LA3 LANGLEY AFB AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

Aircraft Operations

As an active, combat-ready unit, the Initial F-22 Operational Wing would conduct training at Langley airfield and in the associated training airspace. Aircraft performing training activities generate noise and emit exhaust that can affect the noise environment and air quality. Maintenance activities, construction, and ground vehicles also produce emissions that can affect air quality. All training and other activities must be performed safely and with regard for all other users, both in the air and on the ground. Because these training activities have the potential to affect safety and airspace management, the Air Force has analyzed them in this Draft EIS. Aircraft operations addresses airspace management and use, noise, air quality, and safety.

The affected environment for aircraft operations at Langley AFB includes the base, the airspace surrounding the airfield, and the associated training airspace. A description of the factors used to define the affected environment and the methods used to evaluate baseline conditions are presented in Appendix AO-1. For this Draft EIS, the best available data were used for this new generation of advanced fighter aircraft. However, there are limitations to the extent of data since this aircraft is new, with four prototypes flying. Noise, air quality, and safety data have been collected to the greatest extent possible for F-22 specific aircraft.

Noise data have been collected on the F-22; however, none of the aircraft have flown the full range of maneuvers and engine power settings needed to develop the complete noise database required for noise analysis. Although the Air Force used the prototype F-22 aircraft for data collection, it is still possible the developmental test engines may be further modified as a result of ongoing testing. Therefore, a composite approach was used to model noise for the F-22. Current data on the prototype aircraft were used as well as information on comparable turbofan engines and other similar fighter aircraft power settings, speed, and maneuvering.

As a new, developing aircraft, the F-22 and its systems (e.g., engines, avionics) have evolved since the first flight in 1997 and will continue to evolve in the future. Acquisition of detailed knowledge of the outputs (such as noise levels and emissions) resulting from F-22 operations has followed a similar evolutionary pattern. Basically, this information will improve in precision the more the F-22 flies and undergoes evaluation.

This evolution in knowledge of F-22 outputs (especially noise) has clearly evolved over the past few years. In the environmental analysis performed on the F-22, *F-22 Force Development Evaluation and Weapons School Beddown, Nellis AFB* (Air Force 1999a), the best available information was used (at that time only one F-22 prototype had been flown). This information indicated that the noise profile of the F-18A Hornet formed an appropriate surrogate for the F-22 at that time.

By 2000, when the F-22 *Conversion of Two F-15 Fighter Squadrons to F-22 Fighter Squadrons at Tyndall AFB, Florida* (Air Force 2000a) environmental analysis was completed, the Air Force Research

Laboratory had collected additional F-22 noise data. Correlating these data to the known noise signatures for other aircraft led the Air Force to continue to use the F-18 as the best available surrogate for the F-22.

As noted above, further actual noise data on the F-22 has been collected. Although these data do not provide a complete noise database, they demonstrate the evolution of information on the aircraft. These data further establish that a composite of comparable engines and fighter aircraft best characterize the noise profile for the F-22.

For air quality, the best available data were also used. The F-22 uses a new propulsion system, the F119-PW-100, which is a low-bypass ratio turbofan built by Pratt & Whitney. This engine is still under test and evaluation and may require changes depending on the test program. Many operational parameters of this new engine are classified or competitively sensitive. In an effort to approximate the fuel emissions that would be expected for this F119 engine, the F100 series of engines were evaluated. These series of engines were chosen because they most closely represent the function of the F119 engine and the power settings anticipated to be used by the F-22.

Safety data are unavailable for the F-22 because there are only four test and evaluation prototype aircraft flying. There have not been enough flight hours to accurately depict the safety record for this new aircraft. Therefore, similar fighter aircraft safety records have been used and conclusions drawn based on their flight history.

Although some F-22 data for noise, air quality, and safety are currently incomplete or unavailable, this Draft EIS provides a thorough analysis of known parameters. The Council on Environmental Quality (CEQ) regulations implementing the National Environmental Policy Act (NEPA) recognize that such a situation may occur. This situation is managed in accordance with 40 Code of Federal Regulations (CFR) § 1502.22, *Incomplete or Unavailable Information*, which provides the following guidance:

> When an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an Environmental Impact Statement, and there is incomplete or unavailable information, the agency shall always make clear that such information is lacking.
>
> (a) If the incomplete information relevant to reasonably foreseeable significant adverse impacts is essential to a reasoned choice among alternatives, and the overall costs of obtaining it are not exorbitant, the agency shall include the information in the Environmental Impact Statement.
>
> (b) If the information relevant to reasonably foreseeable significant adverse impacts cannot be obtained because the overall costs of obtaining it are exorbitant, or the means to obtain it are not known, the agency shall include within the Environmental Impact Statement the following:
>
> 1. A statement that such information is incomplete or unavailable;
>
> 2. A statement of the relevance of the incomplete or unavailable information to evaluating reasonably foreseeable significant adverse impacts on the human environment;

3. A summary of existing credible scientific evidence which is relevant to evaluating the reasonably foreseeable significant adverse impacts on the human environment; and

4. The agency's evaluation of such impacts based upon theoretical approaches or research methods generally accepted in the scientific community. For the purposes of this Section, "reasonably foreseeable" includes impacts which have catastrophic consequences, even if their probability of occurrence is low, provided that the analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason.

As indicated above, data for the F-22 aircraft that are necessary to model the aircraft's noise, air quality, and safety are incomplete. While the costs to obtain complete data are not exorbitant, those data cannot be obtained at this time due to limitations on aircraft performance during its developmental stage, the need for further testing of operational aircraft, analyses during normal (versus developmental) flying conditions, and time to develop a flight safety record (40 CFR §§ 1502.22[b]; 1502.22[b]1). The data and factors used in this analysis are presented in the body of this Draft EIS and further detailed in Appendices AO-1 through AO-3.

No-Action Alternative

Under the no-action alternative, Langley AFB would not be the base for the beddown of the Initial F-22 Operational Wing. Ongoing Air Force and interagency programs and activities at Langley AFB would continue operating at planned levels as reflected in current Air Force management plans. These plans include recent activities that have been approved by the Air Force and have existing NEPA documentation.

No action means no decision to beddown the Initial F-22 Operational Wing at this time at Langley AFB.

Under the no-action alternative, Langley AFB and the 1st FW would continue to host Headquarters ACC. Aircraft operations and airspace management and use associated with the 1st FW would continue at current levels. There would be no change in the use of existing airspace. Under the no-action alternative, existing noise levels would not change, either in the vicinity of the base or under the affected airspace. Impacts to air quality from emissions would reflect current and ongoing activities in the region. Langley AFB would continue to operate under conditions in its Synthetic Minor Operating permit and comply with all applicable state and federal laws and regulations. There would be no change in aircraft operations; therefore, there would be no new safety issues. Operation and maintenance activities conducted at Langley AFB would continue in accordance with all applicable safety directives.

LA3.1 Airspace Management and Use

LA3.1.1 Base

Affected Environment

Airspace currently supporting sorties at Langley AFB includes airspace immediately surrounding the base. This airfield airspace is controlled by the Langley AFB control tower for arriving and departing aircraft. A total of 17,531 sorties were conducted at Langley AFB under baseline conditions. Supporting airspace also includes the larger airspace encompassing Langley AFB; the Richmond, Norfolk, and Newport News/Williamsburg International Airports; Naval Air Station (NAS) Norfolk/Chambers; and Walker Army Heliport. The Federal Aviation Administration (FAA)-operated Norfolk Approach Control provides air traffic control services within this airspace to aircraft arrivals and departures at each of the above airports. Aircraft operating from Langley AFB transition to or from both the Langley Tower and Norfolk Approach Control. Transitions from one airspace unit to another are common practices at thousands of airfields, and aircraft perform these operations safely and effectively every day. Aircraft at Langley AFB have flown in this airspace environment for many decades without conflict with civil or commercial aviation.

Environmental Consequences

Beddown of the Initial F-22 Operational Wing at Langley AFB would not adversely affect airspace management and use within the local air traffic environment. The replacement of F-15C operations by the F-22 would result in an approximate 7 percent net increase in sorties above baseline conditions. No airspace modifications or changes to base arrival or departure procedures would be required to accommodate the F-22 aircraft performance or airfield sorties. Therefore, effects on airspace use in the local air traffic environment would be negligible.

Comparative Summary of the Five Potential Basing Locations

Airspace management procedures in the vicinity of each base are adequate to support the additional sorties associated with the proposed beddown. Sorties at Langley would increase by 7 percent, Eglin sorties would increase by 16 percent, Elmendorf sorties would increase by 26 percent, Mountain Home sorties would increase by 58 percent, and Tyndall sorties would increase by 43 percent. Despite the variation in increases, there would be no noticeable effect on airspace management at any of the bases. Only at Mountain Home, where an additional runway would be constructed, would effects differ from the other locations.

LA3.1.2 Airspace

Affected Environment

The affected environment for Langley AFB consists of both primary and occasional use airspace (refer to Table LA2.2-1 and Figure LA2.2-1). Primary airspace includes the MOA and over-water Warning Areas the F-22 would use on a continuing basis for training. This airspace receives 95 percent of Langley AFB's current F-15C use and would continue at the same levels for the F-22s under the proposed action. In total, the F-15Cs fly 7,563 sortie-operations in the seven primary

airspace units (six Warning Areas and one MOA). Warning Areas W-72 and W-386 receive the most use by the F-15Cs, but other aircraft (Navy F-14, F-18) dominate activities in these units. On the other end of the spectrum, Langley's F-15Cs fly relatively few sortie-operations in W-107 and W-110. Occasional use airspace is composed of a number of MOAs, Warning Areas, and other airspace units used for less than 5 percent of the sortie-operations when primary airspace is unavailable. On average, sortie-operations by F-15Cs from Langley AFB are less than one flight per flying day in the occasional use airspace. This pattern of sortie-operations would continue with the F-22s and be maintained at this minimal level.

Primary Use Airspace
Farmville MOA
W-72
W-107
W-110
W-122
W-386
W-387
Occasional Use Airspace
Echo MOA
Evers MOA
Hatteras B ATCAA
Buckeye MOA
W-132
W-134
W-157
W-158
W-177
VR-1574
Dare County Range (R-5314)

Section LA2 describes the baseline use of the airspace and its general parameters. Figure LA3.1-1 provides the location and floor (upper) and ceiling (lower) altitudes of the primary airspace units for Langley AFB.

A number of MTRs overlap three Warning Areas (W-107, W-122, W-386). There are three MTRs that coincide with W-122 and one each at W-107 and W-386. Close coordination of scheduling and use of these MTRs, MOAs, and Warning Areas by the respective scheduling agencies ensures safe air traffic operations throughout this region. Therefore, other air traffic traveling in these airspace units are not in conflict with military flight activities. See Appendix AO-1 for further discussion of the MTR coincidence with MOAs and Warning Areas

Environmental Consequences

Selection of Langley AFB for the Initial F-22 Operational Wing would not result in adverse effects on airspace use and management throughout this region. This proposed action would not require any changes to the current lateral or vertical configuration of the primary and occasional use in MOAs, ATCAAs, or Warning Areas, nor would it alter their normally scheduled times of use. Based on an average of 260 flight training days per year, the only measurable net increase in daily average sortie-operations would be in W-386 (seven additional daily sortie-operations) and W-72 (four additional daily sortie-operations). All other primary use airspace units identified for this alternative would have little or no change to daily average use (i.e., less than one additional sortie-operation). Activities in occasional use airspace would remain comparable to baseline levels.

Only two of the over-water Warning Areas would have measurable net increases in daily average sortie-operations from Langley-based F-22 operational training.

In general, this proposed action would have no adverse effects on general or commercial aviation throughout this region. The limited number of Langley aircraft military operations conducted in the overland MOA minimizes the potential for intrusion of these operations on the public/private airports beneath the MOA or on any rules aircraft operating on visual flight through or beneath the MOA (Appendix AO-1). Greater use of the over-water training areas has been key to minimizing potential impacts of military training activities on high-density commercial air traffic operating along

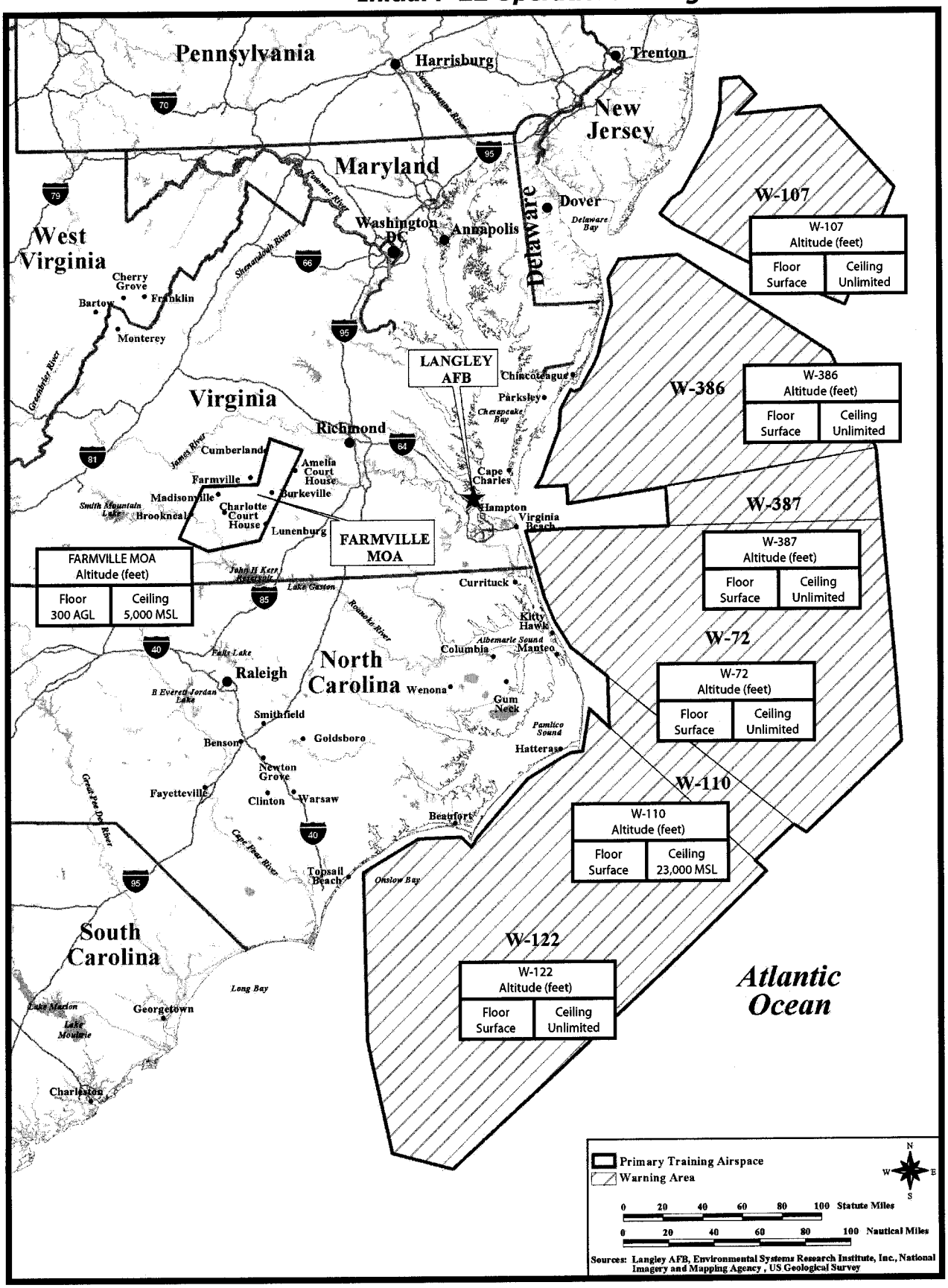


Figure LA3.1-1
Langley AFB Affected Airspace Environment

the federal airways, jet routes, and other corridors throughout this coastal region. Therefore, since the proposed beddown represents a continuation of current activities with only minor increases in sortie-operations, no adverse impacts in airspace use and management would be expected.

Comparative Summary of the Five Potential Basing Locations

Airspace management for the training airspace associated with all five beddown locations would be unchanged as a result of the F-22 beddown. There would be no substantive differences in the consequences at any of the five locations to airspace management.

LA3.2 Noise

Within this Draft EIS, noise is described by the sound level. Sound level is the amplitude (level) of the sound that occurs at any given time. When an aircraft flies by, the level changes continuously, starting at the ambient (background) level, increasing to a maximum as the aircraft passes closest to the receptor, and then decreasing to ambient as the aircraft flies into the distance. Sound levels are on a logarithmic decibel scale; a sound level that is 10 decibels (dB) higher than another will be perceived as twice as loud. More specific noise metrics include Maximum Sound Level (L_{max}), the Sound Exposure Level (SEL), Day-Night Average Sound Level (DNL), and Onset-Rate Adjusted Monthly Day-Night Average Sound Level (L_{dnmr}). A-weighted levels are used for subsonic aircraft noise, and C-weighted levels are used for sonic booms and other impulsive noises. A "C" is included in the symbol to denote when C-weighting is used. Each of these metrics is summarized below and discussed in detail in Appendix AO-1.

- Maximum Sound Level (L_{max}) is used to define maximum noise levels. L_{max} is the highest sound level measured during a single aircraft overflight. For an observer, the noise level starts at the ambient noise level, rises up to the maximum level as the aircraft flies closest to the observer, and returns to the ambient level as the aircraft recedes into the distance.

- Sound Exposure Level (SEL) accounts for both the maximum sound level and the length of time a sound lasts. SEL does not directly represent the sound level heard at any given time. Rather, it provides a measure of the total sound exposure for an entire event averaged over 1 second.

- Day-Night Average Sound Level (DNL) is a noise metric combining the levels and durations of noise events and the number of events over an extended time period. It is a cumulative average computed over a 24-hour period to represent total noise exposure. DNL also accounts for more intrusive night time noise, adding a 10 dB penalty for sounds after 10:00 pm and before 7:00 am. DNL is the appropriate measure to account for total noise exposure around airfields such as Eglin AFB.

- Onset-Rate Adjusted Monthly Day-Night Average Sound Level (L_{dnmr}) is the measure used for subsonic aircraft noise in military airspace (MOAs or Warning Areas). This metric accounts for the fact that when military aircraft fly low and fast, the sound can rise from ambient to its maximum very quickly. Known as an onset-rate, this effect can make noise seem louder due to the added "startle" effect. Penalties of up to 11 dB are added to account for this onset-rate.

- C-Weighted Day-Night Sound Level (CDNL) is day-night sound levels computed for areas subjected to sonic booms. These areas are also subjected to subsonic noise assessed according to L_{dnmr}.

Comments received during scoping placed special emphasis on a comprehensive presentation of noise effects. Aircraft noise effects can be described according to two categories: annoyance and human health considerations. Annoyance, which is based on perception, represents the primary effect associated with aircraft noise. Far less potential exists for effects on human health. Appendices AO-1 and AO-2 provide detail on these effects and the studies used to identify them.

Studies of community annoyance to numerous types of environmental noise show that DNL correlates well with effects, and Schultz (1978) showed a consistent relationship between noise levels and annoyance. A more recent study reaffirmed and updated this relationship (Fidell *et al.* 1991). The updated relationship, which does not differ substantially from the original, is the current preferred form.

In general, there is a high correlation between the percentages of groups of people highly annoyed and the level of average noise exposure measured in DNL. The correlation is lower for the annoyance of individuals. This is not surprising considering the varying personal factors that influence the manner in which individuals react to noise. The inherent variability between individuals makes it impossible to predict accurately how any individual will react to a given noise event. Nevertheless, findings substantiate that community annoyance to aircraft noise is represented quite reliably using DNL.

Relation Between Annoyance and DNL

DNL	***% Population Highly Annoyed***
65	12.3
70	22.1
75	36.5
80	53.7
85	70.2

In addition to annoyance, the effect of noise on human health was raised during the public scoping process for this Draft EIS. Other factors that can be used to evaluate a noise environment are noise-induced hearing loss, speech interference, and sleep disturbance. Effects on speech and sleep also contribute to annoyance.

A considerable amount of data on hearing loss have been collected and analyzed. It has been well established that continuous exposure to high noise levels (such as that occurring in a factory) will damage human hearing (USEPA 1978). Hearing loss is generally interpreted as the shifting to a higher sound level of the ear's sensitivity to perceive or hear sound (sound must be louder to be heard). This change can be either temporary or permanent. Federal workplace standards for protection from hearing loss allow an A-weighted time-average level of 90 dB over an 8-hour work period, or 85 dB averaged over a 16-hour period. As shown later in this section, noise levels associated with the activities of the F-22s would be more than 30 dB below these standards. In a MOA or Warning Area, the operations are random and widely dispersed. The random nature of operations and the wide altitude structure within the MOA make it unlikely that any one location would be repeatedly overflown over a short duration.

Studies on community hearing loss from exposure to aircraft flyovers near commercial airports showed that there is no danger, under normal circumstances, of hearing loss due to aircraft noise (Newman and Bettie 1985). Commercial airport traffic is much more continuous and frequent than

at a military airfield and also commonly lower in altitude than flights in MOAs or Warning Areas. In Warning Areas and MOAs, military aircraft fly at varied altitudes, rarely fly over the same point on the ground repeatedly during a short period, and occur sporadically over a day. These factors make it unlikely that any hearing loss would occur (Thompson 1997). Other factors, described in Appendix AO-1, demonstrate the lack of potential hearing loss from the F-22 beddown.

Another non-auditory effect of noise is disruption of conversations. Speech interference associated with aircraft noise is a primary cause of annoyance to individuals on the ground. Aircraft noise can also disrupt routine activities, such as radio listening, television watching, or telephone use. The disruption generally lasts only a few seconds, and almost always less than 10 seconds. It is difficult to predict speech intelligibility during an individual event, such as a flyover, because people automatically raise their voices as background noise increases. A study (Pearsons *et al.* 1977) suggests that people can communicate acceptably in background A-weighted noise levels of 80 dB but some speech interference occurs when background noise levels exceed 65 dB. Typical home insulation reduces the noise levels experienced by 20 dB or more, which decreases speech interference.

Noise-related awakenings form another issue associated with aircraft noise. Sleep is not a continuous, uniform condition but a complex series of states through which the brain progresses in a cyclical pattern. Arousal from sleep is a function of a number of factors including age, gender, sleep stage, noise level, frequency of noise occurrences, noise quality, and presleep activity. Quality sleep is recognized as a factor in good health. Although considerable progress has been made in understanding and quantifying noise-induced annoyance in communities, quantitative understanding of noise-induced sleep disturbance is less advanced.

Studies (Fidell *et al.* 1994; Pearsons *et al.* 1995; Kryter 1984) of the effects of nighttime noise exposure on the in-home sleep of residents near military airbases, civil airports, and in several households with negligible nighttime aircraft noise exposure, revealed the SEL as the best noise metric predicting noise-related awakenings and a strong influence of habituation on susceptibility to noise-induced sleep disturbance.

To date, no exact quantitative dose-response relationship exists for noise-related sleep interference. Yet, based on studies conducted to date and the USEPA guideline of a 45 DNL to protect sleep interference, useful ways to assess sleep interference have emerged. If homes are conservatively estimated to have a 20-dB noise insulation, an average of 65 DNL would produce an indoor level of 45 DNL and would form a reasonable guideline for evaluating sleep interference. This also corresponds well to the general guideline for assessing speech interference.

LA3.2.1 Base

Affected Environment

Langley AFB has supported operations by a wide variety of aircraft throughout its 83-year history. These aircraft have ranged from World War I biplanes and World War II bombers to the current F-15C fighters. Other aircraft currently operating out of Langley AFB include F-16 fighters, C-21 transports, and aircraft used by the NASA-Langley Research Center on base. Because the mix of based and transient (visiting) aircraft using Langley AFB has varied over the years, the shape and extent of areas affected by aircraft noise has also varied.

DNL, or Day-Night Average Sound Level, is the most widely accepted metric for assessing airfield noise.

Since the beddown of the F-15Cs at Langley AFB, the noise conditions have remained consistent over the years. Aircraft realignments, F-15 model upgrades, and requirements of national defense constitute minor changes at various points in time; however, general trends have been maintained. Noise levels experienced today are the same levels expected under a no-action decision, where no F-22s would be based at Langley AFB. The baseline noise levels, expressed as Day-Night Average Sound Levels (DNL), were modeled based on operations as they occur today – aircraft types, runway use patterns, engine power settings, altitude profiles, flight track locations, airspeed, and other factors. Appendices AO-1 and AO-2 present further information on noise metrics and the methods used for defining airfield noise levels.

Air Force requirements for flying at night (i.e., after dark) are normally met during seasons (like winter) with early sunsets. This practice limits the amount of late night flight operations to the maximum extent possible. Langley AFB operates under a program designed to reduce noise, particularly at night. A local quiet-hours program is employed between the hours of 10:00 pm and 6:00 am to limit disturbance. F-15C environmental night operations after 10:00 pm and before 7:00 am are infrequent and account for only 5 percent of total activity at the airfield. These operations are typically composed of arrivals (i.e., aircraft returning to the base). In addition, the base uses the runway that directs air traffic departures over the water east of the base.

To identify the areas affected by noise, a program known as NOISEMAP is used to generate noise contours. This program depicts noise levels ranging from 65 to 85 DNL or greater in 5 dB increments. Table LA3.2-1 and Figure LA3.2-1 present the baseline noise conditions for Langley AFB. These contours take into account Langley's attempt to reduce noise disturbances through such actions as minimizing night flying, avoiding flights over heavily populated areas, and use of jet engine noise suppressors for many maintenance activities.

Table LA3.2-1. Acreage Under Baseline Noise Contours in the Vicinity of Langley AFB

Noise Contour (DNL)	*Acres Affected: On Base*	*Acres Affected: Off Base*[1]	*Acres Affected: Total*
65-70	574	6,478	7,052
70-75	620	3,038	3,658
75-80	433	1,256	1,689
80-85	388	291	679
>85	684	6	690
Total	2,699	11,069	13,768

Note: 1. Off-base acreage includes both land and water.

Noise levels of 65 DNL or greater affect both on-base and off-base lands. Most (80 percent) of the affected area lies off base, but 44 percent of this off-base area consists of water. Section LA3.12, Human Resources, describes the land use implications of these noise levels.

Noise due to construction and maintenance equipment, as well as general vehicle traffic is a common, ongoing occurrence in the base environment. Existing, continuing military construction projects are currently in progress at Langley AFB. Trucks, as well as heavy equipment, are usually found in the base environment on a daily basis to support these existing facility and infrastructure upgrades.

Public scoping concerns included differences in noise generation of the F-22 compared to the F-15C and the effect of noise increases on the surrounding communities.

Environmental Consequences

Under the proposed action, the area affected by noise levels of 65 DNL or greater would decrease by approximately 366 acres (see Table LA3.2-2 and refer to Figure LA3.2-1). This decrease results from an approximate 1,200-acre reduction in the area affected by noise levels of 65 to 75 DNL; however, there would be an approximate 800-acre increase in the area affected by noise levels greater than 75 DNL.

Table LA3.2-2. Acreage Under Noise Contours in the Vicinity of Langley AFB Comparison of Baseline and Projected Conditions

	BASELINE			PROJECTED			CHANGE		
Noise Contour (DNL)	*Acres Affected: On Base*	*Acres Affected: Off Base[1]*	*Acres Affected: Total*	*Acres Affected: On Base*	*Acres Affected: Off Base[1]*	*Acres Affected: Total*	*Acres Affected: On Base*	*Acres Affected: Off Base[1]*	*Acres Affected: Total*
65-70	574	6,478	7,052	507	5,457	5,964	-63	-1,021	-1,084
70-75	620	3,038	3,658	622	2,928	3,550	+2	-110	-108
75-80	433	1,256	1,689	508	1,548	2,056	+75	+292	367
80-85	388	291	679	402	576	978	+14	+285	299
>85	684	6	690	811	39	850	+127	+33	160
Total	2,699	11,069	13,768	2,850	10,548	13,398	155	-521	-366

Note: 1. Includes off-base land and water acres.

At Langley AFB, off-base areas subjected to 65 DNL or greater would be reduced by 521 acres. On base, areas subjected to noise levels above 65 DNL would increase by 155 acres. Section LA3.12 describes the implications for the changes in land use affected by noise (excluding water). Overall, noise conditions on the ground would not change perceptibly.

Three factors cause this reduction in affected area: (1) the F-22 accelerates more quickly to climb speed; (2) the F-22 is able to set a lower power level sooner than the F-15C on takeoff and, therefore, the F-22 would generate more noise closer to the runway and less noise further from the runway (i.e., over the areas surrounding Langley AFB); and (3) the F-22 (compared to the F-15C) would require fewer maintenance activities where the engine is run at varying speeds along the flightline.

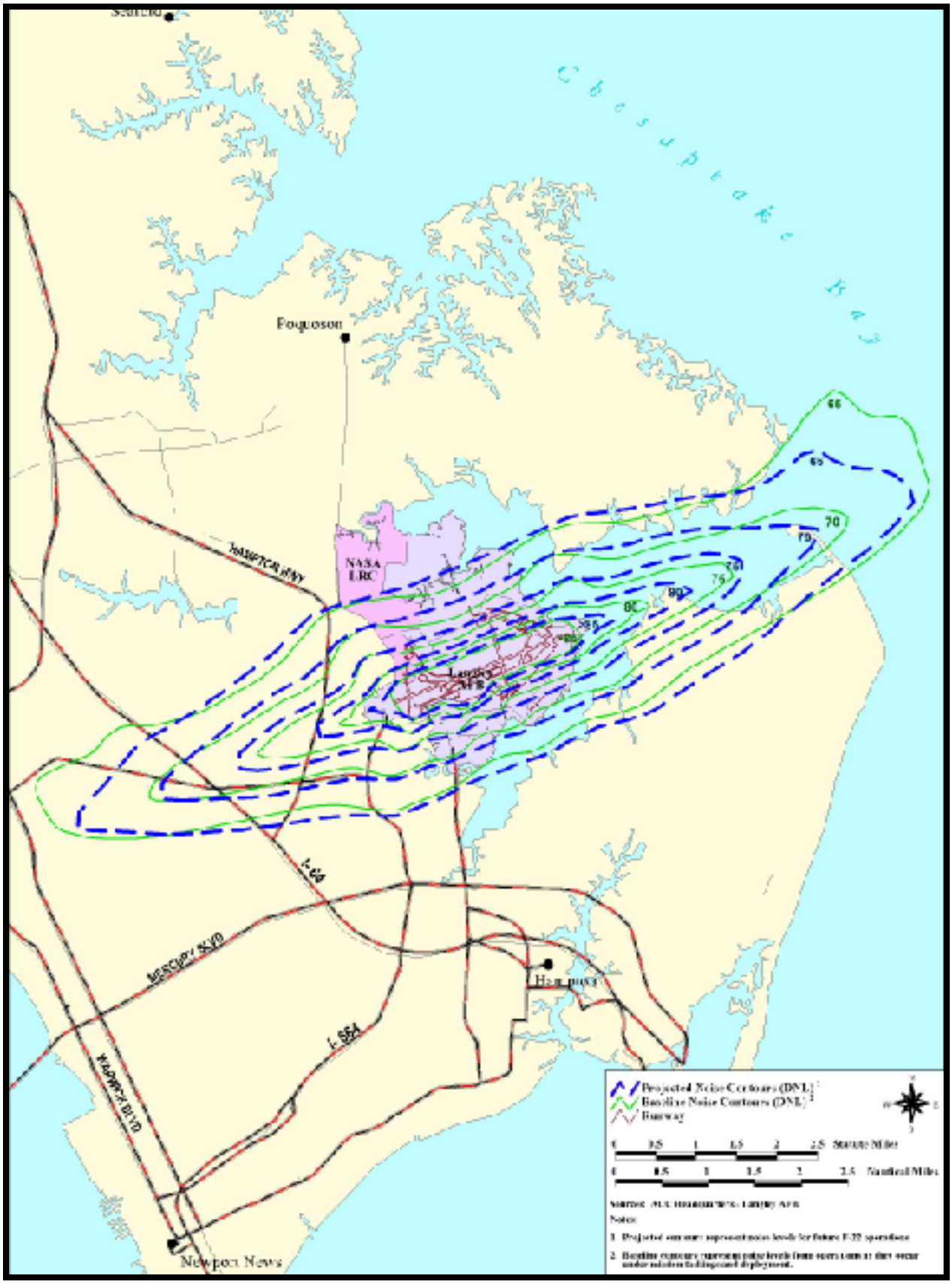


Figure LA3.2-1
Baseline and Projected Noise Contours at Langley AFB

Short-term noise increases due to construction and renovation, as well as infrastructure (stormwater and electric lines) installment and realignment would occur. Construction occurs in stages, the earlier stage entails trucks, bulldozers, and other heavy construction equipment for the major construction projects (e.g., hangars, apron). This stage of construction would be temporary and isolated. Most of these projects would be undertaken adjacent to the flightline, occupy industrial areas, and be isolated from any off-base communities. In addition, construction would take place during daylight hours and would follow best management practices to minimize noise to any off-base receptors. Construction noise would be contained within base environs since most heavy construction would occur near the flightline, where noise would be compatible with ongoing activities.

Comparative Summary of the Five Potential Basing Locations

Langley and Elmendorf have the least potential for noise environmental consequences among the basing locations. The total off-base area affected by noise levels of 65 DNL or greater decreases by 366 acres at Langley, and at Elmendorf, the off-base affected area increases by 607 acres, but essentially all of it overlies military land or water. Although the affected area would increase by 3,875 acres at Tyndall and 2,455 acres at Mountain Home, respectively, the effects on off-base lands would be negligible: most of the area outside Tyndall is water, and at Mountain Home, the lands are used for grazing/agriculture. Increases of 1,623 acres at Eglin would, however, affect 123 acres of residential land use.

LA3.2.2 Airspace

Affected Environment

Within MOAs and Warning Areas, subsonic flight can either be dispersed and randomly occurring or, due to either airspace configuration or training scenarios, it may be concentrated or channeled into specific areas or corridors. The Air Force has developed the MOA-Range NOISEMAP (MR_NMAP) computer program (Lucas and Calamia 1996) to calculate subsonic aircraft noise in these areas. MR_NMAP can calculate noise for both random operations and operations channeled into corridors. MR_NMAP is supported by measurements in several military airspaces (Lucas *et al.* 1995). The affected airspace for Langley AFB includes MOAs and Warning Areas in which random aircraft operation is the norm.

The primary noise metric calculated by MR_NMAP and used in this assessment is DNL (also know as L_{dn} or, by extension, L_{dnmr}). DNL has been computed for each of the seven primary airspace units for baseline or no-action and for the proposed action. As discussed in Appendix AO-2, this cumulative DNL metric represents the most widely accepted method of quantifying noise impact. However, it does not provide an intuitive description of the noise environment. People often desire to know what the loudness of an individual aircraft will be; MR_NMAP and its supporting programs can provide the L_{max} (Table LA3.2-3) and SEL (Table LA3.2-4) that account for both the duration and intensity of noise events for individual aircraft at various distances and altitudes. The L_{max} indicates the noise that would be heard by an individual the instant an aircraft flies overhead. SELs reflect the noise levels of a flyover, including

L_{dnmr} is the monthly average Onset-Rate Adjusted Day-Night Average Sound Level (DNL). Noise levels are calculated the same way for both DNL and L_{dnmr}. For this Draft EIS, all noise levels were interpreted using L_{dnmr}. However, to enhance readability, these noise levels will be referred to as DNL throughout the document.

the maximum level, averaged over 1 second as the aircraft approaches and departs. Both measures are described in Appendix AO-2.

Table LA3.2-3. Representative A-Weighted Instantaneous Maximum (L_{max}) in dB Under the Flight Track for the Aircraft at Various Altitudes in the Primary Airspace[1]

			ALTITUDE IN FEET ABOVE GROUND LEVEL						
Aircraft Type	*Airspeed (Knots)*	*Power Setting[2]*	*300*	*500*	*1,000*	*2,000*	*5,000*	*10,000*	*20,000*
F-15C	520	81% NC	119	114	107	99	86	74	57
F-22[3]	520	70% ETR	120	116	108	99	85	71	54
F-16A	450	87% NC	112	108	101	93	80	67	50
F-18A	500	92% NC	120	116	108	99	85	71	54
F-14A	530	100% NC	115	111	103	94	80	67	51
B-1B	550	101% RPM	117	112	106	98	86	75	61

Note: 1. Level flight, steady high-speed conditions.
2. Engine power setting while in a MOA. The type of engine and aircraft determines the power setting: RPM = rotations per minute, NC = percent core RPM, and ETR = engine throttle ratio.
3. Projected based on F-22 composite aircraft.

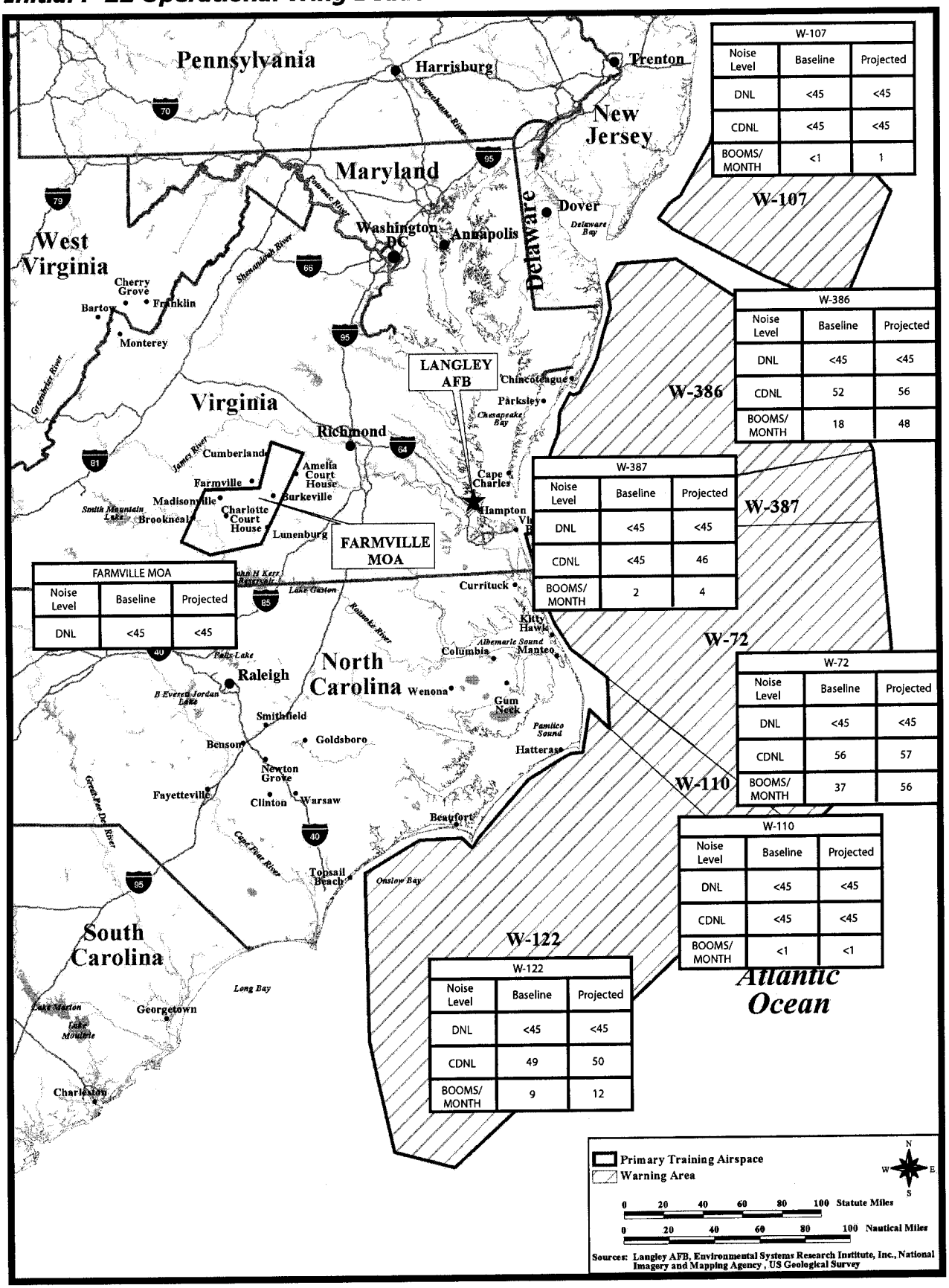
Table LA3.2-4. Sound Exposure Levels (SEL) in dB Under the Flight Track for Aircraft at Various Altitudes in the Primary Airspace[1]

		ALTITUDE IN FEET ABOVE GROUND LEVEL						
Aircraft Type	*Airspeed (Knots)*	*300*	*500*	*1,000*	*2,000*	*5,000*	*10,000*	*20,000*
F-15C	520	116	112	107	101	91	80	65
F-22[2]	520	118	114	108	101	89	77	62
F-16A	450	110	107	101	95	85	74	59
F-18A	500	118	114	108	101	89	77	62
F-14A	530	112	109	103	96	84	73	58
B-1B	550	116	112	107	101	92	82	70

Notes: 1. Level flight, steady high-speed conditions.
2. Projected based on F-22 composite aircraft.

Figure LA3.2-2 shows the baseline and projected noise levels for the seven primary airspace units. As these data show, noise levels in all seven primary airspace units are below 45 DNL. Noise was not explicitly computed for the occasional use airspace because of the low amount of use (i.e., less than 5 percent of total F-15C sortie-operations). The numbers of F-15C sortie-operations in these occasional use airspace units are so low that their influence on the cumulative noise is negligible.

Supersonic flight for fighter aircraft in the Warning Areas is primarily associated with air combat training, which generally occurs above 10,000 feet MSL. No supersonic activity is permitted in the



W-107		
Noise Level	Baseline	Projected
DNL	<45	<45
CDNL	<45	<45
BOOMS/ MONTH	<1	1

W-386		
Noise Level	Baseline	Projected
DNL	<45	<45
CDNL	52	56
BOOMS/ MONTH	18	48

W-387		
Noise Level	Baseline	Projected
DNL	<45	<45
CDNL	<45	46
BOOMS/ MONTH	2	4

FARMVILLE MOA		
Noise Level	Baseline	Projected
DNL	<45	<45

W-72		
Noise Level	Baseline	Projected
DNL	<45	<45
CDNL	56	57
BOOMS/ MONTH	37	56

W-110		
Noise Level	Baseline	Projected
DNL	<45	<45
CDNL	<45	<45
BOOMS/ MONTH	<1	<1

W-122		
Noise Level	Baseline	Projected
DNL	<45	<45
CDNL	49	50
BOOMS/ MONTH	9	12

Figure LA3.2-2
Baseline and Projected Noise Environment for Langley AFB Primary Airspace

Langley AFB MOAs. The amplitude of an individual sonic boom is measured by its peak overpressure, in pounds per square foot (psf), and depends on an aircraft's size, weight, geometry, Mach number, and flight altitude. Table LA3.2-5 shows sonic boom peak overpressures for the F-15C and F-22 in level flight at various altitudes. Maneuvers can also affect boom amplitude, increasing or decreasing overpressures from those shown in Table LA3.2-5.

Table LA3.2-5. Sonic Boom Peak Overpressures (psf) for F-15 and F-22 Aircraft at Mach 1.2 Level Flight

	ALTITUDE (FEET)			
Aircraft	*10,000*	*20,000*	*30,000*	*40,000*
F-15C	5.40	2.87	1.90	1.46
F-22	5.68	3.00	1.97	1.50

Aircraft exceeding Mach 1 always create a sonic boom; however, not all supersonic flight activities will cause a boom at the ground. As altitude increases, air temperature decreases, and the resulting layers of temperature change cause booms to be turned upward as they travel toward the ground. Depending on the altitude of the aircraft and the Mach number, many sonic booms are bent upward sufficiently that they never reach the ground. This same phenomenon, referred to as "cutoff," also acts to limit the width (area covered) of the sonic booms that reach the ground (Plotkin *et al.* 1989).

When a sonic boom reaches the ground, it impacts an area which is referred to as a "footprint" or (for sustained supersonic flight) a "carpet." The size of the footprint depends on the supersonic flight path and on atmospheric conditions. Sonic booms are loudest near the center of the footprint, with a sharp "bang-bang" sound. Near the edges, they are weak and have a rumbling sound like distant thunder.

Sonic booms from air combat training activities have an elliptical pattern. Aircraft will set up at positions up to 100 nautical miles apart, before proceeding toward each other for an engagement. Aircraft will fly supersonic at various times during an engagement exercise. Sonic booms can occur as the aircraft accelerate toward each other, during dives in the engagement itself, and during disengagement. The long-term average (CDNL) sonic boom patterns also tend to be elliptical.

Long-term sonic boom measurement projects have been conducted in four airspaces: White Sands in New Mexico (Plotkin *et al.* 1989), the eastern portion of the Goldwater Range in Arizona (Plotkin *et al.* 1992), the Elgin MOA at Nellis Range in Nevada (Frampton *et al.* 1993), and the western portion of the Goldwater Range (Page *et al.* 1994). These studies included analysis of schedule and air combat maneuvering instrumentation data, and they supported development of the 1992 BOOMAP model (Plotkin *et al.* 1992). The current version of BOOMAP (Frampton *et al.* 1993; Plotkin 1996) incorporates results from all four studies. Because BOOMAP is directly based on long-term measurements, it implicitly accounts for such variables as maneuvers, statistical variations in operations, atmospheric effects, and other factors.

A variety of aircraft conducting training perform flight activities that include supersonic events. Predominantly, these events occur during air-to-air combat, often at high altitudes. Roughly 3 to 10 percent of air combat training flight activities, depending upon aircraft type, result in sonic booms within the primary over-water Warning Areas where supersonic activities are authorized. On average, F-15Cs fly supersonic about 7.5 percent of the time, with Mach numbers usually 1.1 or less, but occasionally up to about 1.3. This is typical of all the current generation supersonic aircraft studied in development of BOOMAP.

Langley-based aircraft are authorized for supersonic activity only in offshore Warning Areas.

For Langley AFB, supersonic operations are in offshore Warning Areas; therefore, under most conditions, sonic boom footprints would fall entirely over the ocean. There is, however, variability in the distance that sonic booms will propagate (or travel) and, in some situations, booms may reach the shore. Those situations depend on specific flight parameters and atmospheric conditions. Aircrews and mission planners are aware of the effects of those conditions and follow procedures that avoid or minimize on-shore booms. By following these procedures, the occasional on-shore boom would be infrequent.

One question asked during scoping was, "will there be an increase in the number of sonic booms?"

Figure LA3.2-2 provides baseline and projected supersonic noise levels and sonic booms, CDNL, in affected airspace. This figure also shows the estimated number of booms per month that would reach the water at an average location in each airspace. Individual sonic boom footprints would affect areas from about 10 square miles to 100 square miles, which is a small portion of the area under the airspace. The booms-per-month values account for the total number of booms and the average area affected by each.

Environmental Consequences

Despite increases in sortie-operations, proposed F-22 flight activities would not perceptibly increase noise levels in the primary or occasional use airspace. In all seven primary airspace units, noise levels would remain below 45 DNL (refer to Figure LA3.2-2). With the exception of W-387, noise levels in the primary airspace units would decrease minimally. The decreases would result from the higher altitudes used by the F-22s in comparison to the F-15Cs. F-22s would fly, on average, 80 percent of the time above 10,000 feet MSL, and 30 percent of the total time would be spent above 30,000 feet MSL. Given the rare sortie-operations in the occasional use airspace, no change in noise levels would occur.

Noise from individual F-22 overflights would be similar to other aircraft using the primary MOAs and Warning Areas.

Refer to Table LA3.2-3 for SELs for subsonic noise of several aircraft, including the F-22. Current data indicate that F-22 noise levels would be similar to most other aircraft commonly using the primary airspace units. Given that the majority of F-22 flight activity would occur above 10,000 feet MSL, noise levels would not be noticeably different from those found under baseline or no-action conditions. There is no substantive difference among the alternative basing locations for airspace subsonic noise; all are negligible.

The F-22 has enhanced supersonic capability relative to the current-generation fighter aircraft. It is projected that its supersonic time would be more than three times that of aircraft such as the F-15C (25 percent versus 7.5 percent). For example, during a typical 14-minute air-to-air engagement, the F-22 would be supersonic 3 to 4.5 minutes, while the F-15C would be supersonic 1 to 2 minutes. The F-22 would also commonly achieve Mach numbers up to about 1.3 versus 1.1 for the F-15C. The combination of more supersonic time and higher Mach number would result in a sonic boom environment six to seven times that of a similar number of F-15Cs. There are, however, two mitigating factors.

The increased performance of the F-22 is expected to create more sonic booms per training mission than the F-15C.

First, the majority of F-15C supersonic activity is below 30,000 feet, while 60 percent of F-22 supersonic activity would be above 30,000 feet. Booms generated at high altitude are weaker than those at low altitude. Applying the boom amplitudes shown in Table LA3.2-5 to the altitude distributions for the two aircraft types, impact per boom for the F-22 would be about 60 percent of the F-15C, for an enhanced boom factor (i.e., potential to generate booms) of about four.

The second mitigating factor is that not all F-22s would fly at full capability. In a typical combat training mission of 2 versus 2 or 4 versus 4, aircraft on one side would fly as F-22s, while aircraft on the other side would limit their performance to emulate enemy aircraft, which are current-generation technology. Thus, half of the F-22 sorties would have the enhanced boom factor, while the others would fly as non-F-22s and would not have an enhanced boom factor.

In the analysis of supersonic activity, the enhanced boom factor has been applied to half of the F-22 sorties, while other aircraft follow the BOOMAP model as originally developed. This corresponds to an increase in CDNL of 4 dB. If the enhanced boom factor were applied to all the F-22 sorties, the F-22 component of CDNL would increase by 6 dB rather than 4 dB. Individual sonic boom amplitudes would be approximately the same as current fighters such as the F-15C. Refer to Figure LA3.2-2 for the projected F-22 CDNL in the primary airspace units. Applying the enhanced boom factor to one-half the F-22 sorties increases sonic boom exposure (CDNL) by less than 1 to 2 dB in W-72, W-107, W-110, and W-122. Boom exposure in W-386 and W-387 would increase by 4 dB. Sonic booms would increase in W-72, W-122, W-386, and W-387. In W-72 and W-386, booms would increase by 19 and 30 per month, respectively. Three additional booms per month would occur in W-122 and two more per month in W-387.

Comparative Summary of the Five Potential Basing Locations

Noise effects from increased flight activities in the training airspace represent the most prominent factor in assessing the differences among the basing locations. For airspace units, subsonic noise would not change perceptibly under the proposed action at Langley or for any of the alternative locations. Despite increases in sortie-operations in these airspace units, the greater use of higher altitudes by the F-22 would reduce their noise contribution. Supersonic activity and sonic booms would increase substantially in some airspace units, but for Langley, Eglin, and Tyndall, these increases would occur over water where the effects would be minor. Increases in sonic booms over land would result in greater potential for impacts under the Mountain Home and Elmendorf

alternatives. In Mountain Home airspace, an increase of 55 sonic booms per month would be concentrated in two adjacent overland MOAs, resulting in greater potential effects than the other alternatives. Impacts for Elmendorf, also with overland MOAs, would be less than Mountain Home because the increase in sonic booms in any individual airspace unit would be less (1 to 28 per month) and the supersonic activity would be dispersed over several MOAs.

LA3.3 Air Quality

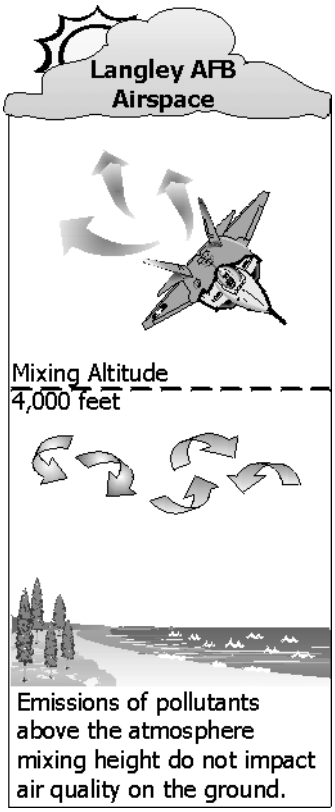
Air quality in a given location is described by the atmospheric concentration of six pollutants: ozone (O_3), nitrogen dioxide (NO_2), carbon monoxide (CO), sulfur dioxide (SO_2), particulate matter equal to or less than 10 microns in diameter (PM_{10}), and lead. As part of the Clean Air Act (CAA), the USEPA has established criteria for these pollutants. These criteria, set forth as national ambient air quality standards (NAAQS) represent maximum levels of background pollution that are considered safe, with an adequate margin of safety, to protect the public health and welfare. Based on measured ambient criteria pollutant data, the USEPA designates areas of the United States as having air quality better than (attainment) or worse than (nonattainment) the NAAQS. Individual states are delegated the responsibility to regulate air quality in order to achieve or maintain air quality in attainment with these standards. States are required to develop a state implementation plan (SIP) that sets forth how the CAA provisions will be implemented within the state. The SIP is the primary means for the implementation, maintenance, and enforcement of the measures needed to attain and maintain the NAAQS in each state. Details of the NAAQS and specific regulatory requirements for sources of these emissions in attainment and nonattainment areas are included in Appendix AO-1.

The CAA also establishes a national goal of preventing degradation or impairment in federally designated Class I areas. Class I areas are defined as those areas where any appreciable degradation in air quality or associated visibility impairment is considered significant. As a part of the Prevention of Significant Deterioration (PSD) Program, Congress assigned mandatory Class I status to all national parks, national wilderness areas (excluding wilderness study areas or wild and scenic rivers), and memorial parks greater than 5,000 acres. In Class I areas, visibility impairment is defined as atmospheric discoloration (such as from an industrial smokestack) and a reduction in regional visual range. Visibility impairment or haze results from smoke, dust, moisture, and vapor suspended in the air. Very small particles are either formed from gases (sulfates, nitrates) or are emitted directly into the atmosphere from sources like electric utilities, industrial fuel burning processes, and vehicle emissions. Stationary sources, such as industrial areas, are typically the issue with impairment of visibility in Class I areas, so the permitting process under the PSD program requires a review of all Class I areas within a 62-mile (100-kilometer) radius of a proposed industrial facility. Mobile sources, including aircraft and their operations at Langley AFB, are generally exempt from review under this regulation. While the review under the PSD permit program does not apply directly to base operations at Langley AFB, this analysis assessed a 62-mile radius area as a screening tool for reviewing potential visibility impacts.

Pollutants considered in this Draft EIS include volatile organic compounds (VOCs), which are precursors to (indicators of) O_3, nitrogen oxides (NO_x), which are also precursors to O_3 formation, as well as CO, SO_2, and PM_{10}. Airborne emissions of lead are not addressed because the affected areas contain no significant sources of this criteria pollutant.

LA3.3.1 Base

Affected Environment



The affected environment varies according to pollutant. For pollutants that do not undergo a chemical reaction after being emitted from a source (PM_{10}, CO, and SO_2), the affected area is generally restricted to a region in the immediate vicinity of the base. However, the region of concern for O_3 and its precursors (NO_x and VOCs) is a larger regional area (i.e., the Hampton Roads Air Quality Control Region [AQCR]) because they undergo a chemical reaction and change as they disperse from the source. This change can take hours, so depending upon weather conditions, the pollutants could be some distance from the source.

Another factor used in defining the affected environment is mixing height. Mixing height is the upper vertical limit of the volume of air in which emissions may affect air quality. Emissions released above the mixing height become so widely dispersed before reaching ground level that any potential ground-level effects would not be measurable. Emissions of pollutants released below the mixing height may affect ground-level concentrations. The portion of the atmosphere that is completely mixed begins at the earth's surface and may extend up to altitudes of a few thousand feet. Mixing height varies from region to region based on daily temperature changes, amount of sunlight, and other climatic factors. An average mixing height of 4,000 feet conservatively characterizes the conditions at Langley AFB and its vicinity. This mixing height was derived from a review of historical data (USEPA 1972) and a detailed analysis of morning and afternoon mixing heights at a nearby upper air monitoring station in Wallops Island, Virginia (USEPA 2000a). Impacts of the proposed action can be evaluated in the context of the existing local air quality, the baseline emissions for the base and region, and the relative contribution of the proposed action to regional emissions.

Base Environment

The Virginia Department of Environmental Quality (DEQ) has primary jurisdiction over air quality and sources of stationary source emissions at Langley AFB. Stationary source emissions at Langley AFB under the baseline (and under no-action) include jet engine testing (off the aircraft), degreasing, storage tanks, fueling operations, heating and power production, solvent usage, and surface coating. Emissions from stationary sources at the base constitute a small fraction of overall base emissions, as shown in Table LA3.3-1 below. Hypothetical calculations for all criteria pollutants demonstrate that maximum potential base-wide emissions from stationary sources are less than the CAA Title V threshold (i.e., 100 tons per year), with the exception of NO_x. However, actual emissions are significantly less than the potential emissions (Air Force 1999b). Therefore, the base has applied for, and received, a Synthetic Minor Operating permit from the state of Virginia. This operating permit effectively caps the base's emissions by imposing federally enforceable emission limits, ensuring the base's status as a Minor Stationary source.

Mobile source emissions include aircraft operations (takeoffs and landings), aerospace ground equipment (AGE), ground support equipment (GSE), and maintenance aircraft operations performed with the engines still mounted on the aircraft (engine run-ups and trim checks). Emissions from aircraft takeoffs and landings, as well as other flight operations at the base, considered all based and transient aircraft. Aircraft emissions were calculated for all flight activities below the mixing height (4,000 feet). These emissions, combined with those from the other mobile sources, account for the majority of the emissions from the base.

Table LA3.3-1. Baseline Emissions for Langley AFB Affected Environment

	POLLUTANTS (TONS PER YEAR)				
Base Emissions Source Category	***CO***	***VOCs***	***NO_x***	***SO_2***	***PM_{10}***
Stationary Sources	14.5	33.1	29.8	1.0	4.5
Mobile Sources	760.9	104.5	241.2	5.6	8.2
TOTAL Base Emissions	775.4	137.6	271.0	6.6	12.7

Sources: Air Force 2000b.

Regional Environment

Langley AFB is located within the Hampton Roads Intrastate AQCR #223. The Hampton Roads AQCR includes four counties (York, James City, Isle of Wight, and Southampton), as well as nine independent cities (Chesapeake, Hampton, Newport News, Norfolk, Poquoson, Portsmouth, Suffolk, Virginia Beach, and Williamsburg). This area includes substantial industry, several military and commercial airfields, and a large population that generate emissions. Table LA3.3-2 summarizes the regional emissions (stationary and mobile) of criteria pollutants and precursor emissions for this AQCR. Baseline Langley AFB emissions are incorporated into these totals for the AQCR. For each criteria pollutant, Langley AFB contributes less than 1 percent of regional emissions. This would be the same under a no-action decision.

Table LA3.3-2. Regional Emissions for Langley AFB Affected Environment

	POLLUTANTS (TONS PER YEAR)				
Regional Emissions	***CO***	***VOCs***	***NO_x***	***SO_2***	***PM_{10}***
Hampton Roads AQCR	257,325	79,750	83,560	110,220	49,860

Sources: Commonwealth of Virginia 1996.
USEPA 2000b.

Air quality in the Hampton Roads AQCR has been designated as either in "attainment" or "unclassifiable/attainment" with the NAAQS for all pollutants. However, the area was recently redesignated for O_3 from marginal nonattainment to attainment (*Federal Register* 629123, June 26, 1997). Therefore, the area is considered in "transitional attainment" or "maintenance" for O_3 and its pollutant precursors (VOCs and NO_x). As part of this redesignation to attainment, the area must ensure that all previous nonattainment measures remain in place. In addition, Virginia DEQ has submitted a maintenance plan to USEPA that provides for the continued attainment of the NAAQS for O_3 until 12 years after redesignation. This maintenance plan, incorporated into a SIP revision,

provides an attainment emission inventory for the AQCR, allowable growth budgets, and identifies the limits on the amounts of pollutants in the area necessary to attain the NAAQS.

In addition to its current status as a "maintenance area" for O_3 attainment, the Hampton Roads area is expected to be designated as nonattainment for the new 8-hour O_3 standard (pending a decision from the United States Supreme Court, expected sometime in 2001). However, these new standards are currently unenforceable. While the future implementation is still uncertain, the USEPA has proceeded with initial designations based on 3 years of consecutive monitoring data. Designations are either "nonattainment" or "attainment/unclassifiable." Virginia DEQ (Commonwealth of Virginia 2000) has recommended to the USEPA that the Hampton Roads area be classified as a nonattainment area for the new O_3 standard. According to USEPA (March), conformity and other planning requirements would be triggered on the effective date of the final USEPA designations (USEPA 2000c).

The Hampton Roads AQCR inventory for CO, VOCs, and NO_x was obtained from the SIP Revision (i.e., maintenance plan) and includes stationary point source emissions, on-road mobile sources, off-road mobile sources, and area sources. Point source emissions include stationary source emissions from Langley AFB and other military and industrial sources in the area. On-road mobile source emissions include emissions from vehicular-related activities from on-road motor vehicles that are registered to use public roadways and utilize gasoline or diesel fuels. This category includes the contribution of off-base use of private and government vehicles associated with military and civilian personnel at Langley AFB. Off-road mobile sources include aviation emissions, locomotive emissions, and marine vessels. Aviation and marine vessels include both commercial and military sources. Area source emissions include those from solvent/coating use, vehicle refueling, as well as combustion emissions from heating of industrial, commercial, and residential facilities.

Environmental Consequences

The air quality analysis for the proposed action at Langley AFB quantifies the changes (increases and decreases) due to the proposed Initial F-22 Operational Wing beddown. The CAA prohibits federal agencies from supporting activities that do not conform to a SIP that has been approved by the USEPA. To assess the affects of the proposed action, analysis must include direct and indirect emissions from all activities that would affect the regional air quality. Emissions from proposed actions are either "presumed to conform" (based on emissions levels which are considered insignificant in the context of overall regional emissions) or must demonstrate conformity with approved SIP provisions.

Information on projected aircraft operations incorporated F-22-specific data on maintenance run-up procedures, uninstalled engine cell testing, and typical ground run-up times (taxi, idle-in and idle-out times) for each landing-takeoff cycle (personal communication, McGettrick and Myers 2000, 2001). Time-in-modes for take-off, climb-out, and approach were based on default time-in-modes developed for comparable jet aircraft. Modal-specific emission factors and fuel flow rates are not currently available for the F-22 engines. The advanced design of the F-22 includes the development of a new propulsion system, the F119-PW-100, a low-bypass turbofan engine. The engine is still under test and evaluation and many operational parameters are classified or competitively sensitive.

The F-22 would require fewer maintenance activities where the engine is run at varying speeds along the flightline, thereby reducing emissions.

Therefore, according to NEPA guidance, *Incomplete and Unavailable Information*, 40 CFR §1502.22, the analysis uses the best available data.

A composite set of emission factors and fuel flow rates for each pollutant at each power setting was developed based on recently published modal emission factors for the F100 series of engines (Air Force 1999c) using JP-8 as a fuel. The F100 series engines are the power plants of both the F-15 and F-16 aircraft. Details of the emission factors and time-in-modes used for the analyses are included in Appendix AO-3.

Direct emissions generated by both stationary and mobile sources at Langley AFB are detailed in Table LA3.3-3. Stationary sources include external and internal combustion sources, engine cell testing, and other aircraft maintenance operations. Mobile sources include aircraft operations (takeoffs and landings), aircraft maintenance run-ups, and exhaust emissions from aircraft ground support equipment. This analysis reflects the changes associated with drawdown of F-15Cs and the overall increase of aircraft and sorties associated with the beddown of F-22s.

Table LA3.3-3. Projected Direct Emissions for Langley AFB Affected Environment

	POLLUTANTS (TONS PER YEAR)				
Base Emissions Source Category	***CO***	***VOCs***	***NO_x***	***SO_2***	***PM_{10}***
Projected Stationary Sources	12.3	32.7	21.5	1.0	4.5
Projected Mobile Sources	793.6	107.3	203.8	7.1	14.9
Baseline Stationary Sources	14.5	33.1	29.8	1.0	4.5
Baseline Mobile Sources	760.9	104.5	241.2	5.6	8.2
Stationary Sources Change	-2.2	-0.4	-8.3	0.0	0.0
Mobile Sources Change	32.7	2.8	-37.4	1.5	6.8
TOTAL Change in Base Emissions	30.5	2.4	-45.7	1.5	6.8

With the exception of NO_x, direct emissions at the base would increase for the criteria pollutants. Importantly, overall emissions for NO_x would decrease, primarily because the F-22 is designed to require far fewer maintenance activities involving engine tests. Comparison of F-15C and F-22 emissions from engine test activities and flying operations (Table LA3.3-4) indicates that the F-15C generates substantially more emissions from engine tests. In contrast, F-22 flying operations at the base would generate more emissions (including NO_x) as a result of increased sorties and different engine types. Mobile sources, particularly F-22 flying operations, would contribute the most emissions but no mobile or stationary thresholds would be exceeded.

Table LA3.3-4. Comparison of Emissions from Engine Tests and Flying Operations for F-15Cs/F-22s at Langley AFB

	CO	*VOCs*	*NO_x*	*SO_2*	*PM_{10}*
Engine Tests	44.2/2.5	7.7/0.5	80/3.6	0.171/0.01	1.3/0.1
Flying Operations	128.6/164.6	20.6/26.6	128.7/166.2	4.5/6.2	4.8/12.6

Indirect emissions are those not generated from sources at the base but which contribute to the regional inventory, such as emissions from vehicles from commuting personnel and/or construction workers. Table LA3.3-5 shows the total regional (direct and indirect) contribution from the proposed action at Langley AFB.

Table LA3.3-5. Regional Emissions for Langley AFB Affected Environment

	POLLUTANTS (TONS PER YEAR)				
Source Category	***CO***	***VOCs***	***NO_x***	***SO_2***	***PM_{10}***
Base Emissions (Direct)	30.5	2.4	-45.7	1.5	6.8
F-22 Commuting Contribution (Indirect)	-11.8	-1.6	-2.4	-0.1	-0.1
TOTAL F-22 Projected Contribution	18.7	0.8	-48.1	1.4	6.7
Regional Emissions (Hampton Roads AQCR)	257,325	79,750	83,560	110,220	49,860
TOTAL Percent F-22 Projected Regional Emissions Contribution	0.01%	0.01%	-0.06%[1]	0.001%	0.01%

Note: 1. The Initial F-22 Operational Wing beddown would result in a net decrease in air emissions of NO_x. This net decrease is primarily the result of elimination of trim checks and decreased engine testing/maintenance times.

Relative to overall regional emissions, the proposed beddown would result in negligible increases in four of five criteria pollutants and a decrease in NO_x. This net decrease is primarily the result of elimination of trim checks and decreased engine testing/maintenance times. These changes would not measurably change regional air quality or affect attainment status.

All projected activities associated with the F-22 beddown would generate emissions below de minimis thresholds.

For proposed federal actions with emissions that are small in relation to regional emissions (like this F-22 Operational Wing proposal), it is unlikely that the increased emissions would contribute to or interfere with achieving the NAAQS. General conformity regulations set forth in 40 CFR 51 Subpart W, and adopted in the Virginia Administrative Code (9 VAC 5 Chapter 160), outline *de minimis* levels of emissions, below which it is presumed that the action conforms to the SIP. The *de minimis* levels for O_3 precursors in a maintenance area outside of an O_3 transport region (i.e., Hampton Roads AQCR) are 100 tons per year of VOCs emissions and 100 tons per year of NO_x. In addition, the proposed action's emissions (both direct and indirect) must be compared to the regional inventory to determine if the emissions are "regionally significant." Emission increases of O_3 precursors (NO_x and VOCs) would be well below the 100 tons per year *de minimis* threshold thus demonstrating compliance with CAA conformity requirements. In addition, the proposed action emissions are well

below the regional significance threshold defined by 10 percent of the regional emissions (i.e., 836 tons per year of NO_x and 797 tons per year of VOCs).

Temporary Construction Emissions		
	Tons per year	***% Regional Contribution***
CO	48	0.02
VOCs	9	0.01
NO_x	25	0.03
SO_2	2	<0.01
PM_{10}	3	<0.01

While construction activities are of temporary nature and short duration, emissions during the construction period were quantified to determine their impacts on regional air quality. The construction phase would span a three-year period from 2002 to 2004, with maximum emissions occurring in 2002. These maximum annual emissions were compared to existing baseline emissions and federal conformity *de minimis* thresholds for O_3 precursors (VOCs and NO_x). Sources of emissions considered during the construction phase include exhaust from internal combustion engines, exhaust from diesel-powered construction equipment, fugitive dust from the construction site, as well as indirect emissions from construction worker commuting. Construction emissions would be negligible compared to base and regional emissions and below the 100 tons per year *de minimis* federal conformity thresholds for NO_x and VOCs.

Visibility impairment due to base emissions from the proposed action would be minimal since there are no PSD Class I areas within the standard 62-mile radius of the base.

Comparative Summary of the Five Potential Basing Locations

There would be negligible differences in air quality impacts at any of the five beddown installations. No base would exceed regulatory thresholds. The contribution to annual regional emissions of criteria pollutants would be less than .01 percent at Langley, Eglin, and Elmendorf; between 0.1 percent and 10 percent at Mountain Home, and between .01 percent and 1 percent at Tyndall.

LA3.3.2 Airspace

Affected Environment

The likelihood for air quality impacts associated with airspace use was evaluated based on the floor altitude of the primary MOAs and Warning Areas relative to the mixing height for pollutants. The affected environment for Langley AFB includes overland and over-water airspace. Flight activities occur consistently (almost 100 percent) below the average mixing height of 4,000 feet AGL only in the Farmville MOA overland airspace unit. In the Warning Areas, sortie-operations are almost all (89 percent or greater) above 5,000 feet MSL and few, if any, sources of emissions exist under these over-water airspace units. No activities occur in W-387 below the mixing height.

Table LA3.3-6 summarizes baseline emissions for aircraft operating in these airspace units. Appendix AO-3 provides details of the calculations used to estimate aircraft emissions.

Table LA3.3-6. Baseline Emissions for Langley AFB Affected Primary Airspace

	Pollutants (tons/year)				
Affected Airspace[1]	*CO*	*VOCs*	*NO_x*	*SO_2*	*PM_{10}*
Farmville MOA	3.41	1.12	132.72	0.17	0.23
W-72	27.76	2.69	404.39	0.79	9.88
W-107	1.90	0.38	14.32	0.04	0.55
W-110	0.07	0.02	1.00	0.00	0.02
W-122	9.75	2.14	106.22	0.26	2.18
W-386	6.40	1.20	130.90	0.22	1.44
W-387	0.36	0.04	4.26	0.01	0.11

Note: 1. Airspace units with a floor below 4,000 feet AGL (mixing height); W-387 floor is not below the mixing height.

None of the affected primary airspace units overlie any nonattainment or Class I PSD areas. Two Warning Areas (W-122, W-110) include sortie-operations at altitudes below the mixing height, about 10 miles offshore from Cape Hatteras National Seashore, but it is not a Class I area.

Emission concentrations associated with aircraft operations are minimal, considering the large size of the airspace units. Because these emissions are dispersed over millions of acres, most of it over water, they do not measurably affect air quality.

Environmental Consequences

Table LA3.3-7 summarizes projected emissions in the primary airspace units due to the proposed action. There would be appreciable NO_x increases in the Farmville MOA where F-22s would spend the majority of their flight time below the mixing height. These emission increases, the result of increased sortie-operations, coupled with higher emissions from the F-22 aircraft (compared to the F-15C), would be less than 50 tons per year for NO_x and less than one ton per year for all other criteria pollutants. Air emissions would also increase in W-72. Although the F-22s would spend only about 5 percent of the time below the mixing height as opposed to about 11 percent of the time for F-15Cs, emissions would increase in this airspace unit due to an increase of more than 1,000 additional sortie-operations per year for the F-22. Projected emissions in W-387 are unchanged from baseline conditions since all operations in this airspace would occur above the mixing height. Decreases in criteria pollutant emissions in other airspace units (W-107, W-110, and W-386) are the result of the lower amount of F-22 operations at altitudes below the mixing height compared to the F-15Cs.

Table LA3.3-7. Projected Emissions for Langley AFB Affected Primary Airspace

	Pollutants (tons/year)[1]				
Affected Airspace	*CO*	*VOCs*	*NO_x*	*SO_2*	*PM_{10}*
Farmville MOA	3.11	1.64	177.76	0.28	0.69
W-72	37.07	4.45	440.31	0.97	13.69
W-107	1.89	0.38	14.20	0.04	0.55
W-110	0.06	0.01	0.94	0.00	0.02
W-122	10.26	2.23	107.44	0.27	2.40
W-386	5.82	1.06	108.53	0.21	1.52
W-387	0.36	0.04	4.26	0.01	0.11

Note: 1. To compare totals to baseline, refer to Table LA3.3-6.

Projected emission concentrations associated with F-22 aircraft operations would be minimal considering the large size of the airspace units. Because these emissions would be dispersed over millions of acres, much of it over water, they would not measurably affect air quality.

Comparative Summary of the Five Potential Basing Locations

Emissions from aircraft operations would be transitory and dispersed over extensive areas. Overall emissions in the airspace would be minimal and no substantive difference exists among the basing alternatives relative to air quality impacts.

LA3.4 Safety

LA3.4.1 Base

Affected Environment

Typical aircraft safety concerns for a base include aircraft mishaps and bird-aircraft strikes. Data on mishaps within 10 nautical miles of an airfield reveal that 75 percent of aircraft accidents occur on or adjacent to the runway and in a corridor extending out from the end of a runway for 15,000 feet. Three zones within this corridor are established based on aircraft mishap patterns: the Clear Zone (CZ), Accident Potential Zone (APZ) I, and APZ II. Within the CZ, which covers a 3,000-by-3,000-foot area at the end of each runway, the overall accident risk is highest. APZ I, which extends for 5,000 feet beyond the CZ, is an area of reduced accident potential. In APZ II, which is 7,000 feet long, accident potential is the lowest among the three zones.

Aircraft mishaps and their prevention, as defined in Appendix AO-1, represent a paramount concern for the Air Force. Class A mishaps, associated with a loss of life, loss of an aircraft, or costs in excess of $1 million, provide an indicator of aircraft safety. The F-15C aircraft has a lifetime historical Class A mishap rate of 2.65 per 100,000 flying hours (Air Force 2000a). Comparing this mishap rate to the number of annual flying hours logged by Langley's F-15Cs in the past five years

(96,571.6) (personal communication, Jones 2000), a Class A mishap would be predicted to occur approximately once every 1.93 years.

In the last 5 years, there have been two Class A F-15C accidents involving aircraft from Langley AFB. One accident occurred at Nellis AFB, Nevada, and the other occurred in Langley AFB's over-water training airspace. Neither occurred in the base airfield environment. In comparison to overall F-15C rates, these two accidents reflect a mishap rate of 2.07, or one Class A mishap every 2.5 years for the F-15Cs operating from Langley AFB (personal communication, Layman 2000).

One safety issue raised during Langley AFB scoping was whether the F-22 aircraft would discard or dump fuel in or around the base airspace. The F-22 does not have the ability to dump fuel. The F-15C has the ability to dump fuel in an emergency, but this is not normal Air Force practice and is not done in the base airspace environment. Procedures require that in an emergency, fuel may be discarded at 5,000 feet MSL or higher over water so that the fuel evaporates before reaching the surface.

Bird-aircraft strikes and the hazards they present form another safety concern for aircraft operations. The Air Force Bird-Aircraft Strike Hazard (BASH) Reduction Program was established to reduce bird strikes through awareness, bird control, bird avoidance, and aircraft design. Air Force Pamphlet 91-212, dated 1 April 1997, provides guidance for implementing an effective BASH reduction program. Appendix AO-1 of this Draft EIS contains additional information on the Air Force BASH Program.

Langley AFB has established a Memorandum of Understanding with the United States Department of Agriculture (USDA) for the assignment of a USDA biologist and a technician to Langley AFB to manage the base BASH program. They have recently completed a study of the potential for bird strikes in and around Langley AFB and have published a base-specific Bird Strike Reduction Plan. Historically, Langley AFB aircraft have experienced approximately 13 bird-aircraft strikes per year. About one-quarter of the strikes involved damage to engines with the aircraft safely returning to base (personal communication, Kendrot 2000).

Environmental Consequences

Safety zones at Langley AFB would not change as a result of the F-22 beddown. The existing encroachment of commercial and educational land uses makes Langley AFB have a slightly greater potential for impact than the alternative bases. Aircraft safety conditions may change for a period of time because when new military aircraft first enter the inventory, the accident rate is higher than it is for older aircraft. Historical trends do, however, show that mishaps of all types decrease the more an aircraft is flown.

By the time the proposed F-22 operations would begin at Langley AFB, the testing and pilot training phases for the aircraft's integration into the operational force will have progressed substantially. Significant knowledge will have been gained about the aircraft's safest flight regime. At Langley AFB, only experienced fighter pilots will serve in operational units.

The F-22 does not have the ability to dump fuel overboard, and is currently not projected to have this capability in the future. Therefore, fuel dumping would not be a concern with the F-22.

Since the F-22 would operate in the same airfield environment as the F-15C, the overall potential for bird-aircraft strikes would increase because of the increased sorties associated with the F-22. The potential for increase would be mitigated to some degree because the F-22 would more rapidly reach altitudes above where the majority of bird strikes occur.

Comparative Summary of the Five Potential Basing Locations

There would be no substantive difference among the five bases relative to safety. Existing BASH programs and other safety programs would remain in place. Land use development is encroaching into safety zones at Langley, but does not occur at the other bases. For the additional runway at Mountain Home AFB, new safety zones would extend off base but would not be incompatible with existing land use.

LA3.4.2 Airspace

Affected Environment

At Langley AFB, F-15Cs have a Class A mishap rate of 2.07 per 100,000 flying hours, slightly lower than the 2.65 per 100,000 flying hours lifetime rate for all F-15Cs. Since mishaps generally occur most frequently near airfields and during low-altitude flight, activities of F-15Cs in the Warning Areas and MOAs have a reduced potential for mishaps. Similarly, bird-aircraft strikes in these airspace units are negligible because the F-15Cs fly much higher than the zone where most (95 percent) strikes occur.

Environmental Consequences

Aircraft safety and bird-aircraft strikes would not measurably differ from baseline conditions. The increase in sortie-operations would be off-set by the higher altitudes flown by the F-22s.

Beddown of the Initial F-22 Operational Wing at Langley AFB would have minimal impact on baseline airspace management, noise, air quality, and safety conditions.

Comparative Summary of the Five Potential Basing Locations

There would be no substantive difference among the alternative bases or training airspace units relative to potential safety impacts. The only difference would be a minor increase in flare use in overland areas for Elmendorf and Mountain Home, but both bases would continue to implement restrictions on flare use designed to minimize fire risks.

Natural Resources

Natural resources include native and exotic biota, their habitats, and the physical medium necessary for these resources to function. Biota are plant and animal life and are typically referred to as vegetation and wildlife, respectively. When groups of plant and animal species in a given area are linked by ecological processes, they are referred to as communities. A special community designation discussed in this document is threatened, endangered and special status species/communities. This designation

refers to those plant and animal species or areas that are afforded special regulatory status (i.e., Endangered Species Act [ESA]). The term *habitat* is also used to describe natural resources and refers to the necessary physical and biological features to sustain plant and animal species. Physical medium, as discussed in this section, includes the soil and water that provide the foundation for all biota. A description of the components used to define the affected environment and the methods used to evaluate baseline conditions are presented in Appendix NR-1.

Designations of special status species protection are generally in accordance with specific acts (i.e., ESA, Marine Mammal Protection Act [MMPA]) as established by specific agencies (i.e., United States Fish and Wildlife Service, National Marine Fisheries Service). Due to the overlapping jurisdiction of some agencies and acts, individual species often exhibit multiple state and federal status designations. For example, species identified as federal threatened or endangered in accordance with the ESA are often, but not always, also designated as threatened or endangered in accordance with state statutes. To avoid confusion and ensure clarity in the Draft EIS, please refer to Appendix NR-2 when counting special status species or determining the special status designations of species potentially occurring on base and under the affected airspace.

No-Action Alternative

Under the no-action alternative, Langley AFB would continue to manage its natural resources in accordance with state and federal regulations and in accordance with the Langley AFB Integrated Natural Resources Management Plan. Although considered negligible, ongoing impacts to natural resources would continue. Langley AFB is an active participant in the Chesapeake Bay Program and would continue to employ best management practices, such as the use of filter fences and vegetative plantings, for erosion control and shoreline stabilization and wetland enhancement projects. Under the no-action alternative, threatened, endangered, and special status species/communities and marine communities would continue to be overflown without substantive impact. There would be no additional adverse impacts to soil and water resources. Langley AFB would continue to upgrade its existing stormwater and sanitary water system, continue to monitor water effluent discharges, and comply with all state and federal water quality laws and standards.

LA3.5 Soil and Water

LA3.5.1 Base

Affected Environment

Langley AFB falls within the Outer Atlantic Coastal Plain physiographic region of southeastern Virginia, an area characterized by a low, flat plain with a gentle eastward slope of 1 foot per mile and elevations of 5 to 11 feet above MSL. Earth-moving, dredging, and filling activities associated with development of Langley AFB have altered soil profiles to the extent that soil horizons do not concur with local soil surveys from adjacent off-base areas.

Langley AFB, with two perennial streams, falls entirely within the watershed of the Chesapeake Bay; most of Langley AFB is located within its 100-year floodplain. Drainage in the area is poor, and low areas have been dredged and channeled to facilitate drainage.

Langley AFB participates in long-term water quality and ecosystem programs for the Chesapeake Bay watershed.

Fifty-three outfalls drain Langley AFB, with 26 outfalls associated with areas that contain industrial activities. All outfalls discharge into the southwest or northwest branches of the Back River. Stormwater runoff pollutant levels fall within acceptable limits specified in Virginia's National Pollutant Discharge Elimination System (NPDES) permit (40 CFR 122).

Langley AFB is a participant in the Federal Agencies Committee established by the USEPA's Chesapeake Bay Program. Through the 1994 *Agreement of Federal Agencies on Ecosystem Management of the Chesapeake Bay*, the Federal Agencies Committee is committed to long-term and specific water quality and ecosystem goals for the Chesapeake Bay watershed.

Environmental Consequences

Construction would be in the 100-year floodplain and would disturb 16 acres of developed or landscaped areas exhibiting fill material substrate. Approximately 82 tons of soil are expected to erode due to F-22 related construction activities.

Since more than five acres would be disturbed by construction of F-22 related facilities, a Virginia Pollutant Discharge Elimination System (VPDES) stormwater permit would be required. Under the permit, the base must provide a Storm Water Pollution Prevention Plan (SWPPP) that describes best management practices to be implemented to eliminate or reduce sediment and non-stormwater discharges. With proper design and implementation of the SWPPP, impacts from erosion and offsite sedimentation would be negligible. Langley AFB would have a negligible potential for consequences to soil and water.

Comparative Summary of the Five Potential Basing Locations

Langley AFB would have a negligible potential for consequences and be comparable to Eglin and Elmendorf. Land area disturbed would be approximately 16 acres for Langley; 10 acres for Eglin; 46 acres for Elmendorf; 440 acres for Mountain Home; and 73 acres for Tyndall. Based on area affected, the greatest potential for impacts to soils and water would occur at Mountain Home followed by Tyndall.

LA3.6 Terrestrial Communities (Wildlife and Vegetation)

LA3.6.1 Base

Affected Environment

Natural terrestrial communities at Langley AFB were historically characterized by uplands of mixed hardwood and pine and bottomland areas of cypress and gum. Shrubby marsh vegetation would have bordered herbaceous wetland communities. Today, the majority of Langley AFB is landscaped or capped with pavement or concrete. Native terrestrial, upland communities exist as small, remnant patches characteristic of old field succession. Terrestrial vegetation associations found within and around Langley AFB include mixed oak and hardwood forest, pine woodland, and sweetgum and hardwood bottomland (Air Force 1998a). A total of 10 percent (288 acres) of the base remains forested (Air Force 1998a).

Wildlife on the base are wide-spread species that are habitat generalists or tolerant of disturbance and include a wide variety of game and furbearing species, small mammals, waterfowl, songbirds, raptors, amphibians, reptiles, and fish. The proximity of the base to estuarine and marine habitats of Chesapeake Bay provides habitat for a variety of neotropical migrants and waterfowl. Common plant and animal species and habitats characteristic of the base are summarized in Appendix NR-3.

Environmental Consequences

Under the proposed action, construction would disturb approximately 16 acres. These areas are previously developed or landscaped, currently experience high levels of continual human activity, lack native terrestrial habitat, and exhibit a low level of biodiversity.

Construction would displace disturbance-tolerant wildlife species occupying marginal habitat. Therefore, adverse effects to individual species of native plants and animals are expected to be negligible.

A decrease of about 366 acres would occur under the projected noise contours (i.e., above 65 DNL) with the Langley AFB proposed action. Wildlife species inhabiting area under noise contours associated with the base have likely habituated to aircraft noise and the proposed changes in noise levels are not expected to represent biologically significant changes for these species (see Appendix NR-4 for a discussion of the effects of noise on wildlife).

F-22 construction projects at Langley are all located in previously disturbed areas and have little potential for consequences to the natural environment.

Comparative Summary of the Five Potential Basing Locations

Impacts to the terrestrial community on base were determined from an analysis of the quantity and diversity of habitat and species in the proposed construction zone and under the noise contours for the F-22. Construction at Langley would affect 16 acres of previously developed area; much of the remaining base is similarly developed and exhibits marginal habitat and relatively low species diversity. The amount (10 acres) and quality of habitat in the construction area at Eglin is similar to Langley. Construction at Elmendorf would affect a larger (46 acres), more naturally diverse area than either Langley or Eglin. Construction at Mountain Home would affect disturbed habitat dominated by exotic species; however, the sheer size (440 acres) of the construction area would have an effect greater than Langley or Eglin and similar to Elmendorf. Construction at Tyndall would affect 73 acres of habitat supporting a diversity of species; areas adjacent to the construction area and under the base noise contours support the highest diversity of habitat and species relative to any of the other locations.

LA3.6.2 Airspace

Affected Environment

Overland airspace includes five airspace units (one primary and four occasional use) covering over 3.7 million acres of land in four states (see Appendix NR-3). This airspace occurs primarily over the

Southeastern Mixed Forest province ecoregion (Bailey 1995); land cover is a mosaic of hardwood and pine forests, other natural plant community types, and farmland. Forests cover about 52 percent of the land. Deciduous, evergreen, and mixed-forest types are fairly evenly distributed under the Farmville MOA. A total of 75,484 acres of special use areas (i.e., state parks, state forests, and wildlife refuges) occur under the five airspaces. Only Farmville MOA is considered primary use overland airspace (refer to Figure LA3.1-1), with other overland airspaces receiving only occasional use.

Environmental Consequences

Based on projected aircraft operations and review of the literature on the effects of noise on wildlife (see Appendix NR-4), impacts to wildlife under airspace from the proposed action would not be significantly different from baseline conditions and are not expected to adversely affect terrestrial populations for the following reasons: (1) many wildlife species have habituated to (become use to) subsonic noise associated with jet aircraft, and there would be no perceptible increase in subsonic noise levels; (2) the percent of F-22 flight time (5 percent) below 5,000 feet AGL would be less than half of current F-15C use (11 percent); (3) existing airspace restrictions over certain sensitive areas, such as wildlife refuges and sensitive habitats, would continue; (4) use of chaff and flares in the over-water airspace would continue at rates similar to baseline; however, use of chaff and flares are not allowed over land at Langley AFB; and (5) supersonic flight would not occur over land for the proposed action.

Comparative Summary of the Five Potential Basing Locations

Because proposed differences in subsonic noise levels under airspace are not expected to be biologically significant, impacts to the terrestrial community were primarily determined from an analysis of the number and altitude of sonic booms relative to the size, type, and diversity of habitat underneath airspace. Supersonic activity would occur only over-water Warning Areas for Langley, Eglin, and Tyndall and only above 10,000 feet MSL. Because Eglin and Tyndall airspace covers a larger, more biologically diverse area, impacts to the terrestrial community are expected to be relatively greater at these bases than at Langley. Because Elmendorf overland airspace includes a diversity of species and special habitat areas that would be subject to sonic booms, impacts would be slightly greater than Eglin or Tyndall. Increases in sonic booms in the airspace associated with Mountain Home would be substantial. This factor, in combination with the number and nature of wildlife species underlying the Mountain Home airspace, suggests that potential consequences would be greater than those associated with any of the other locations.

LA3.7 Wetland and Freshwater Aquatic Communities

LA3.7.1 Base

Affected Environment

Wetlands at Langley AFB encompass approximately 652 acres, 462 acres of which are non-freshwater estuarine wetlands. Freshwater wetlands on base include palustrine forested, emergent, and scrub-shrub wetlands. Forest and scrub-shrub wetlands occur in low-lying upland areas with nutrient-poor sandy soils and are dominated by bottomland hardwood trees and shrubs. Emergent

wetlands primarily occur as small remnant patches, along drainage ditches, and as tidal marsh (Hobson 1996; Air Force 1998a).

Salt and freshwater marshes of the northwest and southwest branches of the Back River, New Market Creek, Brick Kiln Creek, Tabbs Creek, and Tides Mill Creek surround the base on three sides. Tidal flow from the Chesapeake Bay is substantial along these margins; however, most inland freshwater wetlands have been filled, drained to ditches, or converted into golf course features (Air Force 1998a). Currently, Langley AFB is in the process of restoring and stabilizing sections of Chesapeake shoreline through the establishment of smooth and saltmeadow cordgrass fringe marsh.

Environmental Consequences

No wetlands, streams, creeks, or ponds/lakes have been identified in the proposed construction area; therefore, wetlands and freshwater aquatic communities would not be affected. Best management practices would be applied to control sedimentation and erosion during construction, thereby avoiding secondary impacts to wetlands. A Clean Water Act Section 404 permit for discharges to waters of the United States is not anticipated. As may be required by Executive Orders 11988 (Floodplain Management) and 11990 (Protection of Wetlands), the appropriate designee of the Secretary of the Air Force will publish a "finding of no practicable alternative" for any activities impacting floodplains and wetlands, respectively.

Comparative Summary of the Five Potential Basing Locations

Impacts to wetlands and freshwater aquatic communities were determined from the extent of filling, draining, and sedimentation anticipated during construction. Direct impacts to wetlands would not occur at Langley, Eglin, or Elmendorf. Construction at Mountain Home could impact aquatic communities (including wetlands) although a jurisdictional wetland delineation would be required to make a final determination. Potential impacts to wetlands (26 acres) and the need for a Section 404 permit are greatest at Tyndall although a jurisdictional wetland delineation would be required to determine the precise acreage of wetland impact.

LA3.7.2 Airspace

Affected Environment

Wetlands and aquatic habitats cover almost 373,000 acres of land under the airspace. Wetlands beneath airspace are primarily palustrine forested, inland and forested estuarine along shorelines (see Appendix NR-3). Intact wetland systems of the southeast support high levels of biological diversity, host many endemic species, and provide habitat for migrating birds along Atlantic flyways.

Environmental Consequences

The proposed action would not fill or otherwise directly impact wetlands under airspace. Impacts to wildlife that use these habitats are discussed under sections LA3.6 and LA3.9.

Comparative Summary of the Five Potential Basing Locations

Direct impacts to wetlands and freshwater aquatic communities underlying airspace are not anticipated as a result of the proposed action and alternatives. Indirect impacts to species comprising these communities would not be appreciably different among beddown locations and are expected to be negligible.

LA3.8 Threatened, Endangered, and Special Status Species/Communities

LA3.8.1 Base

Affected Environment

Ten special status species occur, or have the potential to occur, on Langley AFB (Appendix NR-2). These include Harper's fimbristylis, Northeastern beach tiger beetle, Tidewater intestitial amphipod, barking tree frog, Mabee's salamander, tiger salamander, canebreak rattlesnake, bald eagle, great egret, and peregrine falcon. Nine have special state status and two have federal status. No critical habitat occurs on base. Special status species or communities are identified in Appendix NR-2.

One of the federally listed threatened species, the bald eagle, occurs at Langley AFB. Surveys conducted in 1993 and 1994 indicated that foraging by bald eagles occurs to a limited extent within creeks and marshes of the base. Habitat suitable for nesting or roosting occurs among the loblolly pines on the northern side of the base, but no nesting or long-term roosting was observed. Uniform age/size structure of loblolly pine stands may limit use of the base as nesting or roosting habitat (Barrera 1995). The second federally listed threatened species, the northeastern beach tiger beetle, has no record of occurrence on base; it typically inhabits broad sandy beaches and has become a species of increasing concern within the Chesapeake Bay ecosystem.

Environmental Consequences

Species listed, proposed for listing, or candidates for listing as threatened and endangered in accordance with the ESA are not likely to be adversely affected by the proposed action. Critical habitat for the bald eagle does not exist on base, and increases in noise levels and aircraft operations on base are not expected to be significant (Air Force 1998a).

Neither federal nor state sensitive species would be adversely affected by the proposed F-22 beddown at Langley AFB.

Incidentally occurring federally listed, proposed, or candidate species are not likely to be adversely affected by the proposed action because their temporal exposure is short, no critical habitat exists on base, and they do not use Langley AFB for nesting or other critical life cycle functions.

State-protected species (see Appendix NR-2) would also not be adversely affected by the proposed action because their habitat will not be altered and because changes in noise levels on base are not expected to be biologically significant. At Langley AFB, no special species or sensitive habitats are expected to be impacted.

Comparative Summary of the Five Potential Basing Locations

Impacts to threatened, endangered, and special-status species/communities were determined by the potential of these species/communities to be impacted during construction or from aircraft operations under the base noise contours. Langley has the lowest potential for adverse consequences because construction and aircraft operations would have no effect on special-status species/communities. Construction and aircraft operations at Eglin and Elmendorf are also unlikely to affect special-status species/communities; however, the proximity of protected species (least tern at Eglin and Beluga whale and six state species at Elmendorf) result in a slightly higher potential for impacts at these bases than at Langley. Additional surveys and species information at Eglin and Elmendorf could result in a no effect determination for these species. Mountain Home has a slightly greater potential for impacts because habitat of the burrowing owl, a special-status species, may be affected. Tyndall has the greatest potential for impacts because the threatened flatwoods salamander uses habitat similar to that found in the construction zone.

LA3.8.2 Airspace

Affected Environment

Sixty special status species occur or have the potential to occur under airspace used by Langley AFB (see Appendix NR-2). Twenty-five of these species are associated primarily with marine environments, including 12 federally listed species, 1 state sensitive species, and 3 state-listed species. Thirteen species receive protection under the Marine Mammal Protection Act (MMPA) (see Appendix NR-2). The remaining special status species are exclusively associated with coastal and inland terrestrial environments.

Waters beneath marine airspace support several endangered whales: the fin whale, the sperm whale, the humpback whale, the sei whale, and the northern right whale. The fin, sperm, humpback, and sei whales are found in relatively large numbers just off the continental shelf. Additionally, a northern right whale calving area, designated as critical habitat, is located in an area off the coasts of Georgia and northern Florida. This area is associated with the Grey's Reef National Marine Sanctuary, a portion of which falls under marine airspace associated with the proposed action.

Five species of federally protected marine turtles potentially occur under Langley AFB affected marine airspace. The Atlantic green sea turtle was listed federally endangered on July 28, 1978. This turtle ranges along the Atlantic coast in waters warmer than 20° Celsius (C). They are found in shallow waters along the marine coastline feeding on seagrass and algae and utilize unoccupied reefs and beaches for basking. Mating takes place near nesting beaches, which are found in tropical and subtropical waters. Cape Canaveral, Florida, is the northern most nesting locality in the United States (Virginia Tech 2000a). This nesting beach is south of any airspace that may be used by the F-22.

The Atlantic hawksbill sea turtle was listed as federally endangered in 1970. Although it may be at times pelagic, in general it is a turtle of coral and rock reefs of tropical and subtropical regions. It consumes a diet of algae, seagrass, sponges, soft corals, and anemones. Little is known about their nesting habits in the United States and, as a result, most of the nesting information that has been

extracted is from studies in other areas. In the Gulf of Mexico, nesting is most commonly reported between May and August, but they may nest any time of year in other regions.

Kemps' Ridley sea turtle was listed as endangered throughout its range on December 2, 1970. It may be pelagic, especially as juveniles, but as adults can be found in the Gulf of Mexico and the northwestern Atlantic Ocean (National Marine Fisheries Service [NMFS] 2000). They are frequently found in shallow bays and lagoons. Primarily the Kemp's Ridley sea turtle is a crab eater but it also consumes sea urchins, mollusks, jellyfish, and seaweed. Due to their diet they are considered more of a bottom dweller than other sea turtles.

The leatherback sea turtle was listed endangered throughout its range on June 2, 1970. On the Atlantic coast, leatherbacks can be found as far north as the Gulf of Maine during the summer months (NMFS 2000). They mainly eat jellyfish but also consume sea urchins, mollusks, crustaceans, fish, and seaweed. Large numbers of these sea turtles may migrate between summer foraging grounds and nesting beaches. Nesting beaches are characterized as being high energy and steep.

Finally, the loggerhead sea turtle was listed as threatened on June 2, 1970. Usually a turtle of the open ocean, it can also occur in estuaries, salt marshes, bays, and lagoons. Its diet consists of horseshoe crabs, jellyfish, sponges, fish, eelgrass, and seaweed. It nests along the Atlantic coast from North Carolina to Florida. Nesting beaches generally have a gentle sloping aspect with nests excavated above the high-tide mark. Loggerheads nest at the same beach throughout their life with very little straying from that site (Virginia Tech 2000b).

Environmental Consequences

Species listed or proposed for listing, and candidates for listing as threatened and endangered in accordance with the ESA, are not likely to be adversely affected by the proposed action. Critical habitat under airspace is also not likely to be adversely affected.

Environmental assessments that were prepared for actions occurring at all of the overland MOAs found that no significant impacts to special status species would occur from the subsonic use of these airspace units (Air Force 1994a, 1996, 1998b). The United States Fish and Wildlife Service requires a 1,320-foot (horizontal) buffer area around one bald eagle nest between mid November and mid July underneath the Farmville MOA (Air Force 1998a).

Nesting bald eagles could be overflown when accessing airspace over the marine environment; however, because overflights in this area will be at high altitudes, this species is not expected to be adversely affected by the proposed action (see Appendix NR-4).

The NMFS has expressed concern about the northern right whale (personal communication, Mantzaris 2000). This whale is known to migrate under the airspace, summering north near Cape Cod, and wintering and calving under the southern airspace off the coast of the Georgia and Florida border (Figure LA3.9-1). Due to lack of visual cues over water, fighter aircraft rarely engage in air-to-air

The Magnuson-Stevens Fishery Conservation and Management Act, 16 U.S.C. 1801 et. seq. requires federal agencies to assess potential impacts to Essential Fish Habitat. Aircraft operations under the Langley airspace will not impact Essential Fish Habitat.

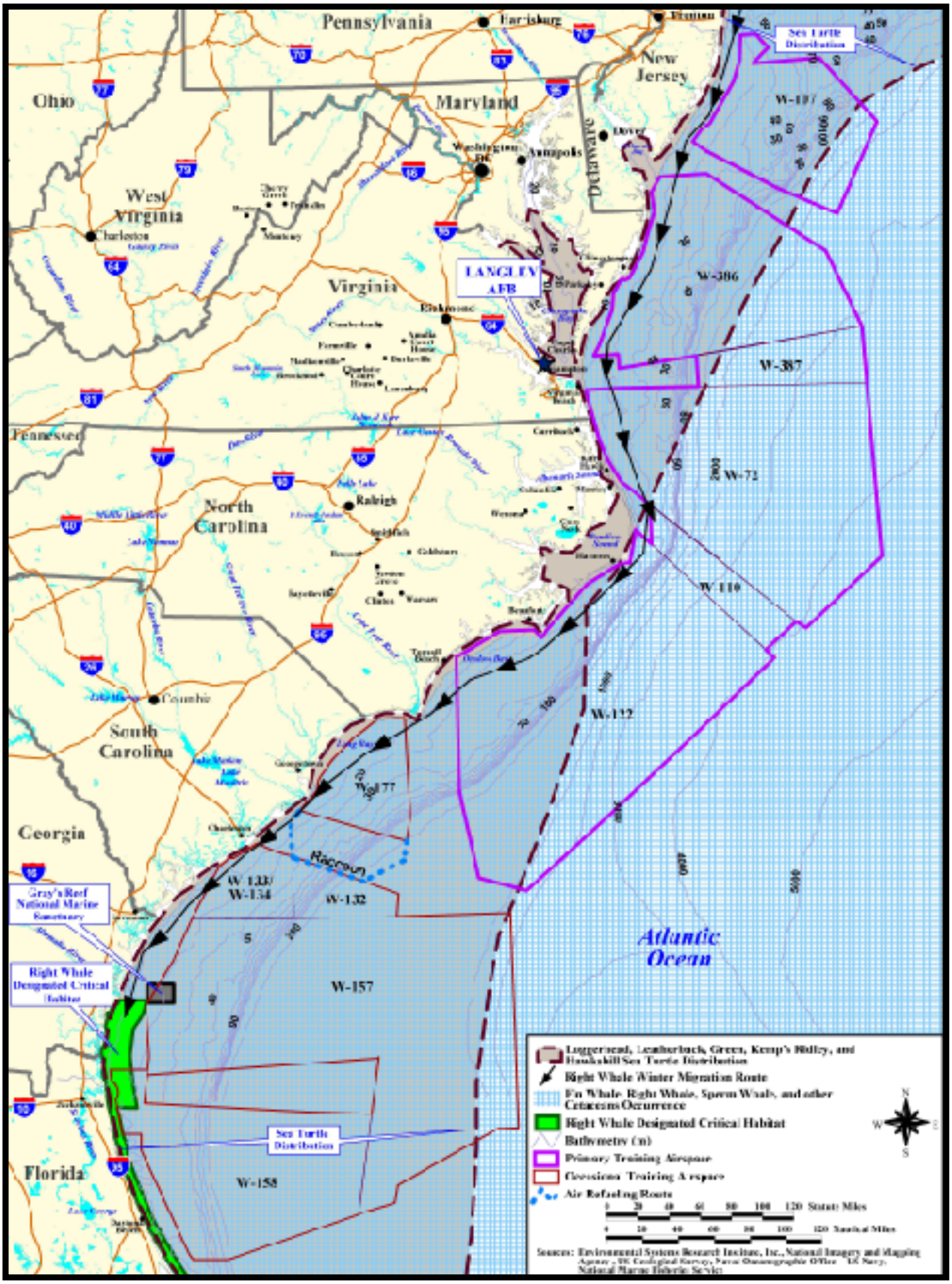


Figure LA3.9-1
Marine Communities Identified Under Primary and Occasional Airspace Associated with Langley AFB

training below 5,000 feet MSL. Sonic booms over the sensitive calving areas could cause individuals to dive; however, Air Force Instruction (AFI) 13-201 limits supersonic operations over water to above 10,000 feet MSL and more than 15 nautical miles from any land area. Therefore, potential impacts to this species are considered insignificant.

Although a minor increase in sorties (7 percent) is projected under the proposed action, over-water altitude restrictions and the absence of nesting habitat under airspace are expected to result in no effect to marine turtles.

Other marine species, such as harbor seals and manatees, would be using portions of the area as a movement corridor. Seals are most sensitive to disturbance when resting on land. Since manatees spend most of their time below the surface, and since they do not startle readily, no effect of aircraft overflights on manatees would be expected (Bowles *et al.* 1991).

Comparative Summary of the Five Potential Basing Locations

Training airspace associated with Langley, Eglin, and Tyndall that is used for supersonic activity consists entirely of over-water Warning Areas; therefore, the potential for impacts to special-status species/communities at these bases are lowest for the five locations. The bases with only overland airspace, Mountain Home and Elmendorf, tend to have a greater potential for impacts to special-status species due to supersonic activity and associated increases in sonic booms. Because the Mountain Home airspace is essentially one unit, the effects of sonic booms would be less dispersed, and the potential for impact greater, than at Elmendorf.

LA3.9 Marine Communities

LA3.9.1 Base

Although Langley AFB property does not include open water marine habitat, noise contours associated with the proposed action extend over marine habitat, and the base is a participant in Chesapeake Bay conservation efforts (see section 3.5.1). Activities associated with the proposed action on base would not affect marine communities.

Comparative Summary of the Five Potential Basing Locations

Relatively small components of Langley, Eglin, and Tyndall include marine communities; however, the lack of physical disturbance to the marine environment and the lack of biologically significant changes in noise conditions on base are expected to result in negligible impacts to the marine community. Because training airspace for Mountain Home and Elmendorf do not overlie marine communities, there would be no potential for impacts.

LA3.9.2 Airspace

Affected Environment

Langley AFB primary and occasional use airspace includes over 500 miles of coastline, including the mouth of the Chesapeake Bay, and extends 180 miles into the ocean (refer to Figure LA3.9-1).

This part of the Atlantic Ocean is classified as cold temperate waters with a range of 5° to 20° C and exhibits important phytoplankton production areas. This area also serves as an important migration flyway in North America (Klages 2000). About 25 percent of all nesting pairs of ospreys nest in the Chesapeake Bay region.

Environmental Consequences

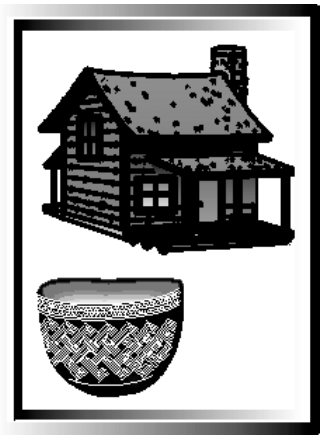
Access to the over-water airspace from Langley AFB could cross the mouth of the Chesapeake Bay; however, aircraft altitudes at this point would be too high to adversely affect marine communities. Therefore, no additional subsonic effects to marine communities are expected as a result of the proposed action.

Since F-22 aircraft supersonic sortie-operations would occur over the ocean and not along the shoreline where wildlife nest and congregate, adverse effects from noise to shoreline habitats and associated species are not expected. Marine airspace is currently used for aircraft operations above 5,000 feet MSL. Due to lack of visual cues over water, fighter aircraft rarely engage in air-to-air training below 5,000 feet MSL. Incidental flights below this altitude are not intended and would, therefore, be rare. Visual impact from aircraft usually is negligible at 1,000 feet AGL (Lamp 1989, Bowles 1995). Appendix NR-4 presents a summary of literature on the effects of noise on wildlife. Langley AFB has the lowest potential for consequences to marine communities for the basing locations where these communities are overflown. Refer to section LA3.8.2 for a discussion of marine mammals protected by the MMPA.

Comparative Summary of the Five Potential Basing Locations

The potential for impacts to the marine community under Langley, Eglin, and Tyndall airspace is low due to current restrictions on flying below 5,000 feet MSL and the absence of supersonic flight below 10,000 feet MSL. Because training airspace for Mountain Home and Elmendorf do not overlie marine communities there would be no potential for impacts.

Cultural and Traditional Resources



Cultural and traditional resources are any prehistoric or historic district or site, or building, structure, or object considered important to a culture, subculture, or community for scientific, traditional, religious, or other purposes. Cultural and traditional resources include archaeological resources (both prehistoric and historic), historic architectural resources, and traditional resources. Significant cultural resources are analyzed for potential adverse impacts. Significant resources are those that are eligible for inclusion in the National Register of Historic Places (NRHP) or that are identified as important to traditional groups. Significant traditional resources are identified by Native American or other traditional groups. Department of Defense (DoD) *American Indian and Alaska Native Policy* (November 21, 1999) requires an assessment, through consultation, of the effect of proposed DoD actions that may have the potential to significantly affect protected tribal resources, tribal rights, and Native American and Alaska Native lands, before decisions are made by any military service.

Visual resources are usually defined as areas with unique features that are a result of the combined characteristics of the natural and human aspects of land use. Examples of the natural aspects of land include wild and scenic rivers, topography, and geologic landforms. Examples of human aspects of land use include scenic highways and historic districts. The assessment of visual and aesthetic value involves a characterization of visual features in the study area.

No-Action Alternative

The no-action alternative would have negligible impacts to cultural resources as a result of ongoing activities at Langley AFB. The base was surveyed in 1990 and 1997, and results indicated that much of the base exhibits a low potential for archaeological sites, primarily because previous activities, such as dredging, filling, roadwork, and runway construction, have destroyed any potential for intact deposits. In the event that features are discovered during any activity, Langley AFB would implement the standard Air Force procedures in AFI 32-7065 for unanticipated archaeological discoveries and maintain compliance with applicable regulations and established procedures for the protection and conservation of cultural resources.

Under the no-action alternative, visual resources would not be impacted. Langley AFB would continue to operate as an industrial area and an active air base. There would be no change in the overall scenic perspectives on base or any changes that would obscure views of the base.

LA3.10 Visual

LA3.10.1 Base

Affected Environment

Langley AFB is near the southern end of the lower Virginia Peninsula on the Back River, a branch of the Chesapeake Bay. The base is in the Coastal Plain Physiographic province on Hampton Flat, a nearly flat plain that gently slopes toward the east, with elevations between 5 and 8 feet above MSL. The main base occupies 2,883 acres of the total site.

The largest structures on base are the aircraft operations and maintenance facilities located in the southern portion of the base. NASA operates a facility complex in the northwestern, south, and southeastern portion of the base. The large wind tunnels and aeronautical test equipment that comprise the NASA facility resemble a large industrial area. A number of older operations buildings on base, such as the Albert Kahn-designed hangars, give the base a character reflecting its history as an important airbase from the beginning of the aviation era.

Many of the residential areas are characterized by tree-lined streets and historic brick structures

The residential areas on base are located along the Back River in the southeastern and northeastern portions of the base. The Lighter-Than-Air, Heavier-Than-Air, and airfield areas are eligible for the NRHP as a potential Langley Field Historic District (see Figure LA3.10-1).

Much of the vegetation on base was planted at the time of the base's original construction (circa 1916). Towering oak trees are

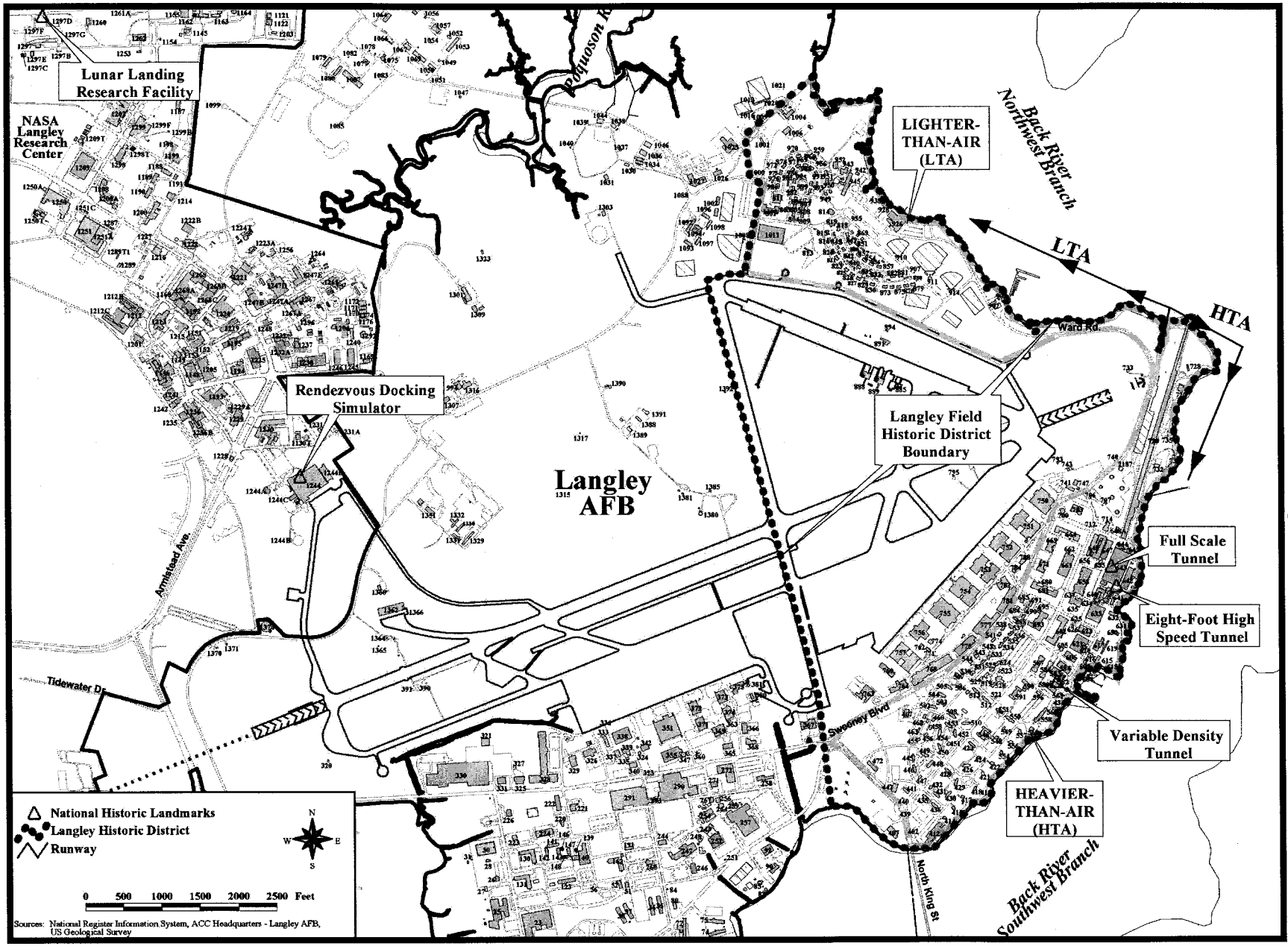


Figure LA3.10-1
Langley Field Historic District Boundary

the dominant species of trees in the Historic District. They have been used mainly as street plantings and as decorative plantings around many buildings. The uniformity of size and shape, as well as the fairly regular placement of these trees, are a unifying factor throughout the base, giving it a distinctive character. These trees, along with a number of smaller species, play a major role in breaking up open areas and providing shade for buildings, parking, and lawn areas.

Environmental Consequences

Determination of the significance of the impact on visual resources is based on the level of visual sensitivity in the area (refer to Appendix CR-1 for a description of the analytical approach).

Langley AFB is currently exposed to military aircraft overflights. As a result of using the base daily for takeoffs and landings, military aircraft have become a common and expected aspect of the visual environment. Although beddown of the F-22 would increase overall aircraft sorties by 7 percent, this increase would not likely affect visual resources because visual sensitivity on base is low and aircraft overflights are common.

Construction projects included in the proposed action would be designed and constructed to be architecturally consistent with the existing environment and compatible with existing facilities and structures. Although demolition and renovation of historic buildings will be done in compliance with the Secretary of the Interior's Standards, Langley AFB will have a greater potential for visual environmental consequences than the alternative bases. The addition of new structures to previously undeveloped areas would not alter the visual character of the area, because these types of buildings would be expected in an airfield environment.

Langley AFB personnel would continue to coordinate and consult with the Virginia Department of Historic Resources (DHR) regarding historic buildings and effects of the visual changes of new construction on the NRHP-eligible Langley Field Historic District. Section LA3.11.1 includes an analysis of potential visual impacts within the historic district.

There is little likelihood for consequences to visual resources under the airspace.

Comparative Summary of the Five Potential Basing Locations

The potential for visual impacts is low at all bases because of the preexisting military character and industrial uses. Langley has the greatest potential for visual impacts because of the presence of numerous historical resources. Eglin has less likelihood of impacts compared to Langley and Elmendorf and is similar to Tyndall and Mountain Home.

LA3.11 Cultural

LA3.11.1 Base

Affected Environment

Archaeological Resources

A comprehensive archaeological resources overview produced a base sensitivity map which indicated that most of Langley AFB had been disturbed by construction or other impacts (Air Force 1998c). The Virginia DHR concurred that archaeological resources were absent in those areas subjected to systematic shovel testing, and that an archaeological survey would not be required for areas covered by existing runways, roads, parking lots, and certain existing buildings. They indicated, however, that additional survey of areas identified as having moderate or low archaeological potential might be necessary in the future (Air Force 1998c).

Thirteen archaeological sites have been identified within the base or on the base border with NASA, and none are within the area of affected environment of the proposed action.

Architectural Resources

Architectural surveys at Langley AFB have identified an area encompassing the Lighter-Than-Air, Heavier-Than-Air, and airfield areas as eligible for the NRHP as a potential Langley Field Historic District (refer to Figure LA3.10-1). Historic District resources (ca. 1917 to 1945) illustrate the evolution of construction within the Army Air Corps and are associated with the development of Langley Field, the Army Air Corps, and NASA. Of the 379 Air Force buildings and structures in the potential district, 285 are contributing resources. Appendix CR-2 lists contributing buildings to the Langley Field Historic District. A draft NRHP nomination was prepared for Langley Field Historic District, although the district is not presently listed on the NRHP (NRIS 2000).

The Langley Field Historic District has 285 contributing buildings and structures.

Virginia DHR has concurred with the proposed district boundary and list of contributing and non-contributing building resources (Air Force 1998c). Property types include aircraft operations facilities; administration, residential, and recreational facilities; wind tunnels; laboratories; runways; taxiways; road systems; and landscape features. Some of these structures lie within the area of affected environment for the proposed action.

Cold War-era resources (1946 to 1989), including those associated with the National Advisory Committee for Aeronautics (NACA)/NASA, also have been documented at Langley AFB. Five of these are listed on the NRHP (Table LA3.11-1). Four are also National Historic Landmarks (NHL) (NPS 2000): the Variable Density Tunnel, the Rendezvous Docking Simulator, the Lunar Landing Research Facility, and the Full Scale Tunnel. The Variable Density Tunnel is the first wind tunnel in the world to use the principle of variable density air pressure to test scale model aircraft. The Rendezvous Docking Simulator is the only surviving trainer used by Gemini and Apollo astronauts to practice rendezvous and docking techniques. The Lunar Landing Research Facility

was used to prepare astronauts to land on the moon. The Full Scale Tunnel is the first full-scale wind tunnel built by the NACA, the parent agency of NASA.

Table LA3.11-1 summarizes NRHP-listed historic properties within or immediately adjoining the base. None of these are within the area of affected environment for the proposed action.

Table LA3.11-1. National Register-Listed Historic Properties at Langley AFB

City	*Property*	*Location*
Hampton	Lunar Landing Research Facility National Historic Landmark	Langley Research Center (NASA property)
	Rendezvous Docking Simulator National Historic Landmark	Langley Research Center (NASA property)
	Variable Density Tunnel National Historic Landmark	Langley Research Center (Air Force property)
	Full Scale Tunnel National Historic Landmark	Langley Research Center (Air Force property)
	Eight-Foot High Speed Tunnel	Langley Research Center (Air Force property)

Source: NRIS 2000.

Traditional Resources

No traditional resources or Native American issues have been identified at Langley AFB (Air Force 1996). No federally recognized Indian tribes or lands are located in Virginia. The Bureau of Indian Affairs (BIA) identifies Tribal Designated Statistical Areas for four tribes in eastern Virginia: the Mattaponi, the Pamunkey, the Chickahominy, and the Eastern Chickahominy (BIA 1998). The Commonwealth of Virginia recognizes several tribes in eastern Virginia: the Chickahominy, the Eastern Chickahominy, the Pamunkey, the Mattaponi, and the Nansemond (Virginia Indian Council 1997). The BIA has been contacted to identify federally recognized Indian tribes that may have an interest in the area of affected environment.

Environmental Consequences

The proposed action would include construction of nine new buildings and associated infrastructure, and alterations to project facilities for Gold Flag, Security Forces, Chaplain, Armament, and Operations/Logistics Group Staff. Demolition of Hangars 754, 755, and 756 and construction of the flightline kitchen, AGE fuel island and parking, three consolidated maintenance/operations facilities, and infrastructure improvement projects would take place within the boundaries of the Langley Field Historic District.

The aircraft hangars to be replaced are contributing members of the Langley Field Historic District.

No impacts to archaeological resources are expected under the proposed action. No archaeological resources were identified in previously surveyed portions of the area of affected environment. Those areas that have not been surveyed include some locations with a moderate potential for historic remains (Wheaton *et al.* 1991).

However, these areas were heavily disturbed by World War II and later construction. Any unsurveyed areas would be addressed in compliance with Section 106 of the National Historic Preservation Act (NHPA) prior to construction.

Adverse impacts to architectural resources would potentially occur under the proposed action. Such impacts include building demolition, renovation, and the introduction of visual elements out of character with the Langley Field Historic District:

1. *Building Demolition*. Buildings 754, 755, and 756 (built in 1932) would be demolished and replaced with three new Consolidated Maintenance/Operations Facilities. The aircraft hangars are contributing resources to NRHP-eligible Langley Field Historic District (Air Force 1998). Prior to demolition, documentation and recordation of all affected resources would be completed in compliance with Section 106 of the NHPA and in accordance with a Memorandum of Agreement among the Air Force, State Historic Preservation Office (SHPO), and Advisory Council for Historic Preservation (ACHP).

2. *Building Renovation*. Impacts could occur as a result of alterations to Building 757, a contributing member of the Langley Field Historic District. Alterations to this facility would be coordinated with the base cultural resources manager to ensure the alterations would be made in compliance with Section 106 of the NHPA and the *Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings* (Weeks and Grimmer 1995).

3. *Visual Impacts*. Construction of three new hangars, the flightline kitchen, the AGE fuel island and parking, building renovation, and infrastructure projects within the Langley Field Historic District would introduce visual elements that could diminish the integrity of the Langley Field Historic District. Designs for new construction within the view shed of the historic district would conform to the base architectural, landscape, interior design, and engineering standards, and to the *Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings* (Weeks and Grimmer 1995). Construction designs would be submitted to the Virginia DHR for review.

Consultation with the DHR and ACHP regarding effects of the proposed action is underway. Table LA3.11-2 lists potentially affected Langley AFB buildings and effects under the proposed action.

No impacts to traditional resources are likely under the proposed action, because no traditional resources have been identified at Langley AFB. There are no federally recognized Indian lands or resources at Langley AFB, and no issues have been identified by federally recognized or other Indian groups in Virginia. Contact with the BIA has been initiated to identify potentially interested Indian groups.

Comparative Summary of the Five Potential Basing Locations

The potential for impacts to archaeological resources is low at all five bases. Construction would occur in areas with a low probability for intact resources. Langley AFB has the greatest potential for impacts to architectural resources because the proposed construction would demolish several historic hangars and construction would occur within a historic district. However, historic

mitigation would be accomplished as part of the proposed action. Eglin and Elmendorf have the second greatest potential for impact to historic buildings. Mountain Home and Tyndall have the lowest potential for impact because of the lack of potentially historic buildings. The potential for impacts to traditional resources is low at all bases.

Table LA3.11-2. Langley AFB Buildings and Infrastructure Associated with the Proposed Action

Building/Infrastructure	*Proposed Action*	*Langley Historic District Status*	*Effects*
369	Major renovation	Outside District	No effect
371	Minor renovation	Outside District	No effect
754	Demolition	Contributing member	Adverse effect
755	Demolition	Contributing member	Adverse effect
756	Demolition	Contributing member	Adverse effect
757	Minor renovation	Contributing member	No adverse effect
760	Minor renovation	Non-contributing member	No effect
763	Moderate renovation	Non-contributing member	No effect
Base Operations/Weather	Construction	Outside District	No effect
Low Observable Composite Repair Facility	Construction	Outside District	No effect
Flight Simulator	Construction	Outside District	No effect
Flightline Kitchen	Construction	Within District	No adverse effect
AGE Fuel Tanks	Construction	Within District	No adverse effect
Vertical Wing Tank Storage	Construction	Outside District	No effect
Fighter Squadron Operations/Maintenance Hangars (3)	Construction	Within District	Adverse effect
Airfield Infrastructure	Apron, stormwater construction	Outside District	No effect
Flightline Infrastructure	Fire protection, utilities construction	Within District	No adverse effect
Infrastructure and Facilities Upgrades	Electrical, communications, water, storm, and sanitary	Outside District	No effect

LA3.11.2 Airspace

Affected Environment

A number of NRHP-listed properties are located under Langley AFB airspace. In addition to these resources, there are likely to be additional cultural resources that are either eligible or potentially eligible for NRHP listing under airspace. Appendix CR-2 identifies NRHP-listed properties under primary use airspace. Contact with the BIA has been initiated to identify federally recognized Indian groups that may have an interest in the area of affected environment.

Farmville MOA lies above southern Virginia (refer to Figure LA2.2-1). NRHP-listed historic properties under Farmville MOA include historic farms and plantations, courthouses, historic districts, schools, a tavern, and a Civil War battlefield. One NHL, Sayler's Creek Battlefield near Farmville, was the location of the last major engagement between the armies of Lee and Grant before the surrender at Appomattox Court House. No federally recognized Indian tribes or lands underlie this airspace (BIA 1998).

Warning Areas 386, 387, 72, 107, 110, and 122 are located over the Atlantic Ocean off the coast of New Jersey, Delaware, Maryland, Virginia, and North Carolina. One National Historic Landmark, the wreck of the USS *Monitor*, lies under airspace in the Cape Hatteras, North Carolina area. Airspace overlies many areas of potential submerged archaeological sites, especially along the capes, shoals, and inlets off the coast of North Carolina (Division of Archives and History 1985). The remains of many historic vessels are in this area, including those representing the history of naval warfare in the region, such as the USS *Monitor*.

Environmental Consequences

Under the proposed action, F-22 airspace use in Farmville MOA is expected to increase by about 37 percent over existing use. Subsonic noise would decrease overall under the training airspace. Supersonic activity (sonic booms) is expected to generally increase from 0.2 boom per month in W-107 to 30 booms per month in W-386. All supersonic actions are expected to take place above 10,000 feet MSL and to continue to be limited to those areas that currently support supersonic flight.

Because the F-22s would typically operate at higher altitudes than F-15Cs, aircraft noise would decrease slightly over existing conditions in most airspace. Ongoing airspace use by F-15C aircraft has not been known to impact significant historic properties or traditional resources. Because F-22 aircraft use would result in a general decrease in subsonic noise under the proposed action, no impacts to historic properties or traditional resources are expected. All supersonic actions are expected to take place above 10,000 feet MSL in over-water Warning Areas. Supersonic events are not expected to impact submerged archaeological sites. No federally recognized Indian tribes or resources underlie Langley AFB primary use airspace and impacts to traditional resources are not expected.

Chaff and flare use is not expected to impact significant cultural resources under the airspace. Previous and existing use of chaff and flares by F-15C aircraft is not known to have impacted cultural resources. A slight increase in use by F-22 aircraft also is not expected to result in impacts, as chaff and flare use is not allowed over land at Langley AFB.

Comparative Summary of the Five Potential Basing Locations

The potential for impacts to archaeological and architectural resources under airspace is low for all five bases. The potential for impacts to traditional resources under airspace is also low for Langley, Eglin and Tyndall. It is highest for Mountain Home and Elmendorf because of Native American reservations and Alaska Native traditional resources under airspace.

Human Resources

Human Resources include land use, socioeconomics, and environmental justice. Appendix HR-1 contains the methodological approach for evaluating the potential effects of the beddown of the Initial F-22 Operational Wing to the human environment. The proposed Initial F-22 Operational Wing beddown and related training activities would not substantially change aircraft operations, overflights, or noise levels at Langley AFB or in its associated airspace.

The affected area for human resources includes areas on base and the surrounding communities, specifically those jurisdictions whose economies are closely associated with base activities. For the land use and environmental justice resources, the effects on areas underlying the airspace are also considered.

No-Action Alternative

The no-action alternative would have no additional impacts on land use, socioeconomics, or environmental justice. Land use and existing land use patterns would remain the same under the no-action or the proposed action. The area would continue to experience development growth around the base. Langley would continue to cooperate with the local communities in developing its Air Installation Compatible Use Zones (AICUZ) programs. Langley AFB would continue to operate and contribute to the economic health of the region. The socioeconomic status in the region would remain the same. Under the no-action alternative, demographic patterns associated with minority populations, low-income populations, and children would remain the same.

LA3.12 Land Use

LA3.12.1 Base

Affected Environment

Langley AFB is located adjacent to the city of Hampton between the northwest and southwest branches of the Back River. The installation comprises 2,883 acres near the southern end of the lower Virginia Peninsula.

Land uses on Langley AFB are grouped by function in distinct geographic areas. For example, residential areas are primarily located in the eastern portion of the base, while aircraft operations and maintenance facilities are located in the southern portion. Land use planning on Langley AFB is guided by adopted plans and programs. The Langley 2020-Commanders General Plan provides an overall perspective concerning development opportunities and constraints. The base has Area Development Plans that focus on specific, geographically based development issues. The integrated Natural Resource Management Plan is used to coordinate natural resource management.

Part of this 24-screen movie theater and the Thomas Nelson Community College are considered incompatible with current land use recommendations.

Langley AFB is located within an area classified as a coastal zone. Consequently, the base must ensure that any development is, to the maximum extent practicable, consistent with the policies of the approved Virginia Coastal Resource Management Program.

The installation's west boundary is formed by marshlands, single-family residential, and mixed commercial development in the city of Hampton. In addition to the urban development associated with the Hampton Roads area, numerous military facilities are located in proximity to Langley AFB. The NASA-Langley Research Center also borders Langley AFB to the north. Table LA3.12-1 presents a list of land uses within the baseline Langley AFB 65 DNL noise contour line as depicted on Figure LA3.2-1.

Table LA3.12-1. Land Uses within the Langley AFB Baseline 65 DNL Noise Contour

Land Use	*Percentage*
Residential	4
Commercial	2
Other Urban Uses[1]	2
Agricultural Land	5
Undeveloped Lands[2]	31
Water	37
Langley AFB	17
NASA-Langley Research Center	2

Notes: 1. Transportation and communication uses.
2. Forest, beaches, wetlands.
Source: USGS 1994.

Base plans and studies present factors affecting both on- and off-base land use and include recommendations to assist on-base officials and local community leaders in ensuring compatible development. In general, land use recommendations are made for areas affected by both the potential for aircraft accidents (refer to section LA3.4, Safety) and aircraft noise (refer to section LA3.2, Noise). There are safety zones defined for each end of the runway based on the analysis of historic mishap data that defines where most aircraft accidents occur. At Langley AFB, the Air Force has acquired most property within one of the zones (the clear zone). Largely undeveloped, a portion of the Armistead Avenue public right-of-way does traverse the west clear zone. Accident potential zones overlie water to the east and private or state-owned property to the west. The land uses of the zone to the west are small businesses, some residential and part of a 24-screen movie theater (which is also located in the second accident potential zone). The Commonwealth of

Virginia's Thomas Nelson Community College campus is also within the second accident potential zone (Air Force 1998b). Land uses designed for large gatherings of people, such as the college and the movie theater, are considered incompatible with current land use recommendations. Because the ultimate goal of such programs it to promote public safety and well-being, as well as preserving the operational capabilities of Langley AFB, additional incompatible development in accident potential zones is not recommended. The city of Hampton has implemented regulations to assist in limiting any additional incompatible development. Affected areas of Newport News have been developed with sufficient regulations to preclude inconsistent future development.

During scoping, people wanted to know if there would be expansion of noise contours or accident potential zones.

Noise contours in these plans are generated by the modeling program NOISEMAP. These noise contours are used to describe noise exposure around the base and support compatible land use recommendations. Noise is one of the major factors used in determining appropriate land uses since elevated sound levels are incompatible with certain land uses. When noise levels exceed a DNL of 65 dB, residential land uses are normally considered incompatible. Further, the percentage of persons highly annoyed by noise can be estimated based upon varying noise levels. Noise exposure (depicted with contours) from operations occurring today at Langley AFB are shown in Figure LA3.2-1. These contours provide the baseline against which to measure the projected change should the F-22 be based at Langley AFB.

Noise sensitive receptors (hospitals, schools, and churches) may occur within the vicinity of an airfield. At Langley AFB, one elementary school (Luther W. Machen Elementary), two secondary schools (Bethel High and Point Option Alternative High), two higher education campuses (Thomas Nelson Community College and Old Dominion University Peninsula Higher Education Center), and two churches occur within the 65 DNL and above contours. Under the edge of the current 65 DNL contour line, southwest of the base, a new 194-bed hospital expansion of the existing CarePlex facilities is under construction.

Environmental Consequences

The Initial F-22 Operational Wing beddown would require construction and modification of facilities on base and would result in a decrease in personnel and an increase in sorties. However, this should not adversely affect on-base land uses. Proposed development would be consistent with base plans, particularly because it would occur in proximity to other similar and compatible land uses.

Under the proposed action, no modifications to the safety zones are anticipated. Land uses within these areas would remain as described in the affected environment. There would be no land use consequences due to on-base construction.

Figure LA3.2-1 also depicts the projected NOISEMAP contours should the F-22s replace the F-15Cs at Langley AFB and illustrates the variation in the baseline and projected noise environment. Under the proposed action, some areas exposed to noise, decrease in total acreage while other areas increase depending upon the contour. For example, off-base areas exposed to 65 to 70 DNL decrease by about 308 acres, with 146 of the 308 acres being residential use. This decrease is primarily attributed to the F-22's ability to accelerate more quickly to climb speed and reduce power sooner than the F-15C on takeoff. As such, the F-22 would generate more noise closer to the runway and less noise farther from the runway. The areas exposed to higher DNLs, such as 70 DNL and above, would increase between 107 to 197 acres, depending on the specific contour. Residential use within these areas comprises between 5 and 54 acres.

Amount of Off-Base[1] Land Area Change from Baseline to Projected at Langley AFB

Noise Contours (DNL)	*Total Land Area in Baseline (acres)*	*Total Land Area in Projected (acres)*	*Total Change (acres)*	*Total Residential Area Contained in Areas of Decrease/Increase (acres)*
65-70	3,769.5	3,462.0	-307.5	-146.3
70-75	1,612.2	1,718.7	106.5	53.7
75-80	682.6	879.3	196.7	5.0
80-85	102.5	251.3	148.8	0.0
>85	6,172.7	6,316.2	143.5	-87.6

Note: 1. All referenced acreages are located off Langley AFB.

Upon closer comparison of the baseline to the projected noise contours, there would be an overall increase of about 144 acres of shifted exposure surrounding Langley AFB. Inspection of the lands newly affected by the noise contours to determine the number of residences affected revealed the following: 65 to 70 DNL contour - 905 dwelling units; 70 to 75 DNL contour - 320 dwelling units; 75 to 80 DNL contour - 266 dwelling units; and the 80 to 85 DNL contour - 73 dwelling units. Residential use in these areas includes some medium- to high-density development (apartments and townhomes), and single family homes on 8,000 to 20,000 square foot lots. Although the comparison of current F-15C baseline to projected contours indicate an overall increase, these areas have historically exposed to noise over the last several years and fall within published contours used for land use planning around the installation. Thus, the "increased" areas have been a part of the noise environment for some time.

In contrast, there is a decrease of approximately 88 acres (i.e., -146.3+53.7+5=87.6) of designated residential land due to the overall decrease in the projected size of the 65 to 70 DNL contour (refer to Figure LA3.2-1). Inspection of these areas revealed 997 dwelling units (single-family detached homes and apartments) under the baseline 65 to 70 DNL would not be included under the projected contour. Nine dwelling units in a portion of the baseline 70 to 75 DNL contour would not be exposed under that projected contour.

Average household size in the Langley area, as identified in the 1990 census, is 2.57.

No new sensitive receptors would be exposed under the proposed action; however, three schools (Luther W. Machen Elementary School, Bethel High and Old Dominion University Peninsula Higher Education Center) currently located within the 65 to 70 DNL contour southwest of the base, may experience higher noise levels, as will the expanded CarePlex/hospital facility.

In order to better understand the effects of aircraft noise on individuals in the vicinity of the airfield and underlying other aircraft use areas, numerous studies have been undertaken. Aircraft noise effects can be described according to two categories: annoyance and human health considerations. Annoyance, which is based on a perception, represents the primary effect associated with aircraft noise. Far less potential exists for effects on human health. Studies of community annoyance to numerous types of environmental noise show that DNL correlates well with effects. Schultz (1978) showed a consistent relationship between noise levels and annoyance. A more recent study reaffirmed this relationship (Fidell *et al.* 1991).

A number of studies have been conducted that analyze the effects of aircraft noise on people. These studies focus on effects in two categories: annoyance and human health. A complete discussion of this topic can be found in Appendix AO-2.

In general, there is a high correlation between the percentages of groups of people highly annoyed and the level of average noise exposure measured in DNL. The correlation is lower for the annoyance of individuals. This is not surprising considering the varying personal factors that influence the manner in which individuals react to noise. The inherent variability between individuals makes it impossible to predict accurately how any individual would react to a given noise event. Nevertheless, findings substantiate that group or community annoyance to aircraft noise is represented quite reliably using DNL. Table LA3.12-2 presents the relation between annoyance and DNL. The change in population highly annoyed as a result of the project was estimated by multiplying the number of off-base dwelling units identified in newly affected areas (i.e., areas experiencing either increases or decreases in noise levels, based on 5 dB intervals) by the average household size in the area, and then applying the percentage of population highly annoyed for each noise level. For the Langley AFB alternative, 818 additional people would be highly annoyed due to increased noise levels, whereas 321 people would experience decreased annoyance due to decreased noise levels.

Table LA3.12-2. Relation Between Annoyance and DNL

DNL	*Percent of Population Highly Annoyed*
65	12.3
70	22.1
75	36.5
80	53.7
85	70.2

Source: Finegold *et al.* 1994.

Appendices AO-1 and AO-2 include additional information regarding aircraft noise effects. For purposes of the land use analysis, it is important to note that human effects is one of the factors used to determine appropriate land uses for areas in proximity to airfields. Assessments of land use compatibility can then be used to develop community land use plans, guidelines, and regulations.

As stated above, the area (land and water) affected under the proposed action would decrease by 366 acres overall (refer to Table LA3.2-2). There would be fewer people affected overall by aircraft

noise (65 DNL and above) under the proposed action. The affected population under the 70 DNL and above contours could potentially increase. These locations, however, have historically been exposed to elevated noise levels associated with Langley AFB and NASA Research Center.

Residential property values in the vicinity of airfields in general are affected by a variety of non-noise factors such as national, regional, and community economic conditions; national and regional trends in employment, inflation, and interest rates; local population changes; and real estate development (Fidell *et al.* 1996). A 1996 study, *Effects of Military Aircraft Noise on Residential Property Values,* indicates that aircraft noise, "is predictively unrelated to residential property sale prices in the vicinity of Langley Air Force Base [and] . . . strongly suggests a lack of causal relationship as well." Specifically for Langley, property sales trends are historically similar within and outside of the 65 DNL and above contours.

While property values in the vicinity of Langley AFB may be affected by local perceptions of environmental issues, such as noise exposure, the complex interaction of multiple economic and real estate factors makes the estimation of such effects highly speculative. Research indicates no reliable correlation between aircraft noise and residential property sale prices at Langley AFB (Fidell *et al.* 1996).

In summary, the proposed beddown of the Initial F-22 Operational Wing at Langley AFB would result in some areas under the 65 DNL noise contour experiencing an increase in noise. Should the decision be made to place the Initial F-22 Operational Wing at Langley AFB, and once flying operations have commenced, detailed data collection would occur and existing noise studies and land use recommendations would be updated. Therefore, the potential for impacts on land use ownership, plans, or property values is low.

Comparative Summary of the Five Potential Basing Locations

Land use impacts stem from changes in noise levels for off-base areas. Impacts at Langley AFB, where the off-base area affected by noise would decrease with beddown of the F-22, would be greater than at Elmendorf or Mountain Home because residential lands would continue to be affected. Despite an increase of about 2,500 acres affected by noise, the off-base land uses at Mountain Home consist of grazing/agricultural. Consequently, potential impacts would be less than at Eglin and Tyndall where noise would affect 123 and 23 acres of residential land use, respectively. The potential effects of subsonic noise would be the least at Elmendorf since only military lands or over-water areas are affected.

LA3.12.2 Airspace

Affected Environment

This section summarizes land uses underlying MOAs in the proposed action. No lands occur under the Warning Areas. As illustrated in Figure LA3.1-1, the MOAs overlie a three-state area along the south Atlantic Coast of the United States. Although most of the affected airspace is located in Virginia, some areas extend into portions of North Carolina and West Virginia.

The general land use patterns underlying this airspace may be characterized as rural. Agricultural uses include crops and forestry. Within the towns that underlie the airspace, a wide variety of land

use types occur, including residential, commercial, industrial, and public land uses. An analysis of cultural resources under the airspace is provided in section LA3.11.2.

Special use areas have been identified under the MOAs. Appendix HR-2 contains tables summarizing special use areas for each state under the airspace. Special use areas provide recreational opportunities (trails and parks) and/or solitude or wilderness experience (parks, forests, and wilderness areas). Recreational areas include large public land areas such as state or national parks, and forests and reserves that may include individual campgrounds, trails and visitor centers.

Land use under the Farmville MOA has abundant recreation opportunities, including wildlife management areas and state parks and forests. Hunting, fishing, hiking, and picnicking are all popular activities.

Environmental Consequences

Under the proposed action, subsonic noise would vary little from baseline conditions (refer to section LA3.2, Noise). Most noise levels are expected to remain below 45 DNL. Where noise levels are higher than 45 DNL, they generally remain the same for the proposed action described for the affected environment and no-action alternative. Therefore, the use of airspace by the F-22 aircraft would have a negligible effect on land use patterns, ownership, or management practices. Special use areas under the MOAs would not be expected to have any discernable environmental consequences from F-22 overflights.

Comparative Summary of the Five Potential Basing Locations

The potential for impacts to land use as a result of airspace use would be negligible for Langley, Eglin, and Tyndall. For these installations, most of the F-22 sortie-operations and all of the supersonic activity would occur in over-water Warning Areas. Impacts at Elmendorf and Mountain Home would be similar to each other and greater than for the other three locations, because supersonic activity would increase noticeably. At both Elmendorf and Mountain Home, all supersonic activity would occur over land. Increases in sonic booms over special use areas would make the potential for consequences under Mountain Home airspace greater than any other location.

LA3.13 Socioeconomics

LA3.13.1 Base

Affected Environment

Employment and Earnings

Employment and earnings information is presented for the following jurisdictions whose economies are closely associated with activities at Langley AFB: York County; Poquoson, James City County, Williamsburg, Newport News, Hampton, and Norfolk. Comparisons are also presented with conditions for the Commonwealth of Virginia.

In the region, total full- and part-time employment decreased from 501,950 jobs in 1990 to 498,938 in 1997, at an average rate of -0.1 percent annually. The largest contributions to employment in 1997 were made by services (27.0 percent), military (16.6 percent), and retail trade (14.4 percent). For the years 1980, 1990, and 1997, the contribution of the military decreased from 21.7 percent to 21.0 percent and 16.6 percent, respectively. The sectors of the economy exhibiting the greatest addition of jobs over the period 1990 to 1997 were services and state and local government (United States Department of Commerce, Economics, and Statistics Administration [USDCESA] 2000).

The value of payroll associated with government personnel at Langley AFB reached over $356 million in 1999.

In the Commonwealth of Virginia, military employment declined from 6.5 percent of total employment in 1980 to 5.7 percent in 1990 and 4.2 percent in 1997. The sectors of the economy exhibiting the greatest addition of jobs in the state over the period 1990 to 1997 were services and retail trade. The number of personnel stationed at Langley AFB stood at about 8,250 active-duty military and 2,440 civilian workers in 1999.

Non-farm earnings in the region totaled more than $14.1 billion in 1997. The major contributions were made by services (23.0 percent), military (18.4 percent), and manufacturing (14.1 percent). In the Commonwealth of Virginia, non-farm earnings totaled over $129 billion in 1997, with the major contributions made by services (28.5 percent), manufacturing (12.3 percent), and state and local government (10.9 percent) (USDCESA 2000).

In addition to economic effects associated with payroll expenditures by Langley AFB personnel, the installation also purchases significant quantities of goods and services from local and regional firms. In 1999, annual expenditures by the base totaled over $266 million. Further, the Air Force estimates that the economic stimulus of Langley AFB created approximately 5,750 secondary jobs in the civilian economy (Air Force 1999d).

Population

The population of the region increased by less than 1 percent from 1990 to 1999, reaching 670,650 persons in 1999. By comparison, the population of the state of Virginia increased by almost 11 percent during the same period, reaching 6,872,912 in 1999, at an average annual rate of 1 percent (U.S. Census Bureau 2000a).

Approximately 85 percent of the 1999 population of the region resides in cities and towns that range in size from Poquoson (with a population of 11,571) to Norfolk (with a population of 225,875). The largest include Norfolk, Newport News (179,138 persons), and Hampton (137,193 persons).

Military retirees in the vicinity of Langley AFB comprise about 3.3 percent of the total regional population.

The combined regional population is projected to increase from about 679,700 in 2000 to 712,013 by the year 2010 at an average annual growth rate of 0.5 percent.

Based on information provided by Langley AFB concerning the place of residence (by zip code) of personnel assigned to the installation, it is possible to derive an estimate of the number of personnel residing in each of a number of communities in the vicinity of the base. The largest numbers of

military personnel reside in Hampton and Newport News. Compared to the general population, however, military personnel have a greater than average propensity to reside especially in Hampton and are noticeably under-represented in Norfolk, Portsmouth, and Newport News.

Housing

The 1990 United States Census documented 259,577 housing units in the region with a vacancy rate of about 8.4 percent. Of the vacant units, 3.6 percent were for seasonal and recreational use. Of the total number of housing units, 2.6 percent were mobile homes (U.S. Census Bureau 1991).

Over the period 1990 to 1999, an average of 3,136 building permits for residential units was issued annually. The number of units permitted, on an annual basis, varied from a high of 3,729 units in 1993 to a low of 2,533 units in 1997. The majority (78 percent) of these units were comprised of single-family homes. The proportion of units contained in structures with five or more units comprised 18 percent of the new units. The number of such multi-family units permitted varied from a high of 766 in 1994 to a low of 325 in 1999 (U.S. Census Bureau 2000b).

Of the active-duty personnel assigned to Langley AFB in fiscal year (FY) 1999, just over 18 percent resided on base in government family and unaccompanied housing.

Environmental Consequences

Construction activity associated with a beddown decision at Langley AFB will peak in FY 2002 with the expenditure of over $37 million. It is estimated that these expenditures will support 572 construction jobs and 453 secondary jobs, for a total employment effect of 1,025. This number of jobs comprises 0.2 percent of the 1997 level of regional employment. Earnings associated with these jobs would total over $30 million or about 0.2 percent of total non-farm earnings in the region in 1997. It is estimated that a total of 102 workers could temporarily relocate and take up residency in the region in conjunction with these construction activities.

During scoping, people asked how the beddown would affect the local economy.

The F-22 operations would see a decrease of 297 active-duty personnel and an increase of 54 civilian/contractor personnel, for a net reduction of 243 by FY 2007. There would be a subsequent reduction in secondary employment of 115 jobs. Total employment in the region would fall by 358 jobs. Such reductions comprise 2.3 percent of the 1999 base personnel and 0.1 percent of regional employment. The reduction in earnings associated with the personnel reduction is estimated at over $12 million or about 0.1 percent of the total regional non-farm earnings in 1997.

The departure of the active-duty personnel and their dependents (659 persons) and secondary workers and their dependents (25 persons) is partially offset by the addition of 116 persons associated with new civilian and contractor jobs. The net result is a decline of 568 persons by FY 2007. This represents 0.1 percent of the regional population total in 1999.

Between FY 2004 and 2007, a net of approximately 206 off-base housing units could be vacated (both owner-occupied and rented) by those persons leaving the area; this could increase the housing vacancy rate by a negligible amount.

Of the approximately 570 persons expected to leave the region by FY 2007, the largest number (about 310 persons) are expected to reside in Hampton, followed by Newport News (about 100 persons).

There is little likelihood for any socioeconomic consequences under the airspace.

If regional population growth occurred as projected at 0.5 percent annually, the change from the F-22 would result in a slightly higher rate of growth in the FY 2002 to FY 2003 period during construction, and a lower rate of growth from FY 2003 through FY 2007.

Comparative Summary of the Five Potential Basing Locations

Based on differences in both personnel changes and construction projects, the socioeconomic influence of the F-22 beddown would vary among the five bases. Langley is the only base where a decrease in operations employment and earnings would occur. Operations employment would decrease by 358 direct and secondary jobs and earnings would decrease by $12 million. It is also the only base that would not create growth in project-related population and housing demand. Eglin would create the smallest increase in operations employment and earnings and no substantive impacts. Operations employment would increase by 325 direct and secondary jobs and earnings by $10 million. Elmendorf, in a larger urban area, would experience a greater increase in operations employment and earnings than Eglin; operations employment would increase by 390 direct and secondary jobs and earnings by $13 million. Employment at Mountain Home would increase by 1,560 direct and secondary jobs and earnings by $57 million in a small local economy. Tyndall would have the greatest increase in operations employment and earnings, creating 2,392 direct and secondary jobs and earnings of $80 million.

LA3.14 Environmental Justice

LA3.14.1 Base

Executive Order 12898 (Environmental Justice) requires analysis of the potential for federal actions to cause disproportionate health and environmental impacts on minority and low-income populations. Similarly, Executive Order 13045 addresses protection of children from disproportionate environmental health and safety risks from federal actions.

Affected Environment

The analysis of environmental justice for the base and vicinity considers changes in airfield noise levels created by the proposed action. The existing area affected by noise levels of 65 DNL or greater around Langley AFB overlies land areas in the cities of Newport News, Poquoson, and Hampton and over-water areas.

In the Commonwealth of Virginia, where Langley AFB is located, a number of cities are independent of any county organization and, thus, constitute primary divisions of the state. The cities of Hampton, Newport News, and Poquoson are the three independent cities located in the Langley AFB region of comparison. Table LA3.14-1 displays the total population, total minority population, percentage minority, total low-income population, and low-income percentage for these jurisdictions within the region, as well as for the region of comparison as a whole (also see Appendix HR-4). The information presented in Table 3.14-1 is derived from the 1990 United States Census of Population. This is the latest source of information containing data at the required level of detail regarding minority and low-income population groups.

Table LA3.14-1. Minority and Low-Income Populations

Area Name	*Total Population*	*Minority Population*	*Percent Minority*	*Low-Income Population*	*Percent[1] Low-Income*
Langley AFB Region of Comparison	314,843	122,459	38.9	37,309	12.3
Poquoson	11,005	271	2.5	309	2.8
Hampton	133,793	56,847	42.5	13,831	10.8
Newport News	170,045	65,341	38.4	23,169	14.0

Note: 1. The percentage of low-income persons is calculated using a denominator that is less than total persons, since the Census Bureau excludes selected groups from the enumeration.
Source: Geolytics 1996.

For the Langley AFB proposed action, the region of comparison contains 314,843 persons, 38.9 percent of whom are minority, 12.2 percent low-income, and 26.5 percent children.

To satisfy the requirements of Executive Order 13045, *Protection of Children from Environmental Health Risks and Safety Risks*, locations of off-base schools exposed to aircraft noise levels of 65 DNL or above were identified. Currently, three off-base schools in the vicinity of Langley AFB are exposed to aircraft noise levels of 65 DNL or greater: Luther W. Machen Elementary, Bethel High School, and Point Option Alternative High School, which is part of the New Horizons Regional Education Center. These schools are located in Hampton, west of the base.

Environmental Consequences

For the proposed action, over-land noise levels of 65 DNL or greater were identified, and the affected population under these areas was estimated. The off-base population within the 65 DNL and above contour would decrease by 119 persons. (Also see Appendix HR-1 for methodology and HR-4 for additional data on the population distributions.) Although the total population affected by noise levels above 65 DNL would decrease, the population within the 70 to 75 DNL, 75 to 80 DNL, and 80 to 85 DNL noise contours within Hampton could potentially increase by 806 persons. This is, in part, due to the fact that the F-22 would generate more noise closer to the runway and less noise farther from the runway. Of the 806 persons, approximately 278 would be minority (34.5 percent) and 31 would be low-income (3.8 percent), less than the comparable percentages in the region of comparison, which are 38.9 percent minority and 12.3 percent low-income. Considering the lack of any disproportionate effect upon minorities and low-income persons affected by expansion of the 70 to 75 DNL, 75 to 80 DNL, and 80 to 85 DNL noise contours, there would not be disproportionately high and adverse noise impacts on minority populations or low-income populations living under the area affected by aircraft noise from the Initial F-22 Operational Wing beddown at Langley AFB.

Under the proposed action for Langley AFB, no additional schools would be exposed to noise levels of 65 DNL or above. Two schools currently exposed to aircraft noise levels in the 65 to 70 and 70 to 75 DNL range, Point Option Alternative High School and Luther W. Machen Elementary, respectively, could be exposed to increases in noise of approximately 1 to 3 dB or less.

Comparative Summary of the Five Potential Basing Locations

The potential for disproportionate impacts to minority or low-income populations is low at all five bases. No substantive difference exists among the bases relative to environmental justice. Eglin AFB has the greatest potential for impacts from noise and therefore may have a slight, but not substantial, disproportionate impact on children.

LA3.14.2 Airspace

Affected Environment

The overland airspace associated with Langley AFB does not contain a high proportion of minority or low-income populations. Baseline data on minority and low-income populations residing in cities under the airspace are presented in Appendix HR-4. Native American groups within the project region are discussed in section LA3.11, Cultural and Traditional Resources. Several tribes reside in eastern Virginia, including the Chickahominy, the Eastern Chickahominy, the Pamunkey, the Mattaponi, and the Nansemond. None of these tribes are federally recognized, but all are recognized by the Commonwealth of Virginia.

Environmental Consequences

Subsonic noise does not generate environmental justice issues for minority populations, low-income populations, or children living under the airspace. Any noise impacts from supersonic noise would occur in over-water Warning Areas.

Comparative Summary of the Five Potential Basing Locations

No substantive difference exists among the bases' airspace relative to potential environmental justice concerns. Potential impacts at Langley are comparable to Eglin and Tyndall. Concerns were raised during scoping about overflights and sonic booms over traditional use land areas at Elmendorf and Mountain Home.

Community and Infrastructure

Community and infrastructure resources include public services such as potable water, wastewater treatment, electric and natural gas utilities, solid waste management, and hazardous materials and waste. It also includes public schools and transportation. These resources are typically impacted by fluctuations in population and generally occur at the base and environs. Airspace and ranges are not addressed under community and infrastructure, as they are not applicable to this resource. Pertinent regulatory and methodological information can be found in Appendix CI-1. Additional technical information can be found in Appendix CI-2.

No-Action Alternative

The no-action alternative would not change current demand for public services or infrastructure. There would be no change in base population, schools or other social services. Under the no-action alternative, hazardous material use and waste generation at Langley AFB would continue at current trends. The current Environmental Restoration Program (ERP) at the base would continue, and Langley AFB would continue to manage its hazardous materials and wastes in accordance with all applicable laws and regulations.

LA3.15 Public Services

LA3.15.1 Base

Affected Environment

Potable Water

Langley AFB's primary potable water source is Big Bethel Water Treatment Plant. The city of Newport News serves as a backup source for Langley AFB. The two sources are currently operating at 43 and 73 percent of their capacities, respectively (City of Newport News 2000). The total active storage capacity of the Langley AFB system is 3.25 million gallons (Ecology and Environment 1999).

Wastewater Treatment

Wastewater generated at the base is discharged through the sanitary sewer system to the Hampton Roads Sanitation District. A recent assessment of the sanitary system indicated that the system is being upgraded and would be adequate to handle existing and projected needs (Air Force 1998b). The wastewater treatment plant upgrades are expected to be completed in 2002.

Electric Power & Natural Gas

Electric power is provided to the base by Dominion/Virginia Power. Natural gas is provided by Virginia Natural Gas. Both are adequate to meet existing and projected demand.

Solid Waste Management

Contract services are used by Langley AFB for solid waste disposal. All solid waste is collected from the base and disposed of off-site at the Bethel Sanitary Landfill or incinerated at the Hampton Steam Generation Plant (Air Force 1994b). Recycling efforts reduced the amount hauled to Hampton's Waste-to-Energy facility for incineration by 2,280 tons. The waste volume was reduced by about 90 percent, with the remaining 10 percent disposed of as ash at the Bethel Sanitary Landfill (Air Force 1998b).

Schools

Public education for dependent children living on or off base is provided by York County and the cities of Hampton, Newport News, and Poquoson school districts. A total of 94 elementary, middle, and high schools are within these school districts.

Environmental Consequences

There is little likelihood for public services consequences under the airspace.

Langley AB is the only base where the F-22 beddown does not increase the demand for public services.

Public Services

Under the proposed action, there would be a net reduction of 243 base personnel associated with the F-22 beddown. As a result, utility use would be minimally below baseline or no-action conditions. Solid waste generation associated with the demolition of buildings in support of the proposed action would increase in the short term. Langley AFB would need to dispose of this material in a landfill that accepts construction and demolition wastes.

Schools

Under the proposed action, there would be a net reduction of 150 students enrolled in the cities of Hampton, Newport News, and Poquoson and York County school districts. By 2007, if growth occurs in the region as projected, the change would not have a noticeable effect on schools.

Replacement of F-15C with F-22 aircraft is not expected to have consequences to the existing school system around Langley.

Comparative Summary of the Five Potential Basing Locations

The potential for impacts to public services is low for all five potential beddown installations. There would be no increased demand for public services at Langley AFB. There would be a decrease in demand for utilities and a reduction in number of students by 150 in local schools. Comparatively, Eglin would increase school enrollment by 121 students; Elmendorf would increase school students by 161; Mountain Home would increase school enrollment by 686 students. Tyndall, with an estimated 1,063 new students, would have the largest increase in student population. However, due to its relatively remote location and small associated community, Mountain Home would be the least able to absorb the large influx of personnel and their families. Impacts associated with demand for other public services such as water would be the greatest at Mountain Home.

LA3.16 Transportation

LA3.16.1 Base

Affected Environment

Regional and Local Circulation

Access to Langley AFB is provided from Interstate 64 (I-64) via Armistead Avenue to the west of the base and from Mercury Boulevard (U.S. Route 258/Virginia State Route [SR] 32), via LaSalle Avenue (SR 167) or King Street (SR 278). LaSalle Avenue is a four-lane roadway that provides direct access to the main gate with an annual average daily traffic volume of 11,370 vehicles. Traffic volumes on King Street between the gate and Lamington Road were 7,800 vehicles. Armistead Avenue, a four-lane roadway, provides access to the base through the west gate at the intersection with Sweeney Boulevard. At Semple Farm Road, traffic volumes were 12,000 in 1999-2000 (personal communication, Peterson 2000).

Circulation at Langley AFB

Traffic flow on base generally operates well, with the greatest congestion occurring during the morning rush hour. Parking in some areas is a constraint. Parking lot utilization studies and a traffic engineering study for the Community Center and Community South Small Planning Areas were conducted by the Military Transportation Management Command (MTMC) to address areas where congestion was observed. The parking lot studies were conducted near Wing Headquarters; for Buildings 775, 777, 784, and 788; for the area between Sweeney Boulevard and the Southwest Branch of the Back River; Bowen Street on the south; and the fuel tank farm on the north. Recommendations presented in the studies included restriping parking lots and creating parking alternatives such as preferred parking for vehicles involved in car pooling and ridesharing programs; parking and cleanup/change areas for bike riders; and park and ride lots near the Main Gates and housing areas along with a shuttle service. In addition, establishing transfer points near base entries for local bus routes or expansion of bus routes onto Langley AFB was suggested (MTMC 1997).

The traffic engineering study recommended new signal controllers at Sweeney Boulevard and Elm Street and at Sweeney Boulevard and Nealy/Hammond Avenues (MTMC 1996).

Local bus service is available only at the west gate at Armistead Avenue and Sweeney Boulevard. There are no regularly scheduled on-base shuttle services (MTMC 1997). Primary railroads in the region include the C&O Railroad, which parallels I-64 from Richmond, Virginia, and the Virginia and Maryland Railroad, which crosses Chesapeake Bay adjacent to U.S. Highway 13.

LaSalle Avenue is a four-lane roadway that connects the Langley main gate with I-64.

Environmental Consequences

The proposed action is expected to increase traffic during construction and reduce up to 243 vehicle trips to and from the installation by 2007. Current employment on the installation is 10,694 jobs with the potential for approximately 9,000 vehicle trips during the peak travel periods. The proposed decrease in employment and associated travel demand would decrease peak period travel demand by 2.7 percent. The anticipated 2.7 percent decrease in traffic volumes should have no discernible effect on traffic at access gates and adjacent intersections.

Comparative Summary of the Five Potential Basing Locations

The potential for impacts to transportation is low for all five installations. Langley AFB would have a decrease of 243 peak hour vehicle trips and an approximate 2.7 percent decrease in travel demand. Eglin would have an increase of 218 peak hour trips and this would have little impact on congestion. Elmendorf would have an approximate 6 percent increase in traffic and Mountain Home would have an approximate 9.2 percent increase. Tyndall would have the highest potential impact with an increase of 1,500 peak hour trips and one-third increase in base worker travel.

LA3.17 Hazardous Materials and Waste

LA3.17.1 Base

Affected Environment

The majority of the non-weapon hazardous materials used by Air Force and contractor personnel on Langley AFB are controlled through an Air Force pollution prevention process called HAZMART. This process provides centralized management of the procurement, handling, storage, and issuing of hazardous materials and the turn-in, recovery, reuse, recycling, or disposal of hazardous wastes. The HAZMART process includes review and approval by Air Force personnel to ensure users are aware of exposure and safety risks. Langley AFB also has a Spill Prevention and Facility Response Plan (certified in September 2000), and an asbestos management plan provides guidance for the identification of asbestos containing materials and the management of asbestos. The Spill Prevention and Facility Response Plan meets the Federal Spill Prevention Control and Countermeasures requirements, the Virginia Oil Discharge Contingency Plan requirements, and the Coast Guard requirements.

The 1st Fighter Wing Asbestos Management Plan 32-10 provides guidance on the management of asbestos. An asbestos facility register is maintained by Civil Engineering. Persons inspecting, designing, or conducting asbestos response actions in public or commercial buildings must be properly trained and accredited through an applicable asbestos training program. The design of building alteration projects and requests for self-help projects are reviewed to determine if asbestos contaminated materials are present in the proposed work area and, if so, are disposed of in an off-base permitted landfill.

A recently improved fuel handling system currently serves the 1st Fighter Wing.

Langley AFB is a large-quantity hazardous waste generator. Hazardous wastes such as solvents, metal-contaminated spent acids, and sludge from washracks are generated during operations and maintenance activities. Hazarous wastes are managed in accordance with the Langley AFB Hazardous Waste Management Plan dated 31 July 1997. Hazardous wastes are initially stored at approximately 45 Waste Accumulation Points at work locations. A licensed contractor transports the waste from the Accumulation Points to the 90-day storage facility where they are stored until disposal is economically practicable or before 90 days have expired, whichever comes first. A licensed disposal contractor picks up the wastes and transports it off base for disposal in a licensed disposal facility. In FY 1998, the amount of hazardous waste generated during aircraft maintenance was approximately 52,500 pounds. In 1999, it is estimated that about 65,000 pounds were generated during aircraft maintenance activities, including a one-time disposal of approximately 19,500 pounds of absorbent pads that would normally have been disposed of as solid waste but were contaminated as a result of a gasoline spill (personal communication, Parker 2000).

One concern at scoping was whether the low-observable coatings on the F-22 would be hazardous to humans working on and around the aircraft.

DoD developed the ERP to identify, investigate, and remediate potentially hazardous material disposal sites on DoD property prior to 1984. Forty-eight ERP sites, including one at Bethel Manor Housing, have been identified since the ERP began at Langley AFB. Eighteen of the sites have been closed. The remaining 30 sites are regulated under the Comprehensive Environmental Response Compensations and Liability Act (CERCLA) and will be subject to a Federal Facility Agreement that is being negotiated with USEPA Region III. Seventeen sites, including two recently identified non-CERCLA sites, are classified as petroleum sites and are regulated under Virginia underground storage tank regulations (personal communication, Bartels 2000).

Environmental Consequences

Existing Langley AFB hazardous materials and hazardous waste management programs will be retained and used to manage F-22 hazardous materials and wastes. Refer to Appendix CI-1 for more information on these materials and wastes.

Beddown of the F-22 Operational Wing at Langley AFB would generate the smallest increase in hazardous waste when compared with the four alternative beddown locations. Under the proposed action, the amount of hazardous materials used during F-22 aircraft operations and maintenance would increase by less than 10 percent compared to the amounts used to support the F-15C. Additionally, F-22 materials that are hazardous would require special handling procedures. The impact on other base operations that use hazardous materials, such as vehicle maintenance, would be slight. Existing procedures for the centralized management of the procurement, handling, storage, and issuing of hazardous materials through the HAZMART would be adequate to handle the changes and would be retained and used. An increased use of hazardous materials would not cause adverse impacts.

Langley AFB would continue to generate hazardous wastes during various operations and maintenance activities. The base Hazardous Waste Management Plan would be updated to reflect any changes of hazardous waste generators and waste accumulation point monitors. Additional asbestos removal may be required, depending on the scope of the proposed facility renovation plan.

The number of hazardous waste accumulation sites may need to be increased to accommodate a potential increase (less than 10 percent) of hazardous waste generated. The number and location of these points would be determined according to existing Air Force procedures. In the event that any hazardous waste is generated as a result of F-22 maintenance activities that present any unique hazards over those generated by the F-15, Langley AFB would implement hazardous waste control procedures to minimize all potential risks to personnel and the environment. Therefore, no adverse impact is expected from the proposed action.

There is little likelihood for environmental consequences from hazardous materials or waste on base or under the airspace.

A multi-stage field investigation at several proposed sites for F-22 facilities has been completed. The major objectives of the investigation were to determine whether petroleum hydrocarbons and/or solvents had impacted the sites; identify what chemicals, if any, the human population is being exposed to and the risk(s) posed by those chemicals at these sites; and identify potential locations of underground storage tanks and/or buried objects for all the areas investigated. The findings concluded that any construction or intrusive activities at the Utilities Upgrade Area (ERP Site ST-27) and the Base Operations Building 375 Site (ERP Site ST-26) may require engineering controls to mitigate the potential for migration of hydrocarbon fumes into the buildings, and/or protection of site construction workers (USACE 2000). Long-term monitoring is currently ongoing at Site ST-26. Site ST-27 is considered closed and no further work at this site is planned at this time (Air Force 2000c).

Comparative Summary of the Five Potential Basing Locations

The potential for impacts to hazardous waste management is low for all five installations under consideration. Langley AFB would generate the smallest increase in hazardous waste. Eglin would increase hazardous waste by 30 percent over baseline; Elmendorf would increase by 40 percent over baseline; Mountain Home would increase by 50 percent and Tyndall would have a 100 percent increase in hazardous waste. No change in current operations would be required for any of the bases.