AIR COMBAT COMMAND

Installation Development and Design (ID2)

Beale Air Force Base, California

ID2

Final Submittal

October 2010

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1 Introduction

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

As shown in Figure 1.1, Beale AFB is located in Yuba County, northern California, approximately 40 miles north of Sacramento and 10 miles east of the towns of Marysville and Yuba City. Home to Air Combat Command's (ACC's) 9th Reconnaissance Wing (9th RW), Beale AFB provides high altitude intelligence, surveillance and reconnaissance (ISR) capabilities for the nation. In addition to the 9th RW, several associate units find their home at Beale AFB including the Air Force Reserve Command's (AFRC's) 940th Air Refueling Wing (ARW), the 548th Intelligence, Surveillance and Reconnaissance (ISR) Group, California Air National Guard's 162nd Combat Communications Group, Detachment 11 of the 7th Space Warning Squadron, Detachment 21 of the 372nd Training Squadron, and Detachment 218 of the Air Force Office of Special Investigations. As a community, Beale AFB directly supports over 9,600 military and civilians who work, live and play on the installation. The base also supports a local military retired population of over 25,000 veterans and family members.

The Mission Statement and Installation Vision for Beale AFB are provided below:

- The Beale AFB Mission Statement is: "Deliver timely, relevant, and persistent high altitude intelligence, surveillance and reconnaissance, deploy warrior Airmen, and to leverage technology to increase capability for our joint partners."
- The Installation Vision is: "Outstanding, all the time, every time!"

These statements form the foundation and framework for all installation activities and development initiatives.

1.1 Document Scope, Applicability, and Audience

Current guidance removes design process short-circuits by realigning constraints, changing mandates into a performance framework and limiting prescriptive requirements to those critical in meeting Command and Installation functional requirements. Prior editions of design guidance, both at the Command level and the Installation level, relied heavily on mandates and prescriptive formula 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 is highly subjective and has to be approached on a project-by-project basis.

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* serves to provide a current-state snapshot of the installation's "green posture" and will serve as a way to measure changes over time; indicators should change for the better over time as more green design strategies and processes are put into place.

BEALE AIR FORCE BASE

Vicinity Map

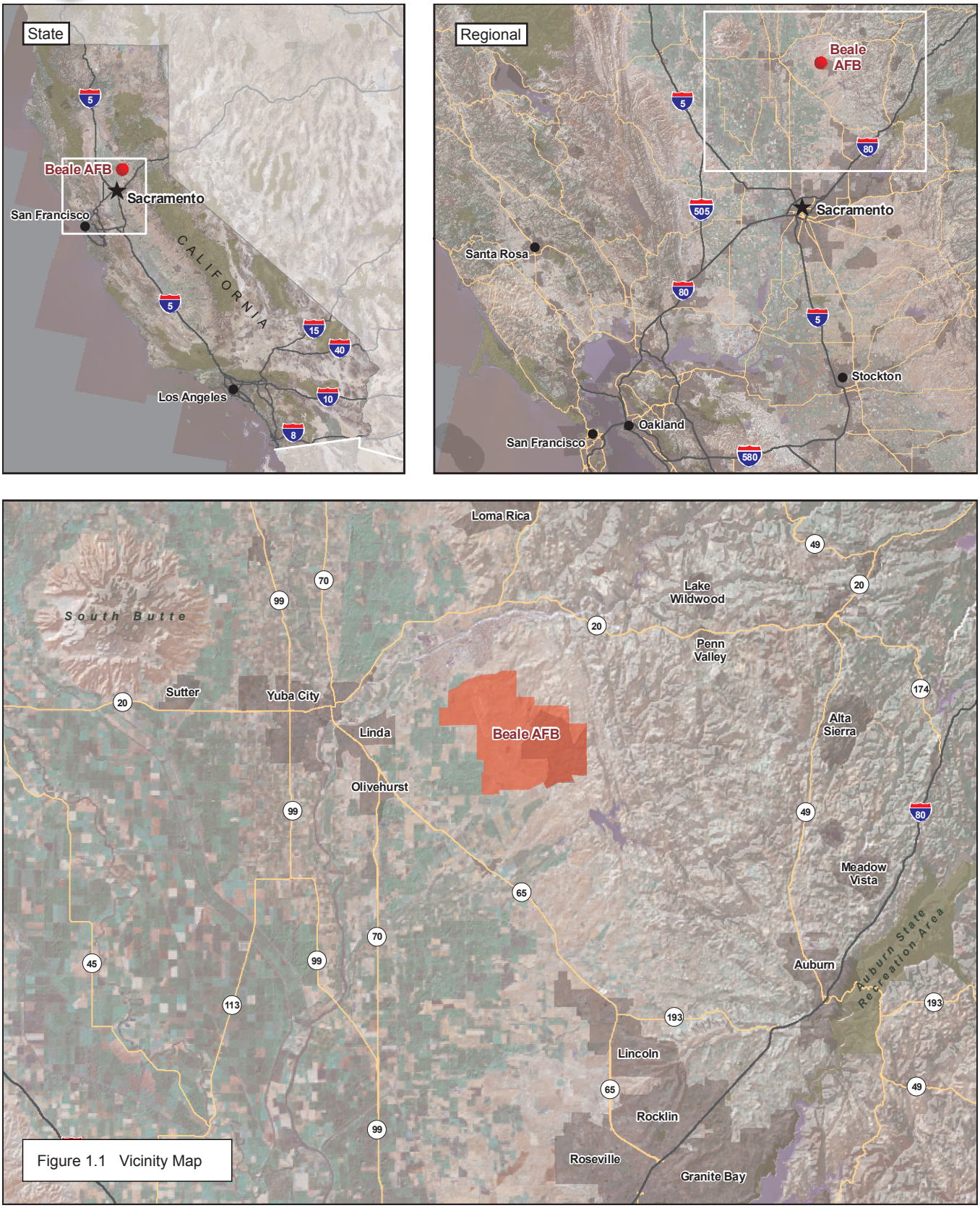

Figure 1.1 Vicinity Map

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 Handbook* (ID2). The ID2 serves to inform Future Year Development Plan (FYDP) site selections, Area Development Plan (ADP) designs, Requirements Document (RD) investigations and Concept Charrette Document (CCD) packages. The ID2 will be summarized in the installation Electronic General Plan (eGP).

Architect-Engineer (A-E) Scope of Work descriptions, Request for Proposal (RFP) solicitations, and Design-Bid-Build (D-B-B) and Design-Build (D-B) contracts shall explicitly identify HQ ACC/A7P sustainable development and high performance green building design 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 citing 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, development and design of projects that 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 Headquarters (HQ) ACC/A7P

The Command's vision is to lead by example and serve as a role model for sustainable development and high performance green building design in the Air Force, the 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 are appropriate to the site, sensitive to the built and natural context, reflective of functional needs, responsive to aesthetic considerations and that they embody green building design.

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 consideration 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, Installation Development and Design (publication forthcoming). This document establishes sustainable development and high performance green building design 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 sustainable development and high performance green design 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 pre-determine 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 Development and Design Review Board (D2 Board). D2 Board evaluations seek to validate conformance with requirements established by Command-level guidance and in 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 failure 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 by the Base Civil Engineer (BCE) Squadron Commander and must clearly document the basis for non-compliance and describe actions that will be taken to offset the deviation. Issuance of a waiver does not establish precedent or a basis for justifying other projects’ non-compliance.

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.

1.4 Organization of this Document

This *ID2 Handbook* is organized into six main chapters and appendices:

- **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&HPGBD, site development and architectural design.
- **Chapter 6 -** Provides a list of acronyms.
- **Appendices -** Identify specific technical considerations and constraints and other supporting materials.

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2 Installation Image

The Installation Image creates a mental map of how the physical elements of Beale AFB create a sense of place. This sense of place is formed by elements such as districts, paths, edges, nodes, and landmarks. Together these elements create an individual's understanding of Beale AFB. In addition to the elements mentioned above, the mental map often includes ambiguities and areas of conflict such as adjacencies of incompatible land use. Lack of distinctiveness also plays into our perception of a place, along with way-finding issues, ill-defined boundaries, isolation of uses or activities, and lack of character. In general, well-defined elements serve to create a more distinct, memorable and enjoyable place. Lack of distinctiveness or character of a place can be easily resolved through the introduction of strong physical elements in new development. Kevin Lynch, the well-known urban planner and author of *The Image of the City*, refers to this opportunity as "imageability," where the "quality of the physical object" can be created to provide a "strong, vivid image" of the place. This installation image discussion provides insight into the existing conditions found on base, specifically in areas where new development can be accommodated.

2.1 Installation Context

The fundamental tenets of SD&HPGBD should be integral to all planning, design, and construction decision making. In addition to the guidance provided in this *Handbook*, Beale AFB master planners and designers should be familiar with all other relevant documentation, including but not limited to the *eGP, Special Area Management Plan (SAMP), Integrated Natural Resources Management Plan (INRMP)*, and *Integrated Cultural Resources Management Plan (ICRMP)*. The following is a brief overview of the base, which is derived from these and other relevant installation planning documents.

Beale AFB is located within the northeastern portion of the Sacramento Valley of Northern California at geographical coordinates 39°08'20"N 121°26'11"W. The base terrain is characterized by both flat and rolling hills as it is located at the ecological and geographic transition zone between the flat agricultural lands of the Sacramento Valley and the foothills of the western slope of the Sierra Nevada Mountains. Elevations range from approximately 90 feet, National Geodetic Vertical Datum, along the western and southwestern installation boundaries, to more than 500 feet at the northeastern boundary.

The humid continental climate has hot, dry summers and cool, wet, relatively mild winters. Average high and low temperatures during the summer months are 90° Fahrenheit (F) and 60° F, respectively. July is the hottest month, when temperatures occasionally top 100° F. Average winter temperatures range from highs of 60° F to lows of 35° F. January is typically the coldest month and intermittent nighttime freezing temperatures occur in December and January. Average annual precipitation is 22 inches, 95 percent of which falls between October and April. The prevailing wind is from the south-southeast. In the winter months, occasional high winds up to 60 mph couple with periodic heavy rain.

The Yuba and Bear Rivers are north and south of the base, respectively. The base is entirely within the Bear River watershed, with Reeds Creek, Hutchinson Creek and Dry Creek as the three tributaries that run through the base. Vernal pools are extensive in the western, central, and southern portion of the base. These small, shallow, seasonal bodies of water provide unique habitat.

Annual grassland is the predominant vegetation type on base. The eastern portion of the base is an oak woodland environment with higher slopes. Loam soils is the predominate soil type.

Northeastern Vista

2.2 Installation Goals and Objectives

Installation architectural and planning goals below provide the overall guidance for land development, including land use, facility sitings, and infrastructure development. These planning goals and objectives are informed by ACC's goal for a holistic approach to sustainable development and design:

- Integrate sustainable site development and high performance green building design exploration into all new facility and site development projects. The ACC SD&HPGBD Scorecard is a design tool used in conjunction with ACC design guidance that supports exceeding initial U.S. Green Building Council Leadership in Energy and Environmental Design (LEED) incorporation in project development. These SD&HPGBD measures set the stage for further exploration into how designers can achieve exemplary levels of sustainability in their projects and meet all Federal requirements.
- Promote the redevelopment of previously developed sites and reuse of existing buildings. Site redevelopment reduces project costs, uses existing utilities systems, and creates a more compact, linked built environment. Beale AFB can be characterized as having substantial mission land availability, combined with limited driven needs. Continue to explore site redevelopment opportunities within the Main Base and Flightline Districts.

2.3 Installation Development

Beale AFB began its service as an installation in 1942 as Camp Beale, a training post for the 13th Armored Division, and the 81st and 96th Infantry Divisions. During World War II, Camp Beale's 86,000 acres were home for more than 60,000 soldiers. The camp was developed as an orthogonal grid in two areas: the main base at the center of the property and an abandoned area located to the west of the main base. In 1948, the camp transferred from the Army to the Air Force. During the 1950's, surplus land was sold, bringing the current size of the base to approximately 22,000 acres. Currently, Beale AFB is home to approximately 9,600 active duty, dependent residents and civilian population. Today, the predominant existing building designs at the base incorporate sloped metal roofs in brown tones with stucco, exterior insulation finish systems (EIFS) and textured concrete masonry walls in light warm colors. Façade development emphasizes the contrast of light and shadow with prominent building entrances to buildings. Recent renovations to Korean War-era structures employ a similar design vocabulary.

Beale AFB is divided into visually separate districts, each with its own character with regard to activities, functions and location. Architectural elements establish the physical appearance and character of these districts.

2.4 Image Elements

Installation image elements include districts, paths, edges, nodes and landmarks. They create the basic pattern of the installation form and the way we perceive and relate to Beale AFB. Figure 2.1 shows the districts located at Beale AFB. Figure 2.2 is a breakdown of the land uses in the Main Base District. Figures 2.3, 2.4, and 2.5 are the Installation images detailing the edges, nodes, and circulation system for each district.

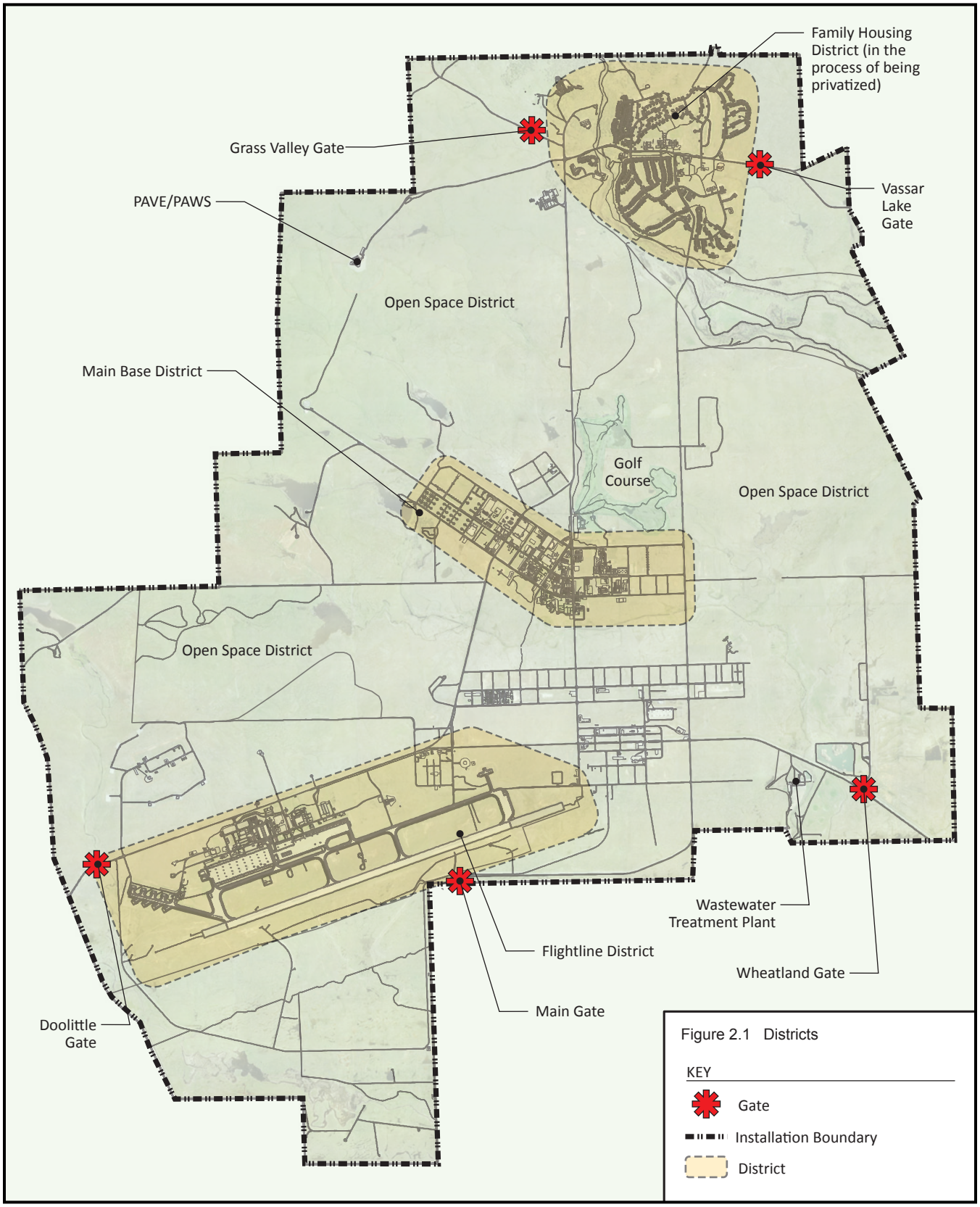
2.4.1 Districts

Districts are areas of the installation, usually larger in size, that are held together by a common identifiable character. While varied uses exist in multiple districts, the areas are generally distinct and uniform in their individual land use and appearance. Each new project has the opportunity to add to the sense of place by reinforcing existing elements or exploring new elements. Due to their scale, districts will incorporate some or all other image elements. Beale AFB has four distinct districts including Main Base, Flightline, Family Housing and Open Space Districts, which are identified in Figure 2.1.

As shown in Figures 2.2 and 2.3, the Main Base District functions as Beale AFB's central business district. Most of the functions of the installation are represented in this district, including dormitories, recreation, industrial, worship, and commercial facilities. Vehicular circulation is arranged in a grid pattern between A and C Streets, extending from Gavin Mandery Drive at the southern boundary to the Family Camp (FAMCAMP) at the northern end of the district. Main arterial streets, Warren Shingle Road and Doolittle Drive, link the Main Base District to the Family Housing and Flightline Districts.

BEALE AIR FORCE BASE

Districts



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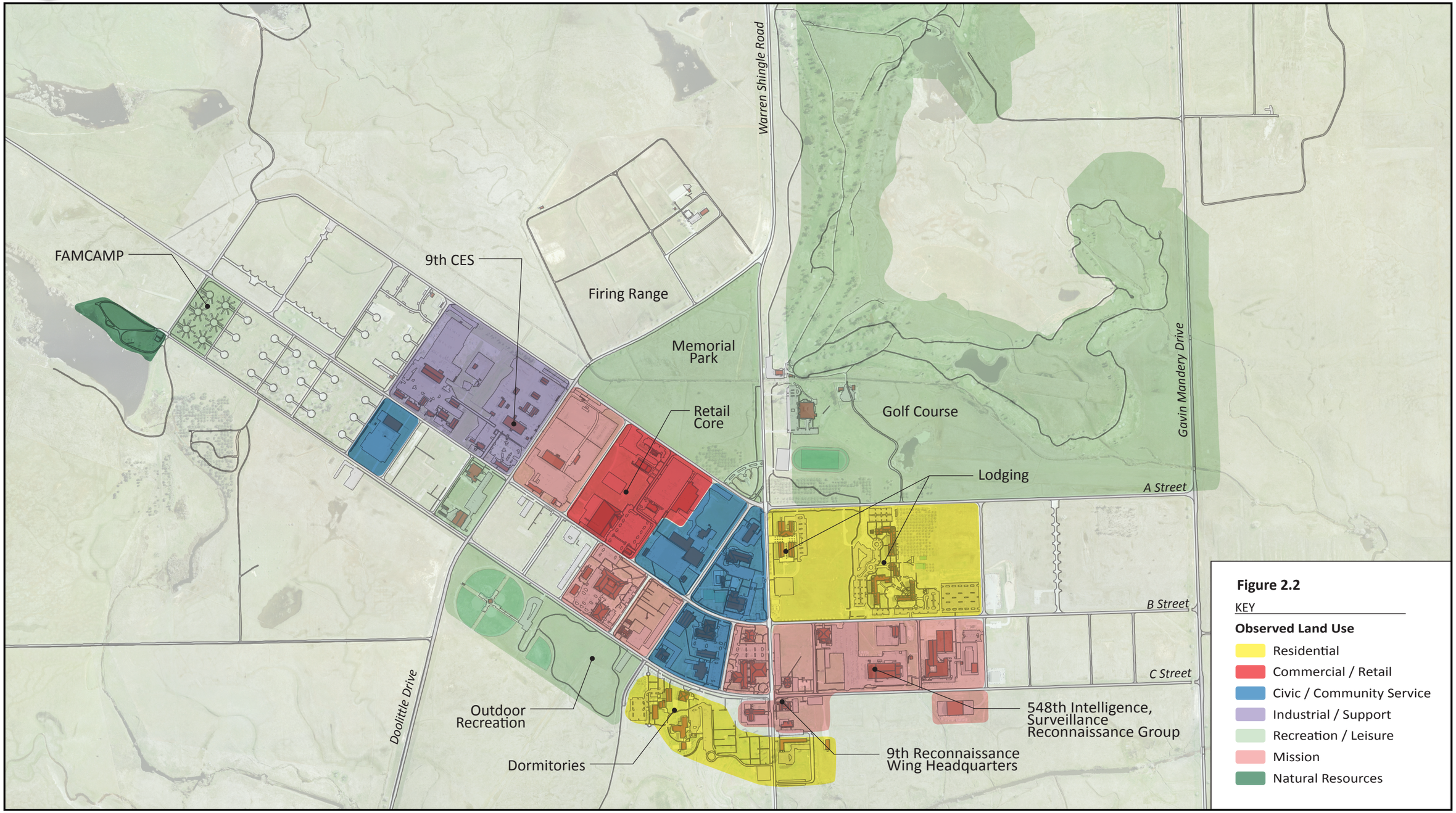
Districts and Tenants: Main Base District



BEALE AIR FORCE BASE

Installation Image: Main Base District

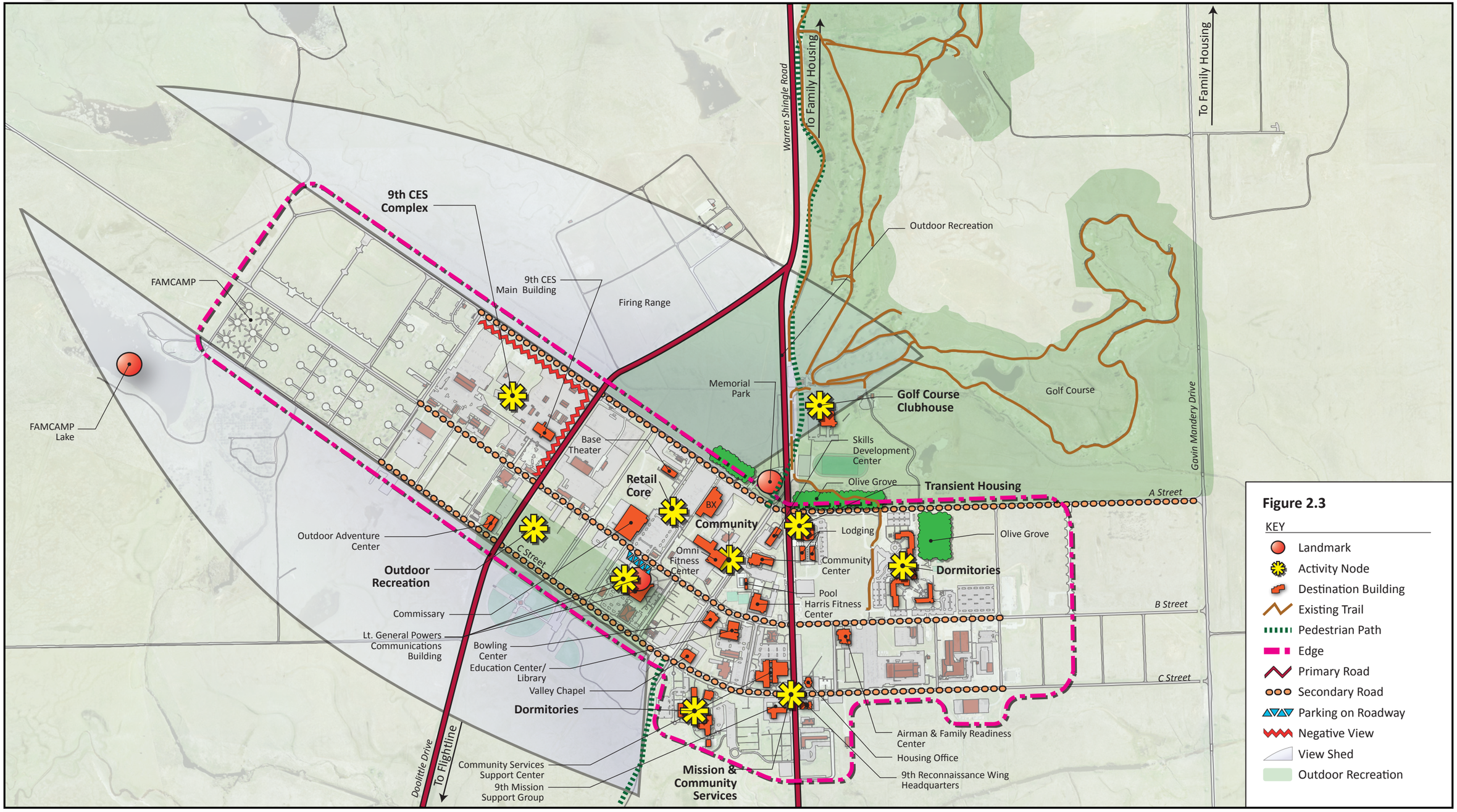


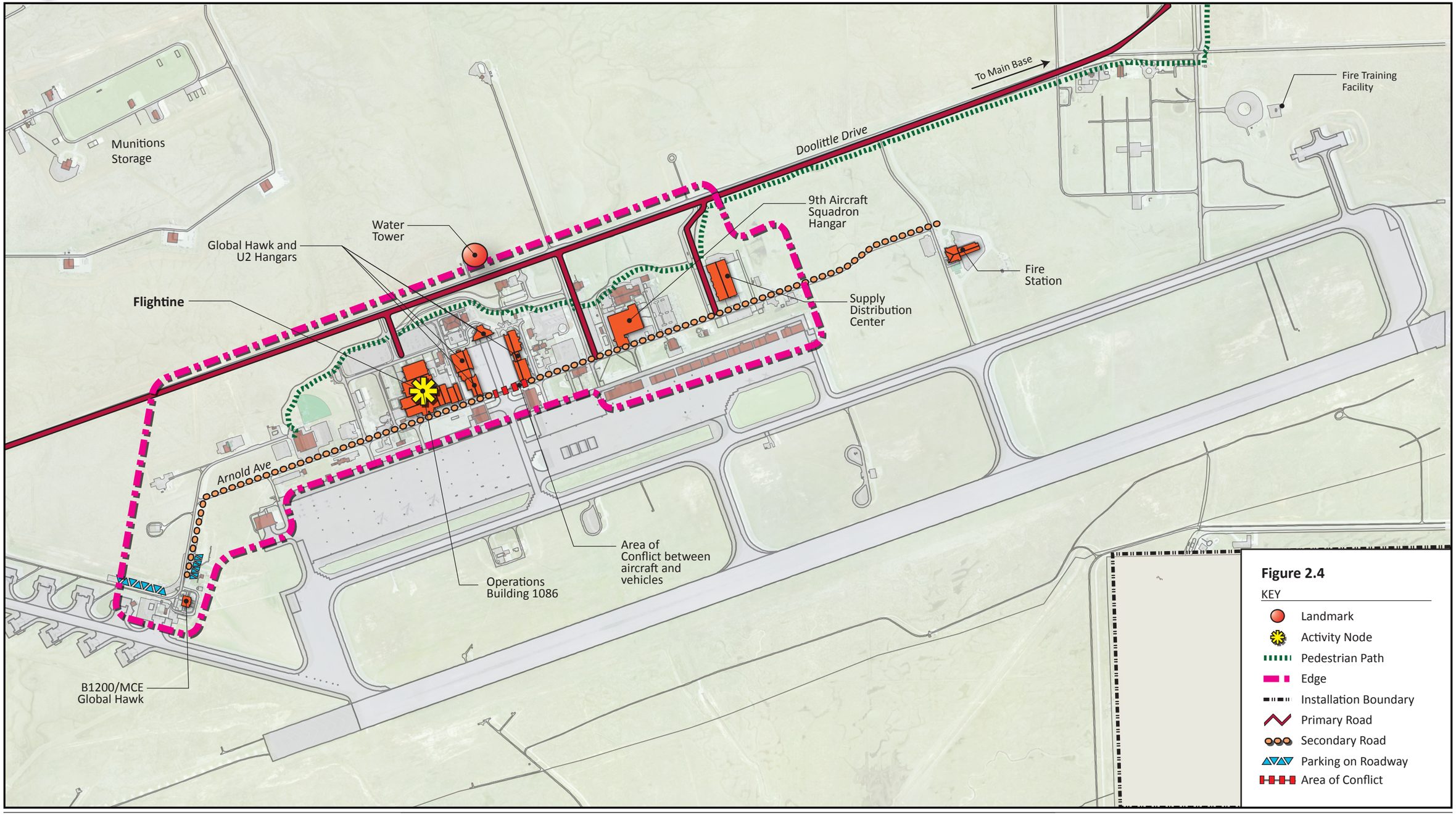
Figure 2.3

KEY

- Landmark
- Activity Node
- Destination Building
- Existing Trail
- Pedestrian Path
- Edge
- Primary Road
- Secondary Road
- Parking on Roadway
- Negative View
- View Shed
- Outdoor Recreation

BEALE AIR FORCE BASE

Installation Image: Flightline District



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Installation Image: Family Housing District

Dormitories

As shown in Figure 2.4, the Flightline District is located in the northwest section of the base. It comprises the linear area between the aircraft runway and Doolittle Drive. Arnold Avenue parallels the runway and apron and serves as flightline's main street. Most facilities serve operational functions, including aircraft maintenance hangars, fire station and fire training, squad operations, and the supply distribution center. Structures range in size from small storage buildings to large aircraft nose docks and the mixed-use Building 1086. Existing development in the Flightline District is industrial in character with utilitarian forms. There is a lack of connected pedestrian circulation systems and landscaping.

As shown in Figure 2.5, the Family Housing District occupies the foothills adjacent to the base's eastern boundary. Accompanied housing is the primary land use; however, other significant functions are represented including the Base Clinic, the Far West and Lone Tree Schools, Shoppette, Foothills Chapel, Youth and Child Care Centers, outdoor recreational facilities, and housing for bachelor/visiting officers.

Its remote location in the oak-covered foothills of the Sierras gives the Family Housing District a distinct character. Natural amenities include excellent views, a temperate climate, abundant wildlife, and the psychological benefit of living in a very different environment from work. The *ID2 Handbook* does not include discussion regarding this district, largely due to the recent military family housing privatization efforts that will upgrade the housing community.

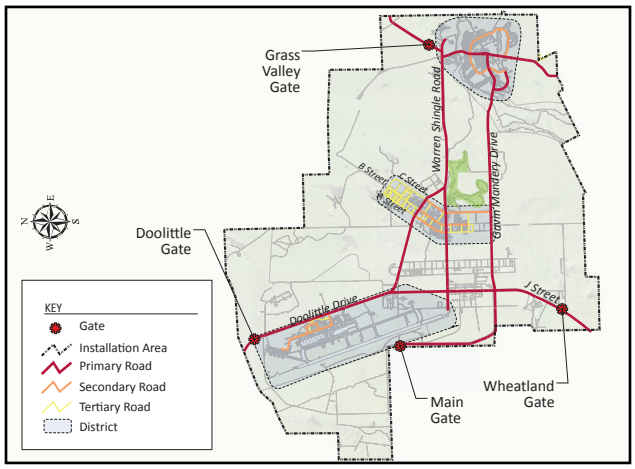
The Main Base, Flightline and Family Housing Districts are separated by large expanses of the Open Space District. Flat grassland dominates the landscape, providing a strong sense of identity for the base. The Main Base and Flightline Districts appear as towns or oases in the plains. Transition from the California Central Valley to the hilly oak savannah ecosystem occurs on the east side of the base. Views of the Sierra foothills and the Precision Acquisition of Vehicle Entry-Phased Array Warning System (PAVE/PAWS) landmark make orientation easy.

In addition to the Golf Course and athletic fields, existing facilities in the Open Space District include the wastewater treatment plant, munitions storage, firing ranges and radar installations.

2.4.2 Paths

Paths are channels along which an observer moves. The pathways at Beale AFB consist of the primary roads including east-west roads, Gavin Mandery Drive, Warren Shingle Road and Doolittle Drive. Doolittle Drive extends to the Flightline District and runs north-south (shown in Figure 2.3 and 2.4).

J Street extends from the Wheatland Gate up to meet Doolittle at the south end of the Flightline District. Warren Shingle Road/N. Beale Road extends east to the Housing District, as does Gavin Mandery Drive. Within the Main Base District, three north-south streets, A, B, and C Streets, form the street grid structure. A Street, the middle street, serves as the key pathway. A continuous bicycle/ running trail extends from the Housing District through the Main Base District to the Flightline District. Bike lanes exist in Main Base following A Street and C Street. Pedestrian pathways exist within Main Base.



Vehicular Circulation

2.4.3 Edges

Edges are boundaries that separate, seams that join, or barriers that close one area from another. At Beale AFB, district edges are distinct and well defined, following the limits of the grid street system. In the Main Base District, the edges follow A Street and C Street and extend north to 34th Street and south to Gavin Mandery Drive (Figure 2.3). To the west of the Main Base District are some of the remnants of Camp Beale, also following a street grid pattern. This area falls into the Open Space District. The Flightline District is formed by Doolittle Drive to the east, the airfield pavements and aprons to the west and north, and J Street to the south (Figure 2.4). The edge conditions found on base represent the built environment and the natural environment. The adjacent and surrounding Open Space District affords expansive views of the open land and foothills of the Sierra Nevada Mountains.

2.4.4 Nodes

Nodes are the physical elements that significantly define the sense of place. Generally, nodes are high activity areas and often serve the community as prime destinations. The activity nodes located in the Main Base District include the Dormitories, Mission and Community Services, Lt. General Powers Communication Building, Outdoor Recreation, 9th Civil Engineer Squadron (9th CES) Complex, Retail Core, Community, and Transient Quarters. Prime destinations or destination buildings are encompassed by these nodes of activity. Some destination buildings are standalone. Recreation facilities also serve as nodes; the Golf Course Clubhouse is also an activity node. The Communications Building serves as both an activity node and destination.

Within the Flightline District, the flightline serves as an activity node with the Operations Building 1086, the 9th Aircraft Squadron Hangar, the Supply Distribution Center and the Global Hawk areas as destination buildings.

2.4.5 Landmarks

Landmarks are usually visual icons in the community that serve as symbols of importance and way-finding. Many different types of physical elements can be seen as landmarks, including buildings, natural features, and utilitarian facilities such as a water tower, but they all have a certain characteristic of being recognizable to the community residents and visitors alike. Base landmarks include Foothills Chapel (Figure 2.5), the Communications Building complex (Figure 2.3) and the PAVE/PAWS facility (Figure 2.1).

Natural features also serve as image elements, reinforcing the sense of place. Memorial Park surrounded by the iconic olive grove remnants, the lake at the FAMCAMP facility, along with the open vistas of the foothills serve as natural feature landmarks.

FAMCAMP Lake

Vista

Communications Building

3 Development Considerations

The ID2 has been prepared to guide integrated development to accommodate the future requirements of Beale AFB. To achieve this integration, design must use a holistic approach where a number of development considerations are addressed throughout the design process for each new project. Development considerations that can positively affect the future success of the base include reuse of existing facilities and sites, infill development sites, circulation, utilities, land use, constraints and green infrastructure. This chapter, Development Considerations, identifies and provides an assessment of the base's existing condition from which opportunities and/or constraints to the implementation of SD&HPGBD development areas are identified and discussed. Infill and development considerations for Main Base and Flightline Districts are shown in Figures 3.1 and 3.2, respectively.

Existing Dormitory Complex

3.1 Reuse Opportunities

Reuse opportunities include the reuse of both buildings and sites, which play a significant role in supporting a sustainable approach to providing for new requirements on base. Building reuse can significantly reduce the project cost, use of materials and carbon footprint of a new facility. Many of the existing facilities within the Main Base District are from the Korean War era and been upgraded by "wrapping" the buildings with a new exterior envelope package. There are few remaining World War II era structures on base and most Cold War era buildings are not eligible for inclusion on the National Register of Historic Places. In general, most buildings suitable for reuse are those of more recent construction; however, determining a building's appropriateness for reuse should consider the date of original and additional structure and should be made on a case-by-case basis. Existing facilities that typically should not be considered for adaptive reuse are wood frame construction and those that have inefficient plan layouts. Construction quality and plan layouts should be reviewed to identify buildings suitable for reuse.

3.2 Infill Opportunities

Site selection is a fundamental decision that affects the outcome of a new development project and the overall functioning of an installation. Selection of a site for redevelopment or infill provides opportunities to reduce the extent of vehicular movement, use existing utilities and capacity, and encourage pedestrian movement through a closer proximity of people and activities. Infill sites are located adjacent to facilities and sites already in use. The reuse of previously disturbed sites conserves open space, limits impervious surface area, and utilizes existing infrastructure and utilities. The infill sites also serve to link activities, while creating a more compact environment, thereby reducing development footprint. Connections to these activities and places are desirable and can be achieved through linking the pedestrian network. Linkage of an existing or previously used site is much more sustainable than use of a "Greenfield" site, often located outside of the area of existing development. Infill development opportunities at Beale AFB largely focus on the redevelopment and reuse of previously disturbed parcels to accommodate new mission facilities.

Renovated 9th Reconnaissance Wing Headquarters Facility

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BEALE AIR FORCE BASE

Infill and Development Considerations: Main Base District

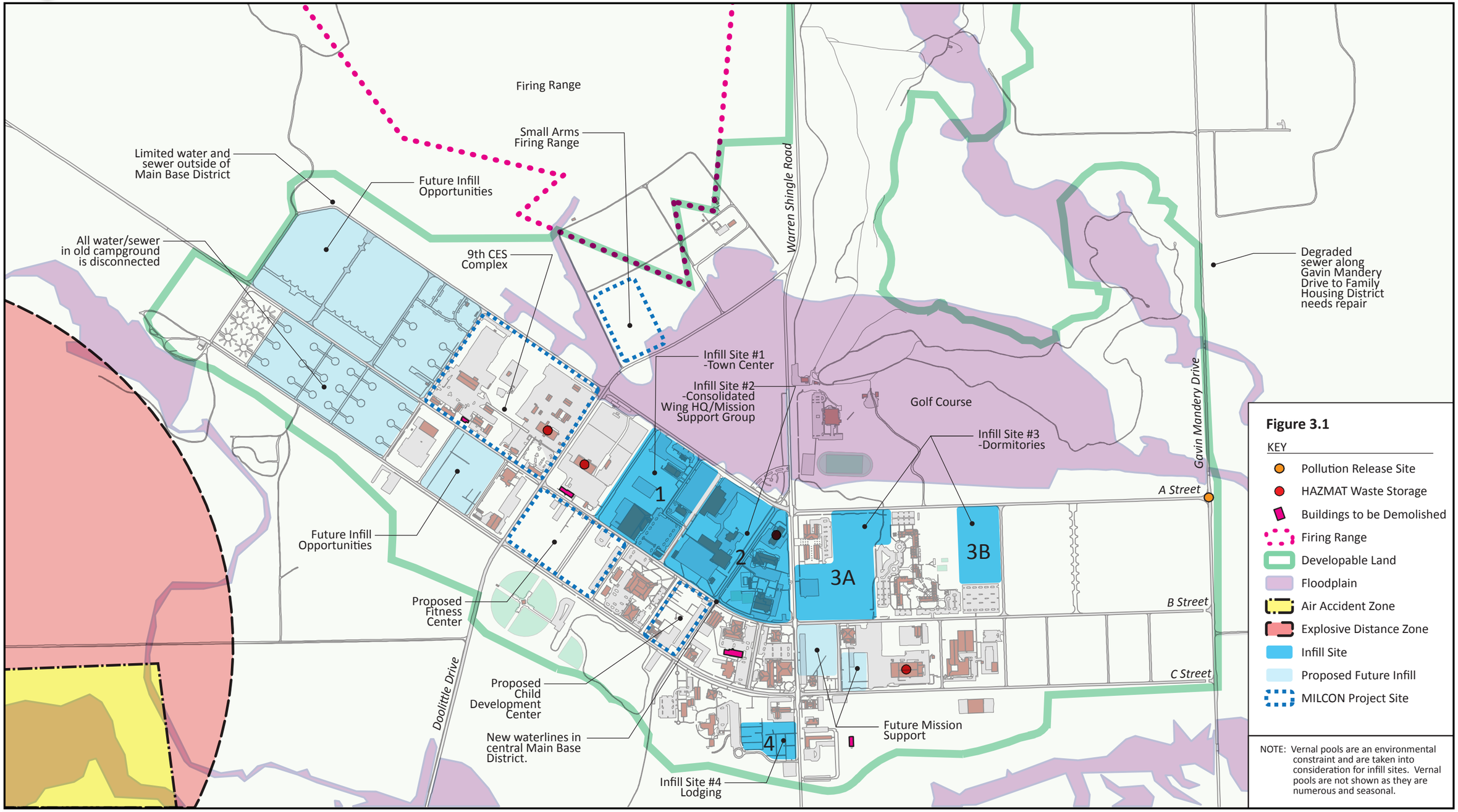


Figure 3.1

KEY

- Pollution Release Site
- HAZMAT Waste Storage
- Buildings to be Demolished
- Firing Range
- Developable Land
- Floodplain
- Air Accident Zone
- Explosive Distance Zone
- Infill Site
- Proposed Future Infill
- MILCON Project Site

NOTE: Vernal pools are an environmental constraint and are taken into consideration for infill sites. Vernal pools are not shown as they are numerous and seasonal.

BEALE AIR FORCE BASE

Infill and Development Considerations: Flightline District

Infill development opportunities include:

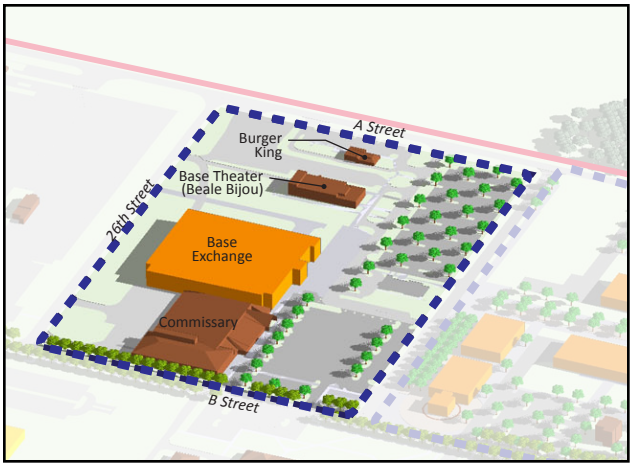
- Infilling within the existing built area boundaries of the Main Base and Flightline Districts creates a dense urban fabric, encourages pedestrian travel, and reduces infrastructure. Current opportunities for infill within the Main Base District are the proposed Fitness Center and Child Development Center.
- Incorporating image elements into the new development.
- Exploring and integrating sustainable site development techniques in the formulation of redevelopment and new development.

In addition to the land use planning and social benefits afforded by denser development, there are also opportunities for:

- Reducing stormwater runoff through a reduction in impervious surface.
- Minimizing the heat island effect.

Infill opportunities occur throughout the Main Base District but are more limited in the Flightline District. Vernal pools occur throughout this district and have been protected through avoidance. This practice has steered new development to previously developed parcels. These redevelopment areas are generally located within the street grid structure of the Main Base and Flightline Districts. While environmental constraints can be overcome through avoidance and mitigation, these conditions help to focus more sustainable development at Beale AFB. Within the Main Base District, multiple opportunities exist for infill development and site reconfiguration.

Commissary

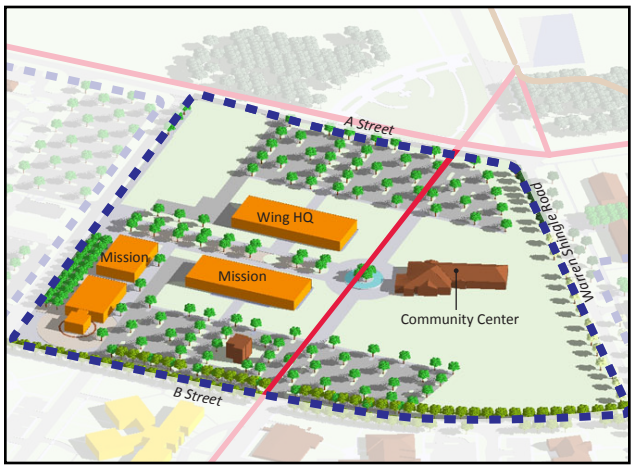


Infill Site #1

3.2.1 Infill Site #1

The Main Base District retail core area, or Town Center, consisting of the Commissary and the Base Exchange (BX), is an opportunity area where infill and reconfiguration can be accomplished while creating a stronger sense of place. A new BX could be located on the site adjacent to the east side of the Commissary. This location would reduce the volume of short vehicular trips between the BX and Commissary. Additional small scale retail pad sites and linear retail opportunities can be placed within the retail core area.

Base Exchange

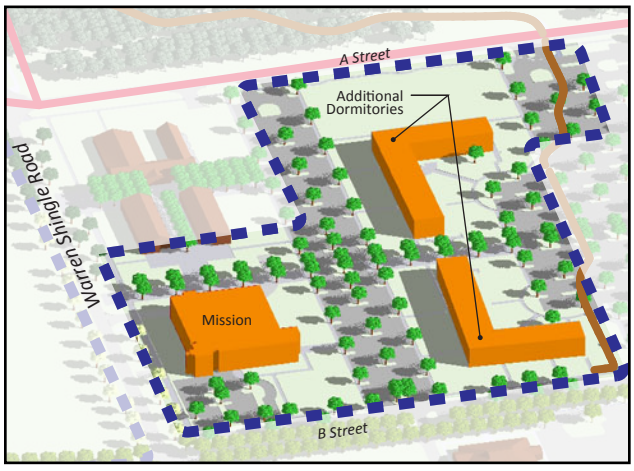


Infill Site #2

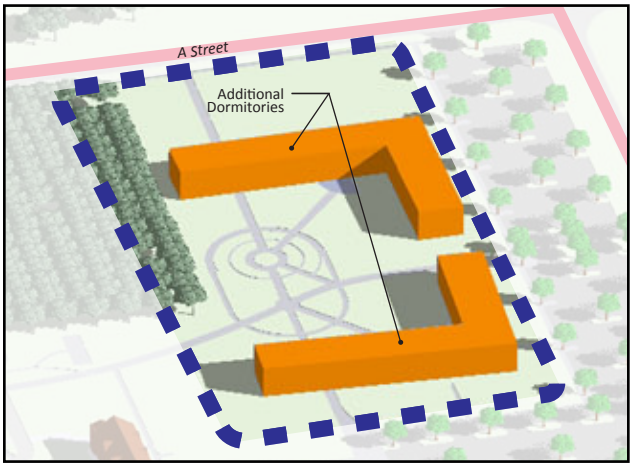
3.2.2 Infill Site #2

The Main Base District community services area adjacent to the retail core is a new opportunity area made possible by the future demolition of the Omni Fitness Center, Harris Gym, pool, tennis courts, and the Skills Development Center, allowing the parcel to be reconfigured. A new Fitness Center and Child Development Center are proposed within the Main Base District.

A prominent location on the arterial roadway, Warren Shingle Road, the site commands the center of the base. By eliminating the section of 23rd Street between A and B Streets, the parcel can be reconfigured to accommodate a significant building program such as a Wing Headquarters and mission facilities. The pedestrian pathway system may be extended through this area.



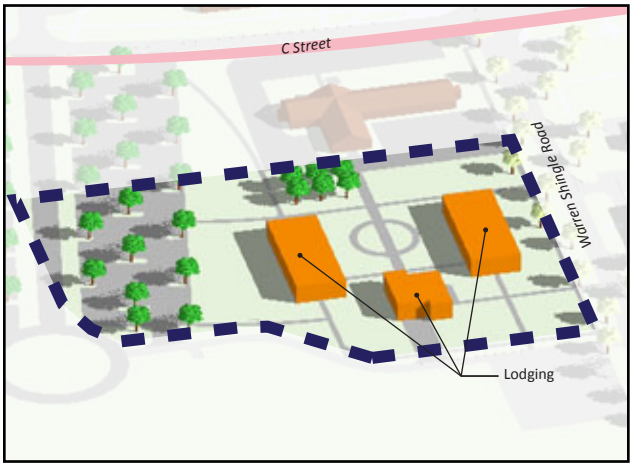
Infill Site #3A



Infill Site #3B

3.2.3 Infill Sites #3A and #3B

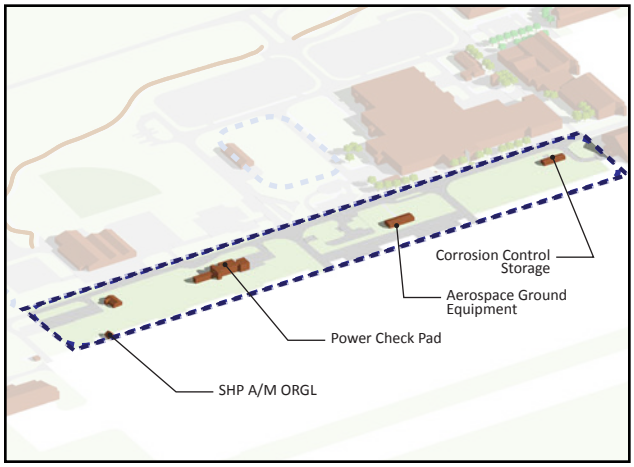
Within the Main Base District, the dormitory area provides the opportunity to create a campus setting for young military professionals. Adequate land area exists between A and B Streets, south of Warren Shingle Road, to provide significant additional dormitory accommodations if needed in the future. Opportunities for mission expansion also exist.



Infill Site #4

3.2.4 Infill Site #4

The fourth infill area in the Main Base District is located to the west of C Street and to the north of Warren Shingle Road. This area has been identified for the consolidation of lodging facilities.



Infill Site #5

3.2.5 Infill Site #5

Infill sites located within the Flightline District include airfield / apron, flightline and non-flightline development opportunities. Two key development projects identified for this district include the new Deployment Facility and the RQ-4 Centralized Operations and Maintenance Facility. Flightline locations have been explored for these facilities; however, final locations have not been determined.

3.3 Circulation

3.3.1 Vehicle Circulation

As shown in Figures 3.3 and 3.4, Beale AFB's urban pattern is based on a street grid system oriented north-south and cross streets organized east-west. Circulation in the Main Base District flows adequately within the grid street system with A, B and C Streets providing multiple pathways to individual sites. The extent of primary arterials and secondary cross streets reflect a system that responded to the needs of 68,000 troops in the past.

Opportunities exist to modify locations of cross streets that would allow for larger parcels of development to be configured for future needs. In general, limited modification is required for the vehicular circulation system to respond to the needs of future development.

Connection between land uses and tenants within the Main Base District is important. With the retail core area adjacent to both mission administration and mission support activities along with community services activities, the north-central portion of the Main Base District is highly accessible. The extensive grid street pattern provides the opportunity to support consolidated, compact and efficient future development.

3.3.2 Pedestrian Circulation

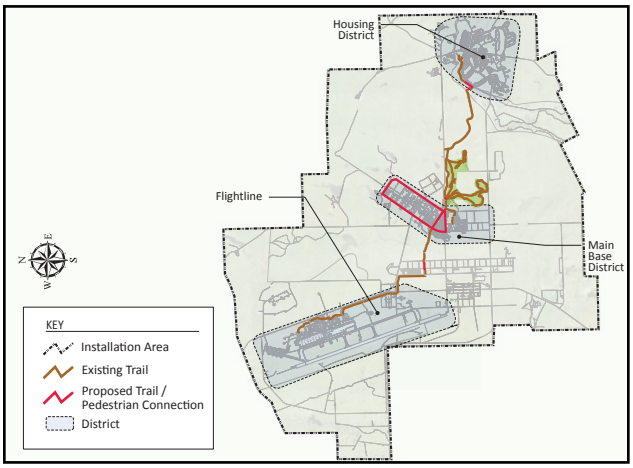
The consolidated north-central portion of main base is located within reasonable walking distances, and is adjacent to mission administration and support activities, community services activities, along with the dormitory area.

Pedestrian connection opportunities include:

- Link key areas within the Main Base District such as the community commercial area and services with dormitories, mission administration and mission support.
- Promote pedestrian movement throughout both the Main Base and Flightline Districts, and individual building complexes. The lack of Flightline District connected pedestrian systems represents an opportunity for district enhancement by linking Flightline District facilities together with a pedestrian walkway system.
- Link buildings with shaded pedestrian walkways.

The trail system at Beale AFB includes the closed loop running track to the west of the Golf Course, along with the trail running from Housing through Main Base extending to and throughout the Flightline District.

- By completing the trail system throughout the base, the opportunity for pedestrian connectivity between and within districts may be achieved.
- The Beale AFB comprehensive trail system can be enhanced, and should link recreational facilities including the new Gymnasium, new pool complex, running trail and dormitories. The trail system should include an on-street bicycle lane looping A and C Streets from 34th Street down to 10th Street.



Trail Locations

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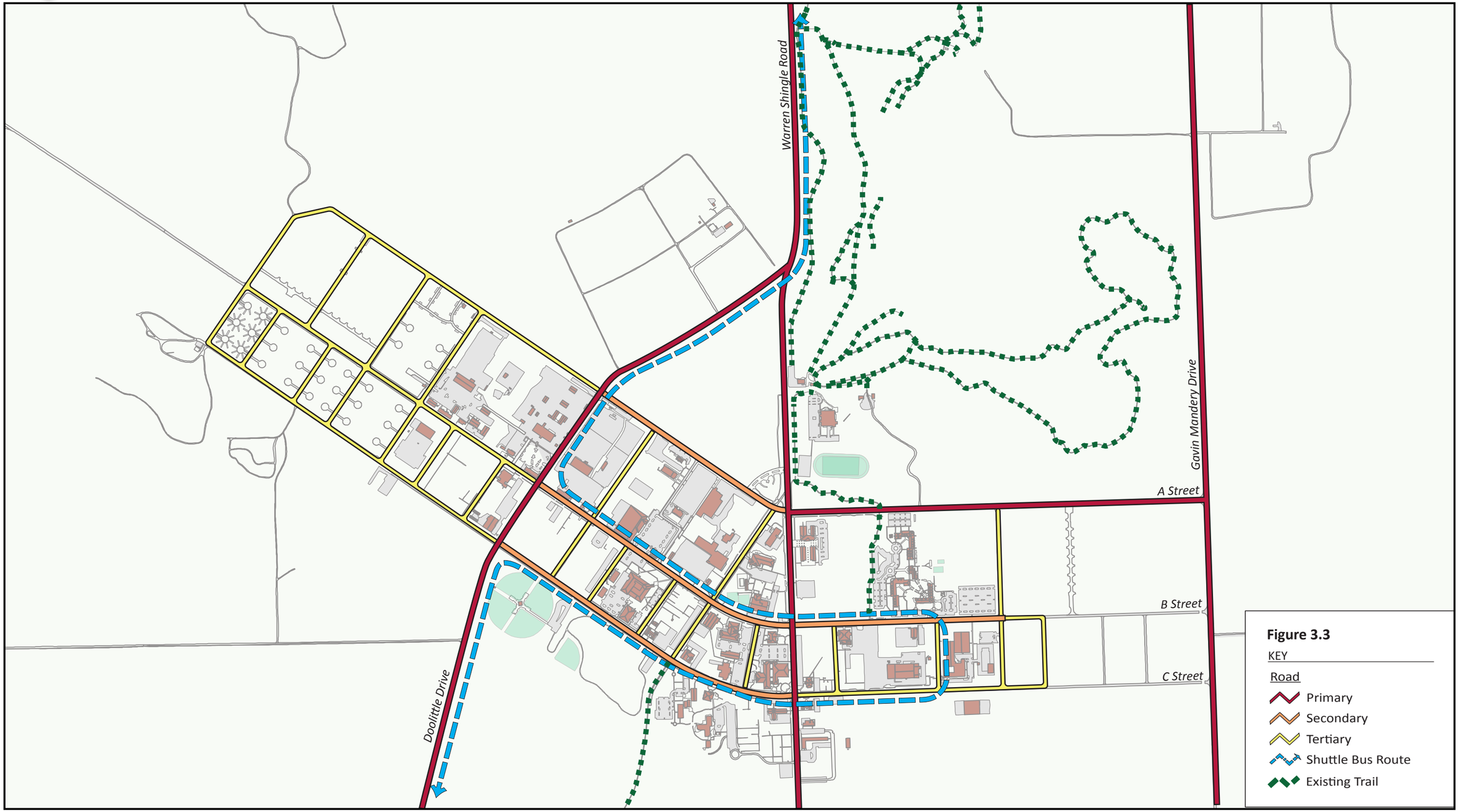
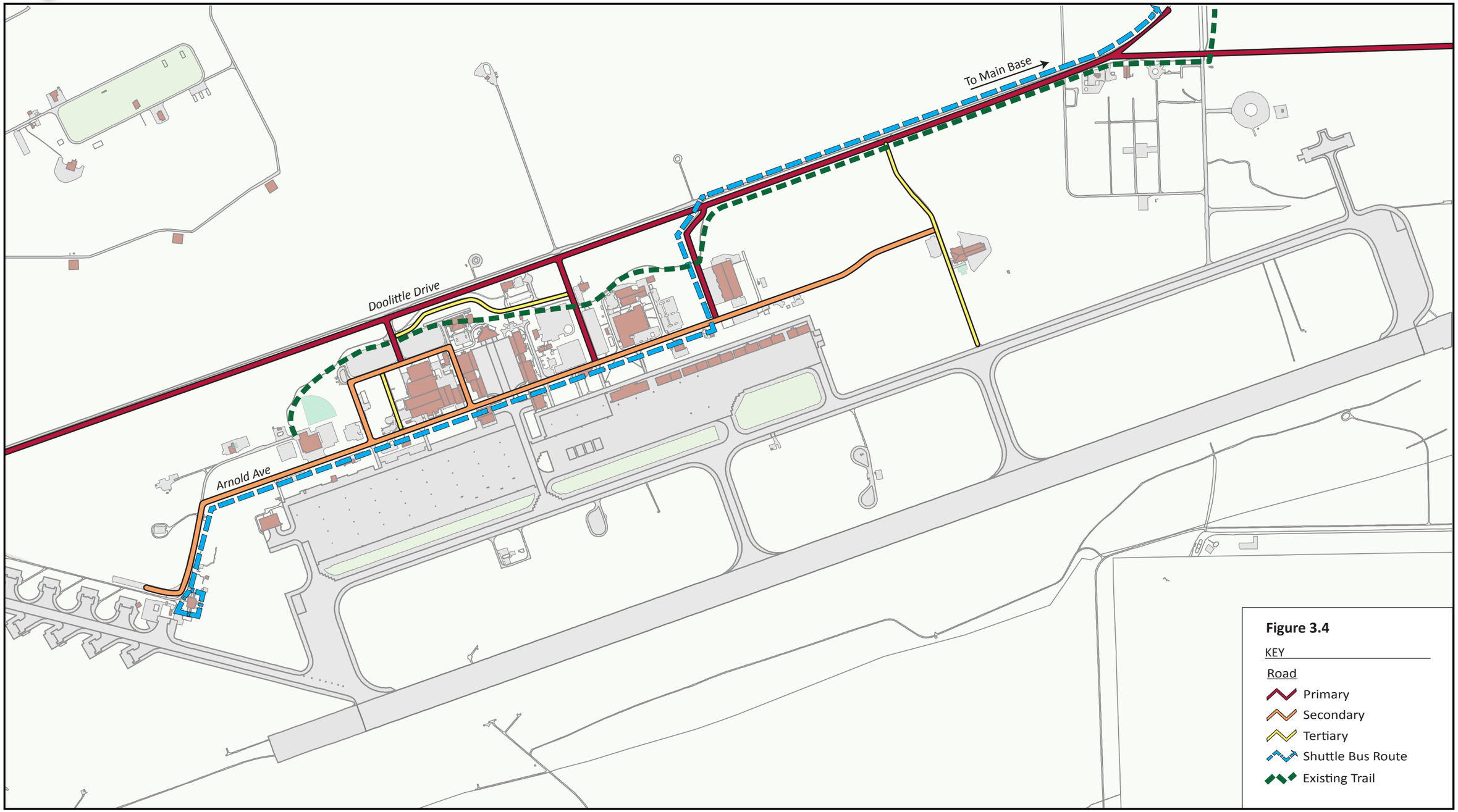
BEALE AIR FORCE BASE

Circulation: Main Base District



BEALE AIR FORCE BASE

Circulation: Flightline District



3.4 Utilities

Potable water, sanitary sewer, electrical power, and natural gas utilities on Beale AFB exist only in the Flightline, Main Base, and Family Housing Districts. Utilities on base typically parallel roadways. In general, the opportunity to support future growth is not limited by the capacity of these systems, although many of the distribution systems require upgrades and ongoing maintenance. A base-wide, stormwater drainage system does not exist. Stormwater is conveyed through open ditches along streets to several discharge points but with no control over quality or quantity. A Stormwater Pollution Prevention Program (SWPPP) is in place that defines the regulatory requirements and recommended Best Management Practices (BMPs) to manage stormwater effectively.

- **Water System.** Beale AFB is completely independent from any outside water source. Water is supplied by wells and is stored and distributed from several different tanks. The Main Base District water main has recently been replaced.
- **Sanitary Sewer System.** The base treats the wastewater and operates the system. Sewage is collected within the three populated districts of the base by gravity and pumped to the treatment plant through the use of lift stations.
- **Electrical System.** Pacific Gas and Electric provides the base's primary electric power. The majority of the electric distribution lines are overhead; however, underground electric distribution lines exist along the Flightline District. The base is continuously working to replace overhead lines underground.
- **Natural Gas.** Pacific Gas and Electric supplies the entire base's gas. Natural gas is provided to the Main Base and Flightline Districts.

3.5 Land Use

Land use at Beale AFB has been logical and follows basic Air Force planning guidance to support the base's mission.

A highly-functioning urban environment does not rely solely on distinct land use separation, but on careful integration of similar, supportive uses. Mixed-use development focuses multiple uses that are co-dependent into an environment that fosters a high quality of life experience. By providing pedestrian linkage throughout the Main Base and Flightline Districts, mixed-use benefits can be anticipated in future development.

3.6 Sustainability Initiatives

Beale AFB has undertaken a number of initiatives to reduce its consumption of natural resources and its impact on the environment. These initiatives also help to reduce dependency on off-base resources. Design teams should be aware of these initiatives to continue to improve upon them.

3.6.1 Natural Area Preservation and Restoration

The majority of the base's acreage is undeveloped and consists of a unique blend of ecosystems that includes grasslands, oak woodlands, stream corridors, seasonal wetlands, vernal pools, and lakes. Because of these important and sensitive environmental features, the base aggressively pursues environmental restoration and protection. To date, 16 acres of vernal pools, 100 acres of riparian habitat and 50 acres of native grasslands have been restored. These restoration programs should be considered in the facility siting process for opportunities to further restore and protect sensitive ecosystems and reduce stormwater runoff rates.

- To help protect sensitive ecosystems, base planners have created development envelopes which concentrate development in three districts: Main Base, Flightline, and Housing. These development envelopes direct growth into compact, pedestrian-oriented developments that are less dependent on the automobile. Areas falling outside of these envelopes are managed for protection of the unique natural resources.
- A *SAMP* is in development as a management tool to achieve a balance between aquatic resource protection and General Plan development. When approved, the *SAMP* will prioritize impact avoidance and target conservation of higher integrity aquatic resources while providing opportunities for development.

3.6.2 Recreational Areas

The active outdoor recreation areas, which include the Golf Course and athletic fields, provide a human connection with the outdoors and opportunities for fitness. The natural and improved recreational areas at the base are shown in Figure 3.5, Green Infrastructure: Main Base District.

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BEALE AIR FORCE BASE

Green Infrastructure: Main Base District

As bases strive to conserve resources through compact development and increased building densities, it is vital that infill is balanced by a green infrastructure network. Green infrastructure represents the network of natural areas and open spaces that conserves ecosystems, helps to sustain clean water and air, and offers benefits to base residents and wildlife. Systems that support the network of green infrastructure include techniques and technology that "can simultaneously help filter air pollutants, reduce energy demands, mitigate urban heat islands, and sequester carbon while also providing communities with aesthetic and natural resource benefits," as stated by the U.S. Environmental Protection Agency (EPA). In terms of land development at Beale AFB, green infrastructure creates a balance between the built and natural environment, where natural systems support and create clean water and temperate air, and support wildlife bio-diversity; and the built systems reduce the burden on natural systems and the environment. Opportunities for enhancement and restoration of the existing natural systems should be explored, including the continued improvements along the water drainage system.

Olive Grove at Dormitories

Major opportunities to enhance quality of life at Beale AFB exist in the form of green infrastructure. Key open spaces, trails and pedestrian walks, natural areas, and recreational assets including Memorial Park, Coyote Run Golf Course, athletic fields, and smaller parks and green spaces, including olive groves, are found surrounding the Main Base and Family Housing Districts. The Flightline District is also linked with the pathway system. With recreational facilities and quality of life activities organized along A Street, the green infrastructure links active and passive recreation activities together with the natural environment. The opportunity to establish connections to these assets and to provide adequate parking to promote outdoor activity should be considered as part of new development.

Utility corridors located within the Main Base District run south to north along C Street extending north to 34th Street, and south to 10th Street. The design of new development provides an opportunity to explore green infrastructure.

Memorial Park

Memorial Park forms the triangular parcel of land between Doolittle Drive, N. Beale Road and A Street. The park incorporates limited lawn areas, tree plantings and vintage aircraft (SR-71) into a green destination on base. Plans are in place to enhance and expand these active and passive recreation opportunities.

New development provides opportunities to incorporate small exterior gathering and passive recreation areas that create an environment that is more engaging and enjoyable for the inhabitants of the adjacent facilities. Shade structures provide comfort during summer use of outdoor spaces while screening reduces visual clutter. Opportunities for implementation are as follows:

- Create a screened edge condition between the Civil Engineering storage areas and Doolittle Drive and A Street.
- Create a landscape edge treatment or buffer around the mission support site along B Street.
- Enhance the existing historic mulberry trees along Gavin Mandery Drive and Warren Shingle

Road by incorporating liner oaks planted in a naturalized pattern.

- Improve the streetscape along B Street by creating a shaded pedestrian walkway.

3.6.3 Energy Conservation Initiatives

Over the years, Beale AFB has implemented a number of initiatives to reduce energy consumption rates and energy costs.

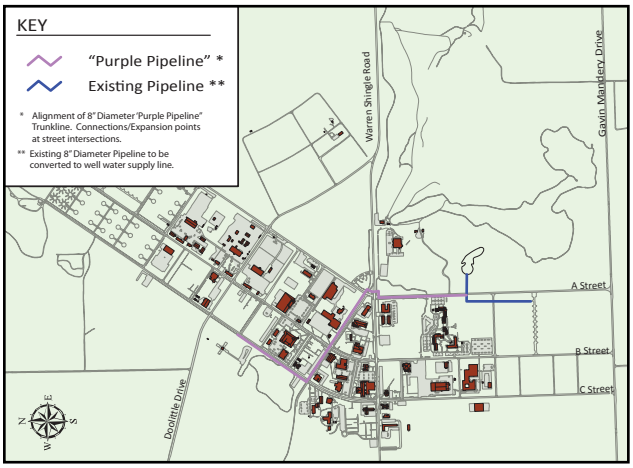
- Substantial efforts have been made toward metering of facilities throughout the base. An individual metering program has been implemented by installing sub-metering for both electric and gas consumption on all new buildings and existing buildings greater than 30,000 Square Feet (SF) to improve energy efficiency with future facility projects.
- Although automatic lighting controls are in place on the flightline, flightline and security lighting is currently manually controlled to decrease energy usage and light pollution, based on actual needs.
- There are $1.5M in upgrades planned to the natural gas distribution system which services the Main Base and Flightline Districts.

3.6.4 Water Conservation Initiatives

Water use at Beale AFB is nearly three times the national average of 80-100 gallons per person per day. As such, the base has implemented a number of initiatives to reduce the use of potable water. Additionally, the base has made reductions in inflow and infiltration to the wastewater treatment facilities.

The June 2010 *Final Water Reuse Feasibility Evaluation Report for Beale Air Force Base* assesses opportunities to replace potable water use with non-potable water on base, reduce potable water consumption, and assist the installation with meeting the Executive Order (EO) 13514, Federal Leadership in Environmental, Energy, and Economic Performance water conservation goals. The report identifies the installation of raw water production well(s) or the use of canal water to irrigate the golf course and thereby provide opportunities to increase the use of non-potable water and decrease potable water demand on base. Some other opportunities are:

- Irrigation of the golf course is provided by treated effluent.
- A plan to eliminate any non-native plantings on the Main Base District is in process. The non-native plants will be replaced with native plants and xeriscape. New development provides opportunities to landscape with natives and xeriscape.
- The base potable water is supplied by onsite wells. A new water treatment plant came online in March 2003. Aging steel pipe has been replaced or is scheduled for replacement throughout the base.
- Much of the base's sanitary sewer system has been in service since World War II. The Sanitary Sewer System Rehabilitation Plan provides a comprehensive strategy to completely repair sewer lines and to develop a phased approach to the wastewater treatment facility. Plans are in the works to replace the line from the main base area to the family housing area as a large amount of groundwater infiltration has been found in this line.



Reclaimed Water Trunkline

3.7 Constraints

Constraints to development and the use of green technologies include natural resources, operations and safety/security. As previously shown in Figures 3.1 and 3.2, natural and operational constraints to development and the use of green technologies occur at Beale AFB; however, there are generally few significant constraints that will affect development. The following sections review the base's development and green technology constraints.

3.7.1 Wetlands and Floodplains

Wetlands and floodplain constraints include vernal pools found in many base locations. The area west

of the flightline contains an especially high density of vernal pools. While vernal pools do exist within the Main Base District, protection measures have been established allowing for development to occur when necessary.

Vernal Pools

3.7.2 Pollution Release and HAZMAT Storage Sites

Constraints to development at Beale AFB include pollution release sites identified as Environmental Restoration Program (ERP)/Resource Conservation and Recovery Act (RCRA) sites as well as HAZMAT storage sites. However, development may be permitted within affected areas with HQ ACC approval. Typically, these major constraints fall outside of the Main Base and Flightline Districts or do not pose significant obstacles to development.

3.7.3 Outdoor Recreation Areas

Outdoor recreation areas represent needed quality of life activities to serve the community and enhance living on the Base. These areas are generally not considered for development.

Lower Blackwelder Lake Park

3.7.4 Noise

A constraint to development are the noise contours associated with aircraft operations. Noise is a quality-of life issue and can directly affect human health if not attenuated through appropriate construction.

Day-Night Average Sound Level (DNL) is the average noise level over a 24 hour period. Much of the base administration, industrial, and unaccompanied housing areas are located within the DNL 65 dB noise level countour. The inclusion of noise reduction measures should be part of all new development and reuse.

3.7.5 Threatened and Endangered Species

The protection of threatened and endangered species and species of special concern on Beale AFB is a planning issue that is being addressed through the *SAMP* and Environmental Assessment (EA) regulatory permits and consultations. The *SAMP* and EA detail procedures for mitigating adverse effects of new development on those species and their habitats. The most significant constraint is the existence of the Fairy Shrimp that is found in the many vernal pools located throughout the base. These areas will greatly limit any construction and expansion outside of the Main Base, Flightline and Family Housing Districts; however, with limited occurrences of vernal pools within the Main Base District, development is possible.

3.7.6 Safety and Security

Safety and security of Air Force assets, personnel and families drive Anti-Terrorism/Force Protection (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.

3.7.7 Operations

The availability of water and energy/power sources are not considered constraints to development at the installation, although the military airfield potentially limits some opportunities for renewable energy generation. Specifically, the feasibility of wind turbine projects may be limited due to the potential

for creating an obstruction or hazard to air navigation or to interfere with surveillance radar. Wind turbine projects are evaluated by the Federal Aviation Administration.

4 Illustrative Plan

The purpose of this section is to graphically illustrate a future vision of the installation. The key element of this section is the Illustrative Plan showing the desired changes or additions to the Installation Image elements, and the resultant urban form achieved by following the ID2 guidance. Building footprints, roadways, parking areas, and pathways are illustrated. The following illustrative plans highlight the establishment of nodes, landmarks and links that create the future vision of the Main Base and Flightline Districts. The Beale AFB Illustrative Plan is shown in Figure 4.1. Enlargements of the Main Base and Flightline Districts are shown in Figures 4.2 and 4.3 respectively.

The Illustrative Plan represents a future vision that is comprised of proposed military construction (MILCON) projects, the expansion of various areas such as the dormitory complex, and also the development of infill sites as identified in Chapter 3. The Illustrative Plan also identifies redevelopment opportunities within the previously developed areas on base. The site opportunities have been shown addressing parking requirements and AT/FP regulations. The development opportunities reflect consolidation of activity and facilities, creating a walkable environment. One of the dominant site features in the Illustrative Plan is the planting of trees within parking areas. A diagonal pattern will maximize shading and reduce the heat island effect. Shading of the parking areas will dramatically reduce the buildup of heat near the buildings and will also serve to reduce the conditioning of make-up air and provide wind breaks. Beale AFB has a tree planting program in place and is incorporating tree planting with MILCON and site improvement projects.

Throughout the Main Base and Flightline Districts, green infrastructure improvements have been identified in the vision. Low impact development (LID) technology integrated into new project development will both enhance the environment and will promote and implement SD&HPGBD. The character of the landscape in Yuba and Sutter Counties along with the entire Sacramento Valley is established by the groves of planted fruit and nut trees. The Beale AFB Illustrative Plan identifies locations where existing groves can be enhanced and new groves of tree planting can be implemented. Extension of the pedestrian/running trail system internal to Main Base is also shown on the Illustrative Plan and ties into other green infrastructure elements.

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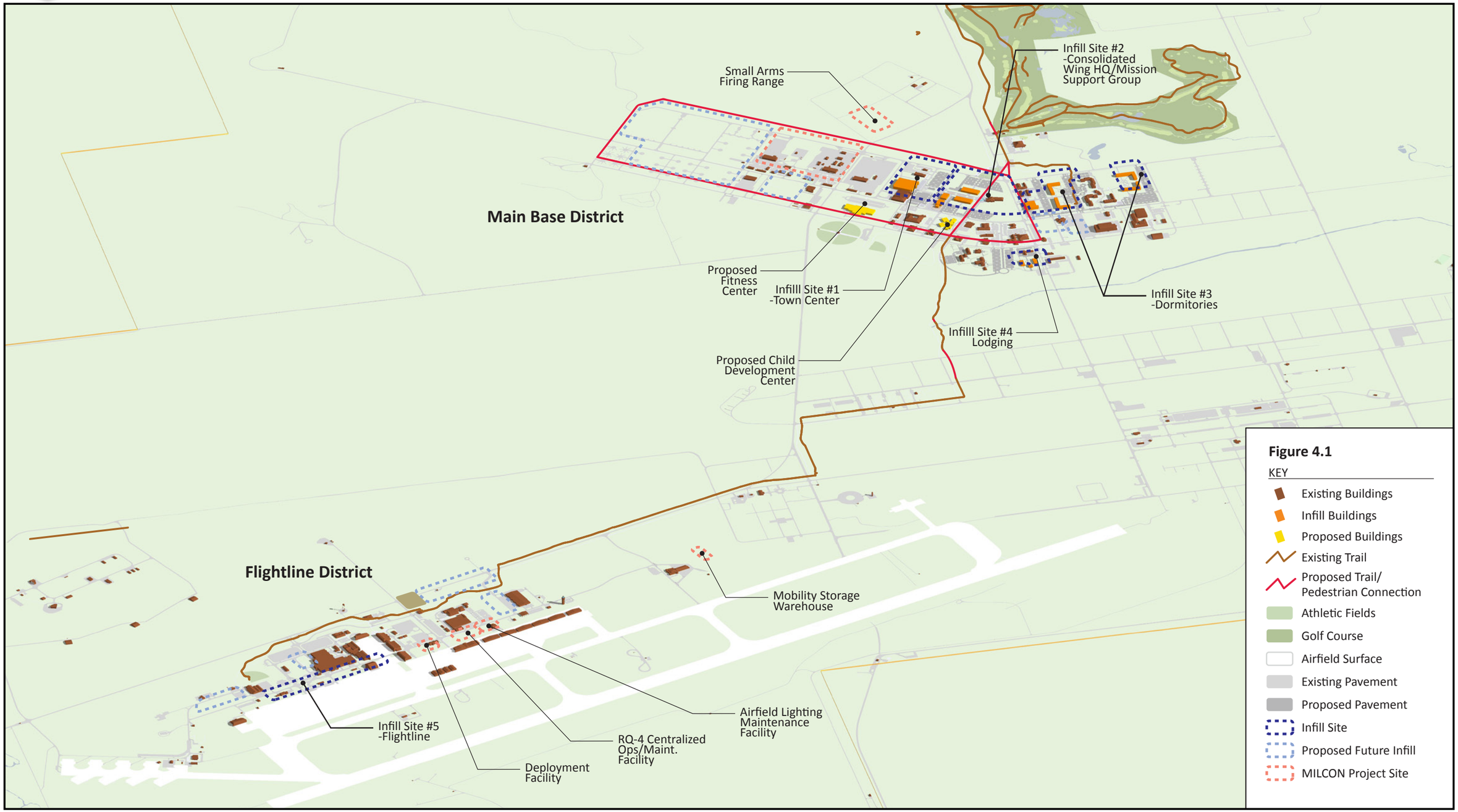
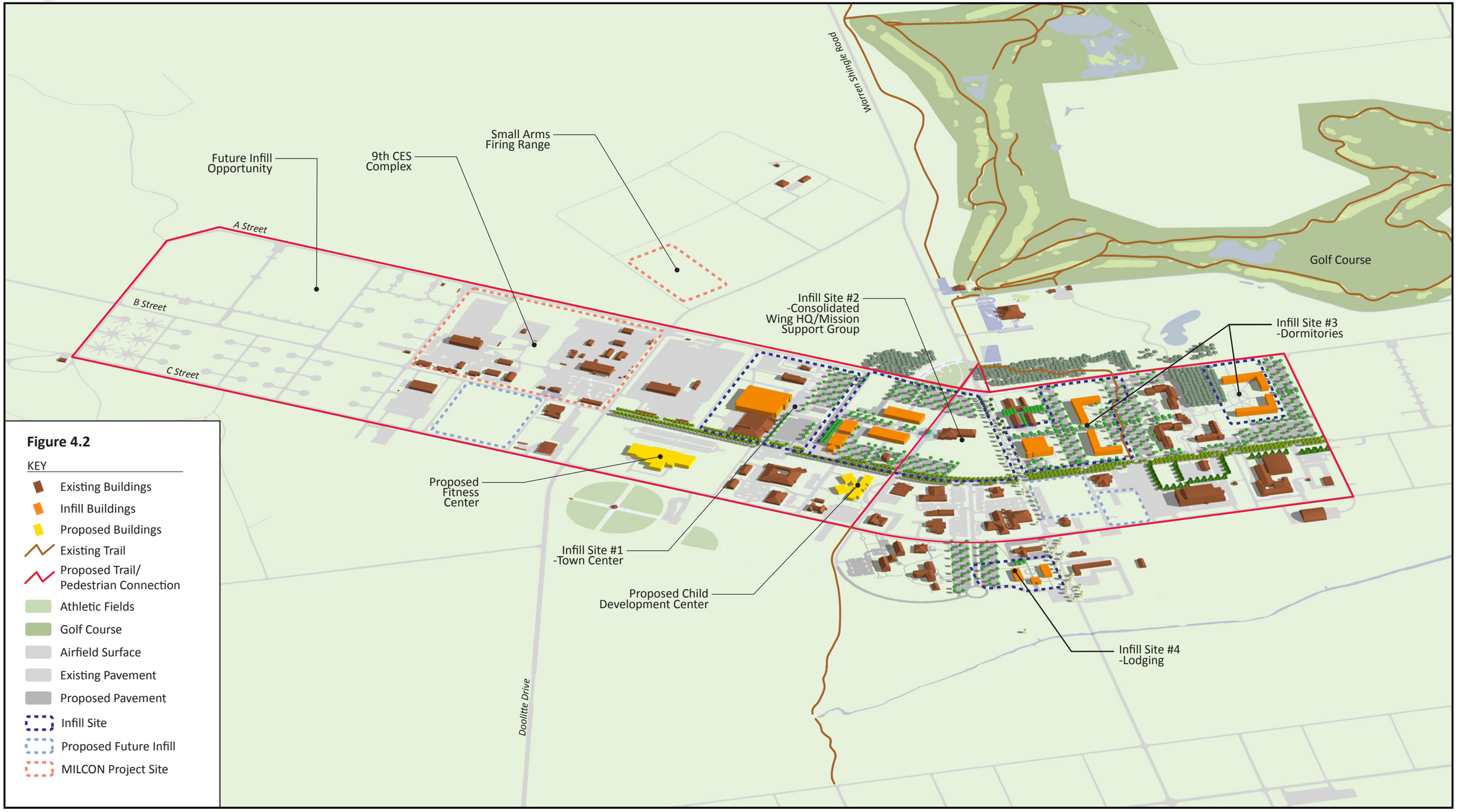
BEALE AIR FORCE BASE

Illustrative Plan: Main Base and Flightline Districts



BEALE AIR FORCE BASE

Illustrative Plan: Main Base



BEALE AIR FORCE BASE

Illustrative Plan: Flightline District

5 Development and Design Guidelines

5.1 Sustainable Development and High Performance Green Building Design

Many factors come into play in the design of a sustainable development. Site sustainability, water efficiency, energy and atmosphere, materials and resources, indoor air quality, and innovation / processes are all focus areas identified by ACC's SD&HPGBD criteria and reporting processes. In addition, the reduction of the heat island effect is a component of sustainable site development. The following topics should be explored and considered during the pre-project development phases of all new construction projects. In each section, the bulleted items list the development and design considerations applicable to all development on Beale AFB.

5.2 Site Development

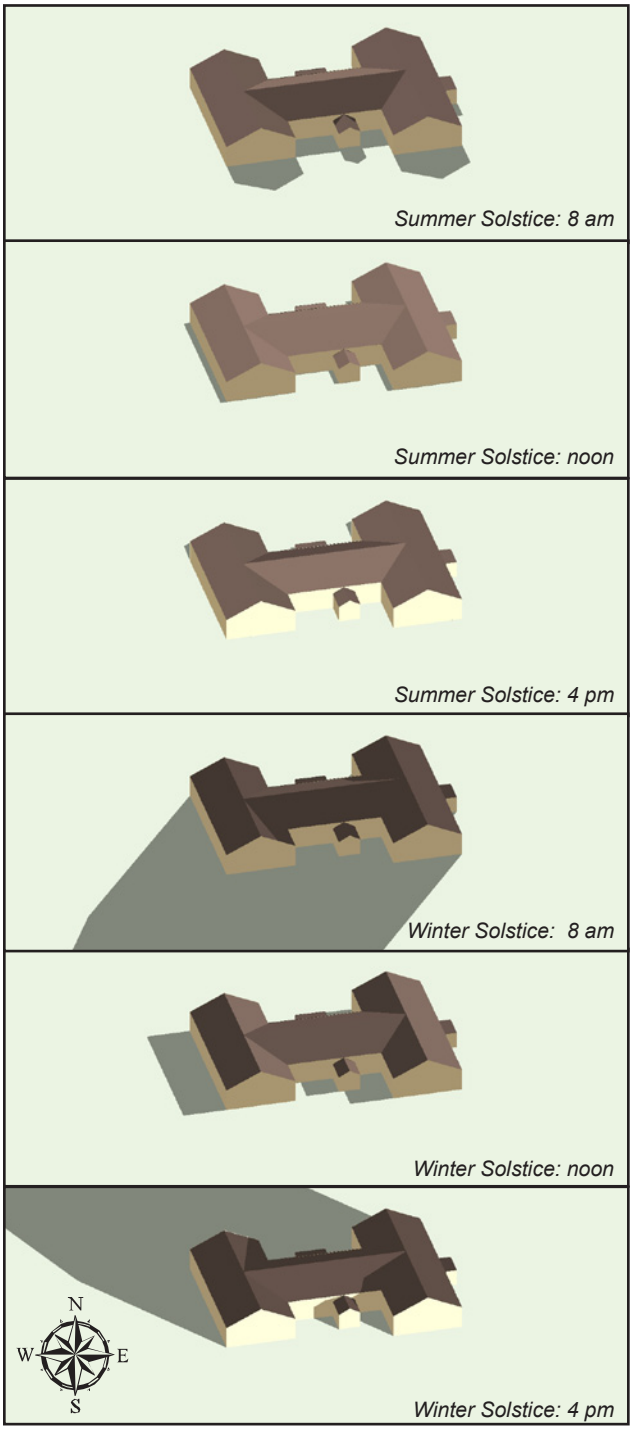
Sustainable development is an area of exploration that includes identifying the preferred location and connectivity for new development, the development's contribution to the urban pattern and land use mix, compactness of the development, access to public, civic and recreation facilities, and the design of movement systems throughout the site and their connectivity to off-site needs.

5.2.1 Solar Orientation and Building Siting

5.2.1.1 Solar Orientation

Beale AFB receives long periods of sunlight during a majority part of the year with the exception of winter months. The Main Base District is organized in a street grid pattern with building site organized streets running north-south and cross streets running east-west. Initially, the first step in siting new buildings is the solar orientation. Ideally, new facilities would be oriented lengthwise along the east-west axis, maximizing solar access, and reducing energy use. In general solar orientation of a building should be to the south, reducing heating costs. Solar shading should be employed in the design of south and west-facing facades.

- Maximizing the shape and orientation of the facility with respect to the sun for passive solar heating, cooling, and daylighting.



Solar Shade Patterns

5.2.1.2 Building Siting

Numerous factors need to be considered when siting new facilities at Beale AFB. Some of these factors include:

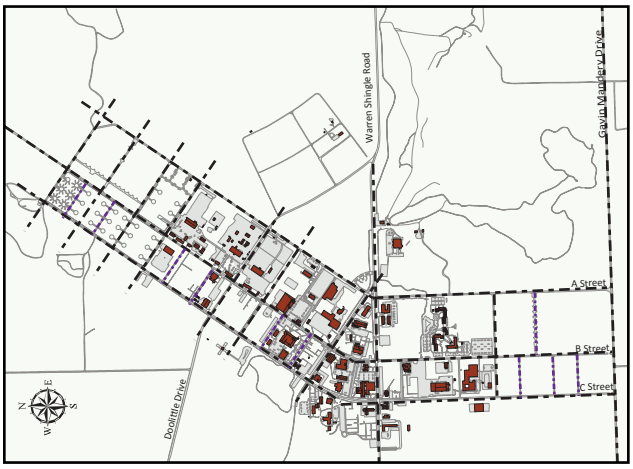
- Existing and future land use.
- Functional relationships between activities.
- AT/FP.
- Building function and size, including consideration of the minimum size and footprint necessary to serve the function.
- Parcel shape and size.
- Operational and natural constraints.
- Infill opportunity.
- Vehicular and pedestrian access.
- Proximity to utility corridors.
- Planning for a dense development pattern to support a combined heat and power plant (co-gen) or separate district heating and cooling plants.
- Orientation of new facilities, and also reuse of existing buildings, should be explored in regard to climatic opportunities and constraints such as solar access, shading, and wind in addition to establishing the importance of the facility.

Building entrances should generally be oriented to the south and east to avoid the prevailing winds. Facility location and orientation within the district along with location of the building on a parcel, should respond to the need for reserving expansion space for the future and establishing the importance of the facility.

Site selection should reflect the level of activity and the importance of the facility. Therefore, prominent sites should be reserved for important facilities. These sites should have a high level of visibility, be located on or near major streets, and should have a high level of connectivity. Co-location of similar future facilities should be taken into account. Sites should be planned for future use based on a hierarchy of importance. As an example, the current 9th RW HQ is located at the intersection of two highly traveled roadways, the site is not prominent, and the facility image does not establish the importance of a HQ facility.

From a functional standpoint, facilities that have significant pedestrian and vehicular traffic to and from the building should be placed or located along vehicular and pedestrian routes. Facilities generating less traffic can be located where access is less critical.

Orientation also establishes the hierarchy of importance on base. From this viewpoint, key facilities should face or front onto the more prominent roadways, but not necessarily on the most highly traveled arterials. Secondary or side street frontage should be reserved for less important facilities, and tertiary streets should be home to the support services including gas station/convenience services and maintenance type facilities.



Main Base District Grid Orientation

Another important aspect of proper siting of new and expanded facilities is the inclusion of AT/FP measures. Many of the facilities at Beale AFB reflect older patterns of development where buildings were located close to roadways and parking was within close proximity of buildings. Beale AFB has the opportunity to further establish AT/ FP stand-off distances through the consolidation of facilities and co-location of parking areas. By consolidating facilities development, a walkable, campus environment can be achieved. AT/FP stand-off distances can be overlapped, further reducing a development's footprint to help create a more sustainable environment. Many of the potential development parcels are large and are able to accommodate substantial building programs.

5.2.2 Access

Individual site or parcel access should be addressed for both existing conditions and new construction. Many of the parking area entrances are located within close proximity of intersections. Recommended distance from an intersection to site entrances should be 100 feet for an arterial, 75 feet for collection streets, and 50 feet for local streets. Most entrances should be located on the secondary streets. The street grid network of the Main Base District lends itself to easy and direct access to most all facilities. This level of connectivity reduces traffic congestion while providing multiple pathways for both vehicular and pedestrian movement.

Individual site access should be addressed in regard to entry sequencing with privately owned vehicle (POV) visitor pass parking outside the control points.

Development envisioned for each district should be designed to incorporate features enhancing connectivity and mobility. Connections to the bicycle network and internal street network, and access to the surrounding vicinity or other uses should be enhanced through connecting uses and promoting pedestrian movement. Street width and traffic calming design should enhance the pedestrian experience while maintaining safety. Streets should have walkway connections that create and link nodes and specific civic destinations.

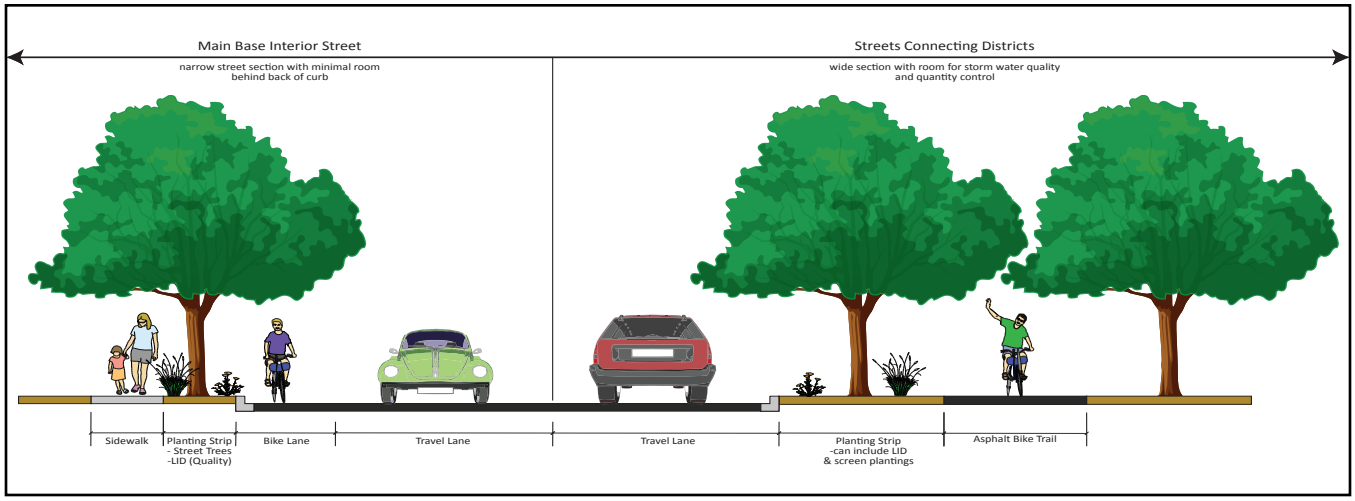
Creating walkable streets will reduce the dependence on vehicular movement for shorter trips within the Main Base District. Compact development (infill and site reuse) reduces development costs while enabling ease of pedestrian movement within the new development. Co-locating many of the daily destinations on base into consolidated locations further reduces traffic and makes travel more efficient.

Enhanced pedestrian circulation can be achieved within the Main Base District through the addition of walkways along roadways and internal circulation within individual sites. Climatic conditions experienced by residents of Beale AFB include both high temperatures and high winds. Protection of pedestrians with shaded walkways and windbreaks will enhance pedestrian movement between buildings, while diminishing dependence on vehicular travel.

All development should be designed to address the following:

- Incorporate features enhancing connectivity and mobility.
- Enhance proximity of destination buildings, bicycle network, internal street network, and access to the surrounding activities through connecting uses and promoting pedestrian movement.
- Design the pedestrian / trail / on-road bicycle systems to enhance the experience while maintaining safety.
- Provide walkway connections along streets that create and link nodes and specific civic destinations.
- Create building entrances that provide direct access to walkable streets and larger pathway systems.
- Locate sidewalks on both sides of walkable streets within the Main Base District.

Streetscape Simulation



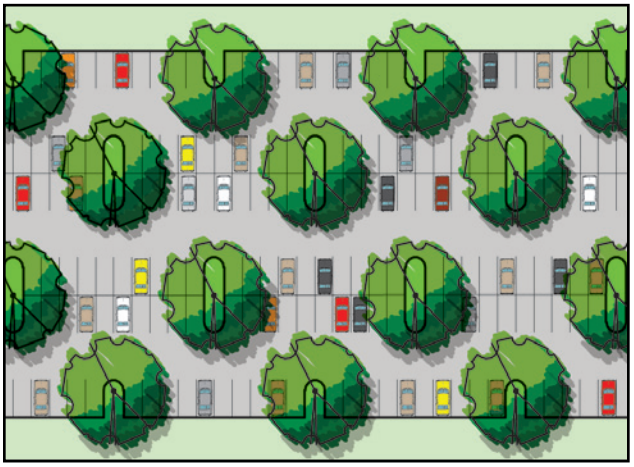
Streetscape/Trail Section

- Provide shading along major pedestrian routes. Achieve with trees, awning devices, buildings, or by other shading measures.
- Provide areas for gathering and passive outdoor recreation measures such as seating or plazas along the pathway network.
- Incorporate in all new development projects, pedestrian movement to and from their site, linking facilities and activity areas together.
- Provide pedestrian connections to link activities and elements within nodes.

5.2.3 Parking and Roads

Both existing and new parking should be coordinated throughout the Main Base and Flightline Districts. Often individual building requirements drive the extent of parking, leading to an oversupply. Parking footprint reduction and location of parking come into play early in the design process. Co-locating parking can reduce the number of parking spaces through providing less overflow spaces than individual isolated parking areas. In addition, by co-locating parking areas, AT/FP is much easier to maintain, and the new development requires less land area to accomplish implementation of the building and site development program.

- Explore the reduction of the parking footprint to eliminate paving through co-locating parking needs and requirements.



Parking Grove

A significant measure in the reduction of heat islands can be achieved through planting trees within parking areas. Create parking groves by planting islands located at staggered intervals of parking spaces. Plantings shade the areas maintaining a cooler surface temperature of the parking areas and creates a desirable environment. Explore pattern spacing, where tree canopies will provide significant shading for parking and hardscape surfaces. Shade trees should be chosen from the Beale AFB Plant List based on low irrigation requirements, and suitability for parking and xeriscape areas. For instance, London Plane trees would be well-suited to provide canopy coverage in parking lots.

- Incorporate LID measures within the development sites and parking areas.
- Create more visually appealing parking lots by introducing landscaped areas and landscaped earth berms to provide relief from larger expanses of asphalt and vehicles.

- Provide shade trees in parking lots, playgrounds, and along pedestrian routes to reduce heat island effect. Place shade trees within planting areas equivalent to one parking space at a diagonal pattern to maximize canopy coverage.
- Consider the placement of shade sails over parking lots for instant heat reduction and integration of solar energy harvesting.
- Where appropriate, consider limiting pavement, such as reducing street sections and parking, and implementing shared parking to reduce runoff and heating effects.

5.2.4 Landscape

Landscape treatment at Beale AFB should follow prior implementation materials and methods at the base. To be consistent with HQ ACC policy, all uses of potable water irrigation should be eliminated, unless required to establish plantings. The use of river rock as ground cover, along with tree planting, has reduced irrigation need significantly. While complete uniformity of landscape treatment on base is not desired, multiple approaches need to be compatible with each other.

- The source of irrigation for all future landscaping should be either a raw water well or canal water.
- Landscape design for future development should employ xeriscaping with plantings selected for low water use. Choose native plants adapted to the specific site conditions to facilitate survival without irrigation.
- Site plantings for new facilities to provide access to the winter sun for passive solar heating and daylighting while shading buildings from hot summer sun. Place deciduous trees on the south, east and west sides of buildings to maximize solar orientation.
- Use plantings to provide shade when designing new walkways and outdoor activity areas. Plants can lower outdoor air temperatures several degrees and create more comfortable outdoor spaces.

5.2.5 Open Space

Incorporation of natural areas, green spaces and habitat not only enhance the pedestrian and overall base experience, but they also support the ecological community. Green space restoration and enhancement by encouraging biodiversity, water quality, natural hydrology and native wildlife habitat will create a higher quality of life for base residents.

Benefits of green infrastructure include:

- Creates attractive, livable communities.
- Promotes use of ecological goods and services (EGS).
- Supports habitat and biological diversity.
- Contributes to human health.
- Stimulates local communities through economic development.
- Provides educational opportunities.
- Moderates the local and regional climate.

Coyote Run Golf Course

Dormitory Exterior Spaces

Dormitory Exterior Spaces

Incorporation of outdoor green living spaces for the working and resident population, along with linking these spaces, will enhance districts. These green places should incorporate environmentally responsive solutions such as natural shading and wind breaks. The configuration of both existing and potential dormitories can create smaller scale outdoor areas that enhance the overall quality of life and promote pedestrian movement throughout the base districts.

- Create green outdoor gathering areas of varying sizes to promote interaction, and support the green infrastructure system.
- Construct naturally shaded pocket parks adjacent to work areas.

5.2.6 Energy & Utilities

Beale AFB has undertaken a number of energy and water efficiency projects at the base to meet goals established by the federal government. Further reductions are still needed. However, this is a challenge that will only be solved by approaching the energy and water conservation in a holistic way.

Planning and design teams should take these energy and utility recommendations into consideration in all development projects.

5.2.6.1 Heating and Cooling

Existing buildings on the base use individual chillers and boilers to provide cooling and heating to the building they serve or, direct-expansion package units.

- Air conditioning condensate from air-handling units should be collected and used as makeup water for water-cooled air conditioning systems.

Heating systems consist mostly of gas-fired boilers, resistance electric or electric heat pumps.

- Replace existing heating boilers (and hot water heaters) to 94 percent efficient or higher condensing-type boilers.
- Within individual buildings, consider use of variable refrigerant flow systems to capitalize on internal heat gains to minimize heating required for the exterior zones of buildings as an alternative to water source heat pump systems.

5.2.6.2 Metering and Controls

Maintain site lighting and flightline lighting to minimum requirements, and maintain manual control of flightline lights.

- Based on data gathered while on site, the exterior lighting is at or slightly above the minimum requirements for the flightline and parking areas.
- The flightline lights are currently manually operated. Automatic controls are in place but maintaining manual control will allow operators to extinguish lights when they are not needed.

- Future development should include central metering and control systems that enable the Base Energy Manager to control energy load of buildings based on actual 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 can be aware of energy consumption. This practice often results in significant savings since building occupants take charge of their own energy habits.
- Beale AFB should consider a “no heat and no cool” program for non-essential buildings from 15 March to 15 May and 15 October to 1 December. This program would need to be considered during the facility siting and design phase.
- Consider increased daylighting and use of skylights to reduce lighting and cooling energy consumption.

5.2.6.3 Water Utilities

Potable water is used for irrigation as well as commercial and industrial uses. The golf course is irrigated with a combination of treated effluent and potable water. In addition, approximately 240 acres of other landscaped areas are irrigated with potable water. The base is taking actions to align with HQ ACC policy that all uses of potable water irrigation should be eliminated, unless required to establish plantings.

- Continue to implement required 2 percent reduction per year of water consumption based on Executive Order 13423.
    - Install the next generation of low flow flush toilets and urinals, and automatic faucets on hand wash sinks.
    - Install building water meters in order to capture and analyze the data to improve water conservation with future facility projects.
    - Recover grey water for non-potable uses (irrigation).
- Replace existing landscaping with native plantings and xeriscape. This reduction in consumption will result in a 33% reduction in water.

Beale AFB has implemented the use of low-flow fixtures throughout the base. The base also uses treated effluent to irrigate the base golf course (in conjunction with potable water).

- Consider the use of the effluent system to satisfy irrigation needs for each new project.
- Consider extending the effluent system beyond the project limits to eliminate other existing uses of potable water irrigation.
- Consider using effluent water for toilet flushing and other non-potable water uses in new construction on the base, as acceptable to local plumbing code.
    - An alternative treatment method will reduce the volume of groundwater pumped from contaminated Site 13 and thus reduce the volume of treated wastewater effluent that can be used to irrigate the golf course, consider the installation of raw water production well(s) or the use of canal water to irrigate the golf course. Furthermore, in new development projects, consider the base-wide implementation of three water sources: drinking, wastewater, and irrigation.
- Consider using air conditioning condensate as make up for water-cooled air conditioning systems, irrigation systems or grey water use.

5.2.6.4 Renewable Energy Infrastructure

Evaluate the potential for on-site renewable energy in the development of new facilities. Incorporation of energy producing elements into new facilities should be explored early in the design process.

- Solar, geothermal, wind and bio-fuel are all potentially viable sources of on-site renewable energy. These sources should be evaluated to determine their cost and effectiveness on Beale AFB.

Solar Harvesting

Location conditions at Beale AFB provide a number of opportunities for using renewable energy sources. Due to advances in technology, discounted alternatives should continuously be reevaluated for application of more durable and reliable products while minimizing mission and maintenance costs.

Solar Energy

Solar technologies that should be explored in the development of new facilities include building integrated photovoltaics using thin film solar cell technology, passive solar thermal mass, cool roofs, green roofs, solar shading, and building ventilation. The application of solar technology should consider the following:

- Use photovoltaic (PV) panels to generate electricity for onsite use. Integrate the use of photovoltaic panels into other sustainable strategies, such as parking lot shading.

- Consider evacuated tube technology solar hot water panels as damaged tubes can be easily replaced without replacing the entire panel. Additionally, water does not leak from the panels when they are damaged, and the panels continue to allow water throughput and heating, even when individual tubes are broken.

Should the use of solar systems become a more widespread source of renewable energy at the base, solar-ready construction with the following traits should be considered during building siting and design:

- If possible, 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 least 200 square feet minimum).
- Include wire and piping in new construction or renovation so that at a later date the building can be easily augmented with solar PV (electric) and/or solar hot water systems.
- Ensure the structural capacity is sufficient 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 Beale AFB energy manager to procure PV or solar hot water systems as funding becomes available, and/or through power purchase agreements with the local utility without requiring corresponding facility upgrades or retrofits.

Ground Source and Turbines
To reduce reliance on fossil fuels, Beale AFB should consider employing ground source geothermal and wind power.

- Consider ground source geothermal heat pump systems for future heating and cooling projects.
- Consider wind turbine power for primary or backup power. Wind turbine application must be considered for its potential effect on the mission. As noted in Chapter 3, the use of wind turbines needs to be evaluated for potential impacts to the mission.

Waste to Energy
Beale AFB hosts roughly 1,500 head of cattle on 11,000 acres from November to May each year. The waste produced by these cattle could potentially be used as a renewable energy source for a "waste to energy" plant. Future development plans could consider burning biomass or municipal solid waste if possible (and natural gas if not) to provide renewable electric and thermal energy.

Renewable Energy

5.2.7 Stormwater

A base-wide, stormwater drainage system does not exist at Beale AFB. Stormwater is conveyed along streets to several discharge points, but with no controls on quantity or quality.

Development plans for the base should acknowledge that these practices are not sustainable and should consider the following, mostly simple, improvements to existing facilities to encourage ground infiltration and reduce the rate of stormwater runoff:

- Incorporate pervious concrete pavements in parking areas and sidewalks. Collecting rainfall and allowing it to infiltrate reduces stormwater runoff, and allows aquifer and groundwater recharge.
    - Converting Beale's parking areas to pervious paving will bring stormwater discharge reported in the *ISA* findings back to pre-development levels.
- Disconnect downspouts from underground, piped systems and redirect the discharge to splash ongrade blocks.
- Capture stormwater for irrigation purposes.

- Over 240,000 kgal of potable water is used each year for golf course and other landscape irrigation. Capturing stormwater runoff from impervious surfaces to replace potable water use will result in a 48% reduction in water use per FTE.

- Consider opportunities to create surface retention of stormwater in heavier use districts to identify contamination levels. Contaminated stormwater should be treated and then discharged to surface waters instead of the sanitary sewer system. The retention basin could also provide a source of water for irrigation or other non-potable uses. However, it might create a bird/wildlife air strike hazard which must be considered in the application of this recommendation.

Energy Independence and Security Act (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… with regard to temperature, rate, volume and duration of flow." To meet this requirement, designers of new projects at Beale AFB should consider the following:

- Implement stormwater requirements under Section 438 of the EISA.

- Review the EPA document 841-B-09-001, which provides technical guidance and requirements for demonstrating that the project meets the goal of Section 438.

- Collocate stormwater management features with AT/FP clear zones to the extent allowable by AT/FP requirements.

5.2.7.1 Low Impact Development

LID focuses on an overarching strategy of reducing the amount of stormwater runoff and capturing the water for the beneficial use by the site. Project designs should incorporate LID in accordance with ACC SD&HPGBD policy and guidance and project designs.

For facilities greater than 5,000 square feet, the Energy Independence and Security Act requires the restoration of pre-development site hydrology to the maximum extent possible. A number of LID strategies can be employed by Beale AFB to establish a sustainable stormwater management system. While many LID options exist, project designers may draw upon specific options that are best suited for Beale AFB.

Landscaped Island

- Strategic Grading: Grade existing land to allow stormwater to drain into specific areas to facilitate quantity and quality stormwater requirements and eliminate unwanted standing water.

- Cisterns: Sub-surface or surface storage tanks designed to accommodate excess stormwater quantity. Water reuse opportunities could include irrigation, toilet flushing or exterior washing; e.g. car washing. It is noted that cisterns are not typically used in this climate, but their use is not impossible. A secondary feed to the cistern, from treated grey water, would be required to ensure a consistent level of non-potable water is available.

Cistern

- Tree/Shrub Depressions: Dense permanent vegetation with a gentle slope to provide water quality pre-treatment between impervious surfaces and stormwater management devices.

- Landscape Islands Storage: Small-scale soil and plant based devices located to promote stormwater infiltration and filtration in parking lots and large areas of paving.

Shoulder Vegetation

- Shoulder Vegetation: Small scale soil and plant based devices located to promote stormwater infiltration and filtration along roadways to eliminate concrete channels.
- Surface Depression: Shallow area of land designed to temporarily retain stormwater.
- Maintenance of Drainage Patterns: Periodic removal of sediment build-up to allow LID devices to function properly.
- Alternative Surfaces: Pavement surfaces such as paving blocks, designed with voids to allow stormwater to infiltrate and reduce runoff.

Pervious Pavement

- Smaller Culverts: Used in conjunction with shoulder vegetation will reduce volume and slow stormwater runoff.
- Elimination of Curb and Gutter: Allows runoff to sheet flow into shoulder vegetation or other small bio-retention device.

Elimination of Curb and Gutter

Reduction of water consumption and wastewater management initiatives should be incorporated into development strategies. Currently, stormwater is handled with an open-surface draining system due to the nature of storm events.

- Develop the stormwater management systems as site amenities.
- Explore low impact development opportunities early in the design process for new development.

5.3 Architectural Design

Beale AFB is located in the Sacramento Valley of north-central California, approximately 40 miles north from the City of Sacramento. The surrounding agrarian landscape is home to many of the growers familiar to Americans. The predominant landscape image of the area is the expansive planted groves of trees. The local communities are typical of most farming areas, with grid street patterns, main streets and low density of development. Nearby towns of Marysville and Yuba City, Linda and Olivehurst do not have a well defined style of architecture or landscape. Buildings in the downtown areas of these communities are generally two or three story, brick structures with main facades highlighted with limited turn of the century detail and ornamentation.

The downtown areas are lacking a sense of place, often due to abandoned structures and open lots located throughout the previous retail cores. Newer structures reflect construction of the 1950's and 1960's and are generally single-story with parking immediately adjacent to building entrances. Tree planting is sporadic at best, but some larger street trees can be found throughout these communities.

Downtown Yuba City

Sutter County Courthouse

The residential portions of these communities also reflect development trends of the 1950's and 1960's with both street grid and curvilinear roadway patterns and single-story ranch style residences. Essentially, these communities do not offer any prime examples of local design and vernacular architecture.

Over the years, Beale AFB has received various new missions bringing with them new building programs, with many of the largest programs occurring in the 1950's and 1960's. Resultant facilities were generally constructed in the late 1950's and into the 1960's when the base became home to the Strategic Air Command in 1956, and the arrival of the 9th RW in 1966.

Buildings were constructed in a single story configuration. Over time, the energy inefficient structures were upgraded by "wrapping" them in an EIFS system of synthetic stucco applied over rigid insulation. Building window, doors and roof systems were replaced along with interior partition re-configuration and new finishes. The upgrades were implemented with the same materials, methods of construction and detailing, creating a unified base architectural image.

Context is established by a clearly defined visual character within each district, and consists of the base's pathways, edges, districts, nodes and landmarks. The districts are Main Base, Flightline, Family Housing and Open Space. Context is also established by the design approach previously established with existing facilities and the hierarchy of buildings. Elements of the built environment that constitute the context for Beale AFB follow.

Flightline District

Each of the four districts has its own design character, order and key elements. Architectural design should relate to the individual district context and help strengthen the positive attributes of the district.

Architectural compatibility can be achieved without uniformity or mimicry. The use of materials is one way that compatibility may be achieved, while new building forms or uses of similar materials can be explored. Exploration of building forms can facilitate incorporation of new ideas and concepts of green architecture. In most cases, building programs drive building forms, which are configured based on green building / environmental response.

The Main Base District is home to many of the non-flightline activities including HQ, mission support, community support, dormitory and quality of life activities and facilities. Individual facilities include the Commissary, Base Exchange, Valley Chapel,

Fitness and Wellness facilities, Auto Hobby Shop, Dormitories, Wing Headquarters, Civil Engineering Squadron, Communications Facility, and other mission-related facilities. The facilities represent a broad range of building types, structural systems, massing, and methods and dates of construction. The majority of the facilities are oriented to the orthogonal street grid system, and are constructed with similar materials and colors that link them together in a unified appearance.

Main Base District

The nature of the facilities located in the Flightline District is utilitarian and generally large scale. The hangars and maintenance facilities reflect the colors used on base, and the materials are cost effective metal siding sheathing large volumes of space. For the newer facilities, details include a concrete masonry unit (CMU) water table base and metal siding above. The older flightline buildings have painted CMU with metal siding above. The buildings in this district follow the alignment of the runways. Squadron operations facilities vary in their appearance due to different materials and building forms. The single story facilities are composed of split face CMU and standing seam metal roofing. Their building forms are varied and respond to a human scale. Many facilities in this district were constructed between the early 1950's and the late 1970's.

The Family Housing District is undergoing a program of revitalization. A family housing privatization contract is scheduled to be signed in 2012. In the meantime, Beale AFB is pursuing a parallel approach by aggressively constructing repairs to family housing, as well as whole house repairs that incorporate LEED concepts. This will become the responsibility of the project owner upon signing of the privatization agreement.

The community services facilities located in the Family Housing District reflect the updated approach. Recent buildings such as the Youth Center use split face CMU, standing seam metal roof and dark anodized windows and doors. Facilities and parking in this district follow specific site constraints.

The Open Space District surrounds the Flightline, Main Base and Family Housing Districts and is comprised of rolling land. The Open Space District is used in part for cattle grazing. Recreational trails exist in the district and link the other districts together. Buildings located in this district are utilitarian in nature responding to specific needs such as the PAVE/PAWS facility. Buildings are constructed with metal panels and low sloping metal roof systems.

PAVE/PAWS

The approach to establishing architectural design concepts suggests two areas for exploration: architectural order and architectural elements.

5.3.1 Architectural Order

General topics that influence architectural concepts include approaches that are applicable to all districts.

5.3.1.1 Plan Complexity and Geometry

Floor plan complexity is a response to program and site conditions. Site conditions include opportunities and constraints reflecting climatic conditions along with views, site approaches, and parcel

configuration. If possible, building floor plans should reflect best practices for common building types and green building technologies. For example, office administration buildings should implement a floor plan configuration that is conducive to ventilation, daylight penetration, and heating and cooling control, while also creating an efficient workstation layout and space utilization.

At Beale AFB, most buildings are simple in form and plan complexity. Building efficiency is most often a product of an efficient plan. However, plan configuration should also draw upon SD&HPGBD principles that respond to climatic and quality of life drivers. For daylighting, building dimensions should not be overly deep from window to core. This limits the benefit of daylighting and also natural ventilation. Most building service functions should be located within the core area, with the exception of mechanical spaces that need exterior access. Reuse potential is a design opportunity that should be explored in initial design of new facilities. At some time in the life of a building, the use will change, requiring the building to be modified to respond to different needs. By creating buildings that can easily respond to additional uses, facilities will have a naturally expanded life. While many facility programs are unique to the programmatic needs, there is room to adjust plan configurations to be suitable for additional varying uses. Another example is that of warehouse facilities. Certain facilities can be designed with the ability to meet a wider range of specific uses through universal design strategies.

Most building configurations at Beale AFB are reasonably suitable for reuse. Some buildings and programs are highly specific in their configuration such as the dormitories. Double-loaded corridors with prototypical room units will limit any potential reuse, other than dormitory re-configuration.

Facility expandability is another opportunity for extension of the useful life of a building. Locating a building on a site which precludes expansion is a certain way to reduce the opportunity for future reuse of the facility. By consolidation of building program on a site and identifying opportunity for expansion, both the site and the building can respond to a wider array of needs in the future. In addition to site consolidation of facilities, the plan configuration of a building can equally respond to opportunities for expansion. Internal circulation corridors can be planned and designed to accept extension.

Locating building services in areas that would easily serve building expansion is also important. Many of the buildings at Beale AFB are sited in a way that limits expansion, whether it was caused by the facility siting itself, or the encroachment of another new facility. Care should be taken to ensure that adequate room exists for all new facilities to expand their footprint in the future.

5.3.1.2 Building Scale and Proportion

Building scale is most often a reflection of facility program. A building envelope essentially wraps a program as efficiently as possible. Large spaces required within buildings often drive the perceived scale of a building. Examples of these types of facilities are gymnasiums, commissaries, and base exchanges. The perceived scale of these large box buildings can be mitigated by wrapping elements of the program around the large spaces in addition to locating the large facades where their impact is lessened. Also, landscape treatment can be implemented to lessen the impact of large simple facades. Building scale is also a way to enhance the importance of a facility's role on Base. Scale perception is a function of how and where a building is seen, and can be manipulated by establishing those viewing positions.

Building Massing

Most of the buildings at Beale AFB are single-story structures that portray the understanding that the activities held within are equal in importance. The 9th RW is housed in a building that does not express its importance.

In a similar role, building proportion plays an important role in demonstrating the use, importance and internal space arrangement. Entrances are an opportunity to be expressive and to deviate from the

proportion and rhythm established in the façade. Special spaces can be announced by elements reflecting a larger or smaller proportion much as level of detail plays a role in defining uses within a building. At Beale AFB, many of the existing buildings are constructed with split face CMU and standing seam metal roofing. The proportion of the roof to exterior wall is roughly equal when the viewer takes into account the height of the sloped roof. The pronounced metal fascia and soffits, often nearing two feet in height, adds to the perception that the roof is too large for the building and that the roof overpowers the building's composition.

Building massing plays an important role in how a building is perceived and also how the overall Base image is characterized. Massing is a reflection of the spatial needs of the internal spaces and circulation and is articulated by the structural system. In conjunction with explorations of scale and proportion, massing and typical bay spacing will define the exterior image of a facility.

Beale AFB's facilities are mostly single story structures with the exception of the dormitories. This massing is largely the result of having available land to spread out development, combined with ease of construction. By consolidating a facility's program into a compact footprint and using multiple floors, the building becomes more efficient, reduces exterior envelope costs, conserves land area, expresses importance, and promotes SD&HPGBD principles.

Single-Story Building

A factor that dramatically affects the perception of massing, proportion, and importance is the selection of a roof system. On single story buildings, sloped roof forms often equal or in some cases exceed the vertical wall elements in height. Care should be exercised to create a building mass that limits the expansiveness of roof systems and focuses attention on the building's main facades.

Structural configuration of a facility can play a significant role in the image of a building. The structural bay is a result of the selection of the most efficient structural system for the building. The structural system does not necessarily need to be expressed either externally or internally. The bay spacing characteristics, however, lead to decisions of fenestrations and building envelope design. With daylighting design playing a lead role in SD&HPGBD initiatives, larger amounts of protected glazing may directly affect design decisions regarding fenestration pattern and extent of glazing. Balance between the extent of daylight glazing and energy consumption should be explored early in the design process.

5.3.1.3 Symmetry and Hierarchy of Elevations

Building symmetry often is used as an expression of importance. Hierarchy of elevations is also used to establish order and supports the image of importance. At Beale AFB, most newer facilities respond directly to their function. Examples include the dormitories and mission support facilities. Older facilities have been adapted over time to house new activities, and upgrades often do their best to accommodate these new functions. Symmetry has not been used extensively at Beale AFB to differentiate facilities within a hierarchy. However, the Lt. Gen. Winston D. Powers Building (Communications Facility) uses symmetry to establish itself as a key facility within the Main Base District. With its entrance orientation facing the intersection, and each front facade oriented to B Street and 24th Street, the Communications Facility takes advantage of its site frontage. New facilities and reuse of existing buildings should address importance of the building in the context of the District.

Within the design of the individual building, a hierarchy of importance for building elements should be established. For example, a main entrance will be more significant than a less-used secondary entrance, and should be reflected and expressed in the development of the elements and associated facades. Facilities at Beale AFB tend to emphasize the main frontage facade and limit enhancement of other facades. Most entrances located on

Symmetry

Shade Sails

Courtyard

secondary facades are underdeveloped, often just a door into the facility. Enhancement of these entrances and facades, along with the entry sequence, should be explored for new development. Creation of meaningful exterior spaces is a design opportunity that can make a significant difference in the quality of life experience on base. Future designs should explore additional articulation of secondary facades.

5.3.1.4 Building Open Spaces

Building open space design includes composing multiple building sites with buildings focused on courtyards, promenades, walkway systems and specific gathering places. By providing these site amenities, the building populations will be less likely to use their vehicles to move from building to building for meetings.

Individual outdoor spaces may be created adjacent to the building served, and also link these spaces together with pedestrian walkways. These exterior areas should receive highlighted landscape treatment, to create the sense of enclosure. Outdoor spaces should be inviting and provide interest to the experience of the pedestrian pathway system, and should also be enjoyed by populations of multiple buildings. Through the development of these protected outdoor spaces, the base residents will be able to enjoy the outdoors for longer seasons, and feel part of the community. Landscape treatment located at these outdoor spaces focuses attention on specific areas creating oasis rather than a blanket approach that develops all areas up to a minimal level of improvement. Protection from climatic elements such as sun and wind help to create successful, enjoyable, and meaningful outdoor open spaces. Provide sun shading, such as fabric shading canopies, and wind breaks for all outdoor passive recreation/gathering spaces.

Main Base District

Outdoor spaces should be developed in conjunction with new building development and redevelopment of existing buildings. Construction of new buildings should integrate site with building and exterior spaces with interior spaces.

Flightline Landscaping

5.3.2 Architectural Elements

5.3.2.1 Fenestration

Fenestration of a building establishes a building's rhythm, level of formality, symbolic nature, and greatly affects one's overall experience of the facility.

Facade rhythm in fenestration is the notion of how windows either repeat at regular or non-regular intervals. Openings that are placed regularly at specific intervals portray a more formal facade.

Fenestration

Fenestration, when viewed in light of technology, will be driven largely by the amount and quality of light in the building. Light shelves and open space adjacent to a building's perimeter will influence the amount of light that is allowed deep into a building. With these methods, less energy is required for artificial lighting.

The provision of daylighting within a building significantly reduces energy consumption through the reduction of lighting requirements. Daylighting's effectiveness is based on how far into the building light can travel. This is dependent upon the placement of walls or partitions. By locating offices and other built-out spaces near the core interior of the building, daylight can penetrate well into the spaces and thereby reduce the need for extensive lighting. The spaces enjoy views of the exterior and provide a much more pleasant workspace. The provision of daylight and views can also contribute to overall employee productivity.

Daylighting provided in a building's lobby can have a significant impact on how a building is perceived. Larger areas of storefront combined with clerestory windows and volume space create an open and expansive impression. The Communications Center is one of Beale AFB's recent buildings that captures this opportunity. Building entrances must always reflect AT/FP and Americans with Disabilities Act (ADA) accessibility requirements.

Communication Facility Lobby Interior

In addition to vision glazing in the form of windows, clerestory windows also provide light deep into the building. Clerestory windows are favorable to skylights due to better water protection.

- Use of daylighting techniques such as reflected light from light table and skylight elements should be explored early within the design process.

Existing facilities at Beale AFB use windows with thermal pane glass and aluminum frames manufactured with thermal breaks.

Windows at Beale AFB are desired to be operable when possible. Operable windows enhance indoor air quality and provide a degree of thermal control by building residents. Shading of the windows is critical to reduce cooling loads. Deep window recesses along with exterior shade devices are ways to control heat gain. North facing glazing also provides a high quality of light to enter into the building. Glazing is predominantly tinted solar brown.

- Fenestration and window construction should be considered early in the design process.

5.3.2.2 Roof Features and Form

Roof systems for new facilities at Beale AFB should provide adequate protection from the elements. Long term maintenance should always be a major consideration in their design. At Beale AFB, the predominant existing roof system is standing seam metal roof. This system has long lasting application; however, with the high winds at Beale AFB, water penetration can become an issue.

Another factor in the selection of a roof system is the extent of the structure protected. Very large structures require significant areas to be under cover. Hangars, warehouse buildings and other large structures benefit from the use of a roof system that has minimal maintenance requirements and allows for low slope roofing applications.

Other buildings, smaller in area and more complex in form, allow greater flexibility in roof system selection. The roof configuration and system selection should be based on the specific geometry of a building's floor plan. Overly complex roof forms should be avoided due to potential leaking problems. Design of complex roof configurations should explore the use of single-ply membrane systems, with high reflective values. Light colored membrane roofing systems along with other cool roof elements work successfully in the Sacramento Valley region and should be explored early in the design process. Design of roof systems should be initiated in concert with SD&HPGBD principles.

At Beale AFB, existing buildings generally have a sloped metal standing seam or batten seam roof in a hip roof configuration. The selection of a roof system for new construction should always take into account SD&HPGBD principles including light color, high reflectivity roof applications. Aesthetic considerations should be taken into account in the roof color selection, as trim colors should match or complement the roof color.

Roof configuration should always include overhead protection at building entrances, both primary entrances and secondary means of egress. Entrance canopies not only protect inhabitants from climatic conditions but also provide visual interest highlighting the entry sequence. Roof configuration should include finished soffits and bird netting at appropriate locations, especially for Flightline facilities.

5.3.2.3 Other Building Features

Walls, roof, and doors/windows greatly define the character of a facility but other elements, smaller in scale and often more refined in detail, also play an important role. Entrance canopies, exterior site construction, such as utility screens, and adjacent exterior spaces, courtyards, patios, etc. all help to establish both the visual image of the facility and also the desire to work or reside in a building. Entrances are high pedestrian movement areas that all inhabitants pass by and through. These types of building elements often tie a building design together and should be designed as highlight or

focus areas. Wall finishes, glazing and storefront, and miscellaneous metal fabrications should draw upon the same palette of materials and methods of construction as the larger facility.

Other building elements include specific design elements that provide a specific service to the building. An example of this type of element is the solar shading device for glazing. These shading

Exterior Solar Shading Device

devices reduce internal heat gain, while providing architectural interest to the exterior facades. There is potential to use this element in new construction. It would allow use of large glazing areas while stopping solar heat gain. This could become a recognizable design element strongly asssociated with Beale AFB's visual character.

Building features include technological responses to climatic need such as solar shading at windows and other elements that can be used to express the sustainable nature of new facilities. Exploration of sustainable building and site elements should be incorporated into the design process for new and reuse building development.

5.3.2.4 Materials

One of the most significant tenets of sustainable design is the use of local sustainable materials. Local materials require less energy to transport and also reflect the unique nature of the location of the base and local design and building customs. Building materials should reflect value in the life cycle of a building in addition to a reduced cost of operations and maintenance.

In addition, the use of local materials helps to establish the character and the visual image. Using a palate of similar or compatible materials and methods of construction will also unify the base in appearance. Care should be given to creating a compatible image rather than an exact replication of building forms. Using compatible materials and methods is an approach that allows new development projects to respond to individual building needs while still creating a unified image of the base.

At Beale AFB, the predominant existing material palette includes the following:

- Roofs, Fascia and Gutters Color: Dark Brown
- Wall Color: Beige
- CMU Color: Tan to Beige
- Windows and Storefront Color: Dark Bronze Anodized

Typical Color Palette

The predominant materials include integrally colored CMU and stucco. Metal panels are also used for large scale Flightline facilities and also facilities in the Open Space and Main Base Districts. CMU construction uses split face CMU and is often also used as a base course for metal buildings. The color of the CMU construction is generally a light to medium tan color, with some variation occurring through the use of split face and smooth or honed finishes. The CMU ties the different project types together through the use of similar or compatible materials.

Stucco is also used, and is found on the majority of the older buildings that have been wrapped with additions and building envelope upgrades. The stucco ranges from lighter beige to tan in color. Metal building elements and components

are uniform in their appearance. Metal cap trim, downspouts and other miscellaneous metals are dark brown and match metal roof installations. Storefronts and windows also match the dark bronze color.

Metal Roof and Stucco

Metal buildings use a pre-finished tan color metal panel system with low sloping metal roofs. Detail and accents for the metal buildings usually include a base course of split faced CMU. Exterior hardware typically is stainless steel.

- New facilities development should explore the use of materials for new applications, while being compatible and supporting the overall unified, harmonious image of the base.
- New development should establish a consistency of materials on Beale AFB.

Metal Siding

CMU Construction

5.3.3 Additional Architectural Direction

The Appendices provide additional architectural direction that is preferred by the base.

Chapter 6 provides a List of Acronyms.

Appendix A includes the Installation Functional/ Technical Constraints and Considerations, which provides installation-centric background information and identification of functional-technical considerations necessary for a fully successful design.

Appendix B provides the current Installation Exterior Plants Checklist.

Appendix C presents the 1985 Soil Survey prepared by the Soil Conservation Service.

Appendix D presents the 1997 Seismic Evaluation prepared by Winzler & Kelly Consulting Engineers.

Appendix E includes installation policy and waiver letters.

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6 List of Acronyms

ACC	Air Combat Command
ADP	Area Development Plan
A-E	Architect-Engineer
AF	Air Force
AFB	Air Force Base
AFRC	Air Force Reserve Command
APZ	Accident Potential Zone
ARW	Air Refueling Wing
AT/FP	Anti-Terrorism/Force Protection
A7PS	Installations and Mission Support Directorate, Sustainable Installations Branch
BMP	Best Management Practices
BX	Base Exchange
CES	Civil Engineering Squadron
CMU	Concrete Masonry Unit
D2 Board	Development and Design Review Board
dB	Decibels (acoustic)
D-B	Design-Build
D-B-B	Design-Bid-Build
DoD	Department of Defense
EA	Environmental Assessment
EIFS	Exterior Insulation and Finishing System
EISA	Energy Independence and Security Act
EGS	Ecological Goods and Services
eGP	Electronic General Plan
EO	Executive Order
EPA	Environmental Protection Agency
ERP	Environmental Restoration Program
FAMCAMP	Family Camp
F	Fahrenheit
FTE	Full-Time Equivalent
FYDP	Future Years Defense Program
HAZMAT	Hazardous Materials
HQ	Headquarters
ID2	Installation Development and Design
ICRMP	Integrated Cultural Resources Management Plan
INRMP	Integrated Natural Resources Management Plan
ISR	Intelligence, Surveillance, and Reconnaissance
LEED	Leadership in Energy and Environmental Design
LID	Low Impact Development
MFH	Military Family Housing
MILCON	Military Construction
MMRP	Military Munitions Response Program
NLR	Noise Level Reduction
PAVE/PAWS	Precision Acquisition of Vehicle Entry-Phased Array Warning System
POV	Privately Owned Vehicle
PV	Photovoltaic
RCRA	Resource Conservation and Recovery Act
RFP	Request for Proposal
RP	Real Property
SAC	Strategic Air Command
SAMP	Special Area Management Plan
SD&HPGBD	Sustainable Development and High Performance Green Building Design

SF	Square Feet
SWPPP	Storm Water Pollution Prevention Program
USGBC	United States Green Building Council
UV	Ultraviolet
9RW	9th Reconnaissance Wing

A Installation Functional/ Technical Constraints and Considerations

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, furnishings, systems, practices, approaches, and finishes historically used and having proven success over time. It is not intended to serve as a comprehensive list of all applicable building codes, regulations, directives, or 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.

Brand Name References

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

A.1 Site Design

A.1.1 Sites on Flightline

- Coordinate with the Airfield Manager and the Civil Engineer Community Planner at the earliest planning stages.
- There are specific distances from runways, taxiways, and aircraft parking areas that must be adhered to when siting any item near the flightline. There are also specific height criteria, obstruction lighting, and aviation paint schemes which must be adhered to for items or structures sited on the flightline. Notification of the Federal Aviation Administration may be required for construction or projects on or near the flightline.

A.1.2 Circulation Systems

A.1.2.1 Primary Walks

- Primary walks: minimum width of 6-feet with standard broom finish.

A.1.2.2 Secondary Walks

- Secondary walks: minimum width of 5-feet with standard broom finish.

A.1.2.3 Tertiary Walks or Recreational Paths

- Tertiary walks: minimum width of 4-feet.

A.1.2.4 Emergency Vehicle Access

- Site buildings: minimum of 50-feet laterally from the closest adjacent building.
- Obtain width, weight, and turning radii of emergency vehicles with Base Fire Department and Safety Office.

A.1.3 Vehicle Parking

A.1.3.1 Design and Dimensions

- Typical parking stall size: 9-feet by 18-feet.
- Perpendicular parking is preferred.
- 90^{o} spaces and two-way traffic aisles typical.
- Loading dock parking: minimum of 10-feet by 35-feet.
- One-way drives with no parking: minimum 12-foot lane.
- Two-way drives with no parking: minimum 24-foot lane.
- Recommended pavement slope: between 1% to 5%.
- Walks adjacent to parking areas with overhanging car bumpers a minimum 6-feet wide.
- Locate parking lots to maximize shared parking with other related facilities.
- Parking lot layouts that promote cross-traffic between parallel streets should be avoided.
- On street, head-in parking is prohibited.

A.1.3.2 Privately Owned Vehicle (POV) Parking

- Headquarters and administrative facilities: 50% of assigned personnel with daily space need.
- Maintenance Shops/Hangars: 38% of the largest shift.

A.1.4 Exterior Lighting

- Streets and parking lots: rectangular cutoff (shoebox-type) fixtures mounted on tapered metal poles.
- Low-level path lighting: use bollard-type fixtures.

A.1.5 Site Furnishings

A.1.5.1 Fences, Screens and Walls

- Provide concrete paving 20 feet out in front of dumpster enclosures.
- Screen mechanical equipment.
- Minimum height of walls: 6-inches above dumpster height. Provide a concrete slab and 6-inch diameter concrete-filled pipe bollards to prevent damage to walls.

Polyethylene privacy fence with steel substrates

- Use panel privacy fences to screen storage areas. The Installation standard fence is Peak Fence System made of 100% high density polyethylene with steel substrates.
- Use of chain-link fencing is limited to high-security functions. Privacy slats may be used in chain-link fencing if approved. Consider using low-level shrubs to soften the appearance of chain-link fences.

A.1.5.2 Bus Shelters

- 5-foot minimum setback from the road edge, sidewalk access, and a paved floor sloped toward the street with handicap curb cut to the street.

A.1.5.3 Seating

- Provide 12-inches of seating for every 225 square feet of plaza space, with a minimum 4-foot length bench seat. Benches may be powder coated steel or aluminum. Seating minimum depth is 12-inches minimum.
- Picnic furniture may be powder-coated, PVC coated steel, or pre-cast concrete.

A.1.5.4 Trash Receptacles

- Trash receptacles: powder-coated steel, aluminum or pre-cast concrete and should match benches and other site amenities at the same location.

A.1.5.5 Planters

- Moveable planters shall not be used except as decorative features incorporated into the design of building entrances or for force protection at building entries. Planters may be used in parks and other areas with prior approval.
- Permanently set oversized planters constructed of cast concrete are preferable to force protection bollards.

A.2 Landscape Architecture

A.2.1 Landscape Development Zones

- Landscape development zones help in defining areas of differing visual significance and importance, as well as patterns of vehicular and pedestrian circulation. In the conceptual phase consider the following:
  - The primary zone is an area that is highly significant to the perceived visual quality and image of an installation, such as main

gates, static displays, community centers, and main roadways. In the primary zone, plant density relative to water use and maintenance requirements may be higher than in the rest of the project site. Only primary roadways in the "Improved" areas of the base would be in the primary zone.

Planting in Primary Zone at the Community Activity Center

Planting in Secondary Zone at the Flightline

Planting in Tertiary Zone at PAVE PAWS parking area

- Secondary zones or transition areas include most of the remaining areas of the installation. These areas mark the conversion from the more lush, green nature of the primary zones to the more natural tertiary zones. They serve as transitions between the highly developed or visually prominent spaces and the industrial facilities. Maintenance and water usage shall be minimal but slightly higher than for the tertiary zone.

- Tertiary zones are those areas requiring little to no long-term landscape development, such as security areas, less public spaces along perimeter fencing, storage yards, tanks farms, and undeveloped land outside of the main base area. The tertiary zones are limited to those parts of the site where very little "people use" is expected. These areas include the outer zones of parking lots, low-visibility areas, and the fringes of a project. In the tertiary zone, plants shall be chosen for their hardiness and low-water usage characteristics, and the ground plane is either left natural or is covered with inert groundcover; very little or no maintenance shall be required.

A.2.2 Screen Plantings

A.2.2.1 Evergreen Trees

- For every 115-feet of area to be screened place a minimum of 8 evergreen trees planted in a staggered row and arranged to visually block the area.

- Evergreen trees should typically be placed between 12-20 feet on center. Spacing depends on the mature size of the tree species selected.

A.2.2.2 Deciduous Trees

- For every 100 feet of area to be screened plant, minimum of 3 deciduous trees for accent and visual interest.

- Spacing is dependent upon on the tree species and varies between 15-35 feet on center.

A.2.3 Lawns and Grasses

A.2.3.1 Grass Species for Irrigated Lawn Areas

- 95% Dwarf Fescue made of three cultivars plus 5% of Bronco, Nugget, or Monopoly Dwarf Kentucky Bluegrass at the rate of 10-lb/1,000 sq ft.

A.2.3.2 Turf

- Limit use of turf.
- Use turf primarily at recreation areas, courtyards, within the 33-foot unobstructed view AT/FP Zone, or other places where it provides the greatest benefit to personnel. Maximum slope for lawn areas is 1:5 (20%).

A.2.3.3 Grass Species for Non-Irrigated Areas

- A composite mix of the following species applied at the rate of 40-lbs per acre: Cucamonga brome, 20-lbs per acre; Vulpia microstachys, 6-lbs per acre; Miniature lupine, 6-lbs per acre; Tomcat clover, 5-lbs per acre; Goldfields, 3-lbs per acre.

A.2.4 Parking Lots

A.2.4.1 Materials

- For parking lots: 2-inch thick asphalt concrete on 6-inch class 2 aggregate base.
- All new roads use thermal plastic striping.

A.2.5 Irrigation Systems

In accordance with ACC policy, all uses of potable water irrigation should be eliminated, unless required to establish plantings. Requires approval from HQ ACC; when approved, use:

- Reduced pressure-type backflow preventers. Backflow preventers are required to be state tested and certified. Provide a lockable, commercially manufactured, insulated, vinyl protective blanket for all backflow preventers. Ensure device is installed with adequate clearance for testing and maintenance.
- Backflow devices shall be tested and certified by a California State approved Backflow Tester [i.e. American Water Works Association (AWWA) or University of Southern California (USC)], at the time of installation and a copy of the test must also be given to the Base Backflow Program Manager (9 CES Utility Section).
- Automatic controllers are to have the following features: solid state or hybrids with dial programming, have non-volatile memory and battery back-up, primary and secondary surge protection, four independent programs and cycle looping, self-diagnostic circuit breaker, master valve circuit, and programmable rain delay. Controllers in outdoor applications are to have weather resistant, lockable steel cabinets, and internal transformer.
- Xeriscaped areas, small planters, and planters adjacent to buildings shall use trickle bubblers or stream bubblers. Medium to large size lawns will use gear driven rotors or low-flow rate multi-stream rotators. Use low angle nozzles in high winds areas. Irrigate shrub and groundcover planters with moderate water requirements with plastic pop-up spray heads, small radius, gear-driven rotors, low flow rate rotary nozzles or bubblers. Provide a minimum of one quick coupler valve per zone. Irrigation heads must be installed a minimum of 2-feet from the exterior wall of structures to eliminate overspray.
- Drip irrigation is used only for temporary irrigation systems, such as to establish native plants that will eventually live without supplemental watering.
- Irrigation piping for pressurized mains over 2-inches in diameter is to be class 315 PVC. Main lines 2-inches and smaller in size and all lateral lines are to be Schedule 40 PVC pipe.
- All piping will have #18 gauge wire colored green for tracer wire installed in trench along side of piping. Wire will run from each head back to respective control and all control valves will run back to backflow device. Ends of tracer wires must be accessible to user at backflow and in control boxes.
- Temporary irrigation is required for existing landscaping when construction activities will interrupt or damage an existing irrigation system.

A.2.6 Exterior Landscape

A.2.6.1 Inert Materials

- In the Main Base District, use washed crushed rock in 2-inch to 3-inch size, smooth river rock in 3-inch to 12-inch sizes or 3/4 inch minus decomposed granite. Rock mulch in the Flightline District to be 3-inch to 12-inch size river rock to avoid FOD (Foreign Object Damage). Coordinate material with building colors. Use of boulders should be limited to accents and to help provide force protection. Boulders should be placed in groups and partially buried to give a balanced and natural appearance.
- Large expanses of rock ground cover should be avoided with no more than 35% of total landscaped areas. Exceptions to 35% limit may be appropriate on sites adjacent to the Flightline.

A.2.6.2 Landscape Fabric Weed Barrier

- Heavy weight, woven, brushed polypropylene, UV stabilized fabric, with a high water flow rate. Landscape fabric is recommended under all rock mulch. Fabric may be used for weed control under organic bark mulch if the slopes are relatively flat and neither flooding nor wind pose erosion problems.
- Do not use fabric under bark mulch near the Flightline, where FOD is a prime concern, or on berms and banks, where washout and slippage will occur.

A.2.7 Plant Species Selection

- Cactus and palm trees are prohibited. Except for lawn areas, select plants that are low-water users and well adapted to the Mediterranean climate and clay soils.
- Refer to current Installation Exterior Plant Checklist for plant selection recommendations (Appendix B).

A.3 Architectural Design

A.3.1 Colors

Typical architectural design colors as follows:

A.3.1.1 Roofs, Fascia and Gutters Color

- Dark Brown, suggest FS 595b #30108 or similar. All roof-mounted items shall be factory finished to match roof color, except plumbing vents which may be field painted to match roof color.

A.3.1.2 Wall Color

- Beige, suggest FS 595b #33578 or similar. Wall louvers, downspouts, and miscellaneous trim should match roof color or adjacent wall color.

A.3.1.3 CMU Color

- To be submitted to Base Architect for approval. Suggested color range: Tan to Beige.

A.3.1.4 Windows and Storefront Color

- Suggested color is to be dark bronze anodized.

A.3.1.5 Steel Doors and Frames

- Field paint to match adjacent wall or roof color or color of aluminum storefront/windows.

A.3.1.6 Exterior and Interior Hardware

- Stainless steel or brass with matching removable cylinders.

A.3.1.7 Colors of Miscellaneous Exterior Elements

- Match railings to building primary trim color.
- Match secondary doors and door frames to primary wall or roof color.
- Factory finish ventilation louvers to match primary wall or door color.
- Post Indicator Valves (PIVs) and bollards should be painted the same color as the fire hydrants.
- Exposed mechanical appurtenances that cannot otherwise be hidden should be the same color as surrounding surfaces.
- Graphics and stripes in paint schemes shall not be used.

A.3.2 Fascias and Soffits

- Gutters may be exposed or integrated into the fascia design.
- Downspouts may be exposed or concealed within exterior walls. Exposed downspouts should be factory-finished to match adjacent wall color.
- Concrete splash blocks should be used where downspouts or rain leaders spill onto grade. Exercise care in locating downspout termination points. Periods of heavy winter rain can cause erosion or flood walkways adjacent to downspout outlets.
- Soffit material should be factory-finished metal or Portland cement plaster (stucco). Color of soffits may be off-white or match adjacent wall color. Alternate soffit materials and colors may be used with prior approval.
- Soffit design shall incorporate ventilation for roof/attic spaces. Soffit vents should be used in conjunction with higher roof vents or louvers.
- When designing new buildings (especially in the Flightline District) design to discourage swallows from nesting on buildings. Avoid 90° angles between soffits and walls. Use slick material if 90° corners are unavoidable. Make horizontal overhangs short enough to prevent sheltering the nests.
- Exterior louvers shall be storm-proof and able to withstand 60 mph winddriven rain without infiltration.

A.3.3 Support Spaces

A.3.3.1 Mechanical Rooms

- Include Mechanical rooms within building; screen exterior mechanical equipment, such as exterior ducts, from view. Doors shall be large enough for equipment removal. Doors shall open from the exterior for maintenance. Provide minimum space of 42-inches around all mechanical equipment for maintenance. If double doors are not possible provide knockout removable walls to allow removal and replacement of large equipment such as boilers.

A.3.4 Door Hardware

- All locks must be compatible with existing key-removable 7-pin style interchangeable core base Master keying system.
- Use heavy duty doors and hardware in high traffic areas (i.e. additional hinges, heavier gauge materials, door closers. etc.).
- Standardize hardware throughout entire facility.

A.3.5 Signage

A.3.5.1 General Guidelines

- Brass lettering shall not be used.
- Exterior signage shall have a standard brown background.
- Banners or advertisements on exterior walls is prohibited.
- Location and content of all exterior signs subject to approval of the Base Civil Engineer. The number of signs will be held to a minimum.

Exterior signage has standard brown background

A.4 Interior Design

A.4.1 Finish Materials

A.4.1.1 Floors

A.4.1.1.1 Sheet Vinyl

- Minimum of 1/16-inch (3.2 gauge in high traffic areas) and monolithic in color and pattern to full depth of wear level.
- Avoid “white” as a predominant color.
- “No wax” finishes should be limited to light traffic wear areas only.
- Use an integral cove base with sheet vinyl flooring in areas where sterilization is a concern. Examples of these types of areas include clean rooms, laboratories, childcare centers, and medical rooms.

A.4.1.1.2 Solid Vinyl Or Vinyl Composition Tile (VCT)

- Tile should be 12-inch by 12-inch, 1/8-inch gauge and be monolithic in color and pattern to full thickness of tile. When applicable, larger tile patterns can be used with prior approval.

A.4.1.1.3 Ceramic Floor Tiles

- Minimum breaking strength of 300 lbs and scratch hardness of 8.0.

A.4.1.1.4 Carpet

- Carpet should be limited to offices/conference rooms unless functional requirements dictate otherwise. Avoid light colors, bold geometric, patterns, and subdued tweeds.
- Use of solid-colored carpet is approved only for Distinguished Visitors quarters in lodging facilities. Carpet borders may be solid in color.
- The standard carpet is: Bigelow Commercial carpet - Mad Broadloom.
  - Construction: Textured multi-colored level loop
  - Face Yarn : 100% solution-dyed or yarn-dyed nylon.
  - Pile Weight: 32 oz/sq. yd.
  - Minimum Density: 7,000.
  - Gauge: 1/10
  - Stitches per inch: 11/inch
  - Backing: 100% synthetic, polypropylene. No jute or natural fibers.
  - Face Weight: The minimum face weights listed in ETL 94-3 apply unless the selected carpet has passed the Appearance Retention Rating (ARR) test at the required level for the type of facility. In this case, the minimum carpet face weight may be automatically waived.
  - Fire Resistance Requirements: Conform to the Federal Flammability Standard DOC FF1-70 (Pill Test) and ASTM E648.
  - Sustainability: green-label certified.
  - Carpet Base: 4-inch or 6-inch high carpet base may be used.

A.4.2 Walls

A.4.2.1 Wall Coverings

- Wall covering used in Commander Suites, conference rooms and special areas as called for.
- Vinyl wall covering and paneling must have a Class A fire rating.
- Whenever possible, terminate wall covering at an inside corner. Where not feasible, provide edging to protect exposed edge.
- Fabric-backed and paper-backed vinyl wall covering are preferred for maintenance and cleanability; fabric backed are generally the most durable. Carpet applied to a wall surface is prohibited.
- Wall coverings add visual interest, hide soil, enhance design characteristics, and coordinate an overall color scheme. Select covering (vinyl, fabric, or acoustical) for specific situations (as outlined above) depending on the functional and durability requirements.
- Prefer wall covering with a business-like or “contract” appearance. Residential or floral patterns is prohibited.

A.4.2.2 Wall Panels

- Acoustical wall panels are an excellent choice for conference rooms, areas which require speech privacy, or areas adjacent to noise from outside (especially in the Flightline Area).
- Do not use gypsum wallboard pre-finished with wallpaper or vinyl wall coverings.
- All wall panels must have a Class A Fire Rating.

A.4.2.3 Acoustic Ceiling Tiles

- 24-inch by 24-inch size tile is preferred.
- Suspension systems may be exposed or semi-exposed. Do not use concealed suspension systems.
- Upgrading ceiling tiles with stepped edges may be used only in executive/command or special areas.
- Do not use acoustical ceiling tiles on walls for sound absorption.
- Black tile may be used only in projection rooms.
- A medium to light texture or fissured tile is preferred.
- Use minimum .65 NRC and .80 light reflectance.
- In high moisture areas such as dining facilities, tile shall be .60 NRC minimum and .80 light reflectancy minimum and meet standard sag resistance.

A.4.2.4 Window Coverings

- Use window coverings that enhance the overall design scheme and meet the functional requirements.
- Fabric blinds shall be avoided.
- Vertical blinds may be used only in executive/command areas. Horizontal blinds should be used in other facilities and may not be necessary where rouladins are specified. Control cords and turning wands should be placed on the same side for ease of handling. Use blackout blinds, draperies, or rouladins for all sleeping rooms.
- Draperies should be used only in executive/command areas, clubs, and billeting rooms or quarters.
- 100% Trivera intrinsic FR Polyester fabrics shall be used to meet fire code requirements. Drapery hardware must be heavy-duty commercial grade. All draperies (except where sheer draperies are used over other draperies) should be lined with neutral colored fabric and have bottom weights at each side and at vertical seams. The lining fabrics should be the same throughout. Draperies for executive/command area, billeting rooms, and general quarters may be triple pinch pleated with 2.5 fullness.

A.4.3 Paints and Coatings

- Paint system Sherwin-Williams “Duration” system (Everclean) or equal.
- Use matte or satin enamel on all walls. Use eggshell finish on the walls of low traffic areas. Use an “orange peel” finish on walls in high traffic areas.”
- Epoxy semi-gloss paint should be used in high use areas such as kitchens, toilets, laundry, medical rooms, lockers rooms, gyms, and eating areas.
- Avoid stark whites.
- Use satin or semi-gloss latex enamel paint on all doors, trim and window frames.
- Painted stencil wall designs are prohibited.

A.4.3.1 Colors

Color selections require prior approval.

Color Sections:

Generally used colors are:

- Ceilings: Sherwin Williams (SW) 7006 Extra White
- Walls:
  - SW 7004 Snowbound
  - SW 6026 Navajo White
  - SW 7070 Site White
  - SW 6518 Ski Slope
  - SW 1193 Silver Lagoon

- Trims and interior doors:
  - SW 6113 Interactive Cream
  - SW 0055 Light French Grey
  - SW 6255 Morning Fog
  - SW 6192 Coastal Plain
- Primer shall be used as recommended by the paint manufacturer.
- Interior paint for concrete floors: Armor Seal 000 HS, B67Q2000. Apply two coats: first coat diluted 50%; second coat full strength. Timeline: 30 days minimum curing prior to applying first coat over fresh concrete; 60 days preferred. Make sure all moisture is gone from the concrete.
- Vary intensity of colors to provide visual relief from the monotony of neutral colors.
- Use small amount of intense colors in accessories and artwork for visual stimulation. All prints and posters must be framed and professionally mounted.
- Quarters should be neutral so occupants may add their preferred accent colors.
- Consider lighting when selecting colors. Actual color rendition will depend upon the lamps specified. Rooms may have a different ambiance at night; quarters, MWR facilities, and other facilities used at night should be designed with consideration for morning and evening occupancy.
- Painting of murals on walls is not allowed. Use painted murals on canvas with frame to allow for easy removal. Paint murals on canvas with frames or have mural reproduced on 1/8-inch thick acrylic surface to allow for easy installation and removal.

A.4.3.2 Interior Signage

A.4.3.2.1 Interior Identification Signs

- Permanent room number signs: 1-inch high numbers raised 1/32-inch and Grade 2 Braille to comply with ADA requirements.
- Identification of signs for permanent public spaces, such as restrooms and stairs shall have one-inch high uppercase letters raised 1/32-inch and Grade 2 Braille to comply with ADA requirements. The international symbol of accessibility shall appear on signs that identify accessible facilities.

A.4.3.2.2 Directional Signs

- Signs used to direct visitors to important areas may be ceiling hung or wall mounted. Wall mounted signs shall have oak or satin frames and inserts to match room number signs, and shall be mounted with centerline 60-inches above the floor. Ceiling-hung signs shall have 3-inch minimum height lettering. Text and arrows pointing up or left shall be left justified. Text and arrows pointing right shall be right justified. Direction signs should usually indicate room numbers, except for high priority destinations such as “Finance” or “Pass Office.”

A.5 Fire Protection

A.5.1 Water Supply System Design and Construction

- Obtain verification methodology from the 9 CES/CEPM in order to calculate the rated flow for each facility. Verify the capability of the existing water supply system and study the possible solutions necessary to meet the required water flow.
- Conduct water flow tests before designing any fire protection system and coordinate planned water pressure and quantity with project designs and specifications.
- The Installation standard is Ames Backflow Assemblies Colt Series 200 and 300 for all vertical installation applications on Fire Systems. In high flow vertical applications, Ames Maxim Series 200 and 300 on fire Systems. Pay special attention to UPC 603.4.18.2. This will combine the clapper valve and backflow and centralize location.
- Provide a dedicated Fire Water line into facility from water main, separate from the potable water/HVAC water entrance when possible. If separate lines are not possible install a Post Indicator Valve (PIV) after the Potable/HVAC water connection exterior to the building.

- Provide 2-1 /2-inch exterior V-type Fire Department External Connection outside mechanical room for sprinklers only.
- Provide alternate power supply for fire pumps.

A.5.1.1 Riser Entrance

- Provide a seismic expansion anchor sleeve detail drawing for firewater entrances to all facilities. Drawing must indicate expansion sleeve, tie-rods, and thrust blocks.

A.5.1.2 Back-Flow Prevention Devices

- Back-flow devices for fire systems 4 inches and above shall be AMES 2000 to 4000 SS or approved equal.
- Locate inside mechanical room.

A.5.1.3 Post Indicator Valves

- Connections to public water systems shall be controlled by post indicator valves (PIVs) of an approved type and located not less than 30 feet from the buildings protected. Exception: If this cannot be done, the post indicator valves shall be placed where they will be readily accessible in case of fire and not liable to injury.
- Where post indicator valves cannot readily be used, as in congested areas, underground valves shall conform to these provisions and their locations and direction of turning to open shall be clearly marked.
- Provide protective bollards if the post indicator or fire hydrant is installed near a parking lot or road. Show PIV and bollard details on drawings.

A.5.1.4 Gate Valves

- Provide a gate valve (outside screw and yoke type) on the fire protection water supply side of the main sprinkler valve inside facilities with sprinklers.
- The gate valve is in addition to the post indicator valve located in the fire protection feed main outside the building. The valve stem must have an alarm switch (Potter brand or equivalent) connected to the facility fire panel to alert the base fire department in event of tampering with the faculty sprinkler water supply.

A.5.1.5 Fire Hydrants

- Hydrants should be wet barrel type, Clow model #960.

A.5.2 Sprinkler Systems

- Locate fire department connection to allow easy access to fire department vehicles.
- Locate fire inspectors' test valve as remote as possible from the riser.
- Sprinkler system shall be electrically connected to the fire reporting system for transmission of sprinkler water flow alarm. Install an exterior horn strobe that will sound only upon initiation of water flow.
- Tamper supervision will be provided for post indicator valve and double check valves.
- Tamper supervision will be provided for Open Stem and Yoke (OS&Y) valve.

A.5.3 Fire Detection and Alarm System

- All new buildings and renovation projects shall have the Notifier addressable fire panel NFS2-3030/E (or newer), Simplex 4100U addressable (or newer) or a Monaco M2 Addressable fire panel. Transceiver to communicate with D-21 fire reporting system (central) is built into the M-2 addressable panel and a BT-XM communicator (newer updated models may be used upon approval) must be installed with the Notifier. Both panels must use voice evacuation for notification to building occupants. Frequency used must be obtained from 9 CES Alarm Shop before ordering the transceiver panel from Monaco Enterprises. Newer Monaco fire panels may be used with approval from Fire Alarm Shop in Civil Engineer. Smaller systems that protect uninhabited buildings and do not require voice evacuation will use the M2 addressable fire alarm panel or other Notifier or Simplex addressable considerations. Multi-node systems must be approved by the fire alarm shop. Fire alarm panel will be located in the electrical or mechanical room or a room with direct outside access. Install smoke detector above the fire alarm panel as per NFPA code requirements. Harsh environment detector may be required. A graphic annunciation panel with silence and reset controls shall be

installed at a location to be determined by the fire department and Fire Alarm Shop. System designs and changes to design during planning and installation must also be approved by the Authority Having Jurisdiction (AHJ) and the FA Shop.

- Mount transceiver antenna on the side of the building, three feet minimum above the roof facing the base fire department receiver. Antenna may be mounted on a lower roof section of the building as long as it is three feet above the lower roof section (easier for maintenance). The entire antenna system shall be in conduit and properly grounded according to NFPA. Additional considerations on mounting locations should be directed to the AHJ.
- Provide fire alarm systems with battery back-up power. Battery will be susceptible to a 72 hr back-up with a 5 minute alarm test.
- All new installation and renovation projects require rough-in inspections by the AHJ and fire alarm shop before walls are enclosed. Wiring for fire alarm systems will be Class A or B wiring (in NFPA 72, style 4, 6 or 7 for signaling line circuits, style Y or Z for notification appliance circuits). Circuits wired for class A shall have a separate return in a separate conduit. Conduits shall be spaced at least four feet apart unless a corridor or space does not allow. Mini monitor modules are acceptable to use on pull stations. Separate power circuits supplying devices shall have an end or line power relay supervising loss of power. All circuits must be supervised. AHJ shall determine Style and exceptions before design is accepted.
- Fire Alarm System Schematics for new design shall show the entire alarm and detection system, all sensors, pull stations, and Fire Alarm Control Panel, etc. Project drawings must show panel and antenna locations and details, and electrical/ wiring details. All programming software, panel databases, and manuals must be provided to the fire alarm shop at final inspection on optical disk (CD or DVD). The programming software must be on the original manufactures disk and be a current version. Authorized distributors or companies may download all programming software and manuals and submit on CD or DVD if applicable.
- Show location of automatic fire doors, fire and/ or smoke dampers, ceiling dampers, and similar means of fire protection for air duct systems in electrical and mechanical drawings.
- Provide a schedule of signs for operation of the Fire Protection System. Provide signage for system valves, piping, and components.
- Provide a schedule of Fire Pumps, Fire Alarm Panels, Transmitters, Alarm Valves, and Fire Protection system equipment with all designs.
- Installed systems must conform to all testing requirements and bear certification stating that the system and equipment has been correctly installed and regulated, functions properly, and meets all applicable laws, norms, and local regulations. The certification shall be signed and stamped by an engineer/technical of the equipment manufacturing company. Provide the 9 CES/CEP all Certificates of Installation for all fire detection, suppression, and life safety systems prior to final acceptance.

A.5.4 Mass Notification Systems

- All new and renovated occupied facilities shall have a Mass Notification System. A Notifier voice evacuation or Simplex voice evacuation system shall be used for mass notification. A Monaco BT-XM Communicator (or newer model) must be used in conjunction with the panels for Mass Notification communication to the D21 system. Occupancy is determined by United Facilities Criteria and/or AHJ. System must be connected to fire alarm system and supervised by fire alarm system. System shall be 70.7VRMS type. Exceptions must be approved.

A.6 Civil Design

A.6.1 General Construction Considerations

- Provide detailed construction phasing and an order-of-work schedule for all major projects to reduce negative impact on nearby facilities and traffic.
- The construction season, except for site work, is nearly unlimited. A six-month rainy season from mid-October to mid-April can preclude site excavation, utility and exterior finish work. Construction in natural or sensitive unpaved areas of the base must be carefully planned and

conducted to minimize sedimentation and erosion and to minimize vegetation disturbance.

- No blasting is allowed on base without permission.
- Utility service (electric, gas, water, plumbing, cable TV, data, communication) to all new facilities (buildings) shall be underground. All underground utility lines shall be marked for easy locating and identification.

A.6.2 Roads, Parking Lots and Sidewalks

- Minimum road widths: 24-feet for two 12-foot lanes. Provide 3-foot paved shoulder and 3-foot gravel shoulder.
- Access roads and parking lots for new facilities shall have sidewalks, curbs and gutters.
- Paving of roads and parking lots: minimum 2-inch thick asphalt concrete on 6-inch thick class 2 aggregate base on compacted sub grade (90%).
- Design Loading Dock areas including truck parking and maneuvering areas for heavy truckloads. Paving minimum 8 inch reinforced concrete.
- All exterior storage to be paved and designed for forklift traffic. Paving minimum 8-inch reinforced concrete.
- With the installation of all new or replacement pavements adjacent to existing or newly planted trees, the edges of street, residential sidewalk or driveway pavements shall be protected by the installation of 24-inch deep tree root barriers to prevent damage or uplift caused by future tree growth. Such uplift can also cause water to pond against structures with resulting water intrusion and mold.

A.6.2.1 Crack Repairs

- Route cracks prior to sealing them; omission of crack cutting operation reduces equipment and labor costs but may decrease treatment longevity. Hot applied sealant requires a three to four month cure time prior to being covered with a blanket or a seal.
- Small cracks (1/4 to 314 inch) will be widened 1/8 inch wider than existing nominal or average width. This will help eliminate the potential for raveling of the pavement along the edges of the crack and will provide a sealant reservoir that has vertical faces. The depth of the routed crack should be approximately 3/4 inch. A backer rod material will be placed in cracks that have a depth greater than 3/4 inch.
- Prepare medium cracks (3/4 to 2 inches) by simply cleaning the crack using a sandblaster, HCA heat lance, or wire brushes, and then cleaning with compressed air. The crack must be inspected to ensure that it is clean and dry.
- Large cracks (greater than 2 inches) should be prepared in the same manner as potholes. A saw should be used to cut away damaged pavement to provide vertical faces. The area should then be filled instead of sealed.
- Small and medium cracks in pavements that are to be overlaid will be filled with an emulsion, a sand emulsion mixture or one of the types of sealants previously mentioned. The material should be recessed in the crack a minimum of 1/4 inch to prevent the material from “bleeding” through the overlay.

A.6.3 Earthworks

A.6.3.1 Backfill and Fill Material

- Backfill material is defined as any material removed during excavation and reused on site. Fill material is defined as any material brought to the site from an outside source. 1) Soil materials for backfill and fill shall be free of clay clods, rock, or gravel larger than 2- inches in any dimension, debris waste, frozen materials, and other deleterious matter. 2) The backfill around utility lines shall be clean and free of rocks larger than 2-inches. 3) All excess soil and construction debris shall be removed from the project site and disposed of appropriately off-base, unless the Project Manager has a use for the soil and coordinates on-base storage plans with 9 CES/CEAN. Soil stockpiled on the installation must be free of rocks, debris and roots larger than 2-inches. Soil stockpiled on the installation must be covered or otherwise stabilized to control windblown dust and storm water runoff.

A.6.4 Storm Drainage

- Use data obtained from Wheatland Weather Station located south of Beale AFB in Yuba County. The building site shall be designed such that 100-year flood plain shall be at least 1-foot below finished floor elevation. Culverts, storm drains and catch basins shall be sized to handle a 25-year storm. Follow Sacramento County regulations for storm drainage.
- All storm water drains and downspouts should run and tie into storm drainage systems and be routed away from the facility to approved locations.
- Storm drains shall not be connected to sanitary sewer systems.
- If downspout cannot be tied to storm drainage system, splash blocks can be used.

A.6.5 Monitoring Wells

- All monitoring wells shall be flush mounted. Exceptions must be approved.
- Construction and repair contractors should coordinate projects with the Environmental Flight (9 CES/CEAN) prior to commencement to determine the location of existing monitoring wells in the project area.

A.7 Structural Design

A.7.1 General Design Criteria

A.7.1.1 Geology

- Soils on the hilly eastern portion of the base are gravelly and rocky with depth to bedrock varying from 10-inches to 40-inches. Occasional rock outcrops occur. The flatter central and western areas of the base have gravelly loam and gravelly clay soils of alluvial origin. Impervious hardpan or claypan layers are common to these soils, and overcompaction from previous training operations often exists, creating constraints on construction and landscape development. Soil borings are needed for all subsurface design. For more information about soils, refer to the Soil Survey (Soil Conservation Service, 1985) (Appendix C).

A.7.1.2 Frost Depth

- The ground at Beale AFB is not subject to deep ground freezing but is subject to surface frost.

A.7.1.3 Seismic and Wind Analysis

- New construction and all major renovations to existing buildings require a seismic and wind analysis completed by a registered structural engineer. Major items that can trigger this requirement include but are not limited to:
  - Removal/alteration of shear walls
  - Removal/alteration of load-bearing elements
  - Alteration of roof systems
  - Alteration of foundation elements

• Note: A seismic evaluation of major facilities was conducted in 1997 by Winzler & Kelly Consulting Engineers (Appendix D).

A.8 Site Construction

A.8.1.1 Site Preparation, Earthwork, Tunneling, Boring and Jacking, Foundation and Load-bearing Elements, Roads and Parking Lots

- Conform to CalTrans Standards.

A.8.1.2 Soil and Foundation Conditions

- Site specific soil borings are necessary to determine soil bearing, pH, and resistivity characteristics. Boring logs for Beale AFB are available. Generally, the ground water table is low and has not been a factor for foundation design. Suitable fill material may be available on-base. Hardpan/claypan soil is common.

A.9 Mechanical Design Plumbing

A.9.1 Backflow Prevention

- Temporary service connections to fire hydrants shall have an approved backflow prevention device with isolation valves up and down stream and supported. It will also be tested and inspected by a California State Approved Backflow Tester.

- Provide backflow prevention devices on the following:
  - Facility main water lines
  - HVAC water make-up lines
  - Facility Fire Protection System water lines
  - Hose bibs
  - Chemical injectors
  - Carbonated beverage and drink dispensers
  - Lawn sprinklers and irrigation systems
- The A/E shall include in the plumbing, HVAC, and mechanical drawings all symbols, details, and requirements for backflow prevention devices on facility main water line.
- Any backflow device installed on the base potable water system must be tested and certified by a California State approved Backflow Tester, i.e., American Water Works Association (AWWA) or University of Southern California (USC).
- At the time of installation a copy of the test must also be given to the Base Backflow Program Manager (9 CES Utility Shop).
- Check valves are not acceptable (as a stand-alone device) for backflow prevention.
- All backflow devices 2.5-inches and up Ames Models 3000SS and 4000SS.
- Provide freeze protection for all outside applications. All exterior located backflow prevention devices (regardless of size) are installed with an insulated cover (tan or green in color).
- For all backflows installed in all high security outside locations, provide lockable insulated enclosures such as Hot Box or Hot Rock.
- Any addition or upgrade to a fire suppression system must also include upgrading the water supply to the fire system with an approved backflow device.
- Any portable trailer or building that requires water and/or sewer service shall have said services installed in accordance with proper building and plumbing codes. Backflows will be required on service lines.
- The contractor is responsible for service connections on rented office trailers and portable buildings.
- Reduced pressure principle backflow devices shall have ball valves (gate valves if over 4-inches) installed on the inlet and outlet of the device by the manufacturer.
- A reduced pressure principle backflow prevention device shall be located as close as practical to the user's connection and shall be installed a minimum of twelve inches (12") above grade and not more than thirty-six inches (36") above grade measured from the bottom of the device and with a minimum of twelve inches (12") side clearance.
- Any addition or upgrade to an existing fire suppression system must include upgrading the water supply to the system with an approved backflow device.
- Pressure regulating valves shall be installed when the residual pressure at fixtures exceed 50 pounds per square inch. The Pressure Reducing Station shall consist of a pressure regulator, strainer, isolating valves and pressure gauges. A reduced-size bypass with a manually operated flow control valve should be provided if necessary.

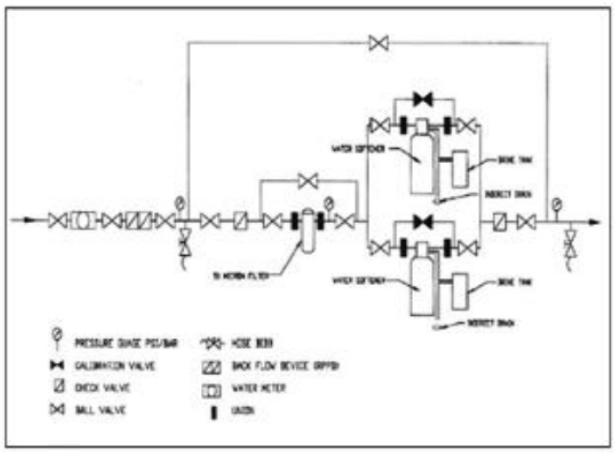
A.9.2 Holding Tanks

- The holding tank, used when systems are drained for maintenance and for glycol/water, shall have a capacity of at least 120% of the served piping. For 2.5-inch and up provide Ames 3000SS or 4000SS.
- Multiple holding tanks for sprinkler water, chilled water, etc., shall be provided as necessary depending on the facility.
- Holding tanks shall be located outside the boiler/mechanical/pump rooms.
- The Base PM shall confirm the use of chemicals, tank size, and number requirement per project with the project A/E.
- The subject system drain may connect to a drywell if there is no glycol or other toxic chemical used in the water/sprinkler system.

- Water/glycol from HVAC/Sprinkler holding tanks shall be pumped out and sent off base for treatment.

A.9.3 Water Softeners

- Beale AFB water wells supply very hard water; 7-10 grains per gallon (GPG) of calcium carbonate (CaCO3) is considered very hard water and Beale's water supply averages approximately 8-9 GPG.
- Only softened water with hardness below 1 GPG of CaC03 shall be provided to boilers, domestic water supplies, and hot water heating systems as make-up water.
- Provide water softeners for all new facilities and renovation designs. System shall be dual-tank type; Kinetico or approved equal.
- The water softener shall be an automatic duplex volumetric type, mechanical, or pneumatically controlled (not hydraulically), salt regenerated, with bacteria static type resins, provided with automatic electronic disinfection. Prior to the water softener shall be a minimum of a 50 micron, automatic flush, mechanical type filter, with synthetic or metallic media. System must not exceed 4 days between regenerations. Discharge of the water softener must not contain less than 1 GPG of hardness.
- High capacity domestic water softeners, industrial, and semi-industrial type are required for all new base dormitories, lodging facilities, large laundry facilities, industrial aircraft and vehicle wash racks (make-up water only), schools, medical treatment facilities, dining facilities, clubs, fitness centers, large kitchens, and any other facilities with high domestic hot water demands. Carefully plan for adequate floor space to install and maintain these large, high flow water-softening systems in designated mechanical rooms.
- Low capacity, commercial type domestic water softeners are required for all new and renovated base facilities not requiring industrial water softening treatment. These small water softeners serve the boiler make-up line and a few sinks and showers in smaller facilities with low domestic hot water demand. The water softener shall be sized for the larger of the 100% HVAC system make-up or the domestic hot water demand.
- Commercial water softeners will generally have a small footprint and lower cost than the industrial type high flow systems required for kitchens and dorms and can be easily located in facility boiler rooms or mechanical rooms. The water softener should be placed on the main building water feed to treat all incoming building water.
- Water softener shall be installed as per the Standard Water Softener Layout (see diagram).



Standard water softener layout

A.9.4 Cold Water Distribution

- Pipes shall be segregated and insulated to avoid temperatures above 20C (68F).
- Water piping (cold, hot, and heating) shall not be installed above electrical conduit or electrical equipment.

A.9.5 Hot Water Distribution

- Facility domestic hot water tank temperature should be maintained at 60°C (140°F) to prevent the growth of deadly bacteria. The hot water delivery temperature at the hot water mixing valve for sinks and shower heads shall not be less than 50°C (122°F). Design hot water distribution supply to be between 50° - 60°C at all times.
- Provide gas-fired water heaters or gas-fired instantaneous point of use domestic hot water heaters in lieu of electric water heaters.
- Provide anti-scald thermostatic mixing valve(s) to reduce water temperature at the source.
- Insulate all hot water pipes.

- Except where gas boiler heat is used, locate hot water tank as close as possible to end use. Small, under-counter, on-demand, water heaters are efficient for locations where large capacity is unnecessary.
- Water heaters shall not be installed above ceilings.

A.9.6 Toilets

- Delta “Innovations” Electronic Faucet model# 591-LGHGMHDF is Installation’s standard faucet. (External mixer shall be included.)
- Flush tanks for toilets and urinals shall not be installed in the interior of walls.
- Toilets and urinals shall be controlled with flush tanks or automatic Flushometer valves. Sloan Flushometer G2 Optima Plus is the Installation’s standard flushometer.
- Water taps must be of the mixer type (before exiting the faucet) with hot supply on the left and cold supply on the right.
- Backflow prevention may be incorporated into sink design where separate devices will not be needed. Exceptions may be made for janitorial sinks where usage is minimal and small hot water tanks may be used.
- Self-rimming vanity type lavatories shall be used in lieu of individual freestanding porcelain sinks where more than one is provided in a toilet area.
- Showers must be individually adjustable for temperature pressure at 2.75 gpm flow with spring time shut off and fixed spray head (adequate pressure must be ensured) and direction.
- All fixtures shall be white in color.

A.10 Gas Systems

- All gas appliances (i.e. boilers, water heaters, ovens, ranges, etc.) shall have their own isolation valve attached to their own service line.

A.11 Electrical Design

- Installation primary distribution consists of 69kV/12,470V, 3 phase, 3 wire, at 60 Hz. Primary voltage is stepped down at substations or at the facility via transformers. The secondary distribution system is a 2, 3 or 4 wire system.

A.11.1 Standby Power

Standby power requirement must be determined on a project by project basis.

- The generator set shall have a control panel mounted on the unit and an autostart and transfer system complete with manual/automatic controls. Maintenance bypasses shall be installed in a segregated section of the LV main distribution panel. The autotransfer panel shall ensure that the generator will never be able to be paralleled with the commercial supply. Generators shall be isolated to reduce ambient sound levels to below 80 decibels, A-weighted (dBA).
- The upstream and downstream circuit breakers of the autotransfer system shall be draw-out type to permit maintenance of the backup systems under insulated conditions while the commercial supply is energized.
- Autostart transfer panels shall be provided with adequate bypass for maintenance and repair and shall be equipped for 4 wire system in accordance with AF132-1063 (only ACC may waive this requirement).
- Fuel storage and day tank(s) shall be provided complete with manual and automatic fuel transfer pumps and leak detection systems. Tanks should be double-walled and provide 72 hours continuous run time for generator and fuel metering device on input and output fuel lines.
- A mobile back-up generator with external outlets will be provided for all mission essential facilities as determined by 9 CES/CEP.
- Critical facilities as determined by 9 CES/CEP shall have installed Real Property Generators. Generators shall be rated to provide a minimum of 80% critical load in accordance with AFI 32-1063.
- Double and disconnecting switches shall be installed in the facility main distribution panel. Provide a receptacle/plug to match base standard. This is due to the possibility of standby generator becoming inoperative and a replacement generator needed.

- All low voltage transformers shall have two +/- 2x5% primary volt taps for voltage adjustment. This should be under Primary/Secondary Distribution and should be low/medium voltage transformers.
- A 120V, 20A receptacle must be provided in close proximity to generator to provide power to battery charger and engine heater.
- Standby generators: ONAN/CUMMINS or equivalent.

A.11.2 Grounding

- All equipment, metallic masses, and concrete reinforcement, etc. shall be grounded in accordance with NEC requirements.
- Grounding dispersion system and main wiring connections shall be calculated in accordance with local laws.
- A single large MV and LV grounding dispersion system shall be provided for all areas of Beale AFB. All substation grounding dispersion systems shall be interconnected without the interposition of any disconnecting device to form a large, single grounding dispersion system.
- All facility grounding systems shall be connected to the grounding system of the electrical equipment supplying the facility.
- The dispersion system interconnection wires shall be installed above all MV and LV cable ducts.
- The grounding systems shall be designed to minimize the installation of circuit breakers with ground fault protection.
- Fencing gate pillars shall be connected with an equipotential connection.

A.11.3 Emergency Lighting

- Emergency lighting systems shall be equipped with IMQ/CE Ni-Cd battery pack equivalent to “Everlux” type, with automatic charger for 3 hours lighting capability. Emergency lighting systems shall be integrated into ceiling mounted lighting fixtures lAW the NEC. Wall mounted emergency lighting apparatus should not be used.
- Fixtures for “EXIT” and “FIRE EXIT” signage must provide clear indication to all means of egress. Signage shall be the continuously lit type, equipped with Ni-Cd battery pack with automatic charger with an end of charge disconnection device and testing button suitable for 3 hour lighting capability. Fixture must have pictograph cover plate.

A.11.4 Energy Monitoring Control System (EMCS)

- The base is continuing with Energy Conservation Measures (ECM) to install a Direct Digital Control (DOC) system throughout. Although all facilities are candidates, historically facilities selected are high-energy users. The DOC system as conceived is an integral part of the future base wide Energy Management and Controls System Support.
- DOC may be described as the operation of Heating, Ventilation, and Air Conditioning local loop control devices, such as valves, dampers, and actuators by a digital computer. Stored programs using inputs from real time sensors determine control actions. The system will replace the local loop pneumatic, electric, or electronic analog controllers.
- The DOC support system used at the Installation is manufactured by Siemens Building Technology, Inc. The Siemens Apogee Insight (proprietary) as the direct digital controls protocol. All software/ hardware shall conform to this system. In addition, all metering (i.e. gas/electrical) shall be compatible with this system.
- This system is a multiple LAN server based system, designed for maintenance management, trouble-shooting, and energy management. The system is comprised of a network of stand-alone units, each capable of DOC and supervisory control. The central equipment consists of a computer server that allows the base to perform manual operations, coordinate systems for energy reduction, view facility status in real time and generate run-time reports on equipment. In order to maintain coordinated system growth, consistency and lower training costs it is imperative that future DOC support systems procurements shall be the Apogee Insight manufactured by Siemens Building Technology, Inc.

A.12 Security Design

A.12.1 Limits on Contractor Work Area

- Works shall be performed only in authorized areas.
- Access to the work areas shall be authorized by 9 SFS.
- Photography on base is not allowed unless specific authorization has been approved by 9 SFS.
- Design Contractors are authorized access only to areas where proposed project is located and to the Base Civil Engineer compound.
- Design Contractors do not have free access to restricted and controlled areas.
- Design Contractors working in restricted areas may be subject to search.
- Base pass application procedure normally requires minimum of 3 business days for processing.
- Work to be performed in the vicinity of airfield pavements (runway, taxiways, aprons, etc.), as well as in restricted areas are subject to interruption due to aircraft takeoffs, landing or taxiing, and stoppage.

A.12.2 Security Fencing

- Standard security fencing: 6'-0" high.
- Where designated as "Priority A," fence shall be 7'-0" high with 20-inches long outriggers each with 3 strands of barbed wire, for a total height of 8'-4".
- All fencing shall be anchored to a concrete base.
- Reinforced chain-link fencing shall specify aircraft arresting cables (general purpose galvanized, class 2, 6 by 19) to impede vehicular attack. Reinforcing cables shall be at placed at a height of 80cm above finished grade. Cable shall be secured to the line posts (connection to be of strength equal to or greater than the shear strength of the cable).
- Fencing grounding requirements: refer to A.11.2 Grounding. Additional specific requirements may be defined on a project by project basis.

A.12.3 Intrusion Detection Systems (IDS)

- "Vindicator" is the base standard.

A.13 Sustainable Design

A.13.1 Sustainable Design Priorities

- Maximize use of solar energy for both warmth and lighting. Provide building occupants with a connection between indoor and outdoor spaces through the introduction of day lighting and views into interior spaces.
- Energy and water efficiency during operations; avoidance of toxic substances and toxic releases.
- Maximize air circulation and ventilation.
- Minimize direct and indirect environmental damage.
- Bio regionally-sensitive land use and site selection.
- Resource conservation during both the selection and construction of materials.

A.14 Communication Systems Design

A.14.1 Manholes and Duct Banks

- Conduits from the facility communications room to the nearest communications manhole: minimum 4-inch inside diameter. For all empty conduits, install mule tape. At least one 4-inch conduit will have 3 each - 3 pocket Maxcell innerduct. Runs between manholes/hand holes shall not exceed 500-feet.
- All conduits must be internal smooth-walled type and minimum Schedule 40 (approx. 14-inch) in wall thickness. Encase conduit in concrete duct bank under hard surfaces.

- Design duct bank systems to no more than 75% fill rate. A target of 50% is preferred.
- Manhole dimensions shall be at least 6-feet W by 9-feet L by 7-feet H. Hand holes shall be at least 6-feet W by 4-feet L by 3-feet H inside dimensions. All manholes shall have round covers, sump holes, belled-end conduits, and pulling-in irons on opposite wall of each duct bank.
- All manholes/hand hole covers shall be lockable with COMM Base standard key, traffic rated as required, GPS information for locations and marked with “cable locate” devices. All splice casing will be stainless steel and marked at both ends of the cable with appropriate cable information, to include all intermediate manhole/ hand holes involved in the cable tie.
- Install conduits a minimum of 36-inches deep and “metallic marker tape” 12-inches below the finished grade. Separate communications conduits from power lines/cable a minimum of 3-inches when encased in concrete and a minimum of 12-inches when separated by soil/ dirt, etc.
- Conduits will be placed on a 2-inch sand base and covered with 2-inches of sand prior to backfilling connectors.
- Design with minimum of one 4-inch conduit with at least 50-foot separation from the main duct bank from the facility communications room and stub/cap conduit 5-feet beyond the site boundary.

A.15 Master Keying

- Design for use of, and compatability with, “Best Lock Corporation” master keying system.
- Key all locks into a uniform master-keyed locking system. Refer to A.3.4 Door Hardware.
- All locks shall be ordered by contractor under “A” KEYWAY, MASTER KEY M1 , SUBMASTER 1, already selected by 9 CES/CEO/CEP.
- Orders or requests shall not be placed or issued by the contractor without the written approval of government since master-keyed locks, cores, and keys cannot be released to unauthorized personnel.

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Installation Exterior Plant Checklist

BOTANICAL NAME	COMMON NAME	CALIFORNIA NATIVE	MATURE HEIGHT (IN FEET)	MATURE WIDTH (IN FEET)	EXPOSURE (F=FULL SUN P=PART SHADE S=SHADE)	IRRIGATION REQUIREMENTS	EVERGREEN/DECIDUOUS	VISUAL AREAS: OPEN SPACE/NATURALIZED AREA	VISUAL AREAS: MAIN BASE	VISUAL AREAS: FLIGHT LINE	STREET TREE	33 FT. ATFP UNOBSTRUCTED SPACE	SCREEN	LAWN AREAS	PARKING AREAS	XERISCAPE AREAS	PLAZAS/ENTRIES/RAISED PLANTERS	WILDLIFE
TREES																		
Acer buergeranum 'Streetwise'	Streetwise Trident Maple		20-25	25	F-P	MED	D		▯	▯	▯	▯		▯	▯		▯	▯
Acer ginnala 'Flame'	Flame Amur Maple		15-20	20	F-P	MED	D		▯	▯		▯		▯			▯	▯
Acer palmatum	Japanese Maple		15-20	10-20	F-P	MED	D		▯	▯		▯					▯	
Acer palmatum 'Bloodgood'	Bloodgood Jap. Maple		15-20	10-20	F-P	MED	D		▯	▯		▯					▯	
Acer rubrum 'October Glory'	October Glory Red Maple		40-50	25-50	F-P	HIGH	D		▯	▯	▯			▯				
Acer rubrum 'Red Sunset'	Red Sunset Red Maple		40-50	25-50	F-P	HIGH	D		▯	▯	▯			▯				
Acer trunc.x plat. 'Pacific Sunset'	Pacific Sunset Maple		25-30	25	F-P	MED	D		▯	▯	▯			▯				
Acer truncatum	Shanting Maple		20-25	25	F-P	MED	D		▯	▯	▯	▯		▯	▯		▯	▯
Aesculus californica	California Buckeye	▯	15-30	20-30	F-P	LOW	D	▯									▯	▯
Arbutus 'Marina'	Marina Strawberry Tree		35	35	F-P	LOW	E		▯				▯	▯	▯	▯	▯	▯
Arbutus unedo	Strawberry Tree		8-35	8-35	F-P	LOW	E		▯				▯	▯		▯		▯
Betula Nigra 'Dura Heat'	Dura Heat River Birch		35-40	20-30	F-P	HIGH	D		▯	▯				▯		▯		
Calocedrus decurrens	Incense Cedar	▯	50-90	40-50	F-P	MED	E	▯	▯	▯			▯	▯		▯		▯
Carpinus betulus 'Fastigiata'	Pyramidal European Hornbeam		35-40	20-25	F	MED	D		▯		▯			▯	▯			
Ceanothus 'Ray Hartman'	Ray Hartman Calif. Lilac	▯	12-15	12-15	F	LOW	E	▯	▯	▯						▯		▯
Cedrus atlantica 'Glauca'	Blue Atlas Cedar		60-80	30-45	F	LOW	E	▯	▯	▯			▯		▯	▯		
Cedrus deodara	Deodar Cedar		60-80	30-45	F	LOW	E	▯	▯	▯			▯		▯	▯		
Celtis australis	European Hackberry		40	25-30	F	LOW	D		▯		▯			▯				▯
Celtis occidentalis	Common Hackberry		50-60	40-60	F-P	LOW	D		▯		▯			▯				▯
Celtis sinensis	Chinese Hackberry		40	40	F-P	LOW	D		▯		▯			▯				▯
Cercis canadensis (and cultivars)	Eastern Redbud		25-35	20-30	F-P	MED	D		▯		▯	▯		▯			▯	
Cercis reniformis 'Texas White'	Texas White Redbud		25-35	20-30	F	LOW	D		▯		▯	▯				▯	▯	
Cercis reniformis 'Oklahoma'	Oklahoma Redbud		25-35	20-30	F	LOW	D		▯		▯	▯				▯	▯	
Cercis occidentalis	Western Redbud	▯	10-18	10-18	F	LOW	D	▯	▯			▯	▯			▯		
Chionanthos retusus	Chinese Fringe Tree		20	20-25	F	MED	D		▯			▯		▯			▯	
Chitalpa tashkentensis (cultivars)	Chitalpa		20-30	20-30	F	LOW	D		▯	▯	▯			▯			▯	
Cinnamomum camphora	Camphor Tree		40-50	50-60	F	LOW	E		▯		•			▯				
Cotinus coggyria 'Royal Purple', 'Purpurea	Purple Smoke Tree		12-15	10-12	F	LOW	D		▯	▯		▯					▯	
Crataegus phaeropyrum 'Washington'	Washington Hawthorn		25	20	F	MED	D		▯		▯	▯		▯				▯
Cupressus arizonica	Arizona Cypress		20-40	10-20	F	LOW	E	▯	▯				▯			▯		▯
Cupressus sempervirens	Italian Cypress		50-60	3-6	F	LOW	E		▯		▯		▯					▯
Fraxinus oxycarpa 'Raywood'	Raywood or Flame Ash		25-40	20-25	F	MED	D		▯		▯			▯	▯			
Fraxinus americana 'Autumn Purple', 'Autumn Applause'	Autumn Applause of Autumn Purple Ash (seedless)		40-60	30-40	F	MED	D			▯	▯			▯	▯			
Ginkgo biloba ' Autumn Gold',	Autmn Gold Maiden Hair Tree		40-50	25-35	F	MED	D		▯	▯	▯			▯	▯		▯	▯
Ginkgo biloba 'Fairmont',	Fairmont Maiden Hair Tree		50-70	20-25	F	MED	D		▯	▯	▯			▯	▯		▯	▯

Installation Exterior Plant Checklist

BOTANICAL NAME	COMMON NAME	CALIFORNIA NATIVE	MATURE HEIGHT (IN FEET)	MATURE WIDTH (IN FEET)	F=FULL SUN P=PART SHADE S=SHADE / EXPOSURE	IRRIGATION REQUIREMENTS	EVERGREEN/DECIDUOUS	VISUAL AREAS: OPEN SPACE/NATURALIZED AREA	VISUAL AREAS: MAIN BASE	VISUAL AREAS: FLIGHT LINE	STREET TREE	33 FT. ATFP UNOBSTRUCTED SPACE	SCREEN	LAWN AREAS	PARKING AREAS	XERISCAPE AREAS	PLAZAS/ENTRIES/RAISED PLANTERS	WILDLIFE
TREES																		
Gleditsia triacanthos inermis 'Shademaster', 'Skyline'	Shademaster or Skyline Honey Locust		35-70	20-50	F	LOW	D		▯	▯	▯			▯	▯			
Juniperus scopulorum 'Tolleson's Blue or Green Weeping'	Tolleson's Green or Blue Weeping Juniper		25-30	25-30	F	LOW	E		▯				▯			▯	▯	▯
Koelreuteria bipinnata	Chinese Flame Tree		20-35	25-35	F	LOW	D		▯		▯			▯	▯			
Koelreuteria paniculata	Goldenrain Tree		20-35	10-40	F	LOW	D		▯		▯			▯	▯			
Lagerstroemia x fauriei 'Catawba', 'Cherokee', 'Dynamite', 'Tuskogee', 'Natachez', 'Pecos', Tuscarora', 'Tuskogee', 'Zuni'	Crape Myrtle hybirds		12-30	15-30	F	LOW	D		▯	▯	▯	▯		▯	▯	▯	▯	
Laurus nobilis 'Saratoga'	Grecian Laurel		12-40	12-40	F-P	LOW	E		▯	▯	▯		▯		▯	▯	▯	
Liquidambar Styraciflоa 'Rotundiloba'	Round-lobed Sweet Gum (seedless)		50-60	25-35	F-P	MED	D		▯	▯	▯							
Liriodendron tulipifera	Tulip Tree		60-80	40	F	HIGH	D		▯	▯	▯			▯				
Magnolia grandiflora 'Little Gem'	Little Gem Southern Magnolia		20-25	8-12	F-P	MED	E		▯				▯	▯			▯	▯
Magnolia grandiflora 'Samuel Sommers'	Samuel Sommers Southern Magnolia		30-40	25-30	F-P	MED	E		▯		▯		▯	▯				▯
Magnolia grandiflora 'St. Mary's'	St. Mary's Southern Magnolia		25-30	20	F-P	MED	E		▯		▯		▯	▯				▯
Magnolia grandiflora 'Russet'	Russet Southern Magnolia		50-60	20-30	F-P	MED	E		▯		▯		▯	▯				▯
Magnolia stellata and cultivars	Star Magnolia		10-15	15-20	F-P	HIGH	D		▯	▯							▯	▯
Malus floribunda	Japanese Flowering Crabapple		15-20	15-20	F	MED	D		▯			▯		▯				▯
Malus 'Louisa'	Louisa Weeping Crabapple		15-18	15	F	MED	D		▯			▯		▯				▯
Malus x Zumi 'Calocarpa'	Zumi Calocarpa Flowering Crabapple		20-25	20	F	MED	D		▯			▯		▯				▯
Malus 'Prairie Fire'	Prairie Fire Flowering Crabapple (fruitless)		15-20	20	F	MED	D		▯			▯		▯			▯	
Malus 'Prairie Rose'	Prairie Rose Flowering Crabapple		15-20	18	F	MED	D		▯			▯		▯				▯
Malus 'Sentinel'	Sentinel Flowering Crabapple		20-25	12	F	MED	D		▯		▯	▯		▯				▯
Malus 'Spring Snow'	Spring Snow Flowering Crabapple (fruitless)		15-25	20	F	MED	D		▯			▯		▯			▯	
Maytenus boaria 'Green Showers'	Mayten Tree 'Green Showers'		30-50	20-35	F	MED	E		▯	▯			▯	▯			▯	
Nyssa sylvatica	Tupelo		30-50	15-25	F	LOW	D		▯		▯			▯	▯			▯
Olea europea 'Swan Hill'*	Fruitless Olive		25-30	25-30	F	LOW	E		▯				▯	▯	▯	▯		
Pinus attenuata	Knobcone Pine	▯	20-80	20-40	F	LOW	E	▯	▯				▯			▯		▯
Pinus brutia	Calabrian Pine		60-80	20-40	F	LOW	E	▯	▯				▯			▯		▯
Pinus canariensis	Canary Island Pine		50-70	15-25	F	LOW	E		▯				▯	▯		▯		▯
Pinus edulis	Pinon Pine	▯	10-20	20-25	F	LOW	E	▯	▯				▯			▯		▯
Pinus eldarica	Mondell Pine		30-80	20-40	F	LOW	E	▯	▯				▯			▯		▯
Pinus halepensis	Aleppo Pine		30-60	20-40	F	LOW	E	▯										▯
Pinus nigra	Austrian Black Pine		35-40	25-35	F	LOW	E		▯				▯	▯		▯		▯
Pinus pinea	Italian Stone pine		40-80	30-60	F	LOW	E	▯	▯		▯		▯	▯		▯		▯

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TREES																		
Pinus sabiniana	Foothill Pine	▯	40-50	30-40	F	LOW	E	▯										▯
Pinus thunbergiana	Japanese Black Pine		20-50	20-40	F	LOW	E		▯				▯	▯				▯
Pinus torreyana	Torrey Pine	▯	40-60	30-50	F	LOW	E	▯	▯				▯			▯		▯
Pistachia chinensis	Chinese Pistache		60	50	F	LOW	D	▯	▯		▯				▯	▯		▯
Pistachia chinensis "Keith Davey'	Keith Davey Chinese Pistache (fruitless)		60	50	F	LOW	D	▯	▯	▯	▯				▯	▯		
Platanus acerifolia 'Bloodgood' and 'Columbia'	London Plane Tree		40-80	30-40	F	LOW	D		▯		▯				▯	▯		
Platanus racemosa	California Sycamore	▯	50-80	30-40	F	LOW	D	▯			▯							
Podocarpus henkelii	Long-leafed Yellow-wood		30-40	20-30	F-P	MED	E		▯		▯		▯	▯			▯	
Podocarpus macrophyllus	Yew Pine		50	20-30	F-P	MED	E		▯		▯		▯	▯				
Prunus cerasifera 'Krauter Vesuvius'	Krauter Vesuvius Flowering Plum		30	30	F	MED	D		▯	▯		▯		▯			▯	
Prunus ilicifolia	Holly Leaf Cherry	▯	10-30	10-30	F	LOW	E	▯	▯				▯			▯		▯
Pyrus calleryana 'Autumn Blaze', 'New Bradford Holmford II', 'Capital', 'Chanticleer', 'Redspire'	Ornamental Pear (listed cultivars)		25-40	15-30	F	MED	D		▯	▯	▯			▯	▯		▯	
Quercus castaneifolia	Chestnut-leafed Oak		50-75	50-60	F	LOW	D		▯		▯					▯		▯
Quercus chrysolepis	Canyon Live Oak	▯	20-60	20-60	F	LOW	E	▯	▯				▯			▯		▯
Quercus coccinea	Scarlet Oak		60-80	35-40	F	LOW	D		▯		▯				•			▯
Quercus douglasii	Blue Oak	▯	40-60	25-50	F	LOW	D	▯										▯
Quercus ilex	Holly Oak		40-70	40-70	F	LOW	E		▯		▯		▯		•	▯		▯
Quercus lobata	Valley Oak	▯	70-80	70-80	F	LOW	D	▯								▯		▯
Quercus rubra	Red Oak		70-80	50-80	F	HIGH	D		▯		▯			▯	▯			▯
Quercus shumardii	Shumard Red Oak		60-80	50-60	F	MED	D		▯		▯			▯	▯			▯
Quercus suber	Cork Oak		70-100	70-100	F	LOW	E	▯	▯		▯		▯			▯		▯
Quercus virginiana	Southern Live Oak		40-60	40-80	F	MED	E		▯		▯			▯				▯
Quercus wislizenii	Interior Live Oak	▯	30-75	30-80	F	LOW	E	▯	▯				▯			▯		▯
Rhus lancea	African Sumac		25	20	F	LOW	E		▯				▯			▯		
Sequoia sempervirens "Aptos Blue"	Coast Redwood	▯	70+	14-30	F-P	MED	E		▯	▯			▯	▯				
Styrax japonica	Jap. Snowdrop Tree		20	15-20	F-P	HIGH	D		▯	▯		▯		▯			▯	
Thuja 'Green Giant'	Green Giant Arborvitae		30-50	10-20	F-P	MED	E		▯				▯					
Tilia cordata 'Green Spires'	Little-leaf Linden		30-50	15-30	F	MED	D		▯									
Ulmus parvifolia 'Drake', True Green','Alee', 'Athena'	Lacebark Elm (listed cultivars)		40-60	50-70	F	MED	E		▯	▯	▯							▯
Umbellularia californica	California Bay Laurel	▯	25-50	20-30	F-P	LOW	E	▯	▯		▯		▯			▯		▯
Vitex agnus-castus	Chaste Tree		25	25	F	LOW	D		▯	▯	▯	▯			▯	▯	▯	▯
Zelkova serrata 'Village Green', 'Geen Vase'	Village Green or Green Vase Japanese Zelkova		50-60	40-60	F	MED	D		▯	▯	▯			▯	▯			

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SHRUBS																		
Abelia grandiflora	Glossy Abelia		7-8	5-6	F-P	MED	E		▯	▯			▯	▯				▯
Abelia grandiflora 'Confetti', or 'Sunrise'	Variegated Glossy Abelia		3-5	4-5	F-P-S	MED	E		▯	▯	▯	▯		▯	▯		▯	▯
Abelia grandiflora 'Edward Goucher'	Edward Goucher Pink Abelia		4-6	4-5	F-P	MED	E		▯	▯			▯	▯	▯			▯
Abelia grandiflora 'Prostrata'	Prostrate White Abelia		1 1/2	3	F-P	MED	E		▯	▯	▯	▯			▯		▯	▯
Abelia grandiflora 'Sherwoodii'	Sherwood's Glossy Abelia		3	3	F-P	MED	E		▯	▯				▯	▯		▯	▯
Arbutus unedo	Strawberry Tree		10-25	15-20	F-P	LOW	E		▯				▯			▯		▯
Arbutus unedo 'Compacta'	Compact Strawberry Tree		6-8	5-7	F_P	LOW	E		▯				▯	▯	▯	▯		▯
Arbutus unedo 'Elfin King', 'Oktoberfest'	Dwarf Strawberry Tree		2-5	5	F-P	LOW	E		▯					▯	▯	▯	▯	▯
Arctostaphylos densiflora 'Dr. Hurd'	Dr. Hurd Manzanita	▯	8-12	6-10	F	LOW	E	▯	▯				▯			▯		▯
Arctostaphylos 'Emerald Carpet'	Emerald Carpet Manzanita	▯	1-2	4-6	P	MED	E		▯	▯	▯	▯			▯	▯	▯	▯
Arctostaphylos 'Pacific Mist'	Pacific Mist Manzanita	▯	2-1/2	3-4	F	LOW	E	▯	▯		▯				▯	▯		▯
Arctostaphylos pajaroensis 'Paradise', 'Warren Roberts'	Pajaro Manzanita	▯	6-10	5-8	F	LOW	E	▯	▯				▯	▯	▯	▯		▯
Arctostaphylos 'Sunset'	Sunset Manzanita	▯	4-5	4-6	F	LOW	E	▯	▯				▯	▯	▯	▯		▯
Arctostaphylos densiflora 'Howard McMinn'	Vine Hill Manzanita	▯	3-6	4-7	F	LOW	E	▯	▯	▯			▯	▯	▯	▯		▯
Arctostaphylos 'John Dourley'	John Dourley Manzaita	▯	3	8	F-P	LOW	E		▯		▯				▯	▯		▯
Artemisia 'Powis Castle'	Powis Castle Artemisia		3	6	F	LOW	E		▯	▯				▯	▯	▯		
Aucuba japonica 'Pictaturata', 'Variegata'	Variegated Japanese Aucuba		6-10	5-8	P-S	LOW	E		▯				▯	▯				
Aucuba japonica 'Serratifolia'	Sawtoothed Japanese Aucuba		6-10	5-8	P-S	LOW	E		▯				▯	▯				
Azalea southern indica (all cultivars)	Sun Azalea		4-6	4-6	P	HIGH	E		▯	▯				▯			▯	
Baccharis pilularis 'Twin Peaks #2', 'Pigeon Point'	Dwarf Coyote Brush	▯	1-2	6	F	LOW	E	▯	▯	▯	▯				▯	▯		
Berberis darwinii	Darwin Barberry		5-10	4-7	F-P	LOW	E		▯				▯	▯	▯	▯		▯
Berberis thunbergii 'Atropurpurea', 'Rose Glow'	Red-Leaf Japanese Barberry		4-6	4-6	F-P	LOW	E		▯				▯	▯	▯	▯		▯
Berberis thunbergii 'Crimson Pygmy'	Dwarf Red-Leaf Japanese Barberry		1-2	1-2	F-P	LOW	E		▯					▯	▯	▯		▯
Buddleia davidii	Butterfly Bush		10	10	F-P	MED	D		▯					▯	▯	▯		▯
Buxus microphylla japonica 'Green Beauty'	Green Beauty Japanese Boxwood		4-6	4-6	F-P-S	MED	E		▯	▯			▯		▯	▯	▯	
Callistemon citrinas 'Little John	Little John Bottlebrush		3	3	F	LOW	E		▯	▯				▯	▯	▯	▯	▯
Callistemon citrinus	Lemon Bottlebrush		4-10	4-6	F	LOW	E		▯				▯	▯	▯	▯		▯
Camellia hiemalis hybrids and cultivars	Camellia		3-10	3-10	P-S	MED	E		▯	▯			▯	▯			▯	
Camellia japonica	Japanese Camellia		3-12	3-10	P-S	MED	E		▯	▯			▯	▯			▯	
Camellia sasanqua (all var.)	Sasanqua Camellia		4-10	4-10	P-S	MED	E		▯	▯			▯	▯			▯	
Carpenteria californica	California Anemone	▯	6-8	3-6	F-P	LOW	E	▯	▯	▯			▯	▯	▯	▯		
Ceanothus 'Blue Jeans'	California Lilac 'Blue Jeans'	▯	4-6	7-9	F	LOW	E	▯	▯		▯		▯	▯	▯	▯		▯

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SHRUBS																		
Ceanothus 'Concha'	California Lilac 'Concha'	▯	6-7	6-8	F	LOW	E	▯	▯	▯			▯	▯	▯	▯		▯
Ceanothus 'Dark Star'	California Lilac 'Dark Star'	▯	5-6	8-10	F	LOW	E	▯	▯	▯	▯		▯	▯	▯	▯		▯
Ceanothus griseus horizontalis 'Yankee Point', Kurt Zadnick'	Carmel Creeper Yankee Point or Kurt Zadrick	▯	2-3	8-10	F	LOW	E	▯	▯	▯	▯			▯	▯	▯		▯
Ceanothus 'Frosty Blue'	California Lilac 'Frosty Blue'	▯	6-9	8-10	F	LOW	E	▯	▯	▯	▯		▯	▯	▯	▯		▯
Ceanothus hearstiorum	Hearst's Ceanothus	▯	1/2	6-8	F	LOW	E	▯	▯	▯	▯	▯			▯	▯	▯	▯
Ceanothus 'Julia Phelps'	California Lilac 'Julia Phelps'	▯	3-5	8-10	F	LOW	E	▯	▯	▯	▯			▯	▯	▯		▯
Ceanothus 'Joan Mirov'	California Lilac 'Joan Mirov'	▯	5-7	7-9	F	LOW	E	▯	▯	▯			▯	▯	▯	▯		▯
Ceanothus 'Joyce Coulter'	Joyce Coulter Mountain Lilac	▯	2-5	6-10	F	LOW	E	▯	▯	▯	▯			▯	▯	▯		▯
Ceanothus 'Ray Hartman'	California Lilac 'Ray Hartman'	▯	12-20	15-20	F	LOW	E	▯	▯				▯	▯	▯	▯	▯	▯
Cercis canadensis (and cultivars)	Eastern Redbud		25-30	20-25	F	MED	D		▯					▯	▯		▯	
Cercis occidentalis	Western Redbud	▯	10-18	10-18	F	LOW	D	▯	▯					▯	▯	▯		
Cercis reniformis 'Texas White'	Texas White Redbud		12-20	10-15	F-P	MED	D		▯					▯	▯	▯	▯	
Cercis reniformis 'Oklahoma'	Oklahoma Redbud		15-20	10-15	F-P	MED	D		▯					▯	▯	▯	▯	
Choisya ternata	Mexican -Orange		6-8	6-8	P-S	MED	E		▯	▯			▯	▯	▯			
Cistus corbariensis (C. hybridus)	White Rockrose		2-5	2-4	F	LOW	E		▯	▯	▯			▯	▯	▯		
Cistus ladanifer	Crimson-spot Rockrose		3-5	3-5	F	LOW	E		▯	▯				▯	▯	▯		
Cistus purpureus	Orchid Rockrose		3-4	3-5	F	LOW	E		▯	▯				▯	▯	▯		
Cistus 'Santa Cruz'	Santa Cruz Rockrose		3-5	3-5	F	LOW	E		▯	▯				▯	▯	▯		
Cistus x skanbergii	Pink Rockrose		3-4	4-8	F	LOW	E		▯	▯	▯			▯	▯	▯		
Cistus 'Sunset'	Sunset Rockrose		3	6-8	F	LOW	E		▯	▯	▯			▯	▯	▯		
Cistus 'Victor Reiter	Vic. Reiter Rockrose		4	4	F	LOW	E		▯	▯				▯	▯	▯	▯	
Cistus 'Warleys'	Warley's Rockrose		2	4	F	LOW	E		▯	▯	▯			▯	▯	▯	▯	
Coleonema (Diosma) album	White Breath of Heaven		4-5	4-5	F-P	MED	E		▯	▯				▯	▯		▯	
Coleonema (Diosma) pulchrum	Pink Breath of Heaven		5-6	5-6	F-P	MED	E		▯	▯				▯	▯		▯	
Correa pulchella 'Mission Bells'	Australian Fuschia		2	6-8	P	LOW	E		▯	▯	▯			▯	▯	▯		▯
Cotinus coggygria	Smoke Tree		20-25	20-25	F	LOW	D		▯					▯		▯	▯	
Cotoneaster microphyllus	Rockspray Cotoneaster		2-3	4-6	F	LOW	E		▯		▯			▯	▯	▯		▯
Cotoneaster microphyllus thymifolius	Dwarf Rockspray Cotoneaster		1-2	3-4	F	LOW	E		▯		▯			▯	▯	▯	▯	▯
Cotoneaster lacteus	Red Cluster Cotoneaster		8	8	F	LOW	E		▯				▯	▯	▯	▯		▯
Dodonea viscosa 'purpurea'	Green Hopseed Bush		12-15	6-8	F-P	LOW	E		▯				▯			▯		
Dodonea viscosa 'purpurea'	Purple Hopseed Bush		12-15	6-8	F-P	LOW	E		▯				▯			▯		
Elaeagnus ebbingei (and cultivars)	Ebbinger's Silverberry		6-15	6-15	F-P	LOW	E	▯	▯							▯		▯
Esallonia 'compacta'	Compact Escallonia		3	4-5	F-P	MED	E		▯	▯			▯	▯	▯		▯	▯
Escallonia fradesii	Pink Escallonia		5-8	5-8	P	MED	E		▯	▯			▯	▯				▯
Escallonia 'Newport Dwarf'	Dwarf Escallonia		2-1/2	4	P	MED	E		▯	▯	▯			▯	▯		▯	▯

Installation Exterior Plant Checklist

BOTANICAL NAME	COMMON NAME	CALIFORNIA NATIVE	MATURE HEIGHT (IN FEET)	MATURE WIDTH (IN FEET)	E=FULL SUN P=PART SHADE S=SHADE / EXPOSURE	WATER REQUIREMENTS	EVERGREEN/DECIDUOUS	VISUAL AREAS: OPEN SPACE/NATURALIZED AREA	VISUAL AREAS: MAIN BASE	VISUAL AREAS: FLIGHT LINE	GROUNDCOVER	33 FT. ATFP UNOBSTRUCTED SPACE	SCREEN		PARKING AREAS	XERISCAPE AREAS	PLAZAS/ENTRIES/RAISED PLANTERS	WILDLIFE
SHRUBS																		
Escallonia 'Lou Allen'	Lou Allen Escallonia		5	6	P	MED	E		▯	▯			▯	▯	▯			▯
Euryops pectinatus 'Munchkin'	Compact Grey Bush Daisy		3	4	F	LOW	E		▯	▯					▯	▯		▯
Euryops pectinatus 'Viridis'	Green Bush Daisy		4-6	4-6	F	LOW	E		▯	▯					▯	▯		▯
Feijoa sellowiana	Pineapple Guava		18-25	18-25	F	LOW	E		▯				▯	▯		▯		▯
Fremontodendron californicum (cultivars)	Flannel Bush	▯	6-20	6-15	F	LOW	E	▯	▯			▯	▯			▯		▯
Grevillea 'Noellii'	Noel's Grevillea		4-5	4-5	F	LOW	E		▯	▯					▯	▯		▯
Heteromeles arbutifolia and cultivar 'Davis Gold'	Toyon and cultivar 'Davis Gold'	▯	6-10	6-10	F-P	LOW	E	▯	▯				▯			▯		▯
Hypericum moseranum	Gold Flower		3-4	3-4	P	MED	E		▯	▯				▯	▯		•	▯
Ilex cornuta 'Bufordii'	Buford Holly		8-10	6	F-P	MED	E		▯				▯	▯				▯
Ilex cornuta 'Dwarf Buford'	Dwarf Buford Holly		3	3-4	F-P	MED	E		▯					▯			▯	▯
Ilex cornuta 'Rotunda'	Dwarf Chinese Holly (fruitless)		3	3	F-P	MED	E		▯	▯				▯			▯	
Juniperus chinensis 'San Jose'	Juniper San Jose		2	6	F	LOW	E		▯	▯	▯				▯	▯		▯
Juniperus horizontzlis 'Plumosa Compacta'	Andorra Compact Juniper		1-1/2	4-5	F	LOW	E		▯	▯	▯				▯	▯		▯
Lavatera thuringiaca (and cultivars)	Tree Mallow		6-8	4-6	F	MED	E		▯	▯			▯	▯	▯			▯
Leucophyllum frutescens 'compacta'	Compact Texas Ranger		3-4	3-4	F	LOW	E		▯	▯					▯	▯		▯
Leucophyllum laevigatum	Purple Texas Ranger		3-4	4-6	F	LOW	E		▯	▯					▯	▯		▯
Ligustrum japonicum 'Texanum'	Texas Wax Privet		6-9	6-7	F	MED	E		▯	▯			▯					
Loropetalum chinense rubrum "Burgandy'	Pink Chinese Fringe Flower		5-8	5-7	P-S	MED	E		▯	▯			▯	▯				
Loropetalum chinense rubrum 'Ruby', 'Suzanne', 'Dwarf Purple'	Dwarf Chinese Fringe Flower		3-5	3-5	P-S	MED	E		▯	▯			▯	▯			▯	
Loropetalum chinense rubrum 'Bill Wallace'	Bill Wallace Trailing Chinese Fringe Flower		1	3-4	P-S	MED	E		▯	▯	▯		▯	▯			▯	
Mahonia aquifolium	Oregon Grape	▯	5-7	3-5	F-P-S	LOW	E		▯				▯	▯	▯	▯	▯	▯
Mahonia aquifolium 'Compacta'	Dwarf Orgeon Grape	▯	2	2-4	P-S	LOW	E		▯		▯			▯	▯	▯		▯
Mahonia 'Golden Abundance'	Golden Abundance Mahonia	▯	6-8	5-7	F-P-S	LOW	E		▯				▯	▯		▯		▯
Mahonia pinnata 'Ken Hartman', 'Skylark'	Caifornia Holly Grape	▯	3-6	2-3	F-P-S	LOW	E	▯	▯				▯			▯		▯
Mahonia nevinii	Nevin's Holly Grape	▯	6-8	6-8	F-P-S	LOW	E	▯	▯				▯			▯		▯
Mahonia repens	Creeping Mahonia	▯	3	3-6	F-P-S	LOW	E	▯	▯		▯				▯	▯		▯
Mytus communis	True myetle		6-8	6-8	F-P	LOW	E		▯				▯		▯	▯		
Mytus communis 'Compacta', 'Compacta Variegata'	Compact Myrtle		2-3	2-3	F-P	LOW	E		▯						▯	▯		▯
Myrsine africana	African Boxwood		3-6	3-6	F-P	LOW	E		▯	▯			▯				▯	
Nandina domestica	Heavenly Bamboo		6-8	3-4	F-P	MED	E		▯				▯	▯	▯			▯
Nandina domestica 'Compacta', 'Gulf Stream', 'Plum Passion'	Compact Heavenly Bamboo		4-5	3	F-P	LOW	E		▯	▯				▯	▯		▯	▯
Nandina domestica 'Harbor Dwarf'	Dwarf Heavenly Bamboo		2	3+	F-P	LOW	E		▯	▯	▯			▯	▯		▯	▯

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SHRUBS																		
Nandina nana purpurea	Dwarf Heavenly BAmboo		2 1/2	2	F-P	LOW	E		▯	▯				▯	▯		▯	▯
Nerium Oleander (hardier cultivars)	Oleander		6-12	6-12	F	LOW	E		▯				▯	▯	▯	▯		
Osmanthus x burkkwoodii	Burkwood Osmanthus		4-8	5-6	F-P	LOW	E		▯				▯	▯	▯		▯	▯
Osmanthus x fortunei (and cultivars)	Fortune's Sweet Olive		10	6-8	F-P	LOW	E		▯				▯	▯	▯			▯
Osmanthus fragrans	Sweet Olive		10-15	10-12	F-P	LOW	E		▯				▯	▯				▯
Osmanthus heterophyllus (and cultivars)	Holly-leaf Osmanthus cultivars		3-8	3-6	F-P	LOW	E		▯				▯	▯	▯		▯	▯
Photinia fraseri 'Indian Princess', 'Red Robin'	Compact Photinia		6	6	F	MED	E		▯	▯			▯	▯				
Photinia fraseri	Photinia		10-15	15	F	MED	E		▯	▯			▯	▯				
Pinus mugo mughus	Dwarf Mugo Pine		4-6	4-6	F	LOW	E		▯	▯				▯		▯	▯	
Pittosporum tobira 'Wheeler's Dwarf'	Wheelers Dwarf Mock Orange		2	5	F-P	MED	E		▯	▯	▯			▯	▯		▯	
Pittosporum tobira 'Cream de Mint'	Variegated Dwarf Mock Orange		2	5	F-P	MED	E		▯	▯	▯			▯			▯	
Pittosporum tobira 'Variegata'	Variegated Mock Orange		6	6	F-P	MED	E		▯	▯			▯	▯				
Podocarpus macrophyllus 'Maki'	Shrubby Yew Pine		6-8	4-6	F-P	MED	E		▯	▯			▯	▯			▯	
Prunus caroliniana 'Compacta','Bright n' Tight'	Dwarf Carolina Laurel		6-10	6-10	F	MED	E		▯				▯					▯
Prunus ilicifolia	Hollyleaf Cherry	▯	10-30	10-30	F	LOW	E	▯	▯				▯			▯		▯
Rhaphiolepis indica (all cultivars)	Indian Hawthorn cultivars		2-5	2-5	F-P	LOW	E		▯	▯				▯	▯	▯	•	
Rhamnus californica 'Eve Case'	Eve Case Coffeeberry	▯	4-6	4-8	F-P	LOW	E	▯	▯						▯	▯		▯
Rhamnus californica 'Mound San Bruno'	Mound San Bruno Dwarf Coffeeberry	▯	3-4	6-10	F-P	LOW	E	▯	▯						▯	▯		▯
Rhamnus californica spp. Tomentella	Coffeeberry	▯	4-8	4-8	F-P	LOW	E	▯	▯				▯			▯		▯
Rhus ovata	Sugar Bush	▯	5-10	5-10	F	LOW	E	▯	▯				▯			▯		▯
Rosmarinus Officinalis 'Irene', 'Ken Taylor', 'Huntington Blue', Lockwood de Forest', 'Collingwood Ingram'	Prostrate Rosemary cultivars		1 -2	5-6	F	LOW	E		▯	▯	▯					▯	▯	▯
Rosmarinus officinalis 'Tuscan Blue', 'Miss Jessup's Upright'	Upright Rosemary cultivars		6-7	4-5	F	LOW	E		▯	▯			▯		▯	▯		▯
Rosmarinus Officinalis 'Majorca Pink'	Majorca Pink Rosemary		2-4	2-4	F	LOW	E		▯	▯		▯		▯	▯	▯	▯	▯
Salvia (clevelandii) 'Allen Chickering'	Allen Chickering Sage	▯	4-5	4-5	F	LOW	E	▯	▯					▯		▯		▯
Salvia clevelandii 'Pozo Blue', 'Aromas', 'Whirley Blue', 'Winifred Gilman'	Hybrid Cleveland Sage Cultivars (require good drainage)	▯	3-4	4-5	F	LOW	E	▯	▯							▯		▯
Salvia leucophyla 'Figuero'	Figuero Coastal White Sage	▯	3-4	5-6	F	LOW	E	▯	▯							▯		▯
Salvia leucophyla 'Point Sal'	Point Sal Coastal White Sage	▯	4-6	4-6	F	LOW	E	▯	▯							▯		▯
Salvia 'Bee's Bliss"	Bee's Bliss Hybrid Sage	▯	1-1-1/2	4-5	F	LOW	E		▯	▯	▯				▯	▯	▯	▯
Salvia 'Dara's Choice"	Dara Emery Hybrid Sage	▯	2-3	3-4	F-P	LOW	E		▯	▯	▯				▯	▯	▯	▯
Salvia 'Gracias"	Gracias Hybrid Sage	▯	1/2-1	4-6	F	LOW	E		▯	▯	▯				▯	▯	▯	▯
Sambucus caerula (mexicana)	Blue Elderberry	▯	6-12	4-10	F-P	LOW	D	▯	▯							▯		▯

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SHRUBS																		
Sarcococca hookerana humils	Sarcococca		2	3-7	P-S	LOW	E		▯	▯	▯						▯	▯
Sarcococca ruscifolia	Fragrant Sarcococca		4-6	3-7	P-S	LOW	E		▯	▯	▯		▯	▯			▯	▯
Syringa vulgaris	Common Lilac		15-18	12-15	F-P	MED	D		▯					▯			▯	▯
Teucrium fruticans 'Azureum'	Blue Bush Germander		4-8	4-10	F	LOW	E		▯	▯			▯		▯	▯		▯
Viburnum davidii	Larustinus		2-3	3-5	P-S	MED	E		▯		▯		▯	▯			▯	▯
Viburnum tinus	Larustinus		6-12	4-8	F-P	MED	E		▯				▯	▯				
Viburnum tinus 'Spring Bouquet', 'Dwarf'	Compact Larustinus		3-6	3-6	F-P	MED	E		▯				▯	▯	▯		▯	
Vitex agnus-castus	Chaste Tree		8-15	8-15	F	LOW	E	▯	▯	▯				▯	▯	▯	▯	▯
Xylosma congestum	Xylosma		10-15	8-12	F	LOW	D		▯				▯			▯		
Xylosma congestum 'Compacta'	Dwarf Xylosma		5-8	5-6	F-P	MED	E		▯	▯			▯		▯	▯		

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LOW GROUNDCOVERS, VINES, PERENNIALS, GRASSES																		
Acacia redolens 'Prostrata' or 'Desert Carpet'	Prostrate Acacia		1-2	15	F-P	LOW	E	▯	▯	▯	▯		▯					
Achillea filipendula 'Coronation Gold'	Coronaion Gold Fernleaf Yarrow		3	3-4	F	LOW	E		▯	▯			▯	▯	▯	▯		▯
Achillea millefolium (many cultivars)	Common Yarrow	▯	2-3	3-5	F	LOW	D	▯	▯	▯	▯		▯	▯	▯	▯		▯
Achillea 'Moonshine'	Moonshine Hybrid Yarrow		2	3	F	LOW	D		▯	▯			▯	▯	▯	▯		▯
Achillea tomentosa (and cultivars)	Woolly Yarrow		1/2	2+	F-P	LOW	D		▯	▯	▯	▯	▯		▯	▯	▯	▯
Agapanthus 'Peter Pan' and "Peter Pan Alba'	Dwarf Blue or White Lily of the Nile		2	2	F-P	MED	E		▯	▯	▯		▯	▯	▯		▯	▯
Agapanthus africanus (orientalis) (many cultivars)	Blue Lily-of-the-Nile		4-5	2-3	F-P	MED	E		▯	▯			▯	▯	▯		▯	▯
Ajuga reptans (many cultivars)	Carpet Bugle		1/2	1+	F-P	MED	E		▯	▯	▯	▯					▯	▯
Arctostaphylos uva ursi cultivars ('Green Supreme' recommended)	Bearberry cultivars	▯	1/2	5+	P	LOW	E		▯	▯	▯	▯	▯	▯	▯	▯		▯
Arctotheca calendula	Cape Weed		1/2	2+	F	LOW	E		▯	▯	▯	▯	▯		▯	▯		▯
Armeria maritima	Common Thrift		3/4	1	F	MED	E		▯	▯	▯	▯		▯	▯		▯	
Asarum caudatum	Coastal Wild Ginger	▯	1/2	1+	P-S	MED	E		▯	▯	▯	▯					▯	
Asarum lemmonii	Foothill Wild Ginger	▯	1/2	1+	P-S	LOW	E		▯	▯	▯	▯					▯	
Baccharis pilularis 'Twin Peaks #2', 'Pigeon Point'	Dwarf Coyote Brush	▯	1-2	6+	F	LOW	E	▯	▯	▯	▯		▯		▯	▯		▯
Bergenia crassifolia (and cultivars)	Winter-Blooming Bergenia		1-2	2+	P-S	MED	E		▯	▯	▯						▯	
Bergenia cordifolia (and cultivars)	Heartleaf Bergenia		1-2	2+	P-S	MED	E		▯	▯	▯						▯	
Calamagrostis x acutifolia 'Stricta', 'Karl Foerster'	Stricat and Karl Foerster Feather Reed Grass		3-6	2-3	F	MED	D		▯		▯		▯	▯				▯
Carex caryophyllea 'The Beatles'	Mop Head Sedge		1/2	2+	F-P-S	MED	E		▯	▯	▯	▯	▯				▯	
Carex glauca (flacca)	Blue Sedge		1/2-1	1+	F-P	MED	D		▯	▯	▯		▯	▯			▯	
Carex nudata	Callifornia black-flowering Sedge	▯	1-2	1-2	F-P-S	HIGH	D	▯	▯	▯	▯		▯				▯	
Carex pansa	Callifornia Meadow Sedge	▯	1/2	1+	F-P	MED	E	▯	▯	▯	▯	▯	▯				▯	
Carex testacea	Orange-leaved Sedge		1-1/2-2	3+	F-P	HIGH	D		▯	▯	▯		▯	▯			▯	
Carex texensis	Catlin Sedge		1-1/2-2	2	F-P	HIGH	D		▯	▯	▯		▯	▯			▯	
Carex tumulicola	Berkeley Sedge	▯	1	1+	F-P	MED	D		▯	▯	▯		▯	▯			▯	
Ceanothus hearstiorum	Hearst's Ceanothus	▯	1/2	6-8	F	LOW	E		▯	▯	▯	▯	▯	▯	▯	▯	▯	▯
Ceanothus x 'Centennial'	Centannial Hybid California Lilac	▯	1/2-1	6-8	F-P	LOW	E		▯	▯	▯		▯	▯	▯	▯	▯	▯
Ceratostigma plumbaginoides	Dwarf Plumbago		1/2-1	3-10	F-P	MED	E		▯	▯	▯		▯	▯				
Clematis armandii	Evergreen Clematis (vine needs support)		20	varies	F	MED	E		▯	▯							▯	
Cotoneaster dammeri 'Lowfast', Coral Beauty'	Bearberry Cotoneaster		1/2	10	F	LOW	E		▯	▯	▯	▯	▯	▯	▯	▯	▯	▯
Crocosmia crocosmiflora	Montbretia		3-4	1	F	LOW	D		▯	▯				▯			▯	•
Dietes iridioides	Fortnight Lily		3-4	2	F-P	LOW	E		▯	▯			▯	▯	▯	▯	▯	

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LOW GROUNDCOVERS, VINES, PERENNIALS, GRASSES																		
(Moraea, Dietes vegeta)																		
Duchesnea indica	Indian Mock Strawberry		1/2	1-2	F-S	LOW	D		▯	▯	▯	▯					▯	▯
Elymus condensatus 'Canyon Prince'	Canyon Prince Wild Rye	▯	2-3	1-2	F-P	LOW	D	▯	▯	▯	▯		▯	▯	▯	▯		▯
Erigeron karvinskianus	Santa Barbara or MeXican Daisy		1-2	3	F-P	LOW	E		▯	▯	▯		▯	▯	▯	▯	▯	▯
Erigeron karvinskianus 'Spindrift', 'Moerheimii'	Compact Santa Barbara or Mexican Daisy		1	1-3	F-P	LOW	E		▯	▯	▯		▯	▯	▯	▯	▯	▯
Erigeron glaucus 'Wayne Roderick'	Wayne Roderick Fleabane	▯	1	1-3	F-P	LOW	E		▯	▯	▯		▯	▯	▯	▯	▯	▯
Euonymous fortunei 'Colorata' , 'Emerald Gaiety'	Winter Creeper		1	20	F-P	MED	E		▯	▯	▯		▯	▯		▯	▯	
Euphorbia charcias 'Dwarf'	Dwarf Mediterranean Spurge		1-1/2	3	F-P	LOW	E		▯	▯				▯	▯	▯	▯	
Euphorbia charcias wulfenii (and cultivars)	Mediterranean Spurge		3-4	3-4	F-P	LOW	E		▯	▯				▯	▯	▯	▯	
Euphorbia griffithii 'Fire Glow', 'Fire Charm', 'Dixter'	Fire Glow, Fire Charm or Dixiter Spurge		3-4	3-4	F-P	LOW	E		▯	▯				▯	▯	▯	▯	
Euphorbia x martini (and cultivars)	Compact Spurge		3	3	F-P	LOW	E		▯	▯				▯	▯	▯	▯	
Festuca California 'Serpertime Blue'	Blue California Fescue	▯	2-3	6	F-P	LOW	E		▯	▯	▯		▯	▯	▯	▯	▯	▯
Festuca idahoensis 'Siskiyou Blue'	Siskiyou Blue Idaho Fescue	▯	2	2-3	F-P	LOW	E		▯	▯	▯		▯	▯	▯	▯	▯	▯
Festuca ovina 'Glauca'	Blue Fescue	▯	1	1	F-P	LOW	E		▯	▯	▯	▯	▯	▯	▯	▯	▯	
Fragraria chiloensis	Wild Strawberry	▯	1/2-1	2-3	F-P	MED	E		▯	▯	▯	▯					▯	▯
Gazania linearis 'Colorado Gold'	Colorado Gold Gazania		1/2	2	F-P	LOW	E		▯	▯	▯	▯		▯	▯	▯	▯	▯
Gazania rigens leucolaena	Trailing Gazania		1/2	2+	F-P	LOW	E		▯	▯	▯	▯		▯	▯	▯	▯	▯
Helictotrichon sempervirens	Blue Oat Grass		2-3	2-3	F	MED	E		▯	▯			▯	▯	▯		▯	▯
Helleborus orientalis hybirds	Lenten Rose hybrids		1-1-1/2	2	P	MED	E		▯	▯	▯			▯			▯	
Hemerocallis hybrids (evergreen and semi-evergreeen)	Day Lily Hybrids		2-3	2-4	F-P	LOW	E		▯	▯			▯	▯	▯		▯	▯
Heuchera 'Lillians Pink', 'Rosatta'. 'Canyon Delight'	Alum Root hybrids	▯	1/2-1	1	P	MED	E		▯	▯	▯	▯					▯	▯
Heuchera maxima	Island Alum Root	▯	1-2	1-2	P	MED	E		▯	▯	▯						▯	▯
Heuchera 'Palace Purple'	Alum Root	▯	1-1/2	1	P	MED	E		▯	▯	▯						▯	▯
Hypericum calycinum	Aaron's Beard		1	1-2+	P	MED	E		▯	▯	▯		▯					
Iberis sempervirens 'Purity'	Purity Cardy Tuft		1/2	2+	F-P	MED	E		▯	▯	▯	▯	▯	▯			▯	
Iberis sempervirens 'Snowflake'	Snowflake Cardy Tuft		1	3	F-P	MED	E		▯	▯	▯		▯	▯			▯	
Iris douglasiana	Douglas Iris	▯	1-2	2-3	P	LOW	E		▯	▯	▯			▯			▯	▯
Iris 'Pacific Coast Hybirds'	Pacific Coast Hybird Iris	▯	1-2	1-3	P	LOW	E		▯	▯	▯			▯			▯	▯
Jasminum polyanthum	Pink Blooming Jasmine (needs support)		Vine	20	F-P	MED	E		▯		▯		▯				▯	
Juncus patens	California Gray Rush	▯	2-3	2-3	F-P	MED	E	▯	▯	▯			▯	▯				▯
Juniperus chinensis procumberns 'Nana'	Japanese Garden Juniper		1/2-1	10	F-P	LOW	E		▯	▯	▯	▯	▯	▯	▯		▯	▯

BOTANICAL NAME	COMMON NAME	CALIFORNIA NATIVE	MATURE HEIGHT (IN FEET)	MATURE WIDTH (IN FEET)	EXPOSURE (F=FULL SUN P=PART SHADE S=SHADE)	WATER REQUIREMENTS	EVERGREEN/DECIDUOUS	VISUAL AREAS: OPEN SPACE/NATURALIZED AREA	VISUAL AREAS: MAIN BASE	VISUAL AREAS: FLIGHT LINE	GROUNDCOVER	33 FT. ATFP UNOBSTRUCTED SPACE	BANKS/EROSION CONTROL	ACCENT/MIXED BORDER	PARKING AREAS	XERISCAPE AREAS	PLAZAS/ENTRIES/RAISED PLANTERS	BENEFITS WILDLIFE
LOW GROUNDCOVERS, VINES, PERENNIALS, GRASSES																		
Juniperus horizontailis 'Emerald Spreader'	Emerald Spreader Juniper		1/2	6-8	F	LOW	E		▯	▯	▯	▯	▯	▯	▯	▯	▯	
Juniperus horizontailis 'Hughes'	Hugh's Juniper		1/2	6-8	F	LOW	E		▯	▯	▯	▯	▯	▯	▯	▯	▯	
Juniperus conferta 'Blue Pacific'	Blue Pacific Shaker Juniper		1	6	F	LOW	E		▯	▯	▯	▯	▯	▯	▯	▯		▯
Juniperus horizontailis 'Monber'	Icee Blue Juniper		1/2	6-8	F	LOW	E		▯	▯	▯	▯	▯	▯	▯	▯	▯	
Juniperus horizontailis 'Prince of Whales'	Prince of Whales Juniper		1/2	6-10	F	LOW	E		▯	▯	▯	▯	▯	▯	▯	▯	▯	
Juniperus horizontailis 'Wiltonii'	Blue Rug Juniper		1/2	6-10	F	LOW	E		▯	▯	▯	▯	▯	▯	▯	▯	▯	
Kniphofia uvaria (and hybrids, cultivars)	Red-hot Poker		1-3	2-5	F-P	LOW	E		▯	▯			▯	▯	▯	▯	▯	▯
Lavandula angustifolia 'Munstead', 'Hidcote'	Munstead and Hidcote English Lavender		1-4	1-4	F	LOW	E		▯	▯			▯	▯	▯			▯
Lavandula intermedia 'Provence'	Provence French Lavender		2-3	2-3	F	LOW	E		▯	▯			▯	▯	▯			▯
Lavandula stoechas 'Otto Quast','Madrid Pink', 'Madrid Blue'	Spanish Lavender cultivars		1-3	1-3	F	LOW	E		▯	▯			▯	▯	▯			▯
Lavatera thuringiaca and cultivars 'Barnsley', 'Rosea', etc.	Tree Mallow and cultivars		6-8	6	F	MED	E		▯					▯			▯	▯
Leonotis ocymifolia	Lion's Tail		4-5	2-3	F	LOW	E		▯	▯				▯		▯		▯
Leucophyllum frutescens 'compacta'	Compact Texas Ranger		3-4	3-4	F	LOW	E		▯	▯				▯	▯	▯		▯
Leucophyllum laevigatum	Purple Texas Ranger		3-4	4-6	F	LOW	E		▯	▯				▯	▯	▯		▯
Liriope muscari (and cultivars)	Big Blue Lily Turf		1 -1 1/2	2	F-P	MED	E		▯	▯	▯			▯			▯	▯
Liriope muscari 'Variegata', 'Silvery Sunproof', 'Silvery Midget'	Variegated Big Blue Lily Turf		1 -1 1/2	2	P	MED	E		▯	▯	▯			▯			▯	▯
Liriope spicata sp. and 'Silver Dragon'	Creeping Lily Turf		1/2-1	2+	P	MED	E		▯	▯	▯	▯	▯				▯	
Miscantus transmorrisonensis	Evergreen Maiden Grass		5-6	3-4	F-P	MED	E		▯	▯			▯	▯				▯
Muhlenbergia rigens	Deer Grass	▯	3-5	3-6	F-P	LOW	E	▯	▯	▯	▯		▯	▯	▯	▯		▯
Mulhlenbergia filipes	Purple Muhly Grass		3	3-4	F	LOW	E		▯	▯				▯	▯	▯	▯	▯
Mulhlenbergia capillaris	Hairy Awn Muhly		3	3-4	F	LOW	E		▯	▯				▯	▯	▯	▯	▯
Narcissus spp.	Daffodil and Narcissus		1	1	F-P	LOW	D	▯	▯	▯				▯	▯	▯	▯	
Orgianum laevigatum 'Herenhausen', 'Hopley'	Ornamental Oregano		1-2	1-2	F	LOW	E		▯	▯	▯			▯	▯	▯	▯	▯
Orgianum rotundifolium 'Kent Beauty'	Round Leaf Oregano		3/4-1	1	F	LOW	E		▯	▯	▯			▯	▯	▯	▯	▯
Orgianum vulgare humile (O. compactum nana)	Creeping Oregano		1/2	1-2	F	LOW	E		▯	▯	▯	▯	▯		▯	▯	▯	▯
Orgianum vulgare aurea	Golden Creeping Oregano		1/2	1-2	F	LOW	E		▯	▯	▯	▯	▯		▯	▯	▯	▯
Ohiopogon japonicus	Mondo Grass		1	1	P	MED	E		▯	▯	▯			▯			▯	
Ohiopogon japonicus 'Nana'	Dwarf Mondo Grass		1/2	1	P	MED	E		▯	▯	▯	▯					▯	
Pachysandra terminalis (and cultivars)	Japanese Pachysandra		1/2-1	2+	P-S	MED	E		▯	▯	▯	▯					▯	
Panicum virgatum 'Heavy metal'	Heavy Metal Switch Grass		4	4-6	F	MED	D		▯	▯				▯				▯
Panicum virgatum 'Rotstrahlbusch'	Rays Red Switch Grass		4	6-8	F	MED	D		▯	▯				▯				▯

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LOW GROUNDCOVERS, VINES, PERENNIALS, GRASSES																		
Pennistem alopecoroides	Fountain Grass		3	3-5	F	MED	D		▯	▯				▯			▯	▯
Pennistem orientale	Oriental Fountain Grass		2-3	2-3	F-P	MED	D		▯	▯				▯			▯	▯
Penstemon gloxinioides 'Cultivars'	Border Penstemon		2-4	2-4	F-P	MED	D		▯	▯				▯			▯	▯
Penstemon heterophyllus	Foothill Penstemon	▯	1-2	1-2	F-P	LOW	D	▯	▯	▯						▯		▯
Phlomis fruticosa	Yellow Jerusalem Sage		2-4	2-3	F	LOW	E		▯	▯			▯	▯	▯	▯		
Phormium tenax (dwarf cultivars)	Dwarf New Zealand Flax cultivars		1-3	1-2	F-P	LOW	E		▯	▯				▯	▯	▯	▯	
Phygelius capensis (and hybrids)	Cape Fuschia		3-4	4+	F-P	MED	E		▯	▯				▯		▯	▯	▯
Ribes viburnifolium	Evergreen Currant	▯	2-3	4-5	P	LOW	E		▯	▯	▯		▯	▯		▯		▯
Rubus calycinoides 'Emerald Carpet'	Taiwan White Raspberry		1-2	2-5	F-P	LOW	E		▯	▯	▯	▯	▯		▯		▯	▯
Scaevola 'Mauve Clusters'	Muave Clusters Fan Flower		1/2-1	3-4	F	MED	E		▯	▯	▯	▯	▯				▯	
Sedum spurium 'Dragon's Blood'	Dragon's Blood Stonecrop		1/2	1-3	F-P	LOW	E		▯	▯	▯	▯	▯			▯	▯	
Teucrium chamaedrys	Germander		1-2	3-4	F	LOW	E		▯	▯	▯		▯	▯	▯	▯	▯	▯
Teucrium chamaedrys var. compactum	Compact Germander		1/2	1-1/2	F	LOW	E		▯	▯	▯	▯	▯	▯		▯	▯	▯
Teucrium chamaedrys 'Prostratum'	Prostrate Germander		1/2	2-3	F	LOW	E		▯	▯	▯	▯	▯	▯		▯	▯	▯
Teucrium poliium cossonii	Majorcan Teuerium, Purple Poley		1/2	4	F	LOW	E		▯	▯	▯	▯	▯			▯	▯	▯
Thymus lanuginosus	Wooly Thyme		1/4	3	F	LOW	E		▯	▯	▯	▯	▯			▯	▯	
Thymus praecox ssp.arcticus (serpyllum) and cultivars 'Pink Chintz', 'Reiter', 'Coccineum'	Creeping Thyme and cultivars		1/2	5-6	F-P	MED	E		▯	▯	▯	▯	▯			▯	▯	▯
Thymus citriodoros 'Doone Valley'	Doone Valley Lemon Thyne		1/2	3	F	LOW	E		▯	▯	▯	▯	▯			▯	▯	▯
Trachelospermum jasminoides	Star Jasmine		1-2	6-15	P	MED	E		▯	▯	▯		▯	▯	▯		▯	
Verbena tapien cultivars	Tapien Hybird Verbena		1/2	2-4	F	LOW	E		▯	▯	▯	▯	▯	▯		▯	▯	▯
Vinca minor	Dwarf Periwinkle		1/2	2	P-S	MED	E		▯	▯	▯	▯	▯				▯	
Whipplea modesta	Yerba de Selva	▯	1/2-1	3	P-S	LOW	E		▯	▯	▯	▯	▯				▯	
Wisteria sinensis (and cultivars)	Chinese Wisteria (vine needs support)		20+	6-10	F-P	MED	E		▯								▯	▯

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