerns, with no significant toxicity, water quality, vegetation, or soils impacts except in the case of large volume spills. Both lignosulfonate compounds and hygroscopic salt solutions are corrosive to metals, particularly aluminum. Thus, range management, security, logistical, and tactical vehicles would need to use vehicle wash facilities if roadways are treated with these groups of dust control agents.

Selection of the appropriate dust control products would be based on testing alternative products on dirt and gravel road segments. Based on general characteristics and performance elsewhere, environmentally friendly synthetic polymers and hygroscopic salt solutions appear to be the most promising groups of dust control agents. Hygroscopic salt solutions have a proven record of effectiveness and are ideally suited to use in areas with high humidity. Although chloride salts increase metal corrosion rates, the vehicle wash facilities included in the Proposed Action and the RLA Alternative would effectively address that issue. Calcium and magnesium chloride are considered non-hazardous, and thus there are no restrictions on the transportation of these products. Calcium chloride generally is provided in dry form (powders, flakes, or pellets), and can be mixed with either fresh water or seawater to create the solution used in dust control applications. The typical application rate for a 35 percent solution is about 0.5 gallons per square yard. Given the naturally high chloride exposure from sea salt aerosols in marine air, the use of hygroscopic salts for dust control at USARHAW installations would pose no significant environmental risks.

Army tests at Fort Hood, Texas and Fort Sill, Oklahoma indicated that calcium chloride solutions were more effective and longer lasting than various synthetic polymers or calcium lignosulfonate (USAEC 1996). The calcium chloride solutions provided emission reductions of 60 to 83 percent 30 days after the initial application. These dust control levels were achieved during extended drought conditions on unpaved roadways carrying high traffic volumes. Traffic volumes on test road segments at Fort Hood were approximately 3,000 to 10,000 vehicles per day. Traffic volumes at Fort Sill were about 1,200 to 8,000 vehicles per day. Test road segments at Fort Hood had much higher volumes of tank and other tracked vehicles than did test road segments at Fort Sill. Given the absence of tracked vehicles, significantly lower traffic volumes, and persistent high humidity levels, emission reductions provided by calcium chloride solutions at USARHAW installations should be significantly higher than the levels measured at Fort Hood and Fort Sill. The dispersion modeling results presented in the installation chapters assume a 90 percent control effectiveness factor.

The Army has committed to mitigating dust from vehicle traffic on unpaved roads through a combination of road paving, dust control chemical applications, and/or the use of washed gravel for surfacing military vehicle trails. As noted above, the extent of gravel washing would have to balance dust reduction goals with engineering requirements for achieving a stable roadway surface. Monitoring road surface moisture conditions and dust generation levels would be important components of an adaptive management program that seeks to optimize the proper timing of dust suppressant applications. To the extent possible, planned dust suppressant applications should be scheduled to immediately precede periods of significant convoy traffic.

Regulatory and Administrative Mitigation 2. The Army will develop and implement the DuSMMoP as discussed above under "Regulatory and Administrative Mitigation 1."

To reduce fugitive dust associated with the use of military vehicle trails, the Army will implement dust control measures such as dust control chemical applications, the use of washed gravel for surfacing, spraying water, or paving sections of trails. The extent of gravel washing would have to balance dust reduction goals with engineering requirements for achieving a stable roadway surface. Selection of the appropriate dust control products would be based on testing alternative products on dirt and gravel road segments. Based on general characteristics and performance elsewhere, environmentally friendly synthetic polymers (such as polyvinyl acetate and vinyl acrylic) and hygroscopic salt solutions (such as calcium chloride or magnesium chloride) appear to be the most promising groups of dust control agents. The Army will monitor road surface conditions and will apply palliatives as necessary. If moisture levels are adequate to suppress dust, than application of dust palliatives would not be necessary. To the extent possible, the Army would plan dust suppressant applications to be scheduled to immediately precede periods of significant convoy traffic.

Less than Significant Impacts

Emissions from construction activities. The Proposed Action would include numerous construction projects at various installations, with construction activities occurring from 2004 into 2009. Nitrogen oxide emissions from construction equipment at SBMR would be

100 tons (91 metric tons) in 2004, 149 tons (135 metric tons) in 2005, and less than 58 tons (53 metric tons) per year from 2006 through the end of the construction period in 2009. Nitrogen oxide emissions from construction equipment at PTA would be 192 tons (174 metric tons) in 2005 and 184 tons (167 metric tons) in 2006. Construction emissions at DMR would be less than 57 tons (51 metric tons) per year for any pollutant. Construction emissions at KTA would be less than 22 tons (20 metric tons) per year for any pollutant. As noted in Section 3.5, federal ozone standards have not been exceeded in Hawai'i, and maximum ozone levels in recent years have been well below the current state and federal standard. Emissions of ozone precursors associated with construction projects under the Proposed Action would create too small a net increased in ozone precursor emissions to have a measurable effect on ozone levels and would not affect the attainment status of the area. Consequently, construction activities would have a temporary and less than significant air quality impact at any installation under the Proposed Action. In order to reduce impacts on air quality during construction, each phase of construction would be scheduled to minimize the dust generating activities and materials, and construction contractors will comply with the provisions of Hawai'i Administrative Rules, Sec. 11-60.1-33 on Fugitive Dust and recommendations from the State on it's Coastal Zone Management Act concurrence letter as part of the requirements of construction contracts.

Emissions from ordnance use. Overall project-wide ordnance use by the 25th ID(L) would increase by about 25 percent under the Proposed Action. Approximately 96 percent of the annual ordnance use would consist of small arms ammunition (pistol, rifle, shotgun, and machine gun ammunition), each item of which has only a very small propellant charge. Ordnance items with explosive or pyrotechnic components (such as mortars, artillery, mines, demolition charges, smoke devices, flares, or blast simulators) would represent about four percent of the annual ordnance use. Emissions from ordnance use have not been quantified. However, the literature on emissions from ordnance firing and detonations clearly establishes that the detonation process is fundamentally different from normal combustion processes in terms of generating air pollutant emissions. As noted in a recent USEPA publication (Mitchell and Suggs 1998), unconfined detonations are essentially a decomposition process in which molecular constituents are broken down into simpler byproducts, and molecules more complex than the starting molecules are not formed. Instead, most of the energetic material is converted into simple gaseous products such as carbon dioxide, carbon monoxide, water vapor, nitrogen gas, nitric oxide, and nitrogen dioxide. Based on the general nature of detonation processes and the very low emission rates that have been published in studies of munitions firing and open detonations, emission quantities from ordnance use are very small and include only trace quantities of hazardous components. Emissions associated with ordnance use pose very little risk of creating adverse air quality impacts. Consequently, air quality impacts from munitions use under the Proposed Action are considered less than significant.

Engine emissions from military vehicle use. Project-wide military vehicle use would increase by over 50 percent under the Proposed Action. Based on the estimated mix of vehicle types and the estimated frequency of vehicle use, annual project-wide emissions from military vehicle use would increase by about 98 percent compared to No Action conditions. Nevertheless, the net increase in annual emissions would be too small to affect the attainment status of any installations. The pollutant with the highest estimated annual net increase in emissions would be nitrogen oxides, which would increase by 82 tons (75 metric tons) per year for all installations combined. Consequently, emissions from military vehicle use would be a less than significant impact under the Proposed Action.

Emissions from increased aircraft operations. The Proposed Action would not result in any meaningful change to existing Army helicopter flight operations in Hawai'i. Airfield improvements at WAAF and BAAF would accommodate increased use of fixed wing cargo aircraft (C-130 and C-17 aircraft) for transporting troops and equipment to PTA. The Shadow 200 UAV would be used during many training exercises at various installations under the Proposed Action. However, current patterns of helicopter flight activity would continue to be the dominant Army flight activity. The project-wide net increase in emissions resulting from added cargo aircraft and UAV flight activity would be small. Consequently, the increase in aircraft emissions under the Proposed Action would be a less than significant impact.

Emissions from wildfires. Tracers, flares, and pyrotechnics have the potential for starting wildfires on training range areas. The use of such munitions would increase somewhat under the Proposed Action, with a corresponding increase in the potential for wildfires. The relatively low frequency of wildfires and their typically small size result in only small quantities of emissions. Consequently, emissions from wildfires on range areas would be a less than significant impact under the Proposed Action.

Other emissions from personnel increases. The Proposed Action would increase the overall number of military personnel at SBMR by 810. This represents a 5.5 percent increase in combined military and civilian personnel compared to No Action. Estimated emissions associated with the net increase in commute vehicle traffic would be approximately 8.2 tons (7 metric tons) per year of reactive organic compounds; 67 tons (61 metric tons) per year of carbon monoxide; 7.5 tons (7 metric tons) per year of nitrogen oxides; 0.05 ton (0.05 metric ton) per year of sulfur oxides; and 11.3 tons (10.3 metric tons) per year of PM_{10}. These emission quantities would be too small to affect the attainment status of the area. Consequently, emissions from increased commute traffic at SBMR would be a less than significant impact under the Proposed Action. Personnel would not increase at other installations.

Reduced Land Acquisition Alternative

Significant Impacts

Impact 1: Wind erosion from areas disturbed by military vehicle use. Air quality impacts would be the same under Reduced Land Acquisition as those under the Proposed Action.

Regulatory and Administrative Mitigation 1. The mitigation measures for wind erosion from areas disturbed by military vehicle use would be the same as discussed for the Proposed Action.

Significant Impacts Mitigable to Less Than Significant

Impact 2: Fugitive dust from military vehicle use. Vehicle numbers and estimated annual VMT by military vehicles would be essentially the same under Reduced Land Acquisition as discussed for the Proposed Action. Fugitive dust impacts are significant but mitigable to less than significant with the mitigation measures described below.

Regulatory and Administrative Mitigation 2. The mitigation measures for fugitive dust from off-road vehicle maneuver activity would be the same as discussed for the Proposed Action.

Less than Significant Impacts

Emissions from construction activities. Reduced Land Acquisition would require most of the same construction projects as discussed under the Proposed Action. QTR2 would be constructed at PTA instead of at SBMR. Nitrogen oxide emissions from construction equipment at SBMR would be 100 tons (91 metric tons) in 2004 and 126 tons (114 metric tons) in 2005. Nitrogen oxide emissions from construction equipment would be 213 tons (193 metric tons) in 2005 and 186 tons (169 metric tons) in 2006. Construction emissions at DMR would be less than 57 tons (51 metric tons) per year for any pollutant. Construction emissions at KTA would be less than 22 tons (20 metric tons) per year for any pollutant. . Emissions of ozone precursors associated with construction projects under the Proposed Action would create too small a net increased in ozone precursor emissions to have a measurable effect on ozone levels and would not affect the attainment status of the area. Consequently, construction activities would have a temporary and less than significant air quality impact at any installation under the RLA Alternative.

Emissions from Ordnance Use. Ordnance use under Reduced Land Acquisition would be essentially the same as ordnance use under the Proposed Action. As discussed for the Proposed Action, emissions associated with ordnance use would pose very little risk of creating adverse air quality impacts, so air quality impacts from munitions under Reduced Land Acquisition are considered less than significant.

Engine Emissions from Military Vehicle Use. Military vehicle use under Reduced Land Acquisition would be essentially the same as that discussed for the Proposed Action. Because the project-wide net emissions increase would be too small to affect the attainment status of any installation, emissions from military vehicles would be a less than significant impact under Reduced Land Acquisition.

Emissions from Increased Aircraft Operations. Reduced Land Acquisition would have the same small effect on emissions from aircraft operations as that discussed for the Proposed Action, so the increase in aircraft emissions under Reduced Land Acquisition would be a less than significant impact.

Emissions from Wildfires. Reduced Land Acquisition would have essentially the same potential for wildfires as that discussed for the Proposed Action. As noted for the Proposed Action, emissions from wildfires would be a less than significant impact under Reduced Land Acquisition.

Other Emissions from Personnel Increases. Reduced Land Acquisition would have the same personnel increase as that discussed for the Proposed Action. Emissions from added commute traffic would be the same as that discussed under the Proposed Action. Because these emission quantities would be too small to affect the attainment status of the area, emissions from increased commute traffic at SBMR would be a less than significant impact under Reduced Land Acquisition.

No Action Alternative

Less than Significant Impacts

Emissions from ordnance use. Overall project-wide ordnance use under No Action would be about 21 percent less than under the Proposed Action. Based on the general nature of detonation processes and the very low emission rates that have been published in studies of munitions firing and open detonations, emissions associated with ordnance use pose very little risk of creating adverse air quality impacts. Consequently, air quality impacts from munitions use under No Action are considered less than significant.

Engine emissions from military vehicle use. The military vehicle fleet would remain at the current 659 vehicles under No Action. Estimated annual emissions from vehicle engine operations would be well too small to affect the attainment status of any installations. Consequently, military vehicle engine emissions would have a less than significant impact under No Action.

Fugitive dust from military vehicle use. Vehicle numbers and estimated annual use levels would remain at current conditions under No Action. Because existing conditions have not led to any known violations of state or federal ambient air quality standards, the fugitive dust from military vehicle use would have a less than significant impact under No Action.

Wind erosion from areas disturbed by tactical vehicle use. Vehicle maneuver activity would remain the same as current conditions under No Action. Because existing conditions have not led to any known violations of state or federal ambient air quality standards, wind erosion from disturbed areas would be a less than significant impact under No Action.

Emissions from increased aircraft operations. There would be no change in aircraft operations at WAAF or BAAF under No Action. Consequently, there would be no increase in aircraft emissions under No Action. Because there would be no change from current conditions and because current conditions have not created any known violations of state or federal ambient air quality standards, emissions from aircraft operations under No Action would have a less than significant impact on air quality.

Emissions from wildfires. There would be no change in the use of tracer rounds or pyrotechnics under No Action. The risk of wildfires on training ranges would remain the same as present conditions. Emissions from wildfires under No Action are unlikely to produce substantial air quality impacts in off-base areas. Consequently, emissions from wildfires on range areas are considered a less than significant impact under No Action.

Other emissions from personnel increases. There would be no changes in personnel numbers at SBMR under No Action. Emissions from commute traffic under No Action would remain the same as under current conditions. Because there would be no change from current conditions and because current conditions have not created any known violations of state or federal ambient air quality standards, emissions from these sources would have a less than significant impact under No Action.

No Impact

Emissions from Construction Activities. No construction projects are associated with No Action, so there would be no air quality impacts from construction under No Action.