AIR COMBAT COMMAND

INSTALLATION SUSTAINABILITY ASSESSMENT REPORT

Desert Landscaping at Dormitory Building 330

Revised/Updated
Final
May 2012

Holloman Air Force Base
New Mexico

Sustainability assessment summary of Holloman Air Force Base to establish baseline metrics, to identify actionable opportunities and investment strategies, and year-over-year comparisons.

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"So we have a choice to make. We can remain one of the world's leading importers of foreign oil, or we can make the investments that would allow us to become the world's leading exporter of renewable energy. We can let climate change continue to go unchecked, or we can help stop it. We can let the jobs of tomorrow be created abroad, or we can create those jobs right here in America and lay the foundation for lasting prosperity."–President Obama, March 19, 2009

EXECUTIVE SUMMARY

Due to expanding requirements and diminishing resources as well as lacking holistic/integrated design approaches, HQ ACC/A7PS has formulated a process for measuring sustainability at Air Combat Command (ACC) installations. This process will establish baseline metrics to identify actionable opportunities and investment strategies, and facilitate year-to-year comparisons. There are many individual efforts already in place at HQ ACC/A7PS and at the installation level. It is within this context that the ACC Installation Sustainability Assessment (ISA) process and report was developed. This report summarizes the current and recommended sustainability efforts at Holloman Air Force Base (AFB) and provides a basis for comparison and benchmarking.

Numbers have been calculated for the five sustainability indicators at Holloman AFB for their mission support functions. Additionally, flying mission numbers have been established for the total carbon footprint and energy intensity to show their additional effect on the installation's overall impact on sustainability. The circle indicators, as shown in the chart below, represent how Holloman AFB compares to industry-recognized benchmarks[1]. Green indicates a metric is on target or better than target. Yellow indicates a metric is slightly off target. Red indicates a metric is off target.

MISSION SUPPORT			
Carbon Footprint[1]:	21,148	mTons	Yellow
Energy Usage:	602,783	MMBTU	Green
Water Conservation:	396.35	Mg	Red
Waste Production:	3,170	tons	Green
Land Utilization:	184	SF/acre	Yellow

FLYING MISSION			
Carbon Footprint:	113,723	mTons	Red
Energy Usage:	1,602,150	MMBTU	Green

[1]Does not include commuting

SF = square feet; mTons = metric tons; Mg = million gallons; MMBTU = million British thermal units

Fiscal year (FY) 10 is the inaugural year for the ISA report; therefore, this report does not provide year-to-year comparisons but it does establish a baseline for all future measurements.

ACC has a solid history of successes with sustainability initiatives; however, progressive action must continue. This report outlines a concise, measurable, and repeatable process that can be utilized year to year. Upon this installation's yearly assessment and data analysis, recommendations and actionable items will be established and monitored. ACC HQ/A7PS's role includes identifying synergies between installations to implement new and bridge existing sustainability initiatives. The ACC HQ/A7PS ISA will deliver a positive return on investment and promote leadership in sustainable initiatives.

[1]Industry recognized benchmarks are noted where referenced within the report.

I. INTRODUCTION

A. Installation Sustainability Assessment (ISA) Definition

The Installation Sustainability Assessment (ISA) is a process by which an installation's relative level of sustainability can be measured, identifies and recommends installation-specific improvement strategies, and it is expressed in five key indicators: (1) Carbon Footprint, (2) Energy Usage, (3) Water Conservation, (4) Waste Reduction, and (5) Land Utilization. Identified improvement strategies will allow for the bridging of diverse sustainable initiatives (i.e., energy, heat island effect, water conservation, habitat/watershed protection, and restoration, new construction practices) and a more efficient implementation of these initiatives as it will account for installation-wide conditions. Additionally, overall review of completed ISAs will provide valuable trend analysis across installations. Direct comparison of installations is not the focus due to differing missions, climate variations, and unique installation attributes.

Sustainable design is a design philosophy that seeks to maximize the quality of the community and the built environment while minimizing or eliminating the negative impact to the natural environment. The word installation is defined as the grounds and buildings that belong to a given institution, and specifically refers to the Air Force installation in this document. Sustainability initiatives include conscious efforts to protect habitats, optimize land use, produce zero waste, reduce heat islands, improve air quality, reduce light pollution, use energy efficiently, and maintain the health and well-being for a community.

Initiatives to improve on a particular established indicator typically will also have an effect on other indicators. In determining and prioritizing actionable items, it is important to take into account this interaction to determine which initiatives will result in the most positive outcome and highest return on investment.

B. ISA and the DoD Strategic Sustainability Performance Plan

The *Installation Sustainability Assessment* (ISA) process, metrics, and indicators were initially developed in 2009 by HQ ACC as a means for measuring the overall "green posture" of the installation. In late 2010, the Department of Defense (DoD) published the Strategic Sustainability Performance Plan (SSPP) that identified department wide goals.

HQ ACC reevaluated the ISA process, metrics, and indicators in light of policy established in the SSPP in order to determine if there were conflicts or if changes were needed in the ISA.

The following table provides a summary of the evaluation. The ISA anticipated and aligned favorably with the broad goals and policy in the SSPP. Few modifications in the ISA data collection were needed and those have been fully incorporated into this updated ISA. The SSPP identified some goals that are completely outside the ability of the ISA to collect and report as, to the best of our knowledge; this information is not currently being collected (recall that the ISA relies on collecting data from existing sources).

Bottom Line: The ISA will remain ACC's tool for evaluating the progress of an installation towards the goals and performance expectations of the SSPP.

The following headers are provided in the following table.

- *SSPP Goals* are the goals and sub-goals taken directly from DoD's SSPP.
- *Changes to Align ISAs with SSPP Goals* shows three categories addressing how the ISA aligned with the SSPP.
    - *Few/No ISA Changes* indicates that the original data collect and the data input format of the ISA aligned very closely with the SSPP. *Modifications* that were needed have been incorporated into the ISA.
    - *ISA Additions (data available)* means that the ISA did not originally collect or have a data input format for these goals that were eventually identified in the SSPP. For the most part the data is available *for* collection. However, some of the data may not be easily accessible. Modifications to the ISA spreadsheet have been made for inputting the new data.
    - *Goals outside the ability of the ISA to collect and report* refer to goals that are not applicable to ACC *installations*. It also includes goals for which installations do not have the ability to collect the data for measuring progress against the goal.
- *Data Status and Location* addresses the location within the electronic ISA worksheet where data can be found and inputted in order to calculate progress towards meeting the SSPP goals. It also identifies what data has been collected for each goal.

COMPARISON AND ALIGNMENT OF ISA AND SSPP

SSPP Goals		Changes to Align ISAs with SSPP Goals			Data Status and Location
		Few/No ISA Changes	ISA Additions (Data Available)	Goals Outside the Ability of the ISA to Collect and Report	
Goal 1	**Use of Fossil Fuels Reduced**				
Sub-Goal 1.1	Energy intensity of facilities reduced by 30% of FY03 levels by FY15 and 37.5% by FY20	●			• Data collected in the ISA is acceptable. • Data input under the Energy Tab Spreadsheets.
Sub-Goal 1.2	18.3% of energy consumed by facilities is produced or procured from renewable sources by FY20	●			• Data collected in the ISA is acceptable. • Data input under the Energy Tab Spreadsheets. • Sustainable Measures Tab worksheet shows a separate table for facilities with the energy intensity bar chart showing the renewable component.
Sub-Goal 1.3	Use of petroleum products by vehicle fleets reduced by 30% by FY20 relative to FY05	●			• Data collected in the ISA acceptable. • Data input under the Energy Tab Spreadsheets. • Sustainable Measures tab shows reduction in transportation energy use and separates petroleum and renewable sources.
Goal 2	**Water Resources Management Improved**				
Sub-Goal 2.1	Potable water consumption intensity by facilities reduced by 26% of FY07 levels by FY20 Assessment of ISA	●			• Data collected in the ISA is acceptable. • Data input under the Water Tab Spreadsheets. • Sustainable Measures Tab shows the percent improvement from baseline in the per built SF table.
Sub-Goal 2.2	Reduce industrial and irrigation water consumption 20% by FY20 from FY10 baseline			●	• Water Tab spreadsheet updated to provide data entry points for when data becomes available. • Data not currently available for input in the ISA for this metric. No separate metering for industrial uses.
Sub-Goal 2.3	All development and redevelopment projects of 5,000 square feet or greater maintaining pre-development hydrology to the maximum extent technically feasible		●		• Water Tab spreadsheet modified to add a yes/no box with a percent compliance. • Data not originally collected for sub-goal.
Goal 3	**Greenhouse Gas Emission from Scope 1 and 2 Sources Reduced 34% by FY20, Relative to FY08**	●			• Data collected in the ISA is acceptable. • Data input under the Energy Tab Spreadsheets.
Goal 4	**Greenhouse Gas Emission from Scope 3 Sources Reduced 13.5% by FY20, Relative to FY08**				
Sub-Goal 4.1	Greenhouse gas emission from employee air travel reduced 15% FY20 relative to FY11		●		• Operations Tab spreadsheet modified to a yes/no box with a percent compliance. • Data not originally collected for sub-goal.
Sub-Goal 4.2	30% of eligible employees teleworking at least once a week, on a regular, recurring basis, by FY20		●		• Operations Tab spreadsheet modified to a yes/no box with a percent compliance. • Data not originally collected for sub-goal.
Sub-Goal 4.3	50% of non-hazardous waste diverted from disposal in landfills not owned by DoD by FY15, and thereafter through FY20	●			• Data collected in the ISA is acceptable. • Waste Management Tab has a check box for verification of the waste is going to non-DoD landfill.

COMPARISON AND ALIGNMENT OF ISA AND SSPP

SSPP Goals		Changes to Align ISAs with SSPP Goals: Few/No ISA Changes	Changes to Align ISAs with SSPP Goals: ISA Additions (Data Available)	Changes to Align ISAs with SSPP Goals: Goals Outside the Ability of the ISA to Collect and Report	Data Status and Location
Goal 5	**Solid Waste Minimized and Optimally Managed**				
Sub-Goal 5.1	All DoD organizations implementing policies by FY14 to reduce the use of printing paper		●		• Operations Tab spreadsheet modified to a yes/no box with a percent compliance. • Data not originally collected for sub-goal.
Sub-Goal 5.2	50% of non-hazardous solid waste diverted from the waste stream by FY15, and thereafter through FY20—not including construction and demolition debris	●			• Data collected in the ISA is acceptable. • Data input under the Waste Management Tab Spreadsheets.
Sub-Goal 5.3	60% of construction and demolition debris diverted from the waste stream by FY15, and thereafter through FY20		●		• Waste Management Tab spreadsheet modified to add a header for C&D debris. • Data not originally collected for sub-goal.
Sub-Goal 5.4	Ten landfills recovering landfill gas for use by DoD by FY20			●	• Not applicable to ACC installations.
Goal 6	**The Use and Release of Chemicals of Environmental Concern Minimized**				
Sub-Goal 6.1	On-site releases and off-site transfers of toxic chemicals reduced 15% by FY20, relative to FY07		●		• Waste Management Tab spreadsheet modified for listing reportable quantities. • Data not originally collected for sub-goal.
Sub-Goal 6.2	100% of excess or surplus electronic products disposed of in environmentally sound manner		●		• Operations Tab spreadsheet modified to a yes/no box with a percent compliance. • Data not originally collected for sub-goal.
Sub-Goal 6.3	100% of DoD personnel and contractors who apply pesticides are properly certified through FY20		●		• Operations Tab spreadsheet modified to a yes/no box with a percent compliance. • Data not originally collected for sub-goal.
Goal 7	**Sustainability Practices Become the Norm**				
Sub-Goal 7.1	95% of procurement conducted sustainably				• Operations Tab spreadsheet modified to a yes/no box with a percent compliance.
Sub-Goal 7.2	15% of existing buildings conform to the guiding principles on high performance and sustainable buildings by FY15, holding through FY20			●	• ACC/A7PS is evaluating how to implement this goal.
Goal 8	**Sustainability Built into DoD Management Systems**				
Sub-Goal 8.1	All environmental management systems effectively implemented and maintained		●		• Operations Tab spreadsheet modified to a yes/no box with a percent compliance. • Data not originally collected for sub-goal. Data is available.
Sub-Goal 8.2	Sustainability of transportation and energy choices in surrounding areas optimized by coordinating with related regional and local planning		●		• Operations Tab spreadsheet modified to a yes/no box with a percent compliance. • Data not originally collected for sub-goal. Data is available.
Sub-Goal 8.3	All DoD installations have Integrated Pest Management Plans prepared, reviewed, and updated annually by pest management professionals		●		• Operations Tab spreadsheet modified to include a year and review date. • Data not originally collected for sub-goal. Data is available.

C. Goals and Objectives

The ISA has been established to formulate a process for measuring sustainability at the installation level. ISAs take a comprehensive look at ACC installations and will address, at a minimum, current use of renewable energy, green procurement practices, infrastructure systems, existing facility operations, conservation plans, environmental compliance, biological resources, habitat protection, watershed restoration, land use, and environmental stewardship.

The ISA will be used to:

- Report the findings
- Establish a baseline for year-to-year comparisons
- Define sustainable initiatives
- Identify synergistic opportunities between diverse initiatives
- Support the Mission, improve the quality of life, and conserve resources over time
- Create an awareness of impacts and a catalyst for cultural change

D. Setting the Context

Flying Mission:

Flying Mission includes anything that directly affects or has direct participation in flight. The flying mission calculations currently take into account fuel usage only.

Mission Support:

Mission Support includes all other activities on the installation. Mission support calculations include resources consumption for everything except flying mission fuel consumption. .

E. Process

1. Data Collection Categories

The ISA categories are a way of grouping data that was collected and used to calculate a set of sustainability criteria. In summary, the ISA data collection categories are:

1. **Development—**Includes land use, building utilization, transportation, noise, and light emissions.
2. **Energy—**Includes electrical, gas, oil, and liquid propane gas consumption; power purchased from utility or generated on site; and transportation and mission fuels for government vehicles and support equipment.
3. **Water—**Includes domestic, irrigation, and storm water as well as its source and its usage.
4. **Waste—**Includes solid and liquid waste production and its usage.
5. **Operations—**Includes best management practices (BMPs) such as procurement, training, maintenance, and purchasing program for energy efficient equipment.

The following defines the five data collection categories in more detail:

Development:

Expanding human requirements and economic activities are placing ever-increasing pressures on land resources, creating competition and conflicts and resulting in suboptimal use of resources. By examining all land uses in an integrated manner, it is possible to minimize conflicts, make the most efficient tradeoffs, and link social and economic development with environmental protection and enhancement, thus helping to achieve the objectives of sustainable development.

Land use refers to the activities practiced by humans on land. Land supports uses such as residential, industrial, and commercial facilities; recreational areas; natural infrastructure areas; and transportation functions. Integrating a green infrastructure with community connectivity in land use planning is essential to achieving sustainable developments as they incorporate multiple environmental benefits including:

- Reducing storm water runoff volumes and reducing peak flows by using the natural retention and absorption capabilities of vegetation and soils.

  The capacity of the land can be generally categorized as either pervious or impervious. Pervious includes areas that allow rainwater to pass through them and soak into the ground instead of flowing into storm drains. Impervious includes areas that are mainly constructed surfaces covered by impenetrable materials such as asphalt, concrete, brick, and stone. These materials seal surfaces, repel water, and prevent precipitation and melt water from infiltrating soils. Impervious surface areas include rooftops, sidewalks, roads, and parking lots. The impacts of increased impervious surfaces to storm water runoff should be controlled to mimic natural conditions and to protect water quality. Increasing the amount of pervious ground cover increases storm water infiltration rates that reduces the volume of runoff entering our combined or separate sewer systems, and ultimately our lakes, rivers, and streams.

- Improving the rate at which groundwater aquifers are recharged or replenished.

  Groundwater provides approximately 40 percent of the water needed to maintain normal base flow rates in our rivers and streams. Enhanced groundwater recharge can also boost the supply of drinking water for private and public uses.

- Preventing pollutants from being transported to nearby surface waters.

  Once runoff is infiltrated into soils, plants and microbes can naturally filter and break down many common pollutants found in storm water.

- Limiting the frequency of sewer overflow events by using the natural retention and infiltration capabilities of plants and soils which will reduce runoff volumes and delay storm water discharges.

- Capturing and removing carbon dioxide (CO_2) from the atmosphere via photosynthesis and other natural processes of plants and soils that serve as sources of carbon sequestration.

- Mitigating the effects of urban heat islands and reducing energy demands by providing increased amounts of urban green space and vegetation.

  Urban heat islands form as communities replace natural land cover with dense concentrations of pavement, buildings, and other surfaces that absorb and retain heat. Heat from the sun is absorbed by impervious surface areas and is radiated back into the atmosphere, increasing temperatures in the surrounding area. Additionally, buildings and streets trap and concentrate waste heat from vehicles, factories, and air conditioners. The displacement of trees and vegetation minimizes their natural cooling effects. Trees, green roofs, and other green infrastructure lower the demand for air conditioning energy, thereby decreasing emissions from power plants.

- Improving air quality by incorporating trees and vegetation in urban landscapes.

  Trees and vegetation absorb certain pollutants from the air through leaf uptake and contact removal. If widely planted throughout a community, trees and plants can even cool the air and slow the temperature-dependent reaction that forms ground-level ozone pollution.

- Providing increased access to recreational spaces and wildlife habitats including greenways, parks, urban forests, wetlands, and vegetated swales.

- Impacting overall human health by providing vegetation and green space.

  Research has linked the presence of trees, plants, and green space to provide a stronger sense of community, improved performance, and even reductions in physical and mental illnesses.

- Improving accessibility by reducing travel distances and improving transportation options by creating nodes such as rideshare and bus stops.

  Community connectivity, or clustering, refers to land use patterns in which related activities are located in proximity to one another. Clustering makes it easier to do things such as run several errands at the same time or socialize.

- Protecting greenfields and preserving habitat and natural resources by clustering buildings.

- Reducing greenhouse gas emissions contributing to the carbon footprint as a result of decreased vehicle use travelling to and from sites.

  Transportation fuel consumption and emissions contribute to climate change, smog, and particulate pollution, all of which have negative impacts on human health.

- Controlling noise levels below 65 decibels that is considered an acceptable level in suitable living environments.

  The Noise Control Act of 1972 (Public Law 92-574) directs federal agencies to comply with applicable federal, state, interstate, and local noise control regulations. Sound quality criteria disseminated by the U.S. Environmental Protection Agency (USEPA), the U.S. Department of Housing and Urban Development (HUD), and the Department of Defense (DOD) have identified noise levels to protect public health and welfare with an adequate margin of safety. Responses to noise vary depending on the type and characteristics of the noise, the expected level of noise, the distance between the noise source and the receptor, the receptor's sensitivity, and the time of day. These levels are considered acceptable guidelines for assessing noise conditions in an environmental setting.

- Reducing light pollution through fixture types, direction of light, lighting control, and improved airfield lighting.

Energy:

Energy is constantly consumed for the operations of every installation. Data is already being collected by installation personnel to capture all energy sources used at the installation, including transportation fuels and mission fuels. Energy sources may include petroleum, natural gas, electricity, coal, and renewable resources such as hydropower, solar, wind, geothermal, biomass, and ethanol. Using existing data, the amount and type of energy consumed is further analyzed to establish a baseline measure for year-to-year comparisons and to monitor the reduction of energy consumption.

Energy usage results in undesired emissions into the environment. Installations typically do not monitor all emissions. Collecting the installation energy data provides the opportunity to calculate a carbon footprint measure (Flying Mission and Mission Support) for the installation that can be monitored year to year.

Water:

The current water distribution systems at most installations and communities are designed to meet multiple supply needs:

- Potable requirements (e.g., drinking, cooking, cleaning, etc.)
- Firefighting
- Municipal, commercial, and industrial needs
- Non-potable applications (e.g., toilet flushing, landscape irrigation, heating, cooling, etc.)

In some areas of the United States, dual distribution systems have been implemented that provide a primary system for delivering high-quality drinking water and a secondary system for non-potable water applications. By using alternative sources for water supplies either to meet non-potable needs or to replenish existing water sources, higher-quality sources of drinking water can be preserved. Capacity and functionality of alternative infrastructure systems need to be considered in cases where separate systems are provided for potable and non-potable applications (e.g., water reuse and recovering gray water, rain water, or storm water).

Per the Energy Independence and Security Act (EISA) of 2007, any development or redevelopment project involving a Federal facility with a footprint that exceeds 5,000 square feet (SF) shall use site planning, design, construction, and maintenance strategies for the property to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to temperature, rate, volume, and duration of flow. As mentioned under the Development category, storm water is critical to sustainable development. The combination of reducing water consumption; reusing storm, gray, and waste water as water sources; and treating runoff are sustainability goals related to water/storm water.

Waste:

Solid and liquid waste on an installation consists of paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, and hazardous wastes, each of which take their own time to degenerate. The size of the annual waste stream is determined from monthly waste-hauling reports detailing the total tons and cost of the waste that has been hauled. Waste streams include landfill, recycling, hazardous, compost, and any others that are being used on the installation.

Responsible waste management of hazardous and nonhazardous waste is essential to protecting human health and the environment. This includes conserving resources by reducing waste, preventing future waste disposal problems by enforcing regulations, and cleaning up areas where waste may have been improperly disposed.

Wastewater is any water that has been adversely affected in quality by human influence. In the most common usage, it refers to the municipal wastewater that contains a broad spectrum of contaminants resulting from the mixing of wastewaters from different sources. Grey water comprises 50 to 80 percent of the wastewater produced from such activities as dish washing, laundry, and bathing. The amount of the annual wastewater produced on an installation is calculated as a percentage of the reported total monthly gallons and cost of the municipal domestic water consumption.

Treated wastewater can be used for irrigation, fire protection, toilet flushing, artificial wetlands, processing, and cooling towers. Reusing wastewater contributes to conserving water and protecting waterways.

Operations:

Operational BMPs that have been found to be an effective and practical means in protecting or enhancing the environment include such activities as green procurement of goods and services, training, maintenance, and purchasing programs for energy-efficient equipment.

Green procurement is the purchase of environmentally preferable products and services for things such as recycled paper, green cleaning supplies, office products, and printing services. In addition to being cost effective, green procurement reduces the amount of solid and hazardous waste generated and reduces consumption of energy and natural resources.

Proper training of operations and maintenance staff on the use of building systems results in energy savings with minimal upfront investment. The environment benefits from less energy being consumed and less emissions being put into the atmosphere and the building owner benefits from the cost savings associated with less energy being used.

In commercial buildings, use of equipment is the fastest-growing consumer of electricity. Purchasing and using energy-efficient equipment and appliances saves on the total energy being used and the costs associated with their use.

2. Preliminary Research and Data Collection

HQ ACC/A7PS obtained applicable data and reports for the installation from available resources. Examples of reports used as data sources include the Integrated Natural Resources Management Plan, Integrated Cultural Resources Management Plan (ICRMP), Storm Water Pollution Prevention Plan, Integrated Water Quality Management Plan, Drinking Water Management Plan, Pollution Prevention Management Plan, Hazardous Waste Management Plan, Solid and Hazardous Waste Compliance, Economic Impact Statement, Environmental Restoration Program Site Summaries Report, Department of Energy Report, Transportation Fuel Reports, Real Property Reports, and geographical information system database. Information gathered is from resources that already exist. Creation of new reports/data by installation personnel is not required.

3. On-Site Evaluation and Data Collection

A four-person A/E team consisting of an architect, a civil engineer, and two urban planner/designers met with base personnel and surveyed and documented base assets the week of 15 November 2010. While at the installation, the A/E team interviewed available environmental, engineering, and operations flight staff, such as, but not limited to, natural and cultural resources; air, water, and solid and hazardous waste managers; civil, electrical, and mechanical engineering; community planning; energy and lighting, including high-voltage alternating current (HVAC) maintenance; engineering; procurement; and real property personnel to supplement the data collected previously from HQ ACC/A7PS as well as to collect data not previously obtained.

4. Data Analysis

The data collected was entered in the pre-established spreadsheet form. Pre-established sustainability indicators were calculated that are quantifiable, repeatable, simple, and represent installation-wide sustainability conditions. The metrics establish a baseline for year-to-year comparison, and document compliance or non-compliance with Federal guidance and other applicable agency governances (e.g., Executive Orders (EOs), Energy Policy Act (EPAct) 2005, EISA 2007, MAJCOM directives, etc.).

5. Findings Summary

This report and supporting documentation is a compilation and summary of the information collected and the sustainability indicators calculated for Holloman AFB. The data was evaluated using criteria and protocol that is standard to this initiative and provides a consistent reporting structure. HQ ACC/A7PS will review these results and conclusions to identify potential projects, policy changes, incentives, and year-to-year comparisons.

The following defines the sustainability indicators and methodologies in more detail.

Carbon Footprint:

Carbon Footprint is the measure of the impact human activities have on the environment in terms of greenhouse gas emissions produced, measured in tons of CO_2.

Gases that trap heat in the atmosphere are referred to as greenhouse gases. Some greenhouse gases, such as CO_2, occur naturally and are emitted to the atmosphere through natural processes and human activities. Other greenhouse gases are created and emitted solely through human activities. Human activities typically produce the following greenhouse gases:

- **CO_2—**CO_2 is produced through the burning of fossil fuels (oil, natural gas, and coal), solid waste, and trees and wood products. CO_2 is also produced as a result of other chemical reactions.
- **Methane (CH_4)—**CH_4 is emitted during the production and transport of coal, natural gas, and oil. CH_4 emissions also result from livestock and other agricultural practices and by the decay of organic waste in municipal solid waste landfills.
- **Nitrous Oxide (N_2O)—**N_2O is emitted during agricultural and industrial activities as well as during combustion of fossil fuels and solid waste.
- **Fluorinated Gases—**Hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride are synthetic, powerful greenhouse gases that are emitted from a variety of industrial processes.

In the U.S., energy-related activities account for three-quarters of our human-generated greenhouse gas emissions, mostly in the form of CO_2 emissions from burning fossil fuels. More than half the energy-related emissions come from large stationary sources such as power plants, while approximately one-third comes from transportation. Industrial processes (such as the production of cement, steel, and aluminum), agriculture, forestry, other land use, and waste management are also important sources of greenhouse gas emissions in the U.S. (USEPA).

For reporting carbon footprint, the General Reporting Protocol v1.1 May 2008 from The Climate Registry was used. This protocol was used to calculate the carbon footprint, as it is one of the most widely accepted systems in the U.S. and offers a relatively simple approach that can be adapted to installation-wide systems. Where data was available, Scope I and Scope II emissions and some of Scope III emissions have been included. Scope I emissions are all direct greenhouse gases from combustion sources to refrigerant leaks. Scope II includes indirect greenhouse gas emissions from offsite power generation. For this report, Scope III includes an estimate of employee commuting greenhouse gas emissions. Where possible, direct calculations of materials consumed or released to calculate the equivalent greenhouse gas emissions have been used. In some cases, the use of generalized lookup figures and/or averages to generate quantities of emissions has been allowed. It is important to track the greenhouse gas emissions relative to mission fuels and transportation fuels to allow comparisons to other public and corporate entities.

Energy Usage:

Energy usage is integral to every facet of our daily lives and is a critical component of a sustainable installation. The long-term reliance on non-renewable resources can be decreased and renewable resources can be developed in an environmentally and economically responsible manner. This potential for improved energy usage is important as carbon-based energy sources are the most significant contributor to greenhouse gas emissions.

For reporting energy use, actual usage data from the base was captured from reporting practices in the government. For the purposes of this project, the energy usage data was separated into building/site energy and transportation categories. Transportation data was further broken down into flying mission and mission support categories along with quantifying which energy sources are from bio-based (green) and/or renewable sources. These numbers are used to provide energy consumption relative to full-time equivalent (FTE) and installation building square footages along with allowing analysis of green/renewable sources and Flying Mission versus Mission Support consumption. It was important to separate mission energy consumption from standard transportation due to the large amount of fuels required for aircraft. This separation also provides a fair comparison to other public campuses or corporate entities.

Water Conservation:

As the demand for fresh, clean water for irrigation and industry increases, underground aquifers are being drained faster than they can be refilled. Pollution and changing climatic conditions are adding to the burden on fresh water supplies. Poor land development creates more impervious surfaces which generate higher levels of runoff, while more natural areas decrease the amount of runoff.

For reporting water conservation, the domestic water use is captured and compared to the installation population and building square footages for comparison year to year.

Storm water conservation is based on comparing the 2-year post development calculation to a 2-year pre-development (greenfield) calculation using the U.S. Department of Agriculture, Natural Resource Conservation Service (NRCS), Soil Conservation Service Method as outlined in Urban Hydrology for Small Watersheds Technical Release 55. Any increase in runoff has the potential for contaminated or polluted waters from parking lots, streets, and the airfield to reach water systems off site, resulting in a need for improved containment and/or treatment.

Waste Reduction:

Every economic activity produces waste. The average human uses 45 to 85 tons of materials each year. Due to diminishing resources and recent legislation, bases need to reduce the amount of waste produced and increase the amount of waste recovered. Composting has the potential to significantly alter the amount of waste thrown into local landfills.

For reporting waste reduction, data is captured regarding total waste, landfill, recycling, compost, hazardous, and the costs associate with each. The data is compared to installation population, USEPA recommended guidelines, and tracked year to year.

Land Utilization:

Community sustainability requires a transition from poorly managed sprawl to land use planning practices that create and maintain efficient infrastructure, ensure a sense of community, and preserve natural systems. Many current land use practices have converged to generate haphazard, inefficient, and unsustainable sprawl. Stratified land use policies and inadequate funding for demolition of obsolete facilities isolates employment locations, shopping and services, and housing locations from each other, thereby creating excessive transportation and creating excessive hard surfaced areas.

For reporting land use, source data was gathered on the installation that provides a baseline site area along with area breakdowns for buildable, non-buildable, and habitat areas. Combining this information with building footprints and building areas by category/use codes allows the breakdown of land use and utilization of the installation. Some of the starting basic calculations include total building area relative to the buildable land along with the total non-built or green area relative to the entire site. An attempt was made to provide a reference of built area relative to the site occupancy. Currently, the square footage per FTE being used to provide a comparison of building area against the installation's population and to depict the utilization of the building space is twice the code-recommended square footage.

6. Recommendations

The recommendations described in this report are derived from the specific information obtained at the installation and are intended for further definition and development of projects that would have a direct and viable impact for the sustainability of the installation. The recommendations are categorized within the pre-established sustainability indicators. Ultimately, this list will be used to develop a prioritized group of projects.

II. INSTALLATION INFORMATION

A. Background

Holloman AFB is located in Otero County, in southeastern New Mexico, approximately six miles west of Alamogordo. Within its contiguous boundaries (main base) are 52,411 acres, including a recent land parcel transfer of 1,262 acres from the Bureau of Land Management near the Lake Holloman complex in the southwestern portion of the base (National Defense Authorization Act 1994). The installation has water rights on an additional 7,332 acres of noncontiguous land in the Boles Wells Water System Annex (BWWSA) and Bonito Lake. Holloman AFB is bounded to the northwest by the U.S. Army-administered White Sands Missile Range (WSMR), which extends roughly 100 miles to the north and south and 40 miles east and west, as well as by the White Sands Monument on the southwest corner of the base.

The base is located at the center of the Tularosa Basin. Surrounding mountain fronts vary in vegetation cover from xerophytic shrublands, to juniper-pinyon savannas, to high mountain meadows at their peaks. Dominating the area are diverse, broad expanses of lowland desert environments, including gypsum dunelands punctuated by playas and intermittent drainages.

Major land areas include the following (INRMP, 2010):

- The Cantonment comprises approximately 8,000 acres within the southern portion of the base. The landscape has been highly modified to accommodate the majority of functions conducted by the military, including base housing and personnel support facilities. Topography is relatively level, with elevations ranging from 4,042 feet in the far northeast corner to 4,127 feet west of the airfield. Although the natural landscape has been fragmented by broad road networks and permanent structures, nearly 60% is covered in native vegetation.
- The dunelands and High-speed Test Track areas comprise approximately 23,000 acres and extend roughly from the test track facilities to the Holloman AFB western boundary. The striking natural features of the area are the constantly transforming white gypsum sand dunes that progressively grade eastward into the alluvial flat shrublands with gypsiferous soils.
- The northern grass-shrubland area north of Douglas Road is approximately 19,000 acres. From this nearly level and moderately undulating topography, Tularosa (Tula) Peak rises abruptly 984 feet above the surrounding basin floor. Broad, deeply incised drainages move alluviated materials from upland reaches westward into the dunes.
- Lake Holloman wetland complex public access area comprises approximately 1,800 acres north of U.S. Highway 70 and 131 acres south of the highway in the southernmost part of the base, directly south of the Cantonment. Prominent physical features within the unit are Lake Holloman and Stinky Playa. In 1997, in cooperation with the U.S. Fish and Wildlife Service (USFWS), Holloman AFB built a system of berms, ditches, and control structures to create a wetland roughly encompassing the area between Lagoon G and Lake Holloman. Prior to the establishment of the constructed wetland, surface water comprised 222 acres and included the group of lagoons north of Lagoon G. This area serves as the water containment for treated sewage effluent from the Holloman AFB wastewater treatment plant. By law, the area is open to the public.

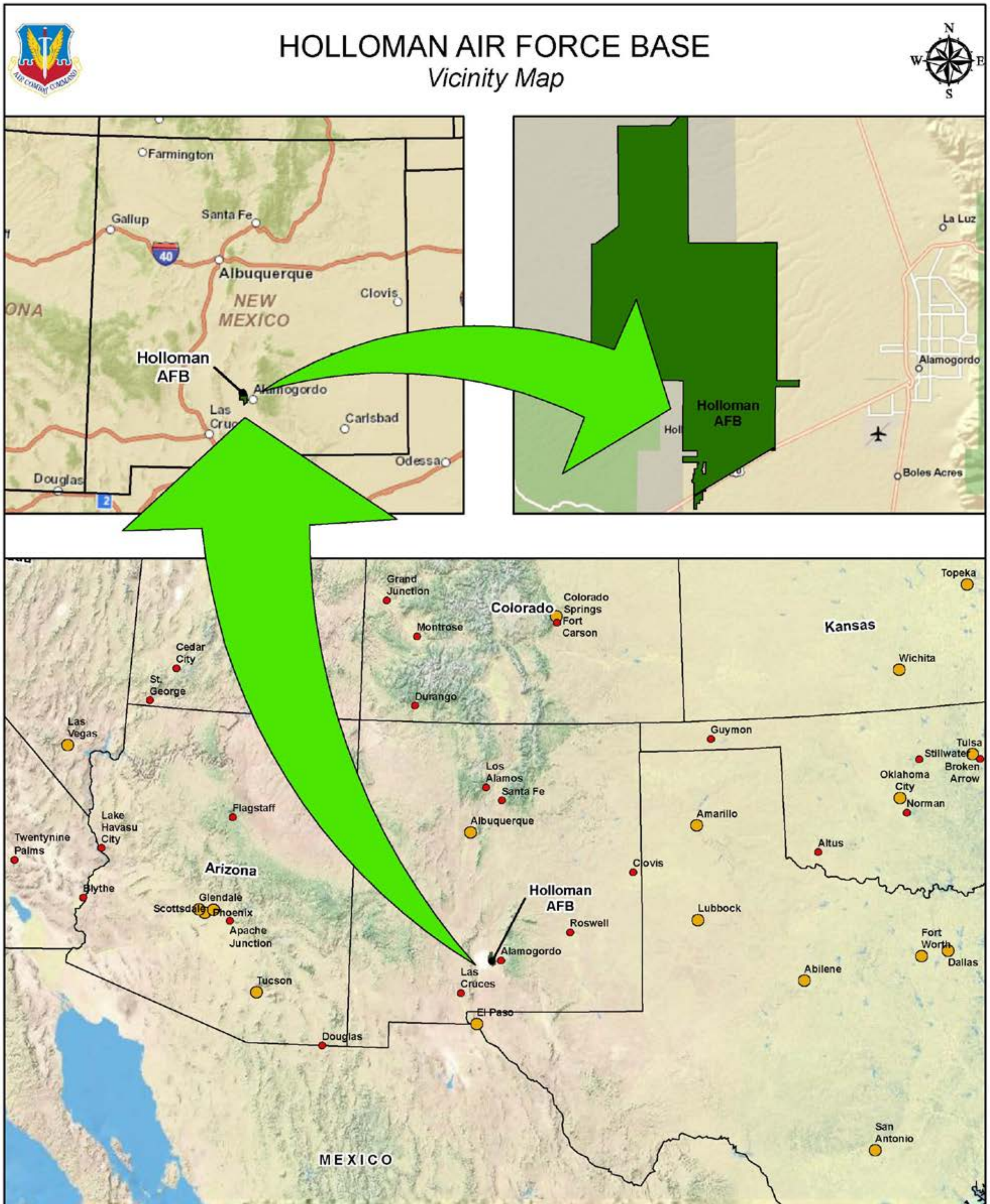
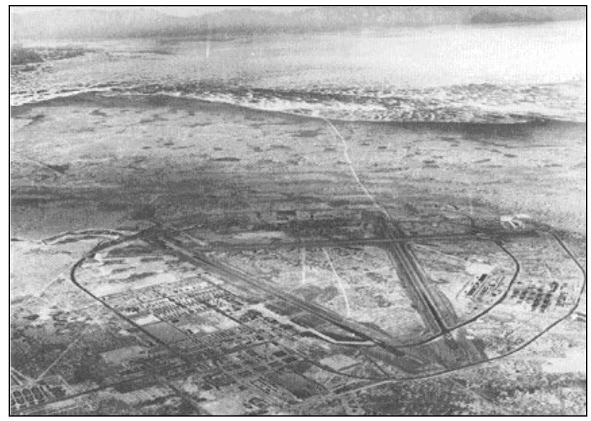

HOLLOMAN AIR FORCE BASE
Vicinity Map
N
W
E
S
Farmington
Gallup
Santa Fe
40
Albuquerque
NEW MEXICO
Clovis
Holloman AFB
Alamogordo
Las Cruces
Carlsbad
Odessa
Douglas
La Luz
Alamogordo
Holloman AFB
Boles Acres
Grand Junction
Colorado
Colorado Springs
Fort Carson
Montrose
Kansas
Topeka
Wichita
Cedar City
St. George
Durango
Las Vegas
Guymon
Tulsa
Stillwater
Broken Arrow
Oklahoma City
Norman
Los Alamos
Santa Fe
Flagstaff
Albuquerque
Amarillo
Lake Havasu City
Twentynine Palms
Arizona
Altus
Clovis
Blythe
Glendale
Scottsdale
Phoenix
Apache Junction
Holloman AFB
Roswell
Lubbock
Alamogordo
Fort Worth
Dallas
Las Cruces
Tucson
Abilene
El Paso
Douglas
San Antonio
MEXICO

Figure 1-1

B. History

On 13 April 1941, the Alamogordo Army Air Field (AAAF) was established and construction began on an extensive bombing and gunnery range later known as the Alamogordo Bombing and Gunnery Range. Facilities were designed to mimic the Royal Air Force base, used in the British Training Program for World War II bomber crews. A Royal Air Force base is typically made up of a cantonment area, west area, and north area. From 1942 through 1945, the AAAF served as a training base for more than 20 different bomber groups, including B-17s, B-24s, and B-29s. Typically, these groups trained their personnel for about six months before deploying to combat in either the Pacific or European theaters (INRMP, 2010).



Almodorgo Army Air Field, 1944

On 16 July 1945, in the northwest corner of the Alamogordo Bombing and Gunnery Range (now WSMR), the first atomic bomb was detonated at the Trinity Site. In 1946, more lands became available within the Tularosa Basin and Holloman AFB was reassigned to be a missile development facility. By 1947, the Air Force became a separate service and AAAF was transferred to the Air Materiel Command to conduct guided missile programs. On 13 January 1948, the base was renamed Holloman AFB after Col. George V. Holloman, an early pioneer in guided-missile development. The range was 64 miles long, running north and south, and 38 miles wide. At this time, the Army Ordnance Corps built White Sands Proving Ground, with a range just south of these lands. The combined range of these facilities was 100 miles long and 40 miles wide (Mattson and Tagg 1995). Under army management, on 01 September 1952, the Holloman AFB Bombing and Gunnery Range was combined with the Army Range to form the "Integrated White Sands Range" (INRMP, 2010).

From 1952 to 1970, missile development and testing included the Snark, Matador, Mace, Falcon, Aerobee, JB-2 Loom, and Firebee missiles. High-speed sled tests, high-altitude balloon projects, and Aeromedical Field Laboratory experiments were also conducted. During this time, the Central Inertial Guidance Test Facility and the Radar Target Scatter Test Facility were developed. The Primate Research Facility trained the first chimpanzee to make a suborbital flight and the first chimpanzee (Enos) to orbit the earth. In 1972, the base was taken over by Tactical Air Command and became primarily a fighter base with some developmental testing continued. On 15 November 1991, command responsibility passed from the 833rd Air Division to the 49th Fighter Wing. Today, the 49th Fighter Wing provides leadership to the installation. Two projects started during the Cold War continue on the base, the High-speed Test Track and the Primate Research Lab (both are considered tenant organizations) (INRMP, 2010).

C. Mission

Holloman AFB is one of the Air Combat Command resources under the 12th Air Force, headquartered at Davis-Monthan AFB, Arizona. The 12th Air Force controls ACC forces based in the western United States and Panama and is the air component for U.S. Southern Command and U.S. Strategic Command (battle management). It also has Joint Task Force/Battle Management responsibilities for U.S. Strategic Command. Since 2004, the 12th Air Force has served as the Air Force model for the future of the combined Air and Space Operations Centers.

Holloman AFB is home to the 49th Fighter Wing. The wing provides F-22 Raptors, combat-ready training for Airmen, and training for MQ-1 Predator and MQ-9 Reaper pilots and sensor operators, as well as continuing support to the German Tornados. The 49th Fighter Wing serves as the forefront of military operations, with capability to rapidly mobilize and deploy assets and personnel worldwide to meet peacetime and wartime contingencies.

The mission of the base is to maintain over 50 years of 49er excellence by providing:

- Mission-ready forces and equipment to meet worldwide contingencies
- The best training for our people and international aircrews
- Quality support for all base personnel, associate units, and the local community

The 49th Fighter Wing formerly supported national security objectives, as directed by the Joint Chiefs of Staff, with F-117 Nighthawks. The mission has changed to higher capability F-22A squadrons for training and deployment. The Wing can rapidly mobilize and deploy worldwide to meet peacetime and wartime contingencies. The 49th provides training and fighter weapons instructor courses for German Air Force aircrews. The 49th Fighter Wing provides morale, welfare, and administrative support for over 4,200 assigned personnel.

F-22 Raptor, Holloman AFB

D. Geography

The Base has a total area of 81.9 square miles, of which less than 0.1 square miles of it is water.

Coordinates: 32°51′09″N 106°06′23″W

State: New Mexico

County: Otero County

Elevation: Elevation is 4,093 feet above mean sea level

Terrain: Nearly level to gently sloping

Soils: Soils at Holloman AFB are well drained and unstable. All soils have a high gypsum and salt content and are composed of the Holloman-Gypsum and -Yesum soil complex that covers more than two-thirds of the installation. None of the installation soils are very productive due to high gypsum and salt content. Base soils are very corrosive due to the high concentration of soluble salts

E. Climate

Holloman AFB is located in a semi-arid region within the northern portion of the Chihuahuan Desert. The climate resembles other semi-arid regions with warm to hot summer days, cool nights, and mild winters.

Temperature: December through March are the coolest months with average temperatures ranging from 41-46°F. Freezing temperatures are common from late November through early March.

July is typically the hottest month, with average temperatures of 81°F and mean maximum temperatures of 93°F. Daytime temperatures in summer commonly reach 100°F (INRMP, 2010).

Precipitation: Ranifall averages 8.6 inches annually. Nearly half this amount falls within the months of July through September). Snowfall averages 4.8 inches annually and occurs primarily between the months of December and February.

Evapotranspiration is usually high due to dry air, large daily solar radiation totals, seasonally high winds, and warm temperatures. The annual evaporation rate at Holloman AFB is between 65 and 70 inches with 40 to 45 inches lost from May to October. Low precipitation amounts and high rates of evapotranspiration deplete the soil of moisture, making summer rains critical to the survival of plants and animals (INRMP, 2010).

Humidity: Average Annual Relative Humidity measured at El Paso (NOAA, average 1987 to current):

TIME OF DAY	RELATIVE HUMIDITY
5:00 AM	57%
11:00 AM	35%
5:00 PM	27%
11:00 PM	45%

Wind: The highest wind speeds occur from April through July, reaching median speeds of 25 mph. At 13-18 mph, velocities are great enough to pick up large amounts of dust; and winds from 32-46 mph will break twigs from trees. During the month of May, wind velocities are greater than 17 mph, approximately 90% of the time. From February to June, prevailing winds are from the west. During July to September, the prevailing winds are south to southeasterly, and from October through January, the prevailing winds are from the north (INRMP, 2010).

Holloman AFB Wind Power Classification is 2-3 (marginal–fair).

WIND POWER CLASSIFICATION	WIND POWER DENSITY	WIND SPEED
2-3	200 to 400 w/m² @ 50m aboveground level	12.5 to 15.7 mph @ 50m aboveground level
Source: National Renewable Energy Laboratory, http://www.nrel.gov/gis/wind.html w/m² = watt per square meter; m = meter; mph = miles per hour		

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

F. Demographics

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

G. Water

Surface Waters:

The Lake Holloman wetland complex at the southern part of the base covers 1,898 acres. There are a total of 868 acres of jurisdictional waters, including 120 acres of wetlands and 750 acres of non-wetland waters.

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

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

Groundwater:

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

Potable Water:

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

H. Plants and Animals

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

[2] a watercourse that conducts an intermittent or ephemeral flow


White Sands Pupfish

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


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

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

I. Cultural Resources

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

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

J. Recreation

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

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

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

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

- **White Sands National Monument—**Self-guided hiking trails, primitive overnight camping and picnicking
- **Lincoln National Forest—**Camping, hunting, and hiking

- **Oliver Lee State Park—**Camping, picnicking, hiking trails, and an illustration of some of the history of turn-of-the-century ranch life found in Otero Country

K. Regional Priority Credits (RPC)

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

SSc6.1—Storm Water Design and Quantity Control

Intent—Limit disruption of natural hydrology by reducing impervious coverage, increasing on-site infiltration, reducing or eliminating pollution from on-site storm water runoff and eliminating contaminants.

SSc7.1—Heat Island Effect (Non-Roof)

Intent—Reduce heat islands to minimize impacts on microclimates and human and wildlife habitats.

SSc7.2—Heat Island Effect (Roof)

Intent—To reduce heat islands' to minimize impacts on microclimates and human and wildlife habitats

WEc.1 (Option 1, 50 Percent)—Water Efficient Landscaping

Intent—Limit or eliminate the use of other natural surface or subsurface water resources available on or near the project site for landscaping irrigation

WEc.3 (Percentage Reduction Required, 40 Percent)—Water Use Reduction

Intent—Further increase water efficiency within buildings to reduce the burden on municipal water supply and wastewater systems.

EAc.2 (Percentage of Renewable Energy Required, 9 Percent)—Onsite Renewable Energy

Intent—Encourage and recognize increasing levels of on-site renewable energy self-supply to reduce environmental and economic impacts associated with fossil fuel energy use.

III. FINDINGS

A. Description

A set of five sustainability indicators has been established to summarize the installation's level of sustainability: 1) Carbon Footprint, 2) Energy Usage, 3) Water Conservation, 4) Waste Reduction, and 5) Land Utilization. These indicators have been established to consolidate the large amount of data analyzed into a few comprehensive outputs.

The findings associated with the indicators presented below are based on the population and consumption numbers presented in the following table.

POPULATION AND CONSUMPTION NUMBERS, HOLLOMAN AFB

Base Area (acres)	52,411
Usable Building Area (SF, 2010)	6,131,154
Base Population	
Military	4,241
Civilian	2,893
Dependent Population (2007)	4,583
2010 Energy Use[1]	
Electric Use (kWh)	77,399,597
Natural Gas (cf)	238,435,000
Potable Water (Mgal)	396.35
2010 Mission Fuel Usage (gal)	
Aviation Fuels	11,887,185
Diesel	134,849
Gasoline Fuel	265,848
2009 Non-Mission Fuel Usage (gal)	
Diesel	164,306
Gas fuel	137,589
Bio Diesel	13,057
Waste[2]	3,170
Municipal Waste (tons)	3,141.7
Municipal Waste Recycled (tons)[3]	1,066

[1]Base only; no housing
[2]Includes landfill, recycling, compost, hazardous, and other
[3]1,181 tons of concrete and asphalt construction/ demolition debris diverted from the landfill and stored on-site in FY10
SF = square feet, kWh = kilowatts hour, cf = thousand cubic feet, Mgal = million gallons, and gal = gallons

B. Current Sustainability Indicators

Refer to the following pages for a summary of findings for the five sustainability indicators for Holloman AFB.

1. Holloman Carbon Footprint

In the context of the ISA, carbon footprint is a measure of the Carbon Dioxide (CO2) and other Greenhouse Gas (GHG) generated to produce energy that is used by the installation. Each energy source has an associated CO2/GHG value based on the source (e.g., gas, coal, solar, etc.) and the process used to convert fuels (e.g. gasoline engine, jet engine, oil furnace, etc.) to a usable form.

Total Carbon Footprint Holloman AFB is 134,871 mTons (includes Flying and Support Missions)

ACC and Holloman AFB jointly need to establish a goal for the installation's carbon footprint. Currently, based on industry benchmarks, Holloman AFB produces an average carbon footprint for mission support transportation and facilities and a larger one for flying mission shown on the following page.

Annual Total Mission Support Carbon Footprint for Holloman AFB is 21,148 mTons

MISSION SUPPORT—Transportation[5] (No Commuting[3])

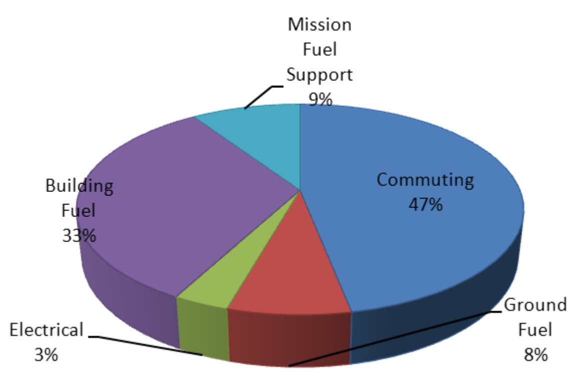
Annual Total Carbon Footprint: 6,736 mTons

Per FTE	Baseline (2005):	(A)	mTons/FTE/year
	Previous Year: (2008)	(A)	mTons/FTE/year
	Current Year (2009):	0.94	mTons/FTE/year
	Benchmark[1]:	7.54	mTons/FTE/year
	% Reduction from Baseline:	-	
	% Reduction from Previous Year:	-	
Per Built SF	Baseline (2005):	(A)	mTons/1,000 SF/year
	Previous Year (2008):	(A)	mTons/1,000 SF/year
	Current Year (2009):	1.17	mTons/1,000 SF/year
	Benchmark[2]:	20.44	mTons/1,000 SF/year
	% Reduction from Baseline:	-	
	% Reduction from Previous Year:	-	

MISSION SUPPORT—Facilities[6]

Annual Total Carbon Footprint: 14,412 mTons

Per FTE	Baseline (2003):	2.99	mTons/FTE/year
	Previous Year (2009):	1.73	mTons/FTE/year
	Current Year (2010):	2.02	mTons/FTE/year
	Benchmark[1]:	7.54	mTons/FTE/year
	% Reduction from Baseline:	32%	
	% Reduction from Previous Year:	-17%	
Per Built SF	Baseline (2003):	4.04	mTons/1,000 SF/year
	Previous Year (2008):	2.15	mTons/1,000 SF/year
	Current Year (2010):	2.50	mTons/1,000 SF/year
	Benchmark[2]:	20.44	mTons/1,000 SF/year
	% Reduction from Baseline:	38%	
	% Reduction from Previous Year:	-17%	



MISSION SUPPORT CARBON FOOTPRINT[4] (INCLUDES COMMUTING[3])

[1]Per the American College and University Presidents' Climate Commitment (ACUPCC), the weighted average for college campus' carbon footprint based on 2008 reportings is 7.54 mTons/FTE.
[2]Per the American College and University Presidents' Climate Commitment (ACUPCC), the weighted average for college campus' carbon footprint based on 2008 reportings is 20.44 mTons/1,000 SF.
[3]Greenhouse gases from personal commuting (i.e., back and forth to work) is not included in the Mission Support Transportation calculation table because personal commuting is not part of the SSPP goals. However, in order to gain an understanding of the base's energy/carbon footprint from commuting it is included in the pie chart as a percentage of the Mission Support footprint.
[4]Definitions for pie chart categories can be found in IV. Glossary of Terms and Abbreviations.
[5]Mission Support—Transportation includes ground fuel and mission support fuel quantities shown in the pie chart.
[6]Mission Support—Facilities includes electrical and building fuels shown in the pie chart.
(A) = Data is incomplete.

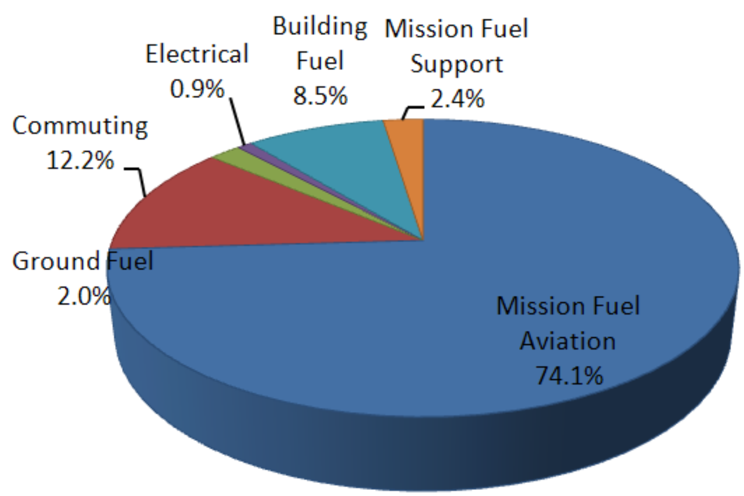
1a. Holloman Carbon Footprint—Flying Mission

Annual Total Flying Mission Carbon Footprint for Holloman AFB is 113,723mTons

FLYING MISSION[1]

Annual Total Carbon Footprint:	113,723	mTons	
Baseline (2003):	(A)	mTons/FTE/year	Per FTE
Previous Year (2009):	15.63	mTons/FTE/year	
Current Year (2010):	15.94	mTons/FTE/year	
Benchmark[1]:	7.54	mTons/FTE/year	
% Reduction from Baseline:	-		
% Reduction from Previous Year:	-2%		
Baseline (2003):	(A)	mTons/1,000 SF/year	Per Built SF
Previous Year (2009):	19.38	mTons/1,000 SF/year	
Current Year (2010):	19.73	mTons/1,000 SF/year	
Benchmark[2]:	20.44	mTons/1,000 SF/year	
% Reduction from Baseline:	-		
% Reduction from Previous Year:	-2%		

Flying Mission, Support, and Commuting Carbon Footprint Percentages



TOTAL CARBON FOOTPRINT[4]
FLYING, SUPPORT, AND COMMUTING

- The total grassland needed to offset the total carbon footprint
  for Mission Support is 53,107 acres = 4 times the installation area
  for Flying Mission is 204,738 acres = 1.5 times the installation area
- The Flying Mission carbon footprint is equivalent to 39 Pentagons
  1 Pentagon = 77,015,000 cu. ft.

[1]Per the American College and University Presidents' Climate Commitment (ACUPCC), the weighted average for college campus' carbon footprint based on 2008 reportings is 7.54 mTons/FTE.
[2]Per the American College and University Presidents' Climate Commitment (ACUPCC), the weighted average for college campus' carbon footprint based on 2008 reportings is 20.44 mTons/1,000 SF.
[3]Definitions for pie chart categories can be found in IV. Glossary of Terms and Abbreviations.
(A) = Data is incomplete.

2. Holloman Energy Usage

Total Energy Usage Holloman AFB is 2,204,933 MMBTU (includes Flying and Support Missions)

ACC and Holloman AFB jointly need to establish a goal for the installation's carbon footprint. Currently, based on industry benchmarks, Holloman AFB produces a low energy use footprint for both Mission Support activities and Flying Mission activities shown on the following page.

Annual Total Mission Support Energy Usage for Holloman AFB is 602,783 MMBTU

MISSION SUPPORT—Transportation[5] (No Commuting[3])

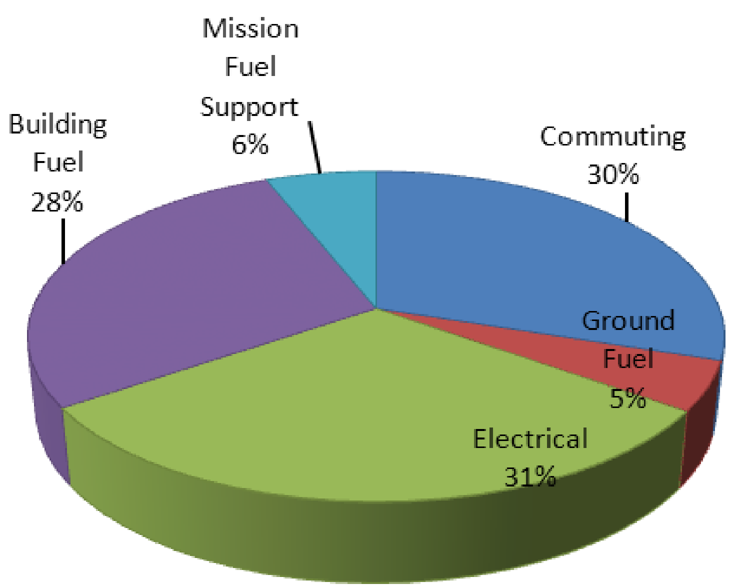
Annual Total Energy Usage: 93,584 MMBTU

Per FTE	Baseline (2005):	(A)	MMBTU/FTE/year
	Previous Year (2008):	(A)	MMBTU/FTE/year
	Current Year (2009):	13.12	MMBTU/FTE/year
	Benchmark[1]:	327.00	MMBTU/FTE/year
	% Reduction from Baseline:	-	
	% Reduction from Previous Year:	-	
Per Built SF	Baseline (2005):	(A)	MMBTU/SF/year
	Previous Year (2008):	(A)	MMBTU/SF/year
	Current Year (2009):	0.02	MMBTU/SF/year
	Benchmark[2]:	0.13	MMBTU/SF/year
	% of Energy from Renewable Source:	0.4%	
	% Reduction from Baseline:	-	
	% Reduction from Previous Year:	-	

MISSION SUPPORT—Facilities[6]

Annual Total Energy Usage: 509,199 MMBTU

Per FTE	Baseline (2003):	97.11	MMBTU/FTE/year
	Previous Year (2009):	64.30	MMBTU/FTE/year
	Current Year (2010):	71.38	MMBTU/FTE/year
	Benchmark[1]:	327.00	MMBTU/FTE/year
	% Reduction from Baseline:	26%	
	% Reduction from Previous Year:	-11%	
Per Built SF	Baseline (2003):	0.13	MMBTU/SF/year
	Previous Year (2009):	0.08	MMBTU/SF/year
	Current Year (2010):	0.09	MMBTU/SF/year
	Benchmark[2]:	0.13	MMBTU/SF/year
	% of Energy from Renewable Source:	0%	
	% Reduction from Baseline:	33%	
	% Reduction from Previous Year:	-11%	



MISSION SUPPORT ENERGY USAGE[4] (INCLUDES COMMUTING[3])

[1]Per the American College and University Presidents' Climate Commitment (ACUPCC), the weighted average for college campus' carbon footprint based on 2008 reportings is 7.54 mTons/FTE.
[2]Per the American College and University Presidents' Climate Commitment (ACUPCC), the weighted average for college campus' carbon footprint based on 2008 reportings is 20.44 mTons/1,000 SF.
[3]Greenhouse gases from personal commuting (i.e., back and forth to work) is not included in the Mission Support Transportation calculation table because personal commuting is not part of the SSPP goals. However, in order to gain an understanding of the base's energy/carbon footprint from commuting it is included in the pie chart as a percentage of the Mission Support footprint.
[4]Definitions for pie chart categories can be found in IV. Glossary of Terms and Abbreviations.
[5]Mission Support—Transportation includes ground fuel and mission support fuel quantities shown in the pie chart.
[6]Mission Support—Facilities includes electrical and building fuels shown in the pie chart.
(A) = Data is incomplete.

2a. Holloman Energy Usage - Flying Mission

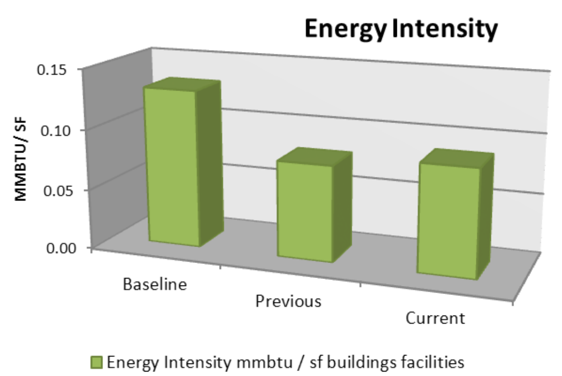
Annual Total Flying Mission Energy Usage for Holloman AFB is 1,602,150 MMBTU

FLYING MISSION

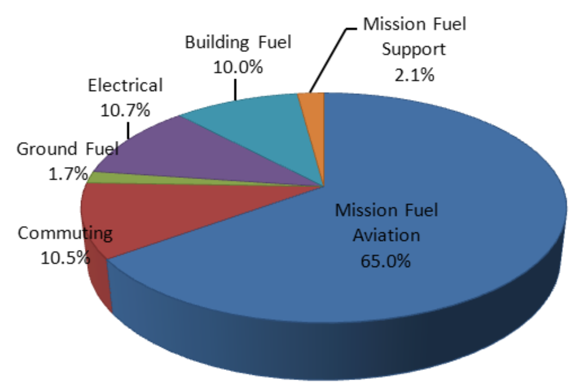
Annual Total Energy Usage:	1,602,150	MMBTU	
Baseline (2003):	(A)	MMBTU/FTE/year	**Per FTE**
Previous Year (2009):	220.26	MMBTU/FTE/year	
Current Year (2010):	224.58	MMBTU/FTE/year	
Benchmark[1]:	327.00	MMBTU/FTE/year	
% Reduction from Baseline:	-		
% Reduction from Previous Year:	-2%		

Baseline (2003):	(A)	MMBTU/SF/year	**Per Built SF**
Previous Year (2009):	0.27	MMBTU/SF/year	
Current Year (2010):	0.28	MMBTU/SF/year	
Benchmark[2]:	0.40	MMBTU/SF/year	
% Reduction from Baseline:	-		
% Reduction from Previous Year:	-2%		

Energy Intensity per Square Foot of Total Building Space



Flying Mission, Support, and Commuting Energy Usage Percentages



TOTAL ENERGY USAGE[3]
FLYING, SUPPORT, AND COMMUTING

- % of total energy from a renewable source
  for Mission Support is 12%
  for Flying Mission is 3%

[1]Per the American College and University Presidents' Climate Commitment (ACUPCC), the weighted average for college campus' carbon footprint based on 2008 reportings is 7.54 mTons/FTE.
[2]Per the American College and University Presidents' Climate Commitment (ACUPCC), the weighted average for college campus' carbon footprint based on 2008 reportings is 20.44 mTons/1,000 SF.
[3]Definitions for pie chart categories can be found in IV. Glossary of Terms and Abbreviations.
(A) = Data is incomplete.

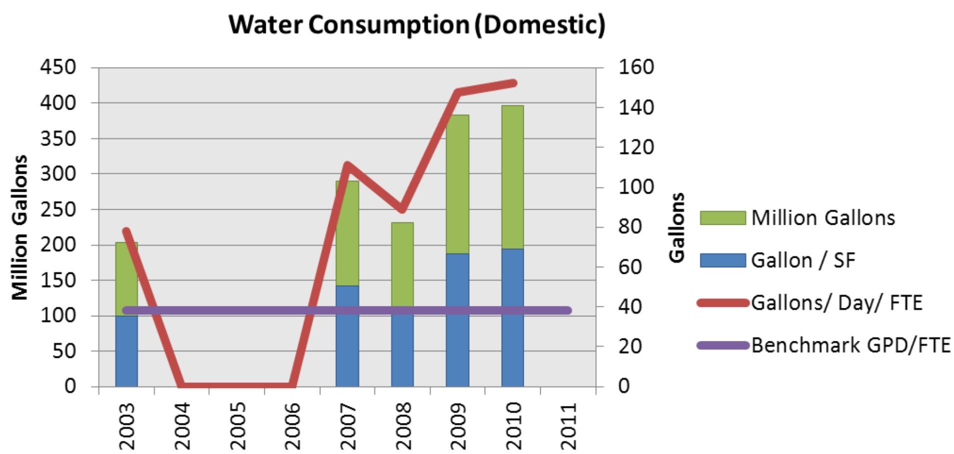
3. Holloman Water Conservation

ACC and Holloman AFB jointly need to establish a goal for the installation's water conservation. Currently, based on industry benchmarks, Holloman AFB has water consumption per FTE above the benchmark range.

MISSION SUPPORT

Annual Total Water Consumption:	396.35	Million Gallons	
Baseline (2007):	111.31	Gallon/FTE/day	**Per FTE**
Previous Year (2009):	147.35	Gallon/FTE/day	
Current Year (2010):	152.21	Gallon/FTE/day	
Benchmark[1]:	28-38	Gallon/FTE/day	
% Reduction from Baseline:	-27%		
% Reduction from Previous Year:	-3%		

Baseline (2007)):	50.35	Gallon/FTE/day	**Per Built SF**
Previous Year (2009):	66.65	Gallon/FTE/day	
Current Year (2010):	68.85	Gallon/FTE/day	
Benchmark[2]:	-	Gallon/FTE/day	
% Reduction from Baseline:	-27%		
% Reduction from Previous Year:	-3%		



[1]Per Yudelson Associates, Benchmarking Campus Sustainability, 2010.
[2]Benchmark has yet to be established relative to an AFB. This could be established either through the initial ISA investigation or through an additional research project.
(A) = Data is incomplete.

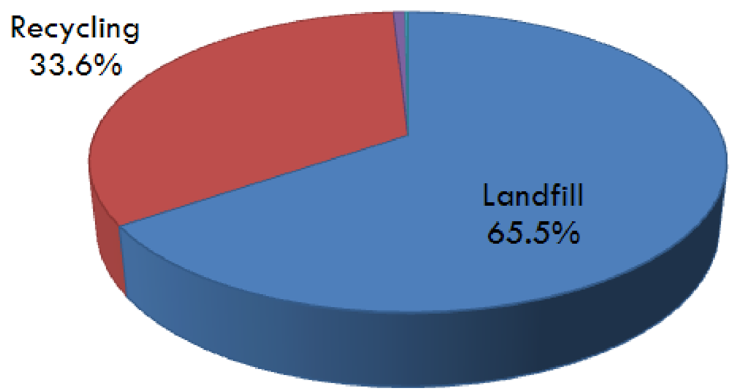
4. Holloman Waste Reduction

ACC and Holloman AFB jointly need to establish a goal for the installation's solid waste reduction. Currently, based on industry benchmarks, Holloman AFB produces a low amount of solid waste.

MISSION SUPPORT

Annual Total Waste Production:	3,170	Tons	
Current Year (2009):	2.43	LBS/FTE/day	Per FTE
Benchmark[1]:	4.62	LBS/FTE/day	

Current Year (2009):	1.10	LBS/SF/day	Per Built SF
Benchmark[2]:	-	LBS/SF/day	
% Non-Hazardous Waste Diverted from Landfill	34%		



- Total % of composted waste material
  Currently is 0%

[1]Per the USEPA Municipal Solid Waste in The United States: 2007 Facts and Figures, the annual municipal solid waste (MSW) generation rate in 1960 was just 2.68 pounds (lbs.) per person per day; it grew to 3.66 lbs. per person per day in 1980, reached 4.50 lbs. per person per day in 1990, and increased to 4.65 lbs. per person per day in 2000. Since 2000, MSW generation has remained fairly steady. The generation rate was 4.62 lbs. per person per day in 2007.

[2]Benchmark has yet to be established relative to an AFB. This could be established either through the initial ISA investigation or through an additional research project.

5. Holloman Land Utilization

ACC and Holloman AFB jointly need to establish a goal for the installation's land utilization. Currently, based on industry benchmarks, Holloman AFB building density is significant under the benchmark of 60,000 SF/acre while the amount of square footage per FTE is significantly higher than the benchmark. Additional studies and comparisons among ACC installations need to be completed to provide a weighted opinion on land utilization.

MISSION SUPPORT

Total Building Density[1]:

Current Year (2010):	184	SF/Acre
Benchmark[2]:	60,000	SF/Acre
Previous Year (2009):	183	SF/Acre
% Change from Previous Year:	0%	

Total Building Utilization[5]:

Current Year (2010):	808	SF/FTE
Benchmark[3]:	160	SF/FTE
Previous Year (2009):	807	SF/FTE
% Change from Previous Year:	0%	

MISSION SUPPORT

Total % Green Space[6]:

Current Year (2010):	98%	
Benchmark[4]:	-	
Previous Year (2009):	98%	

Total % Building/Impervious[7]:

Current Year (2010):	10%	
Benchmark[4]:	-	
Previous Year (2009):	10%	

Total % Building/Footprint[8]:

Current Year (2010):	74%	
Benchmark[4]:	-	
Previous Year (2009):	74%	

- 6,110 average daily traffic at the gates = 0.86 trips per FTE
- 0.23 people per acre of Mission Support developable area

[1]Building density = ACSES real property records, building square footage/property acreage.
[2]Per the U.S. Green Building Council (USGBC) LEED-NC guidelines, development density must be equal to or greater than 60,000 SF/acre.
[3]Per building code guidelines, the average gross square foot per FTE figured at 2 times code standard is 160.
[4]Benchmark has yet to be established relative to an AFB. This could be established either through the initial ISA investigation or through an additional research project.
[5]Building Utilization = ACSES real property records, building square footage/population
[6]% Green Space = Non-Built Green area/Total Installation area.
[7]% Building-to-Impervious = ACSES real property records and Geobase, usable building square footage/impervious area.
[8]% Building-to-Footprint = ACSES real property records and Geobase, usable building square footage/building footprint area.

C. Year-to-year Sustainability Indicators

This is the initial report for Holloman AFB; therefore, year-to-year comparisons do not exist at this time. For reports in future years, comparisons will be provided for the established sustainability indicators:

1. **Carbon Footprint**
2. **Energy Usage**
3. **Water Conservation**
4. **Waste Reduction**
5. **Land Utilization**

D. Current Sustainability Initiatives

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

Natural Area Preservation:

Holloman AFB actively protects the habitat of the White Sands Pup Fish located along the Lost River, which cuts through the base property north of the main base areas. Holloman AFB has also developed constructed wetlands at the south end of the base between Lagoon G from the old treatment process and Lake Holloman. Both areas provide valuable natural habitat to local species, and preservation of the areas help to minimize the impact of Holloman AFB on the local environment.

Energy Conservation:

- Energy Studies:
  - A geothermal feasibility study has been completed and has determined that there is a weak case for geothermal energy at the base.
  - The base is working on an environmental impact statement for a 600-acre PV Array near the Atlas program area. Payback on an array will be difficult because of low energy costs ($.08/kW).
  - Regional renewable energy projects are being considered by the White Sands Working Group, which includes local NASA facilities, Ft. Bliss and the Missile Range.
  - Reduction in Energy Consumption:
  - The base REM is managing a work plan to achieve a 30% reduction of the 2003 Energy Use by the year 2015. The work plan includes a diverse list of planned or potential projects to replace lighting; install occupancy sensors; implement/change energy management policies, audits and energy management plans; and incorporate solar-based renewable energy development (mostly PV, some solar thermal).
  - The base has already completed a number of energy efficiency projects such as lighting ballast replacement and occupancy sensor installation.
  - The base has been operating an Energy Monitoring Control Systems (EMCS) using Direct Digital Control (DDC) to control HVAC equipment in some buildings at the base and would like to expand the EMCS coverage.

- The base has an active Energy Management Steering Group led by the Wing Command that has been working on implementing policies to control energy consumption such as turning off non-essential equipment and performing nighttime energy audits.
- Submetering:
  - Standard analog meters exist on approximately 42 facilities on base for subinvoicing of tenants on base.
  - The advanced metering program, which is currently being executed, includes 50 facilities, all over 35,000 square feet.
  - The program will be expanded to include the nine remote-piloted vehicle facilities, which are high-intensity users.
  - Systems being installed are Tridium systems with a Niagara based platform.
  - Reporting to the central data collector is through wireless radio mesh.

Water Conservation Initiatives:

- Over the past 20 years, the base has significantly reduced water consumption by replacing turf areas with xeriscaping and Astroturf.
- The base is getting ready to start a program to build a 400,000-gallon tank for storage of effluent water to irrigate the golf course. Golf course irrigation currently accounts for 16 to 20 percent of potable water consumption at the base, and the new tank will eliminate all potable water irrigation of the golf course.
- Five areas of the sewer system were investigated and repaired to remove inflow and infiltration[3] from the sanitary sewer system. The five areas consisted of abandoned lines that were not plugged or deteriorated lines. Correcting the five areas removed approximately 90,000 gallons of infiltration from the sanitary sewer system.

Waste Reduction Initiatives:

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

E. Guidance Compliance Summary and Matrix

Refer to Appendix C to review required compliance with current Federal guidance.

[3]Excess water that flows into sewer pipes from groundwater and stormwater is called infiltration and inflow

IV. RECOMMENDATIONS

The Holloman AFB team has already implemented many forward-thinking programs to reduce energy and potable water use and enhance the environment on base. Holloman AFB stands out for its implementation of construction and demolition debris management program, an active energy management group that has identified a means of achieving energy policy goals and extensive implementation of xeriscaping for water management. The first recommendation is to "keep doing what you're doing" because the team has already achieved substantial progress and has more great ideas programmed in the funding pipeline. However, even more will be expected in the future. To name just a few of the demanding goals[4] ahead for members of the Federal government, by 2030, all new buildings will need to reduce their fossil fuel-generated energy consumption by 100 percent; by 2015, installation energy intensity (British thermal units [BTUs]/SF) must be 30 percent lower; and greenhouse gas emissions must drop by 28 percent and potable water usage must drop by 26 percent by 2020. This is not the first round of tough energy and water reduction goals faced by the Air Force and by the Holloman AFB team and over the last 20 years, much of the "low-hanging fruit" has been successfully picked. Recommendations fit into the following categories:

- Encouraging implementation and/or extension of existing successful programs.
- Ideas for enhancing sustainability on base for "free" by making the most of natural solutions that mimic ecosystem services and capitalize on existing natural assets such as the sun.
- Some "high-hanging fruit" ideas for long-term, significant improvement, possibly requiring programming and investment. Small, incremental gains alone will not, in many cases, be enough to meet the extremely ambitious requirements mandated for the Federal Government.

Ultimately the recommendation listed below should be used to develop a prioritized group of projects.

A. Carbon Footprint

Holloman AFB is presently receiving all of their purchased electricity from local utility company El Paso Electric. The mix of fuels providing that power is as follows: nuclear 45 percent, natural gas 23 percent, coal 7 percent and the remainder is unspecified purchased electric and a fraction of a percent as renewable energy source generated by El Paso Electric.

A.1 Issue/Condition—Holloman AFB is located in an area of the country with relatively high solar energy potential (approximately 5.5kWh/m^2/day according to maps from the National Renewable Energy Laboratory), yet Holloman AFB currently utilizes very little solar energy on the base. Base staff is aware of the energy potential but has only recently been able to fund solar energy harnessing projects.

Recommendation—Holloman AFB staff should continue to incorporate PV projects on the base as funding becomes available. With the locally low cost of energy, PV projects might not be able to fund themselves through a guaranteed payback period, but could provide opportunities to raise energy awareness on base and reduce the reliance of the base on external energy sources that could increase in cost in the long term.

Recommendation—Holloman AFB staff should investigate means for utilizing solar thermal energy on the base. Staff is currently looking at solar thermal heating of the existing pools at the fitness center on base, which may lead to future solar thermal water heating projects on the base. Staff and designers of new construction projects could also consider the benefits of solar thermal for radiant heating of

[4]See Appendix C for a cross walk of federal requirements

conditioned spaces at the base. Through the implementation of trombe walls on building facades that are oriented towards the south. Trombe walls use solar radiation to warm an air gap behind a glazing surface on the exterior side of the south-facing wall. The wall has vents at the top and bottom that use the rising action of the heated air in the air gap to push warm air out of the top vent and draw cool air in from the bottom vent without any mechanical means. During summer months, the top vent can be closed and heated air in the air gap forced to the outside to pull air through the bottom vent in the wall for natural ventilation and air movement through the building.

A.2 Issue/Condition—Holloman AFB includes a Bare Base unit that routinely tests and exercises generator equipment. Currently generated energy is discharged and not utilized or otherwise captured. Base staff is aware of the waste of energy and is studying what work will be required to incorporate the power source into the local grid to capture and utilize the currently wasted energy.

Recommendation—Holloman AFB needs support from headquarters to fund a study to determine means for capturing this free energy. Wasting the energy is an unnecessary increase in GHG emissions. Using the energy would help to reduce the base's Scope 2 GHG emissions by reducing power consumption from outside sources.

A.3 Issue/Condition—Holloman AFB is located 12.5 miles from the center of Alamogordo, with not much housing for base staff located between the center and the base. With the majority of approximately 7,000 staff commuting daily to the base, Scope 3 GHG emissions are significantly increased. Holloman AFB already implements a 5/4/9 alternative work schedule policy to reduce commuting one day out of every two weeks and the local public transit system, Z-Trans, runs a route through the base.

Recommendation—Create a base-wide ride-share program. Provide preferred parking (the closest spots to the building besides handicap parking) for car/vanpools. Preferred parking spots not only encourage ride sharing but also contribute to Leadership in Energy and Environmental Design (LEED) certification of buildings by possibly earning one LEED point.[5] Ride-sharing of vehicle trips to/from base reduce the number of single-occupancy vehicles on the road, reduce the average vehicle miles traveled (VMT) on base, and reduce the use of single occupancy vehicles.

Recommendation—Extend the current alternative work schedule policy to also allow for 4/10s, which would reduce commuting by one day of every week, doubling the current alternative work schedule policy. Alternatively, the base could investigate a policy of telecommuting for base staff either with a standard 5 day, 8 hour shift schedule or coupled with one of the alternative work schedules discussed. Telecommuting also cuts back on commuting days which will help to reduce Scope 3 GHG emissions. Early implementation of a telecommuting policy also starts the base towards achieving goal 4.2 of the DoD Strategic Sustainability Performance Plan (SSPP[6]), which is to have 30% of eligible employees telecommuting one day per week by FY20.

Recommendation—Develop a program to encourage use of the on-base public transportation route currently offered by Z-Trans. Use of the existing public mass transit system also reduces Scope 3 GHG emissions from the base. Mass transit vehicles also help to reduce traffic congestion.

[5]To earn LEED credit 4.4 "Alternative Transportation: Parking Capacity" under Option 1, a building project must fulfill two requirements. 1) size parking capacity not to exceed minimum requirements and 2) provide preferred parking for carpools and vanpools for 5 percent of the total provided parking spaces.

[6]DoD Strategic Sustainability Performance Plan (the Plan) provides a coherent approach both for complying with multiple federal requirements for sustainability and for assuring the mission. The document was issued in 2010.

Recommendation—Provide an on-base transportation system for base staff and visitors. A system of publicly available bicycles and helmets or a free on-base shuttle bus is necessary so that staff can utilize ride-share or public transit and still have a means for moving about the base during the day. Without that mobility, staff will revert to driving their individual vehicles.

B. Energy Usage

Base personnel have implemented and investigated a wide variety of approaches to managing energy use, resulting in many progressive programs and practices. Additional projects should be considered to build upon past success, continue existing programs, and consider new options for energy savings.

B.1 Issue/Condition—The staff at Holloman AFB is actively involved in energy-minimizing programs as a means to address the base carbon footprint and energy costs. Staff has implemented policies to improve energy efficiency at the base and is considering additional policies to implement. Continue existing programs and expand them where practical. Implement new programs that have proven to be effective at other installations. Examples of existing programs to continue/expand or new programs to start are highlighted below as recommendations.

Recommendation—Some air handlers have economizers in place to use free-cooling when air temperatures are below 55°F and cooling is required. The buildings with Energy Management and Control System (EMCSs) are considering the use of CO_2 monitors to perform demand-controlled ventilation when spaces are lightly staffed. Continue this practice on new construction and major renovation for energy savings. It also contributes to LEED credits for indoor environmental quality and energy savings.[7]

Recommendation—One no-cost policy to be considered for Holloman AFB is the implementation of a “no heat and no cool” mandate for non-critical facilities. Holloman AFB staff has already begun evaluation of implementing such a policy for a one-month period. If determined to be effective, this is typically a policy that can be implemented twice per year, once in the spring and once in the fall.

Recommendation—Lighting systems are continuously being modified to use more energy-efficient lamps and equipped with photocells and timers to minimize actual use. The base should continue to replace lighting systems with more energy-efficient lamps and should review the set points for lighting controllers to reduce the hours that the lights are on. The base may consider a study of the nighttime uses of lit parking areas to determine if all parking areas require the lighting that is currently used.

B.2 Issue/Condition—Reducing the installation’s energy intensity (on a BTU/SF basis) and increasing use of non-fossil fuel-generated energy is a complex problem that will only be solved by looking at the base energy situation in a holistic way. The base’s infrastructure and facilities systems need to be evaluated and a resulting energy master plan and program needs to be developed, which is informed by a tremendous amount of facility, equipment, and energy usage data. An integrated energy master plan can discover base-wide energy savings on the order of 50 percent or better and identify geographically appropriate sources of renewable energy. The function of the master plan is to identify the projects that not only provide the best potential for meeting the goal of 30 percent energy savings by 2015 (EISA §431), but also show economic benefit through a life cycle cost analysis. An energy master plan goes beyond quick payback periods and individual building projects to

[7] LEED Indoor Environmental Quality credit 1–Outdoor Air Delivery Monitoring and Energy and Atmosphere credit 1–Optimize Energy Performance.

illuminate the "high-hanging fruit" that can provide an order of magnitude improvement in energy savings across the entire installation.

Recommendation—Develop an energy master plan to discover the best alternatives to achieve EO, EISA, and EPAct mandates. An energy master plan will identify a base-wide strategy that not only decreases the base's carbon footprint but also does it in a manner that saves energy use and cost. Alternatives that would be studied and vetted by an energy master plan team would include:

A. Using combined heat and power plants (co-gen), burning biomass if possible and natural gas if not. Any modification to the type of heating used should favor non-electrical power sources to reduce the Source 2 greenhouse gas (GHG) emissions and minimize energy costs.

B. Constructing district heating and cooling plants.

- District heating enables the use of co-generation plants to heat and power multiple buildings independent of local utilities. In lieu of steam distribution, a high-temperature hot water system that distributes hot water under pressure could be used to minimize construction and maintenance costs of the distribution network.

- District cooling plants provide the most energy-efficient means to produce air conditioning and also allow more use of thermal energy storage (such as ice storage). Developing chilled water overnight results in approximately seven percent savings simply due to the generation occurring during cooler hours of the day.

C. Changing over facilities using electric heat to using heat pumps or district heating. A master plan would likely recommend, at a minimum, converting electric-only systems to heat pumps in places that are both heated and air conditioned, which would also allow retrofitting to district heating in the future.

D. Replacing existing heating boilers (and hot water heaters) to 94 percent or higher condensing-type boilers in the event that district heating can not be used.

E. Using variable refrigerant flow systems that can use internal space heat gains to minimize heating required for the exterior envelope of buildings as an alternative to water source heat pump systems.

F. Recommending locations for installation of additional advanced meters for electricity and gas to enable individual users to monitor their energy use. Real-time energy use displayed in each facility can result in significant savings since users take charge of their own habits.

G. Installing a comprehensive facility-based EMCS that allows trained operations staff to monitor and modify energy use continuously.[8]

B.3 Issue/Condition—Air conditioning systems are mostly air-cooled, serving individual buildings. Water cooled units have been discouraged because of the difficulties the extreme hardness of the locally available water could create for the water cooled systems. The installation routinely replaces refrigerants of various types in these existing air-cooled units. Not only is the low efficiency of these units creating a greater carbon footprint than if water-cooled equipment were in use, but the loss of refrigerant is increasing greenhouse gas emissions. Proper implementation of water-cooled units could overcome the challenges presented by the water hardness.

[8] An energy master plan would also include LCCA to determine if the cost of additional operating staff would be off-set by energy savings and reduced HVAC calls.

Recommendation—Water-cooled systems for larger facilities will save considerable electrical energy and decrease the amount of refrigerant lost from air conditioning equipment. A large central chiller facility providing chilled water to districts of the base can provide even more significant savings in energy and greenhouse gas emissions. The large distribution system acts as a thermal reservoir (the "flywheel" effect) that a diverse group of buildings use, and a central plant is more efficient in aggregate than many smaller air conditioning units. Having a central location also allows for more efficient treatment of hard water prior to use in the water-cooled system and a single. The central location would also provide for a single point of maintenance for general repairs or for addressing water scale build-up of water hardness.

B.4 Issue/Condition—Holloman AFB is located in a desert climate that experiences on average 30-degree temperature swings between day and night. These large swings can require cooling during the day and heating during the evening in order to maintain a comfortable temperature.

Recommendation—A return to historic construction practices of using rammed earth wall construction can help to balance the large temperature swings in the local climate. Rammed earth construction has been increasingly used in residential applications in the Las Cruces, NM area and has recently been successfully incorporated into an Army Corps of Engineers Energy Pilot Project in the Las Cruces, NM area. The thick, earthen walls act as a thermal mass that gather heat during the day and release it at night and provide the opposite effect for cooling during the day. The thermal mass helps to balance the temperature swing and allows heating and cooling systems to operate more efficiently.

Recommendation—A central ice storage plant could be considered for a central cooling system on the base. The ice plant could benefit by using cooler nighttime temperatures for producing ice mass to use for cooling during the day. The cold-water distribution lines could be operated as a closed-loop system that would require a one-time treatment for water hardness with minimal additional treatment of make-up water to prevent issues associated with the local extreme water hardness. A district cooling system increases in efficiency as the number of buildings attached to the system increases by creating its own thermal storage system within the distribution piping , and the lower the electrical usage of the base during peak loads as well as all season long.

Recommendation—A combined heat and power plant associated with an individual building or a set of buildings can provide air conditioning, heating and power that will minimize energy use on a daily basis and can also provide opportunities for utilizing renewable fuel sources. Energy used to create air conditioning during the day can be stored as thermal energy for use to heat the facility at night.

B.5 Issue/Condition—Holloman AFB uses the ACC Sustainable Development and High Performance Green Building Design (SD&HPGBD) Scorecard as its green building self-assessment metric. The scorecard assembles and consolidates EOs, Public Laws, and Federal Agency rulemaking on SD&HPGBD requirements with the LEED Rating System. Using the scorecard is a way to achieve the desired LEED rating and meet critical statutory minimum requirements.

When applied in context, the scorecard rating system can illuminate opportunities for sustainable design, often with low- or no-cost choices. Some choices carry an upfront cost but provide long-term operational cost savings, and are value-added building features. Starting with programming, the base can direct the design and construction of the building to achieve certain LEED and other federal requirements that base level engineers deem to add the most value and advance the base towards their specific sustainability goals. Without direction otherwise, contractors often choose to satisfy requirements based on upfront cost alone.

Recommendation—Use the ACC scorecard requirements to guide and inform building projects towards lower life-cycle costs and enhanced sustainability.

Recommendation—Train the programming staff and design/engineering staff in the LEED Rating System and scorecard application.[9] A scorecard checklist must be completed for military construction projects, and can also be completed for Sustainment, Restoration, and Modernization building projects to inform their design. The checklist outlines a strategy that will inform all other stages of building design, so it is critical that base-level programmers understand LEED and the application of the scorecard; how it supports broader energy, water, and sustainability goals; and how to choose appropriate points for building projects.

Recommendation—Enhanced commissioning is a scorecard credit which carries an upfront cost to implement, but provides value to the installation in reducing long-term energy and maintenance costs.[10] As building energy systems become more advanced to meet higher levels of energy efficiency, commissioning becomes even more critical to assure those energy systems function as intended. Enhanced commissioning is recommended because of the rapid payback period and long-term operational cost savings.

Recommendation—Choose roofing material and color to earn scorecard credits. For low slope roofs (≤2:12), the roof surface must have a Solar Reflectivity Index (SRI) of 79 or greater, and for steep slope roofs (>2:12) an SRI of 29 or greater is required.

Recommendation—When siting a building and developing early schematic design, maximize the shape and orientation of the building with respect to the sun for passive solar heating, cooling, and daylighting. This will maximize the energy performance the building achieves "for free" as a result of the sun and will help earn points in several categories. Although some areas of Holloman AFB are established in a grid pattern that does not follow proper solar orientation, a new building sited within these existing areas can still be laid out to maximize the length of façade on the most east-west alignment within the grid.

Recommendation—Site buildings such that occupants can walk or bike to adjacent services and amenities instead of driving, ideally embodying the LEED concept of "Community Connectivity"[11] Include safe pedestrian and bike ways in base development plans.

Recommendation—Set aside 5 percent of parking for car/vanpools and 5 percent for low-emitting vehicles in preferred locations near building entrances. This embodies the LEED concept[12] and encourages alternative transportation.

Recommendation—Maximize water use reduction in all new buildings. By choosing plumbing fixtures that meet EPA Water Sense standards or current IPC high-efficiency fixture standards , projects can earn scorecard points[13] and will also assist the base in achieving the potable water reduction goal of 26 percent reduction by 2020 compared to a 2007 baseline.[14]

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[9]AFIT's Civil Engineer School offers a one-week course in LEED, for example.
[10]"The Cost-Effectiveness of Commercial Building Commissioning," by Lawrence Berkeley National Laboratory (LBNL), Dec 15, 2004
[11]Sustainable Site credit 2.
[12]Sustainable Site credit 4.3 and 4.4.
[13]Water Efficiency credit 3.1, 3.2 and Innovation and Design credit 1 are all achievable by achieving gradually higher water efficiency. Under LEED NC v2.2 a maximum of three points can be earned by reducing water use by 40%. Under LEED NC v3, a maximum of five points can be earned with 45% water use reduction.
[14]Executive Order 13514 §2(d)(i).

C. Water Conservation

The Holloman AFB team has already implemented significant water conservation measures at the base. High efficiency fixtures are already extensive throughout the base. The majority of landscape on the base requiring irrigation has been replaced by low or no-use xeriscaping techniques or Astroturf where a lawn appearance or use needs to be maintained. Plans for storage and reuse of wastewater treatment plant effluent for irrigation of the golf course are being carried out. In the case of water conservation, much of the "low-hanging fruit"–the projects that are easily executed because they have a justifiable life cycle cost or even a return on investment–has been completed.

C.1 Issue/Condition—Potable water reduction strategies (effluent water for most irrigation, low-flow, and sensored fixtures) have been executed prior to FY07, which is the EO 13514 benchmark for a 26 percent reduction of potable water use. Current strategies for achieving the new reduction requirements are not likely to present a significant return on investment.

Recommendation—Continue and expand upon the implementation of low-flow water fixtures and automated faucets in base facilities to the maximum extent feasible. Although the program has been fairly exhausted on the base, it is important to continue to promote the installation of low-flow water fixtures. The program might be further expanded by implementing the use of effluent water for toilet flushing and other non-potable water uses in new construction on the base, as acceptable to local plumbing code.

Recommendation—Expand water use education beyond the Alamogordo Water Conservation program to educate personnel and dependents at the base on the importance of reducing water use and the effects that excessive water use has on the environment. In particular, education on proper irrigation techniques for personnel using potable water irrigation in the family housing area can have a significant impact on reducing potable water use. Educate personnel and dependents on the source of the goals, the extent of the goals, and emphasize command support (Commander-in-Chief and HQ ACC) established for water use reduction so they are aware of the challenge and can have buy-in to the goals.

Recommendation—Expand the use of effluent water for irrigation to additional areas of irrigation on the base at the two remaining natural turf sports fields. The base needs to determine/estimate the amount of potable water still used for irrigation, by area, to execute life-cycle cost analysis of projects to replace the potable water system with effluent water systems.

Recommendation—Because base activity was significantly reduced during FY07, which is considered the baseline year, the energy manager should pursue evaluation of the reduction goal based on adjusted 2007 baseline that considers a "per full time equivalent (FTE)" rate of consumption for base facilities instead of a per square foot basis. Records indicate that water use for the base in FY07 was 304.6MGAL and that it increased to 383.7MGAL in FY09, however anecdotal evidence from base staff indicates that the base staff levels may have more than doubled during this timeframe, which overall would show a significant reduction in the water used per FTE. To further develop this argument, accurate quantities for FTE staff for FY07 and the current fiscal year should be obtained. Although this approach will not relieve the base of its goal requirements, it will provide background if the base is unable to meet the reduction goal.

C.2 Issue/Condition—Potable water use on base is not sufficiently metered to be able to identify and target high use activities and areas. Currently, only 30 water sub-meters are used on the base at facilities for which subinvoicing must be performed, 14 of which are used just to separate the privatized housing water consumption. Potable water is used for irrigation in the family housing area and along the flightline, for washing of planes, and for filling fire suppression tanks that are not maintained in potable water conditions. Because these uses are not sub-metered, insufficient data exists for comparing life-cycle costs of new systems to use effluent water to current potable water use costs. The lack of sub-metering also does not provide sufficient information for a baseline of irrigation and industrial use consumption for goal 2.2 of the DoD Strategic Sustainability Performance Plan (SSPP) issued June 2010.

Recommendation—Install additional water sub-meters at locations upstream of specific irrigation and industrial water use areas using potable water.

Recommendation—Change all potable water irrigation in the family housing areas and on the two remaining irrigated sports fields to effluent irrigation. If after educating the residents of family housing on the safety of the using effluent water for irrigation, there are still safety concerns, the irrigation systems can be installed as drip irrigation systems, which have minimal potential for direct contact with the effluent water. Alternately, base staff could encourage further implementation of Astroturf replacement of natural turf areas to eliminate the need to irrigate lawn areas.

D. Waste Reduction

D.1 Issue/Condition—Holloman AFB CES/CEAN staff has been attempting to collect data regarding construction and demolition debris disposal but has so far been limited to documentation of the onsite asphalt and concrete debris disposal areas controlled by the CES/CEAN branch. Monthly data calls to project managers on base have not received responses for tabulation of construction and demolition debris. Documentation of construction and demolition debris disposal and or diversion from the landfill is important to documentation of compliance with goals 4.3 and 5.3 of the DoD SSPP.

Recommendation—All project managers shall respond to monthly data calls from CES/CEAN branch for tabulation of construction and demolition debris. A policy may need to be implemented by the wing commander to ensure this policy is heeded.

Recommendation—Require all projects teams, regardless of funding source or execution agency, to divert 60 percent of construction and demolition debris away from the landfill. This will meet the requirement found and the newly published DoD Strategic Sustainability Performance Plan, 2010, and will earn LEED Materials and Resources credit 2.1 "Construction Waste Management-Divert 50 percent from Disposal." ACC command level guidance will also identify 60 percent diversion as a requirement. Another possibility is to write performance-based contracts that encourage teams to achieve 75 percent or higher levels of waste diversion in support of LEED MR Credit 2.2.

Recommendation—CES maintains several rolloff dumpsters for debris from miscellaneous projects on base. At least one dumpster should be designated as specifically for use for disposal of construction and demolition debris and CES/CEAN shall record the disposal of the construction and demolition debris at the time of their monthly data call.

D.2 Issue/Condition—Holloman AFB is located in an area where commercial recycling is not significantly supported, which has largely limited recycling efforts at Holloman AFB to paper, cardboard, scrap metal, and oil.

Recommendation—Holloman AFB should maintain an estimate of recyclable waste materials generated by the base that are not being recycled and enter into dialogue with local business leaders with an interest in further developing recycling programs in the Alamogordo area. Holloman AFB would likely be a significant contributor to an expanded local recycling program and having estimates of the amount of material that the base could contribute could assist in developing a business plan for a local expanded services recycling facility.

E. Land Utilization

E.1 Issue/Condition—Achieve by 2030 zero-net-energy in buildings entering the planning process after 2020. Also, all new Federal buildings and Federal buildings undergoing major renovations shall reduce their fossil fuel-generated energy consumption (baseline 2003) by 65% (2015), 80% (20202), 90% (2025), and 100% (2030). The Air Force is also required to reduce its energy intensity (BTUs/SF) by 30 percent by 2015, and to reduce greenhouse gas emissions by 28 percent by 2020. Enacting such dramatic improvement in energy efficiency without dramatic construction cost increases will require taking maximum advantage of "free" energy savings. Passive solar design of buildings can reduce a building's energy demand by as much as 30 percent, at essentially no cost. Holloman AFB cannot afford to develop new buildings without maximizing solar orientation for energy savings.

Recommendation—Maximize solar orientation through land development planning. All future area development plans (ADP) in areas without an established road system must be laid out and new buildings oriented, such that solar heat gains/losses are optimized. This is generally with the long axis of buildings east-west and solar exposures to the north and south. The layout of new streets in an ADP often dictates the future orientation of buildings toward the street and as such, aligning the street grid according to the sun is critical. Aligning streets and buildings on an east-west axis will serve the dual purpose of also optimizing those buildings to host rooftops solar panels, should such an opportunity arise. To assure compliance, any ADP or building not designed to optimize passive solar gains should require permission/review from a higher level of authority.

E.2 Issue/Condition—Holloman AFB uses the ACC SD&HPGBD Scorecard as its green building self-assessment metric. Use of the scorecard can illuminate opportunities for sustainable development, often with low- or no-cost choices. One opportunity is called "Community Connectivity," which rewards development within a half-mile radius[15] of at least 10 community amenities (restaurants, library, shopping, churches, etc.) and high-density housing, such as dormitories or apartments. There must also be pedestrian access between the amenities, housing, and the building to earn scorecard credit. Holloman AFB can apply this metric to future developments and ADPs to see if a plan encourages mixed-use development and connectivity and will enhance the walkability and bikeability of Holloman AFB. Developing towards improved connectivity will have many "free" benefits such as reduced VMT on base, reduced associated greenhouse gas emissions, improved fitness for those who chose to walk/bike.

Recommendation—Develop, track, and improve over time a community connectivity metric for the installation. Measure the diversity of services/uses within an area with a half-mile radius around future development and use the metric to highlight and encourage mixed-use development. This practice will help achieve "free" but meaningful scorecard points.

[15] A half-mile radius was chosen because it is the distance a typical person is willing to walk instead of drive. It equates to roughly a five-minute walk.

V. GLOSSARY OF TERMS AND ABBREVIATIONS

Term	Definition
Alternative work schedule	Work schedules that do not follow the traditional format of an 8-hour day Monday through Friday; alternatively compress the 40 hour work week into fewer days or allow staff to work remotely.
Aviation fuel	All special grades of gasoline for use in aviation reciprocating engines, as given in the American Society for Testing and Materials (ASTM) specification D 910. Includes all refinery products within the gasoline range that are to be marketed straight or in blends as aviation gasoline without further processing (any refinery operation except mechanical blending). Also included are finished components in the gasoline range, which will be used for blending or compounding into aviation gasoline.
Baseline	A standard reference case or condition used as a basis for comparison. Establishing a clearly defined baseline is important and defining a repeatable baseline is essential if the work is to be compared to results of other work.
Baseline year	The year in which the baseline was established.
Benchmark	A standardized problem or test case that serves as a basis for evaluation or comparison. The terms benchmark and baseline are often used interchangeably. Consistent and repeatable benchmarking requires clearly defined performance metrics and protocols for developing the reference case to serve as the baseline.
Buildable area	Land use classification areas including administration, aircraft operations and maintenance, community commercial, community service, manufacturing and production, and medical/dental.
Building Fuel	Includes gas, oil, and liquid propane gas used for buildings..
CO_2 equivalent	A metric measure used to compare the emissions from various greenhouse gases based upon their global warming potential (GWP). CO_2 equivalents are commonly expressed as "million metric tons of CO_2 equivalents (MMTCDE)." The CO_2 equivalent for a gas is derived by multiplying the tons of the gas by the associated GWP. (MMTCDE = (million metric tons of a gas) * (GWP of the gas))
CO_2 equivalent (CO_2e)	A measure for describing how much global warming a given type and amount of greenhouse gas may cause, using the functionally equivalent amount or concentration of CO_2 as the reference. For a given mixture and amount of greenhouse gas, the amount of CO_2 that would have the same GWP, when measured over a specified timescale (generally, 100 years).
Carbon equivalent	A metric measure used to compare the emissions of different greenhouse gases based upon their GWP. Greenhouse gas emissions in the U.S. are most commonly expressed as "million metric tons of carbon equivalents" (MMTCE). GWPs are used to convert greenhouse gases to CO_2e–they can be converted to carbon equivalents by multiplying by 12/44 (the ratio of the molecular weight of carbon to CO_2). The formula for carbon equivalents is: MMTCE = (million metric tons of a gas) * (GWP of the gas) * (12/44)
Carbon footprint	The total set of GHG emissions caused directly and indirectly by an individual, organization, event or product.
Climate Registry	A nonprofit collaboration between North American states, provinces, territories, and Native Sovereign Nations to record and track the greenhouse gas emissions of businesses, municipalities and other organizations. Data submitted to the Climate Registry is inputted into the Climate Registry Information System (CRIS), which was developed on EPA's CRAVe-EATS platform.
Commuting	Calculated based on average commuting distance of base FTE using a mix of passenger car and light trucks used for commuting. A typical fuel MPG is calculated for each and summed to calculate the total gallons of fuel used for commuting.
Current year	The FY in progress.
Design guideline	A set of rules and strategies to help building designers meet certain performance criteria such as energy efficiency or sustainability.

Term	Definition
Electrical	Electricity usage entered is for the KWH used by the base annually. Note that the relationship between energy intensity and carbon footprint varies based on the mix of coal, natural gas, diesel, fuel oil, nuclear, wind, solar, and hydro electric energy production within the eGRID region.
Energy	The capacity for doing work as measured by the capability of doing work (potential energy) or the conversion of this capability to motion (kinetic energy). Energy has several forms, some of which are easily convertible and can be changed to another form useful for work. Most of the world's convertible energy comes from fossil fuels that are burned to produce heat that is then used as a transfer medium to mechanical or other means in order to accomplish tasks. In the United States, electrical energy is often measured in kWh, while heat energy is often measured in BTUs.
Energy efficiency	Using less energy to provide the same level of energy service. Also referred to as efficient energy use and is achieved primarily by means of a more efficient technology or process rather than by changes in individual behavior.
Energy intensity	Ratio between the consumption of energy to a given quantity of output; usually refers to the amount of primary or final energy consumed per unit of gross domestic product.
Energy recovery	Includes any technique or method of minimizing the input of energy to an overall system by the exchange of energy from one sub-system of the overall system with another. The energy can be in any form in either subsystem, but most energy recovery systems exchange thermal energy in either sensible or latent form.
Energy Star	An international standard for energy efficient consumer products. Devices carrying the Energy Star logo, such as computer products and peripherals, kitchen appliances, buildings and other products, save 20%-30% on average.
Fiscal Year (FY)	The period used for calculating the annual ("yearly") sustainability indicators. The U.S. government's FY begins on October 1 of the previous calendar year and ends on September 30 of the year with which it is numbered. For example, FY for 2008 is written as "FY08" or as "FY07–08."
Fleet	Two or more vehicles.
Flying Mission	Includes anything that directly effects or has direct participation in flight or deployment operations.
Footprint	The outline of the total area of a lot or site that is surrounded by the exterior walls of a building or portion of a building, exclusive of courtyards. In the absence of surrounding exterior walls, the building footprint shall be the area under the horizontal projection of the roof.
Full-time Equivalent (FTE)	In the U.S. Federal government, FTE is defined by the Government Accountability Office (GAO) as the number of total hours worked divided by the maximum number of compensable hours in a work year as defined by law. For example, if the work year is defined as 2,080 hours, then one worker occupying a paid full time job all year would consume one FTE. Two employees working for 1,040 hours each would consume one FTE between the two of them.
General aviation	That portion of civil aviation, which encompasses all facets of aviation except air carriers. It includes any air taxis, commuter air carriers, and air travel clubs, which do not hold Certificates of Public Convenience and Necessity.
Geographical Information System	An information system that integrates, stores, edits, analyzes, manages, shares, and displays geographic information that is linked to a specific location.
Grassland	Terrestrial ecosystem (biome) found in regions where moderate annual average precipitation (25 to 76 centimeters or 10 to 30 inches) is enough to support the growth of grass and small plants but not enough to support large stands of trees.
Green space	A land use planning and conservation term used to describe protected areas of undeveloped landscape. Also known as open space.

Term	Definition
Greenhouse effect	The effect produced as greenhouse gases allow incoming solar radiation to pass through the Earth's atmosphere, but prevent part of the outgoing infrared radiation from the Earth's surface and lower atmosphere from escaping into outer space. This process occurs naturally and has kept the Earth's temperature about 59°F warmer than it would otherwise be. Current life on Earth could not be sustained without the natural greenhouse effect.
Ground Fuel	Ground Fuel is considered the total of all government vehicle fuel used outside flightline fuel use.
Incentive program	A formal scheme used to promote or encourage specific actions or behavior by a specific group of people during a defined period of time.
Indicator	A parameter, or a value derived from a set of parameters, that points to, provides information about, or describes the state of a phenomenon. It has significance beyond that directly associated with the parameter value. Indicators are one of many tools for simplifying, quantifying, and communicating vast amounts of information in ways that are more easily understood. They are also useful for alerting us to what areas that need more attention, as well as areas that see improvement.
Industrial sector	Construction, manufacturing, agricultural and mining establishments.
Installation	A facility directly owned and operated by or one of its branches that shelters military equipment and personnel and facilitates training and operations.
Land classification	The analysis of land according to its use. Land classifications include agricultural, industrial, recreational, and residential.
Land use	The human modification of natural environment or wilderness into built environment such as fields, pastures, and settlements.
Land use planning	The term used for a branch of public policy which encompasses various disciplines which seek to order and regulate the use of land in an efficient and ethical way.
Leadership in Energy and Environmental Design (LEED)	Green Building Rating System, developed by the USGBC, provides a suite of standards for environmentally sustainable construction.
Lumen	A measure of the perceived power of light.
Meter	Metering devices used on utility mains for electricity, water and gas.
Metric	Any measurable quantity. A performance metric is a metric of some performance characteristic; however, not all metrics are performance metrics. For example, area is a metric, but it is not a performance metric.
Metric ton	Common international measurement for the quantity of greenhouse gas emissions. A metric ton is equal to 2205 lbs. or 1.1 short tons. See short ton.
Military	Any property or aspect of a military.
Mission Fuel	This includes aviation fuel only. That is, the fuel needed for the aircraft to fly.
Mission Support	Includes all other activities on the installation that do not directly affect flight and deployment operations.
Mission Support Fuel	This fuel is used for vehicles working on the flightline. It does not include fuel used for aircraft.
Offset	An agent, element, or thing that balances, counteracts, or compensates for something else.
Performance goal	A specific statement of a desired level of achievement. Performance goals must be measurable and definite such that progress can be evaluated. Performance metrics should be carefully chosen to measure progress toward performance goals.
Performance indicator	A high-level performance metric that is used to simplify complex information and point to the general state or trends of a phenomenon. Performance indicators are used to communicate general trends and are often used on a program planning level to show progress toward goals. See the definition of indicator for more discussion.

Term	Definition
Performance metric	A measurable quantity that indicates some aspect of performance. Performance metrics should measure and communicate progress toward achieving performance goals. There are different levels of performance metrics.
Performance objective	A general statement of a desired achievement.
Population density	A measurement of population per unit area or unit volume.
Potential energy	Energy stored within a physical system that has the potential to be converted into other forms of energy, such as kinetic energy, and to do work in the process. The standard unit of measure for potential energy is the joule, the same as for work or energy in general.
Power generation	The process of creating electricity from other forms of energy. Also known as electricity generation.
Previous year	12-month period prior to the current year.
Procedure	A standard method or set of methods for determining one or more performance metrics.
Procurement	The acquisition of goods and/or services at the best possible total cost of ownership, in the right quality and quantity, at the right time, in the right place and from the right source for the direct benefit or use of corporations, individuals, or even governments, generally via a contract. Simple procurement may involve nothing more than repeat purchasing. Complex procurement could involve finding long term partners or even 'co-destiny' suppliers that might fundamentally commit one organization to another.
Renewable energy	Energy obtained from sources that are essentially inexhaustible, unlike, for example, the fossil fuels, of which there is a finite supply. Renewable sources of energy include wood, waste, geothermal, wind, PV, and solar thermal energy. See hydropower, PV.
Residential sector	An area or portion consisting only of housing units.
Transportation sector	Consists of private and public passenger and freight transportation, as well as government transportation, including military operations.
Abbreviations/Acronyms	
AAAF	Alamogordo Army Air Field
Acre	A unit of area equal to 43,560 SF
AFB	Air Force Base
BACnet	building automation and control networks
BMP	Best Management Practice
BTU	British thermal unit: The quantity of heat required to raise the temperature of 1 pound of water 1°F at or near 39.2°F.
BWWSA	Boles Wells Water System Annex
CFS	cubic feet per second
CH_4	Methane
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent based on the GWP
DoD	Department of Defense
EISA	Energy Independence and Security Act
EMCS	Energy Management and Control System
EO	Executive Order
EPAct	Energy Policy Act
F	Fahrenheit
FTE	full-time equivalent
FY	fiscal year
GHG	greenhouse gas
GWP	global warming potential
kGal	thousand gallon
kW	Kilowatt

Term	Definition
kWh	kilowatt hour
HVAC	high-voltage alternating current
I&I	infiltration and inflow
lb.	Pound
ICRMP	Integrated Cultural Resources Management Plan
INRMP	Integrated Natural Resources Management Plan
LEED	Leadership in Energy and Environmental Design
m	Meter
MMBTU	One Million Btus. A Btu is the quantity of heat required to raise the temperature of 1 pound of water 1°F at or near 39.2°F.
mph	miles per hour
MSW	Municipal Solid Waste
mTons	metric tones
mW	Milliwatt
N_2O	nitrous oxide
NOAA	National Oceanic and Atmospheric Association
NRCS	Natural Resource Conservation Service
PV	Photovoltaic
SD&HPGBD	Sustainable Development and High Performance Green Building Design
SSPP	Strategic Sustainability Performance Plan
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGBC	U.S. Green Building Council
VMT	vehicle miles traveled
w/m2	watt per square meter
WSMR	White Sands Missile Range

VI. APPENDICES (NOT INCLUDED)

A. Data Collection Forms and Supporting Documentation

1. Development

2. Energy

3. Water

4. Waste

5. Operations

Note: All the information on LEED for new building construction and renovation needs to be obtained from the local COE from Mr. John Long, John.L.long@usce.army.mil, 575.572.6095, ext. 111.

A.1 Development: The following pages include the development data collection forms, data sources and supporting documentation that supports the information reported in the Installation Sustainability Assessment for Holloman AFB.

A.2 Energy: The following pages include the energy data collection forms, data sources and supporting documentation that supports the information reported in the Installation Sustainability Assessment for Holloman AFB.

A.3 Water: The following pages include the water data collection forms, data sources and supporting documentation that supports the information reported in the Installation Sustainability Assessment for Holloman AFB.

A.4 Waste: The following pages include the waste data collection forms, data sources and supporting documentation that supports the information reported in the Installation Sustainability Assessment for Holloman AFB.

A.5 Operations: The following pages include the operations data collection forms, data sources and supporting documentation that supports the information reported in the Installation Sustainability Assessment for Holloman AFB.

B. Data Sources

The following are data sources received from HQ ACC/A7PS and Holloman AFB:

1. Reports
   a. Design Compatibility Standards, Holloman AFB, 2010
   b. Integrated Natural Resources Management Plan, 2010
   c. Holloman AFB, eGP, as of December 2009
   d. Installation Environmental Restoration Program (ERP) Site Summary
2. Holloman AFB, New Mexico, Miscellaneous Data Provided by Holloman AFB
   a. Building Management systems, as of 2010
   b. 7115 Report, as of January 2010
   c. Hazardous Waste Generation/Cost, for 2009
   d. Building Metering Information, as of January 2010
   e. Storm Water Multi-Sector Permit
   f. Hazardous Waste Recycling, for 2009
   g. Buildings Retrofitted with Water Saving Device, as of 2010
   h. Area Development Plans
3. Holloman AFB, New Mexico, Data Provided by HQ/ACC/A7PS
   a. Mission Fuel Data Use for 2010
   b. Non-Mission Fuel Data Use for 2009
   c. Potable water, Electric, and Natural Gas for the Main Base and Military Family Housing (2003, and 2006-2010)
4. Geobase Data
   a. Data provided by both HQ ACC/A7PS and Holloman AFB
5. Meeting Minutes

C. Expanding Requirements

There are expanding requirements for military facilities constantly being developed and issued. The expanding requirements include new EOs, Statutes, Directives, Rulemaking, and Guidance.

1. EO 13514
2. EO 13423
3. EPAct 2005
4. EISA of 2007
5. Higher Level DoD and HAF directives
6. MAJCOM directives
7. Key Air Force Environmental Goals
8. Other Federal Agency rulemaking and guidance
9. See Separate Attachment Appendix C for a Crosswalk of Regulations

D. References

Building and Electric Metering Data

Cooperative Agreement for the White Sands Pupfish, 2006

Community Center Transportation Improvement Plan, 2010

Holloman AFB, 7115 Report

Holloman AFB Design Compatibility Standards, 2010

Holloman AFB, eGeneral Plan

Holloman AFB, Gate Study Out Brief, June 2009

Holloman AFB, 2010 Integrated Cultural Resource Management Plan, 2010

Holloman AFB, 2010 Integrated Natural Resource Management Plan, 2010

National Renewable Energy Laboratory, http://www.nrel.gov/gis/wind.html

NOAA, 2008, http://lwf.ncdc.noaa.gov/oa/climate/online/ccd/avgrh.html

Toxic Release Inventory

Water metering Data

Z-Transit information

Other publications and websites used as resources:

1. http://epa.gov/
2. http://www.eere.energy.gov/
3. www.un.org/esa/dsd/susdevtopics/sdt_land.html
4. http://www.nps.gov/sustain/spop/jtree.htm
5. http://www.eia.doe.gov
6. ISAUK Research Report 07-01, A Definition of Carbon Footprint, June 2007
7. http://acupcc.aashe.org/ghg-scope-statistics.php
8. http://www1.eere.energy.gov/femp/program/printable_versions/waterefficiency.html