Excerpts from:

Facilities Excellence Plan

Buckley Air Force Base Colorado

31 December 2007

Full document:

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FACILITIES EXCELLENCE PLAN

BUCKLEY AIR FORCE BASE COLORADO

31 December 2007

Prepared by
OZ Architecture

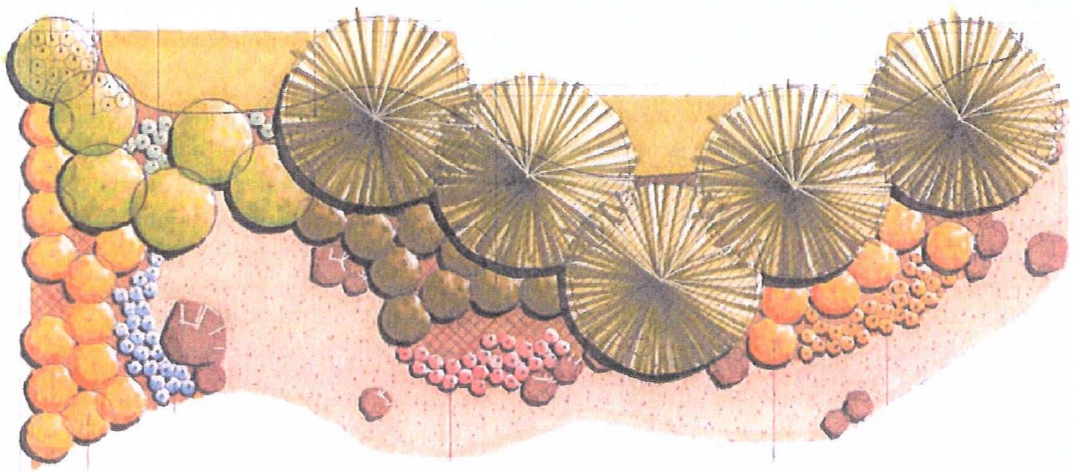
For:
460th Space Wing
Buckley Air Force Base, Colorado

Under:
Contract Number: FA2543-03-D-001
Delivery Order Number: 0019

5.3 Seven Xeriscape Principles

5.3.1 Planning and Design

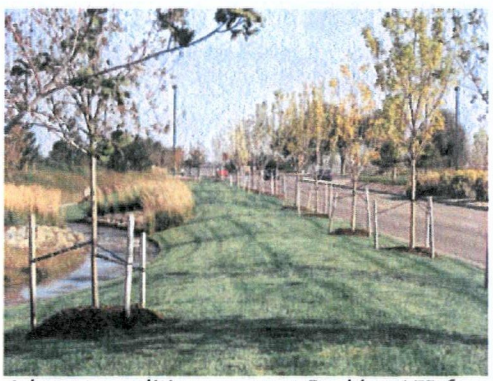
As each new facility is planned, it is important to consider the traditional aspects of site design, topography, slope orientation, user needs, program elements, soils, vehicular and pedestrian circulation, access, and existing vegetation. The integration of Xeriscape principles with traditional site planning enables the designer to introduce water conservation methods throughout the design process. Special attention should be placed upon the microclimates created by the building and subsequent plant grouping and locations.



The tremendous and rapid development of Buckley AFB requires careful planning and coordination to anticipate the impact of future facilities on run-off volume and stormwater flow patterns.

5.3.2 Minimize Turf

Throughout the site design process, it is important to limit areas of high water use turf to areas of intensive use by people. Such areas include active recreation areas and areas highly visible by pedestrians (i.e. building main entrances). Turf grasses should be used as a ground plane amenity and not just as infill material. High water use turf should not be used on slopes greater than 4:1, or in medians and narrow strips of planting that are less than 12' wide, whether in a parking lot application, roadway median or setback area.



Adverse conditions prevent Buckley AFB from supporting lush lawns and fescue turf areas. The Base Standard for future ground cover is Prairie Shortgrass and Buffalo Grass (See: Section 5.7 - Approved Seed Mixes)

5.3.3 Irrigation

Irrigation systems should be zoned so those plant materials with similar water demands are on the same irrigation zone (i.e. high water use turf separated from shrubs and ornamental grasses). Professionally designed and drawn irrigation plans should be an integral part of each new building or landscape plan. The plans should specifically address application methods, natural precipitation, and application rates for the individual zones. Plans also need to indicate tap locations, controller type, type and size of heads, drip methods, type and size of mainline, laterals, water pressure, and meter locations. Hand irrigation by water truck is permitted at Buckley AFB only to establish self-sustaining prairie grasses and Buffalo grass for one year, and only in areas that do not have access to an existing water line.

5.3.4 Plant Material

Plant selection and location are critical components of the xeriscape principles. Plants should be placed together in groupings of plants that require similar amounts of water. Within the plant palette there are plants that are more appropriate for more formal applications than others. The low water use plants tend to have a more informal appearance and arrangement than higher water use plants. An additional issue with regard to plant selection is the stand-off distances from buildings and other related force protection requirements. The force protection guidelines need to be followed. The plant material should be placed in masses rather than sporadically placed for maximum visual impact. In addition, maintenance is easier and quicker around one massed shrub bed, rather than around many plants scattered in turf areas.

5.3.5 Mulches

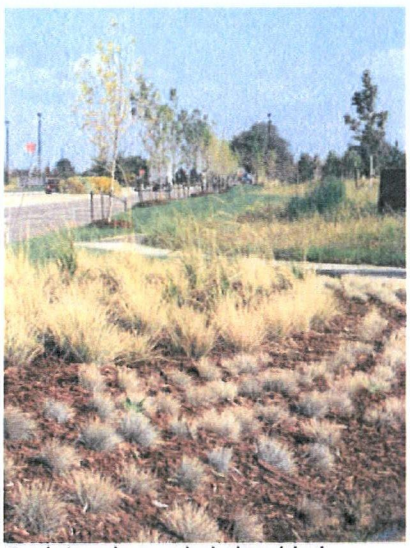
Organic mulches act to cool the soil during hot weather, thereby reducing the evaporation and subsequent water use. Mulches also reduce the growth of weeds and buffer soil temperature fluctuations throughout the year. Inorganic mulches are very beneficial and have excellent applications for specific purposes. When rock mulches are used, it is beneficial to use a variety of sizes and integrate larger boulders into the design palette to provide greater visual interest. Grouping the larger rocks together to create, for example, dry streambeds, is an effective technique. Large expanses of rock mulch by themselves are not good examples of xeriscape principles, because they create hot, hostile, and uninviting spaces. Volcanic rock will not be allowed to be used as a bed mulch.

Organic Mulch

The trees and shrubs should be placed in mulched areas rather than in turf areas so that irrigation can be zoned separately. This arrangement also facilitates easier maintenance activities. An alternative to the vast expanses of rock mulch includes dry-land grass

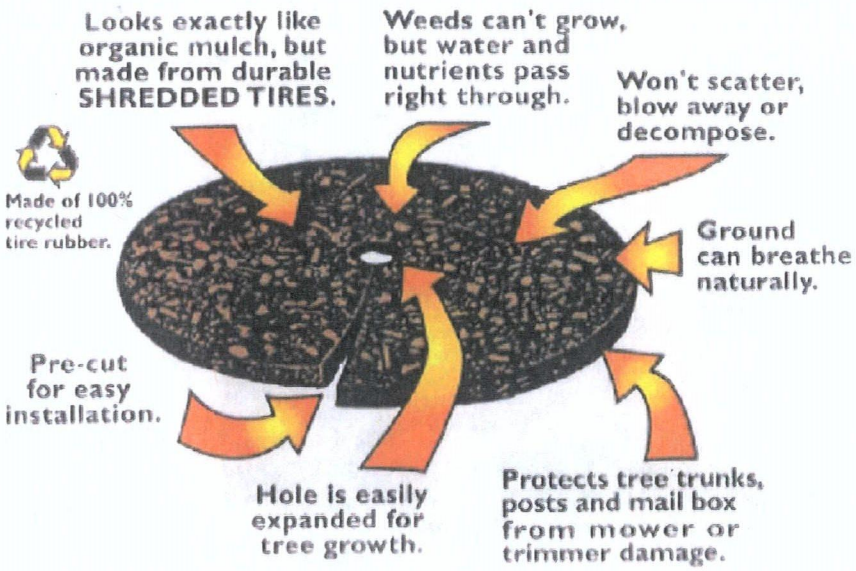
areas that receive periodic watering and mowing. Transitions from the intensive landscape to these remote areas can be created by shrub and tree masses and mowing patterns.

Approved organic tree-bark mulch.



Reclaimed recycled shredded rubber mulch is approved at Buckley AFB. Natural tree-bark mulch tends to fade and deteriorate with Colorado's high UV exposure.

Recycled rubber mulch tree ring. Cost-Benefit estimates vary widely between vendors and maintenance contractors.



Recycled shredded rubber tree rings are approved as a substitute for conventional tree-bark mulch.

5.3.6 Soil Evaluation and Improvements

The soils on Buckley Air Force Base are typically clay with fine sand or sand with silt or clay. Some soils are susceptible to collapse, and expansive soils are occasionally encountered.

Although you cannot turn clay soils into ideal planting soils, you can improve them by a variety of methods that will cause the soil particles to form small granules and crumbs. The best treatment for this purpose is to incorporate large amounts of organic matter into the soil to improve soil structure. The improved condition may remain even long after the organic matter has disappeared.

Aged one-year-old dairy manures, green plant material, compost and leaf mold are especially good for improving soil condition. Materials that decay very slowly, such as peat moss, straw, sawdust, rice hulls and shredded bark are somewhat less desirable because they do not aggregate the soil as well. These organic materials, when first incorporated into the soil, will compete with plants for the available nitrogen, an important plant nutrient. Apply extra nitrogen to the soil when using these materials, especially if you intend to plant immediately after adding the organic matter.

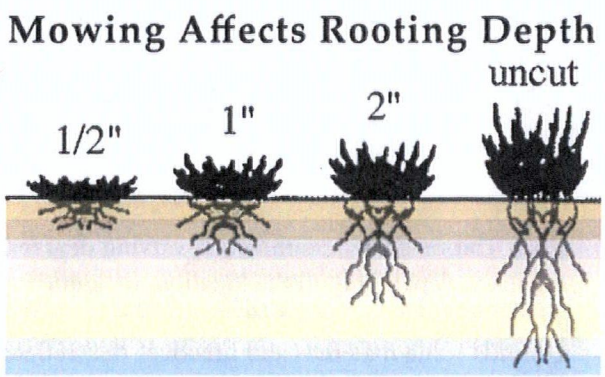
The slowly decaying materials, such as sawdust and bark, do not necessarily improve soil structure immediately. They serve mainly as fillers to increase the percentage of large pores and to improve soil permeability, or drainage. Large quantities of these materials are generally required to have value as fillers; as much as one-half, by volume of soil, could be needed for the treatment.

Gypsum is often recommended to improve clay soils. However, this amendment is primarily useful for improving sodic (alkali) soils, which often have poor structure. Gypsum will not improve a clay soil unless the soil also happens to be sodic.

Adding sludge from the waste water treatment facility has proven to be an effective soil amendment.

5.3.7 Maintenance Practices

Sound maintenance practices include regular watering, fertilizer applications, pesticide management, and sound horticultural principles. With the integration of xeriscape principles it will become more important to ensure that properly scheduled maintenance practices occur. The mowing height and mowing schedule will impact the growth, health, and appearance of the different types of grasses. For optimal root growth and drought resistance, turf grasses should be mowed at a 2 1/2" – 3" minimum. Native grass areas do not need to be mowed and in actual fact, perform and establish better if left in an unmowed condition. Mowing at a turf height exposes the crown of sensitive native grasses to direct sunlight, resulting in sunscald. If a more manicured look is necessary, management practices should be adjusted to include a 6" to 8" mowing height. Sunscald is minimized and still allows the reestablishment of the prairie. Mowing every 6 to 8 weeks during the establishment period, however, can facilitate weed control. Establishment watering is also recommended.



Non-irrigated self-sustaining grasses are the preferred ground cover for all disturbed, eroded, or degraded areas at Buckley AFB. Buffalo grass and Prairie Shortgrass should be left un-mowed.

Regular aeration and mulching of clippings reduces soil compaction, improves aeration, controls excess thatch, increases water infiltration, encourages root growth and further improves drought resistance of turf areas. Soil improvements, annual applications of organic matter and using organic mulches in the shrub beds will increase the water-holding capacity of the soil in those areas.

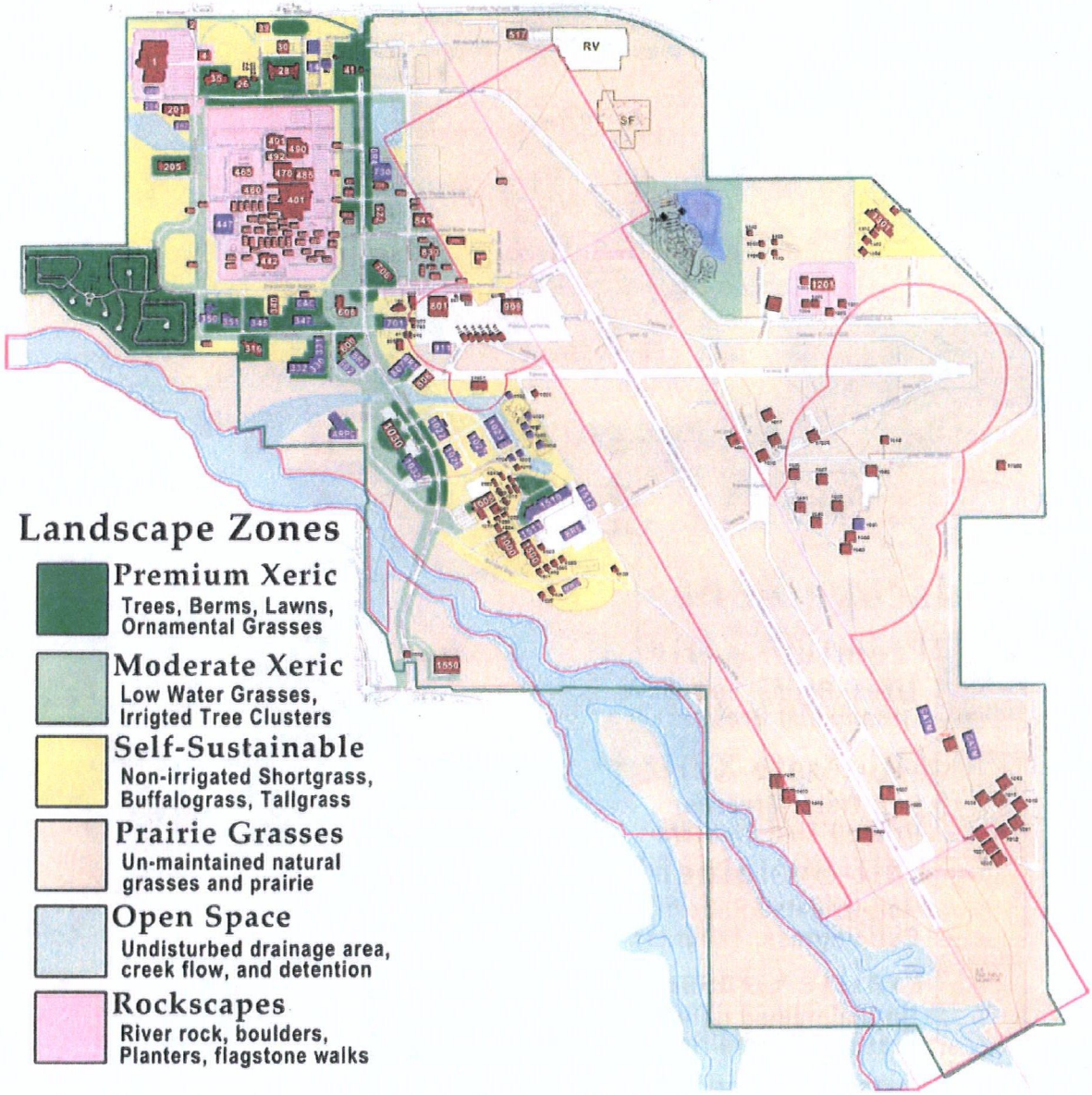
Initially, as areas are renovated and retrofitted from turf areas to shrub areas, maintenance personnel will need to become familiar with the different maintenance requirements for the new areas. This initially may result in higher maintenance costs. The time to mow, aerate, and fertilize turf areas is greater than the time required to weed, replace mulch, fertilize and clean up shrub areas.

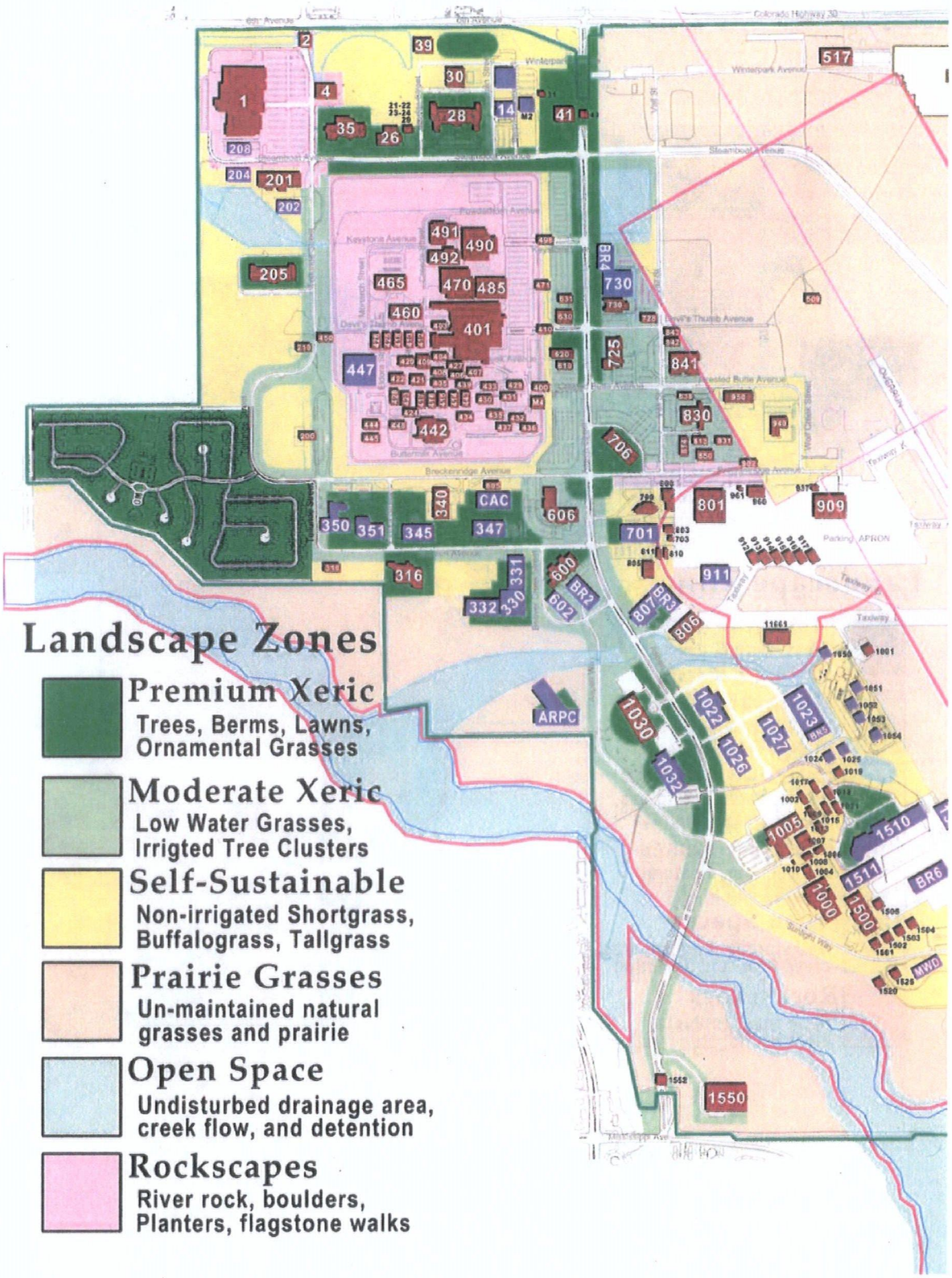
5.4 Design Guidelines

Buckley AFB has established 4 Tiers of landscape treatment (See: Base Landscape Zone Map) designed to create a refined **'Colorado High Prairie'** landscape theme throughout the Base.

- Tier 1 - Premium Landscape & Feature Areas
- Tier 2 - Moderate Landscape & Secondary Streetscapes
- Tier 3 - Self-Sustaining Non-Irrigated Prairie Grasses
- Tier 4 - Undisturbed Prairie & Open Spaces

Each Tier or Zone recommends varying degrees of density, water use, plant species, and landscape intensity, depending on the location, prominence, visibility, and function of the area. This FEP strives to enhance the visual appearance of major roadways, streetscapes, open areas, and facility grounds using materials and practices that reflect the severe shortage of water and maintenance funds available to the Base. Each Zone incorporates plant materials selected from the Buckley Plant List for low-water requirements, adaptability to high plains conditions, and pleasing aesthetic form.





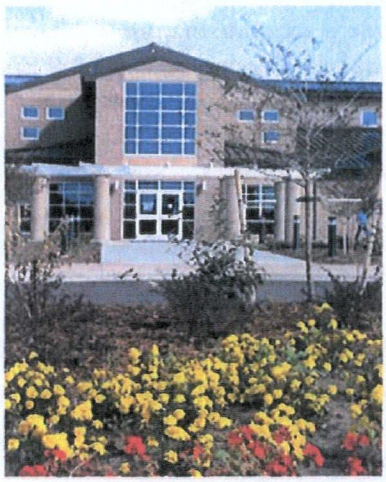
The predominant landscape theme within the developed area of the Base is clusters of Evergreen pine trees located at building entryways, patios, picnic areas, streetscapes, and, major roadway intersections. Most of these Evergreens are quite mature and healthy, some standing over 40-feet tall. Evergreen pine trees are an established design precedent at Buckley AFB, and they are an appropriate landscape feature for a Base with majestic panoramic views of the Rocky Mountains. Evergreen pine trees selected from the approved Plant List are recommended as part of good site design around all facilities, especially entry features.

This Facilities Excellence Plan offers considerable latitude and design freedom to the landscape designer. Landscaping should be designed with sufficient variety to provide year-round color and visual interest.

- Plant materials shall be selected from the Buckley Approved Plant List.
- Plant materials shall be obtained from reputable local sources and be acclimated to local climate conditions prior to planting.
- Plant materials shall meet or exceed the minimum standards of the Colorado Nursery Act,
- Deciduous Shade Trees shall be minimum 3-1/2" caliper.
- Deciduous Ornamental Trees shall be minimum 2-1/2" caliper.
- Evergreen Trees shall be minimum 8'-0" height.
- Deciduous Shrubs shall be minimum 5-gallon container, B&B preferred.
- Ornamental Grasses shall be minimum 1-gallon container, 5-gallon preferred.
- Seed grasses shall be applied at a minimum of 25-pounds per acre.

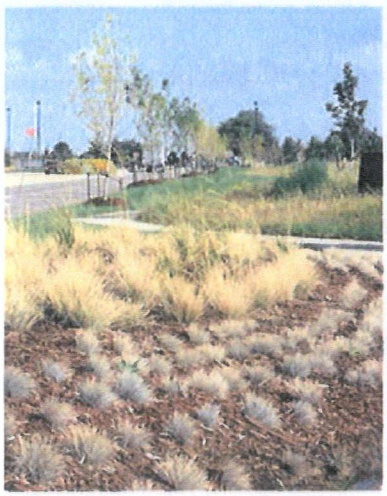
The landscape sketches included in this Chapter offer suggestions that illustrate typical applications for each of the 4 Tier Levels.

5.4.1 Tier 1: Premium Landscape



Premium Level

High-water
High-maintenance



Buckley AFB Goal: Reduce water irrigation 50% by FY 2015 (5% per year).

The Premium Zone includes the most visible and prominent areas along the North Aspen Street Corridor, Steamboat Avenue, and streetscapes within the Community Center along A-Basin Avenue and athletic fields. Small pockets of Tier 1 Premium landscaping are recommended for picnic parks, static displays, Entry Gate roadways, and other high priority facilities. Tier 1 Premium landscaping is characterized by:

- Dense clusters of ornamental grasses.
- Limited use of blue fescue turf grass and sod grass.
- Built-up berms with seeded short-grass prairie mix and shrub borders.
- Meandering pedestrian walkways with adjacent shrubs and plant beds.
- Generous use of Evergreen pine trees.
- Staggered placement of deciduous shade trees.
- Use of sod grass for athletic fields.

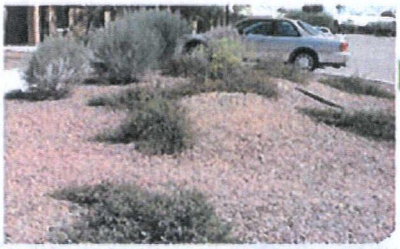
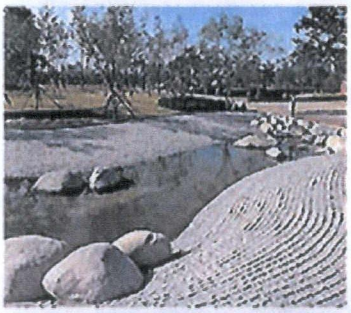
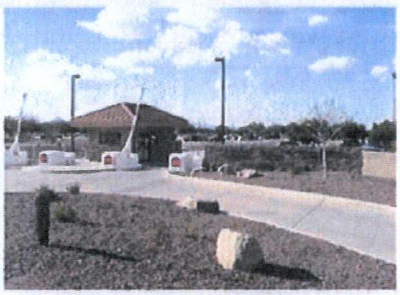
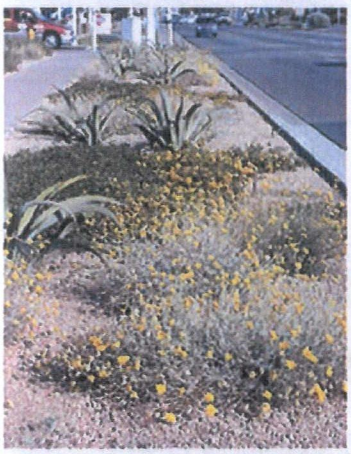
5.4.2 Tier 2: Moderate Landscape

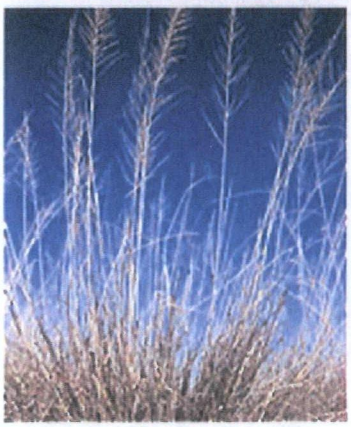
The areas identified for Moderate Landscape treatment include the South Aspen Corridor, the Telluride Loop, and some high visibility streetscapes and facilities within the Industrial Area. Tier 2 Moderate landscaping is characterized by:

- Evergreen pine trees and ornamental grasses at building entries and strategic focal locations.
- Short-grass prairie grass; fescue sod and seed grasses are prohibited.
- Limited use of deciduous shade trees.
- Limited use of built-up berms.

Tier 2 Moderate landscaping includes ornamental grasses and Xeric plant beds at focal areas. Recycled rubber mulch is recommended for long-term durability and excellent water-retention characteristics.

5.4.3 Tier 3: Self-Sustainable Landscape


Sustainable Level

Prairie Grasses &
Rockscapes
Mulch Beds
Low-maintenance
Low-water



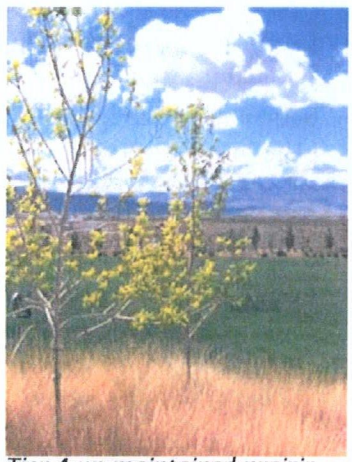
Tier 3 Self-Sustainable Landscape areas are generally located in less populated areas of the Base where erosion control is more important than visual interest. Facilities located in the Tier 3 Zone are encouraged to plant small areas of Premium landscaping at primary entrances where irrigation water is available. However the majority of Tier 3 land area will be a seeded with a variety of non-irrigated Prairie Grasses following Best Management Practices for erosion control. Sustainable Landscape areas are characterized by:

- Short-grass Prairie mix adjacent to maintained streets and buildings.
- Tall-grass Prairie mix at remote un-mowed or un-maintained areas.
- Well designed 'rockscape' beds with clusters of granite boulders.
- Limited areas of ornamental grasses, trees, and shrubs at entryways and patios, with well designed mulch beds, and meandering river rock borders.
- Wetland and Overflow grasses at detention basins and storm flow areas.

5.4.4 Tier 4: Undisturbed Prairie & Open Space

All other areas of the Base will be left in their natural non-irrigated and undisturbed state. This includes the vast majority of the East Base, the Toll Gate Creek wetlands, the storm drainage flow areas, and the Open Area buffer zones around the perimeter of the Base. Mowing is generally prohibited, except within the boundaries of the Primary Airfield.

Tier 4 Self-Sustaining non-irrigated tallgrass and Buffalo Grass is the preferred standard for erosion control throughout the developed areas of Buckley.



Tier 4 un-maintained prairie grasses are predominant throughout the East Base Industrial Area and Toll Gate Creek Open Space.

5.5 Best Management Practices for Self-Sustaining Grasses

The primary goals of landscaping at Buckley AFB are:

- Improve erosion control and protection of watersheds from excess sediment.
- Prevent soil loss due to storm water runoff and wind erosion.
- Achieve maximum water conservation by establishing Self-Sustaining non-irrigated turf grasses wherever possible.
- Prevent the intrusion of noxious weeds and pests through careful selection of plant materials.
- Improve the aesthetics and visual appeal of streetscapes and facilities with creative and responsible landscape design.

The single most effective and most visible improvement to achieve all of these goals will be an aggressive effort to re-vegetate and restore all disturbed and eroded areas within the developed area of the Base with Self-Sustaining non-irrigated prairie grasses. The Best Management Practices specified in this Section are mandatory practices enforced by Federal, State, and Local regulations.

Landscape designers and planners must incorporate Self-Sustaining non-irrigated prairie seed grasses selected from the Approved Plant List for large area turf and lawn projects. These grass mixes were designed to yield tremendous long-range benefits with a short life-cycle payback. All of the best planning and landscape design is futile if these Best Management Practices are not strictly followed.

5.5.1 - Permits & Forms

Prior to performing landscaping work at Buckley AFB the contractor shall:

- Obtain authorization and signatures on a Base Civil Engineering Work Clearance Request (AF 103). From civil engineer customer service desk.
- Obtain a Storm Water Pollution Prevention Permit from base environmental.
- Submit a Notice of Intent (NOI) to the US Environmental Protection Agency.

5.5.2 Compost

- Existing topsoil shall be removed during excavation for new construction and stockpiled at the direction of the Project Manager. The Project Manager shall evaluate the topsoil to determine if it is suitable for reapplication after seeding.
- A soil analysis shall be performed to identify any additional soil amendments that may be required.
- Organic soil amendments (compost) shall be uniformly applied over the entire landscaped area at a minimum depth of 2 inches and incorporated to a depth of 8 inches (for a 20% to 30% inclusion rate) using a rotary tiller.
- Compost shall meet or exceed US EPA Class A standard, 40 CFR Section 503. Certificates of Compliance for Compost shall be submitted indicating grade and compliance with state and local regulations.
- Pre-planting fertilizer and pH adjusting agents (e.g., lime and sulfur) may be applied before incorporation as necessary.

- Rake the soil surface smooth prior to seeding. The soil surface shall be free of large clods, roots, stones greater than 2-inches, and other material which might interfere with planting and subsequent site maintenance.
- Water thoroughly after seeding. Topdress newly seeded turf areas with ¼-inch layer of fine compost (3/8-inch screen, minus), then water to protect against hot, dry weather or drying winds.
- Where an irrigation system is unavailable, water shall be provided by the Contractor and hand applied by truck.
- The Contractor may request permission from the Base to fill water trucks from a Base fire hydrant or from the off-Base reclaimed water station. In either case water usage will be metered and billed to the Contractor.

5.5.3 Seeding

- Seed mix shall be specified by the Project Manager from the Buckley Approved Plant List published in the Facilities Excellence Plan (Short-grass Prairie Mix; Overflow Seed Mix; Tall-grass Prairie Mix; or Wetland Seed Mix).
- All seeding shall be accomplished using a drill seeded using a mechanical power drawn drill followed by packer wheels or drag chain.
- Use a drill seeder capable of handling native seed. Mechanical power-drawn drills shall have depth bands set to maintain a planting depth of at least 0.5-inches into the soil and shall be set to space the rows not more than seven (7) inches apart. Seed that is extremely small shall be sowed from a separate hopper adjusted to the proper rate of application.
- On slopes greater than 4:1 the contractor shall broadcast seed on freshly disturbed (raked or harrowed) soil surfaces. Following broadcast seeding the contractor shall immediately rake or harrow the seeds into the surface. Raking shall be accomplished using metal-tined garden or landscape rakes. If harrowing is used, an English harrow or its equivalent shall be used. Seed must be uniformly distributed in the broadcasting device, and seed must be evenly distributed throughout the limits of the project.
- Cover the applied seed with a soil thickness no greater than 0.5 inches deep.
- Add a 'Nurse Crop' seed such as oats or rye to all seed mixes. These germinate quickly, reduce soil erosion, provide quick green cover, save soil moisture, and discourage weed growth by shading the soil surface until the grass seed has proper conditions to germinate and provide cover.

5.5.4 Hydro Seeding / Hydro Mulching Prohibited

- Hydraulic seeding or hydraulic mulching is not permitted. The practice of applying grass seed to the surface of the soil along with a slurry of water and cellulose mulch has proven to have a poor performance record at Buckley AFB.

5.5.5 Planting Season

- Seeding shall be restricted according to the following timetable and specifications:
- Spring seeding is allowed from Spring thaw to May 15th, where "spring thaw" is defined as the earliest date in which seed can be buried 0.5-inches into the surface topsoil through normal drill seeding methods.
- Fall seeding is allowed from September 15th until consistent ground freeze, where "consistent ground freeze" is defined as that date on which frozen surface topsoil prevents burying the seed 0.5-inches through normal drill seeding methods.
- Seeding accomplished outside the time intervals listed above may be allowed only when the Contractor's request is approved in writing. The contractor will be responsible for re-seeding, re-mulching, and repairing any areas which fail to produce vegetation.

5.5.6 Mulch

- Mulch shall be applied after seeding, consisting of long-stemmed weed-free and seed-free straw or hay, applied at a rate of 2-tons per acre. Mulch shall be crimped into the soil surface.

5.5.7 Erosion Control Blankets

- Erosion Control Blankets shall be applied after seeding on all slopes up to 1:4 gradients. Blankets shall be machine-produced mat with a biodegradable agricultural straw matrix (0.5 lbs/sq yd). The blankets shall have a 12-month typical functional longevity and be designed for use on geotechnically stable slopes and channels with a shear stress up to 0.50 pounds per square foot.

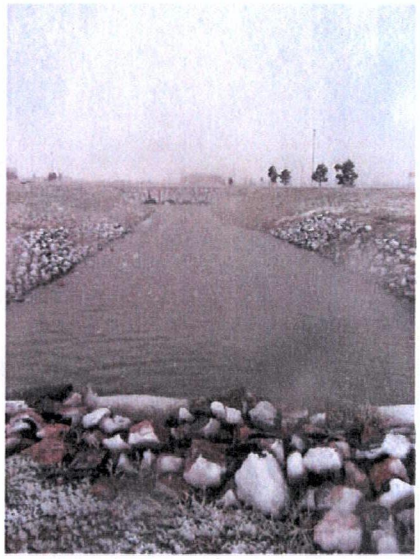
5.5.8 Vegetation Establishment

- Vegetation will be considered established when all seeded areas are assured of developing a satisfactory stand of growth. Dead spots up to 0.5 square feet in size must not exceed ten percent (10%) of the total seeded area. Dead spots greater than 0.5 square feet shall be re-seeded and freshly re-mulched.
- The site shall be free of eroded areas and free from infestation of noxious weeds.
- Upon acceptance of the seeded areas, a 90-day maintenance period will commence. During the maintenance period the Contractor is responsible for all aspects of establishment and maintenance to ensure vigorous and healthy growth of seeded species.
- The Contractor shall inspect weekly for insect damage, nutrient deficiencies, weeds, and disease and take immediate corrective action.
- Water the seeded area during the maintenance period only as necessary to maintain a healthy stand of seeded species. Over-watering will not be permitted.

6.2.4.2 Storm Water Management

The 460 SW is responsible for all aspects of stormwater management on Buckley AFB, as the permitee and operator of a Municipal Separate Storm Sewer System (MS4) issued by the US Environmental Protection Agency. This responsibility includes construction and industrial activities conducted by either the Air Force or tenant organizations.

The following items shall be used as a checklist or guide for systems in addition to the Environmental Site Requirements and documents referenced above:



The swales along Aspen Street divert most surface drainage to a wetland valley.

- Provide Storm Sewer Plans that address layout, materials, water quality, infiltration, and detention. Materials shall include, but not be limited to:
  - Reinforced Concrete Pipe
  - Flared-End Sections
  - Riprap or buried geotextile fabric
- Water Quality measures shall include products such as silt fencing, sediment logs, and more.
- Stormwater runoff volumes and velocities at new development sites shall be as close as practical to pre-development values.
- Best Management Practices (BMPs) to control erosion and sediment during construction and post-construction phases shall be utilized. Refer to the City of Aurora Drainage Criteria Manual, Urban Drainage and Flood Control District (UDFCD) volumes, and Unified Facilities Criteria (UFC) 3-210-10, Design: Low-Impact Development Manual.
- Regional detention ponds are preferred as opposed to site-specific detention ponds.
- Provide maintenance procedures/plans for drainage and water quality measures (i.e. swales, detention ponds, etc.)
- Coordinate storm sewer and storm water management design and construction with all other site utility systems both horizontally and vertically to avoid conflicts.
- Provide State SWMP/NPDES
- Coordinate with landscaping plans; specifically the seed mixes for swale, overflow, and detention areas.

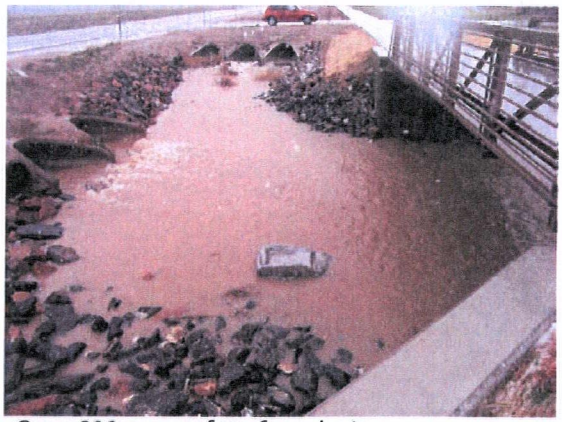
The Industrial Valley Detention Pond collects stormwater from a 300 acre area with capacity to control outflow from a 100-year flood event.

Major stormwater improvements will need to be constructed in the Beaver Creek and Aspen Way area before the future Army Reserve Personnel Center and future Medical Complex can be built in this area.

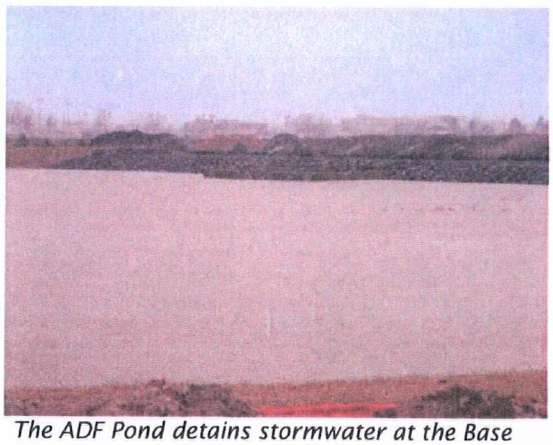
Extensive grading in progress in preparation for development of 6 large new Base facilities. Stormwater drainage patterns were the governing factor in determining new facility locations.

All manholes on the Buckley AFB storm water system shall be marked "Storm Sewer"

Micro-planning for stormwater drainage is equally important as macro regional planning.



Over 600 acres of surface drainage converge at this single point, flowing under the pedestrian bridge into the ADF Detention Pond.



The ADF Pond detains stormwater at the Base Western Perimeter before passing through a controlled outflow structure into the City of Aurora.