**AIR COMBAT COMMAND**

A7PS

# Installation Development and Design (ID2)

## Holloman Air Force Base, New Mexico

ID2

25 August 2011

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# 1 Introduction

This document addresses planning, design, and construction criteria guidance for Holloman Air Force Base (Holloman AFB) (Figure 1-1) so that implementing Sustainable Development and High Performance Green Building Design (SD&HPGBD) objectives become primary considerations along with building site, context, program needs, and function.

Sustainability is generally considered to be the integration of ecology, sociology, and economics in addressing master planning and building design; however, master planning and design for military installations requires additional considerations. Sustainable planning and design solutions for military installations are directly linked to mission sustainment, quality of life for personnel and families, conservation of natural resources, and economic realities.

Located in Otero County, New Mexico, Holloman AFB is approximately six miles west of Alamogordo. Holloman AFB is home to the 49th Wing. The wing supports manned fighter aircraft, remote piloted aircraft, foreign military fighter training and many tenants to include a 10 mile long high speed test track.

- *The Holloman AFB vision is to:*
  - *Use land and facilities wisely.*
  - *Maintain and repair facilities and infrastructure to facilitate efficient and effective accomplishment of the Holloman AFB mission.*
  - *Foster positive relationships with local communities to promote compatible land use surrounding the base; to protect, develop, and efficiently use shared resources such as water; and to develop the civilian workforce, necessary services, and contractors.*
- *The mission of the base is to maintain over 50 years of 49er excellence by providing:*
  - *Mission-ready forces and equipment to meet worldwide contingencies.*
  - *The best training for our people and international aircrews.*
  - *Quality support for all base personnel, associate units and the local community.*

## 1.1 Document Scope, Applicability, and Audience

This document provides a performance framework that limits prescriptive requirements to only critical functional requirements to allow sustainable design flexibility. Prior editions of design guidance, both at the Command and Installation level, relied heavily on mandates and prescriptive formulas relating to the building form, aesthetics and materials, and this often narrowed design-phase investigations into plan arrangement exercises.

Installation-level development and design guidance focuses on the identification of regional and local design characteristics, common building methods and preferences, architectural context, landscape standards, infill and building density opportunities, future vision and the establishment of installation-centric preferences, and strategies. Building aesthetics and character cannot be fully established prior to conducting the concept charrette, as aesthetics develop and evolve in response to multiple drivers. Designing and then evaluating aesthetics and architectural character are subjective.

Companion information to this document is provided in the form of an Installation 3D mass model, photographic log database and the Installation Sustainability Assessment (ISA). The Installation 3D mass model is dimensionally accurate and reflects overall building massing, height and form. The photographic log database includes all structures on the installation, with the exception of family housing units and utility sheds. The ISA provides a current-state snapshot of the Installations “green posture” and establishes a baseline to measure changes over time. Indicators should change for the better over time as more green design strategies and processes are put into place.

### 1.1.1 Applicability

Publication of this document serves to supersede previous installation-level design guidance. All external references to installation-level guidance documents now refer to the Installation Development and Design (ID2) Handbook. The ID2 serves to inform Future Year Development Plan site selections, Area Development Plan (ADP) designs, Requirements Document investigations, and Concept Charrette Document packages. The ID2 will be summarized in the installation Electronic General Plan (eGP).

Architect-engineer scope of work descriptions, request for proposal solicitation and design-bid-build and design-build contracts shall explicitly identify Headquarters (HQ) Air Combat Command (ACC)/ Installations & Mission

# HOLLOMAN AIR FORCE BASE

*Vicinity Map*

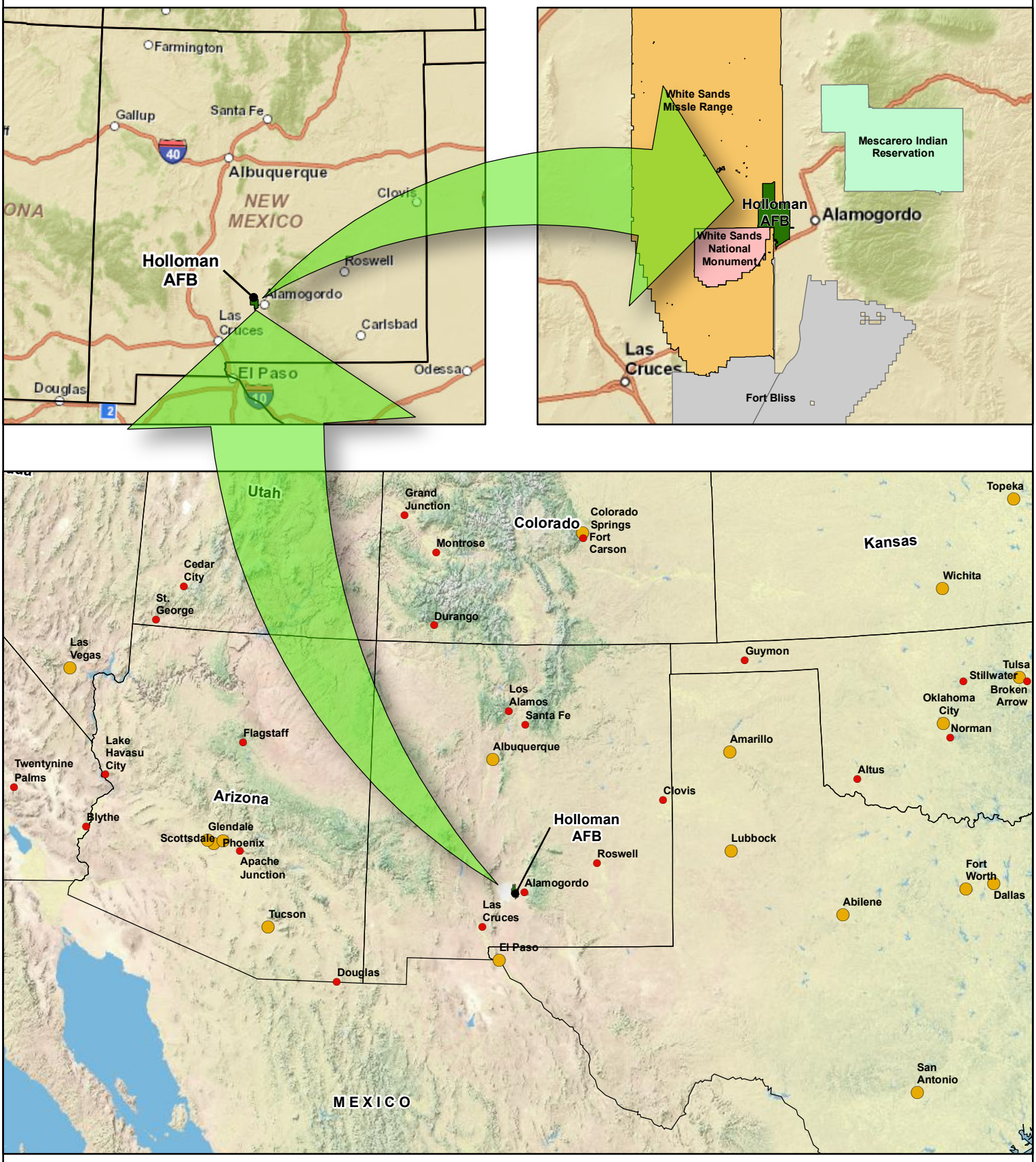



**Figure 1-1**

Support Programs Division (A7P) SD&HPGBD requirements and objectives as functional requirements.

The ID2 shall not be referenced in design and/or construction solicitations as establishing mandates relative to facility aesthetics, character, or form. All design and/or construction solicitation packages shall include contract provisions that cite the ID2 as containing broad considerations and shall require government review of design proposals in the source selection trade-off and evaluation process. Contractor's responsiveness to ID2 considerations shall carry weight as a significant evaluation factor in determining the overall acceptability and value of the proposal to the government.

### 1.1.2 Audience

This document provides criteria and considerations used in the planning and development and design of projects. These criteria and considerations are in addition to technical criteria readily available to professional architects, planners, engineers and interior designers. This document and companion information sources shall be used as primary references in all planning/siting considerations, building renovation projects, and new construction projects.

## 1.2 Development and Design—A Holistic Approach

### 1.2.1 HQ ACC/A7P

The Command's vision is to lead by example and serve as a role model for SD&HPGBD in the Air Force, Department of Defense (DoD) and the federal government. When "Green Design" is infused into every facet and decision, immediate and long-range benefits, including healthier working environments, reduction of the installation's carbon footprint and enhancing the enduring quality of facilities while lowering the total cost of facility ownership, will be realized. To this end, development and design strategies must consider a myriad of factors and influences and ensure solutions embody green building design and are appropriate to the site, sensitive to the built and natural context, reflective of functional needs and responsive to aesthetic considerations.

Green design is not optional. Implementing green building design (functional constraints) objectives is required to produce a complete and usable facility or a complete and usable improvement to an existing facility. A green building design approach forms the functional and technical foundation for all performance requirements, development considerations, and design constraints made, referenced, or otherwise used in this document.

"Green design" is synonymous with "quality design." Quality design strategies produce results that conserve energy; make efficient use of resources; produce visually appealing structures; reduce environmental degradation; create built environments that are livable, comfortable, safe, enduring, and productive; and shrink the environmental impact of our operations.

## 1.3 Development and Design—Requirements and Evaluation Metrics

### 1.3.1 HQ ACC/A7P Requirements

Command-level requirements are described in ACC Instruction, ID2 (publication forthcoming). This document establishes SD&HPGBD objectives as primary functional constraints, prescribes HQ ACC/A7P review and oversight processes, identifies architectural and engineering design considerations, and promulgates performance and prescriptive constraints.

### 1.3.2 Installation Requirements

The ID2 aligns with command-level guidance and is intended to be a vital component in developing strategies appropriate to smart growth development and the building site, sensitive to the built context, reflective of building program and scale and responsive to object/background importance. It should also fully implement SD&HPGBD objectives. The ID2 describes constraints and identifies objectives necessary to accomplish quality design. Topics and focus areas include installation context, architectural context, an Illustrative Plan, overarching development and design guidelines, site selection and development considerations, landscape design issues, architectural design objectives and technical constraints.

Technical constraints can be generally categorized either as "Non-Negotiable," such as compatibility with existing fire-alarm communication or keying systems, or "Negotiable," such as a brick blend generally used throughout the installation. "Non-Negotiable" constraints should not directly or indirectly predetermine building aesthetics, character, or form or limit/restrict investigation of high performance green building design strategies.

### 1.3.3 HQ ACC Development and Design Review Board (D2 Board) Evaluation Metrics

Projects meeting threshold levels established in the *ACC Instruction* (publication forthcoming) will be evaluated by the HQ ACC D2 Board. D2 Board evaluations seek to validate conformance with requirements established by Command-level guidance and this document and seek to validate adherence to principles of quality design, such as optimizing benefits from site selection and energy use, protecting and conserving water resources, utilizing environmentally preferable products, enhancing indoor environmental quality and optimizing operational and maintenance practices. All development and design solutions must embody an *"appropriate response"* and reflect a responsible use of public funds.

Evaluations of aesthetics and architectural design are inherently subjective, and the D2 Board reserves latitude in evaluating design strategies on a project-by-project basis. Design aesthetics, architectural character, and appropriate building form cannot be prescriptively determined in advance of conducting a concept development charrette, as these characteristics arise only *after* consideration and synthesis of all design drivers. Setting aesthetic preconditions short-circuits design development and will be avoided.

### 1.3.4 HQ ACC D2 Board Evaluations

D2 Board evaluations may produce recommendations (non-mandatory), directives (mandatory), or a combination of both. In extreme cases, D2 Board directives may include project stoppage in order to address continued or critical failures in meeting functional constraints.

Directives must be implemented, unless in very rare and extenuating circumstances a waiver is first endorsed by the D2 Board and then approved by HQ ACC/A7. Waiver requests must be submitted to HQ ACC A7P for D2 Board endorsement and HQ ACC/A7 approval. The request must document the basis for non-compliance and describe actions that will be taken to offset the deviation. The waiver request should also indicate if the scope of the request is for a single project, a set of projects, an area of the installation, or the entire installation. The waiver approval letter will define the scope of its applicability.

### 1.3.5 Installation Evaluation Metrics and Evaluations

Installation metrics are those used by the D2 Board with additional interest in evaluating the implementation of installation-centric technical requirements. Installation evaluations may result in recommendations (non-mandatory), directives (mandatory), or a combination of both.

Metrics are related to the installation's carbon footprint, energy intensity, waste production, water usage, and land use. Major areas of D2 Board interests include, but are not limited to: site selection and development; architectural design excellence; passive solar design, plan flexibility and adaptability; high performance green design; energy performance and modeling; workspace environment; costs; and operations and facility maintenance.

## 1.4 Organization of this Document

This ID2 Handbook is organized into five main chapters:

- **Chapter 1, Introduction—**Familiarizes the reader with the need, scope and applicability, requirements and organization of the document
- **Chapter 2, Installation Image—**Provides insight into the existing conditions found on base, specifically in areas where new development can be accommodated
- **Chapter 3, Development Considerations—**Provides information regarding opportunities and constraints found within the development areas
- **Chapter 4, Illustrative Plan—**Provides a view of potential development opportunities in the next 10 to 20 years
- **Chapter 5, Development and Design Guidelines—** Highlights approaches to areas of SD&HPGBDs, site development and architectural design
- **Appendices—**Identify specific technical considerations and constraints and other supporting materials

# 2 Installation Image

This section presents a discussion of the installation context, which identifies the natural and manmade condition present at the installation. It is within these conditions that planning, design, and construction decision are made. The context discussion is followed by a discussion of design goals that help define the future "image of the base." Also identified and evaluated are the physical elements of the installation that make up the current "image" of the base. These elements include paths, edges, nodes, landmarks, and districts. This report uses the element framework established in Kevin Lynch's *The Image of the City*.

The physical elements that make up an image of a community or military installation form an impression of the installation for military and civilian personnel, families, and visitors. The sense of place that is established through the combination of paths, edges, nodes, and landmarks adds to the quality of life for installation residents and workers. The way these elements are treated can add to the knowledge or perception of the important locations on the installation and provide visual directions for traversing the installation.

- A well-established hierarchy of roads (or paths) provides a driver with strong clues as to whether they are in the right location. An important element of road hierarchy is how the streetscape is treated. Roads should be limited, serve a defined purpose and, in most instances, the streetscape should be shared with pedestrians.

  The hierarchy of paths also extends to the pedestrian environment. Paths should provide a pleasant way to walk, bike or jog throughout the installation and should be designed appropriately for their task, which ranges from simple access to a building, an installation-wide bike trail or pedestrian plazas and walkways in high-density nodes.

- Edges can physically separate areas and function, but edges can also form screens to reduce or eliminate views of certain areas. Edges can be used to frame a visitor's perspective of an installation, frame nodes, and highlight landmarks.

- Nodes are associated with multiple image elements, such as locations where decisions are made or locations that draw higher densities of people. A node is in many cases distinctly different from many other locations on an installation because that area is a relatively constant center of gravity for social or work-related gatherings. Nodes can be highlighted and identified through the establishment of a landmark.

- Although signage is necessary to assist people in wayfinding, landmarks are an important way to direct people from one place to another. Landmarks serve many purposes, from inspirational to simple functional structures. Height, scale, and site are typical elements of a landmark; however, they are not always used to the maximum extent.

## 2.1 Installation Context

Planning, design, and construction decisions need to be based on the fundamental tenets of sustainable design. They also require an understanding of natural resource conditions from the region to the site, geographically specific environmental priorities, and the needs of personnel to effectively complete their tasks.

### 2.1.1 Resource Overview

The main base occupies 52,411 acres and also has water rights on an additional 7,332 acres of noncontiguous land in the Boles Wells Water System Annex (BWWSA) and Bonito Lake. Holloman AFB is bounded to the west by the WSMR and the White Sands National Monument.

There are a total of 3,664 Air Force active-duty personnel on Holloman AFB, as well as 577 German Air Force personnel. Of the 4,241 military personnel, 2,793 live off base and 1,448 live on base (Holloman AFB, 2010). There are a total of 833 family housing units and 805 dormitory quarters. According to 2007 base data, there were 4,583 active-duty military personnel dependants. The total annual pay of $266,325,675 includes military, appropriated, and non-appropriated personnel and private businesses (Holloman AFB, 2007). According to Holloman AFB's 7115 Real Property Report (16 December 2010) there is a total of 6,131,154 square feet of building space.

Alamogordo has an estimated population of 36,000 with approximately 63,000 people in the county. The county population density is approximately nine people per square mile. Only 11 percent of the land area in the county is privately owned. The remaining 89 percent is in federal, state, and tribal ownership. The U.S. military is a major economic engine for Otero County (Otero County Comprehensive Plan 2005).

#### 2.1.1.1 Climate

The climate at the base, which resembles other semi-arid regions with warm to hot summer days, cool nights, and mild winters, is influenced by its location between mountain ranges and a winter minimum/summer maximum precipitation regime.

- The installation averages 8.6 inches of rain annually, with an average humidity of 48 percent.
- Nearly half the rainfall occurs between July and September, with thunderstorms generally short in duration and high in intensity.
- The annual evaporation rate is between 65 and 70 inches with 40 to 45 inches lost from May to October.
- December through March are the coolest months, with average temperatures ranging from 41°F to 46°F. Freezing temperatures are common from late November through early March.
- Snow fall averages 4.8 inches annually.
- July is typically the hottest month, with average temperatures of 81°F and mean maximum temperatures of 93°F. Daytime temperatures in summer commonly reach 100°F.
- There are more than 300 days of sunshine per year.
- Holloman AFB Wind Power Classification is 2-3 (marginal–fair).
  - The highest wind speeds occur from April through July, reaching median wind speeds of 25 mph.
  - During May, wind velocities are greater than 17 mph approximately 90 percent of the time.
  - Prevailing winds are from the west from February to June. From July through September, the prevailing winds are south to southeasterly, and from October through January, the prevailing winds are from the north.

## 2.1.1.2 Topography/Geology

The base is located at the center of the Tularosa Basin, which covers about 6,500 square miles. The basin is bounded to the east by the Sacramento Mountains, rising up to 10,000 feet above mean sea level. Approximately 40 miles to the west is the San Andres Mountains, with peaks just over 8,000 feet. Because the basin is closed (i.e., no water flows out of it) surface water that does not evaporate or soak into the ground eventually accumulates at playas or intermittent dry lakes.

Tularosa Peak is the highest point within the main base, reaching an elevation of 4,330 feet, the lowest point is the southern tip of Stinky Playa at 4,015 feet. The major landforms of the main base include a small Permian Age rock outcrop, gypsum sand dunes, flat to gently sloping alluvial plains, and alkali flats and playas.

## 2.1.1.3 Soils

Soils at Holloman AFB are well drained and unstable. All soils have a high gypsum and salt content and are composed of the Holloman-Gypsum and Yesum soil complex, which covers more than two-thirds of the installation. None of the installation soils are very productive due to high gypsum and salt content. The gypsum is highly corrosive to ferrous metals, toxic to many plant species and tends to dissolve when exposed to water. The design process must take into consideration the unique soils of the base, which are shown in Appendix A, Figure A-1. Soil descriptions are provided in Appendix A on page A-2.

## 2.1.1.4 Surface Waters

Lake Holloman is in the southern portion of the base. The lake water is brackish and has wide seasonal area variations.

Although there are no perennial streams within the base, it is crossed by several southwest-trending arroyos[1] that transport surface water drainage flow (Figure 2-1). All arroyos except Lost River terminate in the gypsum dune fields at the western boundary of the base.

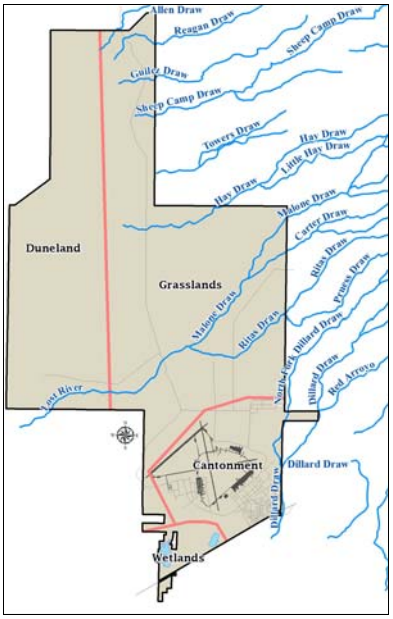



**Figure 2-1** *Surface Water Drainage*

Most of the runoff from the developed areas of the base flows through a drainage ditch to Lake Holloman. Other base drainage ditches flow east or southeast to Dillard Draw or to undrained depressions, some of which are jurisdictional wetlands.

## 2.1.1.5 Groundwater

Groundwater under the main base occurs at a depth as shallow as three feet below the surface. The water is too salty for consumption and is not considered legally potable. It is highly alkaline with total dissolved solids is the area of 100,000 milligrams per liter. Groundwater is very corrosive due to the high concentration of soluble salts.

[1] A watercourse that conducts an intermittent or ephemeral flow.

### 2.1.1.6 Potable Water

The base relies on two sources for potable water. The BWWSA supplies the base during the summer months. Water from Lake Bonito is used by the base during the cooler months. The water from the lake is transported through a 90-mile pipeline mostly owned by the base and operated by the city.

### 2.1.1.7 Air Quality

Holloman AFB and the surrounding area are currently in compliance with the New Mexico State Implementation Plan and its requirements for National Ambient Air Quality Standards for all "Criteria Air Pollutants." The base is within an attainment area.

### 2.1.1.8 Noise

The entire main base area—with the exception of some of the family housing area—is within the 70+ DNL contours (Appendix A, Figures A-2 and A-3) so all construction will require noise attenuation. Many facilities in high noise areas shall have levels of noise attenuation. See Appendix C for guidance references for land use compatibility in high noise zones and noise attenuation.

### 2.1.1.9 Plants and Animals

With much of the Tularosa Basin's suitable wildlife habitat limited, due to ranching, farming, and urban and rural development, Holloman AFB provides relatively diverse habitats for aquatic and terrestrial species. Currently, no federally listed threatened or endangered plant or animal species are known to occur on Holloman AFB.

The White Sands Pupfish is the most sensitive species found on base. Under a Cooperative Agreement for Protection and Maintenance of White Sands Pupfish, 2006, essential habitat on Holloman AFB includes all stream channels of Malone Draw and Lost River and a corridor 660 feet wide, extending 330 feet from either side of the center of the stream channel. Limited use areas exist adjacent to the habitat to prevent degradation.

*White Sands Pupfish*

*Saltceder: Absorbs large amounts of water and creates large deposits of salt.*

Holloman AFB is dominated by xerophytic shrubland and grassland communities. Over 5,000 acres of the base, including 700 acres of disturbed roadsides, have invasive weeds. The three most problematic weeds are Saltcedar, African rue, and Malta star-thistle.

### 2.1.1.10 Cultural Resources

Holloman AFB has a rich cultural history spanning more than 10,000 years, from prehistoric hunting and gathering peoples to pre-Pueblo subsistence agriculturists followed by early historic settlements. Surveys of the main base have identified a total of 250 archaeological sites. There are numerous pre-1946 (WW II) and Cold War era architectural resources on base as well as pre-military ranching and agriculture architectural resources

Detailed information is available in the Holloman Air Force Base Integrated Cultural Resources Management Plan (ICRMP).

### 2.1.1.11 Recreation

Numerous outdoor recreation facilities at Holloman AFB are available to military and government personnel and their families. Recreational activities include sport centers, a golf course, parks and jogging paths, camping, sports range, horseback riding, hunting, fishing, bird-watching, and off-road vehicle activities. Several areas within Holloman AFB are open for public use including Lake Holloman and the constructed wetlands.

Lake Holloman provides the most activities for the general public. Currently, bird-watching is the most popular activity provided for the general public because of the high biodiversity and density of birds. The area southeast of Lake Holloman is open to the public for primitive camping.

Hunting and trapping are prohibited in all areas of Holloman AFB unless specifically authorized by the base to manage wildlife populations in a particular area. Off-road vehicle use, such as ATVs and motorbikes, are allowed only in designated areas within the Borrow Area at times when it is not in conflict with military missions.

Off-base recreational areas located near the base include several state parks and a unit of the National Park Service. Nearby outdoor recreation areas include:

- **White Sands National Monument:** Self-guided hiking trails, primitive overnight camping, and picnicking.
- **Lincoln National Forest:** Camping, hunting, and hiking.
- **Oliver Lee State Park:** Camping, picnicking, hiking trails, and an illustration of some of the history of turn-of-the-century ranch life found in Otero County.

## 2.1.2 Design Information

The following is location information for the base:

- **Latitude:** 32°51'09"N and106°06'23"W
- **Altitude Above Sea Level:** 4,093 feet
- **Heating Degree Days:** 3,257 (based on 65°F)
- **Cooling Degree Days:** 1,681(based on 65°F)
- **Sun Altitude Angles:** Noon on 21 December = 33.7°; Noon on 21 June = 80.5°
- **USDA Plant Hardiness:** Zone 7b-8a (5-15° F)
- **Winter Design at 99%:** 23°F outside*
- **Winter Design at 99.6%:** 18°F outside[1]
- **Summer Design at 1%:** 97°F DB/63°F[1]
- **Summer Design at 0.4%:** 99°F DB/63°F[1]
- **Air-to-Refrigerant Condensing Units/Chillers at:** 105°F ambient temperatures[2]

### 2.1.2.1 Notes

- Where interior temperatures are critical, refer to UFC 3-410-01FA.
- Design of air cooled condensers and chillers to be based on 105 °F. For more information see Appendix B, Section 6.5.2.
- Should Cooling Towers be considered for future use, tower design should be according to: 87°F DB/70°F WB.

## 2.1.3 LEED Rating System, Regional Priority Credits

Regional Priority Credits (RPC) were introduced in the Leadership in Energy and Environmental Design (LEED®) 2009 rating systems to provide an incentive to the achievement of credits that address geographically specific environmental priorities. Regional Priority Credits are not new LEED credits, but instead are existing credits that the U.S. Green Building Council (USGBC) chapters and regional councils have designated as particularly important for their areas. The incentive to achieve the credits is a bonus point. If an RPC is earned, then a bonus point is awarded to the project's total points.

- SSc6.1 Storm Water Design and Quantity Control:
  - **Intent:** Limit disruption of natural hydrology by reducing impervious coverage, increasing onsite infiltration, reducing or eliminating pollution from onsite stormwater runoff, and eliminating contaminants.
- SSc7.1 Heat Island Effect–Non-Roof:
  - **Intent:** Reduce heat islands to minimize impacts on microclimates and human and wildlife habitats.
- SSc7.2 Heat Island Effect–Roof
  - **Intent:** To reduce heat islands to minimize impacts on microclimates and human and wildlife habitats.
- WEc.1 (Option 1, 50 Percent)–Water Efficient Landscaping:
  - **Intent:** Limit or eliminate the use of other natural surface or subsurface water resources available on or near the project site for landscaping irrigation.
- WEc.3 (Percentage Reduction Required, 40 Percent)–Water Use Reduction:
  - **Intent:** Further increase water efficiency within buildings to reduce the burden on municipal water supply and wastewater systems.
- EAc.2 (Percentage of Renewable Energy Required, 9 Percent)–Onsite Renewable Energy:
  - **Intent:** Encourage and recognize increasing levels of onsite renewable energy self-supply to reduce environmental and economic impacts associated with fossil fuel energy use.

# 2.2 Installation Goals and Objectives

The 49th Wing established architectural and design goals that provide the overall guidance for land development, including land use, facility sitings, and infrastructure development. The design guidelines in this document have been developed in response to those goals as well as the Command's goal for a holistic approach to sustainable design and development. The installation's architectural and design goals are the following:

## 2.2.1 Site Development

- Provide site development and building forms appropriate to the location.
- Locate facilities with similar or related functions in the same vicinity.
- Provide functional layouts that completely satisfy user needs.

- Relegate parking to a subordinate element of the landscape.
- Encourage pedestrian circulation.
- Relate building forms to each other.
- Minimize disturbed area and provide outdoor green space for facility occupants.
- Create small clusters of related buildings, as opposed to spreading buildings out across the landscape
- Provide positive drainage away from building foundation.

### 2.2.2 Environment

- Use indigenous landscaping that requires little or no irrigation and little or no maintenance.
- Reduce waste generation, enhance environmental quality, and minimize consumption of natural resources.
- Make smart design decisions for sustainable facilities rather than making design decisions to achieve "points" under the Leadership in Energy and Environmental Design (LEED®) certification process.

### 2.2.3 Cost/Labor

- Exteriors shall be clad with low maintenance materials that are architecturally compatible with surrounding facilities and their natural environments.
- Optimize life-cycle costs without disregarding initial cost limitations.
- Select materials and systems that minimize preventative maintenance costs.

### 2.2.4 Approval

- Obtain user approval of design concept layout prior to pre design conferences in order to prevent costly changes during final design, contracting, and construction. This is normally done through a Customer Concept Document (CCD) prior to preparation of programming documents. The CCD is generally only used for the MILCON process.

## 2.3 Installation History

Holloman AFB, originally established as Alamogordo Army Air Field, began construction in 1942 as a temporary wartime base. Primarily serving as a training base for bomber pilots and crews, Holloman AFB is most well known during this period for the detonation, at the Trinity Site, of the first atomic bomb developed under the Manhattan Project. Following a brief deactivation after World War II, the base entered a period lasting into the late 1960s focused on research and development, primarily, beginning with pilot-less aircraft, guided missiles and allied equipment. Renamed Holloman AFB in 1948, the base continued its function of guided missile and space research and development until 1968. As part of the space research effort, the Primate Research Facility trained the first chimpanzee (Ham) to make a suborbital flight and the first chimpanzee (Enos) to orbit the earth.

In 1968 the 49th Tactical Fighter Wing was assigned to the installation. Soon after, the Tactical Air Command (TAC) assumed command of the base. Upon deactivation of the TAC in 1992, command was transferred to Air Combat Command, the base's current command. The 49th Fighter Wing, Holloman AFB's current host unit, was formed 1941 and took over host duties in 1991 with the inactivation of the 833rd Air Division. Holloman AFB is currently home to F-22A stealth fighters.

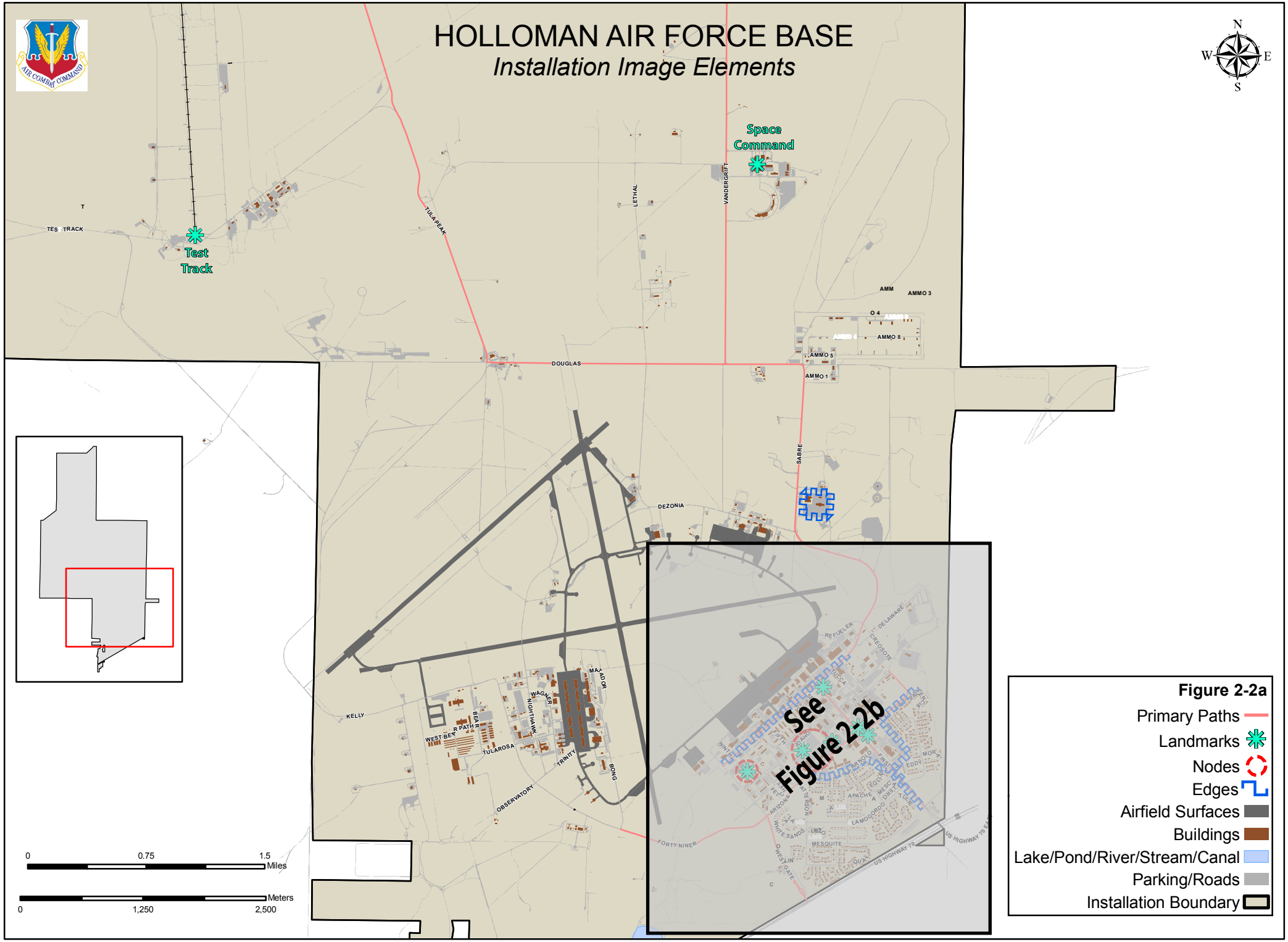
As of July 2007, there are 21 German Air Force Tornadoes and 600 German military personnel assigned to Holloman AFB. The German Air Force is the largest associate unit at Holloman AFB. The installation is also home to the 46th Test Group, the 4th Space Surveillance Squadron, the 846th Test Squadron, and many other units and organizations.

## 2.4 Image Elements and Recommendations

Figures 2-2a and 2-2b show the locations of image elements at Holloman AFB. Installation image elements include paths, edges, nodes, landmarks, and districts. They form the basic pattern of the installation form and the way personnel and visitors perceive the installation and relate to it. The following discussion related to image elements provides a brief overview of the existing elements and recommendations.

### 2.4.1 Paths

Paths can be essentially defined as movement corridors. On Holloman AFB, paths include roads and sidewalks. They function as basic orientation to the installation by providing the means to access most areas on base. Beyond their basic utility as a mover of people, paths provide the traveler with visual experiences with the other elements that comprise the installation image. Primary paths on the installation are identified in Figures 2-2a and 2-2b.


HOLLOMAN AIR FORCE BASE
Installation Image Elements
Space Command
Test Track
TES TRACK
TULA PEAK
LETHAL
VANDERGRIFT
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AMM
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AMMO 4
AMMO 8
AMMO 5
AMMO 1
SABRE
DEZONIA
KELLY
WEST BEAR PATH
BEAR
TULAROSA
NIGHTHAWK
WAGNER
TRINITY
MALADOR
BONG
OBSERVATORY
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Figure 2-2a
Primary Paths
Landmarks
Nodes
Edges
Airfield Surfaces
Buildings
Lake/Pond/River/Stream/Canal
Parking/Roads
Installation Boundary

# HOLLOMAN AIR FORCE BASE
## *Installation Image Elements*


**Figure 2-2b**

- Pedestrian Paths
- Primary Paths
- Landmarks
- Nodes
- Edges
- Airfield Surfaces
- Buildings
- Lake/Pond/River/Stream/Canal
- Parking/Roads
- Installation Boundary

The primary vehicle paths at Holloman AFB are First Street, Arizona Avenue, Forty Niner Avenue, West Gate Avenue and and Sabre Road. The primary pedestrian paths are First Street, New Mexico Avenue, Connecticut Street/Dorm Mall and 6th Street.

Arterials direct the highest volume of traffic to their desired destinations on the installation or to the gates to exit the installation. The collector streets and local roads provide access to most facilities on the installation and are primarily in a grid pattern.

The streetscape along First Street could be improved with additional pedestrian amenities to promote walkability and safety.

A good example of hardscape and landscape plantings along New Mexico Avenue

In recent years, the installation has implemented reductions of on-street parking and reconfiguration of parking lots in the community and flightline areas. The mission support areas still have on-street parking, but traffic flow is limited in these areas.

Although there is a sidewalk system that connects most portions of the installation, the sidewalk system is, in some locations, disjointed.

All sidewalks should be well connected and end at a point of destination. A continuous permeable zone should be established between the sidewalk and street curb to help reduce runoff and promote a sense of pedestrian safety on higher volume streets

In addition to some connectivity issues, another issue with these paths is the lack of pedestrian amenities. There are very few shade trees and other pedestrian amenities, such as benches, along many sidewalks. The pedestrian mall in the dormitory area does provide pedestrian amenities.

There is a multi-use trail on the installation that serves the main base area. However, there is no linkage between the base and the community of Alamogordo.

- *Over time, the installation should upgrade certain portions of the road and pedestrian system to strengthen overall circulation, including the pedestrian realm, and enhance the visual elements of the streetscape.*

## 2.4.2 Edges

Edges are elements that form physical or visual boundaries between areas. They can be simple walls, fences, vegetation, or infrastructure. Typically, these features are not as dominant in a person's mind as primary paths, such as arterial roads, but they can be significant organizing features for land form. At Holloman AFB there is a strong association between fences and arterial road corridors. Edges are identified in Figures 2-2a and 2-2b.

Most prominent edges on the installation are formed by colored split-face concrete masonry unit (CMU) walls. The walls are prominent features by the family housing areas and the installation schools. The fences around the perimeter of the family housing areas and the schools provide safety as well as mitigating noise and visual impacts associated with arterial road traffic and industrial activities.

This pedestrian entrance illustrates the prominence of CMU walls as an edge that provides safety and visual barrier to the school.

CMU fencing (edge) is integrated with flightline facilities (Building #868, west side of Bong Street) and is a good example of a strong edge that provides security.

The flightline areas have edges formed by CMU fencing that is primarily for security. Flightline fencing is generally integrated with facilities, so CMU color schemes are compatible.

Portions of Delaware Avenue are framed by CMU security fencing, which blends in with the existing color palette of nearby structures.

- *Edges should be considered for use to physically separate dissimilar areas and function and eliminate views of certain areas. Edges should also be used to frame a visitor's perspective of an installation, frame nodes, and highlight landmarks.*

## 2.4.3 Nodes

Nodes are typically destination areas. A prime example of a node at Holloman AFB is the BX/Commissary complex; this is a place where people concentrate, particularly during lunch and on Saturdays. Nodes are shown in Figures 2-2a and 2-2b.

The BX anchors the community center destination node that attracts a large number of people throughout the day. The scale of the BX makes it a well known landmark on the installation.

Another destination with concentrated activity is the fitness center, which generates considerable pedestrian traffic from the nearby dormitories.

The Fitness Center is a major social/destination node and is also a strong visible landmark on the base.

- *Higher building density—within the constraints of AT/FP—and a strong pedestrian realm, encourages walking between facilities. Such a setting encourages longer stays within a community center area and provides opportunities for social contact and gatherings in all areas.*

- *Implementation of the concept of "downtown" Holloman will form a compact node of diverse functions or services—similar to a small town center—which would increase the reasons for personnel and families to extend their stay in the area.*

- *Complementing compact nodes of buildings with outdoor gathering areas enhances the public realm and quality of life. This type of node, with well thought-out pedestrian movement amenities, reduces reliance on automobiles. Although automobiles cannot be ignored, they are subordinate to the pedestrian realm within a compact node of diverse functions and services.*

## 2.4.4 Landmarks

Although nodes can be considered reference points, landmarks are probably the most common reference point for people. In some cases, they are simple objects, such as a sign or tree, or they can be more complicated, such as some type of structure. They can also be symbolic, static display of aircraft or a monument. Although landmarks can be simple objects, they can be important to wayfinding for personnel and visitors because they can be seen from a distance. Locations of landmarks are shown in Figures 2-2a and 2-2b.

An example of an installation landmark is the static displays at Heritage Park on First Street. Heritage Park was designed to prominently display Holloman AFB's history, important flags, and the POW/MIA monument. The park is used for important functions, such as change of command ceremonies, and provides a permanent home to the Honor Guard.

Dominant buildings in a landscape are often very important landmark elements. Civic buildings, such as Wing Headquarters and the chapel, should be strong landmarks on an installation. At Holloman AFB, 49 Wing headquarters is a dominant building in the streetscape of First Street.

The siting of the chapel in the community center and associated streetscape elevates the status of this civic building to a landmark along New Mexico Avenue. The BX cannot be seen from a distance, but the scale of the building form certainly identifies its location in the community district, and it is very likely a common reference for drivers.

Due to its size and prominence in the landscape, the fitness center is another landmark building. Another prominent landmark building is Building 222, Military Personnel Flight. In these cases, landmarks should be significant elements of the overall character of a district.

- *Dominant buildings and facilities important to daily living and installation operations should be evaluated during the programming and design process as to whether they would function as landmarks. The early determination of a building's "status" will affect site orientation.*

The Chapel is a well known landmark facility in the Community District.

Landmarks can also be large areas with a defined characteristic, such as the outdoor recreation complex.

- *Landmarks should be used to enhance wayfinding.*

## 2.4.5 Districts

Districts are small to large areas within the installation that have a common identifiable character; however, there are some facilities that may not reflect the overall character of a district. As an example, the German Air Force HQ and the 49 Wing headquarters (Buildings 45 and 29) are multi-level administrative buildings that are in a district characterized by one-level industrial facilities.

The base districts[2] are shown in Figures 2-3a and 2-3b and described below with recommendations. The common characteristics of a particular district signify a place. Because of their scale, districts will incorporate some or all other image elements and, in most cases, incorporate common functions.

[2]Family housing areas are not included in the districts narrative because housing is privatized. Design elements for housing were determined through collaboration between the Air Force and the developer.

# HOLLOMAN AIR FORCE BASE
## *Design Districts*

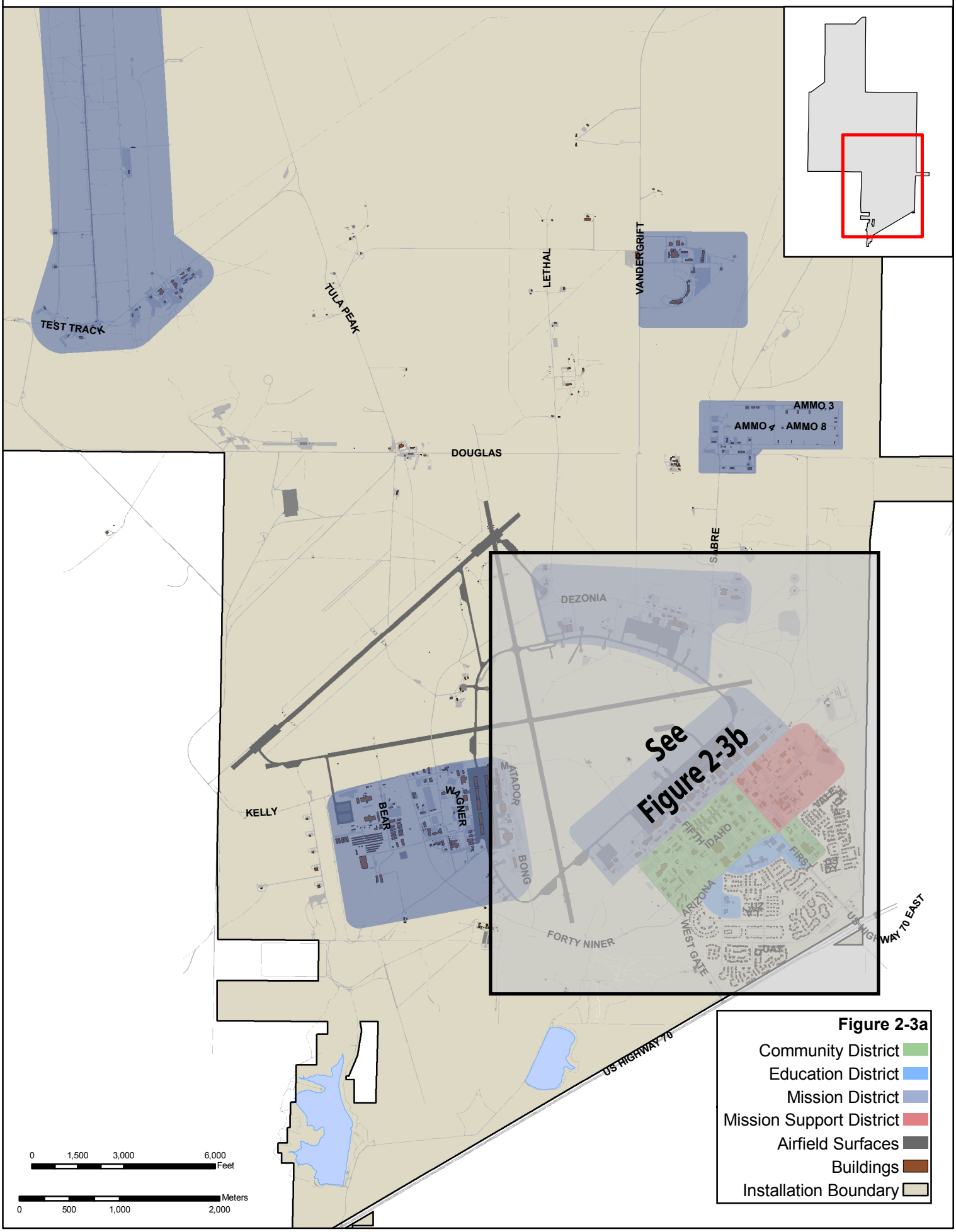


**Figure 2-3a**

- Community District
- Education District
- Mission District
- Mission Support District
- Airfield Surfaces
- Buildings
- Installation Boundary

# HOLLOMAN AIR FORCE BASE
## *Design Districts*

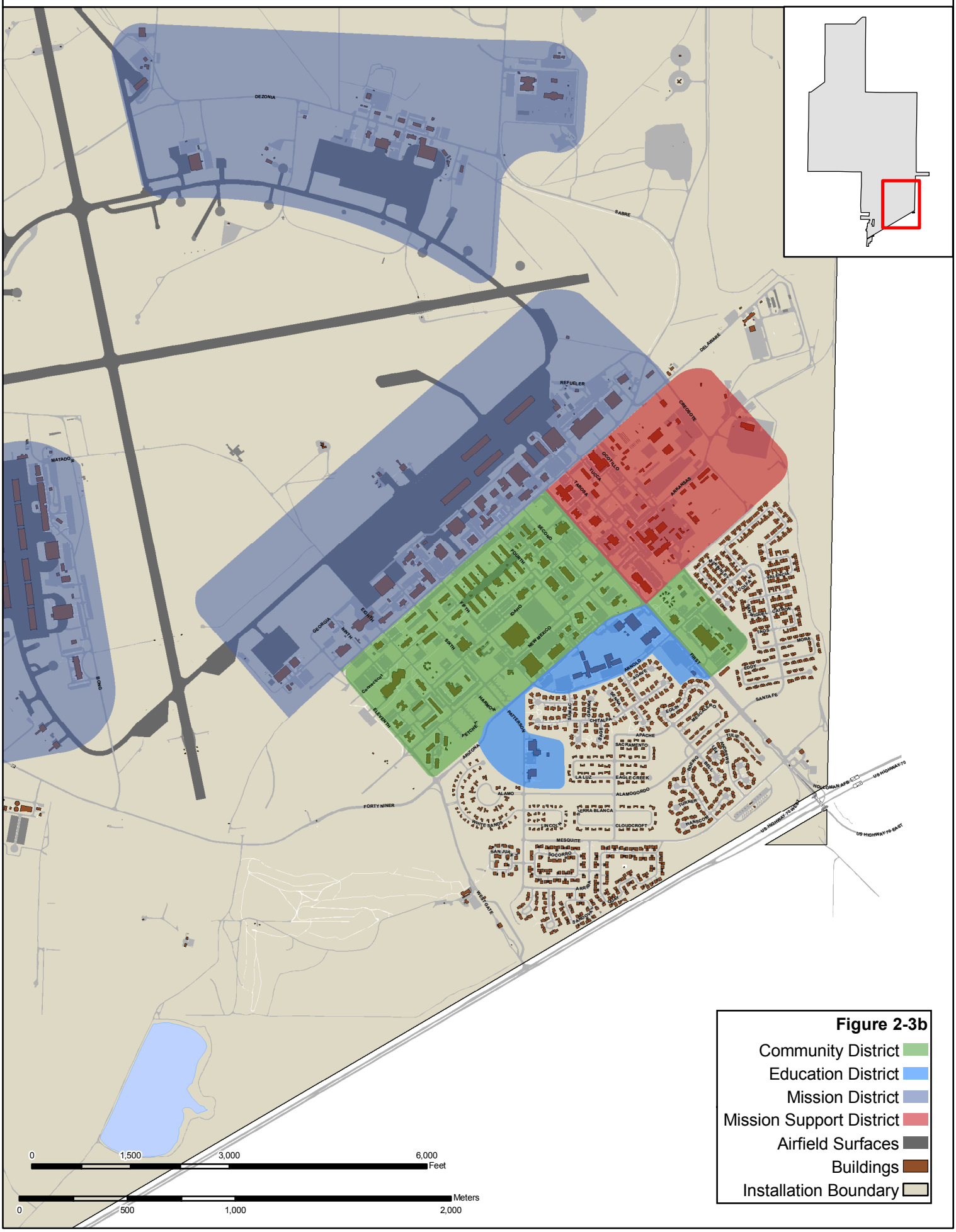


**Figure 2-3b**

- Community District
- Education District
- Mission District
- Mission Support District
- Airfield Surfaces
- Buildings
- Installation Boundary

Districts at the base are characterized by certain functions, materials, and scale and are defined as:

- Mission
- Mission Support
- Community
- Education

## 2.4.5.1 Mission District

The Mission District is characterized by the aircraft operations functions of the installation. These areas include aircraft maintenance hangars, squadron operations buildings, and research and training facilities. Most functions in this district are directly tied to accomplishing the mission of Holloman AFB and the mission of the Air Force, which in many cases requires larger structures, but with a relatively low density of personnel per facility.

- *Because there is a low density of personnel per facility, it is unlikely that a strong pedestrian circulation system can be established. However, effort should be taken to mitigate pedestrian and vehicle conflicts.*

Administrative facilities within the district supporting the maintenance, training, and research functions provide a higher working population density and are typically along Delaware Avenue in the main base area, Wagner and Bong Streets at the west ramp, and along Dezonia Road at the north ramp.

- *The administrative facilities should be used as transitional facilities between districts in the main base and west ramp areas.*

- *There should be a strong and safe pedestrian connection between the Mission District and the Community District in the main base and the Mission District and the Mission Support District at the west ramp.*

Optimal building orientation should maximize mission sustainment, with all other building orientation considerations secondary. Because mission sustainment is the highest priority, all facilities in the Mission District will have a strong orientation towards the flightline.

- *Building orientation that reduces energy loads should be implemented where possible. Optimal solar orientation along the main base flightline is problematic; however, individual building form can maximize solar gain. Solar orientation should be much easier to accomplish at the west ramp and at the north ramp.*

**Mission District Architectural Characteristics**

Color, mainly brown and tan shades, and scale, mainly one-story structures, are the key unifying elements of the installation as a whole.

The Mission district reinforces base consistency with its color selection. Color schemes have been adhered to in a very consistent manner. Building materials have been limited to metal panel walls, EIFS, stucco, and metal roofing for most buildings. The EIFS and stucco examples are older buildings, which are being phased out over time, as is the painted CMU seen on the west ramp fire station #869. Metal panels and roofs are encouraged on new structures, for both consistent appearance and sustainable contribution as a recycled material. Masonry appears on administrative support buildings and is used successfully as a wainscot on the new AGE building #818. See Section 5.3.2.4 for further discussion of materials and colors.

Hangar scale is directly derived from function, lending unique character to the Mission District. In many cases, single-story administrative support functions appear on the opposite side of the flight lines. These provide opportunities to break down large masses with more human scale, as discussed in Section 5.3.1.2.

Landscape planning for mission-specific facilities, such as hangars and maintenance/storage buildings, is absent at most buildings due to the functional nature of the District. Some landscaping is provided at transitional buildings and those housing administrative support functions.

## 2.4.5.2 Mission Support District

The Mission Support District is characterized by industrial functions that support the flying mission. These areas include warehouse and storage facilities, smaller-scale administrative facilities and research and development facilities. Because most of the functions in this district are industrial, there is a relatively low density of personnel in most facilities. The low density of people, dispersed development pattern and the requirement for extensive pavement for GOV parking and outdoor storage make it unlikely that a strong circulation system dedicated to pedestrians can be established or warranted.

There are administrative facilities within the district supporting industrial functions, as well as a few facilities along First Street, such as the German Air Force and the 49 Wing headquarters buildings that provide a higher working-population density. These facilities also function as transitional land use activities between this district and the community center on the west side of First Street.

Building 55 (49 CES) is a good example of a building incorporating elements of an administrative facility on the "public" side of the building and industrial materials on the "non-public" side of the building.


The Shoppette is a prime example of a facility that is not "typical" of the Mission Support District, but does represent a transition to the Community District to the south of First Street.

**Mission Support District Architectural Characteristics**

The buildings within the mission support district reflect the evolution of the base over time. A number of older buildings, including painted smooth-face CMU and tan-colored stucco are interspersed with newer facilities of metal panel construction. Metal wall and roof panels in beige and brown tones are the predominant materials for warehouses and hangar buildings. Similar to the Mission District, administrative support buildings with larger occupancies, such as the Civil Engineering Building 55, include integrally colored masonry construction.

Existing roofs include low slope, dark bronze, tan, and off-white metal roofs, some with large, turned-down fascias. Visual unity can be enhanced by standardizing the palette of materials and colors.

The mission support district is also mainly devoid of landscaping due to its functional character. Fencing is a mix of colored split-face CMU walls and Type-A Chain Link Security Fence.

## 2.4.5.3 Community District

A trend in master planning is to allow a higher density of diverse functions and services in the community area. Essentially, the Community District concept is revisiting the idea of a neighborhood commercial district or small-town commercial district where most, if not all, basic services (e.g., retail, medical, and institutional) are provided.


The former BX has been successfully renovated for family-support services and the Airmen's Attic.

The Community District extends west of First Street and is comprised of unaccompanied Airmen housing, administrative facilities, outdoor recreation, community services, and community commercial functions. Other functions in this district are temporary housing, the chapel, and the club.

Many of the facilities in this district function as gathering places for living, working, shopping, and recreation and generally support higher densities of people than the other districts on the installation. The types of facilities and land use activities within this district are similar to those found in a small downtown or neighborhood center. However, the existing development density in the Community District is not typical of a small downtown or neighborhood center.

- *Although the dormitory area and the commercial retail cluster have some density, the density of the "entire" Community District can be enhanced to encourage walking. Infill development should be considered.*

Although Air Force installations are not true copies of towns or neighborhood centers, when considering the future vision for this district a higher density development pattern including some multi-story structures (2-3 stories) can be visualized. The district would host a vehicle circulation system that is downplayed and vehicle parking is subordinate to buildings and the landscape. The higher density of buildings is supported

by a pedestrian circulation system that encourages walking or riding bikes to a variety of uses within that district. High densities and short, walkable distances are common factors seen in successful communities. This type of compact development pattern is necessary to provide more future development options and promote the green development strategies that arise out of mixed uses and increased densities.

- *As part of Community District planning, pedestrian and roadway circulation patterns and parking lot layouts should be reevaluated.*

Other typical features of a downtown district are parks and formal outdoor spaces. There are parks located within the district; however they are located on the west end of the district.

- *A park in a central location would be an inviting gathering place that could physically tie all nearby facilities at a central gathering place.*

**Community District Architectural Characteristics**

Like the Mission Support District, the Community District has been built over time and includes examples of every material used on base (smooth-painted CMU, stucco, EIFS, brick and integrally colored split-face and decorative CMU). The most positive recent construction includes the Fitness Center (Building #588) and the new Fire Station (#525), both of which are integrally colored split-faced CMU in a couple of colors, with quality architectural details including wainscoting, recessed downspouts, shade features, and accent block. New construction should follow these examples.

The installation post office is a building that has no context with any other building in the Community District and should not be used as an example for future building design at Holloman AFB.

Two-story construction is more common in this district than any of the others. As previously stated, multi-story construction reinforces the district identity and is encouraged.

- *Positive xeriscaping development along New Mexico Avenue should be replicated throughout the district to help develop a cohesive sense of place*.

## 2.4.5.4 Education District

The Holloman AFB Elementary and Middle Schools are located south of the Community District and in proximity to family housing. These facilities have a highly specialized purpose: their function is to educate children. This district is indirectly tied to sustainment of the Holloman AFB mission, but immensely important to quality of life for families.

**Educational District Architectural Characteristics**

The northeast portion of the Education District is surrounded by integrally colored split-face and decorative CMU walls, which isolate the district from the rest of the base. The buildings within the walls include flat-roofed construction with red-orange brick and tan EIFS/stucco walls.

The Educational District is unique in its function, defined by the population it serves. As such, the Educational District should retain its own identity while maintaining a relationship to the base. Redevelopment of the Educational District has begun with the construction of the new Child Development Center (CDC) in the southwest portion of the district.

- *This district would benefit from a comprehensive development study, which should carefully consider the aesthetic of the new CDC.*

Although utilitarian in design, the installation elementary and middle schools provide an important quality of life function for families of Airmen.

The Education District effectively severs the Community District into two pieces. Location and treatment of the Education District should be considered in master planning the base.

### 2.4.5.5 Transition Areas Between Districts

To provide flexibility in facility design, districts should no longer have a distinct edge that separates one district from another. Transitional areas between the districts shown in Figures 2-3a and 2-3b will allow designers to utilize design elements and building forms from each of the bordering districts for a new facility. The ability to integrate design elements from neighboring districts will provide an element of architectural transition and unity throughout the base.

## 2.4.6 Distinguished Visitor Routes

Distinguished Visitor routes serve an important function as the primary entrance to the installation for Airmen, families and visitors. The following roadway segments are considered Distinguish Visitor routes:

- First Street to the southern installation boundary.
- Arizona Avenue from First Street to Eleventh Avenue/West Gate.
- Eleventh Avenue from Arizona to Base Operations (Building 577).

As Distinguish Visitor routes, the following design considerations need to be considered when undertaking projects or improvements along these routes:

- *Distinguished Visitor routes should have an elevated status for streetscape and building design and materials. Although the intent is to minimize landscaping on the installation, these corridors should receive a higher investment for road signage, pedestrian amenities (possibly bike lanes), street lighting, and plant materials.*
- *Significant landmarks are appropriate for important locations such as the intersection of First Street and Arizona Avenue and the First Street terminus at Delaware Avenue.*
- *Multi-story (2-3 stories) buildings are appropriate as they make bold impressions, elevate the importance of an area, and can function as landmarks.*

# 3 Development Considerations

Planning for a more sustainable installation requires analyses of land use and functional relationships, facilities reuse, circulation patterns, and development constraints. Through these types of analyses, opportunities for more compact development, improved pedestrian and vehicle circulation can be realized.

## 3.1 Reuse Opportunities

The installation has been reusing buildings for many years and continues to do so. However, the age of some structures, changing requirements for work space and the requirement to reduce the amount of square feet of facilities is making building reuse more problematic. Large-scale building reuse is not a likely scenario in the short-term; however, there are many opportunities for consolidation into existing facilities, as well as some development of new facilities on vacant parcels at Holloman AFB.

Some structures will be demolished for functional reasons and to meet the Air Force requirement to reduce installation building footprints by 20 percent by the year 2020. Reuse opportunities will primarily be focused on backfilling and consolidation as the installation redevelops based on new and expanding missions.

One example of functional consolidation into an existing facility is the Mission Support Group (MSG). The MSG is located in several buildings throughout the main base, including Buildings 29 and 222. A consolidation effort would improve management effectiveness by consolidating most, if not all, administrative functions into one facility.

### 3.1.1 Area Development Plans

Area Development Plans (ADP) prepared in 2011 will be used to guide future development at the base. The ADPs account for most of the unconstrained land on the installation, including the main base, west ramp, north ramp and outlying research compounds. The basic framework for the ADPs was established through sustainable goals and objectives, that—when implemented—will meet, or exceed ACC, Air Force, DOD and federal guidelines for sustainability. The ADP process identified opportunities for building reuse, new facility construction, pedestrian and vehicular circulation improvements and improvements to overall quality of life. However, there were some areas on the installation that did not have an identified program or function in the ADPs. A review of these areas identified a limited number of opportunities for future development and infill.

## 3.2 Infill Opportunities

Infill development allows for the development of modern facilities that more effectively meet the needs of the Air Force to maintain mission capabilities, reduce energy consumption, and enhance the working and living conditions of personnel and families. Infill development should be prioritized to fill in vacant parcels to create a dense, compact development pattern. Redevelopment of previously developed sites should also be a high priority. The lower priority development areas are previously undeveloped areas farther removed from the center of the installation. Infill sites for Holloman AFB are shown in Figure 3-1.


Building 29 could be utilized for consolidation of Mission Support Group functions after construction of the 49 Wing Headquarters building.

# HOLLOMAN AIR FORCE BASE

*Infill Sites*

Infill development along with the execution of the 2011 ADPs and the use of multi-story (2-3 stories) buildings will create a more compact development pattern that can be used to promote a greater degree of mixed-land use opportunities and consolidated functions. This type of development pattern reduces the distance personnel must walk between activities and promotes less reliance on vehicle use. It also provides opportunities to:

- Reduce storm water runoff through a reduction in impervious surface.
- Minimize the heat island effect.
- Use centralized heating and cooling systems that can reduce the base's carbon footprint through less energy consumption. Centralized systems are most effective and efficient if they serve a mix of land uses, which results in a diversity of load demand. These systems also provide opportunities for efficient use of thermal storage, as well as the potential for cogeneration and biomass. With proper land use planning and system design, central plants can be very efficient.

## 3.2.1 Infill Site #1

This site is located northwest of the intersection of First Street and Arizona Avenue (Figure 3-2) and is within the transition area between the Community District and the Mission Support District. The size of the site allows a considerable amount of flexibility for building design that would further increase personnel density in the area. The proximity of this site to the diverse activities in the Community District and other important administrative functions nearby will encourage more pedestrian movement and less reliance on vehicles.

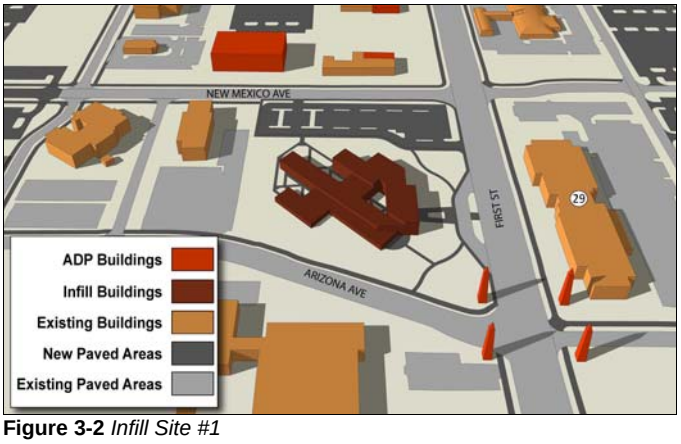


**Figure 3-2** *Infill Site #1*

Because this site is a gateway to the installation, it calls for an activity of importance and construction of a distinct building of significance, such as a 2-3 story administrative building. A possible future function for this site could be an alternative site for a new 49 Wing Headquarters with a transitional design that supports its location between the Mission Support and Community Districts. Arizona Avenue—immediately west of First Street—is on an east-west axis, which is ideal for constructing a significant building that can be oriented to maximize solar gain. Although an east-west orientation for a prominent building would seem to be out of context to other nearby buildings, the site allows flexibility to maintain a strong presence on First Street and a relationship with Building 29.

The prominence of this parcel warrants construction of an important landmark which elevates requirements for building design and streetscape improvements associated with development of this site.

## 3.2.2 Infill Site #2

This infill site (Figure 3-3) becomes available as a result of constructing the new lodging facilities along the north side of Arizona Avenue and the demolition of existing lodging located at the northeast corner of Eighth Street and New Mexico Avenue. A possible infill opportunity for this site in the future would be construction of a 3-4 story lodging facility that mimics the new facilities constructed along Arizona Avenue and increases population density within walking distance of diverse activities in the Community District and nearby outdoor recreation facilities The new lodging facility should maximize solar orientation and create outdoor social spaces that have some level of protection from high winds and constant sun exposure. A new park could be developed and connected to the pedestrian corridor that is identified in the ADPs. This park would provide outdoor space immediately adjacent to all installation lodging facilities.

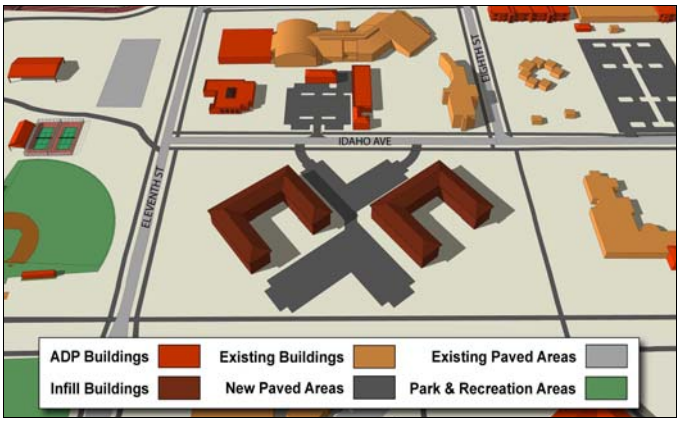


**Figure 3-3** *Infill Site #2*

## 3.2.3 Infill Site #3

Redevelopment within the Mission District of the west ramp flightline should accommodate new or expanding missions, including training (see Figure 3-4). The current lack of development density in this area of the west ramp does not warrant extensive pedestrian amenities for all roads in this area; however, separation of vehicles and

pedestrians should be accomplished when possible. In the long-term, development—and population—density will increase and pedestrian circulation should be improved. Primary pedestrian circulation should be focused along Nighthawk Avenue with connections to Wagner Street and the flightine. Safety should be enhanced through a simplification of the vehicle circulation pattern and reduction in curb cuts. Solar orientation of buildings can be accomplished in this area without creating significant inefficiencies in land use. In this area, orienting the building with the street and adjacent buildings does not override good solar orientation.

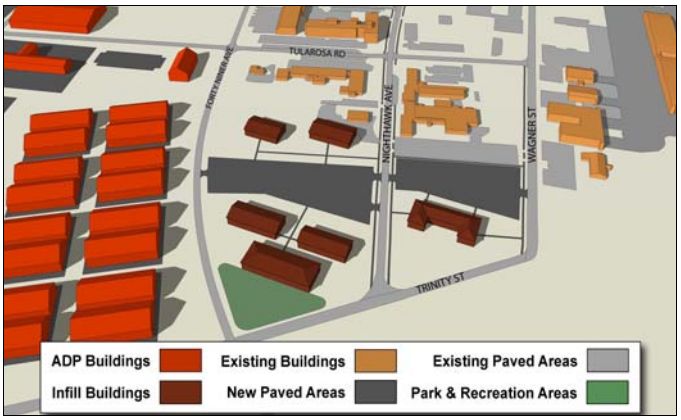


**Figure 3-4** *Infill Site #3*

This infill site also functions as the entrance to the west ramp and is an appropriate location for entry landmarks.

# 3.3 Circulation

## 3.3.1 Vehicle Circulation

The installation circulation pattern extends from First Street, which is the primary road leading into Holloman AFB (see Figure 3-5). This and the other arterial roads account for a large volume of traffic entering and leaving the installation. Secondary and tertiary roads serve the balance of the installation. The proposed infill areas do not require road construction; however, the ADP that includes the Community District encourages the "redevelopment" of New Mexico Avenue from a vehicle street into a pedestrian corridor. Although this pedestrian corridor would eliminate privately-owned vehicle (POV) traffic for several blocks along New Mexico Avenue, public safety access would be maintained. The Community District ADP also recommends that several roads be eliminated to increase development opportunities and create a more pedestrian oriented, campus environment. Some intersections in the Community District are proposed to be converted to roundabouts to improve circulation and reduce emissions from idling vehicles.

With the exception of the Community District, roads within the installation generally have limited pedestrian amenities. First Street is designed to accommodate high volumes of traffic in and out of the installation, but there is currently no road through the installation that provides direct connections to the west ramp, main base, and areas to the north.

## 3.3.2 Pedestrian Circulation

Although there is a narrow pedestrian trail along Sabre Road near the north ramp, pedestrian circulation throughout the installation is generally limited to sidewalks. Sidewalks are scattered and not well connected in some locations. There are no base-wide walking/biking trails that provide access throughout the installation; however, there is a potential for partnering with the local community to establish a bike trail from Alamogordo to the installation. Bike traffic is currently limited to installation streets.

# 3.4 Land Use

The existing land use patterns and areas and future land use maps for the base should be used by the design team to understand functional and compatible land use activities as existing and proposed on the base.

Major land areas of the base (Figure 3-6) include the following:

- The Cantonment comprises approximately 8,000 acres within the southern portion of the base. The landscape has been highly modified to accommodate the majority of functions conducted by the military, including base housing and personnel support facilities.
- The dunelands and high-speed test track areas comprise approximately 23,000 acres and extend roughly from the test track facilities to the Holloman AFB western boundary.

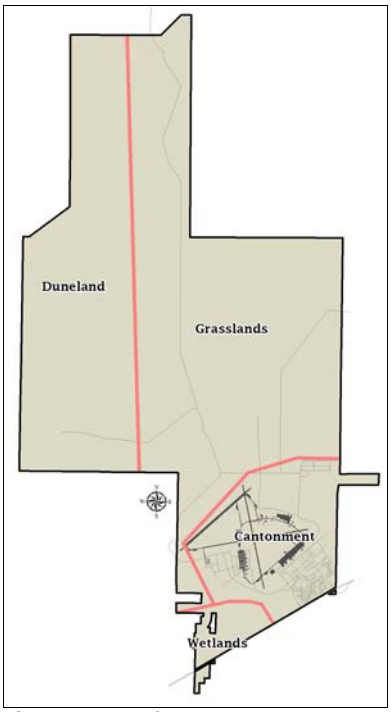


**Figure 3-6** *Land Use Areas*

# HOLLOMAN AIR FORCE BASE
## *Circulation*

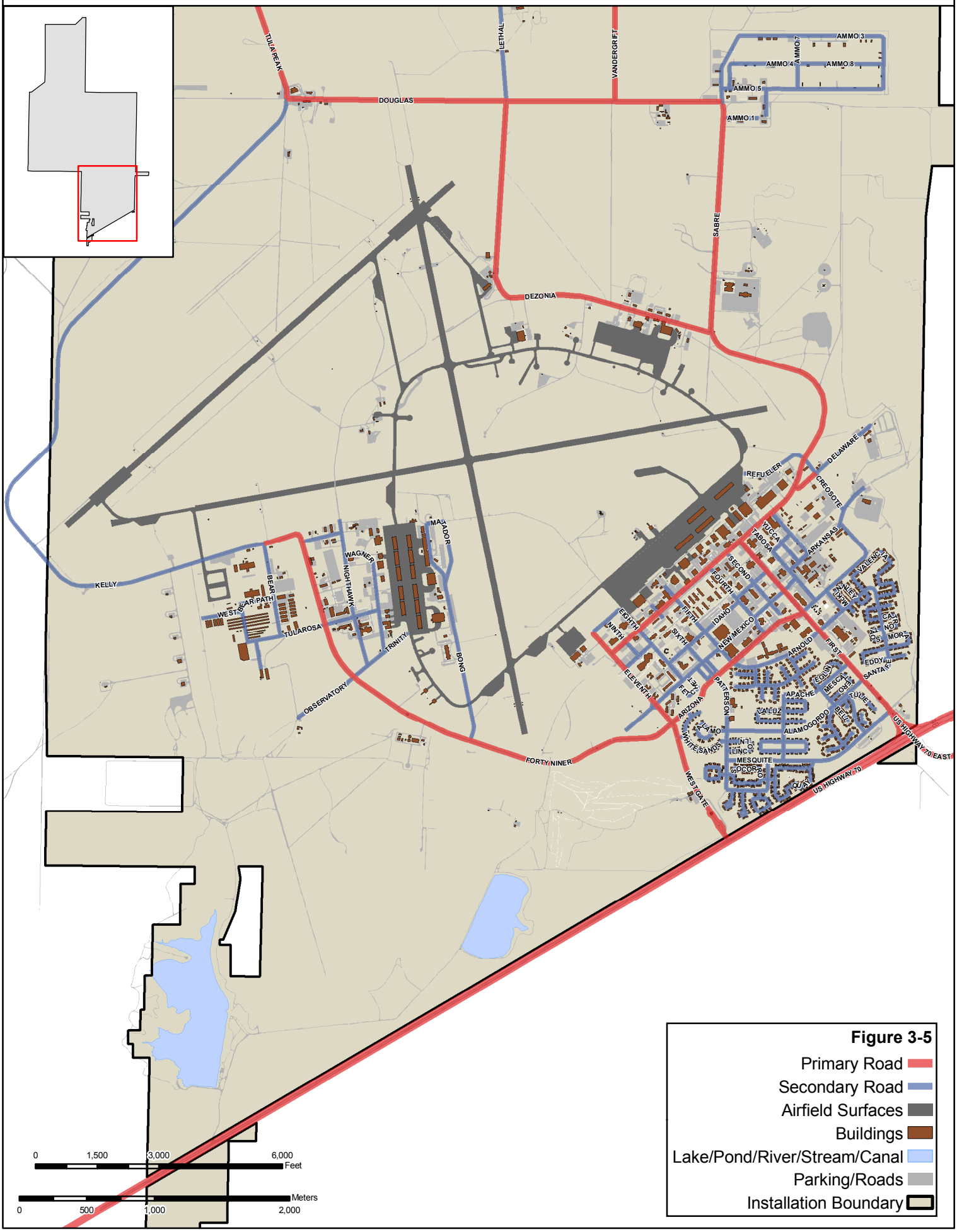


**Figure 3-5**

- Primary Road
- Secondary Road
- Airfield Surfaces
- Buildings
- Lake/Pond/River/Stream/Canal
- Parking/Roads
- Installation Boundary

- The northern grass-shrubland area north of Douglas Road is approximately 19,000 acres.

- The Lake Holloman wetland complex, public-access area comprises approximately 1,800 acres north of U.S. Highway 70 and 131 acres south of the highway in the southernmost part of the base, directly south of the Cantonment

The existing land use layout of Holloman AFB generally has been logical and followed basic Air Force planning guidance to support the base's mission. Future land use locations identified in the eGP are similar to the existing land use found on the base. The future land use map should be modified to reflect the land use changes resulting from the ADPs and the Infill Sites in this ID2 Handbook. Changes to the Future Land Use are discussed below and the locations are shown, by number, on Figure 3-7.

1. The future land use designation for this parcel should be changed from Community Commercial to Aircraft Operations and Maintenance. The parcel of land along Delaware Avenue currently is occupied by Community Commercial functions including the Outdoor Recreation Center, POV car wash and the Auto Hobby shop. Proximity to the flightline may warrant a relocation of these functions in the long-term to accommodate increased mission requirements for the flightline.

2. The Future Land Use map should be revised to show these parcels as Administrative. First Street is the most prominent street on the installation and appropriate for administrative functions and a stronger streetscape presence. Supporting administrative functions such as professional development and education facilities for Airmen are appropriate functions in this area.

3. The vacant parcel between Fourth Street and the BX parking lot is a prime location for a park, so the Future Land Use designation should be changed to Outdoor Recreation. Sidewalks and benches throughout this park will encourage walking through the core of the Community Commercial area.

4. This portion of the installation is focused on child development. With the collocation of the CDC and Youth Center, the area should be designated as Community Service. These facilities are within easy walking distance of family housing and eventually, the expanded Community District, parks and the proposed Community Activity Center.

5. The proposed land use for this parcel should be changed from Community Commercial to Unaccompanied Housing. Construction of new lodging facilities between New Mexico Avenue and Arizona Avenue would increase development density in the community center, which will encourage walking to a variety of facilities including the club, outdoor recreation, commercial establishments and parks. This site allows for optimal solar orientation for the buildings.

6. This site behind the Fitness Center would be an appropriate site for relocation of the outdoor recreation center, POV car wash and Auto Hobby shop. It consolidates multiple "after hours" activities on the south end of the main base and creates a redevelopment parcel for mission-oriented functions along Delaware Avenue. The Future Land Use map should be changed from Unaccompanied Housing to Community Commercial for this site.

7. The Future Land Use designation of these parcels should be changed from Outdoor Recreation to Aircraft Operations and Maintenance. These parcels would provide additional support for flightline facilities. Some portion of these parcels will likely be used for additional POV parking for Airmen working on the flightline.

8. Growing mission requirements may result in additional requirements for Airmen dormitories. The future land use designation of this site should be changed from Community Commercial to Unaccompanied Housing. This site would accommodate additional dormitories in proximity to the existing dormitory complex.

9. A new Dining Facility (DFAC) could be centrally located to the dormitory complex and in proximity to the flightline. This location along Delaware Avenue would be within walking distance of all dormitories and flightline facilities. The land use designation of this parcel should be changed from Unaccompanied Housing to Community Commercial. Building 274, the existing DFAC, could be reused for professional development/education purposes, which would require a land use change from Community Commercial to Administrative.

10. Most of the functions east of Forty Niner Avenue in the west ramp are mission-oriented, so the change from Industrial to Aircraft Operations and Maintenance is warranted. A small parcel within the west ramp area should be designated as Industrial to identify the location of the Fire Station.

# HOLLOMAN AIR FORCE BASE
## *Future Land Use*

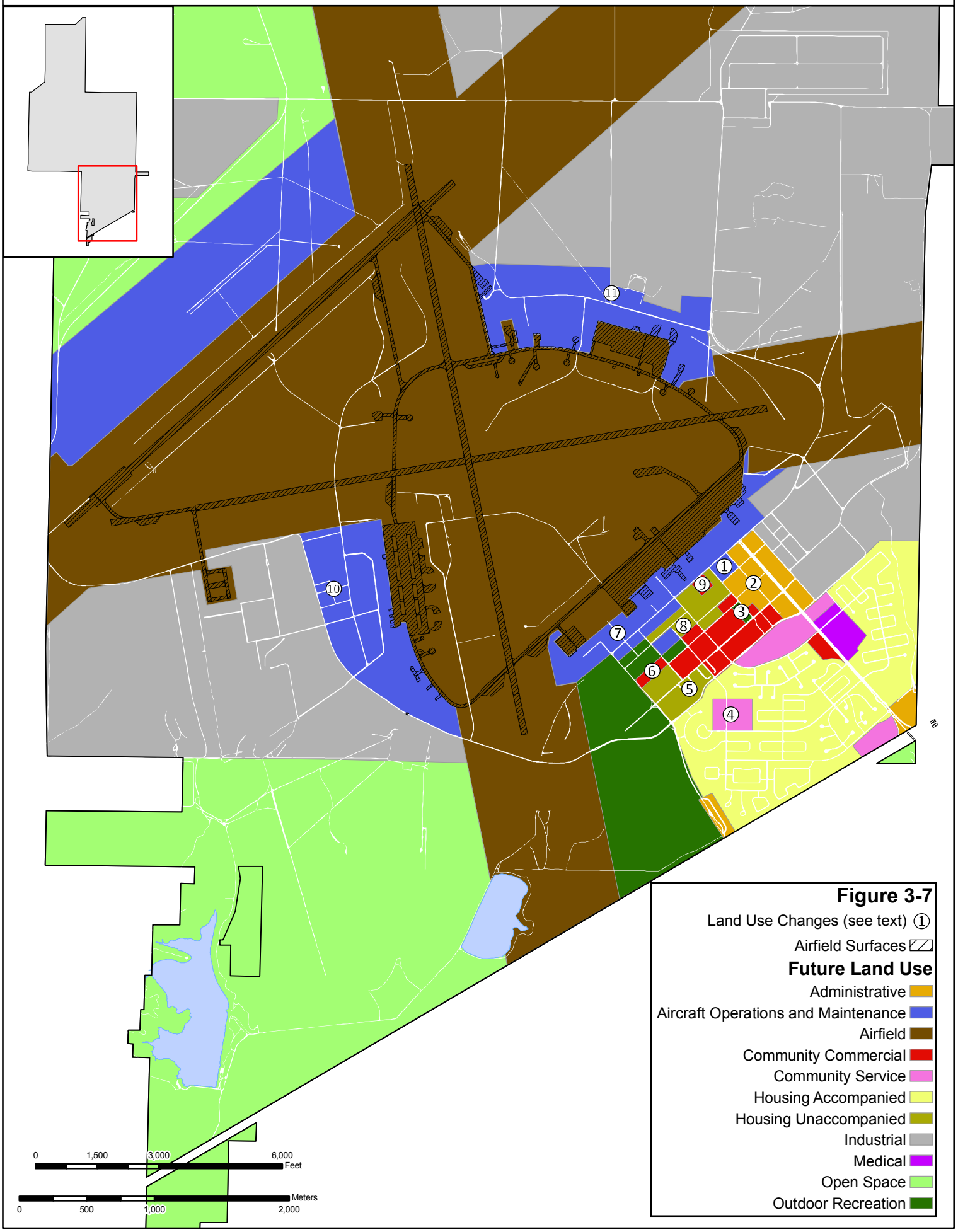


**Figure 3-7**

Land Use Changes (see text) ①

Airfield Surfaces

**Future Land Use**

- Administrative
- Aircraft Operations and Maintenance
- Airfield
- Community Commercial
- Community Service
- Housing Accompanied
- Housing Unaccompanied
- Industrial
- Medical
- Open Space
- Outdoor Recreation

11. All functions on the north ramp are mission-oriented, so the change from Industrial to Aircraft Operations and Maintenance is warranted for the area immediately north of Dezonia Road.

# 3.5 Sustainability Initiatives

Over the years, Holloman AFB has undertaken a number of initiatives to reduce the consumption of natural resources and their impact on the environment. Future actions planned for the base should enhance and improve upon past actions.

## 3.5.1 Natural Area Preservation

Holloman AFB actively protects the habitat of the White Sands pupfish located along the Lost River, which cuts through the base property north of the main base areas. Holloman AFB has also developed constructed wetlands at the south end of the base to manage effluent discharge from the wastewater treatment plant. The wetlands roughly encompass the area between Lagoon G and Lake Holloman. Both areas provide valuable natural habitat to local species, and preservation of the areas helps to minimize the impact of Holloman AFB on the local environment.

## 3.5.2 Energy Conservation Initiatives

Holloman AFB has taken a number of steps to reduce energy consumption.

### 3.5.2.1 Energy Studies

- A geothermal feasibility study has been completed and has determined that there is a weak case for geothermal energy at the base.
- There have been energy studies for hydroelectric power, wind energy, and any other potential source.
- Regional renewable energy projects are being considered by the White Sands Working Group, which includes local NASA facilities, Fort Bliss, and the Missile Range.

### 3.5.2.2 Reduction in Energy Consumption

- Civil engineers are actively managing a work plan to reduce energy consumption by 30 percent from the mandated 2003 baseline. The work plan includes a diverse list of planned or potential projects to replace lighting; install occupancy sensors; implement/change energy management policies, audits and energy management plans; and incorporate solar-based renewable energy development (mostly photovoltaic, some solar thermal).
- The base has already completed a number of energy efficiency projects such as lighting ballast replacement and occupancy sensor installation.
- The base has been operating an Energy Monitoring Control Systems (EMCS) using Direct Digital Control (DDC) to control HVAC equipment in some buildings at the base and would like to expand the EMCS coverage.
- The base has an active Energy Management Steering Group led by the Wing Command that has been working on implementing policies to control energy consumption, such as turning off non-essential equipment and performing nighttime energy audits.

### 3.5.2.3 Submetering

- Standard analog meters exist on approximately 42 facilities on base for sub-invoicing of tenants on base.
- The advanced metering program, which is currently being executed, includes 50 facilities, all over 35,000 square feet. Advanced meters will be added to additional facilities as funding permits. Advanced meters transmit readings to a central controller through a wireless radio mesh.

## 3.5.3 Water Conservation Initiatives

- Over the past 20 years, the base has significantly reduced water consumption by replacing turf areas with xeriscaping and Astroturf.
- The base is getting ready to start a program to build a 400,000 gallon tank for storage of effluent water to irrigate the golf course. Golf course irrigation currently accounts for 16 to 20 percent of potable water consumption at the base, and the new tank will eliminate all potable water irrigation of the golf course.
- Five areas of the sewer system were investigated and repaired to remove infiltration and inflow (I/I) from the sanitary sewer system. The five areas consisted of abandoned lines that were not plugged or deteriorated lines. Correcting the five areas removed approximately 90,000 gallons of infiltration from the sanitary sewer system.

## 3.5.4 Waste Reduction Initiatives

- The base stockpiles asphalt and crushed concrete from pavement removal and repair projects for future use on gravel roads, diverting the material from landfill.
- Although wastewater sludge is disposed of at the municipal landfill, it is of such high quality that the landfill uses it for its landfill cap.

# 3.6 Constraints

Constraints to development and the use of green technologies include natural resources, operations, and safety/security. Figure 3-8 illustrates composite constraints at Holloman AFB. Generally, there are few significant constraints that will affect development at the installation.

- Floodplains associated with the storm water drainage are a very minor limitation to development. The only location where they should affect development is in the vicinity of the 46 Test Group facilities, which is near the Lost River. The floodplain for the Lost River drainage and Malone and Ritas Draws is protected as Essential Fish Habitat for the White Sands pupfish. There are also wetland areas on base. Most of the wetlands are associated with the wetland complex at the southeast corner of the base and do not represent an impediment to development.

- There are Environmental Restoration Program (ERP) sites scattered throughout the installation. There are relatively few sites and most are quite small, so there would be limited constraints associated with an ERP site.

- Another constraint to development is the noise associated with aircraft operations. Noise is a quality-of-life issue and can directly affect human health if not attenuated through appropriate construction. The entire main base area—with the exception of some of the family housing area—is within the 70+ DNL contours so all construction will require noise attenuation.

  The clear zones (CZs) and accident potential zones (APZs) shown in Figure 3-8 are based on statistical analysis of Air Force aircraft accidents throughout the United States. The CZ, the area closest to the runway end, is the most hazardous. Development of vertical facilities should not occur in the CZ. The Air Force generally acquires the land in the CZ through purchase or easement to prevent development.

  APZ 1 is an area beyond the CZ that possesses a significant potential for accidents. APZ 2 is an area beyond APZ 1 with a lower, but still significant, potential for accidents. Statistically, 68 percent of Air Force aircraft accidents occur along the runway or within the CZ, APZ 1, and APZ 2. While aircraft accident potential in APZs 1 and 2 does not warrant acquisition of land by the Air Force, land use planning and controls are strongly encouraged in these areas for the protection of the public. See Appendix C for guidance references for land use compatibility in high noise zones and noise attenuation.

- Similarly, Quantity Distance (QD) arcs are a constraint to development. The Department of Defense Explosives Safety Board has established uniform minimum safety standards for personnel and property that have the potential of being exposed to the effects of an accidental explosion. The safety distance determined for the storage of explosive material at the installation is shown on Figure 3-8 as QD arcs. The arcs are determined through the quantity of explosive material being stored/loaded and the distance separation relationship to provide types of protection. These relationships are based on levels of risk considered acceptable for the stipulated exposures and are tabulated in the appropriate Q-D tables. Separation distances are not absolute safe distances but are relative protective or safe distances. Greater distances than those shown in the tables shall be used whenever practicable. Reference: DoD 6055.9 STD.

- Safety and security of Air Force assets, personnel, and families drive AT/FP setbacks for construction of facilities. The AT/FP setbacks limit opportunities to create truly compact development patterns on the installation. They also limit the ability to site a building that addresses the road and sidewalk in a “new urbanist” style. However, buildings may share the standoff distance created between them, which will help in creating a denser development pattern.

- The availability of potable water in an arid environment such as Holloman AFB is a development consideration. A primary concern associated with sources of potable water is the ability of the base to maintain the rights to the water. As noted in the Water Resources Sustainability Analysis for the Base, Holloman AFB water rights can support the base mission beyond the year 2030; however, the water sources require further investigation to determine reliability.

# HOLLOMAN AIR FORCE BASE
## *Composite Constraints*

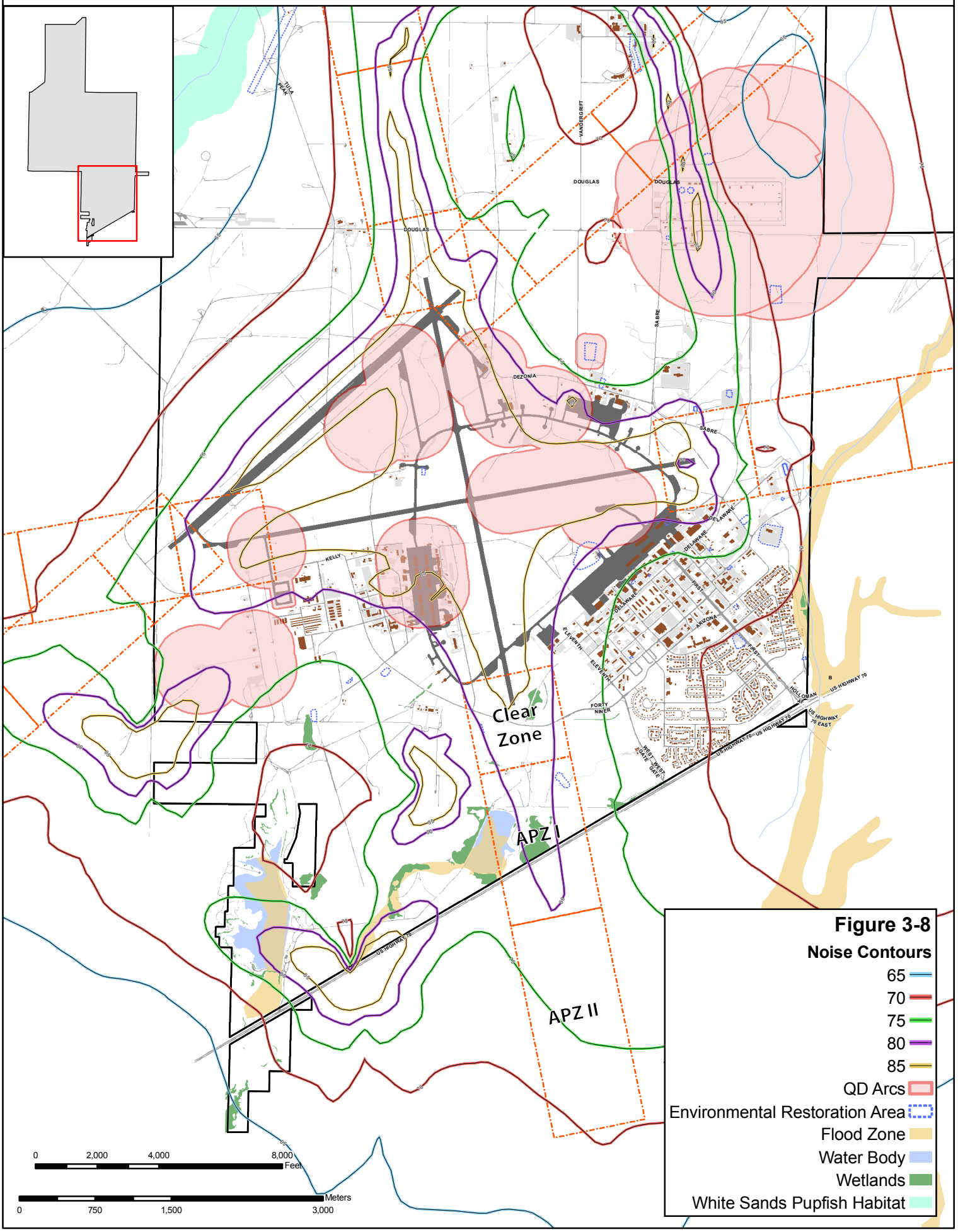


**Figure 3-8**

**Noise Contours**

- 65
- 70
- 75
- 80
- 85
- QD Arcs
- Environmental Restoration Area
- Flood Zone
- Water Body
- Wetlands
- White Sands Pupfish Habitat

# 4 Illustrative Plan

The purpose of the illustrative plan shown in Figures 4-1 and 4-2 is to graphically illustrate the desired, future state of Holloman AFB by:

- Incorporating the sustainable recommendations found in this document.
- Using the infill opportunity areas that were discussed in Section 3.
- Integrating Holloman AFB ADPs and demolition plans.

Implementation of the plan will result in development density increases to enhance the base as a place to work, live and play, while at the same time providing development opportunities to sustain the installation's mission. Increasing the development density of the base will help reduce the reliance on automobiles and encourage pedestrian circulation throughout much of the installation. The quality of life for Airmen, civilians and families will be enhanced with significant improvements to the pedestrian circulation system and additional opportunities for outdoor recreation in the central portion of the main base. Overall, development infill to increase densities occurs where existing buildings are scheduled for demolition and in areas where there is available vacant land and it makes sense to increase the density of development.

The redevelopment of infill sites provides opportunities for low-cost (e.g., achieving good solar orientation) sustainable building design solutions, as well as opportunities for sustainable utility and infrastructure design.

Figure 4-1 shows the design concepts and components embodying infill development for the main base and are labeled as follows:

1. A landmark at the corner of Arizona Avenue and First Street is the first strong visual indicator of the importance of the installation and the pride that Airmen and civilians feel in working here. A new facility at this site should incorporate a high level of design and material construction, and the streetscape should be maintained to a high standard. Appropriate facilities at this site could include Wing Headquarters or other administrative functions of prominence Although there is an unusual road alignment at this intersection, the new facility could be sited to meet requirements for solar orientation[1] and still have a prominent exposure to Arizona Avenue and First Street. An east-west orientation of the building increases the opportunity to create a unique design and meet all AT/FP setback requirements. Pedestrian connectivity to the Community District would be provided along New Mexico Avenue. A direct connection to the multi-use trail along Arizona provides access to family housing and lodging and outdoor recreation areas. Personal vehicle parking is behind and to the side of the new building.
2. This site will accommodate additional lodging facilities within easy walking distance to a large number of diverse activities in the Community District. Open space is enhanced with natural landscapes and outdoor space for social gathering. This space links with the pedestrian corridor along New Mexico Avenue, which connects with a pedestrian circulation system linking the Community Center with the flightline, dormitories, family housing and the outdoor recreation area. Redevelopment at this site would occur following demolition of existing lodging facilities. This site allows construction that would meet solar orientation goals.

Figure 4-2 shows infill development for west ramp, which is labeled as follows:

3. Administration, mission support functions, and or training are the most likely functions for this site. Facility development at this site should maximize solar orientation. Shared-use parking lots should be constructed to serve this area as well as flightline facilities. Pedestrian circulation should extend along Nighthawk Street. As the entry to the west ramp, a landmark should be established at the corner of Forty Niner Avenue and Trinity Street. The two development parcels would include space for landmarks. Landmarks could include static displays and signage identifying the West Ramp and directions to other prominent facilities in the area. Signage identifying primary tenants in the buildings at this site would be provided.

[1]The advantage of having buildings sited with good solar orientation is an overall reduction in energy consumption. Although it is best to face structures directly into the sun, it can be oriented up to 30 degrees away from due south and lose only five percent of the potential savings.

Although desirable, not all new facilities on the installation will be able to maximize solar orientation, but it is important to maintain established setbacks and building orientation in most areas. No matter which building orientation is utilized, the siting of new facilities should result in a compact parking and building relationship that reduces development and infrastructure costs.

# HOLLOMAN AIR FORCE BASE

## Illustrative Site Plan (Main Base)

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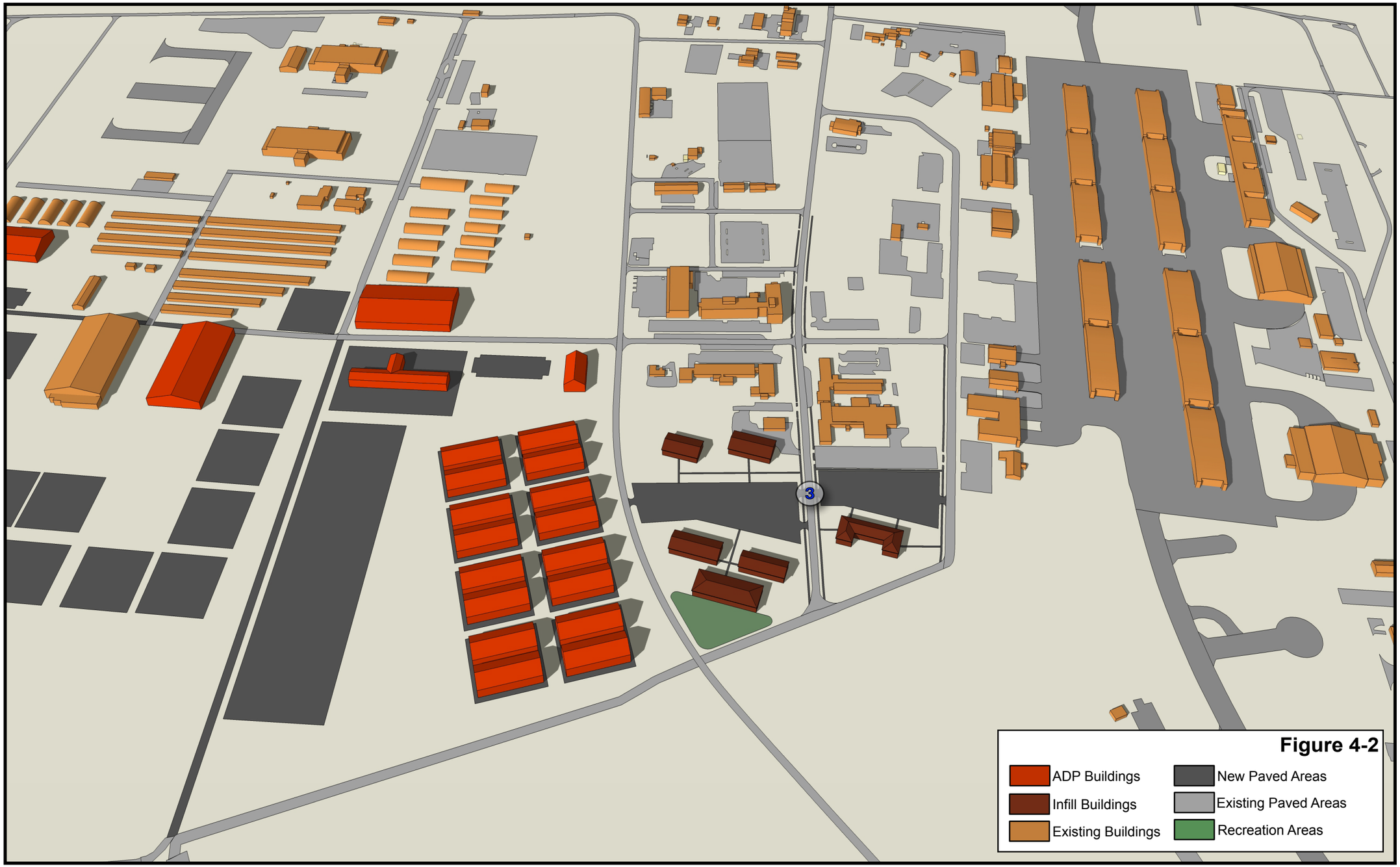
# HOLLOMAN AIR FORCE BASE

## Illustrative Site Plan (West Ramp)



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# 5 Development and Design Guidelines

## 5.1 Sustainable Development and High Performance Green Building Design (SD&HPGBD)

ACC has realigned planning, design and construction practices so implementing SD&HPGBD objectives become primary considerations. These changes will allow SD&HPGBD strategy opportunities to influence the building form.

Holloman AFB is beginning to embrace SD&HPGBD goals with the construction of the AGE building and new fire station, both of which employ sustainable design features.

Also available to Holloman AFB is the ACC SD&HPGBD Scorecard (hereinafter referred to as "Scorecard"), the ACC's green building self-assessment metric. The scorecard assembles and consolidates executive orders, public laws, and federal agency rulemaking on SD&HPGBD requirements with the LEED® rating system. Using the Scorecard is a way to achieve the desired LEED rating and meet critical statutory minimum requirements.

When applied in context, the Scorecard can illuminate opportunities for sustainable design, often with low- or no-cost choices. Some choices carry an upfront cost but provide long-term operational cost savings and are value-added building features. Scorecard requirements can guide and inform building projects towards lower lifecycle costs and enhanced sustainability.

This section provides guidelines related to site development and infrastructure systems as well as architectural order and elements necessary for achieving SD&HPGBD.

## 5.2 Site Development

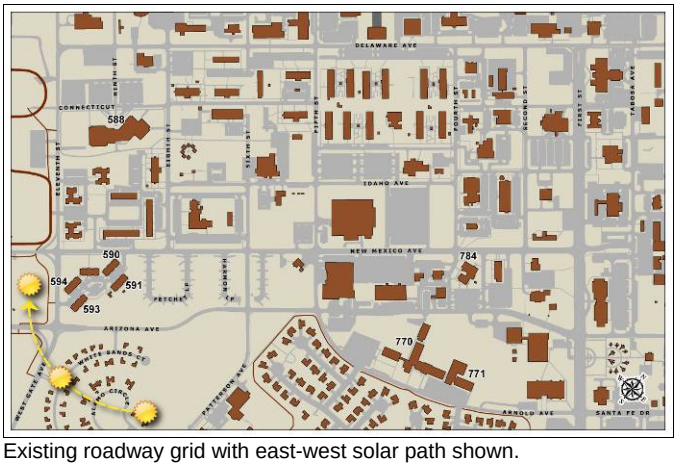
Site development guidelines focus on building siting and orientation, access, parking/roads, landscape, open space, energy, utilities and storm water. Each section includes a brief description of existing conditions. The intent of these guidelines is to provide the designer with general background information for the installation and to provide recommendations for site development. The recommendations identified will help foster the base's green infrastructure.

### 5.2.1 Solar Orientation and Building Siting

#### 5.2.1.1 Solar Orientation

The existing buildings at Holloman AFB are mostly oriented parallel or perpendicular to the primary roadway grid, which is defined by the direction of First Street. First Street is the primary artery leading from the main gate to the flight line. Several roads intersecting First Street provide secondary loops and cross connections between various areas of the base.

In some cases, where roads curve, buildings are oriented parallel to the curve rather than the primary roadway grid. The chapel (Building 784) and school buildings (770 and 771) are examples of this rotation. A few of the barracks buildings (590-1 and 593-4) and the new recreation center (Building 588) were aligned diagonally to the grid, perhaps to add some contrast to the development from the juxtaposition in the siting. These buildings are not necessarily sited to follow an ideal solar orientation, but the diagonal arrangement creates some interesting and pleasing open spaces. The graphic below shows the existing building orientation in the core area of the installation.



Existing roadway grid with east-west solar path shown.

Design and planning teams should maximize the future solar orientation of buildings through land development planning. All future Area Development Plans (ADPs) in areas without an established road system should be laid out and new buildings oriented, such that solar heat gains/losses are optimized. This is generally with the long axis of buildings east-west and solar exposures to the north and south. The layout of new streets in an ADP often dictates the future orientation of buildings toward the street, and as such, aligning the street grid according to the sun is critical. Aligning streets and buildings on an east-west axis will serve the dual purpose of also optimizing those buildings to host rooftop solar panels, should the opportunity arise.

For building sites on a road that is not east-west oriented, the designer should strive to maximize the shape and orientation of the building with respect to the sun for passive solar heating, cooling, and daylighting. However, in most cases orientation of buildings parallel to street should take precedence over irregular solar orientation in siting to avoid inefficiencies resulting from an awkward building orientation. Moreover, other measures may be taken in the specific building design to optimize energy efficiency, such as shading devices at window openings, coordination of deciduous tree plantings, overall building envelope massing, and certain types of skylighting.

*Overall, a building footprint layout analysis is strongly recommended so that buildings are oriented according to the solar guideline (i.e., 15 degrees to east-west) only when it is clear that this will indeed be effective for the actual building design. If solar orientation will not significantly affect the particular building, then it should be oriented squarely with the street or existing building grid.*

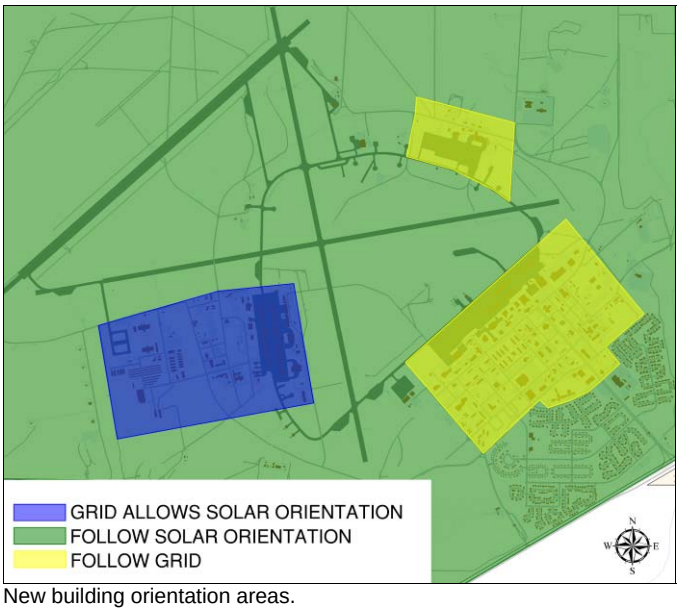
### 5.2.1.2 Building Siting

Numerous factors need to be considered when siting new facilities. Some of these factors include the following:

- Existing and future land use
- Functional relationships between activities
- Orientation and location to maximize functional relationships with other facilities, integrate green space and transportation linkages and maximize solar benefits
- Antiterrorism/Force Protection (AT/FP)
- Building function and size, including consideration of the minimum size and footprint necessary to serve the function
- Parcel shape and size
- Operational and natural constraints
- Infill opportunity
- Vehicular and pedestrian access
- Proximity to utility corridors
- Planning for a dense enough development pattern to support a combined heat and power plant (co-gen), separate district heating and cooling plants and the potential for thermal storage

The graphic above-right identifies the sites on Holloman AFB that need to follow a specific orientation unless a specific design solution can provide more beneficial results.

- *New buildings sited in the yellow areas in the graphic should follow the context of the existing building orientation in that district. Most buildings in this area are oriented parallel or perpendicular to the roadway grid (main part of the base and north flight line).*



New building orientation areas.

- *New buildings sited in the blue areas in the graphic should be sited to follow the roadway grid, but should have a long axis following the east-west orientation of the grid to maximize passive solar orientation where possible (west flight line and adjacent buildings).*

Any buildings sited outside of the aforementioned areas can follow the optimum passive solar orientation (outlying areas).

## 5.2.2 Circulation Improvements

Roads within the installation are generally bare of pedestrian amenities. The network of sidewalks that do exist generally follow the road network and in some cases have been located to connect major activity centers. These sidewalks lack shade and adequate development of crosswalks and curb ramps.

To improve access and the movement of pedestrians and motorists throughout the base, streetscape improvements should be implemented following a complete streets concept.

According to the National Complete Streets Coalition, complete streets are ones "…*designed and operated to enable safe access for all users. Pedestrians, bicyclists and motorists of all ages and abilities must be able to safely move along and across a safe street*." Complete streets could include bike lanes, sidewalks on both sides of the street, frequent street crossings and median islands. The streetscape should include pedestrian amenities, such as benches and landscaping.

The application of streetscape improvements (or the complete street concept) is seen as one of the ways to enhance pedestrian connectivity. As a result, it is recommended that:

- *The installation pedestrian system needs to be expanded as necessary in the Community District and Mission District.*
  - *The improvements in the Community District should include redevelopment of New Mexico Avenue as a pedestrian corridor. This new pedestrian spine should be connected to a strong sidewalk system throughout the Community District.*
  - *Arizona Avenue should become a primary pedestrian linkage with an off-street, multi-use path that extends from the family housing area east of First Street to the quality-of-life area west of Eleventh Street.*
  - *Streetscape features in the Community District should be pedestrian oriented and patterned on the complete streets concept.*
  - *The Distinguished Visitor routes should have an enhanced streetscape treatment that includes pedestrian amenities.*
  - *Streetscape improvements in the Mission and Mission Support Districts should not require the same level of care as complete streets, because this area is not envisioned as a social/gathering area, but appropriate pedestrian circulation paths are necessary to minimize pedestrian and vehicle conflicts.*

Other circulation improvements:

- *The installation-wide pedestrian circulation system should be developed, and where feasible, accommodate multi-use pedestrian options, as well as provide opportunities for a pedestrian linkage to the City of Alamogordo.*
- *The west ramp, north ramp and outlying research and development areas do not have high levels of vehicle traffic; however, where feasible, a sidewalk should be constructed to reduce vehicle/pedestrian conflicts*
- *As pedestrian sidewalks are constructed in the future, separation between the sidewalk and the roadway should be established to promote a sense of pedestrian safety on higher volume streets. Separation between the roadway and sidewalk shall be a minimum of five feet.*
- *Design team look beyond the development site for pedestrian improvement opportunities that connect new development sites with adjacent services and amenities, which will provide an alternative to short-trip driving, ideally embodying the LEED concept of "Community Connectivity."*
- *Vehicle circulation improvements that should be considered include an extension of Arizona Avenue to intersect with Sabre Road on the north side of the flightline. This would provide a significant improvement to base-wide vehicular circulation. Road geometry of Arizona Avenue should be improved north of First Street to allow for pedestrian circulation from the family housing area and to improve safety for a higher volume of traffic.*
- *As development occurs consideration needs to be given to the fact that arterials should have a limited number of curb cuts to minimize safety hazards.*

Appendix B provides additional measures for pedestrian amenities, landscaping and plant selection.

Fully landscaped crosswalk with curb-cuts successfully surrounds Building 224, in direct contrast with dead-end sidewalk across Idaho Avenue.

Striped crosswalk approaching Airmen's Attic shows appropriate use of boulders and bollards for AT/FP, but could be improved with decorative paving, landscaping, seating, lighting, and shade.

## 5.2.3 Parking and Roads

The amount of parking at the base seems to be more than adequate under current conditions. This appears true even during increased Force Protection Conditions (FPCON), when parking lots too close to the entrances of older facilities are barricaded. Newer facilities have parking lots that were developed at the appropriate distance from the building to meet AT/FP standards. As development infill occurs, the need for parking locations will change. New design should be guided by the principles below.

- *Include sustainable design features, such as green infrastructure design solutions for storm water management that are appropriate to locate in a new parking lot development. These systems can be as simple as draining storm water to landscaped areas instead of collection systems to promote infiltration and slow down excess runoff. Green infrastructure design solutions must be designed and sited to prevent sinkholes that can occur due to the soluble nature of local soils. Green infrastructure that incorporates vegetation shall use native vegetation adapted to alkaline and saline content of local soils.*

- *Limit parking to what is required and no more. Maximize the use of existing parking and consider opportunities for shared parking.*

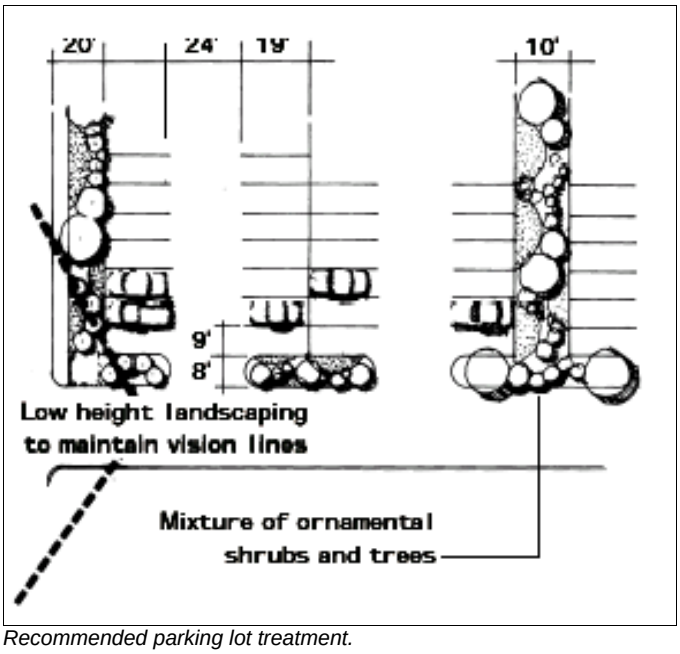
- *Consider reductions in new and existing street sections and parking to reduce runoff and heating effects. Special consideration should be given to the reduction of older parking areas which are not compliant with AT/FP requirements. Eliminate "on-street" parking. If possible, locate parking behind the building it serves.*

- *Consider sustainable paving materials, such as lighter colored pavements and permeable pavers.*

- *Consider the use of narrower roads where appropriate. Road sections are commonly oversized to accommodate infrequent truck traffic instead of sized to meet the design speed and typical traffic volume. Post truck routes and prohibit regular truck traffic to reduce a 24'-wide road section to 20'-wide[1] or to incorporate a bike lane into the existing section.*

- *Incorporate landscaping, including site walls and low- or no-water vegetation at all primary and secondary road edges. Additionally, use screen walls, natural topography and landscaping to screen parking from the public rights of way and adjacent buildings.*

[1]UFC 3-250-18FA allows a 20' wide road section for two-lane roads with no truck traffic, an ADT less than 1,000 and a peak hour volume of 150 vehicles, which may match some of the lower volume roads at Holloman AFB.




*Recommended parking lot treatment.*

- *Use separate parking lots accommodating 50 cars or fewer rather than large lots of 200 or more. Small parking areas reduce the negative visual impact and allow opportunity for additional landscaping. Mitigation measures for the heat-island effect shall be considered in the design process of all parking lots, especially in cases where larger parking lots are required by functional layout.*

- *When selecting trees for parking lots, use rounded, high-branched, dense, and relatively fast-growing trees. Additionally, select trees that can withstand harsher conditions such as sun, glare, heat, and reduced water supply. Avoid trees with low-growing branches. Choose trees and shrubs that require minimum maintenance and will not litter the parking area with branches, fruit, or nuts.*

- *Set aside five percent of parking for car/vanpools and five percent for low-emitting vehicles in preferred locations near building entrances, embodying the LEED concept of limiting environmental impacts from automobile use and encouraging alternative transportation.*

- *Consider adding bus service between key locations at peak times to limit vehicular traffic.*

- *Consider the addition of bicycle paths and shaded bike storage racks to encourage bicycles over vehicles.*

Additional site design direction is included in Appendix B, Section B.3.

Parking areas in front of the BX and Community Center are completely devoid of shade, which contributes to heat island effect. The area could be improved with planting islands.

## 5.2.4 Landscape

Landscape development is limited by the southwest desert environment. Long, hot summers with low rainfall quantities make it a challenge for ornamental plant material to thrive. Existing vegetation at Holloman AFB includes mainly drought-resistant shrubs. The base also makes use of low barrier walls and decorative rocks as landscape elements. Around newer buildings such as the fire station (Building 525) landscape shrub beds include drip irrigation and other xeriscape elements that are appropriate for this climate. Because the salinity of the native soil discourages most plant growth, it is often replaced with topsoil in ornamental planting beds. The largest user of irrigation at Holloman AFB is the golf course. Currently under construction is a piping system that will transport effluent from the sewage treatment plant to the golf course for irrigation. There are also several areas of Astroturf present on the base, including the static plane display and sports fields.

- *Temporary irrigation should be used to establish native or naturalized landscape installations. All future landscape should be designed to avoid the need for long-term irrigation. Permanent irrigation shall be limited to special situations approved by the base.*

- *Where irrigation is essential, the design team should explore sustainable options, including drip irrigation and gray water. The benefits of drip irrigation as a sustainability practice must be weighed against mineral buildup concerns at the base. In the past, bubbler or spray-head-type systems have been preferred by the base.*

- *Use of effluent water for irrigation is encouraged where feasible. This should become a more workable option upon completion of the piping system from the sewage treatment plant.*

- *Strategically placed landscaping should be provided for all new facilities to provide necessary shading for the facilities' solar orientation. Where irrigation options support the use of deciduous trees, place them on the south, east, and west sides to shade buildings during the summer but allow sun in the winter months.*

- *Landscape designs should include low barrier walls and decorative rocks and paving in combination with plantings to maximize impact while minimizing irrigation needs.*

- *The use of natural turf should be avoided. Artificial turf should be considered as an option.*

- *Due to the environmental conditions and limited landscape development at Holloman AFB, all reasonable measures should be taken to preserve existing trees, especially large specimens over an eight-inch caliper.*

More specific landscape recommendations are included in Appendix B, Section B.4.

The low wall barrier around the Auto Hobby Shop yard does a good job screening functions beyond.

Berming and native plants at the dormitories create an effective AT/FP buffer.

This low wall barrier with decorative block filigree at the Dining Facility adds interest and human scale to the base landscape.

## 5.2.5 Open Space

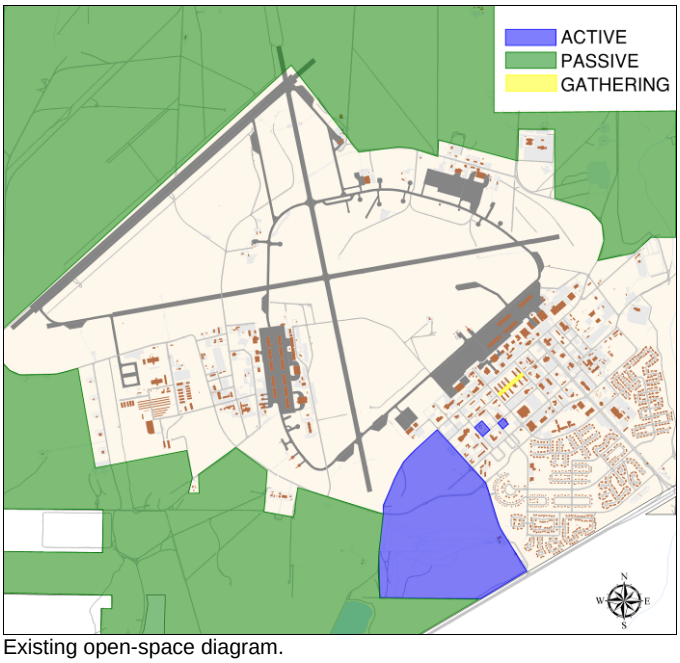
Holloman AFB has both passive and active open space. Passive areas include the area south of Forty-Niner Avenue; most of the area north of Dezonia Road; and the area north of the test track. The northern areas are covered with sparse native vegetation and a limited network of paved roads.

Active open spaces on the base include the outdoor recreation areas south of Eleventh Avenue and surrounding Sixth Street, which consist of softball fields, a football field, running track, playground and community pool area.

Additionally, small covered break areas are sprinkled throughout the base. These include picnic areas with metal or shingled roofs or fabric canopy covering, and three-sided courtyards with outdoor seating, grills and limited vegetation.

There are also some large gathering spaces incorporated into the design of the various barracks complexes and a few recreational trails have been constructed in isolated areas at the base.

The fabric canopy over the children's play area (south of Building 513) is adequate to shade the equipment and make the space usable in the summer heat.




Existing open-space diagram.

The recommended level and frequency of open space development should vary depending on the needs of the development and its surrounding land uses. When planning for future development and open space consider the following.

- *There are large amounts of undeveloped land to the north and south of the containment area, which creates opportunities for future growth and open space. Environmental and functional constraints need to be carefully considered in master-planning these areas.*

- *Infill opportunities exist throughout the more developed sections of the base. Prior to infilling any area, the function and quality of the area should be evaluated for facilities, open space, or both.*

The large gathering space in the dormitories area is one of the few large pedestrian corridors on base. It provides adequate pedestrian access to numerous surrounding facilities.

- *Large, active open space areas should be preserved to function as gathering/multi-use spaces in the troop housing areas.*

- *Occupied buildings should include outdoor break areas equipped with:*

  - *Picnic tables and/or benches that include recycled plastic lumber, special pavement (colored concrete or precast concrete pavers) and barbecue grills where appropriate.*

  - *Shade and shelter from the wind. Shade is critical and is best accomplished by the form of the related building or with shade structures compatible in color, form, and material to the adjacent building. Shade and windbreaks can also be accomplished through the planting of landscape material and berming, but irrigation needs and sources must be carefully considered when landscape is selected.*

Picnic tables, fabric canopy and screen wall provide the basic essentials of an outdoor break area at Building 325.

- *ADPs as well as site-specific developments need to consider open-space linkage between the areas/site and the rest of the base. Linkage corridors need to be created and enhanced in order to encourage and facilitate pedestrian movement. Refer to Appendix B, Section B.4, for recommended species of plants. Site furnishing and component recommendations can be found in Appendix B, Section B.3.7.*

## 5.2.6 Energy and Utilities

Holloman AFB has undertaken a number of energy efficiency projects to meet higher-level policy goals and directives and is pursuing action on a number of water efficiency projects. Base staff is approaching energy and utility conservation from all angles of infrastructure improvement and policy changes to meet the near-term policy goals. Further reduction of the base's resource consumption to meet long-term energy and resource conservation goals is a complex problem that will require a holistic approach to energy and water utilities.

Energy saving recommendations presented in this section are taken from the *Holloman AFB ISA, 2010*. The recommendations build upon sustainability initiatives already in place and are specific to the local conditions and previous, successfully implemented practices. Recommendations should be reviewed by planning and design teams for consideration in ADP and capital improvement projects as well as site-specific projects.

***Follow the energy, water design and equipment standards as shown in the "Air Command Energy and Facility Management Policy" 31 December 2007. A new policy should be out in 2011 or 2012. Replace this policy when the latest approved "Energy and Facility Management Policy" is received from ACC.***

### 5.2.6.1 Heating and Cooling

Air conditioning is the primary thermal load at Holloman AFB. The base has so far mostly used individual air-cooled chiller and boiler units at each building for heating and cooling, while a few buildings use direct-expansion package units. Water-cooled chiller units and central utility systems have so far been avoided on the base due to exceptionally high water hardness.

- *Planning of new buildings should consider distributed water heating and cooling systems. Such systems will allow for greater flexibility in the future to connect to centralized cooling systems or solar thermal heating systems. Excessive water hardness can be addressed by chemical additives in closed-loop systems.*

Increasing density through infill development with centralized utility plants and distribution systems serving multiple buildings within a campus offers a possible order of magnitude improvement in energy savings compared to current development practices.

- *Consider construction of an ice storage/central plant in dense areas on the base to create a district cooling system. Larger cooling districts attached to a single, central plant provide more benefits because the distribution system acts as a thermal reservoir (a "flywheel" effect) and the aggregation of equipment is often more efficient and easier to maintain than individual units at each building.*

Approximately half of the buildings on base use boiler-based heating systems and half use direct-expansion units.

- *Any modification to the type of heating used should favor non-electrical power sources to reduce the Source 2 greenhouse gas emissions caused by the local energy provider's use of coal to generate electricity.*

- *Consider strategies for incorporating solar thermal energy to supply heating for buildings, including thermal massing techniques appropriate for the desert climate, like rammed earth walls or trombe walls.*

- *As the existing boilers (and hot water heaters) require replacement, upgrade to 94 percent or higher condensing-type boilers in the event that district heating or other more sustainable systems cannot be used.*

- *Within individual buildings, consider using variable refrigerant flow systems to capitalize on internal heat gains to minimize heating required for the exterior envelope of buildings as an alternative to water source heat pump systems.*

## 5.2.6.2 Metering and Controls

Advanced metering and control management systems are installed in buildings larger than 35,000 square feet, which was the ACC standard with some additional sub-metering in place for reimbursable tenants. All new and existing systems should be metered according to the latest approved Air Force Facility Metering Policy, 10 July 2009. The policy provides specifications for use of advanced metering and water metering.

- *Ensure advanced metering and control systems are compatible with existing systems to enable the Base Energy Manager to control the energy load of the building based on current energy demand and varying rates in the most advantageous manner to minimize energy use and energy costs.*

- *Consider including real-time energy use displays in each facility, so users are aware of energy consumption. This practice often results in significant savings since building occupants take charge of their own energy habits.*

- *All buildings with >= 10 tons of HVAC should have digital control of the HVAC and all thermostats should be controlled by the EMCS system. A two-hour override should be included with all thermostats.*

## 5.2.6.3 Water Utilities

Holloman AFB has previously installed high-efficiency water fixtures on many areas of the base. The base will also be intercepting and storing effluent from the base operated wastewater treatment plant for irrigation of the golf course and non-potable construction water.

- Consider the use of the effluent system to satisfy irrigation needs for new projects within the vicinity of the golf course, particularly projects that would help to extend effluent water towards the two remaining sports fields using potable water for irrigation. See Section 5.2.4 for the use of effluent water and xeriscaping for water irrigation.

- Consider using effluent water for toilet flushing and other non-potable water uses in new construction on the base, as acceptable to current local plumbing code.

- Continue the use of high-efficiency water fixtures that implement automatic fixture sensors, flow restrictors and flow aerators as well as low-consumption toilets and waterless urinals for each new project.

## 5.2.6.4 Renewable Energy Infrastructure

Local climate conditions at Holloman AFB make it well suited for use of solar energy for power generation and thermal energy. Other renewable energy sources such as wind energy and geothermal present less opportunity, although these potential sources should never be totally discounted because advances in technology continue to provide more durable and reliable products.

### Solar Energy

Solar energy is the strongest candidate for renewable energy at Holloman AFB. The application of solar technology and use should consider the following:

- *Evacuated tube technology solar hot water panels. Damaged tubes can be easily replaced without replacing the entire panel. Water does not leak from the panels when they are damaged since the evacuated tubes are exposed and do not contain water, and the panels continue to allow water throughput and heating even when individual tubes are broken.*

- *Use of small- and large-grid arrays of photovoltaic panels for power generation. Solar PV panel arrays can serve a dual purpose of providing shade to reduce urban heat island effects.*

Should the use of solar energy systems be determined to be impractical for current project budgets, solar-ready construction with the following traits should be considered, at a minimum during building siting and design:

- *Orient the building with a south-facing roof that is un-shaded from 9 AM to 3 PM with a large, rectangular area free from vent pipes, skylights and other penetrations. Roofs do not need to be exactly south facing, but should be within a southeast to southwest orientation. The roof should have adequate uninterrupted square footage for a useful system of panels. At a minimum, at least 200 square feet is required for any solar array. This provides sufficient room for the array and maintenance access and*

*complies with most fire codes. Ultimately, the size of a solar thermal system should be determined by estimating the buildings' hot water demands. Sizing of a photovoltaic array is usually constrained by available space and budget, as excess electricity can be returned to the grid.*

- *Include wire and piping in new construction or renovations so that at a later date the building can be easily augmented with solar PV (electric) and/or solar hot water systems.*
- *Ensure structural capacity to carry future panels and equipment related to solar energy capture, including wind load considerations.*
- *Provide roof access for installation and maintenance.*

Solar-ready construction allows the Holloman AFB energy manager to procure PV or solar hot water systems as funding becomes available and/or through power purchaser agreements with the local utility without costly and disruptive facility renovations.

**Ground Source**

Local conditions at Holloman AFB have been studied through a test well for ground source geothermal and determined to be marginal.

- *Designers contemplating ground source energy should review the results of the geothermal test well study and determine if geothermal is appropriate for the project*.

**Wind Turbines**

Wind resource estimates developed by AWS Truewind in conjunction with the National Renewable Energy Laboratories show that local conditions at Holloman AFB provide marginal opportunity for wind power.

- *Designers contemplating wind energy should review the wind resource estimates and determine if wind energy is appropriate for the project.*

## 5.2.7 Storm Water

Holloman AFB currently operates a storm water system that primarily focuses on the collection and conveyance of storm water away from facilities on base. Site and facility planning for the base should acknowledge that these practices are not sustainable and should consider the following, mostly simple, improvements to existing facilities to disconnect the flow of storm water from collection systems to encourage infiltration and reduce the rate of storm water runoff:

- *Disconnect downspouts from underground, piped systems and redirect the discharge to splash on-grade blocks.*
- *Add curb cuts along existing streets to redirect water collected in gutters to landscaped areas.*
- *Where grades allow, remove the curb and gutter along parking areas to sheet the water off of the parking lot into landscaped areas.*
- *Stormwater design solutions must consider the soluble nature of local soil and the potential for sinkholes.*

EISA Section 438 requires all new and redeveloped federal facilities over 5,000 SF to "use site planning, design, construction, and maintenance strategies for the property to maintain or restore…the predevelopment hydrology…" To meet this requirement, designers of new projects at Holloman AFB should consider the following:

- *Where infiltration of water is planned to be used, designers should be sure to study the infiltration rate of local soils and verify the seasonal conditions of the groundwater table. Local soils at Holloman AFB may react with surface water runoff creating unforeseen erosion conditions.*
- *Designers should be aware that conveyance channels and systems for high flows will still be necessary to accommodate larger, high-intensity storm events at Holloman AFB.*
- *Collocate stormwater management features with AT/FP clear zones to the extent allowable by AT/FP requirements.*

# 5.3 Architectural Design

Buildings at Holloman AFB consist of a variety of types and designs that convey a fairly unified aesthetic throughout the installation due mainly to a common palette of exterior materials and colors. One goal of this section is to convey which architectural elements are encouraged to be maintained in order to preserve this installation's unique image.

The buildings at Holloman AFB convey general uniformity through color palettes and scale. Other characteristics, such as materials and form, vary depending on the building district and function. The districts defined in *Section 2 Installation Image* are organized by function and, to a lesser degree, by architectural character. Each district at Holloman AFB contains various elements and materials from other districts. The purpose of this portion of the document is to provide architectural guidance that will result in providing the installation with a degree of visual order, while allowing designers to seek creative solutions that respond to the unique challenges associated with the contextual setting of the base as well as each individual site and building. It will also serve to guide the designer in maintaining positive elements of each district and in helping to build architectural consistency, without inhibiting the flexibility to provide imaginative design solutions.

## 5.3.1 Architectural Order

Architectural order requires a holistic planning approach that considers solutions appropriate to the building site, sensitive to the built context, reflective of the program needs and scale and responsive to the hierarchical importance and that fully implements SD&HPGBD objectives.

### 5.3.1.1 Plan Complexity and Geometry

A significant portion of the existing buildings' plans tend to be simple due to the straightforward function of the building. Examples of this simplicity would be hangars and maintenance or storage buildings, which are more predominant in the industrial areas and flight line areas (Mission District and Mission Support District). In other areas of the installation (Community District), simple rectangular plans are also prevalent in buildings such as the barracks and administration. In some cases, a complex plan geometry is the result of multiple building additions over time, rather than an intentional design approach.

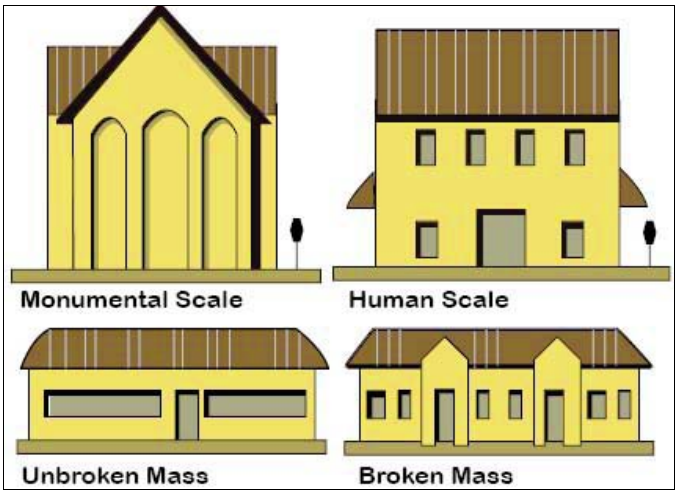
For future development, plan complexity and geometry should be derived primarily from the building's type or function. Less complex programs will still likely result in straightforward plan geometries. However, more complex programs and uses should be seen as an opportunity to provide more interesting buildings, which can better respond to site constraints or better support sustainable design goals such as providing opportunities for enhanced daylighting and views.

The Fitness Center (Building 588) is a good example of complex plan geometry.

A good example of the use of complex plan geometry is the new Fitness Center (Building 588). It is evident that multiple internal functions inform the plan geometry of this building. The complex form provides a more visually interesting building than that of a simple rectangular plan.

### 5.3.1.2 Building Scale and Proportion

Scale refers to the size of building elements in relation to people and surrounding buildings. Buildings of monumental scale feature predominantly vertical facades that dwarf a person and surrounding buildings. Buildings of human scale have more horizontal facades designed to relate to the size of a person. Additionally, the sizes of roof forms, windows, ornament, and landscaping all affect a building's scale. In general, larger windows, plants, and taller roofs relate less to the human scale than do smaller elements. The scale of most existing buildings on Holloman AFB is human rather than monumental scale. Obvious exceptions to this would be hangars and other large flight line or industrial facilities.




Scale and mass diagrams.

- *Unless necessary due to building function, monumental architectural design should be reserved for more ceremonial buildings, such as worship centers and headquarters complexes. These buildings often make use of large, glazed areas at entrances and oversized fenestration elements to draw users to the building entry and to create a scale appropriate to the building's use.*


Inappropriate use of monumental scale.


Appropriate use of monumental scale.

For new developments, building scale and proportion should vary by building type, which in turn will usually vary by district. In general, buildings should be of a scale appropriate for their use or importance. If a building has functions that require large scale building masses, but is not of particular importance or a ceremonial use, effort should be taken to humanize the building scale. One way to achieve this is to surround large-scale functions with smaller-scale functions, thus making a more human scale at the points where people see or approach the facility. An example of this approach is Building 823 on the west ramp.


Lower massing is a good way to help camouflage the larger portion of the structure behind (Building 823).


Stepped massing starts to humanize Building 294, making it more aesthetically pleasing.

Another good practice for buildings with large uninterrupted masses is to use horizontal banding to minimize the impact of these forms by giving them some visual interest.

- *Banding can be in the form of a contrasting material or recesses in the main building veneer. When brick is used, recessed or projected brick soldier courses can create a band.*

Appropriate use of banding at Building 20.

Modulation of vertical façade elements at the German Air Force Building 45 creates a nice rhythm.

Appropriate use of banding at Building 588.

Water tables, or wainscot, may be used to create more of a human-scale for buildings. Water tables should be made of a durable material such as brick or stone. At pedestrian-accessed buildings, the height of the water table should be about one-third the height of the total wall. At larger structures, such as hangars, the proportion should be closer to one-fifth. At buildings that have only one veneer material, the appearance of a water table can be created using banding, or varying wall projections and colors. A good water table example occurs at the new Fire Station, Building 525.


Contrasting material creates a water table look at Building 525 in order to make the building more interesting.

Efforts should be made to modulate vertical elements of the façade, as well. Windows along long stretches of walls could be arranged into groups of two or three and patterned along the wall. Long, straight walls can also receive vertical treatment to break up monotonous horizontal planes. This can be achieved by the use of pilasters and downspouts or varying the protrusion of the wall itself. Successful use of both aforementioned tactics can be seen on the German Air Force Building (45) as well as other locations around the base.

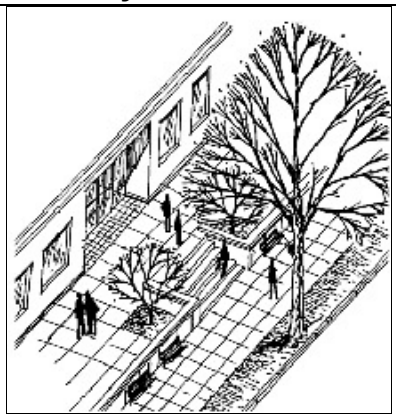

Appropriate use of pilasters and downspouts to modulate wall (Building 57)

Building scale should not be confused with building size. Most buildings at Holloman AFB are single-story buildings. Exceptions include the dormitories and some office buildings. Compact floor plans that extend up, rather than out, reduce land development and utility distribution, thus contributing to sustainable goals.

- *Designers should weigh the building's importance and surrounding context against sustainable goals when deciding upon the number of stories.*

## 5.3.1.3 Symmetry/Hierarchy of Elements

Major building elements should be sectioned into order of importance. Entrances, walkways and non-accessible building faces should all have distinct characteristics that give occupants visual signals as to how the building may be accessed.


Entrance is positive visual experience.

- *Main entrances should be covered for shade and weather and have a vertical appearance that provides a strong indication of pedestrian access. Main entrances should also face the road and be clear of visual obstructions that would block the view of the entrance from the street.*

The pedestrian entrance at Building 224 is clearly delineated.

- *Secondary entrances should have a low roof covering. The appearance of secondary entrances should be minimal in scale and not compete with the main building entrances.*

- *Walkways or colonnades along the face of a building might have a roof covering. In these instances, the roof should be lower than the roof over the main entrance to provide a visual indication of a secondary hierarchy that leads into the larger, main hierarchy.*

- *Major building facades that do not relate to entering the building should be relatively simple and clear of architectural elements that would deter from the* building's entrances. Roofs at these areas should have continuous, straight eaves and ridge lines.

### 5.3.1.4 Building Open Spaces

Open spaces relating to the interior of the building are prevalent across much of Holloman AFB. Office buildings, recreation facilities and barracks all have outdoor areas with a combination of humanizing features, as discussed in *Section 5.2.5 Open Space*.

- *Efforts should be made to create a strong connection between large interior spaces and outdoor spaces.*

With the harshness of the summer sun in this climate, one of the keys to making outdoor spaces useable is to provide shade. Windbreaks are another critical characteristic of useable outdoor spaces at Holloman AFB. In many cases, the building footprint and orientation can create the necessary wind and sun protection. Low walls, berms, and landscaping can also help block strong winds.

The U-shaped floor plan and large shade trees create a pleasant protected courtyard at Building 800.

Successful use of daylighting systems (Building 270).


Successful use of daylighting systems (Building 588).

Daylighting and views to the outside are significant elements that support sustainable design goals and must be incorporated whenever possible. Additional vertical height typically seen in large open spaces, such as vehicle maintenance bays or dining halls, should be leveraged to provide as much natural daylighting as possible. Translucent panels, in the form of clerestories and wall panels should be used to furnish additional daylighting.

- *Holloman AFB promotes the use of daylighting as shown in the photographs on this page.*

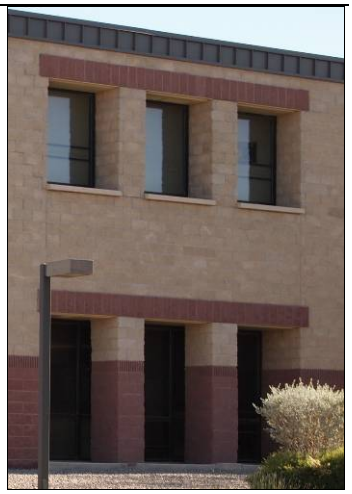
Entries and vestibules should have a strong visual connection to outdoor spaces. These areas also provide a transition between indoor and outdoor environments. Any space inside a building that has access to a courtyard, main entrance or other pedestrian-friendly area should have as much glazing as is possible and practical.

## 5.3.2 Architectural Elements

Along with the items that define architectural order, there are also various architectural elements that define the overall look of Holloman AFB. These elements include fenestration, roof elements, and exterior building materials.

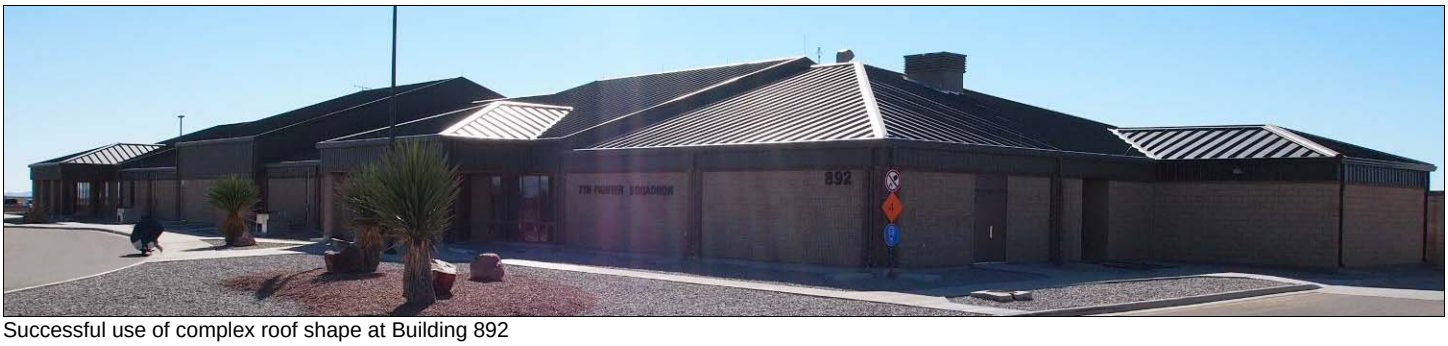
### 5.3.2.1 Fenestration

The majority of windows on existing Holloman AFB buildings are punched openings, which is an appropriate window form for this locale due to the harshness of the summer sun. Large areas of glazing are sometimes used on more prominent buildings or to highlight building entrances.



Fenestration well shaded by a deep overhang at Building 224.

- *In new construction, large areas of glazing should not be used anywhere on a building unless it is north facing, or can be properly screened from direct summer solar gain.*



Successful use of complex roof shape at Building 892

Translucent wall panels can be an attractive way to provide natural light for large interior spaces when views are not possible, such as in clerestories. All new or replacement glazing must be insulated, tinted and have a Low E coating to achieve a high level of energy efficiency.

- *Include simple architectural techniques for solar light shelves that provide natural sunlight into a work area and help reduce the need for artificial lighting. Panels with an architectural feature can be incorporated to reduce or eliminate direct sunlight into windows during peak hours. This will reduce heat input into a building.*

Where possible include simple architectural techniques to provide solar light shelves that provide natural sunlight into a work area and help reduce the need for artificial lighting. Panels with an architectural feature can be incorporated to reduce or eliminate direct sunlight into windows during peak hours, thus reducing heat input into a building.

See Appendix B.2.3, for additional design direction.


Fenestration well shaded by a deep overhang at Building 202.

## 5.3.2.2 Roof Features and Form

Existing roof forms on the installation vary widely. Newer buildings are typically simple gables (both low and steep slopes) or hip roofs. The gable-end façade shape has been incorporated as a feature in several building designs on the installation, including the Heritage Center (25) and The Learning Center (224). Flat roofs are used occasionally on newer buildings of larger footprints, such as Building 274. Older buildings include all of these styles as well as mansard designs.

In general, roof shapes should be simple. More complex roof designs can be an effective way to emphasize more important buildings on the installation without making their floor plan overly complicated. Building 892 is a good example of an interesting series of roof forms utilizing hip roof shapes.

Existing fascias on roofs with standing-seam metal roofing on Holloman AFB have profiles of varying width, depending on the age and function of the building. The new dining hall facility on the west ramp, Building 812, is clad with standing-seam roofing at the eaves, thick prefinished metal at the rake edges and a thinner trim near the front entrance.


Thick metal rake and standing seam cladding at eaves at Building 812 may be more appropriate on a larger scale building.

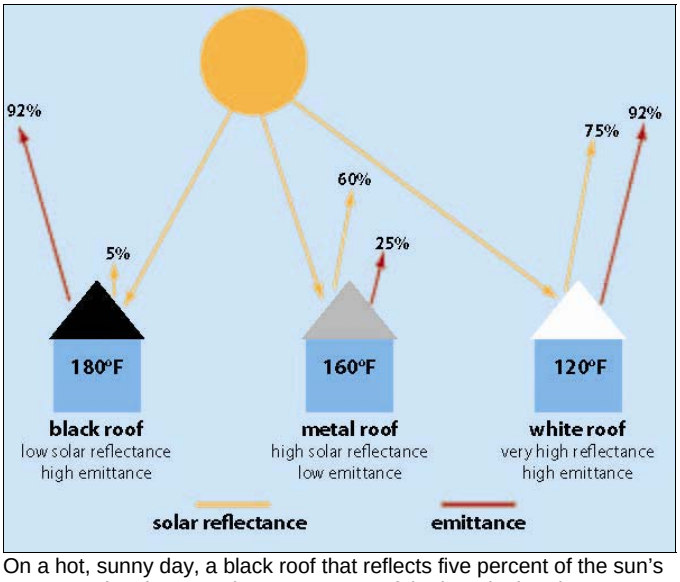
A typical roof slope for steep-sloped roofs is a minimum of 3:12 for most of the installation. Very large buildings, such as hangars, can have a more minimal slope of 1:12 if an appropriate, structural-type standing seam metal roof is provided.


Thin metal rake creates a clean edge but the standing seam fascia at Building 812 entrance is somewhat heavy in appearance. This building also utilizes a strong gable-shaped feature wall.

- *All roofs for new construction should slope unless the building design or other factors do not allow it, however "low-slope" roofs (1/4:12) can be a good solution for larger building masses.*

If low slope roofs are used, a white membrane roof with high solar reflectivity should be used in order to help reduce the heat island effect and utility usage. Roofs at major building elements can have a steeper slope in order to create visual interest. Slopes should not exceed 8:12 at these areas.

Existing low-slope roof can be modified with cool roof coatings. The coating is a surface treatment that has the consistency of thick paint and contains additives that improve their adhesion, durability, suppression of algae and fungal growth, and ability to self-wash, or shed dirt, under normal rainfall. The coating can be applied to a wide range of existing surfaces, including asphalt capsheet, gravel, metal, and various single-ply materials.




On a hot, sunny day, a black roof that reflects five percent of the sun's energy and emits more than 90 percent of the heat it absorbs can reach 180°F (82°C). A metal roof will reflect the majority of the sun's energy while releasing about a fourth of the heat that it absorbs and can warm to 160°F (71°C). A cool roof will reflect and emit the majority of the sun's energy and reach a peak temperature of 120°F (49°C). (Reducing Urban Heat Islands: Compendium of Strategies, 2008)

The installation standard at Holloman AFB has been a dark bronze metal roof color. A few lighter-color metal roofs exist on the northeast end of the base, and tan is used in hangar areas, but dark bronze is by far the predominant material. Manufacturers are responding to the market demand for higher solar reflectivity in dark roofing material. The market now produces standing seam metal roof in dark bronze with a 30 SRI. If a roof is "steep" sloped (according to LEED, that's >2:12 slope), it has to have at least an SRI of 29 to earn LEED credit. When considering the material and color choice for a roof surface, consideration must be given to both solar reflectance and thermal emittance because these properties determine a roof's temperature. The larger these two values are, the cooler the roof will remain in the sun.

The use of vegetative roofs at the base should be considered. The Air Force Engineering Technical Letter (ETL) 11-8: Decision Criteria for Installing Vegetative Green Roofs provides guidance for determining if installing a vegetative roof on a CONUS Air Force facility is suitable. The intent is to give the base a simple tool to justify selection or non-selection of a green roof based entirely on return on investment. According to the ETL, the energy benefits of a green roof at Holloman AFB are high, but the irrigation demand is also high. The overall benefit ranking is just below good.

Roof overhangs can be implemented into new construction, where possible. Overhangs can be especially important elements at south-facing glazing to reduce direct solar gain in summer months. Trellis elements can also be used for sun shading.


Minimal/flush overhang is appropriate for utilitarian buildings.

- *Industrial buildings may have minimal or flush overhangs.*

See Appendix B.2.1, for additional design direction.

### 5.3.2.3 Other Building Features

At main building entrances in the recreational and office district areas, gabled roof canopies are often used as a visual element for covering entrance walks. This design feature could be appropriate for new construction that will have numerous occupants entering the building daily. Concrete block column enclosures or walls are typically used to support the canopies, as shown at Building 55 below. Canopies create shading for glazing at the building entrances, and in some cases are combined with protruding vestibules.

- *All new, occupied buildings should incorporate vestibule design to control heat gain and reduce tracking of pollutants into the building.*

As previously discussed in Section 5.3.2.2, the gable-shaped wall element is used extensively throughout the base. Hangars are designed as a series of gable-roofed boxes, and are most likely the elemental form from which this language is developed. The gable-shaped wall is utilized in a number of different building types in a number of different ways. Building entrances are designed to penetrate through it, as in the case of


Typical hangar buildings on the west ramp exhibit gabled roof vocabulary. This simple shape is an appropriate choice for hangars.

Building 234, or to pass alongside it, as seen at Building 812. A Venturi-like split gable appears at Buildings 17, 20, and 270. This language could be an opportunity for the introduction of clerestory lighting.

The canopy on masonry supports at Building 55 clearly delineates the entry.

Pronounced “book-end” gables and gable as front canopy at Building 234 are an important part of the context at Holloman AFB.


The building entrance is parallel to gable form at Building 812, demonstrating another effective gable technique.


The split gable at Building 17 is a third type of gable shape used at Holloman. This shape provides the opportunity for clerestory lighting when used in the proper solar orientation.

Decorative lighting may be used for visual interest at major architectural elements. Newer building such as Fire Station 525 and Fitness Center 588 make use of building-mounted sconces and site lighting bollards.

- *Wall-mounted light fixtures should have a simple profile and be a “cut-off” type that will not contribute to light trespass.*

An effective use and type of a building-mounted sconce at the Fire Station (Building 525).

Semi-recessed downspout details appear on a number of buildings, providing interest and articulation. This level of detailing should be incorporated into new buildings in the office and recreation districts.

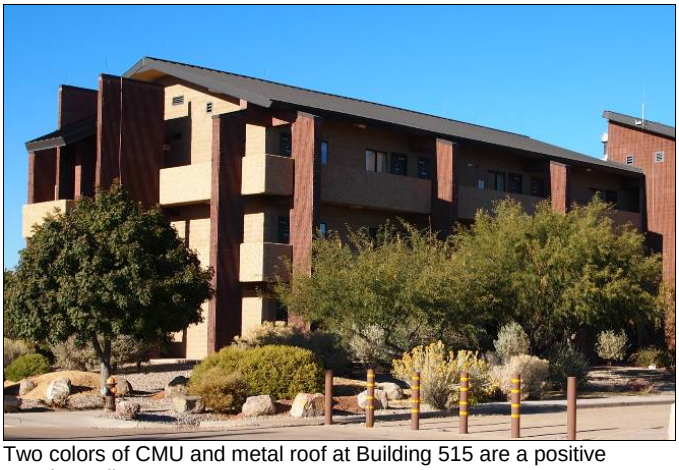

Semi-recessed downspouts at the German Headquarters building (45) are a nice detail.

## 5.3.2.4 Materials—Occupied Buildings

The variety of building types at Holloman AFB can be divided into two overarching categories: Occupied Buildings and Functional Buildings. The existing architecture of the base includes a number of styles and treatments that have evolved over the years. These include painted CMU, decorative

CMU, brick, stucco, EIFS, and metal panels. A number of older buildings have been painted to lend a sense of uniformity to the installation through color. The design of future buildings should be based on use category, either Occupied or Functional.

- *Careful siting of new buildings near buildings of similar function, and therefore similar architectural character, will help add definition to the districts on the installation.*



Two colors of CMU and metal roof at Building 515 are a positive exterior wall treatment.

The most positive exterior wall treatment is the integrally-colored CMU seen on newer buildings. The German Barracks 515 and the new Fitness Center 588 represent a successful application of split-face CMU. Ribbed CMU and open-pattern CMU are seen in building facades and screen walls throughout the installation.

- *Different types of CMU can add texture and interest, but should be carefully considered based on availability and maintenance concerns.*

## 5.3.2.5 Materials—Functional Buildings

Functional buildings, including industrial and flight line buildings in the Mission and Mission Support Districts, consist mainly of pre-engineered metal buildings with metal roofs. Historically a dark bronze metal has been used for roofs, cap flashings, downspouts, door paint and window frames. However, as energy-efficiency requirements have increased, the obvious benefits of lighter-colored exterior materials in a desert environment have become more important. A few functional buildings with lighter roof materials exist on the installation.

- *When considering metal colors, designers should weigh the potential energy benefits with the need to be sensitive to the architectural context.*

A typical pre-engineered metal building (93) is appropriate for utilitarian functions.

Light-roofing, such as this example (Building 375), is encouraged to reduce solar gain.

Where buildings are placed near the edges of occupied and functional areas, the designer should make an effort to provide a blended design. The new AGE Building 818 is a good example of a mix of acceptable exterior wall finishes. The majority of the building combines metal panels on higher wall surfaces with split-face CMU on lower walls to compliment the attached administrative area, also of split-face CMU.

The Youth Center (Building 647) provides appropriate context for other similar facilities such as a CDC.

This new AGE building successfully combines CMU and metal panel (Building 818).

### 5.3.2.6 Materials—Educational Buildings

Educational buildings at Holloman AFB are older buildings, constructed primarily of orange brick; painted, tan CMU; and some exposed aggregate panel. The educational area between Arizona Avenue, Arnold Avenue and First Street is enclosed by split-face and decorative CMU walls, separating it physically and visually from the rest of the base. Within the walls, the orange brick buildings exhibit an entirely different character than the rest of the base. Although the colors and details of the elementary school buildings are dated, the scale and texture of the brick, as well as the quantity of glazing, are positive aspects that help to create a different identity for the school zone than the rest of the base. Future educational designs should not use the same CMU and metal panel as the rest of the base as their primary materials. These buildings need to relate to the rest of the base without providing an overly rigid or institutional aesthetic. Maintaining the color palette but changing the scale of materials might be one way to accomplish this.

Additional materials criteria can be found in Appendix B, B.2.

## 5.3.3 Additional Architectural and Design Direction

Appendix B provides additional architectural and design direction that is currently in use and in some cases, preferred, by the base.

Appendix B includes:

- B.1 Background
- B.2 Architectural Design Elements
- B.3 Site Design
- B.4 Landscape
- B.5 Signage
- B.6 Engineering Standards

# 6 List of Acronyms

| | |
|---|---|
| AAFES | Army and Air Force Exchange Service |
| ABS | Acrylonitrile Butadine Styrene |
| ACC | Air Combat Command |
| ADA | Americans with Disabilities Act |
| ADAAG | ADA Accessibility Guidelines for Buildings and Facilities |
| ADP | Area Development Plan |
| AFB | Air Force Base |
| AFH | Air Force Handbook |
| AFI | Air Force Instructions |
| AGE | Aerospace Ground Equipment |
| AICUZ | Air Installation Compatibility Use Zone |
| AT/FP | Antiterrorism/Force Protection |
| BWWSA | Boles Wells Water System Annex |
| BX | Base Exchange |
| CCD | Customer Concept Document |
| CDC | Child Development Center |
| CMU | Concrete Masonry Unit |
| CPVC | Chlorinated Polyvinyl Chloride |
| CRAC | Computer Room AC units |
| CZ | Clear Zone |
| D2 Board | Development and Design Review Board |
| DB | Dry-bulb |
| DDC | Direct Digital Control |
| DeCA | Defense Commissary Agency |
| DFAC | Dining Facility |
| DNL | Day-night Average Sound Level |
| DoD | Department of Defense |
| DOT | Department of Transportation |
| DV | Distinguished Visitor |
| eGP | electronic General Plan |
| EIFS | Exterior Insulation and Finish Systems |
| EISA | Energy and Independence Security Act |
| EMCS | Energy Monitoring Control Systems |
| EPA | Environmental Protection Agency |
| ERP | Environmental Restoration Program |
| ETL | Engineering Technical Letter |
| F | Fahrenheit |
| FPCON | Force Protection Conditions |
| fps | Feet Per Second |
| FW | Fighter Wing |
| HAFB | Holloman Air Force Base |
| HP | Horsepower |
| HQ | Headquarters |
| HVAC | Heating, Ventilation & Air Conditioning |
| I/I | Infiltration and Inflow |
| I/O | Input/Output |
| IC | Interchangeable Core |
| ID2 | Installation Design and Development |
| ISA | Installation Sustainability Assessment |
| JTA-AF | Joint Technical Architecture-Air Force |
| Kw | Kilowatts |
| LEED | Leadership in Energy and Environmental Design |
| LNS | Lonworks Network Services |
| MSG | Mission Support Group |
| MUTC | Manual for Uniform Traffic & Control Devices |

| | |
|---|---|
| NFPA | National Fire Protection Association |
| OSHA | Occupational Safety and Health Administration |
| pf | Power Factor |
| PB | Polybutylene |
| PP | Polypropylene |
| PSIG | Pounds per Square Inch Gauge |
| PV | Photovoltaic |
| PVC | Polyvinyl Chloride |
| QD | Quantity Distance |
| RPC | Regional Priority Credits |
| RTRP | Reinforced Thermo-setting Resin |
| SD&HPGBD | Sustainable Development and High Performance Green Building Design |
| SRI | Solar Reflective Index |
| TAC | Tactical Air Command |
| UFAS | Uniform Federal Accessibility Standards |
| UFC | Unified Facilities Criteria |
| USACE | U.S. Army Corps of Engineers |
| USAF | United States Armed Forces |
| USGBC | United States Green Building Council |
| WB | Wet-bulb |
| WWF | Welded Wire Fabric |

# 7 List of References

Community Center Transportation Improvement Plan, 2010

Cooperative Agreement for the White Sands Pupfish, 2006

Holloman AFB, 7115 Report

Holloman AFB Design Compatibility Standards, 2010

Holloman AFB, 2010, Economic Impact Statement (data from, 2009) provided by 49th Wing Public Affairs, Sondra Escutia, Senior Airman, USAF

Holloman AFB, 2007, Economic Impact Statement 2007

Holloman AFB, eGeneral Plan

Holloman AFB, Gate Study Out Brief, June 2009

Holloman AFB, 2010 Integrated Cultural Resource Management Plan, 2010

Holloman AFB, 2010 Integrated Natural Resource Management Plan, 2010, Draft

Holloman AFB, 2010 Water Resources Sustainability Analysis

Otero County Comprehensive Plan 2006, http://co.otero.nm.us/Oterococomplan-final-10-05%20small%20-%20Searchable.pdf

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# A Figures

# FIGURES

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# HOLLOMAN AIR FORCE BASE
## *Soils*

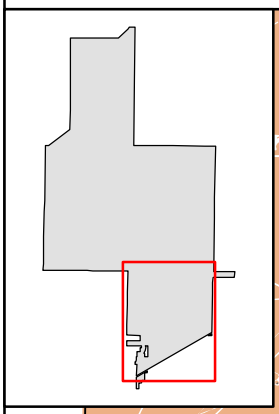





**Figure A-1**

**Soils**

- Duneland Yesum Association
- Holloman-Gypsum land-Yesum complex
- Intermittent Water
- Mead Silty Clay Loam

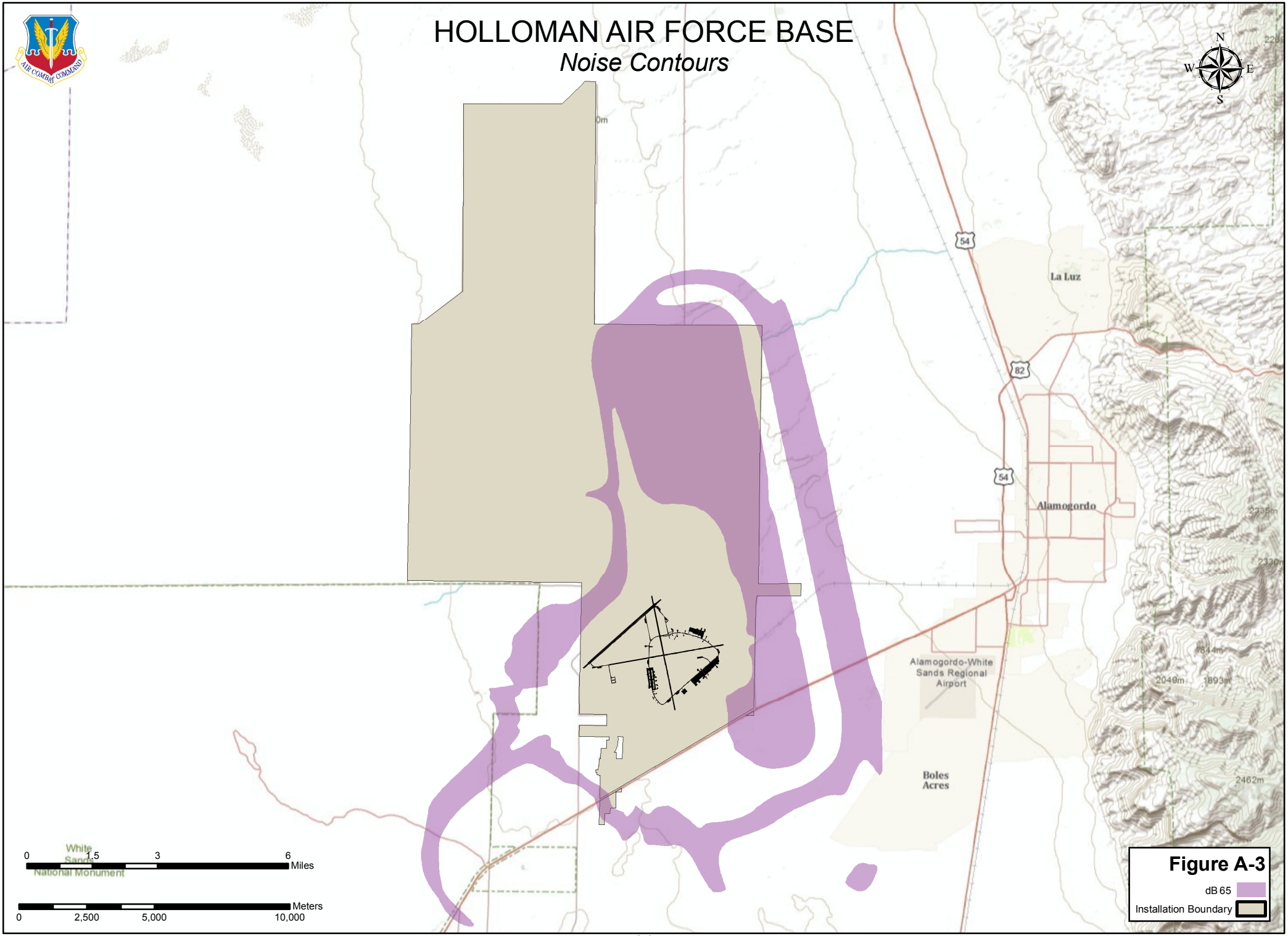
# A.1 Soils on or Near the Main Base

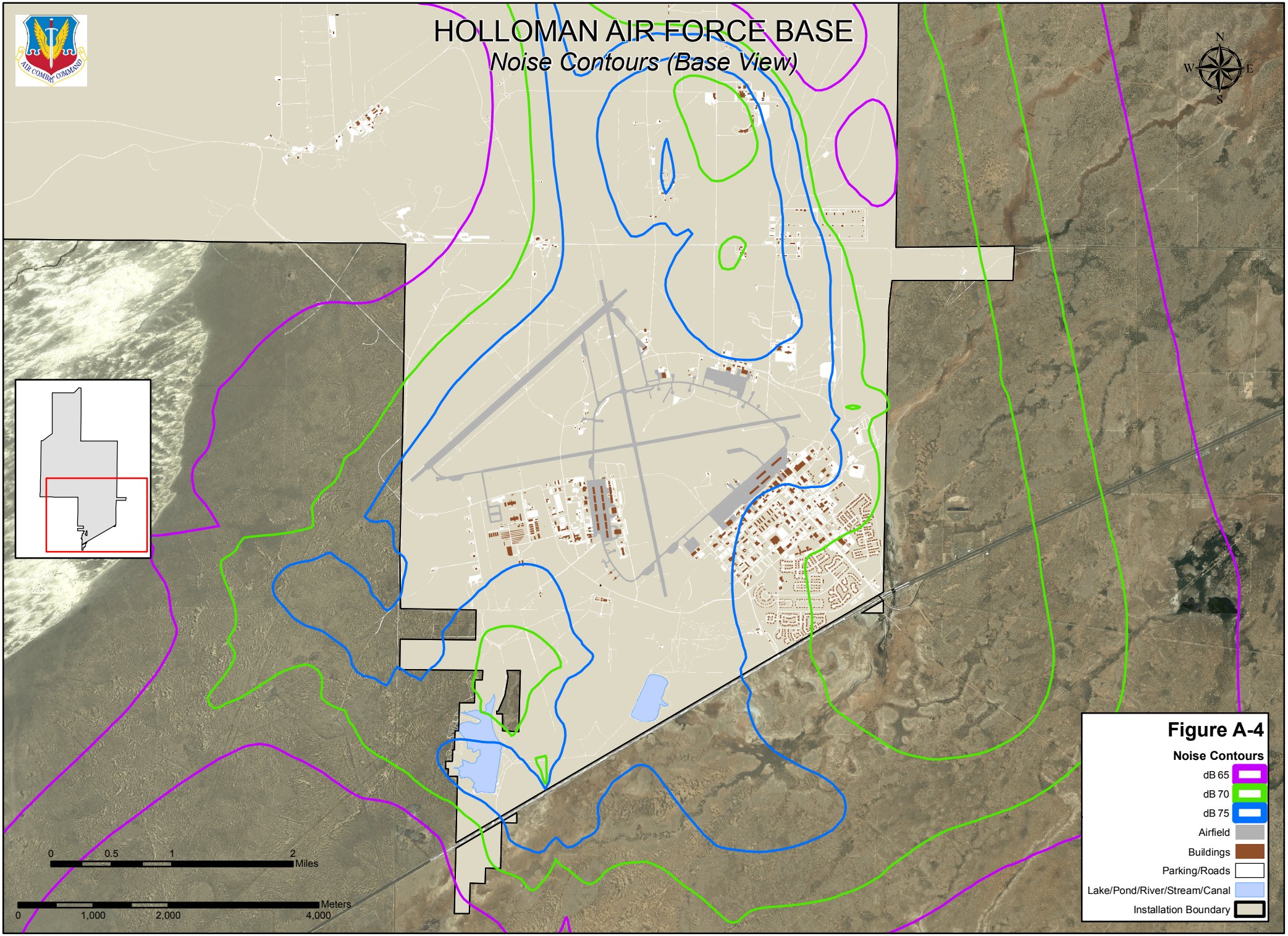
- The Holloman-Gypsum Land-Yesum soil complex (HOB) represents the most common soil type, covering approximately 66.5 percent of the base. It is a complex of shallow and deep well-drained soils and exposed gypsum. The soils have less than five percent slope and were deposited as both water-borne and wind-borne soil particles. Holloman soils (approximately 35 percent of the complex) have a light brown surface layer of very fine sandy loam about 13 inches deep. Gypsum Land, consisting of less than one inch of very fine sandy loam overlies white gypsum and is found mostly along the margins of arroyos, making up less than 30 percent of the mapping unit. The Yesum surface soil is a light brown, very fine, sandy loam about three inches thick, underlain by brown or pink fine sandy loam extending deeper than 60 inches. This soil type makes up approximately 20 percent of the complex. The remaining 15 percent of the complex consists of small areas of Prelo, Largo, Tome, and Bluepoint soils. These mixed alluvial and eolian sediments lie upland to the east from Holloman and are the source for the alluviated red beds found in drainages such as Hay Draw.

- The Duneland Yesum association comprises approximately 14.7 percent of the main base and lies north and south of the Active Dune Land Gypsum type. Both mapping units cover the western portion of the north half of the base, lying predominantly west of the Test Track. The Duneland Yesum association is 55 percent active dune and 30 percent Yesum very fine sandy loam. Yesum soils are depositied by wind, partly-stabilized gypsum dunes. The Active Dune Land is highly unstable and continually shifts, moving in a predominantly northeasterly direction. These dunes are primarily made up of very fine gypsum crystals from Lake Lucero, a relict Pleistocene lakebed.

- The Mead silty clay loam (MEA) covers approximately 4.5 percent of the main base. This poorly drained soil is limited to deeply incised drainages and alkali flats and playas. The soil type consists of fine textured silty soils on less than one percent slope. The soils contain a high salt content because of frequent flooding and become extremely sticky when wet. They are characterized by a 5-inch thick surface layer of reddish-brown silty clay or clay loam, underlain by approximately 48 inches of clay high in salt. Beyond 48 inches deep, the subsoils are formed from lakebed sediments. About 15 percent of the Mead mapping unit consists of gully sides or knolls with Holloman soils or gypsum land.

- The Intermittent Water areas that are shown on Figure A-1 are primarily a part of the wetland land area and are associated with lakes, ponds, depressions, and constructed wetlands.


HOLLOMAN AIR FORCE BASE
Noise Contours
N
W
E
S
54
82
54
La Luz
Alamogordo
Alamogordo-White Sands Regional Airport
Boles Acres
White Sands National Monument
0 1.5 3 6 Miles
0 2,500 5,000 10,000 Meters
Figure A-3
dB 65
Installation Boundary


HOLLOMAN AIR FORCE BASE
Noise Contours (Base View)
N
W
E
S
0
0.5
1
2
Miles
0
1,000
2,000
4,000
Meters
Figure A-4
Noise Contours
dB 65
dB 70
dB 75
Airfield
Buildings
Parking/Roads
Lake/Pond/River/Stream/Canal
Installation Boundary

# B Technical Constraints and Considerations

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# B Technical Constraints and Considerations

## B.1 Background

### B.1.1 General

This section provides installation-centric background information and identification of functional-technical considerations necessary for a fully successful design. It identifies preferred systems and technical components and is intended to describe best practices related to planning, architecture, engineering, and interior design. It identifies materials, furnishing, systems, practices, approaches, and finishes historically used with proven success over time. It is not intended to serve as a comprehensive list of all applicable building codes, regulations, directives, and references or to identify facility-centric or unique user requirements. Functional-Technical Constraints and Considerations need to be specifically addressed in the Basis of Design analysis written during the concept development phase and the design development phase. Understanding the driving forces behind these constraints and considerations will greatly contribute to a successful project outcome.

- All projects at Holloman AFB must be constructed in accordance with:
    - This ID2 document.
    - ACC Command-level Instruction, ID2 (publication forthcoming), which provides command level requirements for many of the topics addressed in this ID2 and appendix.

### B.1.2 Brand Name References

References to equipment, materials, articles or patented processes by trade name, make or catalog number shall be regarded as establishing a standard of quality and not construed as limiting competition.

### B.1.3 Design Criteria for Additions

- When additions are less than 25 percent of the existing building's floor area, it is usually more appropriate to design additions to match the original construction. However, opportunities to meet the current guidelines of the ID2 should be investigated.
- When additions exceed 25 percent of the original building area, investigate upgrading the existing facility to comply with current guidelines of the ID2.
- Whether large or small, additions should not appear as obvious add-ons. Match form, massing, and scale to make the addition and the original structures appear as parts of a new, unified whole.
- Where a high-maintenance existing finish such as paint occurs on an existing building, the addition should provide a low maintenance complimentary material.

## B.2 Architectural Design Elements

### B.2.1 Roofs and Gutters/Downspouts

#### B.2.1.1 Roof Materials

- **Mission District—**Existing standing seam metal roofs match Metal Building Components Inc., "Sahara Tan" kynar finish.
- **Other Districts—**Existing standing seam metal roofs match Lilly Industries Inc., "Medium Bronze" kynar finish.
- R-panels can be substituted for standing seam metal in some instances as a cost-reducing measure.

*Sahara Tan*

*Medium Bronze*

**Figure B-1**
*Roof Materials*

#### B.2.1.2 Rooftop Equipment

- Roof penetrations for plumbing and HVAC and equipment shall not be visible from building front/main entrance and shall be placed on the least visually objectionable side of the roof. These penetrations are considered trim material and should be painted/ manufactured for consistency/ compatibility with the facility.
- Minimize roof penetration.

#### B.2.1.3 Gutters and Downspouts

- Gutters may be integrated into the fascia design or exposed on more utilitarian buildings. Concealed gutters are preferred where possible.
- Exposed downspouts should be factory finished to match adjacent wall or metal roof and trim color.
- Rain diverters, gutters and downspouts, or some other type of diversion device, must be provided over building entrances.

## B.2.2 Exterior Walls

### B.2.2.1 Materials

- Preferred material for occupied buildings is integrally colored split-face CMU.
- Manufacture CMU and mortar with additives to discourage efflorescence.
- Holloman Buff Split-Face CMU shall not be used in the bottom four (4) feet of the wall surface.
- Wall construction for occupied buildings shall meet or exceed the requirements of applicable energy codes.
- All metal finishes shall be a factory-baked painted finish with a 20-year guarantee against fading.
- New buildings shall not require exterior painting.
- Colors currently in use at Holloman AFB are as follows:
  - Split-Face CMU:
    - **Manufacturer:** Del-Norte Masonry
    - **Color:** Holloman Buff
    - **Color:** Holloman Red
  - Painted Exterior Doors:
    - **Manufacturer:** Glidden or Sherwin Williams
    - **Color:** Medium Brown #78-64
    - **Color:** Medium Bronze #2028
  - Metal Wall Panels:
    - **Manufacturer:** Metal Building Components Inc.
    - **Color:** Sahara Tan (matches roof)
    - **Color:** Medium Brown (matches roof)

*Holloman Buff*

*Holloman Red*

*Glidden 78-64*

**Figure B-2**
*Exterior Materials*

## B.2.3 Windows and Doors

### B.2.3.1 Design

- Design building fenestration for user comfort and energy efficiency. Reduction of cooling loads is critical during the hot summer months.
- Deeply recessed punched openings are encouraged to reduce solar gain and relate to existing context. Where appropriate limited window groupings, glazed entry doors with sidelights and other variations are acceptable. However, large curtain wall applications are not appropriate in the desert climate.

Operable windows are encouraged where allowed by codes and standards. Provide screens and orient operable windows to take advantage of cross ventilation.

- Overhangs, porches, colonnades and other strategies to block direct summer solar gain (Figure B-3) are encouraged.

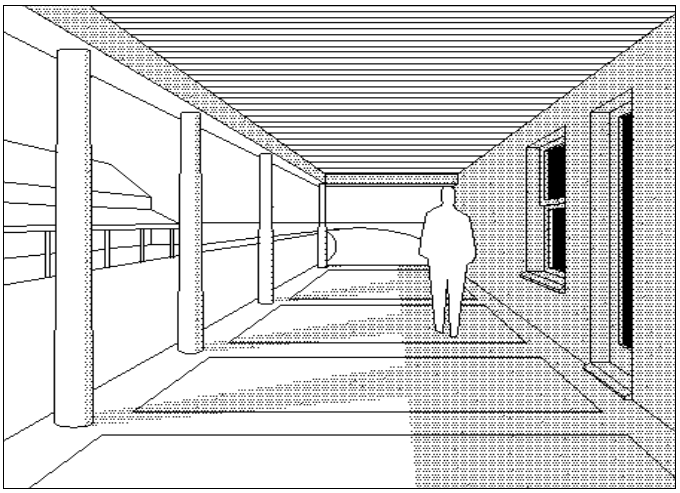

**Figure B-3** *Colonnades and overhangs shade building exterior and reduce cooling loads.*

- Use north-facing clerestory windows and other natural lighting methods to reduce lighting demand and associated cooling loads.

### B.2.3.2 Materials

- The existing base standard is bronze-tinted insulated glazing set in thermally broken bronze anodized frames.
- Glass must be insulated and tinted, with minimum reflectance. Energy-efficient glazing is mandatory.
- Solar shading film shall not be used as a solar control option.
- Facilities in high-noise areas shall have levels of noise attenuation provided in design IAW the Air Installation Compatible Use Zone (AICUZ) AFH 32-7063 AICUZ Handbook AFH 32-7084.
- Toilet windows shall be frosted glass.
- Opening colors and materials currently in use at Holloman AFB include the following (see previous page for color swatches):

- Primary Entrances:
  - **Manufacturer:** Kawneer Co. Inc.
  - **Material:** Anodized aluminum
  - **Color:** Bronze
- Secondary Exterior Doors:
  - **Material:** Painted, galvanized, insulated hollow metal
  - **Color:** Medium Brown
  - **Color:** Medium Bronze
- Hangar Doors:
  - **Manufacturer:** Metal Building Components Inc.
  - **Color:** Sahara Tan
- Windows/Glazing/Storefront System:
  - **Manufacturer:** Kawneer Co. Inc.
  - **Material:** Anodized aluminum
  - **Color:** Bronze

## B.2.4 Interior Design Standards

### B.2.4.1 General Permanent and Non-Permanent Finish Uses

- Permanent finishes:
  - Hard surface structural interior design finishes designed to last 15 to 20 years.
  - Color that endures this time span.
- Non-permanent finishes:
  - Last from five to seven years, such as carpet, vinyl wall covering, upholstery and artwork.
  - Colors shall be appropriate to the facility, generally in mid-range colorations.
  - Pastel or bright colors are to be used sparingly (usually reserved for facilities such as child care centers, youth centers, and bowling centers).
  - Walls of offices and other work areas should be a neutral color.

### B.2.4.2 Detailed Recommendations for Finishes and Treatments

- Vinyl wall covering:
  - Type II in most applications.
- Paints:
  - Use a low-sheen, no-Volatile Organic Compound (VOC), or low-VOC latex for all painted walls, ceiling and trim surfaces. Use semi-gloss finish for trim.
- Lavatories/Bathrooms:
  - Solid polymer (solid-surfacing) counters and backsplashes.
  - Integral bowls in lavatories.
  - High Density Polyethylene (HDPE) toilet partitions and urinal screens in high-usage areas.
- Ceilings:
  - Off-white color to coordinate with wall colors.
  - Ceiling tiles two-foot square with tegular edges.
- Wall Coverings:
  - Wainscot is not recommended in most areas.
  - If wall paneling is required, one accent wall should be covered from floor to ceiling.
  - Chair rails shall be located at the correct height based on the back height of the chairs in the room. Chair rails can be painted or stained.
  - Wainscoting or chair rails shall not be higher than 42-inches in corridors.
  - Vinyl bumper guards are acceptable in corridors, as needed, and shall have coordinating neutral colors.
- Bases:
  - Where floor is vinyl composition tile (VCT), vinyl/rubber base shall be used.
  - Base shall be a coordinating neutral color to the floor surface (no dark or accent colors).
  - Use a four-inch carpet base with dark neutral vinyl/rubber carpet cap in carpeted areas.
  - For borders, the same carpet should be used that meets the wall.
  - Vinyl/rubber base shall be used with carpet tiles in a neutral color with no cove foot. Base shall be installed first with carpet tile butted up to it.
  - In ceramic tile areas, a ceramic tile base shall be used.
- Porcelain Tile/Ceramic Tile:
  - Mottled, flecked, or specked floor tile with coordinating dark tone grout.
  - Tile banding accents or patterns for walls and floors in another neutral shade that coordinates with the dominant tile color.
  - Epoxy grout with grout sealers.
  - Ceramic tile shall be used in restrooms.

- Doors and Doorframes:
  - Stained or painted.
  - If painted, use a mid-range hue accent color or a color related to the wall color.
- Window Blinds:
  - Metal or vinyl horizontal or vertical.
  - Off-white or neutral color.
  - Dark blinds are acceptable if they match the anodized finish of the window frame and the windows are reflective glass.
  - Blackout panels are required.
  - Rod-operated panels from one side.
- Carpet:
  - Bold tweed, nylon, and level-loop carpet at least 28 oz. face weight.
  - Refer to Engineering Technical letter 07-04. Air Force Carpet Standard, 28 March 2007.
  - Solid color for carpet borders. Borders shall be nine inches wide and shall not be used in rooms where furniture will cover the borders.
  - Dormitories: one carpet pattern per building with a different color-way per floor.
  - Dormitories: Use different carpet in living areas than in work areas on the base.
  - Dormitories: Coordinate bedspreads and chair upholstery per floor to the carpet color-way.
- Systems/Pre-Wired Workstations/Modular Furniture:
  - Brown-tone or gray-tone panel fabrics with complementary-colored flipper doors, etc.
  - One type of systems furniture per building.
  - Install systems furniture on carpet tiles (not rolled carpet).

# B.3 Site Design

## B.3.1 Streets

### B.3.1.1 General

- Traffic markings are made by use of 3M A420 (White) or A421 (yellow) traffic tape or equal on all major roads and encouraged use on secondary roads.
- Designers shall minimize landscaping and site walls within 50 feet of intersections and entrances to three feet in height to ensure minimum 100 foot unobstructed views of traffic. No walls, shrubs or trees should occur within 20 feet of any road intersection that may obstruct views. Refer to Department of Defense standards for exact unobstructed view requirements.
- Construction standards in accordance with DoD Force Protection Requirements must adhere to the Unified facilities Criteria (UFC) 4-010-01 and AFH 10-222, Vol. 3. All Installation Entry Control Facilities including visitor centers must comply with the Air Force Entry Control Facilities Design Guide AFI 10-245, DoD Std. 28 and AFH 10-222, Vol. 3.
- AFI: Air Force Instructions can be obtained from the following web site: http://www.e-publishing.af.mil/.
- New building construction projects at Holloman shall comply with curb-to-curb development. That is, as part of the project, the design scope of the site needs to extend from curb to curb of the site that borders existing streets

### B.3.1.2 Alkali-Aggregate Reactivity

- Alkali-aggregate reaction is a chemical phenomena involving the reaction of alkalis from the portland cement and certain aggregates in concrete. This reaction forms a gel around the rim of aggregate particles and this gel absorbs water that can lead to destructive expansion of the portland cement concrete. This expansion may result in map cracking in the surface of the concrete, popouts, spalling, expansion of the concrete or some combination of symptoms. The aggregates involved in such reactions are usually certain forms of silica (alkali-silica reaction) and much more rarely certain forms of dolomitic aggregates (alkali-carbonate reaction). These reactive aggregates may be either the fine or coarse aggregate or both. Damage from this reaction may become evident after just a few years or it may take decades to develop.
- A preliminary assessment of the alkali-aggregate reaction problem in the Air Force has tentatively identified at Holloman AFB, NM, as having reported alkali-aggregate reaction problems.
- Aggregate sources in the vicinity of Holloman AFB, NM, have been recently tested by the government for Alkai-Silica Reactivity. Contact the Albuquerque District, US Army Corps of Engineers (USACE), 4101 Jefferson Plaza NE, Albuquerque, NM 87109-3435. Aggregates to be used for concrete production shall have a measured expansion of less than .08 (DOD), in accordance with current COE guidance, when tested using ASTM C 1260 modified to incorporate the mix design proportions of cementitious materials.
- As a recommendation, coarse and fine aggregates shall be washed.

- Aggregate shall be evaluated and tested by the contractor for alkali-aggregate reactivity in accordance with ASTM C 1260 (modified). ASTM C 1260 shall be modified as follows:
  - Utilize Type V low alkali cement and Class “F” fly in combination with the cemetitious material for the test.
  - Project Class “F” fly ash can be used at a rate between 20 and 30 percent as long as mix meets requirements of mortar bar test (ASTM C 1260).
  - The maximum allowable expansion shall not exceed .08 percent (DOD).at 16 days. The results of such testing investigation shall be submitted to the contracting officer for evaluation and acceptance.

## B.3.2 Parking

- Follow all AT/FP guidance in determining the location and standoffs for all parking lot development at Holloman.
- All construction shall be in accordance with DoD Force Protection Requirements and shall adhere to AFI 10-245, DoD Std. 28, and AFH 10-222, Vol. 3.
- Parking areas shall have standard and handicapped stalls, and twenty-four feet wide driving aisles. Standard parking stalls should be designed to a minimum of 9'x18'. Handicapped stalls shall comply with The Americans with Disabilities Act (ADA) Guidelines and other applicable codes and standards.
- All parking areas are to be striped and signed per Holloman AFB standards.

## B.3.3 Sidewalks

- Sidewalks shall be a minimum four feet wide, with eighteen-inch wide gutters with six-inch high curbs, or any combination thereof, as appropriate.
- For new construction projects, if existing sidewalks do not meet the above standards, the project is responsible for replacing or modifying them to meet that standard. The design responsibility for all new projects is curb-to-curb and that includes sidewalks and landscape.
- Sidewalks shall have ramps at each street intersection designed per ADA guidance and in locations where heavy pedestrian traffic requires access to a sidewalk.
- Due to high salt content in native soils, H2O intrusion must be minimized to prevent sinkholes. All joints shall be sealed, preferably with cold-applied single-component silicon sealant.

## B.3.4 Pedestrian Crosswalks

- Past experience has led to a new Holloman AFB standard of using synthetic fibers in lieu of welded wire fabric (WWF) in concrete, 6" thick or less. If additional reinforcement is required, use #4 grade 60 steel bar reinforcement.
- Pedestrian crosswalks at intersections shall be included as a part of any paving or street improvement project at Holloman AFB.
- Construction shall comply with ADAAG Accessibility Standards and other applicable codes.
- High-traffic intersections must ensure cross-walks are marked according to MUTCD (Manual for Uniform Traffic and Control Devices).
- A pattern should be applied using paint or high reflective tape.

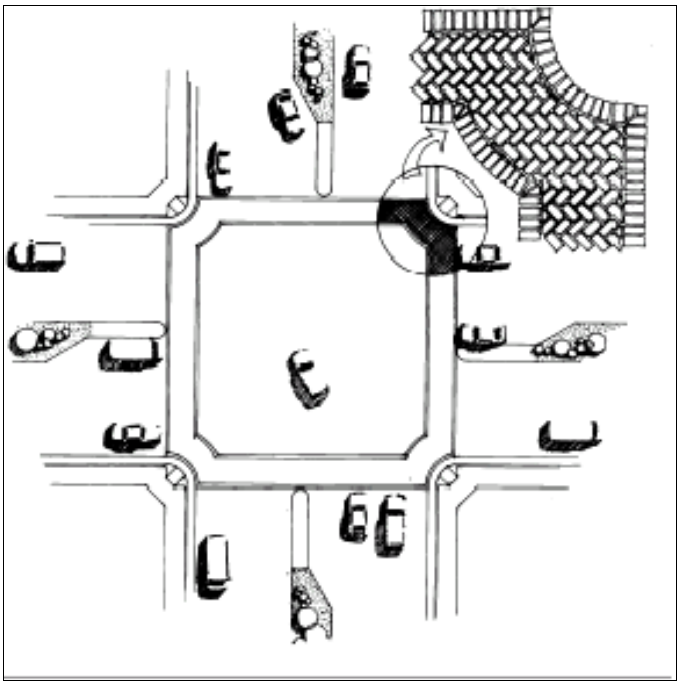

**Figure B-4** *Recommended pedestrian crosswalk treatment.*

## B.3.5 Fences and Site Walls

### B.3.5.1 Design

- Use fences and site walls as security boundaries, visual screens, and windbreaks.
- Continuation of site walls along the northwest street edge of Delaware Avenue as a defined boundary and

visual buffer between the flight line and the balance of the base is encouraged.

- Use screening around mechanical equipment, storage areas, trash dumpsters and other visually objectionable items.
- Three-sided CMU enclosures are preferred, with the open end oriented away from building entrances and primary views.
- When used in conjunction with a new building, the material and design shall complement the building.
- Typical enclosures are split-face concrete block with solid cap top course. Consider decoration as accent color CMU, perforated block or open voids in the block coursing.
- Undulation and height variation is encouraged for stability and for the creation and definition of green spaces where appropriate.
- Equipment screens must allow required clearance for equipment maintenance, removal, and airflow. Provide vehicle access to mechanical equipment areas where necessary. Provide concrete aprons for vehicle access.
- Minimum height of walls shall be 6" greater than dumpster height. Provide concrete slab and 6" diameter concrete filled pipe bollards to prevent damage to walls.
- Locate fences, site walls, dumpsters, etc., in accordance with UFC 4-010-01. Ensure that the visual line of sight for motorists is not obstructed.

### B.3.5.2 Materials

- Typical materials for all districts are as follows:
  - **Material:** Concrete Masonry Units
  - **Manufacturer:** Del Norte Masonry
  - **Colors:** Holloman Red, Holloman Buff
  - **Material:** PVC fencing and chain link fencing, in Mission and Mission Support Districts only.

## B.3.6 Courtyards and Shelters

### B.3.6.1 Design

- All new playground and park designs must include shelters. Shelters are strongly recommended in other areas of new construction, improvement, and renovation projects base-wide.
- When serving a specific building, shelter design shall compliment the building being served.
- Orient shelters and courtyards to take advantage of climatic conditions, such as seasonal sun, shade, and breezes. Consider the effects of blowing dust and debris when building shelters to minimize the trapping and settling of trash and weeds.
- Provide site furnishings, lighting, and landscaping as appropriate.

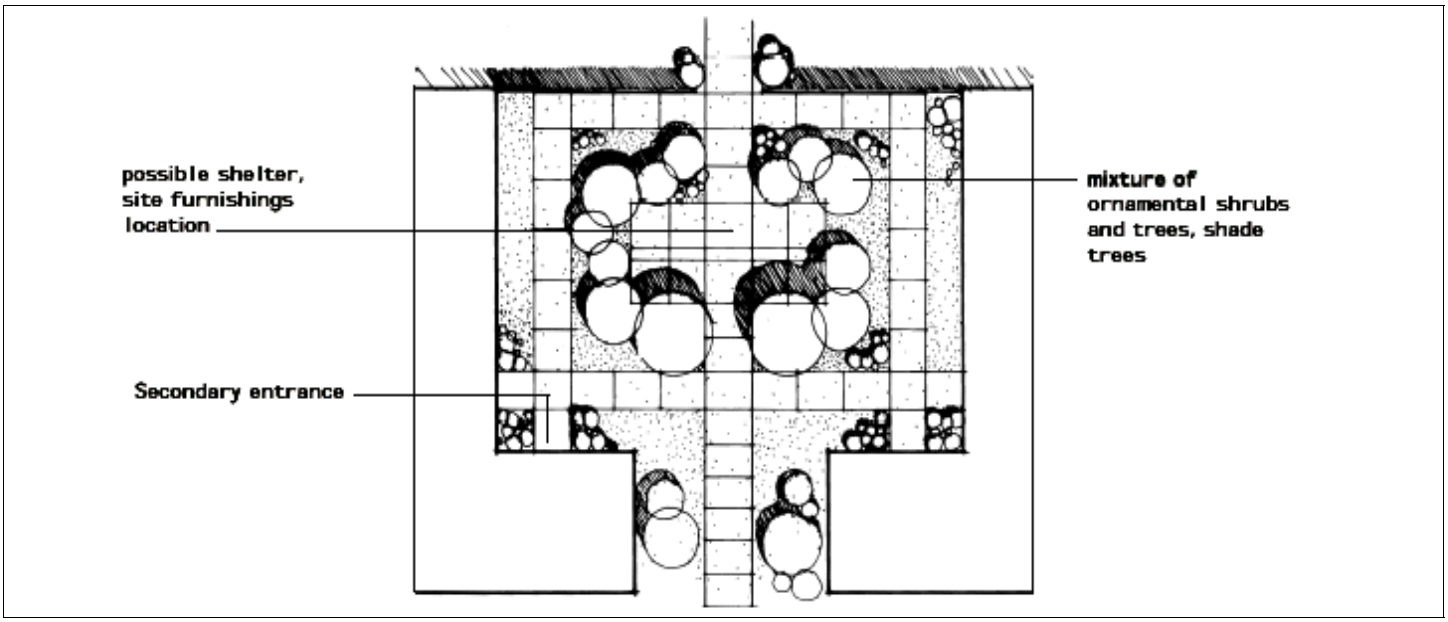


**Figure B-5** *Recommended courtyard landscape treatment.*

## B.3.7 Site Furnishings

### B.3.7.1 Design

- Site furnishing must be made from sustainable products or recycled materials.
- Develop a coordinated approach to site furnishings. This includes trash receptacles, ash urns, benches, tables, mailboxes, drinking fountains, telephone booths, bus shelters, kiosks, bike racks, and picnic shelters.
- Furniture shall be comfortable, durable, vandal resistant, and easily maintained.
- Site furnishings must be accessible to people with disabilities.
- Consider climatic conditions in selection and placement of all site furnishings. Solar factors, such as direct heat gain on metal components (especially play equipment), ultraviolet degradation of plastics and shade for users, shall be addressed. Wind protection, especially during months characterized by strong prevailing winds should also be considered. The prevailing spring winds come out of the west. When possible take advantage of shelters, landscaping and building mass for solar and wind protection.
- Play equipment selection and placement shall consider age groups ranging from preschool to teen. Place equipment away from vehicular traffic paths in a location easily supervised.

### B.3.7.2 Recommended Furnishings

**Benches**

- **Manufacturer:** Victor Stanley, Inc.
- **Style:** Classic Series Model No. CR-138

**Figure B-6** *Bench*

**Bike Racks**

- **Manufacturer:** Brandir International Madrax, Columbia Cascade
- **Style:** Winder Plus (WP158-9-SG-P)

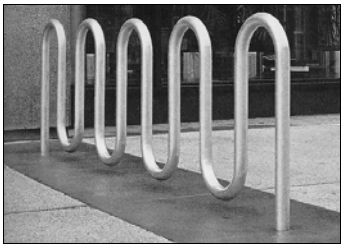

**Figure B-7** *Bike Rack*

**Trash Receptacles**

- **Manufacturer:** Victor Stanley, Inc.
- **Style:** Model S-35 - 3/8" solid steel bars

**Figure B-8** *Trash Receptacle*

## B.4 Landscape

### B.4.1 Landscape Design

- Use only species from the Approved Landscape Plants list in this document. Select specific plant species from the plant list with the appropriate character, height, etc., for the specific function and aesthetic outcome desired. The Approved Landscape Plants list includes regional natives and fully naturalized plant species that are low maintenance and require little or no fertilizer/ pesticides. These plants are alkaline and drought resistant and are able to withstand cold temperatures to 15°F.
- Test soils prior to designing the planting plan. Identify deficient soils, areas of over compaction and soil pH. Modify or replace poor soil prior to planting.
- Consider the likelihood of an above-average loss of plant material. Avoid planning equally spaced, repetitive rows of planting that would be adversely affected by the loss of individual specimens.
- Reduce the need for pruning by planting the correct size plant for a space. Where new planting spaces are being allocated, provide planting areas with adequate width for the desired plant materials.
- Limit turf to areas used for active or passive recreation, and node buildings of significance.
- Recommended landscape uses include using landscaping in conjunction with site walls for visual screening and to define street edges and punctuate main intersections, punctuate parking lot entrances at major buildings and screen parking lots, emphasize node buildings of significance and provide shade or windbreaks where appropriate.
- Use of traditionally planted canopy trees and conifers, due to below-average survival rates, should be limited. Playgrounds, picnic areas, and community open spaces shall use trees in conjunction with manmade structures, if possible, to provide shade and shelter.

**Table B-1** *Approved Landscape Plants*

| Common Name/*Botanical Name* | Description | Culture |
|---|---|---|
| **Trees** | | |
| Whitethorn Acacia, Viscid Acacia, Catclaw Acacia, Guajillo, Acacia *Acacia constricta, A. neovernicosa, A. greggii, A. berlandieri, Acacia* sp. | Small tree to large shrub. Most have small ball-shaped flowers in spring or summer. Select species that are cold hardy. | Cold Hardiness: Varies<br>Soil Type: Adaptable<br>Light: Full Sun<br>Water: Moderate to Low |
| Sweet Acacia *Acacia farnesiana* | Small deciduous tree 15-30' high. Spreading branches, stems armed with paired straight thorns. Yellow ball-like flowers in spring. | Cold Hardiness: To 20°F<br>Soil Type: Adaptable<br>Light: Full Sun<br>Water: Moderate to Low |
| Netleaf Hackberry *Celtis reticulata* | Small- to medium-sized deciduous tree to 30' tall and similar width. | Cold Hardiness: To -10°F<br>Soil Type: Well Drained<br>Light: Partial Shade to Full Sun<br>Water: Moderate to Low |
| Blue Palo Verde, Little Leaf Palo Verde, Texas Palo Verde *Cercidium floridum, C. microphyllum, C. texanum* | Small deciduous tree to 25' tall and similar spread. Yellow flowers in summer. | Cold Hardiness: To 15°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate to Low |
| Desert Willow *Chilopsis linearis* | Deciduous shrub to 25' tall and 15' wide, can be trimmed up to tree shape. Lavender, pink or white flowers, April through September. | Cold Hardiness: To 10°F<br>Soil Type: Well Drained, Adaptable<br>Light: Full Sun<br>Water: Moderate to Low |
| Chitalpa, Chitalpa Tashkentensis *Chilopsis X catalpa* | Small- to medium-sized deciduous tree, to 25' tall and 25'wide. White, pink, or lavender flowers May to November. | Cold Hardiness: To 10°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low to Moderate |
| Arizona Cypress *Cupressus arizonica* | Large evergreen tree, to 50' with 45' spread. Nice shape with good shade. NOTE: This plant can produce large quantities of pollen during several months, which should be considered prior to selecting for planting. | Cold Hardiness: To 0°F<br>Soil Type: Well Drained, Alkaline Adaptable<br>Light: Full Sun<br>Water: Moderate to Low |
| Eucalyptus (Forman's) *Eucalyptus formanii* | Small evergreen tree, 15' to 25' tall, with 10' to 15' spread. | Cold Hardiness: To 15°F<br>Soil Type: Well Drained<br>Light: Partial Shade to Full Sun<br>Water: Low |
| New Mexico Olive, New Mexico Privet *Forestiera neomexicana* | Deciduous shrub 6' to 8' tall and 8' wide. Fast growing and low maintenance once established. | Cold Hardiness: To 0°F<br>Soil Type: Adaptable, Alkaline Tolerant<br>Light: Partial Sun to Full Sun<br>Water: Low |
| Fragrant Ash *Fraxinus cuspidate* | Small deciduous tree to 20' high. Slender tree, with dark green leaves. Clusters of fragrant white flowers in spring. | Cold Hardiness: To 0°F<br>Soil Type: Well Drained<br>Light: Full Sun to Partial Shade<br>Water: Low |
| Gregg Ash *Fraxinus greggii* | Small tree to 25' high or clump-forming shrub. Olive-green leaves. | Cold Hardiness: To 0°F<br>Soil Type: Well Drained, Adaptable<br>Light: Full Sun to Partial Shade<br>Water: Low |
| Texas Ash, Arizona Ash *Fraxinus texensis, Fraxinus arizonicus* | Deciduous tree, 25' to 40' in height, and 25' to 35' crown. | Cold Hardiness: To -20°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low to Moderate |
| Honey Locust (Non-Thorned) *Gleditsia triacanthos var. inermis* | Large tree, 40' tall and 40' wide. Attractive shade tree, with fairly open canopy. Round to irregular canopy form. Only use the thornless variety of honey locust. | Cold Hardiness: To -20°F<br>Soil Type: Well Drained, Adaptable, Fairly Salt Tolerant<br>Light: Full Sun<br>Water: Low to Moderate |
| Golden Ball Lead Tree *Leucaena retusa* | Small- to medium-size tree, 15' to 25' tall and about as wide. Flowers in spring, with yellow golden puffball-like flowers. Often has multiple trunks, but can be trimmed to a single main trunk. | Cold Hardiness: To 5°F<br>Soil Type: Adaptable<br>Light: Full Sun<br>Water: Low to None |
| Arroyo Sweetwood *Myrospermum sousanum* | Small- to medium-sized tree, 15' to 25' tall, and about as wide. Cream-colored flowers in spring. | Cold Hardiness: To 9°F<br>Soil Type: Adaptable<br>Light: Full Sun<br>Water: Low to Moderate |
| Ironwood *Olneya tesota* | Small tree to 25' tall and 25' wide. Showy lavender-colored flowers in late spring. For use in a very sheltered location, such as a courtyard, only. | Cold Hardiness: To 20°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate to Low |

**Table B-1** *Approved Landscape Plants*

| Common Name/*Botanical Name* | Description | Culture |
|---|---|---|
| Palo Verde "Desert Museum"<br>*Parkinsonia aculeataXmicrop* | Small tree to 25' tall and 25' wide. Has green bark and yellow flowers. Thornless variety. | Cold Hardiness: To 20°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate to Low |
| American Pistachio, Texas Pistache<br>*Pistacia texana* | Small, semi-evergreen tree, 25' in height and 25' in width. Green leaves often have bronze tips. | Cold Hardiness: To -10°F<br>Soil Type: Well Drained, Adaptable, Salt and Alkaline Tolerant<br>Light: Full Sun to Partial Sun<br>Water: Low |
| Texas Ebony, Mexican Ebony<br>*Pithecellobium flexicaule, P. mexicanum* | Semi-evergreen, small tree to 20' tall and 20' wide. Dark-green foliage with yellow to cream-colored flowers in summer. Should be planted against south or west facing areas to catch reflected warmth in winter. | Cold Hardiness: To 18°F<br>Soil Type: Well Drained, Alkaline Adapted<br>Light: Full Sun<br>Water: Moderate to Low |
| Mesquite (Various Species)<br>*Prosopis* sp. | Deciduous tree or large shrub. Most have flower spikes spring or summer, fruit pods summer through fall. May need to trim lower branches to achieve tree form. Select cold hardy species. | Cold Hardiness: Varies<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate to Low |
| Honey Mesquite<br>*Prosopis glandulosa* | Deciduous tree or large shrub. Can achieve 25' high and 30' wide, though commonly smaller. Yellow flower spikes April and May, fruit pods summer through fall. May need to trim lower branches to achieve tree form. | Cold Hardiness: To 0°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| Screwbean Mesquite<br>*Prosopis pubescens* | Deciduous tree or large shrub, to 25' high and 25' spread. Spikes of greenish-white flowers, 1-1/2 to 3" long. | Cold Hardiness: To 0°F<br>Soil Type: Well Drained<br>Light: Full Sun to Partial Shade<br>Water: Low |
| Velvet Mesquite<br>*Prosopis velutina* | Deciduous tree or large shrub to 20' high and 30' wide, though commonly smaller. Yellow flower spikes spring and summer, fruit pods summer through fall. May need to trim lower branches to achieve tree form. | Cold Hardiness: To 5°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate to Low |
| Common Hoptree<br>*Ptelea trifoliata* | Deciduous small tree, to 15' tall and 15' wide. Small white flowers. | Cold Hardiness: -30°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate to Low |
| Bur Oak<br>*Quercus macrocarpa* | Large deciduous tree, 40' to 70' in height, and 35' to 60' wide. Excellent yard tree. | Cold Hardiness: To -30°F<br>Soil Type: Well Drained<br>Light: Full Sun to Part Shade<br>Water: Moderate to Low |
| Mexican Blue Oak<br>*Quercus oblongifolia* | Semi-evergreen, small tree or large shrub, to 25' tall and 25' wide. Bluish foliage color. | Cold Hardiness: To 0°F<br>Soil Type: Well Drained, Alkaline, Light: Full Sun<br>Water: Low |
| Mexican Elder<br>*Sambucus mexicana* | Medium, semi-evergreen tree, 15' to 25' tall with a spreading canopy. Clusters of white or cream-colored flowers in summer. | Cold Hardiness: To 10°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate |
| Western Soapberry<br>*Sapindus drummondii* | Deciduous tree, 25' to 30' high and 20' to 25' wide. Nice shade and good fall color (golden). | Cold Hardiness: To -5°F<br>Soil Type: Adaptable<br>Light: Full Sun<br>Water: Low |
| Texas Mountain Laurel<br>*Sophora secundiflora* | Small tree to 15' in height and 15' in width. Has evergreen, dark glossy leaves, and showy wisteria-like clusters of fragrant, purple flowers in spring. This tree should not be planted in housing areas, as the seeds are poisonous if ingested. | Cold Hardiness: To 10°F<br>Soil Type: Well Drained, Alkaline Adapted<br>Light: Full Sun to Partial Shade<br>Water: Low |
| Mexican Buckeye<br>*Ungnadia speciosa* | Small deciduous tree, 15' high and 10' wide. Dark green foliage with golden-yellow fall color. Profuse showy rosy-pink flowers in spring. | Cold Hardiness: To 10°F<br>Soil Type: Adaptable, Alkaline Tolerant<br>Light: Partial Sun to Partial Shade<br>Water: Low |
| Chaste Tree<br>*Vitex agnus-castus* | Small tree to 15' tall and similar spread. Lilac- or white-flowered varieties available. | Cold Hardiness: To 5°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low to Moderate |

**Table B-1** *Approved Landscape Plants*

| Common Name/*Botanical Name* | Description | Culture |
|---|---|---|
| **Cacti, Accents, And Other Succulents** | | |
| Lechuguilla<br>*Agave lechuguilla* | Clumping succulent rosette to 18" tall and 2' wide. Mature plants (will send up a flowering stalk, to 14' tall, with yellow flowers. Central (flowering) plant will die-back at that point, but young offsets (pups) will sprout at the base of the parent plant. | Cold Hardiness: To 0°F<br>Soil Type: Well Drained<br>Light: Partial Sun to Full Sun<br>Water: None to Low |
| New Mexico Agave, Parry Agave<br>Agave neomexicana, Agave parryi | Clumping succulent rosette to 2-1/2" tall and 3' wide. Mature plants (more than 20 years old) will send up a flowering stalk, to 15' tall, with orange or yellow flowers. Central (flowering) plant will die-back at that point, but young offsets (pups) will sprout at the base of the parent plant. | Cold Hardiness: To -20°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: None to Low |
| Agave (Many Available)<br>*Agave* sp. | Clumping succulent rosettes. Mature plants (will send up a flowering stalk, most over 10' tall, with yellow flowers. Central (flowering) plant will die-back at that point, but young offsets (pups) will sprout at the base of the parent plant. | Cold Hardiness: To 0°F<br>Soil Type: Well Drained<br>Light: Partial Sun to Full Sun<br>Water: None to Low |
| Jelly Palm<br>*Butia capitata* | Feather palm to 15' tall. | Cold Hardiness: To 10°F<br>Soil Type: Well Drained, Sandy<br>Light: Partial Shade to Full Sun<br>Water: Moderate |
| Sotol<br>*Dasylirion wheeleri, Dasylirion* sp. | A member of the Agave family. Leaves to 4' tall and 5' wide. A central flower stalk is put up every year. | Cold Hardiness: To 5°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| Cholla<br>*Cylindropuntia* sp. | Cacti closely related to prickly pear, growing upright as a shrub 3' to 8' tall, with elongated pads. Fuchsia flowers in spring and summer, yellow fruit buds in summer. Many varieties and species. | Cold Hardiness: To -5°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| Hedgehog Cactus, Rainbow Cactus, Claret-Cup Cactus<br>*Echinocereus* sp. | Low-growing, clum-forming or single columnar cactus to 16" tall. Large, showy flowers in many colors in spring. | Cold Hardiness: To 20°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| Fishhook Barrel Cactus<br>*Ferocactus wislizeni* | Solitary barrel-shaped cactus to 6' tall and 21" diameter or more. NOTE: Barrel cactus must have documentation proving nursery grown or salvage origin. | Cold Hardiness: To 5°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low to None |
| Ocotillo<br>*Fouquieria splendens* | Unusual deciduous shrub to 20' tall and 15' spread. Bright reddish-orange flowers at tops of stems in spring and early summer. | Cold Hardiness: To 0°F<br>Soil Type: Well Drained, Rocky Soil Preferred<br>Light: Full Sun<br>Water: Low to None |
| Texas False-Agave<br>*Hechtia texensis* | Rosette-forming plant, to about 6" tall and 8" wide, eventually developing offsets with clumps to 18" wide. Medium-green leaves, turning reddish in fall. Similar in appearance to true agaves. | Cold Hardiness: To 15°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| False Red Yucca,<br>Texas Yucca<br>*Coahuilan hesperaloe, Hesperaloe parviflora, H. funifera, Hesperaloe* sp. | Resembles true yuccas, with narrow leaves, to 3' tall and 5' wide. Attractive red flowers on a tall stalk. (Yellow cultivars also available.) | Cold Hardiness: To 0°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| Mammillaria Cactus<br>*Mammillaria* sp. | Low-growing cacti, most less than 1' high. Showy flowers spring or summer. Nice accent plant. | Cold Hardiness: To 15°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| Spice Lily, Manfreda<br>*Manfreda maculosa* | Low growing member of the yucca family to <6" tall and 1' wide with fleshy leaves. Flower stalk to 2' tall with cream-colored flowers. | Cold Hardiness: To 5°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate |
| Beargrass or Sacahuista<br>*Nolina* sp. | Grass-like shrub to 5' tall and evergreen. Sends up a spike of yellowish flowers late spring. | Cold Hardiness: To -5°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low to None |
| Prickly Pear<br>*Opuntia* sp. | Cacti with flattened pads, 2' to 6' tall and 3' to 15' wide clumps. Showy flowers in many colors, spring and summer. Red to purple fruits summer to fall. Many species are available. | Cold Hardiness: To 0°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| Banana Yucca<br>*Yucca baccata* | Low-growing shrub, stemless rosette to 4' tall and 4' wide. | Cold Hardiness: To -5°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |

**Table B-1** *Approved Landscape Plants*

| Common Name/*Botanical Name* | Description | Culture |
|---|---|---|
| Soaptree Yucca<br>*Yucca elata* | Tree-like succulent to 20' and 10' wide. Flowers from May to July. | Cold Hardiness: 0°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| Yucca Species<br>*Yucca* sp. | Many species of yucca are suitable for this area. Note: Tree-forming yuccas must have documentation proving nursery grown or salvage origin. | Cold Hardiness: 10°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| **Shurbs** | | |
| Catclaw Acacia<br>*Acacia greggii* | Large, spreading shrub to 30' high. Covered with curved thorns. Creamy-yellow clusters of flowers in summer. | Cold Hardiness: To 0°F<br>Soil Type: Adaptable<br>Light: Full Sun<br>Water: Low to None |
| Bee Brush, Oreganillo, Spicebush<br>*Aloysia gratissima, A. wrightii* | Deciduous shrub, 5' to 8' in height and 5' to 8' in width. Leaves are very fragrant, with small fragrant white flowers spring through fall. | Cold Hardiness: To 15°F<br>Soil Type: Adaptable<br>Light: Full Sun to Partial Sun<br>Water: Low |
| Triangle-Leaf Bur-Sage, White Bur-Sage<br>*Ambrosia deltoidea, A. dumosa* | Deciduous shrubs, 18" to 2' tall and 2' to 3' wide. Leaves are grey-green or white, with small yellow-green flowers blooming from late winter to spring and occasionally fall. | Cold Hardiness: To 20°F<br>Soil Type: Adaptable<br>Light: Full Sun<br>Water: Moderate to Low |
| Desert Honeysuckle, Flame Anisacanthus<br>*Anisacanthus thurberi, Anisacanthus* sp. | Deciduous shrub, 3' to 6' high and 4' to 5' wide. Showy orange. Flowers in summer. | Cold Hardiness: To 5°F<br>Soil Type: Well Drained<br>Light: Full Sun to Partial Shade<br>Water: Moderate to Low |
| Sand Sage<br>*Artemisia filifolia* | Evergreen shrub, 3' to 6' high, 4' to 6' wide. Leaves are grey-green with a pleasant fragrance. | Cold Hardiness: To -10°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate to Low |
| Wormwood, Sagebrush, White Sage<br>*Artemisia* sp. | Low-growing to moderate-size shrubs, 1' to 4' high. Most have inconspicuous flowers, with green to grey-green foliage. | Cold Hardiness: Most to -10°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate to Low |
| Four-Wing Saltbush<br>*Atriplex canescens* | Evergreen shrub to 6' tall, 4' to 8' spread. Inconspicuous flowers. Showy seeds through winter. | Cold Hardiness: To -10°F<br>Soil Type: Adaptable, Alkaline And Salt Tolerant<br>Light: Sun to Partial Shade<br>Water: Low |
| Desert Broom<br>*Baccharis sarothroides* | Evergreen shrub, 3' to 9' high. Female shrubs have showy fruits fall through winter, a nice “smoky” appearance. | Cold Hardiness: To 15°F<br>Soil Type: Well Drained<br>Light: Full Sun to Partial Shade<br>Water: Moderate to Low |
| Chihuahuan Orchid Tree<br>*Bauhinia congesta* | Small semi-deciduous tree or large deciduous shrub to 8' tall and 12' spread. Showy lavender to white blossoms. | Cold Hardiness: To 10°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate |
| Red Barberry, Algerita<br>*Berberis haematocarpa, Berberis trifoliolata, Mahonia haematocarpa, M. trifoliolata* | Evergreen spiny-leaved shrub 3' to 10' tall. Red fruits ripen in fall, attract birds. | Cold Hardiness: To 20°F<br>Soil Type: Well Drained<br>Light: Sun to Partial Shade<br>Water: Low |
| Woolly Butterfly-Bush<br>*Buddleja marrubiifolia* | Low shrub 3' to 10' tall. Thick and velvety grey-green leaves. Small orange to yellow flowers. | Cold Hardiness: To 10°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate to Low |
| Mexican Bird-of-Paradise<br>*Caesalpinia mexicana* | Small- to medium-sized evergreen shrub to 10' tall and 6' wide. Yellow flowers spring through fall. Can be trimmed to keep compact. | Cold Hardiness: To 20°F<br>Soil Type: Well Drained<br>Light: Full Sun to Partial Shade<br>Water: Low (Infrequent Deep Watering) |
| Red Bird-of-Paradise<br>*Caesalpinia pulcherrima* | Small- to medium-sized shrub to 6' tall and 6' wide with many bright red and yellow flowers in summer to fall. Plant will likely freeze in winter, so best to cut back to ground-level in late fall (November). | Cold Hardiness: To 20°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low (Infrequent Deep Watering) |
| Fairy Duster<br>*Calliandra eriophylla* | Semi-evergreen shrub to 3' high and 4' wide. Red to purple-ish feathery flowers. | Cold Hardiness: To 0°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |

**Table B-1** *Approved Landscape Plants*

| Common Name/*Botanical Name* | Description | Culture |
|---|---|---|
| Spiny Hackberry, Desert Hackberry<br>*Celtis pallida* | Densely branched evergreen shrub, 4' to 15' tall. Small spring flowers, greenish white, attract pollinators, fruits attract birds. | Cold Hardiness: To 10°F<br>Soil Type: Adaptable<br>Light: Full Sun<br>Water: Moderate to Low |
| Winterfat<br>*Ceratoides lanata, Krascheninnikovia lanata, Eurotia lanata* | Evergreen shrub to 4' tall and 3' wide. Foliage is grayish-green; seeds have dense cottony appearance at ends of branches in fall. | Cold Hardiness: To 20°F<br>Soil Type: Well Drained<br>Light: Full Sun to Partial Shade<br>Water: Low |
| Fernbush<br>*Chamaebatiaria millefolium* | Deciduous shrub, 4' to 6' in height and 5' wide. Olive-green, fern-like foliage with showy white blooms in mid-summer. | Cold Hardiness: To 0°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| Desert Willow<br>*Chilopsis linearis* | Deciduous shrub to 25' tall and 15' wide, can be trimmed up to tree shape. Lavender, pink, or white flowers April through September. | Cold Hardiness: To 10°F<br>Soil Type: Well Drained, Adaptable<br>Light: Full Sun<br>Water: Moderate to Low |
| Damianita<br>*Chrysactinia mexicana* | Low-growing evergreen shrub to 2' tall and 2' spread. Showy yellow flowers. | Cold Hardiness: To 20°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| Rabbitbrush, Chamisa<br>*Chrysothamnus nauseosus, Ericameria nauseosus* | Low-growing evergreen shrub to 3' tall and 4' wide. Leaves are grey-green with yellow flowers covering entire plant in fall. | Cold Hardiness: To -10°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low to None |
| Texas Olive<br>*Cordia boissieri* | Deciduous shrub to 10' tall and 10' wide. Large, showy white flowers. | Cold Hardiness: To 18°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| Little Leaf Cordia<br>*Cordia parvifolia* | Deciduous shrub to 6' tall and 6' wide. Showy white flowers in spring and fall. | Cold Hardiness: To 18°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| Rock Cotoneaster<br>*Cotoneaster horizontalis* | Low-growing evergreen to semi-deciduous shrub to 2' tall and 15' spread. Light-pinkish white flowers followed by red fruits. | Cold Hardiness: To -10°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| Cliffrose<br>*Cowania mexicana, Purshia stansburiana* | Large shrub to 8' tall and 6' wide. Fragrant yellow blooms during summer. Feathery plumes form after flowering and persist into winter. Tolerant of reflected light and heat. | Cold Hardiness: To -10°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| Feather Indigo Bush<br>*Dalea formosa* | Low-growing, semi-evergreen shrub, 3' high, and 3' wide. Small violet flowers with yellow throats, March through September. | Cold Hardiness: To 0°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| Black Dalea<br>*Dalea frutescens* | Mostly deciduous shrub, 3' tall, and 4' wide. Brilliant rose-purple flowers late summer to fall. Attracts butterflies. | Cold Hardiness: To 0°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| Indigo Bush<br>*Dalea pulchra* | Evergreen shrub to 5' tall and 5' wide. Clusters of purple, pea-shaped flowers in spring. | Cold Hardiness: To 0°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| Indigobush<br>*Dalea versicolor* | Perennial, mostly evergreen shrub to 3' tall and 4' wide. Purple flowers in spring. | Cold Hardiness: To 0°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low to Moderate |
| Dicliptera, Hummingbird Plant<br>*Dicliptera resupinata,* Justicia resupinata | Perennial subshrub to 2' tall and 4' wide. Shade-loving with lavender-colored flowers all summer. | Cold Hardiness: To 20°F<br>Soil Type: Well Drained<br>Light: Full Shade to Partial Shade<br>Water: Moderate |
| Florida Hopbush<br>*Dodonaea viscosa* | Erect evergreen shrub to 10' tall and 6' wide. Leaves are bright green with ornamental winged fruits in late summer. | Cold Hardiness: To 15°F<br>Soil Type: Adaptable<br>Light: Full Sun to Partial Shade<br>Water: Low |
| Joint-Fir, Mormon Tea<br>*Ephedra* sp. | Medium-size evergreen shrubs, usually from 3' to 5' tall and similar width. | Cold Hardiness: To 10°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |

**Table B-1** *Approved Landscape Plants*

| Common Name/*Botanical Name* | Description | Culture |
|---|---|---|
| Turpentine Bush<br>*Ericameria laricifolia* | Low-growing evergreen shrub to 2' tall and 3' wide. Covered in yellow flowers in fall. | Cold Hardiness: To 5°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low to None |
| Apache Plume<br>*Fallugia paradoxa* | Clump-forming shrub to 8' tall. White flowers in spring and summer with showy plumes following flowers through fall. Leaves turn yellow in fall. | Cold Hardiness: To 0°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| Cliff Fendler-Bush<br>*Fendlera rupicola* | Deciduous to semi-evergreen shrub to 6' tall. Showy white flowers. | Cold Hardiness: To -10°F<br>Soil Type: Well Drained<br>Light: Sun to Partial Shade<br>Water: Moderate |
| Tarbush<br>*Flourensia cernua* | Densely branched evergreen shrub to 3' tall and 3' wide. Flowers from September through December. Stems often appear blackish. | Cold Hardiness: To 10°F<br>Soil Type: Adaptable<br>Light: Full Sun<br>Water: Low |
| New Mexico Olive, New Mexico Privet<br>*Forestiera neomexicana* | Deciduous shrub 6' to 8' tall and 8' wide. Fast growing and low maintenance once established. | Cold Hardiness: To 0°F<br>Soil Type: Adaptable, Alkaline Tolerant<br>Light: Partial Sun to Full Sun<br>Water: Low |
| California Buckthorn, Beech-Leaf Buckthorn, Sawleaf Buckthorn<br>*Frangula (Rhamnus) californica, Frangula (Rhamnus) betulifolia, Rhamnus serrata* | Evergreen shrubs to 10' tall and similar spread. Clusters of small greenish-white flowers late spring and early summer. | Cold Hardiness: To 15°F<br>Soil Type: Adaptable<br>Light: Partial Sun to Full Sun<br>Water: Moderate to Low |
| Mexican Silktassel, Wright Wilktassel<br>*Garrya ovata, G. wrightii* | Evergreen shrub, 5' to 11' tall and 6' wide. Dark green leathery leaves. Showy catkins on male and female plants. Mature plants can be dense and wide. | Cold Hardiness: To 10°F<br>Soil Type: Well Drained<br>Light: Sun to Partial Shade<br>Water: Moderate |
| Soapbush, Guayacan, Texas Lignumvitae<br>*Guaiacum angustifolium, G. coulteri* | Evergreen shrub or small tree to 15' tall and 10' wide. Branches tend to have a gnarled appearance. Flowers are blue-purple and fragrant. | Cold Hardiness: To 25°F<br>Soil Type: Well Drained<br>Light: Full Sun to Partial Sun<br>Water: Low to Moderate |
| Snakeweed<br>*Gutierrezia sarothrae* | Semi-evergreen subshrub to 18" tall and 2' wide. Bright-green, resinous leaves and clusters of tiny yellow flowers covering the plant June through October. | Cold Hardiness: To 0°F<br>Soil Type: Adaptable<br>Light: Full Sun<br>Water: Low to None |
| Rose of Sharon<br>*Hibiscus syriacus* | Deciduous shrub to 10' tall and 6' wide. Showy flowers available in many colors. | Cold Hardiness: To 0°F<br>Soil Type: Well Drained<br>Light: Full Sun to Partial Shade<br>Water: Moderate |
| Creosote Bush<br>*Larrea tridentata* | Spindly evergreen shrub to 8' tall, and 6' wide. Small yellow flowers spring through fall. Pleasant scent, especially after rainfall. | Cold Hardiness: To 0°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| Chihuahuan Sage<br>*Leucophyllum laevigatum* | Evergreen shrub to 6' tall and 5' wide. Covered with 1/2" to 1" purple flowers summer through fall. | Cold Hardiness: To 10°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| Texas Sage, Texas Ranger, Silver Cloud, Green Cloud<br>*Leucophyllum* sp. | Evergreen shrub, 4' to 6' tall and 5' wide. Foliage green to grey-green in color. Showy magenta, blue, or purple flowers all summer and fall. | Cold Hardiness: To 10°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| Wolfberry, Thornbush<br>*Lycium* sp. | Deciduous shrubs, 6' to 10' high and 5' to 8' wide. Purple to white flowers in spring. Some species densely spinose. | Cold Hardiness: To 10°F<br>Soil Type: Well Drained<br>Light: Full Sun to Partial Shade<br>Water: Low |
| Mariola, Guayule<br>*Parthenium incanum, P. argentatum* | Low-growing evergreen shrub to 3' tall and 4' wide. The leaves are grey-green with small pale-yellow flowers. | Cold Hardiness: To 10°F<br>Soil Type: Well Drained<br>Light: Full Sun to Partial Sun<br>Water: Low |
| Desert Rosemary Mint, Mexican Rosemary Mint<br>*Poliomintha incana, Poliomintha* sp. | Semi-evergreen shrub to 3' tall and 4' wide. Small, fragrant, purple flower spikes. | Cold Hardiness: To 0°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low to Moderate |
| Western Sand Cherry<br>*Prunus besseyi* | Deciduous shrub, 3' to 6' in height and equal spread. White flowers in spring followed by edible purple-black fruits. | Cold Hardiness: To -20°F<br>Soil Type: Well Drained<br>Light: Part Shade to Full Sun<br>Water: Moderate to Low |

**Table B-1** *Approved Landscape Plants*

| Common Name/*Botanical Name* | Description | Culture |
|---|---|---|
| Desert Scrub Oak<br>*Quercus turbinella* | Slow-growing evergreen shrub to 8' tall and 12' wide. Leaves are leathery grey-green. | Cold Hardiness: To 12°F<br>Soil Type: Adaptable<br>Light: Full Sun<br>Water: Low to Moderate |
| Littleleaf Sumac<br>*Rhus microphylla* | Heavily branched shrub, 3' to 10' tall. Leaves deciduous. Can be grown into a hedge. | Cold Hardiness: To 20°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate to Low |
| Sugar Bush<br>*Rhus ovata* | Large evergreen shrub to 15' tall and 15' wide. Large white flower clusters in spring. Excellent attractant for birds and butterflies. | Cold Hardiness: -10°F<br>Soil Type: Adaptable<br>Light: Full Sun<br>Water: Moderate |
| Skunkbush Sumac<br>*Rhus trilobata* | Deciduous shrub to 6' tall. Nice fall foliage (red, copper and yellow). | Cold Hardiness: To -20°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate to Low |
| Autumn Amber/Grow Low Sumac<br>*Rhus trilobata "Autumn Amber," R. trilobata "Grow Low"* | Deciduous, low-growing shrub to 3' tall and 10' wide. Nice fall foliage colors, can be utilized as a shrubby ground cover. | Cold Hardiness: To -20°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate to Low |
| Evergreen Sumac, Chihuahuan Leather-Leaf Sumac<br>*Rhus virens, Rhus choriophylla* | Spreading shrub, 10' to 12' tall and 15' wide. Leaves turn maroon in winter then drop right before new leaves grow again. | Cold Hardiness: To 10°F<br>Soil Type: Well Drained<br>Light: Partial Shade<br>Water: Moderate to Low |
| Mexican Blue Sage<br>*Salvia chamaedryoides* | Low-growing perennial to 18" tall and 18" wide. Blue flowers early summer through November. | Cold Hardiness: To 20°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate |
| Desert Sage<br>*Salvia dorrii var. dorrii* | Perennial shrub to 3' tall and 3' wide. Flowers purple, nice contrast with foliage. | Cold Hardiness: -10°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate to Low |
| Mealy Cup Sage<br>*Salvia farinacea* | Low-growing perennial to 18" tall and 18" wide. Blue flowers early summer to November. | Cold Hardiness: To 24°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate |
| Autumn Sage<br>*Salvia greggii* | Low-growing perennial to 3' tall. Reddish to magenta flowers spring and fall. | Cold Hardiness: To 0°F<br>Soil Type: Well Drained<br>Light: Full Sun to Partial Shade<br>Water: Moderate |
| Threadleaf Groundsel<br>*Senecio flaccidus, S. douglassii* | Evergreen perennial subshrub to 3' tall and 2' wide. Foliage is silvery in color, covered with yellow daisy-like flowers April to October. | Cold Hardiness: To 0°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| Velvet Leaf Senna, Desert Sensitive Plant<br>*Senna lindheimeriana, Cassia lindheimeriana* | Perennial, 3' to 6' in height and 2' to 5' in width. Flowers are yellow-orange and bloom from July to October. | Cold Hardiness: To 10°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate to Low |
| Shrubby Senna<br>*Senna wislizeni, Cassia wislizeni* | Large shrub, 8' tall by 8' wide. Showy yellow flowers in spring. | Cold Hardiness: To 0°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate to Low |
| Buffaloberry<br>*Shepherdia argentea* | Deciduous shrub to 3' tall and 4' wide. Bright-red edible berries in fall. | Cold Hardiness: To -20°F<br>Soil Type: Well Drained<br>Light: Full to Partial Sun<br>Water: Low |
| Jojoba<br>*Simmondsia chinensis* | Medium-sized evergreen shrub to 5' tall and 5' wide. | Cold Hardiness: To 18°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| Garrocha, Argentine Tecoma<br>*Tecoma garrocha* | Large shrub, 10' tall and 6' wide. Semi-deciduous, light-green leaves with orange, trumpet-shaped flowers from summer to fall. | Cold Hardiness: To 15°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate to Low |
| Yellow Trumpet Flower<br>*Tecoma stans* | Semi-deciduous shrub to 12' tall and 6' wide. Very showy yellow flowers all season. Also an orange cultivar available. | Cold Hardiness: To 10°F<br>Soil Type: Well Drained<br>Light: Sun to Partial Shade<br>Water: Moderate to Low |

**Table B-1** *Approved Landscape Plants*

| Common Name/*Botanical Name* | Description | Culture |
|---|---|---|
| Arizona Rosewood, Chisos Rosewood, Narrowleaf Rosewood<br>*Vauquelinia californica, V. corymbosa* | Large evergreen shrub to 20' tall and 15' wide. Clusters of small creamy flowers. Attractive foliage. | Cold Hardiness: To 0°F<br>Soil Type: Well Drained<br>Light: Full Sun to Partial Shade<br>Water: Moderate to Low |
| Slimleaf Goldeneye, Skeletonleaf Goldeneye<br>*Viguiera stenoloba* | Evergreen shrub to 3' tall and 3' spread. Bright-green, thread-like foliage with yellow daisy-like flowers from spring through fall. | Cold Hardiness: To 10°F<br>Soil Type: Well Drained, Adaptable<br>Light: Full Sun<br>Water: Low |
| Chaste Tree<br>*Vitex agnus-castus* | Large shrub or small tree to 15' tall and similar spread. Lilac- or white-flowered varieties available. | Cold Hardiness: To 5°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low to Moderate |
| Lotebush<br>*Ziziphus obtusifolia* | Many-branched deciduous shrub to 6' tall and 8' spread. Stems appear greyish with a waxy coating, and the leaves are grey-green. Small black fruits in late fall are excellent food for birds. | Cold Hardiness: To 15°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| **Grasses** | | |
| Sideoats Grama<br>*Bouteloua curtipendula* | Perennial bunchgrass to 2' high, and 1-1/2' wide. Blooms from April to October. Bluish-green foliage dries to tan in fall. Rejuvenate by cutting after dried in fall. | Cold Hardiness: To 0°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate to Low |
| Blue Grama<br>*Bouteloua gracilis* | Perennial shortgrass, 10" to 20" high. Forms a light turf grass and is drought tolerant. | Cold Hardiness: To -20°F<br>Soil Type: Well Drained<br>Light: Full Sun to Partial Sun<br>Water: Low |
| Buffalo Grass<br>*Buchloe dactyloides* | A warm-season grass, forming a uniform and attractive turf (sodgrass). Grows 8" to 10" high but maintains a short appearance. Only cut 2-3 times per year, don't over fertilize. | Cold Hardiness: To -10°F<br>Soil Type: Adaptable<br>Light: Full Sun<br>Water: Low |
| Plains Lovegrass<br>*Eragrostis intermedia* | Perennial bunchgrass to 2' high. Delicate looking seedheads bloom from June to October. Plant has a grey-green to purple-tinged appearance. | Cold Hardiness: To 0°F<br>Soil Type: Well Drained<br>Light: Full Sun to Partial Shade<br>Water: Moderate to Low |
| "Regal Mist" Muhly<br>*Muhlenbergia capillaris* | Perennial bunchgrass to 3' tall and 3' wide. Flowering panicles have a pinkish-red, feathery appearance. Plants should be cut to base in late winter (January or early February). | Cold Hardiness: To 0°F<br>Soil Type: Well Drained, Adaptable<br>Light: Full Sun<br>Water: Low to Moderate |
| Bush Muhly<br>*Muhlenbergia porteri* | Perennial bunchgrass to 3' high and 4' wide. Flowers summer to fall. | Cold Hardiness: 10°F<br>Soil Type: Well Drained<br>Light: Full Sun to Partial Shade<br>Water: Moderate to Low |
| Deer Grass<br>*Muhlenbergia rigens* | Perennial bunchgrass to 3' high and 4' wide. Has showy, 1' long flowering spikes from July to October. Cut at ground level to rejuvenate clumps. | Cold Hardiness: 10°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate to Low |
| Indian Ricegrass<br>*Oryzopsis hymenoides* | Perennial bunchgrass, 1' to 2' high and 1' wide. Light-green leaf blades fade to straw color in fall. Nice accent plant. | Cold Hardiness: To 10°F<br>Soil Type: Well Drained<br>Light: Full Sun to Partial Shade<br>Water: Low |
| Little Bluestem<br>*Schizachyrium scoparium* | Perennial bunchgrass to 2' tall and less than 1' wide. Leaf blades and dark blue-green, fall flower stems are reddish. Entire plant turns to rust color in fall. | Cold Hardiness: To -15°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate to Low |
| Alkali Sacaton<br>*Sporobolus airoides* | Perennial bunch grass to 3' high and 1-1/2' wide. Pale-green leaf blades taper to a long slender tip. Open seedhead panicle from May through October. | Cold Hardiness: -10°F<br>Soil Type: Heavy, Silty, or Clay Soils are Preferred<br>Alkaline Tolerant<br>Light: Full Sun<br>Water: Moderate to Low |
| New Mexico Feathergrass<br>*Stipa neomexicana* | Perennial bunchgrass to 30" tall and 1' wide. Silky awns on seeds are very attractive accents. | Cold Hardiness: To -15°F<br>Soil Type: Well Drained<br>Light: Sun to Partial Shade<br>Water: Moderate to Low |

**Table B-1** *Approved Landscape Plants*

| Common Name/*Botanical Name* | Description | Culture |
|---|---|---|
| **Groundcover** | | |
| Fringed Sage<br>*Artemisia frigida* | Low-growing groundcover to 2' high. Leaves are grey-green with a pleasant fragrance. | Cold Hardiness: To -20°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate |
| 'Centennial' Desert Broom<br>*Baccharis pilularis X sarothroides* | Low-growing grey-green shrub, 3' high to 5' wide. Evergreen. | Cold Hardiness: To 15°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate to Low |
| Winecups<br>*Callirhoe involucrate* | Low-growing herbaceous perennial to 2' tall and 2' wide. Flowers are a rich pinkish-red color with a white center. Re-seeds itself and will slowly fill in an area as groundcover. | Cold Hardiness: To 10°F<br>Soil Type: Adaptable to Most Soils<br>Light: Full Sun, Can Take Some Reflected Light<br>Water: Low |
| Trailing Yellow Dalea, Trailing Indigo Bush<br>*Dalea capitata, D. greggii* | Low-growing shrub, 6" to 1' tall and 3' to 4' wide. Yellow, lemon-scented flowers in late spring and fall. | Cold Hardiness: To 5°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| Creeping Juniper<br>*Juniperus horizontalis* | Low-growing shrub, 6" to 12" in height with a spreading habit. Evergreen. | Cold Hardiness: To -20°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| Drooping Lobelia, Loose-Flower Lobelia<br>*Lobelia laxiflora* | Perennial low-growing shrub to 2' tall, spreading by underground runners. Red flowers in spring. | Cold Hardiness: To 20°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low to Moderate |
| Desert Four O'clock<br>*Mirabilis multiflora* | Low-growing herbaceous perennial to 2' high. Showy, fragrant magenta flowers in summer. Takes on shrub-like appearance. Attracts birds, bees, and butterflies. | Cold Hardiness: To -10°F<br>Soil Type: Adaptable<br>Light: Sun to Partial Shade<br>Water: Moderate to Low |
| Evening Primrose Species<br>*Oenothera* sp. | Low-growing herbaceous perennial to 1' to 2' high. Multiple colors of flowers spring through summer. Attractive to birds, bees, and butterflies. | Cold Hardiness: To -10°F<br>Soil Type: Well Drained<br>Light: Full Sun (Some Partial Shade)<br>Water: Moderate |
| Orange Zexmenia, Shortleaf Jefea, San Pedro Daisy<br>*Zexmenia* sp., *Jefea* sp., *Wedelia* sp., *Lasianthaea* sp. | Low-growing shrubby perennial to 2' high and 3' wide. Yellow to sunflower-like blossoms from spring to fall. | Cold Hardiness: To 20°F<br>Soil Type: Well Drained<br>Light: Full Sun to Partial Shade<br>Water: Low to Moderate |
| **Vines** | | |
| Coral Vine<br>*Antigonon leptopus* | Fast-growing vine grows to 25' length and 25' width. Leaves are heart-shaped with pink, red or white flowers midsummer to fall. Can be planted as a fence cover, but do not plant so it will climb buildings or other plants. | Cold Hardiness: To 20°F<br>Soil Type: Adaptable<br>Light: Full Sun to Partial Sun<br>Water: Moderate to Low |
| Trumpet Creeper<br>*Campsis radicans* | Vigorous growers to 30' length and width. Showy red-orange flowers are very attractive to hummingbirds. | Cold Hardiness: To -10°F<br>Soil Type: Adaptable<br>Light: Full Sun to Shade<br>Water: Moderate |
| Western Virgin's Bower, Old Man's Beard, Bigelow's Leather Flower<br>*Clematis ligusticifolia, C. drummondii, C. bigelovii* | Native vine to 20' length and 10' width. White flowers in summer and plumose showy fruits late summer to fall. Can be planted as a fence cover, but do not plant so it will climb buildings or other plants. | Cold Hardiness: To 0°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| Purple Orchid Vine, Yellow Orchid Vine<br>*Mascagnia lilacina, M. macroptera, Callaeum lilacina, C. macroptera* | Vine growing from 6' to 30' length and similar width. Purple flowers or yellow flowers in late spring. Plant as a fence cover, but do not plant so it will climb buildings or other plants. | Cold Hardiness: To 15°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low to Moderate |
| Little Snapdragon Vine<br>*Maurandya antirrhiniflora, Maurandella antirrhiniflora* | Delicate vine growing 6' to 10' length. Small light-green leaves with magenta to deep-violet snapdragon flowers in summer. Does best when provided a trellis to grow upon. | Cold Hardiness: To 20°F<br>Soil Type: Well Drained, Adaptable<br>Light: Full Sun to Partial Shade<br>Water: Low to Moderate |
| Virginia Creeper<br>*Parthenocissus quinquefolia* | Large native vine to 25' length and 25' width. Lush green leaves with fall foliage a deep-red color. May need to be trimmed regularly. Plant as fence cover, not where it will climb buildings or other plants. | Cold Hardiness: To -30°F<br>Soil Type: Well Drained<br>Light: Partial Shade to Full Sun<br>Water: Low |
| American Wisteria, Texas Wisteria<br>*Wisteria frutescens* | Small to medium native vine, 8' to 20' length. Clusters of light purple to violet flowers in spring. May need some regular trimming. Plant where it can climb. | Cold Hardiness: To -10°F<br>Soil Type: Well Drained<br>Light: Partial Shade to Full Sun<br>Water: Moderate |

**Table B-1** *Approved Landscape Plants*

| Common Name/*Botanical Name* | Description | Culture |
|---|---|---|
| **Other Flowers** | | |
| Moonshine Yarrow, Western Yarrow (Many Cultivars)<br>*Achillea millefolia* | Distinctive silver-grey foliage on this low-growing plant to 18" to 3' tall and 18" wide. Flowers vary in color from cream to yellow to pink. | Cold Hardiness: To -20°F<br>Soil Type: Well Drained<br>Light: Full Sun to Partial Shade<br>Water: Moderate |
| Giant Hyssop<br>*Agastache cana* | Low-growing plant to 2' tall and 2' wide. Rose-pink flower spikes from July through September, with fragrant leaves. Attracts hummingbirds. | Cold Hardiness: To -20°F<br>Soil Type: Well Drained<br>Light: Full Sun to Partial Sun<br>Water: Moderate to Low |
| Licorice Mint Hyssop<br>*Agastache rupestris* | Low-growing plant to 2' tall and 2' wide. Orange flower spikes from July through September with fragrant threadlike grey-green leaves. | Cold Hardiness: To -10°F<br>Soil Type: Well Drained<br>Light: Full Sun to Partial Sun<br>Water: Moderate to Low |
| Flattop Ageratum, Butterfly Mist<br>*Ageratum corymbosum* | Low-growing perennial, to 18" tall and 4' spread. Blue to lilac flowers that attract butterflies. | Cold Hardiness: To 15°F<br>Soil Type: Well Drained<br>Light: Full Sun to Partial Shade<br>Water: Moderate |
| Columbine<br>*Aquilegia* sp. | Attractive fern-like foliage. Showy flowers, many colors available. Grows to 3' tall and 18" wide. | Cold Hardiness: To -30°F<br>Soil Type: Well Drained<br>Light: Partial Shade<br>Water: Moderate to High |
| Prickly-Poppy<br>*Argemone* sp. | Short-lived perennial to 3' tall and 2' wide. Showy white or yellow flowers with crepe paper-like petals. Foliage and stems are covered with yellow stems. | Cold Hardiness: To 15°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| Milkweed, Butterfly Milkweed<br>*Asclepias* sp., *A. tuberosa* | Perennial to 2' tall. Clusters of orange, yellow, or pink flowers at the top of the plant from spring to fall. | Cold Hardiness: To 0°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate to Low |
| Bahia<br>*Bahia absinthifolia* | Perennial to 1' tall and 18" wide. Yellow flowers above silvery foliage. Blooms in spring and fall. | Cold Hardiness: To 15°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| Desert Marigold<br>*Baileya multiradiata* | Short-lived perennial, to 12" tall. Bright yellow flowers spring and summer with grayish foliage. | Cold Hardiness: To 0°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low to None |
| Chocolate Flower<br>*Berlandiera lyrata* | Attractive perennial to 20" tall. Yellow flowers with brown centers, scent similar to chocolate. | Cold Hardiness: To 10°F<br>Soil Type: Well Drained<br>Light: Full Sun to Partial Shade<br>Water: Moderate to Low |
| Sundrops<br>*Calylophus* sp. | Perennial wildflower to 18" tall and 18" wide. Profuse bloomer with yellow flowers spring through summer. Foliage is grey-green. Shear tops of plants off before growing season starts (February or March). | Cold Hardiness: To 10°F<br>Soil Type: Well Drained, Adaptable<br>Light: Partial Sun to Full Sun<br>Water: Low |
| Coreopsis, Calliopsis<br>*Coreopsis tinctoria* | Upright annual, 2' to 3' tall. Red and yellow flowers in spring. | Cold Hardiness: N/A<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate to Low |
| Shrubby Dogweed, Dogweed<br>*Dyssodia* sp., *Thymophylla* sp. | Herbaceous perennial or subshrub, 6" tall and about 1' wide. Yellow daisy-like flowers from April through October. | Cold Hardiness: 10°F<br>Soil Type: Adaptable<br>Light: Full Sun<br>Water: Low |
| Purple Coneflower<br>*Echinacea purpurea* | Upright perennial to 3' tall. Purple to white flowers. | Cold Hardiness: To -20°F<br>Soil Type: Well Drained<br>Light: Partial Shade to Full Sun<br>Water: Moderate |
| Mexican Gold Poppy<br>*Eschscholzia mexicana* | Low-growing perennial or annual. Yellow and cream colored flowers with grey-green foliage. | Cold Hardiness: N/A<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate |
| Blanketflower<br>*Gaillardia* sp. | Perennial. Red or orange flower petals with yellow tips or yellow petals. | Cold Hardiness: To -20°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate |
| Gaura<br>*Gaura lindheimeri* | Herbaceous perennial, 2' to 4' tall with 2' to 4' width. White or pink flowers from June through September. | Cold Hardiness: To -10°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate |

**Table B-1** *Approved Landscape Plants*

| Common Name/*Botanical Name* | Description | Culture |
|---|---|---|
| Purple Verbena, Sand Verbena<br>*Glandularia wrightii, Glandularia* sp., *Verbena* sp. | Low-growing perennial. Purple to magenta flower clusters in summer. | Cold Hardiness: To 15°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| Maximillian Sunflower<br>*Helianthus maximilianus* | Tall plant to 8' tall, for placement along hedges or edges of yards. Twenty to thirty spikes of 30 or more yellow, daisy-like flowers. | Cold Hardiness: To -20°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate |
| Angelita Daisy<br>*Hymenoxys acaulis* | Low-growing shrub to 1' tall. Yellow flowers in summer. | Cold Hardiness: To 10°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate |
| Perky Sue, Four-Nerve Daisy<br>*Hymenoxys argentea, Tetraneuris scaposa* | Low-growing perennial to 1' tall. Yellow flowers from April through August. | Cold Hardiness: To 10°F<br>Soil Type: Well Drained<br>Light: Full Sun to Partial Shade<br>Water: Low |
| Dotted Gayfeather<br>*Liatris punctata* | Perennial plant to 2-1/2" tall. Rose-purple flowers on a spike summer to fall. | Cold Hardiness: To -10°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate to Low |
| Blue Flax<br>*Linum lewisii* | Perennial to 3' tall. Blue flowers late spring to summer. Trim back each winter. | Cold Hardiness: To -20°F<br>Soil Type: Well Drained<br>Light: Full Sun to Partial Shade<br>Water: Moderate |
| Tansy Aster<br>*Machaeranthera bigelovii* | Low-growing plant, 1' to 3' tall. Bright purple to deep magenta flowers late summer to fall. | Cold Hardiness: To 0°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate |
| Blackfoot Daisy<br>*Melampodium leucanthum* | Short-lived perennial to 1-1/2' tall and 2' wide, mound shape. Has fragrant white flowers March to November. | Cold Hardiness: To 0°F<br>Soil Type: Well Drained<br>Light: Partial Shade to Full Sun<br>Water: Moderate to Low |
| Rock Rose<br>*Pavonia lasiopetala* | Short-lived, deciduous to semi-evergreen perennial to 3' tall and 3' spread. Rosy-pink flower from April to October. Should be cut back annually (to ~4" of base) in late winter (February). Can be allowed to self-seed. Attractive to butterflies. | Cold Hardiness: To 5°F<br>Soil Type: Well Drained<br>Light: Full Sun to Partial Shade<br>Water: Low to Moderate |
| Beardtongue, Penstemon<br>*Penstemon* sp. | Perennial plants, 1' to 3' tall. Many varieties and flower colors available. Most are showy and add good color. | Cold Hardiness: To 0°F<br>Soil Type: Well Drained<br>Light: Full Sun to Partial Shade<br>Water: Moderate to Low, Needs to be Heat Tolerant |
| Wooly Paperflower, Paperflower<br>*Psilostrophe tagetina, P. cooperi* | Low-growing perennial, to 1' tall and 18" spread. Covered with bright yellow flowers March through September. | Cold Hardiness: 15°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| Mexican Hat<br>*Ratibida columnaris* | Perennial to 2' tall. Brown-orange flower petals with yellow tips late spring to early fall. Cut stems to ground each winter. | Cold Hardiness: -30°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate to Low |
| Black-Eyed Susan<br>*Rudbeckia hirta* | Biennial or annual plant to 3' tall. Red-orange flower petals with yellow tips summer to fall. | Cold Hardiness: To -10°F<br>Soil Type: Well Drained<br>Light: Partial Sun<br>Water: Moderate |
| Salvia, Sage<br>*Salvia* sp. | Low-growing perennial or annual to varying heights. Most have showy flowers either spring, summer or fall. | Cold Hardiness: To 0°F<br>Soil Type: Well Drained<br>Light: Full Sun to Partial Shade<br>Water: Moderate |
| Globe-Mallow<br>*Sphaeralcea* sp. | Shrubby perennial to 3' tall and 3' wide. Flowers can be shades of orange, red, yellow, or pink. | Cold Hardiness: To 20°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate to Low |
| Mount Lemmon Marigold, Copper Canyon Daisy<br>*Tagetes lemmonii* | Upright perennial shrub to 3' tall and 4' wide. Golden-yellow daisy-like flowers in spring and fall. Very fragrant foliage. Dies back to ground in winter. | Cold Hardiness: To 20°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate |

**Table B-1** *Approved Landscape Plants*

| Common Name/*Botanical Name* | Description | Culture |
|---|---|---|
| Dutchman's Breeches, Turpentine Broom<br>*Thamnosma* sp. | Woody perennial to 12" tall and 18" spread. Yellow urn-shaped petals March through May. | Cold Hardiness: To 15°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| California Trixis, American Threefold<br>*Trixis californica* | Evergreen subshrub to 2' tall and 3' wide. Bright-green lance-shaped leaves with yellow flowers in spring and fall. Plant can be trimmed to base to rejuvenate in spring or summer but not fall. | Cold Hardiness: To 20°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low to Moderate |
| Goodding Verbena<br>*Verbena gooddingii* | Fast-growing perennial to 2' and 4' wide. Purple blossoms from spring to fall. After flowers fade, cut those stems off to keep from looking straggly. | Cold Hardiness: To 15°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate |
| Golden Eye<br>*Viguiera deltoidea* | Evergreen shrub to 3' tall and 3' wide. Pale yellow to white flowers with yellow centers. | Cold Hardiness: To 20°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate to Low |
| Rain Lily<br>*Zephyranthes* sp. | Perennial lily, 8" tall and 20" wide. White, pink, peach, or yellow flowers that emerge in summer following rainfall. | Cold Hardiness: To 5°F<br>Soil Type: Well Drained<br>Light: Full Sun to Part Shade<br>Water: Moderate to Low |
| Desert Zinnia<br>*Zinnia acerosa* | Perennial to 10" tall and 2' wide. White flowers in spring. | Cold Hardiness: To 20°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Low |
| Prairie Zinnia<br>*Zinnia grandiflora* | Perennial to 1' tall. Many bright yellow flowers from late spring to early fall. | Cold Hardiness: To 20°F<br>Soil Type: Well Drained<br>Light: Full Sun<br>Water: Moderate to Low |

- Alternatives to vegetative ground covers are the use of grey/multi-colored rock and limited wood mulches around plants. Rock in multiple colors and sizes allow a variety of application options. Variations in color and variations in the size of the gravel change the look of the mulch. Use of size variation is encouraged (crusher fines, 3/8", 1/2", 3/4", 1-1/2", 4" and boulders scattered around). Gray river rock shall be 1-1/2" as a standard and should be used to economically cover large areas. Colored rock shall be used to break up the "sea of gray." Grey boulders are discouraged and Franklin Red boulders are encouraged. Multi-colored river rock is encouraged to simulate water paths and cover ponding areas. Mounds, depressions and contours shall be used to break up/add variations to the landscaped area. Use of mounds is encouraged and the use of depressions and swales with round river rock is encouraged. Design shall direct drainage away from structures and shall not hinder/block storm water flow. Rock mulch offers sustained color as well as limited maintenance. Landscape that also serves as a force protection barrier, including mounds and large boulders, is encouraged and shall be used in lieu of concrete/concrete masonry unit walls, bollards or both whenever possible.

- Do not use landscape timbers. Metal edging and 6- to 8-inch concrete/concrete masonry unit ribbons are the preferred types of edging.

## B.4.2 Landscape Materials

The following non-vegetative landscape materials are currently in use at the base and available through local nurseries:

- **Rock Colors:** "Franklin Red" crushed rock, "Desert Tan" crushed rock and the common "Gray" 1-1/2" river rock—no other types allowed (e.g., no lava rock, pink rock, etc.).

- **Rock Size:** For "Franklin Red" and "Desert Tan"—crusher fines, 3/8", 1/2", 3/4", 1-1/2", and 4". For "Gray" river rock—1-1/2" only.

- **River Rock:** Multi-color 4" to 10" flat/round river rock.

- **Boulders:** "Franklin Red" color only of 2'x2' and 3'x3' or larger rock boulders.

## B.4.3 Irrigation

- Should bubbler or spray-head irrigation systems be used, provide minimum 1/2" PVC piping and appropriate backflow prevention.

## B.4.4 Landscape Maintenance

- See Maintenance Manual for Landscape Master Plan, Holloman AFB, New Mexico.

## B.4.5 Landscaping Plants Allowed on Holloman Air Force Base

Plants for landscaping and/or xeriscaping on Holloman AFB shall be chosen from the following list. There is a wide variety of plants available in all size/functionality categories, so there shall be no substitutions of other plants not on this list. Do not substitute different species within the same genus, unless specifically stated (e.g. *Acacia* sp., *Echinocereus* sp.). Common and scientific/botanical names are provided to ensure selection of proper species. If further information on a species, whether on this list, is required, or ideas for companion plantings or substitution recommendations for more "traditionally recognized" landscaping plants is desired, please contact 49 CES/CEAN, at 572-6685.

# B.5 Signage

## B.5.1 Exterior Signs

### B.5.1.1 General

- The number of signs should be held to the minimum required for identification and customer service.


**Figure B-9** *Shoppette demonstrates importance of signage standards.*

- Color policy for individual lettering attached to buildings, structures, monuments or entryway glass is white, beige, or bronze. Color policy for other types of exterior signs is white letters on brown background and brown posts, e.g., handicapped, reserved parking, etc., with the exception of signs relating to safety and governed by national standards applicable to the USAF. Such exceptions include traffic control signs governed by the Manual of Uniform Traffic Control Devices (MUTCD) and signs governed by OSHA. Examples include regulatory and traffic control signs (speed limit signs, stop signs, yield signs, etc.) and hazard/danger signs required by OSHA. Such special signs mandated by national standards must be of the required colors and design.

- All signs on base will adhere to standards set forth in ACCI 32-1054 (except that color shall be white letters on brown backgrounds and posts shall be brown as previously discussed).

- **AF Design Guide:** Unified Facilities Criteria (UFC) 3-120-01 Air Force Sign Standard. Air force design guide for specific types of facilities. Can be obtained from Internet web site http://www.wbdg.org/cb/dod/UFC/ufc_3_120_01.pdf and Air Force design guides for specific types of facilities. Can be obtained from internet web site www.e-publishing.af.mil.

- Signage shall strive to utilize recycled content materials.

## B.5.1.2 Building Identification Signs

- Buildings on Holloman AFB shall have a street address affixed near the main entrance if required. The street address is necessary to identify the majority of the facilities on Holloman AFB requiring deliveries, e.g., BITS, UPS, USPS, and FedEx, etc. Building numbers are also used for easy reference and tracking for maintenance and Real Property needs. Building numbers shall be installed and are generally located on the upper-right corner of the main entrance wall or facing the nearest main street. Consideration for building number placement is also given to assist in emergency vehicle responses.

- Street address applications shall be individual bronze or complimentary vinyl letters mounted directly to or above the main entrance door where possible.

- Building identification signs will require Base Architect approval. Building identification signs shall be individual dimensional Helvetica letters, Duronic Bronze in color (plastic or cast metal, all capitals), mounted directly to the exterior wall adjacent to the facility's main entry. This guidance also applies to monument type signs.

## B.5.1.3 AAFES/DeCA Commercial Signs

- Logo and lettering supplied by AAFES/DeCA or the parent organization are required to be light bronze or dark bronze.

- Format shall be AAFES logo followed by facility name; e.g., AAFES Base Exchange. This format shall be used for all AAFES facilities including shoppettes, laundries, dry cleaners, military clothing sales and class six stores.

- Logo and facility name shall be the same height and positioned in one continuous horizontal line if possible.

- Facility name shall be spelled out completely with individual letters.

- Logo and letters shall be mounted directly to the building fascia or exterior wall adjacent to the facility's main entrance and shall be visible from the street.

- Logo and letters shall be light or dark bronze anodized aluminum or plastic in a light or dark bronze color. Select finish color for maximum contrast and readability.

- Logo and letters shall be available in even height increments from 2 to 16 inches. Choose the appropriate size and color for each facility and location.

- The ratio of height to depth of logo and letters shall be approximately 8 to 1.

- **Note:** Use of logos/graphics on other base facilities is discouraged and shall be kept to a minimum, i.e., water tanks east of building 29 and the Command patches on building 523.

## B.5.1.4 Monument Signs

- Monument-type signs at Holloman AFB shall match the aesthetic of the building to which they relate. Preferred construction is split-face CMU with a metal sign insert. Do not use post-mounted signs. The Base Architect shall approve all monument-type signs.

## B.5.1.5 Other Signs

- Marquee signs are defined as those constructed of masonry, illuminated or non-illuminated, with removable/replaceable lettering for updates. Authorized marquee locations are available from base Civil Engineering. Any requests for new marquees shall receive Base Architect approval.

**Figure B-10** *Acceptable building identification numbers.*

- Revolving or moving signs shall not be used.

- Internally lighted signs shall not be used. When night visibility is functionally required, use external flood or spotlights that illuminate both the sign and the adjacent landscape or building.

## B.5.1.6 Lettering Size

- For signs other than those covered by ACC Architectural and Interior Design Standards, size all lettering according to the functional viewing distances.

Keep sign sizes to a minimum. The rule to follow for reading ability is one inch of letter height for each 25 feet of view distance. For example, If a sign is intended to be read from a passing car using a road 100 feet away, the smallest sign lettering would be four inches. Do not oversize the lettering. Lettering on all base signs shall be of the same style. Uppercase Helvetica medium type is required. Building numbers at Holloman AFB are typically 12" tall, and building names are 18" tall.

### B.5.1.7 Products/Treatments

- **Exterior Wall-Mounted Dimensional Letters—** Individual characters shall be cast aluminum with bronze Duranodic finish to match the base standard. Characters shall be flush-mounted against the wall surface using masonry anchors or threaded screws.

- **Pressure-Sensitive Lettering—**Vinyl sheeting for die-cut graphics shall have a 0.003 to 0.006 film thickness and conform to Military Specification M 43719A. Color shall be white. The sheeting shall have a pre-coated pressure-sensitive adhesive backing (Class 1) or positional pressure sensitive backing (Class 3).

## B.5.2 Interior Signs

- Graphics and signage shall be provided as a total system.

- Signs shall be clear matte acrylic plastic with a subsurface printed background.

- Office signs shall have a clear plastic sleeve to accept an identifying insert.

- Door numbers should be alphanumeric (e.g.; 110A).

- MEN and WOMEN signs shall be graphic symbols, centered and mounted on the door at a height where the top edge is five feet, six inches above the floor.

- Heights and locations of signs shall be in accordance with UFC-3-120-01 and mounted with vinyl tape or as recommended by the manufacturer.

# B.6 Engineering Standards

## B.6.1 Underground Plumbing

### B.6.1.1 Current Conditions

The soil at Holloman AFB is underlain with poorly-drained soils of fine loam formed in gypsiferous sediments of folian or alluvial. The soil is highly corrosive. The water table varies from 3 to 15 feet below the ground surface.

### B.6.1.2 General Requirements

Water piping shall be designed for a maximum velocity of 3 fps or manufacturer's recommendation, whichever is less. Only non-ferrous piping shall be used. Plastic piping shall be pressure pipe capable of withstanding 165 psi. Trenching, back filling, and pipe installation shall be done according to manufacturer's recommendations. Pipe shall have minimum cover of 3 feet of clean fill. Tracer wire shall be provided for all non-ferrous buried piping.

No pressure piping shall be allowed under slabs-on-grade unless it is in a crawl space or pipe chase except for the service entrance. The service entrance shall be perpendicular to the slab edge and not extend more than 5 feet under the slab.

Sanitary sewer lines shall be designed in accordance with UFC 3-240-07FA and installed according to manufacturer's recommendations with not less than a 2 fps hydraulic velocity flow. Minimum size of the sewer lateral from the building to the street sewer main shall be 4 inches. The designer shall take into account the prevailing soil conditions when selecting pipe materials. To the extent feasible, do not locate sewer pipes and manholes under pavement. Provide manholes at junctions and changes in direction, slope, and invert elevations of sewers 8 inches and above. Clean-outs are required for 4 and 6 inch sewers. Limit spacing between manholes to 300 feet, except 500 foot spacing is permitted in straight runs of long outfall sewers.

Limit storm sewers serving drainage inlets to not less than an 8-inch diameter and building connections to not less than a 4-inch diameter. Establish storm sewer slopes to provide minimum velocity of 2 fps when pipe is flowing full. Maximum storm sewer design velocity shall be in a non-erosive range for specified pipe material. Design all components of storm sewerage system on a basis of not less than 10-year storm frequency for one hour.

Sewer manholes shall be pre-cast, reinforced concrete manhole sections. Both the exterior and interior surfaces of the manholes shall be epoxy coated. Manholes shall conform to ASTM C478-72. Position manholes at every change of direction; position shall not exceed a maximum distance of 300 feet apart.

Provide reduced-pressure back flow preventers at the service entrance. The reduced pressure zone backflow preventers should be approved by the University of Southern California Foundation for Cross-Connection Control and Hydraulic Research. If required, a mechanical make-up water system shall have a separate air gap type (10 gallon tank and float with pressure-

actuated, gear-driven pumps) back flow prevention device.

Gas lines shall have a maximum working pressure of 60 PSIG. Gas risers shall be anodeless type.

### B.6.1.3 Approved Materials/Treatments

- Supply piping shall be non-metallic such as:
  - Polybutylene (PB)
  - Chlorinated Polyvinyl Chloride (CPVC)
  - Polyvinyl Chloride (PVC)
- Underground Water System:
  - Pipe 4 inches through 12 inches shall be not less than DR18, Class 150 and in conformance with AWWA C-900 PVC, latest revision.
  - PVC pipe over 12 inches shall be no less than DR25, Class 165 and in conformance with AWWA C-905, latest revision.
- Waste, vent, and drainage piping shall be non-metallic, such as:
  - Acrylonitrile-Butadiene-Styrene (ABS)
  - Polyvinyl Chloride (PVC)
  - Polypropylene (PP)
  - Filament-wound Reinforced Thermo-setting
  - Resin (RTRP)
- Gravity sewer piping shall be non-metallic, such as:
  - Polyvinyl chloride (PVC) Type PSM meeting ASTM D3034 or F679 for SDR 35, solvent weld or gasket joints.
- Pressure sewer piping shall be non-metallic, such as:
  - Polyvinyl chloride (PVC) AWWA C900 Class 150 (DR18) or Class 200 (DR14).
- Underground Natural Gas Pipelines:
  - Underground natural gas pipelines using high density (PE3408) or medium density (PE2406) polyethylene pipe installed in accordance with 49 CFR 192 joined with heat fusion, electro-fusion, or mechanical couplings.

## B.6.2 Aboveground Plumbing

### B.6.2.1 Current Conditions

Conditions within the buildings are per industry standards with piping run at right angles to the structure and insulated. Waste piping under slabs exits the building by the most direct route.

### B.6.2.2 General Requirements

In buildings normally occupied by more than 15 persons, provide separate toilet rooms for each sex; position them adjacent to each other and use a common wall for the plumbing chase. In buildings occupied by 1 to 15 employees, a single unisex toilet may be provided. All new buildings shall have at least one wheelchair-accessible toilet for each sex regardless of facility function or mission.

As a minimum, furnish one water closet, one lavatory and a room door that can be locked from the inside for buildings in Mission, Mission Support, Community, and DV Overlay Districts.

### B.6.2.3 Approved Materials/Treatments

- **Water Supply Piping:** PVC/CPVC suitable for transporting water above 150°F.
- **Compressed Air Supply Piping:** Shall be black steel with malleable iron fittings.
- **Waste and Vent Piping:** PVC/CPVC.
- **Drainage Piping:** PVC/CPVC.

## B.6.3 Plumbing Fixtures

### B.6.3.1 Current Conditions

The plumbing fixtures presently installed at Holloman AFB have been selected based on Federal Specification WW-P-541.

### B.6.3.2 General Requirements

- Energy conservation washer-less fixtures shall be all metal construction, no chrome-plated plastic.
- Utilize fixtures meeting EPA Water Sense standards including lavatory faucets with self-closing valves or automatic sensors.
- Showers shall have valves with pressure-balance features.
- Utilize freeze-less wall hydrants. Provide interior wall access (self-draining) with hose attached.
- Wall-mounted drinking fountains are preferred.
- Water softener for hot water systems should be used due to the hardness of level of potable water at Holloman AFB.

- All applications of plumbing fixtures shall be considered for usage by people with disabilities as directed by Air Force guidelines, ADA requirements and the UFAS standards.

Table B-2 suggests plumbing fixture types for the districts on base. The codes below describe different types of each fixture.

1. **Water Closets:** Flush-o-meter valve, siphon-jet, elongated bowl, top supply spud, floor or wall mounted. Seat: Plastic, elongated, open front.

2. **Water Closets (Wheelchair Accessible):** Top rim of bowl shall be 18" above the floor (all others same as 1).

3. **Lavatories:** Enameled cast-iron or vitreous china. Faucet: as required.

4. **Wheelchair Accessible Sinks:** Vitreous china, 20 inches by 27 inches deep.

5. **Urinal:** Wall hung; siphon-jet or washout.

6. **Kitchen Sinks:** Single or double bowl, ledge back with holes for faucet and spout, stainless steel. Faucet: As required.

7. **Service Sinks:** Enameled cast iron. Trap standard, wall-mounted or floor-mounted. Faucet: As required.

8. **Food Service Sinks:** Stainless steel with drain board. Faucet: As required.

9. **Water Coolers:** Self contained; exposed surfaces shall be stainless steel; wall-mounted surface; wall-mounted, semi-recessed; wall-mounted, recessed; wheelchair accessible; free-standing.

10. **Showers:** Wall-mounted for stall or bathtub. Valves: As required.

**Table B-2** *Plumbing Fixture Types*

| Fixture | Mission | Mission Support and Distinguished Visitor Overlay | Community |
|---|---|---|---|
| Water Closets | 1 and 2 | 1 and 2 | 1 and 2 |
| Lavatories | 3 | 3 | 3 |
| Urinals | 5 | 5 | 5 |
| Sinks (Kitchen) | | 6 | 6 |
| Sinks (Service) | 7 | 7 | 7 |
| Sinks (Food Service) | 8 | 8 | 8 |
| Sinks (Medical) | 4 | 4 | 4 |
| Water Coolers | 9 | 9 | 9 |
| Showers | 10 | 10 | 10 |
| Bathtub | | | 11 |

11. **Bathtubs:** Straight front recessed. Enameled cast iron, porcelain enameled. Formed steel, plastic without wall; plastic with high wall.

## B.6.4 Heating

### B.6.4.1 Current Conditions

Heating throughout most of the base, at present, is accomplished with gas-fired furnaces, gas-fired boilers or electric heat pump systems. The transfer medium is either hot air or hot water. Heating in large open bays, hangers, and shops is largely accomplished with radiant gas-fired heaters. Currently, various HVAC equipment components are located outside or on buildings, which does not enhance the appearance of the structure. The base has no central heating plant; the climate in the area does not justify the need for one.

### B.6.4.2 General Requirements

In general, indoor heating setpoints are to be set as stated in the latest version of ***Air Command Energy and Facility Management Policy" 12/31/2007*** **(**ACC/A7OE). Unless otherwise directed by ACC/A7OE, maintain spaces at the following conditions:

- The indoor design temperature for comfort heating for administrative spaces shall be 65°F to 70°F when occupied and 55°F when unoccupied.

- Shops and occupied storage shall be maintained at 65°F when occupied, 55°F when unoccupied.

- Warehouse spaces shall be maintained at 60°F.

- Heating will be 68°F in areas with low levels of physical activity and 55°F in areas of moderate to high levels of physical activity.

- The indoor design temperature for freeze protection will be 40°F.

Provide humidification only as required by other standards to maintain critical facilities within specific ranges or to reduce static electricity. Where indoor relative humidity is expected to fall below 20 percent for extended periods, humidification may be added to increase the indoor relative humidity to 30 percent. Humidification systems shall be provided which do not use corrosion inhibiting chemicals commonly found in central steam systems. Humidifier equipment shall only discharge potable water or potable steam. Due to the high maintenance associated with using raw water for humidification, recommend using humidifiers which operate with reverse osmosis water. Humidifiers that produce steam for dispersion are preferred.

The use of cast iron boilers is discouraged. Provide boiler water testing sample points on all hot water systems. Provide chemical feeding systems on all hot water heating systems. Heat gain and loss calculations may be increased up to 10 percent to account for unanticipated or undefined loads or changes in space usage. Increase boiler and heating coil capacity by 15 percent for normal pickup. Where the control system utilizes a night setback strategy, the equipment capacity may be increased by 30 percent, if justified by the load calculations. Ignore internal and solar loads in calculations for sizing of heating equipment. Include forced and natural ventilation. Where pipes exceed 30 meters in length, calculate piping losses and add to the boiler capacity.

Provide automatic pilot-less ignition systems on all gas-fired equipment. Install temperature sensors on heating supply and return lines. Install pressure gauges with valves on suction and discharge lines to all pumps. Install gas pressure gauges with valves on all gas trains on boilers.

The size of mechanical rooms and the access to the equipment for servicing is one of the most important considerations in designing new systems. Maintenance of the coils, filters, valves, and pumps along with tube removal or servicing shall be considered when designing mechanical systems and their enclosures.

- Access to the mechanical room shall be from the exterior of the building. Provide a backup heating unit in all mechanical rooms with water service entrances, water devices, etc. (natural gas is preferred if available).

If cost effective, include heat wheels in the exhaust duct to heat the air intake in the fresh air duct. Conduct a preliminary economic analysis to ensure there is a benefit to this feature.

Mechanical equipment shall not be located on roofs. All ground-mounted mechanical and electrical equipment shall have a standard factory applied finish and shall be screened from view in accordance with UFC 4-010-01.

Heat pump systems shall have a minimum COP equal to 2.5.

Refer to Section B.6.7 for additional energy conservation guidelines.

Solar heating systems shall be considered when the base indicates that budgeting conditions are favorable for studying their incorporation into the design of a building. These systems, in conjunction with electric heat pumps, may be useful in remote areas where natural gas lines are not available.

Energy sources: natural gas for furnaces and boilers, and electricity for heat pumps. Solar energy is available if the basic scope of a project will allow for its use in design. Equipment selection should be based on the system selected to provide the most energy efficient combination. Equipment types to be used:

- **Type 1:** Boilers shall be steel water tube or fire tube.
- **Type 2:** Heat exchangers shall be shell and tube type or plate and frame type.
- **Type 3:** Heat pumps shall be air-to-air, water-to-air or geothermal closed loop.
- **Type 4:** Circulating pumps shall be centrifugal base mounted, inline horizontal or vertical.
- **Type 5:** Unit heaters shall be horizontal or vertical.
- **Type 6:** Air handling units shall be blow through or draw through packaged type.
- **Type 7:** Fan coil units shall be horizontal, vertical or through the wall type.
- **Type 8:** Radiant heaters shall be natural gas fired.

Applicable Equipment Types:

- **Mission:** Types 1, 2, 4, 5, 6, and 8
- **Mission Supp:** Types 1, 2, 3, 4, 5, 6, and 7
- **Community:** Types 1, 2, 3, 4, 5, 6, and 7

**Controls:** New Direct Digital Control (DDC) systems and modifications to existing systems will be designed to be compatible with the existing Energy Monitoring and Control System (EMCS) and based on the EIA 709.1B (LonWorks) protocol.

Manufacturers of controls equipment produce controls parts that are slightly different in size, connections, features, and whether the controls are pneumatic or electric. Due to these differences, it is highly desirable to use the existing manufacturer of controls for the base systems. This ensures commonality of parts, and helps technicians troubleshoot maintenance problems regardless of the complexity of the controls system in a building.

Temperature controls will be used to the fullest extent consistent with economy of operation. They will be adequately protected against unauthorized adjustments or tampering (locking covers). Heating systems shall be

provided with a control for positive cut-off above 65°F outside temperature.

## B.6.5 Air Conditioning

### B.6.5.1 Current Conditions

Mechanical refrigeration is presently used in general for living quarters, office buildings, dining halls and clubs, hospitals and clinics and shop areas with equipment requiring a controlled environment. There is currently no central cooling system on the base.

### B.6.5.2 General Requirements

In general, indoor heating setpoints are to be set as stated in the latest version of ACC/A7OE. Unless otherwise directed by ACC/A7OE, maintain spaces at the following conditions:

Indoor design temperatures for comfort cooling in occupied offices, auditoriums, computer rooms, etc., shall not be lower than 76°F or higher than 78 to 80°F. The indoor specific humidity is usually not considered an issue during cooling season unless otherwise stated for specific facilities.

When authorized, shop spaces should be maintained at 76°F occupied; 84°F unoccupied.

Garages, warehouses not storing perishable items, equipment rooms, and non-temperature controlled storage rooms shall be unconditioned.

Mechanical ventilation for equipment rooms, etc., shall be designed with thermostatically-controlled louvers and supply or exhaust fans. The ventilation fan will have a two-speed motor, which is sized at the high speed to have adequate capacity to limit the room dry bulb temperature to a maximum of 10°F (6°C) above the outdoor dry bulb temperature when both equipment and ambient loads are at their maximum peaks. As a consequence, mechanical ventilation systems alone will not keep indoor temperatures at 80°F.

In those instances where mechanical ventilation is not able to maintain a space that requires ventilation and space conditions below 100°F, an evaporative cooler should be considered. The indoor design cooling setpoint temperature for evaporative cooling for comfort mechanical ventilation will be 80°F.

In the event that cooling towers are desired for energy efficiency of the chilled water cooling system, provide significant water treatment to prevent scale buildup and deterioration of fill (ACC/7AOE requires the use of water-cooled chillers for cooling loads greater than 100 tons).To minimize the effect of the high percentage of dissolved solids in Holloman AFB water supply, install basket strainers, basin cleaners, and/or centrifugal separators. Consider installation of reverse osmosis water conditioning for initial treatment of makeup water supply. These systems are most cost effective for large district cooling systems.

Evaporative coolers shall not be generally installed on the roof. Select air-cooled condensers based on 105°F ambient temperatures. A central mechanical system shall normally be provided unless specific engineering cost analysis indicates sub systems to be more economical. Locate equipment designed to operate outside behind architectural screening. Avoid locating outside equipment near the main entry of buildings.

Access to equipment for servicing is critical when designing new systems. Coils, filters, valves, pumps or tube removal or servicing is to be considered when designing mechanical systems.

Sloped roofs shall not have any equipment located on them. All equipment located less than 10 feet from the edge of a flat roof shall have a safety railing.

Equipment located on the ground shall be hidden from view by screens, landscaping, etc.

Solar heat gain calculations shall be prepared for all building construction projects at Holloman AFB.

**Energy Source:** All mechanical refrigeration equipment selected for installation shall make exclusive use of electricity, unless there is a need for steam to maintain the operation of a cogeneration facility.

**Equipment:** shall be suitable for the application.

- **Type 1:** Chillers shall be packaged air-cooled type. For chillers up to 20 tons, consider the use of scroll compressors. For larger air-cooled chillers, consider rotary screw compressors. All chiller selections should be based on efficiency requirements of ACC/A7OE, maintenance requirements and life cycle costs.

- **Type 2:** Evaporative coolers shall be side or vertical-downblast discharge blow-through type of material, impregnated with antirot salt and rigidifying saturants. Disposable media shall be used, similar to 2” thick aspen pads. Media efficiency shall be 76 percent at 250-FPM face velocity with no entrainment of pad water. Evaporative coolers shall be designed to provide an indoor temperature of 80°F.

- **Type 3:** Heat pumps shall be air-to-air, water-to-air or geothermal closed loop.

- **Type 4:** Circulating pumps shall be centrifugal base mounted, inline horizontal or vertical. Pumps shall be specified to have the motor and pump base mounted as a unit to ensure proper alignment between the pump and motor prior to connection to the piping.

- **Type 5:** Air handling units shall be blow-through or draw-through packaged type.

- **Type 6:** Fan coil units shall be horizontal, vertical, or through-the-wall type.

- **Type 7:** Chillers shall be water-cooled, centrifugal type, with a water treatment system sufficient to prevent scale buildup. ACC/7EOE requires use of water-cooled equipment for sizes larger than 100 tons. Base final selection on efficiency, maintenance requirements, and life cycle costs.

- **Type 8:** Indoor Air handling units (or blower-coils) with direct expansion (DX) coils matched to a slab mounted remote air-cooled compressor/condenser unit.

- **Type 9:** DX packaged window units or packaged terminal air conditioners (PTAC).

Applicable Equipment Types:

- **Mission:** Types 1, 2, 4, 5, 6, 7, 8 and 9
- **Mission Supp:** Types 1, 2, 3, 4, 5, 6, 7, 8 and 9
- **Community:** Types 1, 2, 3, 4, 5, 6, 7, 8 and 9

**Controls:** New Direct Digital Control (DDC) systems and modifications to existing systems will be designed to be compatible with the existing EMCS System and be based on the EIA 709.1B (LonWorks) protocol. Controls systems and modifications to existing systems will be designed to be compatible with the existing EMCS System.

Manufacturers of controls equipment produce control parts that are slightly different in size, connections, features, and whether the controls are pneumatic or electric. Due to these differences, it is highly desirable to use the existing manufacturer of controls for the base systems. This ensures commonality of parts and helps technicians troubleshoot maintenance problems regardless of the complexity of the controls system in a building.

Temperature controls will be used to the fullest extent, consistent with economy of operation.

Refer to section B.6.7 for additional energy conservation guidelines.

## B.6.6 HVAC Controls

All building with >= 10 tons of HVAC should have digital controls of the HVAC and all thermostats should be controlled by the EMCS system. A two- hour override should be included with all thermostats

All control systems shall be direct digital control (DDC). All damper and valve actuators shall be electronic with a control signal of either 0-10 VDC or 4-20ma. Pneumatic devices shall not be used unless required for interfacing to existing devices in remodeled areas.

The DDC System shall be installed according to the Input/Output (I/O) summary chart for the mechanical systems listed below. The I/O summary sheet shall apply to all equipment included in the project design control scheme, whether equipment is existing, modified or a provision of the project.

1. Chillers and associated pumps
2. Boilers and associated pumps
3. Air handlers and any associated VAV boxes
4. Computer room AC units (CRAC)
5. Exhaust fans
6. Packaged heating/cooling equipment

All building DDC for HVAC equipment shall be based on LonWorks using a LonWorks Network Services (LNS) database and LonMark certified devices. Interface of the building DDC system with the base Energy Monitoring and Control System (EMCS) basewide Ethernet LAN shall be through the use of a Niagara Tridium R2 platform (JACE Controller) per ACC certification requirements.

The EMCS integration shall include complete installation of all hardware and software. This shall include but not be limited to the LNS database conforming to the I/O schedule, system graphic displays, and all applications programming necessary to accomplish the specified sequences of operation. All points required for operation shall be provided in software and hardware.

The contractor shall perform a complete point-to-point test of the completed DDC/EMCS installation. The test shall be conducted by measuring each analog value with a test instrument twice as accurate as the device being measured. The test equipment shall be certified traceable to NIST standards. Each value shall be calibrated in either hardware of software to the specified accuracy.

All outputs shall be exercised on/off or full-scale analog to verify operation of each channel and device. All digital inputs shall be tested by exercising the connected device such as a freeze-stat, smoke detector or differential pressure switch, with a simulated input

condition. Pressure switches for filter status shall be calibrated to the specified pressure using a magnehelic gauge. All test results shall be recorded and documented by the contractor and included in the Operation and Maintenance Manuals furnished to the government.

The contractor shall provide a portable testing and troubleshooting device for use with the completed DDC/EMCS. The portable device shall be supplied with an approved LNS Network Configuration Tool along with the project's database and communications software/ hardware required to communicate to the DDC/EMCS system.

## B.6.7 Energy Efficiency and Water Conservation

***Follow the energy, water design, and equipment standards as shown in the "Air Command Energy and Facility Management Policy" 12/31/2007 (ACC/A7OE)***

At a minimum the following engineered items must be included in construction, repair, and renovation.

- Insulate all fluid-conveying piping. The insulation must at least have a positive-hold double-wrap feature to ensure it doesn't split open during the life of the insulation. (Applies to systems covered by 6.3.2, 6.4.2 and 6.5.2)
- Insulate all ductwork carrying conditioned air though unconditioned spaces. The insulation must have the same double -feature to prevent the insulation from splitting at the seam. (Applies to systems covered by 6.4.2 and 6.5.2)
- Recover heat from exhaust air if cost efficient. (refer to 6.4.2)
- Ue windows that include a double pane and feature low emissivity and other polarizing effects against sunrays. Glass must be insulated, tinted, with minimum reflectance. Energy efficient glazing is mandatory

Current and near future technology makes it possible to achieve high efficiency in mechanical and electrical equipment. These parameters must be considered from a cost advantage as part of the overall project cost.

## B.6.8 Fire Protection

### B.6.8.1 Current Conditions

Most buildings on base have some type of fire protection system. The type found depends on the level of protection needed, the environment in which the system operates in, and the age of the facility.

### B.6.8.2 General Requirements

All sprinkler systems shall be hydraulically designed. Pipe sizes, sprinkler locations, and data for hydraulic calculation signs shall be shown on the drawings.

All new dry/wet fire suppression systems connected to potable water supplies and using water only as a fire suppressant shall have an approved double-check valve backflow preventer and test station.

All buildings shall be equipped with MONACO BT-XF narrowband building radio fire alarm transceiver which reports to MONACO D-21 fire alarm monitoring system, which includes antenna compatible with an existing Monaco D-21 Radio fire alarm monitoring system. Provide antenna and lightning protection as recommended by Monaco. Each transmitter and interface device shall be the manufacturer's current commercial product completely assembled, wired, tested at the factory, and delivered ready for installation and operation. All cabling shall be in conduit, whether exposed or concealed.

Provide an intelligent, addressable fire alarm control panel, using the Notifier AFP-200 or NFS-640 made by Notifier Fire Systems, Northford, CT. Devices are pull stations, duct smoke detectors, heat detectors, flow switches, pressure switches, tamper switches and any initiation devices. Any initiation devices shall be addressable.

**Design Conditions:** The design shall be in compliance with:

- **Unified Facilities Criteria (UFC) 3-600-01:** Fire Protection for Facilities Engineering, Design, and Construction
- **Engineering Technical Letter (ETL) 02-15:** Fire Protection Engineering Criteria—New Aircraft Facilities
- **ETL 98-8:** Fire Protection Engineering Criteria—Existing Aircraft Facilities
- **ETL 01-18:** Fire Protection Engineering Criteria—Electronic Equipment Installations
- **Air Force Instruction (AFI) 32-1066:** Plumbing and National Fire Protection Association (NFPA 13) Installation of Sprinkler Systems

**Distribution:** The underground piping systems shall be PVC. Aboveground piping systems shall be steel pipe of the thicknesses allowed by NFPA 13 Chapter 6 with

threaded or welded fittings. Type K or L copper with high-temperature solder meeting the requirements of NFPA Chapter 6 can also be used for above-ground piping. Steel pipes smaller than 2", with screwed fittings, shall be a minimum of Schedule 40. Schedule 10 steel with roll grooved or welded joints can be used for above-ground pipes 2" and larger. Consider the potential for corrosion in all pipe designs.

**Alarm Systems:** All buildings shall be monitored for fire signals back to the main base Fire Station. For dormitories three stories or higher all areas must be sprinkled and the sprinkler system must be connected with the existing base alarm system. Dormitories shall have dual detection systems and heat/ smoke in sleeping room with a local room alert.

Provide reduced pressure back flow preventers on all service entrances.

## B.6.9 Underground Electrical

### B.6.9.1 Current Conditions

There are three existing primary substations with a total of 55 MVA and a potential of 85 MVA. The primary voltage is 13.2/7.6 KV. The secondary is 480/277V or 208/120V and in some cases 240V.

Housing areas are on a different distribution system with a 12.46KV primary voltage.

### B.6.9.2 General Requirements

Materials and installation shall comply with the latest revisions of National Electric Safety Code and the National Electric Code (NFPA 70).

Because of the corrosive soil conditions, underground electrical distribution shall be 6-way PVC duct encased in concrete. Provide one spare conduit. Use "stirrup" connectors to connect service feeders to overhead conductors.

**Design Conditions:** The design of underground distribution systems shall be based on the calculated demand with sufficient electrical capacity for expansion if allowed or if within the budget.

**Materials:** The materials indicated above shall be comprised of plastic conduit encased in concrete. Allowable plastic conduits include PVC, fiberglass, or similar nonmetallic electrical duct.

Underground distribution shall have junction boxes with load breaks and not manholes. Excess distance between access points shall be avoided with a desired maximum of 250 feet between access points.

All new electrical underground conductors shall be copper. Aluminum conductors shall not be use.

All new pad mounted transformers shall have copper windings. Aluminum windings shall not be used.

## B.6.10 Aboveground Electrical

### B.6.10.1 Current Conditions

Overhead transmission and distribution lines currently exist in most areas of the base. Future overhead electrical distribution shall not be used on the base unless written approval is obtained by the Base Architect. Underground electric service is the standard for the base and shall be included for all service connections.

### B.6.10.2 General Requirements

Materials and installation shall comply with the latest revisions of National Electric Safety Code and the National Electric Code (NFPA 70).

**Overhead Transmission and Distribution Lines:** If overhead transmission lines are used due to excessive underground cost or if the project is at a remote location on base, the poles for this system of distribution shall be sized to handle the application and shall be wood pressure treated with creosote. Concrete poles shall be reinforced or pre-stressed either cast or spun.

Cross arms for wood poles shall be solid wood distribution type and shall be sized for the intended load.

Under built services such as low voltage distribution or communications distribution running on the same pole system shall be installed per N.E.C requirements.

Vertical phases for directional changes of the aerial distribution shall be consistent with the base standard and per N.E.C requirements.

Lightning protection for aerial distribution shall be through the use of a combination static and neutral wire.

**Site Lighting:** Site lighting shall continue to exhibit continuity throughout the base (see B.6.12).

**Grounding:** Provide separate grounding conductors and rods for surge (lightning) arrestors and service neutrals. Provide insulated grounding conductors to all grounding type outlets. Metallic conduit shall not constitute a safety ground. Include the following text in the project specifications: Use three-point ground test and instrumentation. Perform test in presence of the government inspector. Submit results and indicate type of test performed.

**Transformers:** Provide service transformers with delta primary and wye secondary connections for three phase services. All service transformers shall have two 2-1.2 percent taps above and below rated voltage. Provide low percent transformers where short circuit currents permit. Screen all exterior transformers from major circulation routes or common areas.

**Panelboards:** Provide typed panel schedules. Provide manual bypass for all auto transfer generator panels.

## B.6.11 Interior Electric

### B.6.11.1 Current Conditions

The current lighting at Holloman AFB varies from ceiling grid mounted 2'x2' and 2'x4' fluorescent fixtures, to ceiling suspended fluorescent fixtures, to recessed and suspended incandescent fixtures.

### B.6.11.2 General Requirements

Provide wire guards for all open fluorescent lamps. Use energy-saver, 32-watt T-8 fluorescent lamps (or better) and electronic ballast in administrative and similar areas. Use high-pressure sodium lights in bay areas where color rendition is not vital. Provide seismic zone 2 protection for all fixtures, especially ceiling grid mounted fluorescent fixtures. Provide Certified Ballast Manufacturer (CBM) listed ballast. All ballast shall be electronic and shall have 0.90 power factor or greater and with a total harmonic distribution of <10 percent.

Emergency lighting in shops and offices shall be ceiling mounted. No wall packs or bug eyes will be allowed.

### B.6.11.3 Approved Products/Materials

**Wiring Devices:** Provide new devices and plates whenever an area is renovated. All devices shall be recessed except in mechanical rooms and utility areas.

Provide devices rated at 20 amps or greater where heavy use or electrical load dictates the need for 20 amp or greater devices. All wiring shall be copper. No aluminum wire will be allowed.

**Automatic Controllers:** Provide battery backup for lawn sprinkler system controllers and automatic setback thermostats.

**Over-Current Protective Devices:** The minimum sized over-current device for branch circuits is 20 amps. Ensure proper coordination and withstand ratings for all over-current protection devices. Demonstrate coordination with first upstream existing protective device. Replace old circuit breakers with new when remodeling facilities. If replacement breakers are unavailable, replace the entire panelboard. Main fusing is acceptable for limiting short circuit currents; however, place a box with one full set of spare fuses adjacent to main panel.

**Electrical Identification:** Provide plastic panelboard and disconnect labels. Labels shall be laminated (black with white core) engraved with 1/4" high letters. Attach to front exterior of enclosures. Labels shall match plan designations. Provide non-ferrous phase and circuit identification labels in all enclosures for feeder circuit conductors. Provide underground marker tapes for all underground conductors. If underground conductors are not in metallic conduit, provide marker tape with foiled backing to facilitate detection.

**Motors:** All motors of 5 HP or larger shall have single phasing protection of the type that trips when the phase angle between the three phases is not 120 degrees or on an under voltage condition. All motors of 50 HP or larger shall use soft start type.

**Power Factor Correction:** Add power factor (pf) capacitors to induction motors (10 HP or larger) to correct pf to 0.90 (+.05, -.00). Switch pf capacitors in with the motor. Size capacitor IAW IEEE 141, NEMA MG2 and motor manufacturer recommendations.

**Power Service:** Power requirements for buildings shall be 208/120 except 480/277 based on building function.

**Electrical Related Work:** Balance loads on phases within 10 percent at all panelboards. Conduct fault calculations to ensure proper withstand ratings for all protective devices. Ensure coordination for all protection devices, conductors, enclosures, and equipment.

**Raceways:** Conduit run in concrete shall be PVC unless steel conduit is needed for a specific reason, e.g., to limit fault currents. Underground primary voltage feeders shall be in concrete encased conduit.

All penetrations of fire resistance rated walls shall be fire stopped IAW NEC Article 300-21.

Highlight compliance with NEC Articles 300-5(g) and 300- 7(1) regarding moisture seals.

**Conductors:** Aluminum conductors smaller than No. 4 AWG may not be used. In mission-critical facilities, housing, dormitories and transient quarters, aluminum conductors may only be used for service entrances. The smallest branch circuit conductors acceptable are No. 12 AWG. Conductors No. 6 AWG and larger shall have heat resistant insulation.

**Conduits:** All new utility lines shall be run in underground conduit, provide spare conduits from transformer to building. Underground conduit shall be schedule 40 PVC or better.

Compression connectors shall be utilized throughout; set screw connectors will not be allowed.

**Meters:** Meters shall be generally located in rear of building or near service entrance. All new buildings shall include meters for all utility uses. Meters shall be SCADA compatible.

**Lightning Protection:** All new buildings shall have lightning protection. Existing buildings fitted with new roofs shall have lightning protection. As a minimum, lightning protection shall be in accordance with NFPA 780. Some functions may require a higher level of protection; check the applicable AFIs for that function.

# B.6.12. Site Lighting

## B.6.12.1 Current Conditions

Site lighting has generally been approached on a facility- or project-specific basis rather than as a base-wide issue. Building, parking lot, and street lighting varies from facility to facility. Rectilinear bronze light fixtures at Building 812 and at the Child Development and Youth Centers respond well to the buildings' architectural character and begin to create a consistent image.

## B.6.12.2 General Requirements

- All exterior lighting shall meet the efficiency levels established in *Command-level requirements, described in ACC Instruction ID2 (publication forthcoming). In the interim, use ACC Energy and Facility Management Policy)* as well as the specifications found in:
  - Engineering Technical Letter (ETL) 10-18: Light-Emitting Diode (LED) Fixture Design and Installation Criteria for Interior and Exterior Lighting Applications, 13 December 2010, (latest version) and
  - UFC 3-530-01, Design: Interior, Exterior Lighting and Controls, Chapter 8, 10 December 2010, (latest version)
- Lamps currently used are high-pressure sodium unless color rendition and fidelity is a factor. Luminaires shall be dark-skies compliant.
- All poles shall be square, straight steel. For mounting height over 35 feet, a square steel pole tapered toward the top shall be used.
- Luminaries shall be anodized or duranodic bronze aluminum or matching color bronze painted steel finish with appropriate NEMA distribution for its intended function.
- All luminaries shall be rectilinear. Roadway luminaries shall be arm mounted.

Average mounting heights shall be as follows:

- **Sidewalk and Plaza Lighting:** 12' to 50'
- **Special Purpose Lighting:** 20' to 30'
- **Parking and Roadway Lighting:** 30' to 50'

Selection of poles and fixture types for specific functions should be consistent throughout the base.

Lighting levels and installations should vary with the volume and type of traffic and the visual character desired. Use efficient light fixtures to minimize "light pollution" within the Tularosa basin.

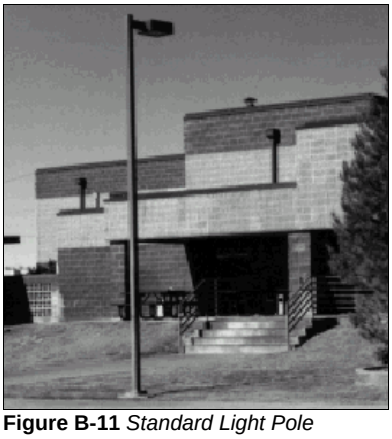

**Figure B-11** *Standard Light Pole*

Coordinate street and sidewalk lighting locations with site amenities (landscaping, furnishings, and signs).

## B.6.12.3 Approved Products/Treatments

- Luminaries:
  - EMCO, San Leandro, CA
  - Infinity II Series—Extruded
  - Widelite, Inc., San Marcos, TX
  - Spectra 10 Series
- Square, Straight Poles:
  - Lexington Standard Corp, Eagan, MN
  - Exact model as required by application.
- Square, Tapered Poles:
  - Valmont Industries, Valley, NB
  - NAFCO, Fon Du Loc, WI
  - Exact models as required by application.

## B.6.13 Security Systems

In order to maintain coordinated system growth, security panels for intrusion detection systems shall be installed by Advantor Corporation or an Advantor Corporation-certified contractor.

Install 3/4-inch conduit from the security panel to the building's main telephone backboard (home run panel). Install a 24 AWG, four wire, Cat 5 telephone cable in this conduit.

The Security alarm panel must be the Advantor Corporation-Advantor Infraguard with LCD keypad. The Advantor panel will be mounted inside the alarmed area. Communication between the Communication Interface Module and the Monitoring System at building 35 must be via a Clean Dedicated Pair (Dry) communications line using 128-bit (or greater) encryption certified by National Institute of Standards and Technology (NIST) or another approved independent testing lab.

The LCD keypad shall be mounted on the inside of the primary entrance of the alarmed area.

Each alarm sensor must have its own alarm point (wired point to point) and be supervised with an End of Line 1000 Ohm resistor. Wiring between the alarm sensors and the Infraguard Panel will be 22 AWG six wire, unshielded. This wiring must be in conduit and not exposed to tampering.

Balanced Magnetic Switch: Magnetic door contacts should be the Sentrol 2700 series, Industrial High Security magnetic door contact for regular pedestrian doors.

A Sentrol 2500 Series, Wide Gap Contact should be used for aircraft hangar doors and the Sentrol 1515a, Maxi-Gap is recommended for large roll up doors. Each door and motion sensor must send a tamper alarm if tampered with. Each tamper point shall be supervised with an End of Line 1000 Ohm resistor.

The 49 SFS Electronic Security Systems is responsible for all software programming necessary for the Advantor system.

## B.6.14 Mass Notification Systems

This section describes the communication system for the individual building mass notification system (MNS) including local operator console, autonomous control unit, battery back-up and notification appliance network including speakers, strobes, wiring, and conduit.

The MNS shall be multi-purpose NFPA compliant, supervised, general-purpose audio, and fire/emergency evacuation system. It shall be connected to the Building fire alarm control panel and communicate with the Base Alarm Management System (Monaco D21) through the existing Monaco narrowband transceivers. For all new construction projects and for projects that exceed 50 percent of original building square footage for renovations/alterations and new additions shall comply with Unified Facilities Criteria 4–021-01 of 9 April 2008 with Change 1, January 2010, Design and O&M: Mass Notification Systems. Use of existing public address system may be appropriate in buildings if new speakers are not cost effective

## B.6.15 Telecommunications

This section describes telephone, pre-wiring, computer support and other communication requirements, which must be addressed in the project design. This criteria is as follows:

The latest edition of following documents form a part of Holloman AFB Design Compatibility Standards and are incorporated by the following references:

- Engineering Technical Letter (ETL) 02-12
- Air Force Instruction (AFI) 33-133, Joint Technical Architecture (Joint Technical Architecture–Air Force [JTA-AF])
- AFI 65-601, Budget Guidance and Procedures, Volume 1.
- Paragraph 3.4.2 of AFI 32-1032, Planning and Programming Appropriated Funded Maintenance, Repair, and Construction Projects.
- ANSI/TIA/EIA-568-B and All Addenda, "Commercial Building Tele-communications Cabling Standard," 2001 (includes System Testing Requirements).

## B.6.16 Corrosion Control

### B.6.16.1 Current Conditions

Soil and groundwater are very corrosive due to the high concentration of soluble salts. Corrosion of buried steel that does not receive appropriate corrosion control is expected to be rapid.

### B.6.16.2 General Requirements

**General:** Corrosion control of Base facilities includes four basic areas:

- Cathodic protection
- Water treatment
- Protective coating
- Material selection

**Cathodic Protection**: Cathodic protection by either sacrifical anodes or impressed current systems is required as identified below. Provide test stations as required by UFC 3-570-02:

- Any ferrous material that comes in contact with the earth. This includes but is not limited to the exterior surface of underground pipes.
- The interior surface of water storage tanks.

**Water Treatment**: The following items shall be included as part of water treatment for HVAC facilities:

- Conductivity meters and chemical feed equipment for condenser water systems on chillers (Open-loop system with cooling tower).
- A pot feeder for closed-loop hydronic systems (both hot and chilled water systems).
- Conductivity metering and chemical feed equipment for boiler water.
- A bleed-off line with an adjustable flow meter on evaporative coolers. This includes direct as well as multiple stage evaporative cooling units.
- Sampling ports for the analysis of water conditions.

**Protective Coating**: Protective coatings shall be applied to the following items:

- Exterior surface of underground ferrous pipes.
- Exterior and interior surface of all storage tanks, both above and below ground. Steel structures such as towers and equipment support stands, etc.

**Material Selection**: Proper selection of materials for a given application can reduce or prevent corrosion. The following are items that are commonly encountered:

- Schedule 80 black steel pipe shall be used for condensate return lines. The corrosive environment of the steam condensate eats away at the inside of the pipe. The extra thickness of the schedule 80 as compared to the schedule 40 pipe allows added life.
- Use type “K” copper pipe if the copper pipe shall be used for applications above 120°F.
- Polyethylene pipe shall be used for low-pressure natural gas lines along with polyethylene valves.
- A dielectric union or isolating flange shall be used between pipes of dissimilar metal.

When metal is in contact with water, either above- or below-ground sacrificial anodes and impressed current systems shall be used. Provide test stations; all rectifiers shall be standardized.

## B.6.17 Protect Building Foundation

Collected water shall be channeled a minimum of 10'-0" from the building perimeter to the base storm water drainage system. A three-foot wide concrete slab shall be placed around the perimeter of each new building.

## B.6.18 Door Hardware

**Door Hinges:** Exterior Door hinges shall be stainless steel, heavy weight ball bearing. Interior hinges shall be stainless steel, ball bearing, or plain bearing. All hinges shall be Satin Chrome finish.

**Door Closers:** Door closers shall be Grade 1, surface mounted, regular or parallel arm mount. Finish shall be BMHA 689, Sprayed Aluminum.

**Exit Devices:** Manufactured by Von Duprin, 99 series with lever trim and cylinders which will accept Best IC cores. Finish of all exit devices shall be Satin Chrome.

**Locksets:** Lever handles shall be provided at all locations for full disabled accessibility. Finish of levers, knobs and all miscellaneous visible parts shall be Satin Chrome finish.

All keyed locksets shall be BEST IC (Interchangeable Core) compatible. 7 pin uncombinated cores and two blank keys per lockset in either A (main base) or E (north and west side of base) keyway. The BEST lock company will supply the cores and key blanks and will call the base locksmith to verify what keyway to send the cores and keys in.

New cipher locks shall be Alarm Lock DL2700IC/26D for interior use and the DL2700WPIC/26D for exterior use. These locks also accept the BEST IC cores for the key override.

**Miscellaneous Hardware:** Stops, flush bolts, etc. shall be Satin Chrome finish. Misc. hardware associated with bronze aluminum storefront type entrances may match the doorframe finish.

**Armor, Kick, and Mop Plates:** Shall be stainless steel, 0.050" (U.S. 18 Gage).

**Thresholds:** Shall be extruded aluminum.

**Exposed Rubber Parts:** On holders, stops, and bumpers shall be gray.

Door hardware should be selected and sized on a case-by-case basis for its specific function. In order to unify the quality and appearance of hardware base wide, the above requirements shall serve as the standard of finish and quality level expected of hardware that may not be specifically listed. The Base Architect shall approve all hardware designs and product selections.

# C Design Standard Reference List

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# C Design Standard Reference List

This appendix provides a list of Air Force/DoD policies, instructions, and technical letters referenced in the ID2. Applicable UFCs are also identified.

## C.1 Metering Policy

- Air Force Facility Metering Policy, 10 July 2009

## C.2 Vegetative Roofs

- Air Force Engineering Technical Letter (ETL) 11-8: Decision Criteria for Installing Vegetative Green Roofs

## C.3 Lighting Resources

- Engineering Technical Letter (ETL) 10-18: Light-Emitting Diode (LED) Fixture Design and Installation Criteria for Interior and Exterior Lighting Applications, 13 December 2010
- UFC 3-530-01, Design: Interior, Exterior Lighting and Controls, Chapter 8, 10 December 2010

## C.4 Air Force AICUZ and Noise Abatement Resources

- AFI 32-7063, Air Installation Compatible Use Zone Program, www.epublishing.af.mil/shared/media/epubs/AFI32-7063.pdf
- AFH 32-7084, AICUZ Program Manager's Guide, www.epublishing. af.mil/shared/media/epubs/AFH32-7084.pdf
- DODI 4165.57, Air Installation Compatible Use Zones, www.dtic.mil/whs/directives/corres/pdf/416557p.pdf
- Abatement measure can be found at: www.afcee.af.mil/shared/media/document/AFD-070914-039.pdf

## C.5 Street Design– AT/FP Standards

- Construction standards in accordance with DoD Force Protection Requirements must adhere to the Unified facilities Criteria (UFC) 4-010-01 and AFH 10-222, Vol. 3
- All Installation Entry Control Facilities including visitor centers must comply with the Air Force Entry Control Facilities Design Guide AFI 10-245, DoD Std28 and AFH 10-222, Vol. 3

## C.6 Parking Design– AT/FP Standards

- All construction shall be in accordance with DoD Force Protection Requirements and shall adhere to AFI 10-245, DoD Std. 28, and AFH 10-222, Vol. 3.

## C.7 Exterior and Interior Signs

- AF Design Guide: Unified Facilities Criteria (UFC) 3-120-01 Air Force Sign Standard

## C.8 Sanitary Sewer

- Sanitary sewer lines shall be designed in accordance with UFC 3-240-07FA and installed according to manufacturer's recommendations.

## C.9 Fire Protection Design Standards

- Unified Facilities Criteria (UFC) 3-600-01: Fire Protection for Facilities Engineering, Design, and Construction
- Engineering Technical Letter (ETL) 02-15: Fire Protection Engineering Criteria—New Aircraft Facilities
- ETL 98-8: Fire Protection Engineering Criteria—Existing Aircraft Facilities
- ETL 01-18: Fire Protection Engineering Criteria—Electronic Equipment Installations
- Air Force Instruction (AFI) 32-1066: Plumbing and National Fire Protection Association (NFPA 13) Installation of Sprinkler Systems

## C.10 Telecommunication

- Engineering Technical Letter (ETL) 02-12
- Air Force Instruction (AFI) 33-133, Joint Technical Architecture (Joint Technical Architecture–Air Force [JTA-AF])
- AFI 65-601, Budget Guidance and Procedures, Vol. 1

- Paragraph 3.4.2 of AFI 32-1032, Planning and Programming Appropriated Funded Maintenance, Repair, and Construction Projects
- ANSI/TIA/EIA-568-B and All Addenda, “Commercial Building Tele-communications Cabling Standard,” 2001 (includes System Testing Requirements)

## C.11 Mass Notification

- Unified Facilities Criteria 4–021-01 of 9 April 2008 with Change 1, January 2010, Design and O&M: Mass Notification Systems

## C.12 Interior Carpet

- Engineering Technical Letter 07-04. Air Force Carpet Standard, 28 March 2007, to calculate minimum pile weight to density ratios