Fort Carson Sustainability Baseline

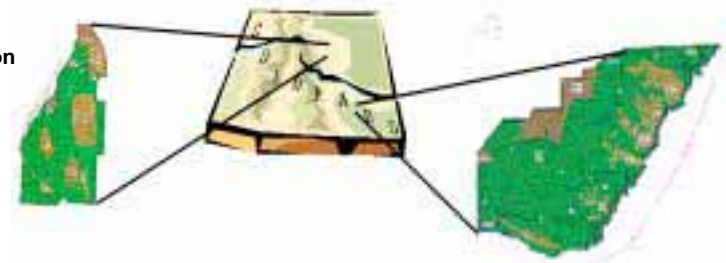
August 2002

Prepared for Fort Carson
and Surrounding Communities

Prepared by the Directorate of
Environmental Compliance and Management

FORT CARSON AT A GLANCE

Fort Carson is located 5 miles from Colorado Springs (population 345,127) and 60 miles south of Denver. Fort Carson comprises 137,404 acres. Piñon Canyon is the maneuver site to the southeast of Fort Carson, and covers 235,896 acres north of West Pueblo. Fort Carson is north of Pueblo; Piñon Canyon Maneuver Site (PCMS) is north of Trinidad. Fort Carson is a power projection platform that supports 10 different units with over 15,800 active duty military personnel. Fort Carson is home to over 900 buildings encompassing 7.8 million square feet of building space. There are approximately 56,000 square feet of building space at PCMS. Fort Carson's major garrison facilities include 1,823 sets of family quarters, 4 schools, a hospital, dental clinics, fitness centers, child-care centers, and other family and youth recreational centers. Currently there are 840 homes and one school under construction. Fort Carson is a great home for our soldiers and civilians, a strong power projection platform with trained combat ready forces, and a committed partner with our civilian and military neighbors.



Fort Carson Mission

"Train, mobilize, deploy, and sustain the combat-ready, multi-component integrated forces of the 7th Infantry Division and Fort Carson… Be a premier Warfighting Center and an effective power projection platform… a responsive and efficient installation. Provide a caring environment for all in a climate of cooperation and partnership with civilian and military neighbors." This translates into the following mission-essential tasks:

- Protect the Force
- Train Active and Reserve Component Units
- Mobilize Reserve Component Units
- Deploy, Sustain, and Redeploy Active and Reserve Component Units
- Manage Resources and Protect the Environment
- Reinvent Appropriate Fort Carson Processes
- Enhance Community Relationships & Partnerships
- Provide a Quality Living and Working Environment for Soldiers, Families, Employees, and Retirees

Fort Carson Population (approximate)

15,000	Active Duty Military
12,000	National Guard
1,800	DA Civilian Employees
1,000	NAF/PX/DeCA Employees
28,800	Family Members
15,400	Retirees
28,360	Retiree Family Members
102,360	**Total Population**

Fort Carson Training Facilities

61	Ranges
12	Drop Zones
56	Training areas
Butts Army Airfield	
Piñon Canyon Maneuver Site (PCMS)	
Total tactical training acreage:	
96,201 (Fort Carson)	
158,620 PCMS	

Message from the Garrison Commander

"Fort Carson…the best place in the Army for soldiers to soldier…leaders to lead…families to grow…and people to work…We are a home to the force…a committed neighbor, trained to deploy, trained to fight, trained to win…the 7th Infantry Division and the Mountain Post Team…a dominant combat ready force for the 21st Century."

— Fort Carson Vision

Fort Carson's mission is to train, mobilize, deploy, and sustain the combat-ready, multi-component integrated forces of the 7th Infantry Division and Fort Carson, and to be a responsive and efficient installation as a premier Warfighting Center and an effective power projection platform. This mission includes providing a caring environment for all in a climate of cooperation and partnership with civilian and military neighbors. This Sustainability Baseline Document and Conference will be used to support that mission for years to come, in the face of decreasing budgets, ever-increasing population growth in Colorado, changing technologies, and greater environmental restrictions.

Fort Carson is the home of the 7th Infantry Division, and is one of America's primary power projection platforms—to include the 3rd Armored Cavalry Regiment; 3rd Brigade Combat Team, 4th Infantry Division (Mechanized); 1-th Special Forces Group (Airborne); 43rd Area Support Group; 2nd Brigade, 91st Division; 4th Regional Reserve Officers Training Corps; Medical Department Activity; Dental Activity; and U.S. Army Garrison. Fort Carson's mission is to train, mobilize, and deploy combat ready forces to fight and win worldwide. Inherent in this mission is the requirement to care for soldiers, their families and the work force, and to sustain a quality installation. Fort Carson has a strategic and national security mission to support worldwide contingencies and respond to global peacekeeping efforts and disasters with trained and ready soldiers.

Fort Carson must function well as a power projection platform now, 25 years from now, and beyond. Infrastructure limitations, mission changes, and dwindling funding pose significant challenges for us in the future. We must be able to effectively integrate sustainability principles into all aspects of how we do business in our daily routines. Incorporating sustainability into the mission will guarantee our ability to accomplish that mission for the long term.

At our Installation Sustainability Workshop, which will take place 4-6 September, 2002, we will bring together Fort Carson personnel, Department of the Army and subordinate headquarter representatives, representatives from other local military installations, civic leaders, members of the local and regulatory communities, and the public, to discuss shared resources and plan for their wise use. Workshop participants will set 25-year goals for addressing the sustainability challenges that face Fort Carson and the surrounding community. We will also identify the community stakeholders and individuals from Fort Carson who will lead our efforts to attain the 25-year goals. This Baseline Document will be used to determine the 25-year goals.

It will not be easy to meet the goals. The effort will require commitment and cooperation across all staffs at the Installation. Additionally, to succeed, we will need the vigorous participation and support of our

Message from the Garrison Commander

neighbors; our Army headquarters; and our partners in state and federal agencies, utilities, regulators, tribes, other area installations, non-government organizations, and the public.

Here is my charge to you: examine the challenges set forth in this document; determine how we want to exist in 25 years; set aggressive, attainable and quantifiable goals; and establish and empower teams that engage the appropriate stakeholders to ensure that Fort Carson's history of proud service to the nation and the world continues indefinitely.

SIMON G. TROMBITAS
Colonel, U.S. Army
Garrison Commander

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EXECUTIVE SUMMARY

Our Sustainability Challenges

Water – The Pikes Peak Region receives an average of 10 to 16 inches of rain per year, usually in intense, short bursts. This means that one of the fastest growing areas in the country receives very little water to support that growth, and pollutants that build up on surfaces such as pavement are concentrated when flowing into rivers and creeks. Water that is transported from other areas for use in the Pikes Peak Region may have existing pollutants. The challenges are to conserve more water with an ever-growing human population, protect watersheds for wildlife and training, and prevent pollution from entering the region's waterways and aquifer systems.

Air Quality – The State of Colorado is concerned about air quality along the Front Range because it is one of the fastest growing regions in the United States. Decreases in carbon monoxide and particulate matter that have occurred over the past 15 to 20 years will be offset in the future by the increased automobile use, industrial activities, and fuel burning for heat and electricity that will accompany the increasing number of people moving into the area. As regional air quality deteriorates, Fort Carson's allowable emission limits on air permits will be tightened. How can Fort Carson sustain the military mission, minimize administrative and operational costs due to air permitting, and help protect regional air quality?

Energy – Energy is an essential resource for Fort Carson's training and deployment missions, and its availability and cost affect the quality of life for soldiers and families. Energy sources at Fort Carson are primarily non-renewable; therefore availability will decrease over the long-term. Inefficient energy use increases operational cost, and increases environmental degradation from resource extraction, climate change, and air pollution. Finally, the cost of energy has doubled over the past decade. How can Fort Carson ensure a reliable supply of energy and reduce costs and environmental impacts, such that the mission is not compromised?

Transportation – The use of petroleum fuels for transportation contributes to regional air quality degradation. Further, the cost of fuel fluctuates and depends on its availability from foreign sources. How does Fort Carson reduce its transportation-related impacts on the air while meeting transportation needs?

Lands – Sustaining Fort Carson's training areas is critical to the mission and long-term viability of Fort Carson as a power projection platform. How can Fort Carson provide realistic training areas through environmental stewardship? How can Fort Carson continue to use its training lands while being a good neighbor to a growing community?

EXECUTIVE SUMMARY

Materials – The large volume of products used at Fort Carson is the result of ingrained practices and habits relating to purchasing and use. Disposal of solid and hazardous materials is getting more expensive. The purchase and use of products add to environmental degradation through harvesting of natural resources, manufacturing, transportation emissions, and disposal. How can the Installation use less, purchase less, substitute more environmentally friendly products, and enhance recycling efforts while still maintaining the core mission of Fort Carson?

Wildlife – How can Fort Carson maintain habitat diversity for native fish and wildlife, while using the land for training and cantonment activities? What can Fort Carson do to help the surrounding community protect the wildlife that inhabits ecosystems surrounding the Installation borders?

Noise – How can Fort Carson sustain its mission of training combat-ready forces in realistic settings that promote soldier survivability and meet defense needs of the United States, while minimizing noise issues with an ever-growing population moving close to its boundaries?

Cultural – How can Fort Carson protect significant cultural resources while maintaining the largest possible area for military training? How can Fort Carson maintain sensitivity to all cultures with traditional ties to lands currently used by the Installation while continuing its use of the land for military training purposes?

WATER

Challenge

The Pikes Peak Region receives an average of 10 to 16 inches of rain per year, usually in intense, short bursts. This means that one of the fastest growing areas in the country receives very little water to support that growth, and pollutants that build up on surfaces such as pavement are concentrated when flowing into rivers and creeks. Water that is transported from other areas for use in the Pikes Peak Region may have existing pollutants. The challenges are to conserve more water with an ever-growing human population, protect watersheds for wildlife and training, and prevent pollution from entering the region's waterways and aquifer systems.

Key Considerations

- **Consumption** – Water is used for many different purposes including residential use, industrial processes, and landscape irrigation. Care must be taken to minimize consumption so that adequate water is available and permit limits are not exceeded.

- **Nonpoint Source Pollution** – As water moves across and through the land, it picks up natural and manmade pollutants and deposits them in lakes, rivers, wetlands, coastal waters, and underground aquifers.
    - Ordnance expended at ranges and munitions-training areas can release pollutants.
    - Erosion on active construction sites and training lands discharges sediment and nutrients into streams and lakes.
    - Runoff from industrial areas such as motor pools may contain automotive chemicals, oil, grease, and metals.
    - Contaminants from leaking underground storage tanks can enter groundwater directly and can travel to surface water and springs.

- **Point Source Pollution** – Specific industrial processes, such as sewage plants, and storm water outfalls that discharge to surface waters constitute point source pollution. These processes usually have permits that limit the allowable level of various pollutants. Failure to meet these limits can threaten water quality in bodies that receive the polluted discharge.

Importance to Fort Carson

Mission – A reliable source of water for drinking, maintaining vehicles for training, landscaping, and industrial uses is critical to Fort Carson's continued operation. In the semi-arid climate in which the Installation is situated, water shortages and maintenance of water rights are a real concern.

Quality of Life – Plentiful, clean water for drinking, hygiene, and aesthetics is essential to a high quality of life.

Cost – Fort Carson spent over $1.6 million for 1,114 million gallons of water in 2000 and $1.6 million for 1,063 million gallons of water in 2001. Because the quality of the water supply is good, only a minor amount of funds was spent on water treatment. It is estimated that approximately $3,626,000 will be spent in 2002 for protection of groundwater and surface water quality, and for water resource restoration. This figure does not include costs for operating the wastewater treatment plant.

Environment and the Community – The Fountain Creek Watershed is currently undergoing major channel changes due to an influx of water from sources outside of the watershed. Additional water causes severe erosion in some areas and deposition in other areas, which can magnify the effects of flooding, disturb riparian systems, and damage property and roadways. The causes of increased water flow include changes in land use from rangeland to urban use (concrete surfaces increase runoff), increased wastewater treatment plant discharge, and transbasin imports of water. The Pikes Peak Region is growing rapidly; eventually, all water users in the area will have to adjust to the growth to sustain the supply and quality of water.

- Fountain Creek is fed by a groundwater system; therefore, it is important to protect groundwater from contamination. An extensive groundwater monitoring system, approved by the State Department of Health, is in place at the Installation. This monitoring system provides comprehensive data on the effects of landfills on groundwater. Groundwater at Fort Carson is not used as a source of drinking water; the groundwater is naturally high in salts where shallow and high in radiation where deep. Increased urbanization causes water quality and quantity problems. Impervious surfaces allow more runoff to enter a stream and contribute pollutants such as gasoline, oil, and salt. In the summer, runoff from paved surfaces can raise stream water temperatures. Due to increased water volumes in Fountain Creek, upstream reaches are being undercut, while downstream reaches have larger deposits of sediments.

  Fort Carson manages seven water rights for wells. Only a few recreation areas and minor activities use well water at the Piñon Canyon Maneuver Site. This is an ongoing activity that requires monitoring and reporting. To retain well rights, beneficial use of the well water must be demonstrated. If beneficial use is not shown, the rights could be subject to abandonment.

Introduction

Water for Fort Carson is supplied by Colorado Springs Utilities. Water is used principally for industrial purposes, personal consumption, vehicle washing and maintenance, and landscaping. Water quality and water quantity are closely related. As the amount of water decreases, pollutants become concentrated and the supply of useable water decreases. Most of the water used in the Pikes Peak Region comes from lakes and reservoirs scattered throughout the mountains. The water is transported via pipeline to supply the region with drinking water that surpasses state and federal standards. Water for the Piñon Canyon Maneuver Site comes from the City of Trinidad. Water for the Turkey Creek Ranch Recreation Area is drawn from a well, treated by reverse osmosis, chlorinated, and stored in two above-ground water tanks.

Colorado Springs Utilities draws the water from 25 reservoirs. Colorado Springs Utilities currently secures supplemental water from the western slope of the Rockies for use on the Front Range. In 2000, Fort Carson used a total of 1,114 million gallons of potable water and released 554.8 million gallons of treated water from its sewage treatment plant. Peak water use occurs in July and August (Figure 1.1), typically the warmest months in the area. Colorado Springs Utilities has sole control over its water distribution; thus, if water supplies decrease in the future, Fort Carson may be allowed to purchase only limited amounts of water, diminishing its ability to accomplish its mission.

Fort Carson has three natural watercourses through the cantonment, all of which drain into Fountain Creek. The drainages are Clover Ditch, B Ditch, and Unnamed Ditch. The remainder of the Installation, including training lands, drains south into Beaver Creek and eventually into the Arkansas River. At this point, the Arkansas River is not heavily impacted by urbanization because the area is not heavily developed. Approximately one-half of the Installation drains into the Fountain Creek Watershed and the other half drains into the Arkansas River Watershed (Figures 1.2 and 1.3).

Regulations At A Glance

Clean Water Act (CWA) – In 1972, the U.S. Congress enacted the first comprehensive legislation to control water pollution. One of the dominant features of the CWA is a federal permitting program called the National Pollutant Discharge Elimination System (NPDES).

The CWA requires states to identify pollution sources for water bodies that fail to meet state water quality standards and to develop Water Cleanup Plans to address those pollutants. The plans establish Total Maximum Daily Loads (TMDL's) that limit the amount of pollutants that can be discharged to the water body while still meeting state standards.

Safe Drinking Water Act (SDWA) – The 1974 SDWA was developed to protect public health. Under the SDWA, USEPA established the Source Water Protection and Wellhead Protection Programs. The Source Water Protection Program emphasizes preventing contamination of drinking water resources and includes wellhead protection and sole-source aquifer watershed control plans. By definition, a sole-source aquifer must be the sole or principal drinking water source for an area, such that contamination would create a significant public health hazard.

Figure 1.1 – Monthly Water Use for Four Years (thousands of gallons)

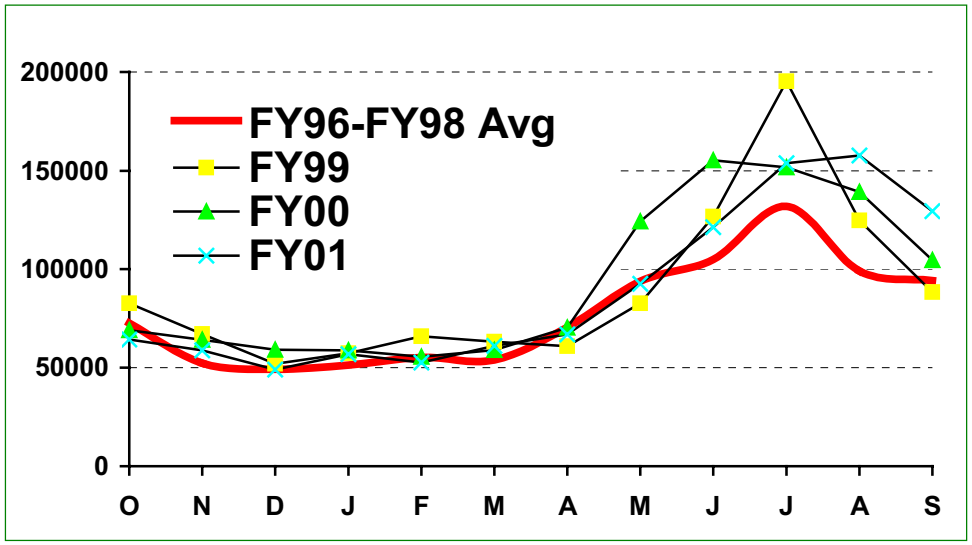
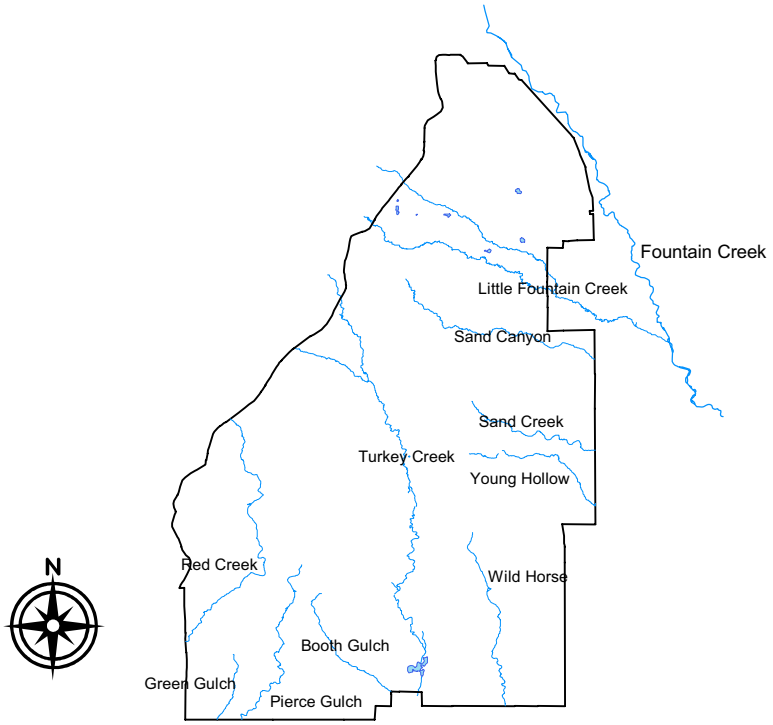


Figure 1.2 – Watersheds on Fort Carson

Figure 1.3 – Fort Carson Stream Map

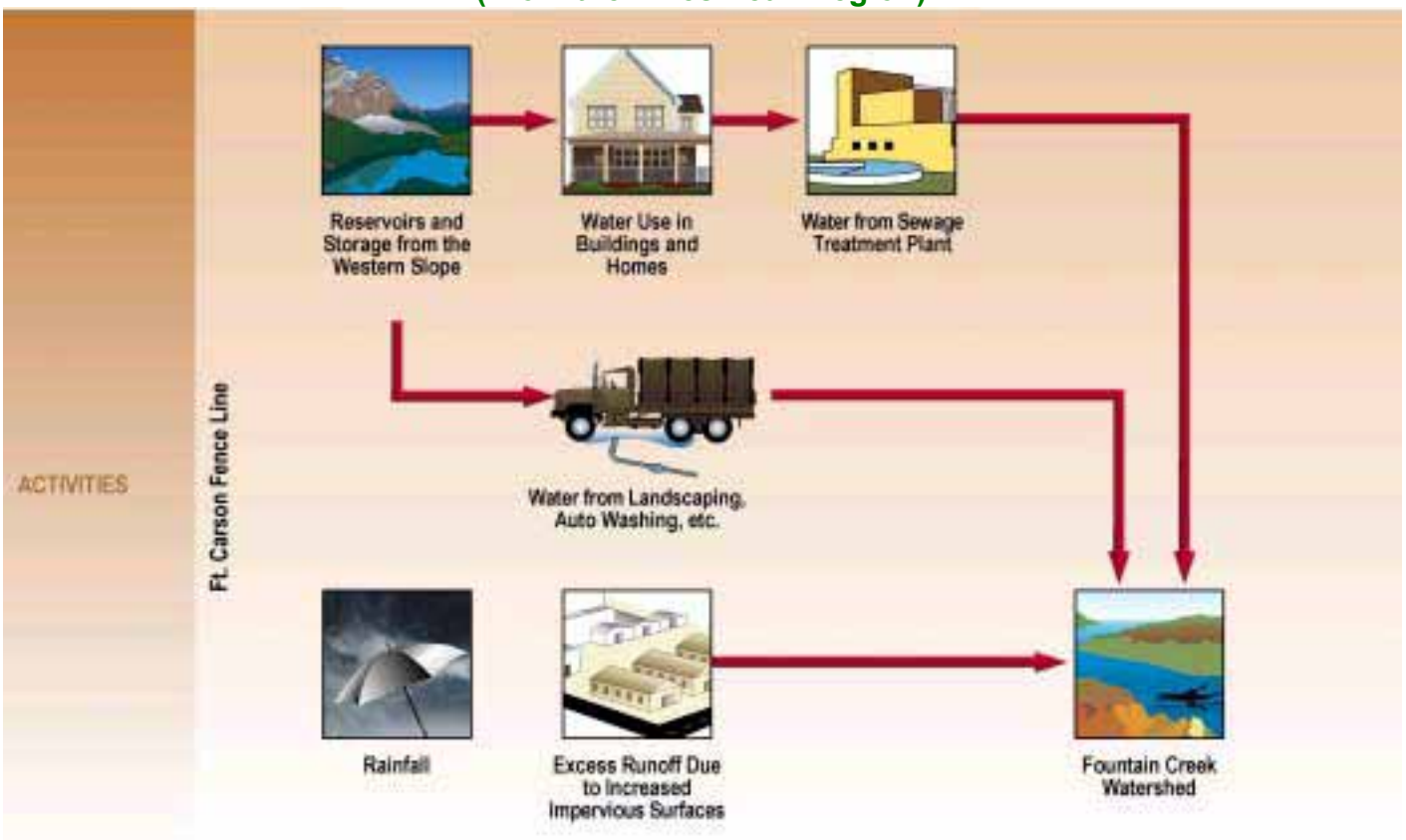


On the Installation, eight reservoirs hold approximately 1,090 acre-feet of water. Fifty-six outfalls have been identified. An outfall is a point on the land where storm water has the potential to discharge into a natural watercourse. Outfalls need to be protected from polluted water, which includes water that is heated or that has drained across paved roadways and is carrying pollutants from vehicles. Through culvert and ditch maintenance, bank sloping projects, reseeding, construction of retention ponds, and drainage control drop

structures, Fort Carson is trying to ensure that water leaving the Installation is clean and released in appropriate volumes.

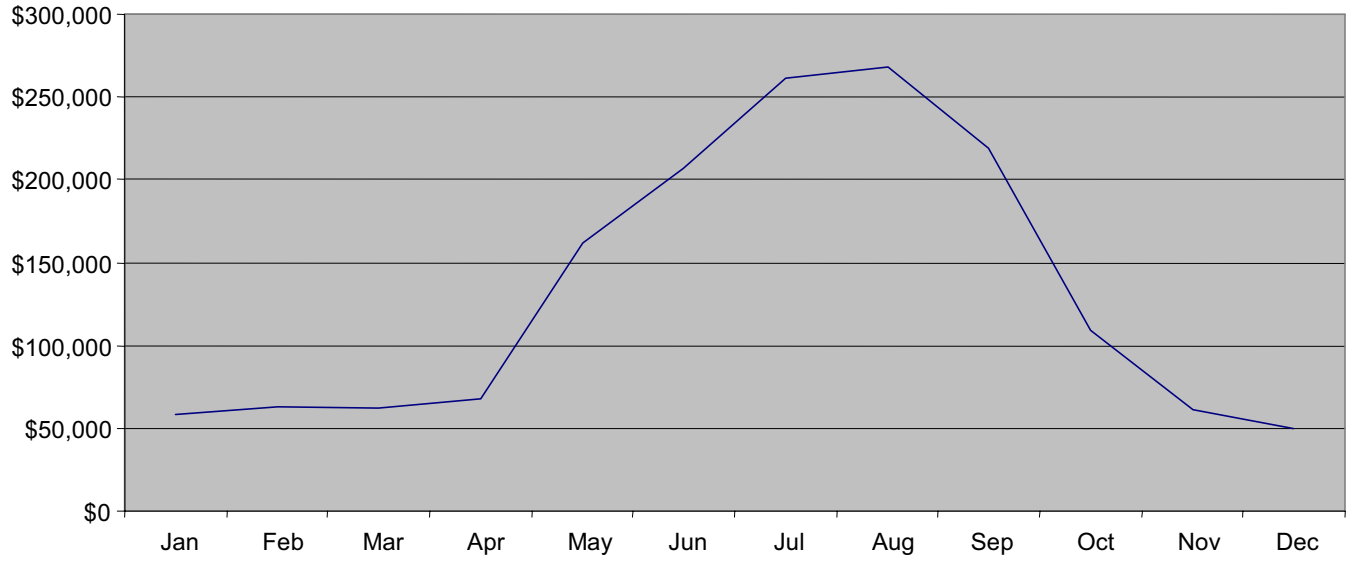
The Fountain Creek Watershed is the primary watershed for the industrial portion of the Installation and surrounding areas. This watershed is undergoing channel changes due to increases in transmountain diversions of water into the watershed and increased urban runoff, which cause increased erosion and flooding problems (Figure 1.4). Erosion and increased flooding decrease the economic value of areas near creeks. The Pikes Peak Area Council of Governments, in which Fort Carson participates, is addressing these issues through the Fountain Creek Watershed Plan Technical Advisory Committee.

Figure 1.4 – Sources of Water Increases to the Fountain Creek Watershed (From the Pikes Peak Region)



Water use increases in the summer months; 90 percent of the increase is due to a greater need for irrigation. This amounts to approximately 200 percent more water, or over one million gallons of water per summer month for irrigation alone. Also, wash rack use due to training rotations increases in the summer. At $1.60 per thousand gallons of water, the total cost for water dramatically increases in the summer (Figure 1.5).

Figure 1.5 – Monthly Costs for Water Use for 2001



Except for localized contamination, water in the Pikes Peak Region is of good quality. For Fort Carson, the primary issues are the potential for groundwater contamination from landfills, the potential for materials spills, and mercury in the Turkey Creek drainage area. The landfills are monitored by a system of groundwater monitoring wells. Hazardous material (HAZMAT) teams address spills immediately. High mercury levels are bioaccumulated in fish and other wildlife in the Turkey Creek drainage area. However, the source of mercury is thought to be natural, and there are no practical actions that may be taken at this point. Fort Carson is currently investigating, remediating, and monitoring the groundwater associated with several landfills, underground storage tanks (UST), and spill sites. There is a hydrologic connection between surface water and groundwater in the area. The proposed budget for water protection for 2002 is $3,626,000. Major restoration and monitoring activities and their costs are listed in Figure 1.6.

Figure 1.6 – Primary Restoration Costs Proposed for 2002

Activity	Cost
Soil vapor extraction system for sewage treatment lagoons at Butts Air Field	$55,000
Long-term monitoring and excavation of impacted soils at the Equalization Basin	$270,000
Long-term monitoring and soil vapor extraction at Building 1515 Service Station	$40,000
Removal of free product from well near site of former UST at Building 1211	$50,000
Continuation of tank and product removal from subsurface at Building 1882 UST	$225,000
Long-term monitoring and cleanup of Landfill 1 area	$135,000
Long-term monitoring at industrial wastewater treatment area	$30,000
Other (continued monitoring, sampling, and maintenance of other sites)	$2,821,000

The Fort Carson Restoration Advisory Board plays a major role in ongoing environmental restoration activities at the Installation. The board consists of personnel from Fort Carson and regulatory agencies, and citizens representing the interests of the surrounding communities. Members meet quarterly and are invited to participate in decisions concerning restoration activities.

The primary receiving waters from the Fort Carson Sewage Treatment Plant are within the Fountain Creek Watershed and Fountain Creek itself. Fort Carson has done much to improve ammonia levels entering Fountain Creek by improving its sewage treatment processes. Unfortunately, due to growth and urbanization in the Colorado Springs metropolitan areas and suburbs, Fountain Creek still suffers from erosion and sedimentation problems as well as impacts from storm water runoff.

Background for Piñon Canyon Maneuver Site

All water from the Piñon Canyon Maneuver Site eventually flows into the Purgatory River or Timpas Creek (Figure 1.7). The streams at the Piñon Canyon Maneuver Site are ephemeral, flowing only seasonally, with high flows in May through August and low or no flows September through April (U.S. Geological Survey Water Resources Report 91-4095).

Figure 1.7 – Map of Piñon Canyon Maneuver Site Waterways

The Army has a strong interest in maintaining the environmental integrity of its training lands. Fort Carson works with federal and state geological surveys and other agencies and universities in continuous study and monitoring of the health of the Piñon Canyon Maneuver Site. The major use of the Piñon Canyon area changed from livestock grazing to military maneuvers in 1985. Some detrimental effects from livestock grazing, such as trampling and destruction of riparian areas may have been mitigated with the change of land use. However, military maneuvers damage vegetation and increase soil compaction, which increases flow into streams. Any long-term increase or decrease in stream flow has deleterious effects on the watershed that contains the stream.

Fort Carson is proactive in addressing water quality and flow at the Piñon Canyon Maneuver Site, with careful training rotation schedules, erosion-control dams, Maneuver Damage Control training, and continuous studies of the area. According to the U.S. Geological Survey (USGS) (Water Resources Report 91-4095), measurements of stream flow and water quality parameters such as cadmium, copper, iron, lead, and dissolved oxygen show no statistical difference at the Maneuver Site since military training began. Sediment yields were smaller or unchanged in all but one of the 21 drainage basins examined in the training area. This could be due to the change from long-term,

widespread plant material removal (from grazing) to short-term, localized plant removal caused by military activities. The rotating schedule for training allows for some plant recovery between training sessions.

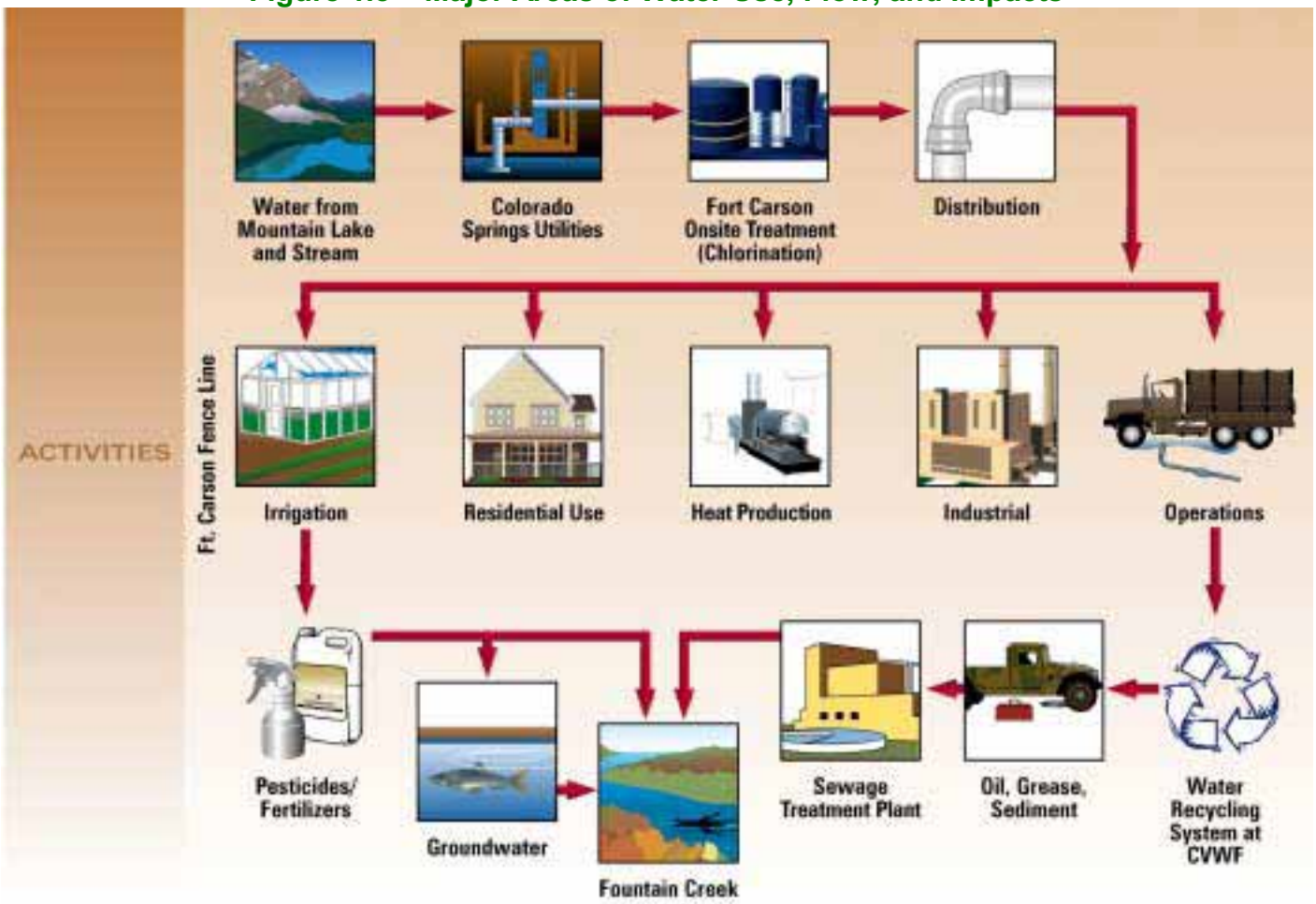
Overall, on the Maneuver Site, range conditions have improved since the primary use changed from grazing to military use (USGS Water-Resources Investigations Report Number 91-4095). There is reduced erosion and reduced sediment transport due to maneuver erosion-control structures such as hardened crossings and erosion-control dams. Improved range conditions and less sediment transport and erosion protect water quality by promoting more stable channels that reflect the natural geomorphology of the stream.

Activities and Impacts

Due to the interconnected nature of water resources, human activities can affect water supply and quality in a number of ways. Pollutants can travel in rainwater over the surface of the ground to waterways or they can filter into groundwater. Pollutants that leach into the ground can travel many miles in unexpected directions in underground streams and contaminate connected surface water systems. Therefore, pollutants from land use activities and discharges that occur within watersheds or aquifer recharge areas can affect surface water and groundwater resources adjacent to and far away from the activity.

Activities on Fort Carson can result in three main types of water-related impacts: depleted water sources, nonpoint source pollution, and point source pollution. Figure 1.8 illustrates the activities and impacts associated with water consumption in Fountain Creek Watershed.

Figure 1.8 – Major Areas of Water Use, Flow, and Impacts



The Human Perspective

Small, individual water reductions can add up to huge conservation measures. For example, El Paso County has 141,516 households; if each household conserves only one gallon of water per day, over 51 million gallons of water may be conserved in El Paso County alone. At Fort Carson, conserving one gallon per household per day, which could be accomplished through water-conserving faucets and low-flush toilets, would conserve up to 2.6 million gallons of water per year and save the Installation $416,000 per year—with no impacts to consumers. Applying xeriscaping techniques, which use native species that do not require irrigation, can also conserve significant amounts of water.

Beyond the Pikes Peak Region

The eastern Front Range of the Rocky Mountains in Colorado is being developed at an incredible rate, leading to increasing water demand. If population on the western slope continues to increase, the amount of water the eastern Front Range can take from the west is likely to decrease. Furthermore, robbing lakes and streams of their water is not a good practice from a riparian and stream system perspective.

Forecast

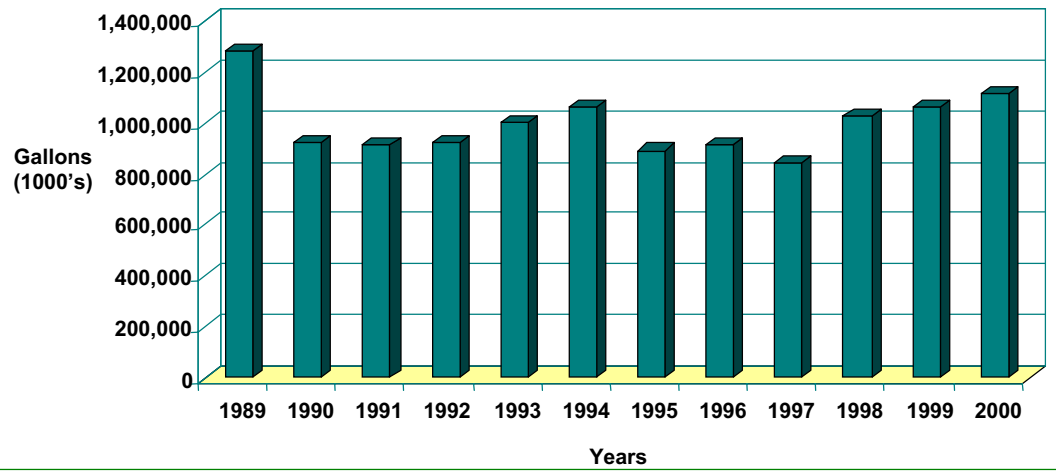
The State Demographer estimates that Colorado will gain 1.7 million new residents by 2020 (http://www.colorado.edu/Law/NRLC/WaterandGrowthFAQ.PDF). Due to increases in development in the area, some dams have been built to provide reservoirs for drinking water. However, some dams that were proposed were not approved, primarily because of concerns over extensive damage to ecosystems. Reallocation of water rights from high-use sectors, such as agriculture, may soon be used to gain more water for Colorado's growing population.

The Supreme Court and nine interstate compacts (which can only be modified by Congress) govern Colorado's water use. These compacts list the rights of each concerned state over shared rivers. As long as there are no modifications to the compacts, Colorado's water rights will remain secure.

Current Sustainability Activities

Fort Carson is progressive in its award-winning water conservation and protection measures. A strong water program requires command support and a proactive champion. The Directorate of Environmental Compliance and Management (DECAM) works closely with the Directorate of Public Works to develop progressive programs that serve the community and the environment as well as the Installation. Figure 1.9 illustrates water use over an 11-year time period.

Figure 1.9 – Water Use: 1989 Through 2000



Central Vehicle Wash Facility – The Central Vehicle Wash Facility is a one-stop location for washing of all military vehicles, especially after training rotations. By centralizing the location, Fort Carson recycles its wastewater and reduces consumption. This system saves 150 to 200 million gallons of water per year and has saved over 4 billion gallons of water since start-up in 1990.

Irrigation by Treated Wastewater – Since 1971, treated wastewater has been pumped from the Installation's sewage treatment plant to irrigate Fort Carson's golf course (180 acres of grass). This practice conserves over 100 million gallons of potable water per year.

Composting Toilets – Designed for high-use recreational facilities, composting toilets have been installed at Iron Horse Park, Fort Carson's main recreational facility, and at the Installation's golf course. This type of toilet uses only 1,825 gallons of water per year instead of the 200,000 gallons used in a traditional toilet. In addition, the 220,000 gallons of wastewater produced by a traditional toilet must be sent for treatment.

Beneficial Landscaping – Some beneficial landscaping measures are currently in place at the Installation. All turf irrigation is operated on a watering schedule for maximum efficiency, moisture probes are used in some areas, and xeriscaping is encouraged and used in some areas. Fort Carson has been designated a "Tree City USA" for 10 consecutive years, due to its use of trees for erosion control, wildlife habitat, and energy conservation. Fort Carson plants more than 150 trees per year.

Leak Detection Surveys – A water leak detection survey at the vehicle wash racks has prevented the potential for leakage of 70 million gallons of water per year.

Ultraviolet Disinfection of Wastewater – Fort Carson was able to greatly reduce its use of gaseous chlorine and gaseous sulfur dioxide by switching to ultraviolet technologies in the disinfection process. This switch has ensured that wastewater is cleaner when released.

Barracks and Family Housing Improvements – Many water flow devices in the barracks and family housing areas have been retrofitted with low flow devices such as one-gallon-per-flush urinals and low flow toilets, faucet aerators, and showerheads.

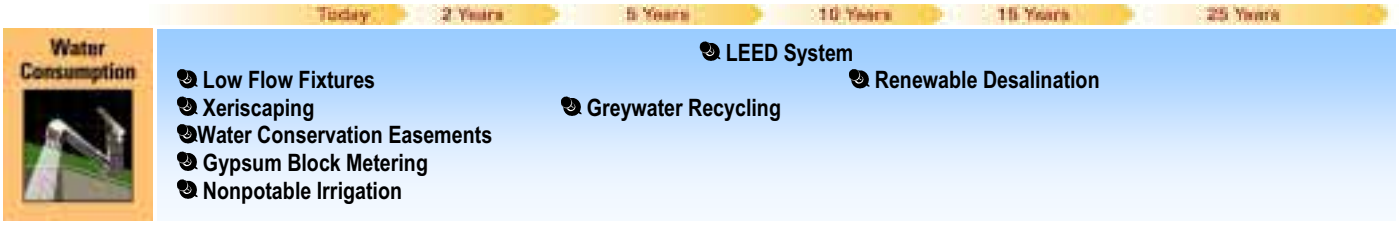
Fountain Creek Watershed Community Participation – Fort Carson actively participates in the Fountain Creek Watershed committee, which works with watershed stakeholders to address erosion and flooding in the Fountain Creek watershed.

Horizontal Axis Washers – DECAM purchased four horizontal axis washers as a pilot study in 1998. The washers have saved money and water as predicted, but are more expensive than traditional washing machines. However, these machines provide significant savings in reduced maintenance costs.

The Realm of Possibility

To become sustainable, Fort Carson is encouraged to identify and plan for innovations that will support the goals established during the Installation Sustainability Workshop. To do this, participants should review the concepts and technologies that are within the realm of possibility now and in the future. This section provides a glimpse of what can be accomplished with existing technology and what can be expected from developing sustainability approaches.

Water Consumption



- **LEED System** – The U.S. Green Building Council's release in 2000 of the Leadership in Energy and Environmental Design (LEED) rating system provides a national standard for evaluating and comparing green building performance. The Army has developed its own version of the LEED standards called the Sustainable Project Rating Tool (SPiRiT), which includes additional rating factors appropriate to military projects and facilities. Projects are rated for sustainability in eight categories: sustainable sites, ***water efficiency***, energy and atmosphere, materials and resources, indoor environmental quality, facility delivery process, current mission, and future missions. More information on the SPiRiT standards can be found at http://www.cecer.army.mil/sustdesign/SPiRiT.cfm. SPiRiT standards that will assist Fort Carson in limiting impact on water quality include:

  - C1 – Water-Efficient Landscaping. Limit or eliminate the use of potable water for landscape irrigation.

  - C2 – Innovative Wastewater Technologies. Reduce generation of wastewater and potable water demand, while increasing local aquifer recharge.

  - C3 – Water Use Reduction. Maximize water efficiency within buildings to reduce the burden on municipal water supply and wastewater systems.

- **Xeriscaping** – Xeriscaping, a landscape design method that creates elegant and water-efficient landscapes that require little or no irrigation, uses native plants that are as attractive as traditional ones (http://www.ciwmb.ca.gov/organics/xeriscaping/default.htm).

- **Irrigation Meters** – Irrigation meters, in use in western Texas, save one to two-thirds of water formerly used for irrigation. A $1 block of gypsum, buried at the root zone, is connected through two wires to a clip-on meter that reads soil moisture. Drip irrigation, which delivers a small amount of water directly to the root zone of plants as needed, also drastically reduces water use.

- **Renewable Desalination** – Freshwater supply is an issue of great importance to the overall sustainability of communities, especially those in water-scarce regions. In some places, desalination is the only way to provide reliable (yet extremely expensive) freshwater to the population. The Greek island of Milos is rapidly reaching the point where freshwater supply will not be adequate for habitation anymore. A pilot project is underway that will tap the island's geothermal energy to desalinate seawater. If successful, the desalination plant will become a net ***producer*** of electricity and will lower the cost of freshwater on the island 200 times, all while producing no emissions (http://www.wbcsd.org/casestud/gerling/index.htm).

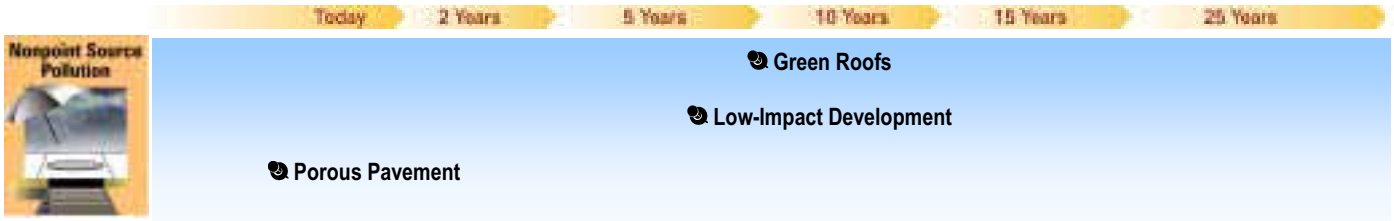
- **Greywater Recycling** – The future of sustainable water use is *in situ* water recycling and reuse. A large portion of the water we use becomes "greywater" when it is washed down our sinks and showers. This water, with minimal treatment by natural and cost-effective means, can be reused many times over for irrigation, flushing of toilets, and even dishwashing. The home or office of the future could provide up to 70 percent of its daily water needs through simple recycling of bath and laundry water. Treatment systems will be low-tech and cost effective, many times using natural bacteria and plants to clean water (http://www.greenbuilder.com/sourcebook/Greywater.html) and http://www.greywater.com/).

- **Camp, Dresser and McKee** – Camp, Dresser and McKee (CDM) have pioneered a number of water management technologies that reduce the impact on local water resources. Aquifer storage and recovery (ASR) systems store storm water and treated wastewater in underground "bubbles" where the water can later be removed. It increases water reserves in times of drought and decreases total drain on natural aquifers. CDM also helps design and build stormwater overflow systems and TMDL management programs that help address point and nonpoint source pollution problems.

- **Water Conservation Easements** – In cooperation with the Nature Conservancy, Fort Huachuca has purchased several water conservation easements. The easements were purchased to restrict water use and preserve ecosystems in the area. The easements decrease the use of water near the installation so that the water is available in the future, while providing a service to the community and the environment.

- **Nonpotable Water Irrigation** – Potable water irrigation can be replaced with water from Fountain Creek at one-half the cost of treated water. Fort Carson already has the pipe connectivity needed to irrigate with water from the river.

Nonpoint Source Pollution

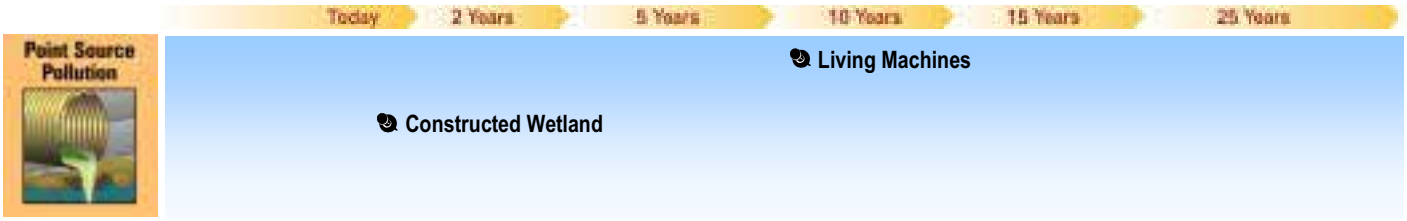


- **Low-Impact Development** – Low-impact development practices can minimize impervious areas, thereby maximizing groundwater recharge (http://www.stormwatercenter.net). Proper management of stormwater protects surface and groundwater from contamination, which is critical to Fort Carson and the surrounding region. Contaminants (e.g., oil, fuel, and sediments) are eliminated if the stormwater is retained on site and allowed to seep into the soil, rather than run off into streams.

- **Green Roofs** – All across the country, thousands of apartment buildings and offices are now growing "green roofs" in place of traditional roofing material. These roofs, made of any number of plant species, soak up water when it rains rather than letting it run off into area rivers and streams. It lowers both the overall volume and contamination levels of the runoff.

- **Porous Pavement** – Porous pavement helps reduce storm water volume and contamination by letting rainwater percolate through the pavement rather than collect and be funneled into local watersheds.

Point Source Pollution



- **Living Machines** – Living Machines® use bacteria, plants, snails, and fish to treat sewage and other wastewaters. The machines look like greenhouses and work by using plants and animals to break down the wastes and digest organic pollutants. Made by Living Technologies, Inc., they have been permitted at 23 locations in 7 different countries, including the United States. They offer better, more stable treatment at the same cost as traditional sewage treatment while decreasing wastewater treatment needs and biosolids disposal.

- **Constructed Wetland** – Fort Knox, KY, is conducting a feasibility study on construction of a wetland that would link the sewage treatment plant outfall to the drinking water intake. A wetland works similarly to the Living Machines® described above; wetland plants and animals purify the wastewater as it flows through the wetland. Constructed wetlands have the potential for containing and treating nonpoint source pollution from ranges and other natural areas.

Fort Carson 25-Year Goals for Water

To be determined by Fort Carson Command and staff, as advised by members of the local and regulatory communities, at the Installation Sustainability Workshop on 4-6 September 2002.

AIR QUALITY

Challenge

The State of Colorado is concerned about air quality along the Front Range because it is one of the fastest growing regions in the United States. Decreases in carbon monoxide and particulate matter that have occurred over the past 15 to 20 years will be offset in the future by the increased automobile use, industrial activities, and fuel burning for heat and electricity that will accompany the increasing number of people moving into the area. As regional air quality deteriorates, Fort Carson's allowable emission limits on air permits will be tightened. How can Fort Carson sustain the military mission, minimize administrative and operational costs due to air permitting, and help protect regional air quality?

Key Considerations

- **Training** – Regional air quality issues can influence training activities such as those requiring use of smokes and obscurants. Modifications in specific activities can reduce the likelihood of specific restrictions in the future.

- **Energy Use** – Generation and use of energy affect regional air sheds. Efficient buildings and renewable energy sources reduce impacts to the air and can reduce long-term costs.

- **Transportation** – Continuing to participate in the development and implementation of a regional mass transit plan with the Pikes Peak Council of Governments will support regional air quality objectives. The Destination 2025 Plan will improve regional air quality, reduce traffic congestion, and contribute to a better community-installation partnership.

- **Product Selection and Use** – Identification and use of environmentally benign chemicals for operations and maintenance (O&M) functions and mission activities can reduce impacts and costs while improving mission readiness and worker safety and health.

Importance to Fort Carson

Mission – Training-related smoke activities are limited by Fort Carson's air permit. Reporting and approval paperwork for use of grenades, fog oil, and smoke pots in training activities can be cumbersome. A three-kilometer buffer zone, in which no smoke-related training activities may take place, has been established around the entire perimeter of the Installation.

Quality of Life – Clean air is critical to good quality of life for soldiers and their families. Asthma rates in cities continue to rise, and air pollution can cause many other health problems, such as reduced lung function, susceptibility to respiratory infections, increased risk associated with existing heart conditions, and respiratory system irritation.

Costs

- The estimated costs to run Fort Carson's air program in 2002:
  - Sampling and Monitoring: $5,000
  - Title V Operating Permit: $68,800
  - Emissions Inventory: $34,000
  - Emission Impact Reviews: $20,000
  - Personal Vehicle Emission Surveys: $8,000
  - Ozone-Depleting Chemical Phase Out: $26,000
  - Fees and Permits: $30,000
  - Dust Mitigation: $300,000
  - Total: $498,800
- Total cost to eliminate and replace ozone-depleting chemicals at Fort Carson: $164,919.
- Cost to provide a new paint booth at Building 8000: $500,000.
- Cost to replace the two Building 1860 boilers: $200,000.
- Fort Carson is currently involved in negotiations with the Colorado Department of Public Health and the Environment concerning permit violations noted during an inspection in 2000. All violations have since been corrected.

Environment and the Community – According to Val Viers, a professor in Physics and Environmental Science at Colorado College, Colorado Springs is likely to violate National Ambient Air Quality Standards (NAAQS) for carbon monoxide on a regular basis by 2030 (http://www.coloradocollege.edu/Publications/access/february1997/4EnvironmentalScienceAquires.html). As a member of the regional community, Fort Carson must continue proactive environmental stewardship activities and limit its contribution to ambient air pollutants.

Introduction

The scenic mountains to the west of Fort Carson pose a special challenge to air quality; they serve as a wall preventing dispersion of pollutants. The mountains and high altitude of the region also cause a winter phenomenon known as atmospheric inversion, the trapping of cold air beneath warm air, which concentrates pollutants at lower levels. If population growth and automobile use continue to expand at the current rate, air quality problems will be exacerbated. As air quality diminishes, quality of life decreases and respiratory illnesses increase. As an inevitable consequence of deteriorating air quality, permit restrictions and regulatory requirements increase and become more stringent, affecting the Army's ability to train effectively for its mission.

Background

As with any installation or industrial activity, Fort Carson has emissions specific to its mission and not related to building or vehicle emissions (detailed in the Energy and Transportation sections of this document). The largest emissions (Figure 2.1) occur in four areas: Training Activities, Vehicle Maintenance Activities, On-Site Utilities Equipment, and Cantonment Activities.

Figure 2.1 – Sources of Air Pollutants at Fort Carson

Sources	Particulate Matter	Nitrogen Oxides	Carbon Monoxide	Sulfur Oxides	Volatile Organic Compounds	Hazardous Air Pollutants
Training Activities	Smoke and Obscurants					
Vehicle Maintenance		Dynamometers	Dynamometers	Dynamometers		Bldg 8000 Paint Booths
On-Site Utilities Equipment	Bldg 1860 Boilers	Bldg 1860 Boilers Bldg 6290 Generators	Bldg 1860 Boilers Bldg 6290 Generators	Bldg 1860 Boilers Hospital Generators		
Cantonment Activities	Unpaved Haul Roads				Bldg 900 Svc Station Bldg 1515 Svc Station Base wide Chemical Use	Basewide Chemical Use Bldg 900 Svc Station

Red = Largest Source on Fort Carson
Blue = Second Largest Source on Fort Carson
Green = Third Largest Source on Fort Carson

Many activities are included under each of the four major categories (Figure 2.1). Training activities refer to those activities performed in the field, such as smoke and obscurant use and weapons firing. Tactical vehicle movement on unpaved tank trails creates fugitive dust. Open burning and open detonation are performed in the field to eliminate unused ordnance. Vehicle maintenance activities are required to keep troops moving and practicing for war. On-site utility equipment, such as boilers and emergency generators, keep buildings that are not connected to the power grid comfortable and ensure uninterrupted systems operations during

power outages. Cantonment activities include miscellaneous emission sources such as gas stations, storage tanks, and landfills.

A Word about Ozone-Depleting Chemicals

Fort Carson maintains an active plan to eliminate the use of Class I ozone-depleting chemicals (those with the greatest potential to destroy the ozone layer) in accordance with all Federal, State, and Department of Defense guidelines. These ozone-depleting chemicals are commonly used as refrigerants in refrigeration and air conditioning units, solvents for cleaning and degreasing operations, fire extinguishing agents, and fumigants for killing pests and weeds. Retrofits with non-ozone-depleting chemicals replaced all fire suppression systems with halon. Three ozone-depleting solvents used on the Installation are being reformulated. However, tactical equipment continues to have fire suppression systems that contain ozone-depleting chemicals; no substitutes have been developed that are as effective in suppressing a fire in an enclosed vehicle and thereby saving soldiers' lives. In an effort to assist with the regulatory compliance recordkeeping and reporting requirements associated with the use of refrigerants, the DECAM purchased a Refrigerant Compliance Manager software program.

Regulations At A Glance

Clean Air Act (CAA) – This federal legislation establishes permitting requirements and limits for activities that release air pollutants. Three major kinds of requirements apply:

1. **National Ambient Air Quality Standards (NAAQS)** – These standards regulate the amount of six criteria pollutants in ambient air. If regional concentrations of ozone, carbon monoxide, particulate matter (e.g. dust), sulfur dioxide, nitrogen oxides, or lead rise above certain standards, operational changes may be required at Fort Carson. The area is currently designated an Attainment/Maintenance area for carbon monoxide.
2. **New Source Performance Standards (NSPS)** – Construction or modification of facilities that may emit air pollutants requires a permit. The permitting process includes a health effects review and public comment opportunities.
3. **National Emissions Standards for Hazardous Air Pollutants (NESHAPs)** – The 1990 CAA Amendments directed the U.S. Environmental Protection Agency (USEPA) to regulate emissions into the air of 189 toxic chemicals, called Hazardous Air Pollutants (HAPs), which are known or suspected carcinogens. Regulations specify emission limits according to industry categories.

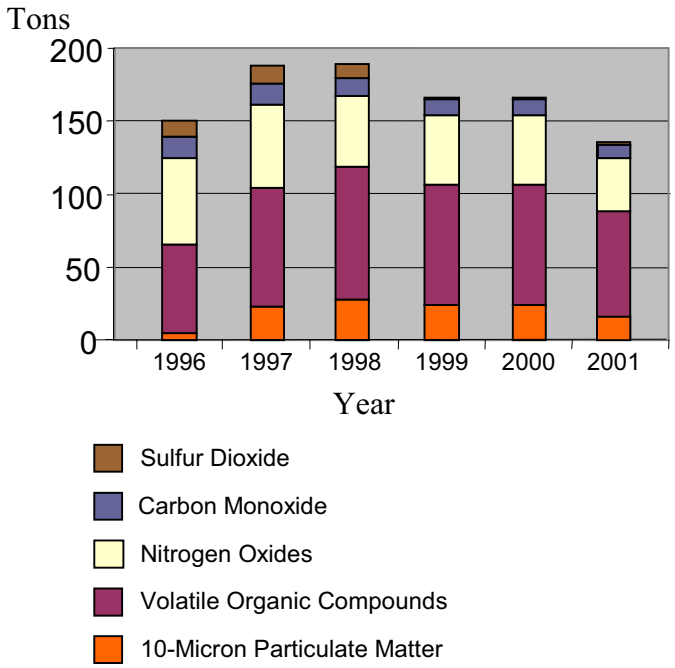
The Colorado Springs area currently is considered "in attainment" for the six criteria pollutants. However, population growth in the area will lead to increased vehicle-miles traveled, which may lead to nonattainment for ozone. In addition, the mountains limit air dispersion, diminishing air quality on a local or regional scale.

Emission Summaries

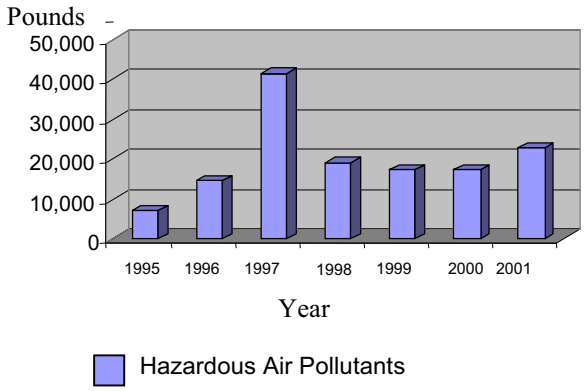
Fort Carson monitors and controls annual emissions of the Clean Air Act's six defined criteria pollutants as well as Hazardous Air Pollutants. Figure 2.2 provides a summary of both criteria and hazardous and toxic air emissions from Fort Carson. These data do not include mobile emissions (e.g., vehicles) or emissions generated by Colorado Springs Utilities to supply power for Fort Carson. Figure 2.3 details specific emission source categories, including those that emit volatile organic compounds (VOCs) and nitrogen oxides. Nitrogen oxides and VOCs react together with sunlight to form harmful ground-level ozone.

Figure 2.2 – Air Pollutant Emissions at Fort Carson

National Ambient Air Quality Standards Criteria Pollutant Emission Levels



Hazardous and Toxic Air Pollutants



Lead Emissions in Pounds per Year

1996	1997	1998	1999	2000	2001
1.9	2.9	22.77	1.56	17.9	0.65

Ozone Precursor Emissions in Tons for 2001

Source	Nitrogen Oxides	Volatile Organic Compounds
Boilers	31.50	0.62
Generators	4.72	0.30
Paint Booths	0.00	14.04
Gas Stations and Tanks	0.00	43.48
Landfill	0.00	6.41
Training Specific (smoke, open burning/open detonation, chemical use)	0.02	9.37
Insignificant Sources	1.37	0.48

Figure 2.3 – Summary of Primary Air Pollutants at Fort Carson (tons per year)

Emission Sources	Particulate Matter	Nitrogen Oxides	Carbon Monoxide	Sulfur Oxides	Volatile Organics	Hazardous Air Pollutants	Ozone-Depleting Chemicals
Boilers	7.20	37.19	9.30	0.76	0.73	0.49	0.00
Engines/ Generators	0.34	3.45	0.76	0.39	0.20	0.00	0.00
Paint Booths	0.49	0.00	0.00	0.00	5.62	2.66	0.00
Gasoline Stations	0.00	0.00	0.00	0.00	33.17	2.44	0.00
Storage Tanks	0.00	0.00	0.00	0.00	0.57	0.71	0.00
Smoke and Open Burning/Open Detonation	11.66	5.83	0.02	0.01	3.23	0.02	0.00
Chemical Usage	0.00	0.00	0.00	0.00	15.77	2.29	0.01
Landfill-Related Issues	0.00	0.00	0.00	0.00	12.40	0.64	0.01
Storage Piles and Haul Roads	21.83	4.64	0.00	0.00	0.00	0.00	0.00

On-Site Utilities Equipment
Cantonment Area Activities
Vehicle Maintenance Activities
Training Activities

Activities and Impacts

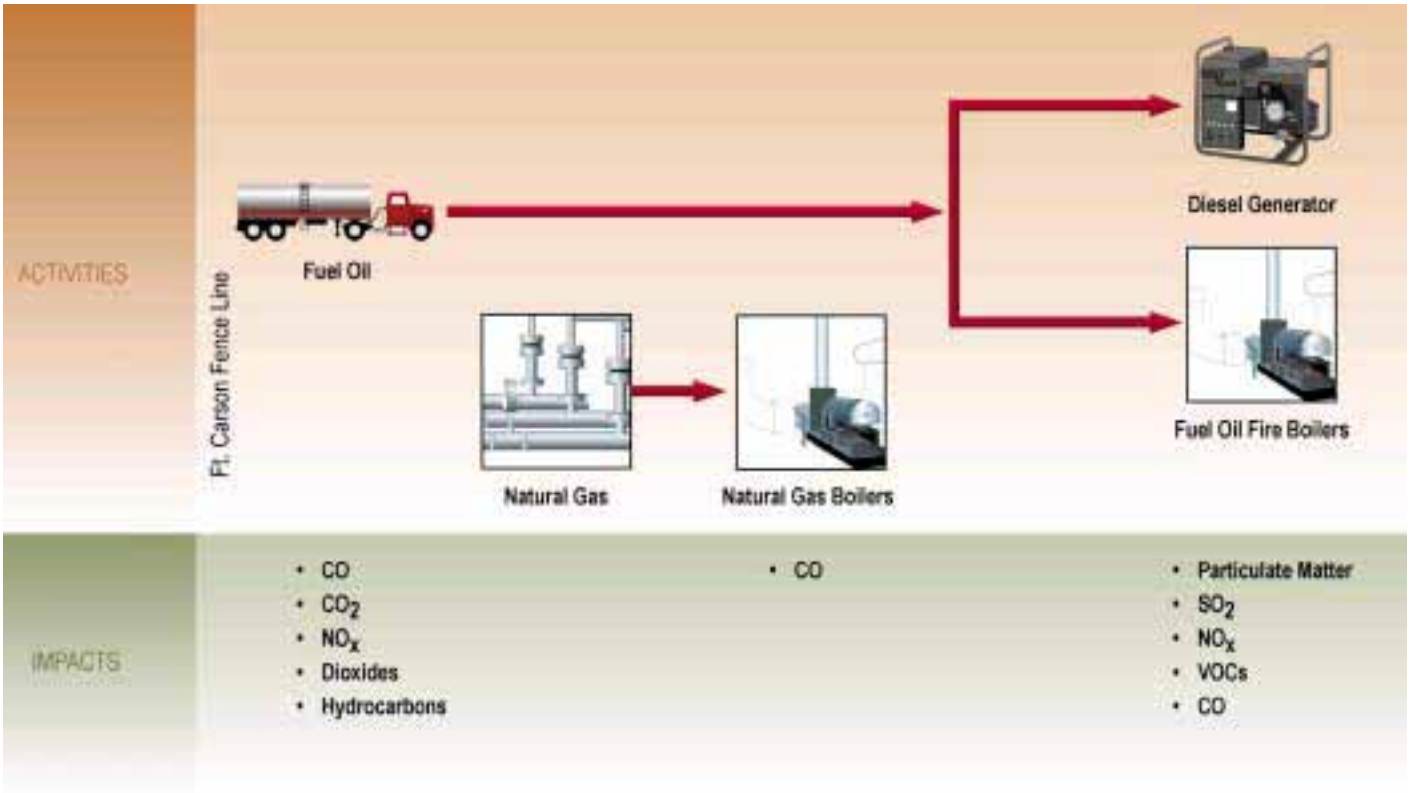
The primary activities listed in the Installation's Title V Air Operating Permit are grouped into five major emission source categories: painting, on-site heat and power generation, vehicle maintenance activities, landfill emissions, and training activities. For this Baseline Document, the aggregate categories are On-Site Utilities Equipment, Vehicle Maintenance Activities, Cantonment Activities, and Training Activities.

On-Site Utilities Equipment

Fort Carson does not obtain all of its power from Colorado Springs Utilities. Some areas are too remote or not connected to the main grid, and some areas must have stand-by sources of power in cases of power outages. Because electricity from the power grid cannot heat all areas, Fort Carson uses boilers. Generators are important to medical, food storage, and other facilities in case of power outages.

Fuel oil is transported to the Installation for use in fuel-oil boilers and generators (Figure 2.4). Pollutants resulting from the combustion of fuel oil include carbon dioxide (a greenhouse gas), sulfur dioxide (contributes to acid rain), and nitrogen oxides (ozone precursors and lung irritants). To reduce the levels of sulfur dioxide resulting from the burning of fuel oil, Fort Carson purchases low-sulfur, distillate fuel oil. Diesel is transported to the Installation for use in some small generators. Diesel fuel contributes the same types of pollutants as fuel oil, but with the potential of increased sulfur dioxide emissions. Natural gas is piped to the Installation for use in the majority of heating systems.

Figure 2.4 – Major Sources of Air Pollution from On-Site Utilities Equipment

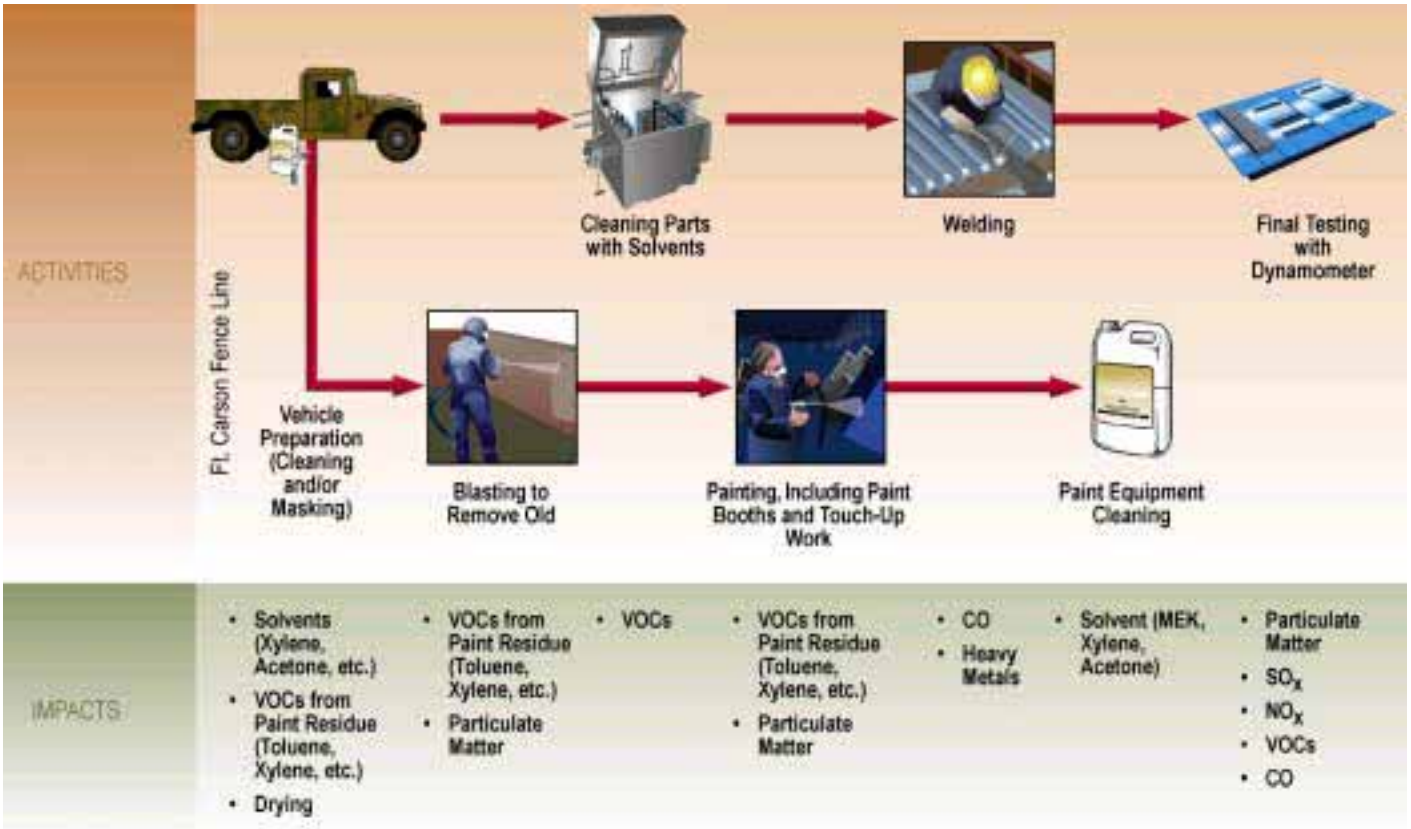


Vehicle Maintenance Activities

Vehicles require regular repair, painting, and refueling to keep the Army moving. To support the Installation's readiness mission and minimize air pollution, proper maintenance of all vehicles is extremely important. Vehicles are often lifesavers in battle situations. Therefore, soldiers must know how to repair them and must have the appropriate tools and materials to do so. Figure 2.5 illustrates the activities involved in vehicle maintenance that cause air emissions; these are not necessarily in chronological order.

Fort Carson uses two types of parts cleaning solvents/systems. The traditional system uses a petroleum naphtha-based solvent that is serviced by the vendor and recycled. Some motor pools use a new citrus-based solvent and filter. The new system is environmentally superior because the filter allows longer solvent use before its recycling.

Figure 2.5 – Major Sources of Air Pollution from Vehicle Maintenance



Touch-up painting is typically done with limited amounts of paint. Personal protective equipment is required. After painting, solvents are used to clean the equipment. Welding occurs on an as-needed basis. Miscellaneous activities that contribute minor amounts of emissions include battery charging (sulfuric acid) and the use of adhesives for gluing in certain repairs.

For large paint jobs, vehicles are cleaned with soap, water, and solvent, and then taped for blasting. Blasting removes paint, which combines with the blast material. At Fort Carson, blast materials are a combination of plastic and garnet, which are returned to the vendor, recycled, and made into picnic tables, dog bowls, planters, and other items. High volume, low-pressure paint guns are used to enhance application efficiency by minimizing over-spray and conserving paint, thereby minimizing pollution. After vehicles are painted, the tape is removed and the paint equipment must be cleaned with a solvent.

Paint used for tactical vehicles is a chemical agent resistant coating, also referred to as "CARC." The chemical composition of CARC includes titanium dioxide, xylene, chromic oxide, butyl acetate, hexamethylene diisocyanate monomer, ketone, and naphtha. As dangerous as these chemicals are, this type of paint is critical in warfare for its resistance to chemical agents during chemical, biological, and radiological warfare.

Additional sources of air emissions not shown in Figure 2.5 are hazardous waste items, such as leftover paint, contaminated cleaning solvent, sandblasting grit and rags, contaminated personal protective equipment, air filters, and paint-saturated rags, wipes, and masking materials.

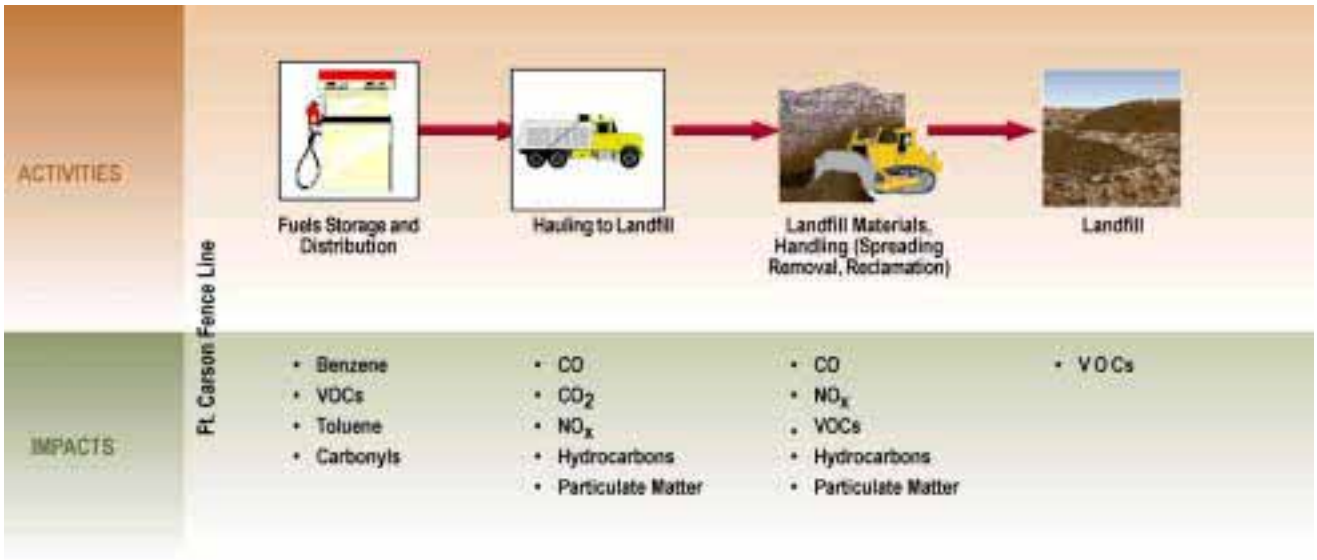
Cantonment Activities

The tactical vehicle fleet and most administrative vehicles require gasoline or diesel fuel. The installation operates two service stations. Fuel is stored in underground or aboveground tanks and dispensed through commercial or industrial delivery systems. All together, these storage and distributing systems contributed a total of 43.48 tons of volatile organic compounds and 3.61 tons of hazardous air pollutants to the atmosphere in 2001, although gasoline stations were a far greater contributor than storage tanks (Figure 2.6).

Tank trails, haul roads to landfills, and troop construction yards are typically unpaved and can cause particulate matter to disperse into the air. Vehicles emit carbon monoxide, nitrogen oxides, and hydrocarbon products. Storage piles and haul roads contributed 29.27 tons of particulate matter to the air in 2001.

Spreading, removal, and reclamation of landfill materials can cause the release of hazardous air pollutants (0.64 tons in 2001) and volatile organic compounds (6.41 tons in 2001). Vehicles used to move the material around also emit pollutants as described in the paragraph above. In April of 2002, landfill operations ceased, and the landfill is now in the closure process. Discontinuing landfill-related activities will reduce the Installation's contribution of hazardous air pollutants and volatile organic chemicals from this particular source. However, transportation of trash off-site for disposal will have associated air impacts.

Figure 2.6 – Major Sources of Air Pollution from Cantonment Activities



Training Activities

Fort Carson's mission is to make soldiers combat-ready. A realistic training environment is critical to the success of military operations and the survival of military personnel. There are many sources of air pollution from training activities (Figure 2.7). Prescribed burns—scheduled, controlled fires that minimize the risk of wildfires—release pollutants, but increase the number of training days because wildfires stop training and cost tremendous manpower, time, and money to contain. (The Lands section contains more information on prescribed burns.)

Soldiers must be transported to Piñon Canyon Maneuver Site, and once there, must have the ability to train in a manner that simulates war situations. Due to the area's climate, topography, soil type, and vegetation, training activities at both Fort Carson and the Piñon Canyon Maneuver Site result in fugitive dust (particulate matter) emissions. However, it is in the best interest of a military unit to minimize the amount of dust, as dust in the air gives away positions to "enemy" units during training and in war situations. Dust suppression costs a minimum of $50,000 per year at Fort Carson and Piñon Canyon; the estimated annual cost to suppress dust from all Fort Carson activities is $300,000.

Smoke and obscurants are used on the battlefield and in training to limit the enemy's visibility. Smoke and obscurants are fast, low-cost countermeasures to enemy surveillance and weapons systems, such as infrared, radar, and visual sensors. Practice in the use of obscurants is critical to battlefield survival.

Excess, obsolete, or unserviceable munitions and explosive materials must be destroyed. Allowing these materials to accumulate can cause serious hazards. Open burning and open detonation are allowed in Fort Carson's Air Operating Permit.

Figure 2.7 – Major Sources of Air Pollution, Flow, and Impacts from Training Activities

The Human Perspective

Fort Carson has made advances in reducing air pollution. Nevertheless, critical equipment such as emergency generators and life-saving materials such as chemical agent resistant coatings are necessary for the Installation to accomplish its mission. Technologies are available to accomplish dramatic reductions in air pollution from several activities. Unfortunately, the costs for these technologies are high. Funding is also needed for research into less polluting methods, machinery, or substances.

The Environmental Protection Agency designated Colorado Springs as an "Attainment/Maintenance" area for carbon monoxide levels on October 25, 1999. Attainment was accomplished through the joint efforts of the State of Colorado and Colorado Springs through a State Implementation Plan (SIP). The SIP specifies how state and local governments plan to achieve and maintain air quality that meets health-based standards. However, the area remains on the margins of attainment and only a few more emission sources will be required to return the area to nonattainment status. Under the General Conformity Rule, Fort Carson is required to address any new emissions of carbon monoxide from new sources and new construction by documenting if the activity or source will significantly contribute to increased carbon monoxide emissions within the Colorado Springs maintenance area.

Beyond the Pikes Peak Region

When soldiers train at other Installations or in foreign battlefields, they know that little or no footprint must be left, or the enemy will discover their position. This care translates into minimizing dust during movement and using obscurants when operations and maneuvers require secrecy. Furthermore, good stewardship practices must be employed to ensure that foreign lands will be left with as little environmental damage as possible. The use of back-up generators, vehicles, and obscurants creates air pollutants that can be transported significant distances. Minimizing these impacts with better practices, materials, or technologies will become increasingly important as countries tighten restrictions on military vehicles and maneuvers in and through their territories.

Forecast

As one of the fastest growing regions in the country, the Pikes Peak Region faces challenges concerning population growth, land use, transportation, and air quality. Communities within the region have the potential to affect Fort Carson directly because deterioration of regional air quality will result in more stringent regulatory and permit restrictions. The restrictions may influence future military training and other Installation operations.

The recent expansion of the Interstate 25 corridor in Colorado Springs cost millions of dollars. Mass transit improvements were not included, although the Pikes Peak Area Council of Governments is developing a "Destination 2025 Plan," which addresses long-term transportation issues in the region. Fort Carson's participation in long-term planning efforts is critical to the development of a sustainability partnership with the surrounding communities.

In 1999, the oxygenated fuel program was relaxed in El Paso County, making it a contingency measure instead of a control measure. Oxygenated fuels reduce exhaust emissions by enhancing combustion. This relaxation of requirements was due, in part, to the area's level of carbon monoxide emissions falling within Federal standards limitations. A University of Denver study claimed that one-half of the carbon monoxide emissions came from the 10 percent of cars on the road that need a tune-up. The study recommended that those emissions be addressed by requiring tune-ups instead of requiring the use of oxygenated fuels (http://216.239.51.100/search?q=cache:l7HAN0NRcYIC:www.fortfreedom.org/k37.htm+oxygenated+fuels+cost&hl=en). Fort Carson should contribute in future decision-making activities that will affect the types of fuels allowed in the area.

Current Sustainability Activities

- **Natural Gas Boilers** – The Directorate of Public Works is working to replace all fuel-oil boiler systems with cleaner natural gas systems.

- **Environmentally Friendly Parts Washers** – The DECAM is developing a program to replace parts washers that use Stoddard solvent with parts washers that use a more environmentally friendly solvent. This project also incorporates servicing the systems and recycling the solvent, which saves money.

- **Dust Suppression Program** – Fort Carson is working to develop better dust suppression methods that use magnesium chloride.

- **High-Volume, Low-Pressure Paint Guns** – High-volume, low-pressure paint guns reduce over-spray by providing a higher volume of air under lower pressure for greater control. The Directorate of Logistics uses several of these paint guns in their primary paint booth at Building 8000.

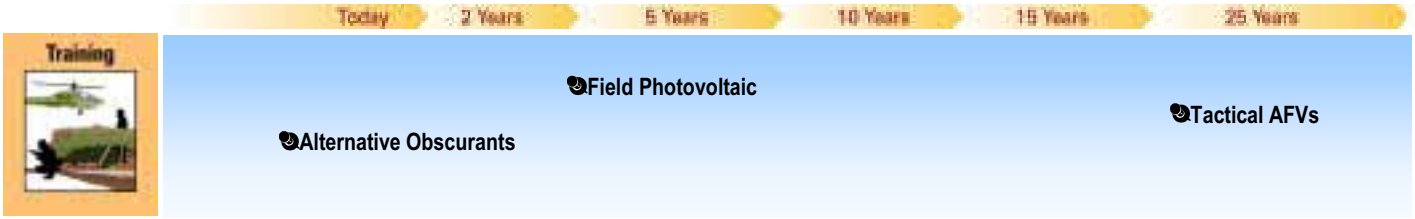
- **Environmental Protection Officer Training Program** – The DECAM developed an intensive 40-hour training program, which includes ways to reduce air pollution, to address all on-site environmental issues.

- **Inspection Program** – Compliance Assistance Officers conduct both scheduled and unscheduled visits to each motor pool on post to ensure that compliance issues are addressed and that simple management practices, such as closing solvent tank lids, are implemented to help reduce air emissions.

The Realm of Possibility

To become sustainable, Fort Carson is encouraged to identify and plan for innovations that will support the goals established during the Installation Sustainability Workshop. Toward this end, participants should review the concepts and technologies that are within the realm of possibility now and in the future. This section provides a glimpse of what can be accomplished with existing technology and what can be expected from developing sustainability approaches.

Training

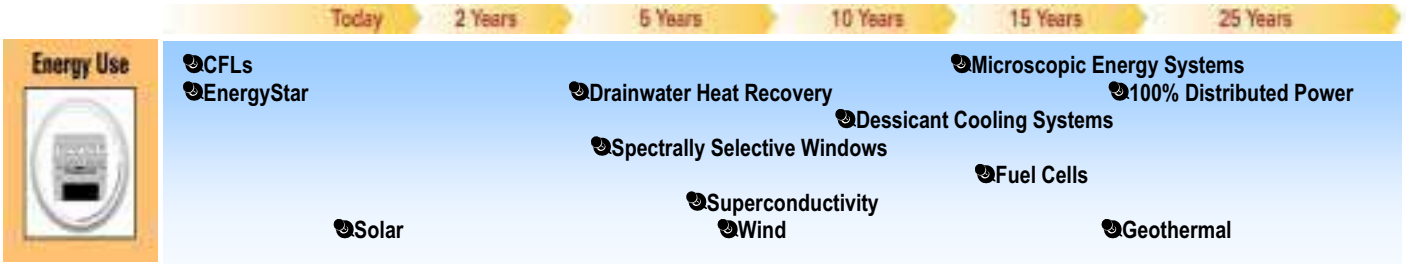


- **Field Photovoltaic System** – The 504th Parachute Infantry Regiment, 82nd Airborne, has developed and tested a mobile photovoltaic system capable of providing up to 80 percent of the power required by a modern tactical operations center. Use of this system would remove the need for dirty diesel generators and improve air quality in and around installations.

- **Tactical Alternative Fuel Vehicles (AFVs)** – While alternative fuels are not currently approved for use in tactical vehicles, advances in technology may someday allow our tanks and armored personnel carriers to run on biodiesel, compressed natural gas, or fuel cells. Beyond the obvious benefit to air quality, moving toward the use of alternative fuels may also have operational benefits. Biodiesel, which is produced from refined vegetable oils, is one of the few truly renewable domestic fuel sources. Vehicles using biodiesel would be immune from variations in foreign oil supply.

- **Alternative Obscurants** – The U.S. Army Environmental Center has determined that certain types of signal smoke grenades and smoke pots may be releasing toxic substances that could endanger soldiers and the environment. The research indicated that dyes in the hexachlorethane smoke pots could be carcinogenic. As a result, a project is underway to develop and test alternative obscurants with less toxic characteristics. If successful, these new dyes would increase soldier safety while decreasing training restrictions implemented to protect surrounding communities. Go to this web site for more information: http://www.estcp.org/projects/pollution/200122o.cfm.

Energy Use



- **Microscopic Energy and Cleanup Systems** – Scientists at the Pacific Northwest National Laboratory (PNNL) and other laboratories are developing a family of microscopic energy systems that are manufactured in much the same way that computer chips are made. Microscopic heat exchangers, evaporators, condensers, gas absorbers, turbines, bioreactors, chemical reactors, chemical separators, pumps, and valves exhibit extraordinary rates of heat and mass transfer. When combined into heating, ventilation, and air conditioning (HVAC) or process equipment, this translates into very high efficiencies

and minimal pollution generation. These miniature components can be combined to create small heat pumps that can be integrated into window frames, with simple, plug-in replacement units if the originals fail. Small, biofueled fuel cells will be developed and can be located wherever heat and electricity is needed. Miniature chemical separation units will be developed for *in situ* cleanup of tanks, wells, aquifers, and other polluted systems—imagine a pen-sized device that can be dropped into a drum of waste to eliminate PCBs.

- **Drainwater Heat Recovery** – It is estimated that up to 80 percent of water-heating bills come from shower/bath water. An innovative technology called drainwater heat recovery uses the latent heat in drainwater to "preheat" cold water before it is sent through a conventional water heater. Drainwater is typically 90 to 95°F when it is piped away from the shower or bath, and 100 percent of that potential energy is wasted. These systems take heated drainwater and run it through tiny spiraling pipes to preheat cold water to a higher temperature, thus reducing the total amount of energy a water heater must expend to heat fresh water. Installing a drainwater heat recovery unit can reduce overall heating bills by as much as 40 percent. USEPA estimates that if 6 million hot water systems were outfitted with drainwater heat recovery systems, carbon dioxide emissions could be reduced by 20 million tons a year (http://www.oikos.com/gfx/index.html).

- **Superconductivity** – Superconductivity, the ability of a material to conduct electricity with zero resistance and almost no loss of power, is a cutting-edge technology that may some day revolutionize the way we think about electricity (http://www.eren.doe.gov/superconductivity/). Today, almost 10 percent of all electricity generated is lost in transmission—radiated as heat from inefficient copper and aluminum wires. Superconductors will lead to the development of a number of new technologies:
    - Transmission wires will carry 100 times more current on a wire no bigger than those currently in use.
    - Super-efficient mass transit systems (similar to the MagLev train in Japan) will transport people at enormous speeds using a fraction of the energy used by current commuter trains.
    - Electric motors using superconductor wiring will operate at a fraction of the cost, improving industrial and residential energy efficiency while saving money.
    - Electric generators will be smaller and lighter and require less fuel to generate power.

- **Compact Fluorescent Lights (CFLs)** – There are a number of commercially available alternatives to traditional incandescent lights. Compact fluorescent lights use 50 to 70 percent less power than incandescent lights of the same intensity. EPA maintains a comprehensive list of CFLs (http://www.energystar.gov/products/cfls/).

- **EnergyStar** – EPA maintains a database of high-efficiency appliances and office equipment. By simply investing in these readily available alternatives, businesses and homes can save hundreds in energy bills every year (http://www.energystar.gov).

- **Desiccant Cooling Systems** – Within the next few years, desiccant cooling systems could save offices and large commercial buildings thousands of dollars per month in electricity bills (http://www.nrel.gov/desiccantcool/tech.html). Used in conjunction with traditional HVAC units, desiccant coolers remove moisture from the outside air, cooling it in the process, which allows for much higher efficiency for the primary cooling unit.

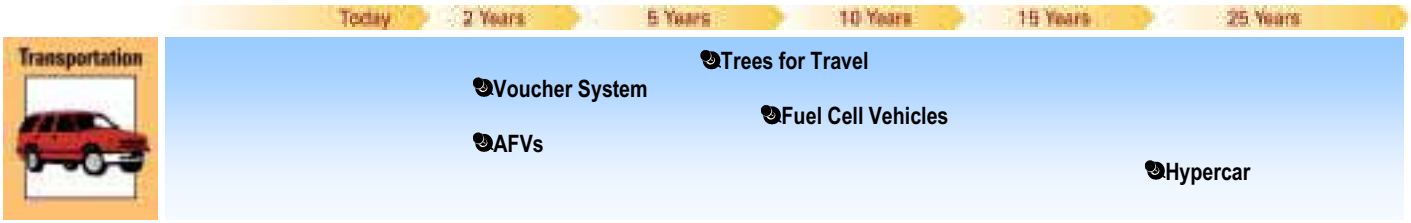
- **Spectrally Selective Windows** – Spectrally selective and chromogenic windows represent the next generation of windows technology. Spectrally selective windows have advanced coatings that filter certain wavelengths of radiation from the incident sunlight, significantly lowering overall solar heat gain. Chromogenic windows are even more advanced, with coatings that change their reflective properties based on ambient temperature or light conditions. Some estimates place the potential energy savings at 40 to 70 percent for electrically heated spaces.

- **Solar, Wind, and Geothermal** – Many Army installations are experimenting with renewable energy sources such as geothermal, solar, and wind, which generate no air emissions. Fort Bliss is doing a feasibility study on developing a wind farm to fulfill the majority of its electrical needs. Fort Hood and Fort Irwin have installed "solargizers," active daylighting of buildings, and solar-powered streetlights to capture the sun's energy. Fort Carson heats a hangar using a solar "wall" on one side of the building. For more information on the realm of possibility and examples of efforts world-wide, see Chapter 12, *Climate: Making Sense and Making Money*, in the book Natural Capitalism.

- **Fuel Cells** – While fuel cells are starting to become available now, most industry analysts believe that it will be 8 to 10 years before they are truly cost competitive with traditional energy systems. These systems work by combining an ionized hydrogen fuel source with air to produce water and electricity. There are NO harmful emissions associated with their operation. They produce electricity that can then be used to heat and power a residence or office space. GE and other large energy services companies have invested millions in this technology and it is only a matter of time before we begin to use fuel cells in earnest (http://www.dodfuelcell.com/).

- **100 Percent Distributed Generation** – Distributed generation works on the premise that the most efficient way to produce electricity for a customer is to produce it at the location where it is needed, thus avoiding losses due to transmission. Imagine a country with no power lines, no polluting smokestacks, and no power companies as we know them today. Imagine instead a country where every home or office has a fuel cell in the basement generating electricity while releasing only water vapor as a byproduct. Or imagine an office building with a solar roof and windows that becomes a net source for power on sunny days. Impossible? Maybe so. However, as technology continues to develop, the day may come when every home and business can generate its own electricity for less than it costs now to buy electricity from a utility.

Transportation



- **Trees for Travel** – Trees for Travel is an organization that will plant trees to offset the pollutants caused by air and vehicle travel. Organizations can keep track of their mileage and send donations to Trees for

Travel. Large land-owning organizations, such as Fort Carson, can start their own program to offset the vehicle emissions caused by transportation activities (http://www.treesftf.org).

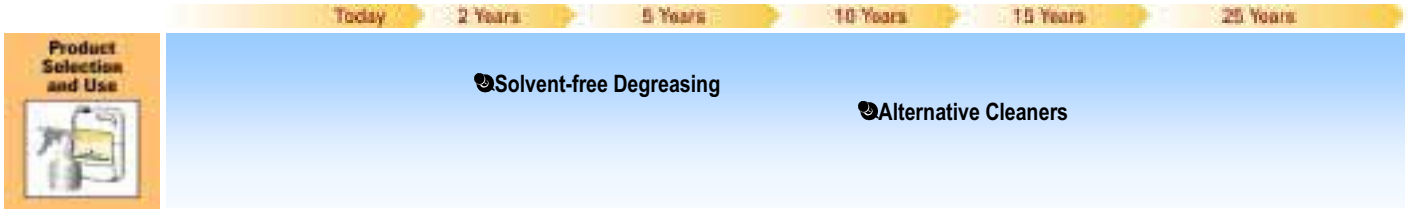
- **Voucher System** – The new Mass Transit Voucher System requires government agencies to pay up to $65/month to cover the costs of employees who take mass transit or van pools to work.

- **Fuel Cell Vehicles** – Toyota and Honda will begin selling Fuel Cell Vehicles in 2003. Toyota Motor Corporation will begin selling fuel cell motor vehicles in mid-2003, possibly becoming the first world automaker to start selling next-generation automobiles. Because of the limited availability of hydrogen for fuel and maintenance personnel for the new vehicles, Japan's No. 1 automaker initially expects to sell only about a dozen fuel cell vehicles—in the Tokyo metropolitan area alone—primarily for use by government offices and leading businesses. A Toyota spokesman confirmed that the company is preparing to launch the vehicle "at the soonest possible time of next year," which is expected to be based on its experimental model, the FCHV-4, and mounted on a sport utility vehicle. The Kluger V. Honda Motor Company is also gearing to launch its own fuel cell model for limited commercial sales next year. DaimlerChrysler Corporation and Ford Motor Company are preparing to launch fuel cell cars in 2004. Fuel cell vehicles, which are powered by hydrogen stored in an onboard, high-pressure tank, emit no harmful pollutants into the air at the point of use (BNA, Feb 2002).

- **Alternative Fuel Vehicles (AFVs)** – The General Services Administration (GSA) provides vehicles that run on alternative fuels, such as natural gas, propane, and electricity. These vehicles have reduced air emissions. Honda, Nissan, and Ford also have alternative fuel vehicles on the market. Fueling stations are needed to make this a viable option on a widespread basis.
    - Acrion Technologies, Inc., developed a method to capture methane from landfills by condensing it to liquid form, vaporizing volatile organic compounds, and using the clean, high-grade fuel that is left for boilers, turbines, or fuel cells.
    - The U.S. Army Research Laboratory Coatings Research team has developed a formulation with a lower volatile organic compound content. This formula, if fully implemented, could reduce volatile organic compound emissions by approximately four million pounds per year (https://www.denix.osd.mil/denix/public/library/PRO97/wrcarc.html). This technology is available now.

- **Hypercar** – Rocky Mountain Institute (RMI) developed a concept design for a "hypercar" and put it in the public domain in the early 1990s. By reconfiguring three key design elements, RMI estimates that 70 to 80 percent of the fuel could be saved, which corresponds to a decrease in air emissions, while making cars safer, sportier, and more comfortable. The three design elements include 1) making the vehicle ultralight by using composites instead of metal, with a weight two to three times less than steel cars; 2) making the vehicle more aerodynamic, so it has much less drag; and 3) making the vehicle's propulsion system hybrid-electric, with the electricity produced on board from fuel as needed. The fuel could be conventional gas or diesel, or a stack of fuel cells, which turn hydrogen and air into electricity. From 1993-98, the private sector committed roughly $5B to developing the hypercar. The major automakers have built prototypes and predict mass production of fuel cell powered cars by 2005; Honda and Toyota already have hybrid-electric vehicles on the market in Europe, Japan, and the United States.

Product Selection and Use



- **Solvent-free Degreasing** – The Army Tank-automotive and Armaments Command (TACOM) and the Army Research Laboratory are testing and evaluating new technologies for solvent-free degreasing. Ideally, the technology will be available within two to five years.

- **Alternative Cleaners** – Many different cleaning agents are available to reduce the use of hazardous air pollutants and ozone-depleting chemicals. Common alternative agents range from water-based to petroleum distillates. A new class of plant-derived cleaners began to emerge in the last decade. Terpenes derived from citrus oils are the most noted of this class. Recently, other plant-derived cleaners have been developed. These include the ethyl lactate-based cleaners derived from corn and soy (http://www.gemtek.com). Plant-derived cleaning agents can be used over a wide range of cleaning applications, from clean room applications to general maintenance.

- **Decreased Paint Emissions** – The Army Corps of Engineering Research Laboratory has developed a cartridge-like device that captures hazardous air pollutants and volatile organic compounds exhausted from painting and chemical cleaning operations, and recycles them for reuse as paint thinners. Available now, this system saves money by eliminating three steps in the filtering process and results in emissions that fall well under regulated levels.

  The same lab has also developed a mobile zone system for painting that concentrates the volatile organic hazardous air pollutants from painting activities. Pollutants are reduced by recirculating ventilation in a spray booth in conjunction with a mobile, partially enclosed space for the painter. The airflow across the worker is improved while the treated volume of air in the paint booth is reduced from 30,000 cubic feet per minute to 2,000 cubic feet per minute, concentrating and reducing the volume of captured pollutants.

Fort Carson 25-Year Goals for Air Quality

To be determined by Fort Carson Command and staff, as advised by members of the local and regulatory communities, at the Installation Sustainability Workshop on 4-6 September 2002.

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ENERGY

Challenge

Energy is an essential resource for Fort Carson's training and deployment missions, and its availability and cost affect the quality of life of soldiers and families. Energy sources at Fort Carson are primarily nonrenewable; therefore, availability will decrease over the long-term. Inefficient energy use increases operational cost and environmental degradation from resource extraction, climate change, and air pollution. Finally, the cost of energy has doubled over the past decade. How can Fort Carson ensure a reliable supply of energy and reduce costs and environmental impacts so that the mission is not compromised?

Key Considerations

- **Energy Conservation** – Many opportunities for reducing energy consumption in existing facilities and operations are available. Fort Carson needs to find the financial resources to invest in these opportunities and the management time to initiate and manage retrofit projects.

- **New Construction** – Significant new construction is underway on Fort Carson. The energy consumed in new facilities will likely remain relatively constant over the 50+ years these buildings are in operation. New buildings can be designed to be substantially more efficient than most buildings constructed today, and more efficient than the inventory of buildings now on Fort Carson. Given the lifetime of new facilities, and the difficulty in radically improving energy efficiency in buildings after construction, energy efficiency needs to be a top-level priority for all new Fort Carson facilities.

- **Energy Independence** – Future energy costs will fluctuate to an even greater degree given recent deregulation of the gas and electricity markets. On-site generation of electricity from renewable sources (e.g., solar and wind) would help stabilize energy costs and improve energy supply reliability. Installation distributed energy sources (e.g., renewable energy and small, distributed generators such as microturbines and fuel cells) can help ensure a reliable energy supply.

- **Green Energy** – The pressure to move to renewable energy sources is significant and growing. Fort Carson can support the development of renewable energy sources by increasing its efforts to buy energy from renewable sources. The adoption of multifueled vehicles that can use biofuels would be another important step toward energy independence and reduced environmental impact.

Importance to Fort Carson

Mission – Reliable, affordable energy is essential to Fort Carson's mission to train, mobilize, and deploy Army ground forces in defense of the nation.

Quality of Life – Good quality of life depends on sufficient heat, hot water, cooling, and clean air.

Cost – Fort Carson spent $4.5 million for electricity and $2.8 million for natural gas in 2000. In 2001, Fort Carson spent $5.7 million for electricity and $6.9 million for natural gas.

Environment and the Community – Energy use at Fort Carson in FY01 resulted in the emission of an estimated 27,410 tons of carbon dioxide (CO_2); 699 tons of nitrogen oxides (NO_X); 753 tons of sulfur oxides (SO_X); and 0.38 tons of mercury, cadmium, and lead from Colorado Springs Utilities. These estimates are based on standard calculations for converting energy used per kilowatt-hour (KWH) to emissions produced (http://www.cleanerandgreener.org/pollution-from-electricity.htm). Colorado Springs Utilities has made great strides in reducing emissions; therefore, these pollution estimates may be higher than the actual emission levels due to the use of innovative pollution-control technologies. While Fort Carson and the surrounding area are in an "attainment" area—violations of National Ambient Air Quality Standards (NAAQS) have not lasted longer than one day in the previous year—special weather and geographic considerations put the area at risk. Atmospheric inversions occur when an upper layer of warm air traps a layer of cool air close to the surface, stagnating the air and preventing pollutants from dispersing. Another important factor is the proximity of the mountains, which block the dispersion of pollutants from the area.

While no air-related environmental enforcement actions have been taken at Fort Carson in the past five years, there are several critical considerations related to energy production and use.

- Over the past 10 years, average carbon monoxide concentrations in the United States have decreased by 37 percent. Due in part to the efforts of Colorado Springs Utilities, carbon monoxide concentrations in Colorado Springs have decreased by 55 percent in that timeframe.
- A new natural gas and steam power plant is being built south of Colorado Springs. Originally expected to address area population growth to 2020, new estimates based on faster-than-expected growth show that the plant will only be able to supply sufficient power until 2012.
- Four horizontal-axis washing machines are being used in barracks at Fort Carson. Compared to standard top-loading washing machines, these machines use 50 percent of the electricity and natural gas, reduce dryer time, and are less harsh on clothing. While more expensive at the outset, life cycle costing may show a long-term savings.

Introduction

Fort Carson's utilities are supplied by Colorado Springs Utilities (CSU). The Directorate of Public Works (DPW) is in charge of utility acquisition and system repair and maintenance. The Directorate of Environmental Compliance and Management (DECAM) coordinates the energy program, which provides education, awareness, and management support to Fort Carson. The Environmental Quality Working Group (EQWG), which includes energy conservation as part of its program, monitors consumption, sets goals, and recommends action. Support for energy conservation includes the DPW Utilities Manager, DPW Energy Savings Performance Contract Manager, DECAM Energy Assistant (half-time), DECAM Energy Manager (position has been open for a while), and five Inspectors that do Energy Inspections as well as HM/Compliance Inspections.

Background

As a community-owned and -operated utility, CSU keeps rates low by reinvesting revenues into operations. Nonetheless, Fort Carson spent an additional $4 million for natural gas and electricity in fiscal year 2001 (Figure 3.1) due to the quadrupling of natural gas prices and an extremely cold winter (Fort Carson used 40 percent more natural gas in November of 2001 than in November 2000). Fort Carson is expected to spend $200,000 more for electricity in FY02. As of July, 2002, prices of natural gas have gone down and the Installation has spent $1.8 million less on natural gas. New housing at Fort Carson, in addition to continued demand for air conditioning, computers, communications, and other electronic applications, will contribute to increasing demands for energy in the coming years. Energy prices and use are expected to rise over the next decade, especially with the new family housing expected to be built during that time.

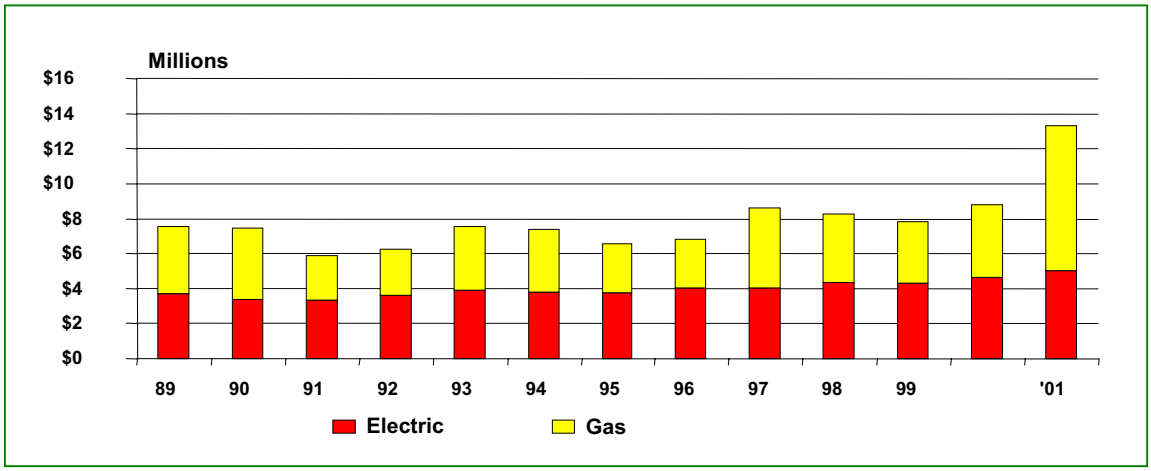
Regulations At A Glance

Numerous energy policies are relevant to energy use on Fort Carson. State and federal performance standards exist for building design, equipment, and appliances.

Executive Order 13123, *Greening the Government through Efficient Energy Management* – President Clinton issued this June 1999 Executive Order, which identifies requirements for reducing energy consumption and greenhouse gas emissions and revokes earlier energy conservation goals. Two key requirements of the Order are that each agency shall (1) reduce energy consumption per gross square foot by 30 percent by 2005 and 35 percent by 2010, relative to 1985; and (2) reduce greenhouse gas emissions attributed to facility energy use by 30 percent by 2010, relative to 1990. Other Executive Order goals include specific energy-conservation objectives for industrial and laboratory facilities, an emphasis on renewable energy, a focus on reducing consumption of petroleum and water, and an emphasis on reducing source energy consumption (even at the expense of greater site energy consumption). The Defense Authorization Act for Fiscal Year 2002 establishes the 2005 and 2010 goals as law and requires annual progress reports.

The Sustainable Project Rating Tool (SPiRiT) is a self-evaluation tool to determine the extent to which a building is "green" or environmentally friendly. A 100-point system assigns ratings on four levels: Bronze (25–34 points), Silver (35–49 points), Gold (50–74 points), and Platinum (75 or more points). SPiRiT points are heavily weighted on energy conservation, with site selection next; additional criteria include water efficiency and materials used. An Army Construction Engineering Research Laboratory (CERL) team can qualify a building, but it is expensive. The Installation can use SPiRiT to do its own evaluation, but the building will not be certified.

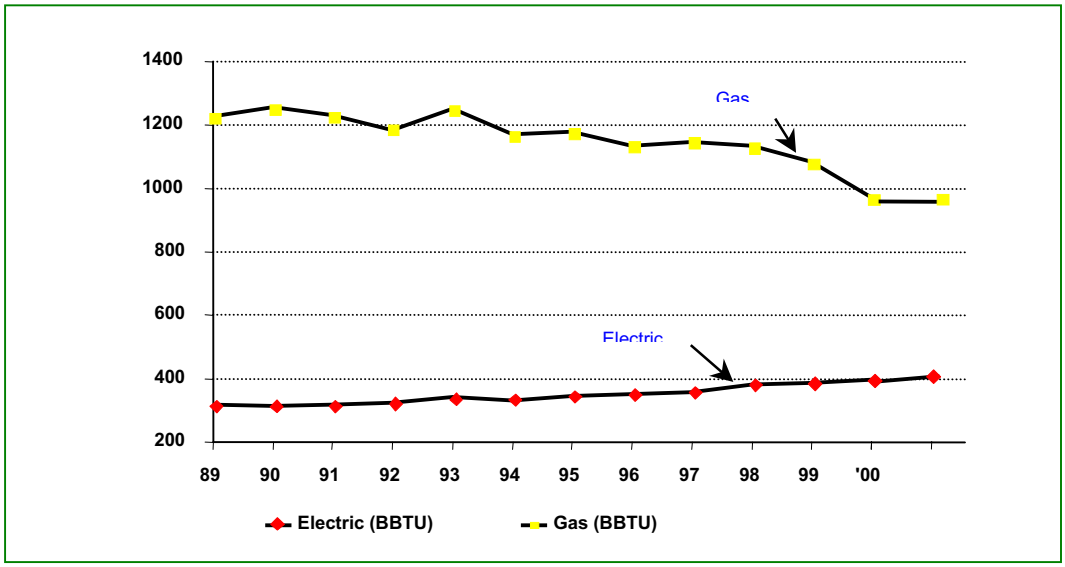
Figure 3.1 – Annual Energy Costs*



*Includes reimbursable costs, which are costs that are spent at the Installation, but reimbursed by tenants in metered facilities.

Figure 3.2 shows Fort Carson's energy consumption over the past decade. Purchases by CSU of short-term or "spot market" electricity when equipment fails or demand exceeds supply accounts for the majority of Fort Carson's electric rate increases. Spot market purchases accounted for only seven percent of electrical purchases in 2001; however, at several hundred dollars per megawatt hour, they drove the overall cost up considerably.

Figure 3.2 – Energy Consumption (BBTU/yr)



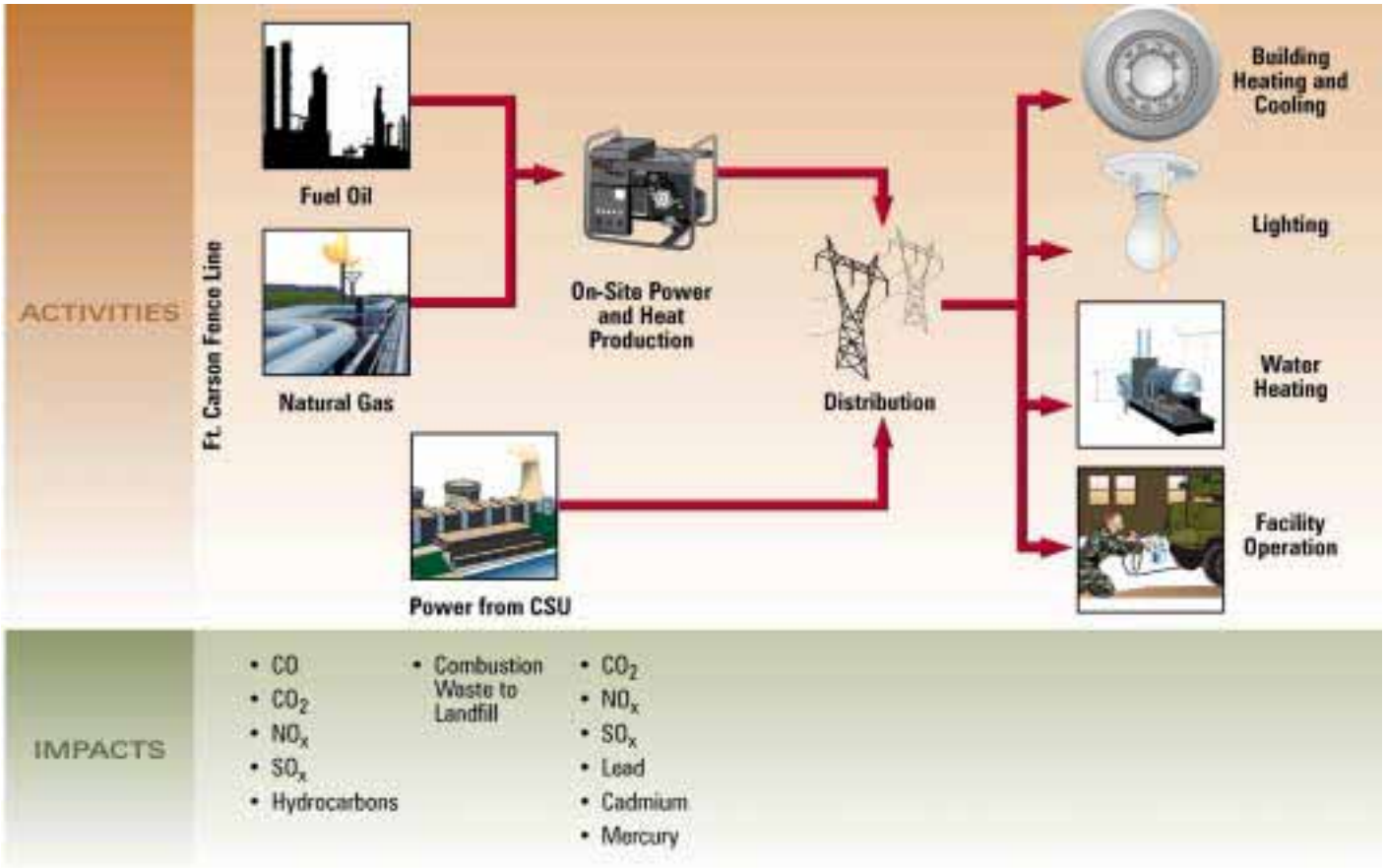
Fort Carson purchases interruptible gas on the open market and locks in prices for periods of time to ensure the lowest cost possible. Natural gas is used primarily to heat facilities; heating fuel is used as a back-up source at the heating plants. Although negotiating prices and purchasing interruptible supplies on the open

market are strategies that reduce the volatility of utilities costs, they may not always save money and could, in fact, increase total energy costs.

Activities and Impacts

Fort Carson cannot accomplish its mission of training, mobilizing, and deploying combat-ready troops without energy. Soldiers and civilians must be comfortable while performing administrative, maintenance and other activities and barracks need to be kept at a reasonable temperature. Figure 3.3 provides a generic look at energy sources, major areas of energy use, the flow of energy at the Installation, and some of the pollutants generated. Energy is obtained mainly from Colorado Springs Utilities. The generation and delivery of energy and heat to the installation create air pollutants while providing lighting, hot water, and building comfort.

Figure 3.3 – Major Energy Sources, Uses, and Impacts



The Human Perspective

For pollution prevention methods in power generation, Colorado Springs Utilities (CSU) is considered one of the best utilities in the country. CSU, which has an output capacity of 623 megawatts (MW) per day, gets its

power from two coal-fired plants, the Ray D. Nixon and Martin Drake power plants. These power plants have the lowest mercury emissions of coal burning power plants in the county, emitting six and nine pounds per year, respectively (http://www.ewg.org/pub/home/reports/brainfood/plants/CO.html). CSU built two 33-MW natural gas turbines in 1999 to use during peak periods and has recently partnered with Coastal Corporation to construct a 480-MW combined-cycle unit fueled from natural gas, which is expected to support Colorado Springs' needs through the next decade. CSU is also researching the use of cleaner-burning coal from Wyoming, which has the potential to reduce emission of sulfur dioxide by 30 percent and nitrogen oxides by 35 percent.

Production of electricity using nonrenewable resources is the leading cause of industrial air pollution in the United States (http://www.green-e.org/what_is/what_is_index.html). According to the American Lung Association, 50,000 to 100,000 deaths per year are caused by air pollution. Studies performed by the U.S. Environmental Protection Agency (EPA) have demonstrated that, for every dollar spent on pollution controls, $45 are gained in health benefits. Sulfur dioxide, nitrogen oxides, ozone, particulate matter, carbon dioxide, and mercury are the primary pollutants caused by electricity generation that affect human health. Respiratory illness, aggravated cardiovascular disease, lowered resistance to infections, and liver and nervous system damage are among the health problems associated with pollutants from electricity generation.

Beyond the Pikes Peak Region

Even though other forms of electrical generation are available from Colorado Springs Utilities, by far the least expensive and most used is coal. The burning of coal for electricity gives off more carbon dioxide per unit than any other type of fossil fuel. On a worldwide scale, coal combustion contributes 30 to 40 percent of the total carbon dioxide emissions generated by fossil fuels (http://www.iclei.org/efacts/coal.htm). Carbon dioxide and other oxides of carbon are associated with global warming.

Coal mining causes environmental damage to the air, land, and water. Waste materials from mining and sludge from coal washing and preparation are placed outside the mine, where rain percolates through, leaching heavy metals and acid into surface water and groundwater. Erosion and runoff of these materials add excessive sediment to streams, altering habitats. Dust from surface mines adds particulate matter to the atmosphere. Most of the environmental costs are not accounted for in the kilowatt per hour price to purchase electricity. Restoration of ecosystems disturbed by coal mining is difficult and often results in completely different habitats (http://www.clnatf.org/resources/reports/).

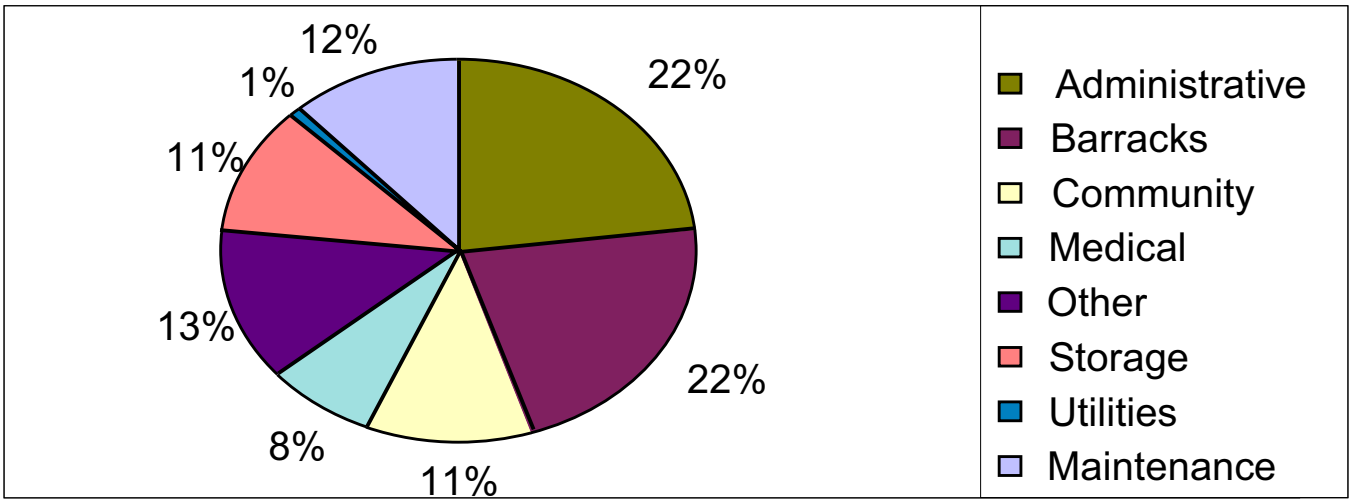
Transportation of coal to the Pikes Peak Region also contributes to air pollution and ecological damage. Truck and train transport add the pollutants from burning liquid fossil fuels into the atmosphere. Clearing rights of way for transportation causes soil compaction, which increases stream sediment loading, habitat destruction, and herbicide contamination from maintenance.

Existing Buildings

Varied building types and functions require different amounts of energy for mission accomplishment. The types of buildings, number of buildings, and percentage of building types are shown in Figure 3.4. The graph does not include data on family housing, which has been privatized at Fort Carson (data are not readily

available). The installation currently operates a Utility Control System, which monitors and controls the temperature for 140 buildings. This system provides for some energy savings, but it is not utilized fully and does not monitor all of the 908 buildings on the installation. A comprehensive approach will require analysis of all buildings to determine needed improvements for energy savings.

Figure 3.4 – Types of Buildings at Fort Carson



New Construction

Plans for new construction on the Installation are extensive. If new buildings with energy-saving measures replace some of the current buildings, energy costs and the pollution resulting from energy production will decrease. Currently, an experimental building that incorporates sustainable principles is being constructed near the Specker and Polio intersection. Over the next two years, Fort Carson plans to spend over $140 million on new military construction, and build three child development centers and a car care center.

Forecast

Plans for new construction on the Installation are shown in Figure 3.5. While these new buildings do not incorporate the SPiRiT standards *per se*, the construction company has used energy efficiency technologies. Fort Carson's energy manager is working to verify the energy efficiency of the new construction.

Figure 3.5 – Plans for New Construction

Construction	Year to Be Completed
Close Combat Tactical Trainer	2002
Army Reserve Center	2002
Colorado Army National Guard Training Site Phase 2	2003
Enlisted Barracks	2003
Battle Simulation Center	2004
Main Fire Station	2006
Digital Multi-Purpose Range	2005
Colorado Army National Guard Armory	2002

In April of 2002, Fort Carson signed up for the Super-Peak (Kilo watcher) Option Agreement. This Agreement provides an opportunity for Fort Carson to save on its annual electricity bill by cutting back on use during peak periods. The cost of electricity is lowered during normal periods, but greatly increased during peak periods (no more than 100 hours per year), providing incentive to reduce energy consumption during periods of high use in the region. The normal cost for electricity is approximately 4.5 cents per kilowatt hour; with the Kilo watcher Option, normal cost is between two and four cents per kilowatt-hour. During super peak periods, electricity cost is 17.5 cents per kilowatt-hour. Figure 3.6 shows the percentage of hours typically used by Fort Carson for each pricing tier. If Fort Carson does not change its utilities usage, the yearly cost for electricity will remain the same, but a reduction in use during peak periods will reduce total costs (the reverse is also true). This plan enables Colorado Springs Utilities to reduce peak load during periods of high demand and low supply, thereby reducing costs and improving reliability.

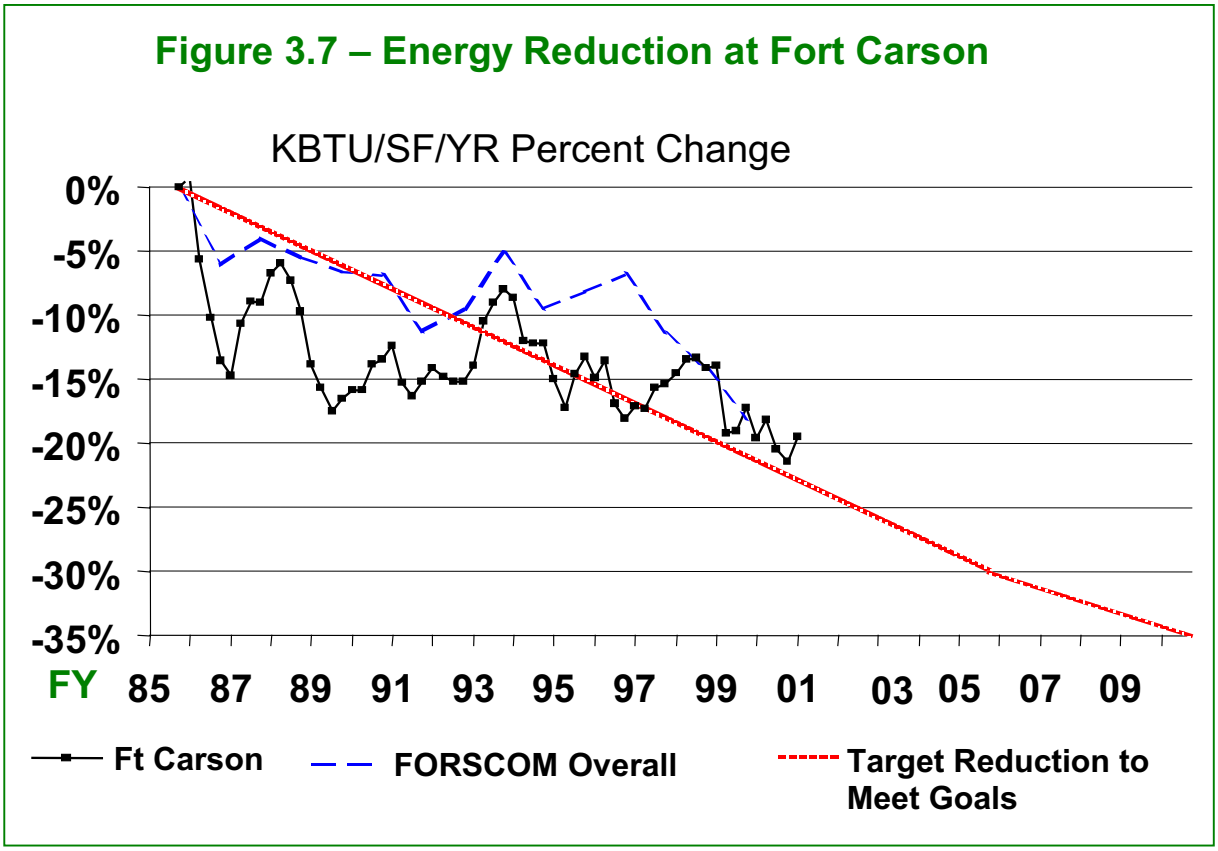
Figure 3.6 – Kilo Watcher Option Table

Tier	Rate (cents/KWH)	When in Effect	Percentage of Hours/Year
Super Peak	$0.1750	Forecasted temperature exceeds 90 degrees and/or critical period as defined by CSU	1%
Normal Peak	$0.0375	Summer (April through September) 11:00 a.m. to 6:00 p.m. Winter (October through March) 4:00 p.m. to 10:00 p.m.	27%
Off Peak	$0.0200	All other hours plus legally observed holidays (see tariff)	72%

Current Sustainability Activities

Fort Carson has several energy conservation measures, activities, and programs in place. A strong energy program requires command support and a proactive champion. The DECAM serves as the energy coordinator and point of contact on all energy matters, per Army Regulation 11-27 and the Energy Policy Act. Additional support is provided by the Fort Carson Energy Manager, pollution prevention personnel, Staff Assistance visits, and Building Energy Monitor and Environmental Protection Officer training.

Current measures to conserve energy at Fort Carson resulted in the energy reductions shown in Figure 3.7. Comparing the black line to the red target reduction line reveals Fort Carson's progress toward its energy goals. Several recent energy conservation efforts are listed on the following pages.



Environmental Quality Working Group – This group, which consists of the Deputy Director, DECAM; representatives from most other Directorates on the Installation; and representatives from military units, meets monthly. They analyze energy use, discuss opportunities to conserve energy, explore operational improvements that will lead to energy savings, and review construction projects for energy efficiency and energy regulation compliance.

Awareness Campaign – Spearheaded by DECAM, the awareness campaign places energy awareness stickers near lights, writes articles on energy conservation, publishes weekly conservation tips in the Mountaineer and via email, and places posters throughout the installation. There is no attempt to gauge the success of the campaign.

Building Energy Monitors – Each building is required to have a DECAM-trained Building Energy Monitor who reports to the Energy Conservation Officer and the Commander on the conservation or consumption activities of building occupants. The Environmental Protection Officer is trained in energy matters.

Energy Savings Performance Contract – In 1999, Sempra Energy Services was contracted to explore energy savings opportunities throughout the Installation. So far, the contractor has performed several activities, including replacing old chillers with less consumptive chillers and conducting a study to replace lights with energy-efficient fluorescent lighting. Payment issues and contract paperwork are slowing down the implementation of retrofit activities.

Periodic Inspections – Environmental Compliance Technicians, who operate out of the Hazardous Waste Staging Yard, conduct unit Staff Assistance Visits for energy conservation activities and report findings to commanders, the Environmental Quality Working Group, the Garrison Commander, and the Commanding General.

Staff Duty Officer – The nighttime Staff Duty Officer is required to report lights left on in buildings and other violations of Army and Installation conservation policies to commanders.

Installation Design Guide – DECAM is very involved in the preparation and update of the Installation Design Guide (IDG). Energy conservation requirements include compliance with energy use budgets for efficient design; renewable energy considerations; efficient heating, ventilation, and air conditioning (HVAC) and lighting; and landscaping conservation criteria. While the Guide is mandated at Fort Carson, it is not adhered to or enforced, and many sustainable options are not included. Environmentally friendly building materials, construction waste recycling measures, and life-cycle energy costing are examples of sustainable design basics that are not included in the Installation Design Guide.

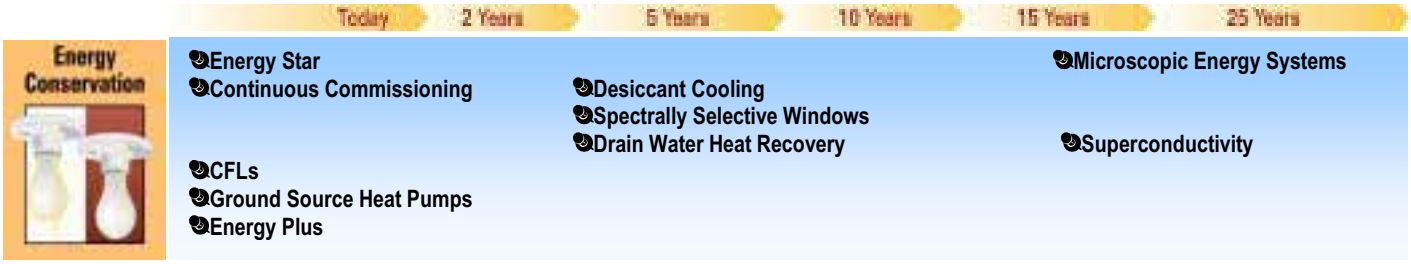
Sustainable Development Planning Charrette – DECAM coordinated a sustainable planning meeting for the Installation in September 2001. The meeting was sponsored by the Department of Energy, Federal Energy Management Program, and the National Renewable Energy Laboratory. The leaders were two architectural firms; attendees included representatives from the Fort Carson Directorate of Public Works and their contractors, Colorado Springs Utilities, the Omaha District Corps of Engineers, and other local military installations. Three teams were set up to examine three areas—water; energy; and materials, waste and recycling—for sustainability at the installation. The teams developed short-, middle-, and long-term goals. Short-term goals included to incorporate sustainable ideas into predesign conferences, enforce use of the IDG for all projects, take advantage of and mandate proper solar orientation, use day lighting for new facilities and renovations as much as possible, set warehouse temperatures at 55 degrees and put people into offices, and distribute the green air federal facilities guide to all relevant staff. Mid-term goals were to put efficiency into performance specs, use solar or photovoltaic (PV) power wherever cost-effective, improve efficiency of proactive design stock, establish design competitions, increase training class education of staff, include an energy class in the standard training regime, and establish an energy sustainability review team. Long-term goals were production of clean, reliable power onsite and construction of new buildings that are independent—that is, that do not rely on the power grid. These goals were not enforceable, and lead agencies and team members were not identified; therefore, projects directed toward meeting these goals have not been initiated at the Installation.

Energy Awareness Partnership with Colorado Springs Utilities – Fort Carson and Colorado Springs Utilities are working together to increase energy awareness at the Installation by partnering to create, publish, and distribute energy conservation information, tips, events, reports, and brochures, and to communicate results of these efforts. Tips and brochures are distributed through the Fort Carson email system. Energy conservation progress is tracked with the energy reduction graph in this report (Figure 3.7).

The Realm of Possibility

To become sustainable, Fort Carson is encouraged to identify and plan for innovations that will support the goals established during the Installation Sustainability Workshop. To do this, participants should be exposed to the concepts and technologies that are within the realm of possibility now and in the future. This section provides a glimpse of what can be accomplished with existing technology and what can be expected from developing sustainability approaches.

Energy Conservation



- **Continuous Commissioning** – This is a process of improving building performance through independent hourly metering, monitoring, analysis, and system fine-tuning to maximize energy conservation. This approach, which involves comparing design intent with actual building operation, has yielded an additional 15 to 45 percent savings beyond traditional conservation measures. For additional information, visit http://www-esl.tamu.edu/cc/.

- **Microscopic Systems** – Scientists at the Pacific Northwest National Laboratory (PNNL) and other research laboratories are developing a family of microsized energy systems that are manufactured in a manner similar to computer chips. Microscopic heat exchangers, evaporators, condensers, gas absorbers, turbines, bioreactors, chemical reactors, chemical separators, pumps, and valves exhibit extraordinary rates of heat and mass transfer. When combined into HVAC or process equipment, this translates into very high efficiencies and minimal pollution generation. These miniature components can be combined to create small heat pumps that can be integrated into window frames, with simple plug-in of replacement units should the originals fail. Small biofueled fuel cells will be developed that can be located wherever heat and electricity are needed. Miniature chemical separation units will be developed for on-site cleanup of tanks, wells, aquifers, and other polluted systems—imagine a pen-sized device that can be dropped into a drum of waste to eliminate PCBs.

- **Drain Water Heat Recovery** – It is estimated that up to 80 percent of water-heating bills come from shower/bath water. An innovative technology called drain water heat recovery uses the latent heat in drain water to preheat cold water before it is sent through a conventional water heater. Drain water is typically 90 to 95°F when it is piped away from the shower or bath; 100 percent of that potential energy is wasted. These systems take warm drain water and run it through tiny spiraling pipes to preheat cold water to a higher temperature, thus reducing the total amount of energy a water heater must expend to heat fresh water. Installing a drain water heat recovery unit can reduce overall heating bills by as much as 40 percent. EPA estimates that, if 6 million hot water systems were outfitted with drain water heat

recovery systems, carbon dioxide emissions could be reduced by 20 million tons every year (http://gfxtechnology.com/).

- **Superconductivity** – Superconductivity, the ability of a material to conduct electricity with zero resistance and almost no loss of power, is a cutting-edge technology that may some day revolutionize the way we think about electricity (http://www.eren.doe.gov/superconductivity/). Today, almost 10 percent of all electricity generated is lost in transmission, radiated as heat from inefficient copper and aluminum wires. Superconductors will lead to the development of a number of new technologies:
    - Transmission wires will carry 100 times more current on a wire no larger than those we use now.
    - Super-efficient mass transit systems (similar to the MagLev train in Japan) will transport people at enormous speeds using a fraction of the energy required by current commuter trains.
    - Electric motors using superconductor wiring will operate at a fraction of the cost, improving industrial and residential energy efficiency while saving money.
    - Electric generators will be smaller and lighter and require less fuel to generate power.

- **Compact Fluorescent Lights (CFLs)** – A number of alternatives to traditional incandescent lights are commercially available. Compact fluorescent lights (CFLs) use between 50 and 70 percent less power than incandescent lights of the same intensity. EPA maintains a comprehensive list of CFLs at http://www.energystar.gov/products/cfls/.

- **Energy Star** – EPA maintains a database of high-efficiency appliances and office equipment. By simply investing in these readily available alternatives, businesses and homes can save hundreds of dollars in energy bills every year (http://www.energystar.gov/).

- **Desiccant Cooling Systems** – In the next few years, desiccant cooling systems could be saving offices and large commercial buildings thousands of dollars each month in electricity bills. Desiccant coolers, which are used in conjunction with traditional HVAC units, remove moisture from the outside air, cooling the air and enabling the primary unit to operate much more efficiently. For more information, see http://www.nrel.gov/desiccantcool/tech.html.

- **Spectrally Selective Windows** – Spectrally selective and chromogenic windows represent the next generation of window technology. Spectrally selective windows have advanced coatings that filter certain wavelengths of radiation from incident sunlight, lowering overall solar heat gain significantly. Chromogenic windows are more advanced, with coatings that change their reflective properties based on ambient temperature or light conditions. Some estimates place the potential energy savings at 40 to 70 percent for electrically heated spaces.

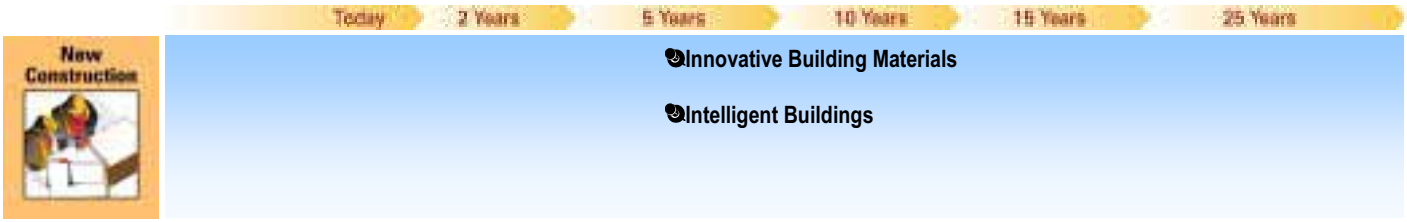
- **Ground Source Heat Pumps** – This technology has been around for 70 years, emits no CO_2, and produces fewer emissions than all other fossil fuels. Ground source heat pumps use the constant subsurface temperature to regulate building temperatures by passing air through the ground and then into the building. This type of system costs twice as much as a conventional system, but saves 50 to 75 percent in energy costs.

- **Energy Plus** – The Department of Energy developed this free software, which incorporates all the design features of a building into a model to simulate building energy use and outputs the results as a text file. It may be downloaded from http://www.eren.doe.gov/buildings/energy_tools/energyplus.

- **Energy Supply and Management** – The City of Chicago estimates that it will save more than $260 million by 2010 through the use of renewable energy, distributed energy sources, and better energy management (http://www.ci.chi.il.us/environment/).

- **Other Resources** – The web site for the Clean Air Campaign of the Pikes Peak Region lists many other resources (http://www.clnair.org/links.html).

New Construction

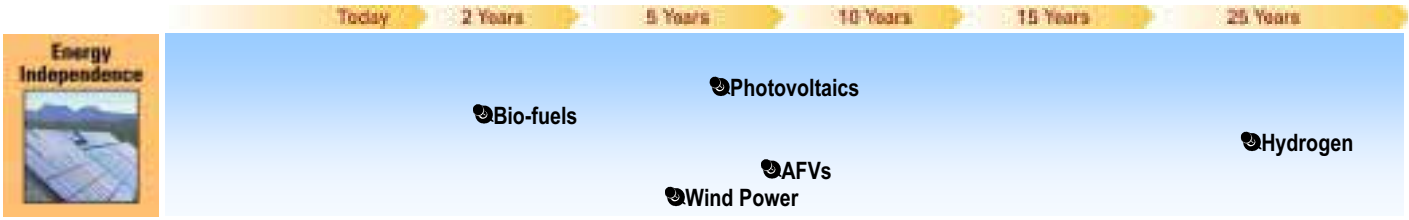


- **Innovative Building Materials** – The building industry and the building products manufacturing industry have aggressive research activities that are providing a host of environmentally friendly and sustainable products. These include soy-based adhesives and foam insulators, shellfish-derived coatings, gas-filled wall panels, and ceramic insulators. For additional information, go to http://www.nahbrc.org/ and click "Green Building" on the navigation bar.
    - The Home Builders Association provides a "Built Green Checklist" on its web site at http://www.builtgreen.org/. While developed for single-family housing use, the checklist is comprehensive and easy to understand, and may be used as a starting point for administrative buildings and barracks.
    - In collaboration with the General Services Administration, EPA successfully modernized a 1.2-million square foot office complex in Washington, D.C. For details of this complex, see http://www.edcmag.com/edc/cda/articleinformation/features/bnp__features__item/0,4120,19197,00.html. (Note, each "gap" in the URL represents two consecutive underscore characters.)
    - The Assistant Chief of Staff for Installation Management requires Army activities to evaluate all facility construction and repair projects using the Sustainable Project Rating Tool (SPiRiT), which is the Army's version of the Leadership in Energy and Environmental Design (LEED) system developed by the U.S. Green Building Council.

- **Intelligent Buildings** – The intelligent building is the future of architecture. It looks like any other building from the outside, but employs sophisticated control systems to make building systems (heating, cooling, ventilation, lights, windows, and appliances) more convenient and efficient. Commercial office buildings are being designed wherein lighting, temperature, and humidity in the space occupied by each worker are regulated according to his/her preferences, and windows automatically darken to provide appropriate ambient lighting for the task at hand. This technology is also appropriate for homes. In Bill Gates' private home, occupants wear an electronic pin that keeps track of them, so the house can adjust

lighting, temperature, music, and/or television shows as they move about. Investors are pumping vast amounts of money into intelligent building research. Intelligent buildings make good financial sense. For example, by turning off unnecessary lights and not heating unoccupied rooms, these buildings can reduce utility bills by 20 to 30 percent.

Energy Independence



- **Photovoltaics** – Photovoltaics (PV) have the potential to provide a significant amount of the nation's electricity supply. *The theoretical potential of PV on rooftops alone could satisfy up to one-third of world electricity demand.* However, they are expensive to manufacture, have not yet realized their efficiency potential, and require lots of space. This situation is starting to change. Overall system efficiency is improving. New products that integrate photovoltaic cells into building materials are now coming on the market. Skylights, awnings, wall panels, and roof shingles now incorporate PV, generating electricity while serving a second structural function. This integrated approach obviates the need for additional land use, reduces total system costs, and makes available thermal energy dissipated by the PV panels for space heating and/or water preheating.
    - The total average power available from solar radiation exceeds current human consumption by 1500 times (Source: World Energy Assessment: Energy and the Challenge of Sustainability; United Nations Development Programme, UN Department of Economic and Social Affairs and World Energy Council: New York, 2001).
    - Fort Huachuca, Arizona, uses conventional solar hot water heaters, photovoltaics, day lighting systems, and solar walls on hangars. Fort Carson has applied some of these technologies; with an average of 247 days of sunshine per year (http://www.coloradosprings-travel.com/), solar technology may have many more uses at the Installation. The Million Solar Roofs program is working to enhance the use of solar hot water and photovoltaic systems through partnerships with the Department of Energy, communities, and other federal agencies.
    - Japan's National Space Development Agency commissioned construction of a space solar power satellite. This technology originated in 1899 with Nikola Tesla, who tried to light homes in Colorado Springs by beaming energy from a tower. The experiment was unsuccessful, but its principles led to the current attempts to capture solar energy. The advantage of a space-based solar array is that it would work even on overcast days.

- **Biofuels** – Biofuels are alcohols, ethers, and other chemicals made from renewable resources (e.g., fast-growing trees, grasses, and algae) and waste products (e.g., agricultural and forestry residues, and municipal and industrial wastes). It is estimated that domestically produced biomass resources could eventually provide at least half of the light duty vehicle (LDV) fuel requirement in the United States. Biodiesel fuels are available today. In the not-too-distant future, biomass will be consumed in fuel cells in vehicles and stationary equipment to produce heat and electricity very efficiently, with virtually no

pollution and no net increase in carbon emissions. Eventually, high-efficiency biomass power plants will allow any facility to generate its electricity on site.

- The use of methane power will be increased in Georgia and other states. Several Electrical Membership Corporations in Georgia plan to generate power using methane from four landfills in the state. Nebraska has a 3.2-megawatt landfill methane power plant.
- Agriculture and wood waste, called biomass when used for electricity generation, is used by the Community Power Corporation of Colorado to generate electricity for single dwellings. For more information, go to http://www.gocpc.com/.

- **Hydrogen** – Hydrogen is not a viable direct energy source since very little free hydrogen is available. Instead, many view hydrogen as the ultimate energy storage and transmission medium. In this context, hydrogen will be extracted from hydrocarbons, biofuels, and water and shipped/piped to another location where it will be burned or consumed in a fuel cell, producing only energy and water vapor. Iceland, which has rich geothermal and hydrologic resources that can be employed to extract hydrogen from seawater, has the goal to become the first hydrogen economy. Iceland New Energy, a consortium that includes Daimler Chrysler AG, Norsk Hydro AS of Norway, Royal Dutch Shell Group, and a Reykjavik-based venture capital fund, has launched projects aimed at promoting the hydrogen economy in Iceland. Three buses powered by hydrogen fuel cells will be introduced into Reykjavik's city transport fleet by the end of 2002. A second project will begin replacing conventional chemical batteries with fuel cells in stationary power structures that are not currently on the regular electric grid.

- **Alternative Fuel Vehicles (AFVs) –** Alternative fuel vehicles (AFVs) are available on a limited basis now, but it will be a few more years before they begin to capture an appreciable market share in the public and private sectors. Honda is working on a zero-emission vehicle that uses fuel cells for power. The state of California will give up to $9,000 in rebates to people who buy super-low-emission vehicles (SuLEVs). Because lower costs per mile are associated with fueling large fleets, buses and other fleet vehicles are prime candidates for alternative fuels such as compressed natural gas (http://www.afdc.doe.gov/afvehicles.html).

- **Wind Power** – Through the 1990s, wind was the fastest growing source of electricity generation in the world. However, the majority of this growth occurred in Europe, where conventional energy costs are higher than those in the United States. With large, untapped, wind energy resources throughout the country and declining wind energy costs, the United States is now moving forward with an aggressive initiative to accelerate the progress of wind technology and further reduce its costs, to create new jobs, and to improve environmental quality. Wind Powering America, an initiative led by the Department of Energy to increase the use of wind power, will expedite the movement of wind technology into the mainstream of the U.S. electricity supply sector. For more information on how to establish a wind farm at your installation, go to http://www.nrel.gov/wind.
    - Wind technology is available from Colorado Springs Utilities. Developments in wind technology include larger, more controllable and grid-compatible turbines; hybrid systems; and stand-alone systems for small, localized uses.
    - Colorado Springs Utilities offers power generated from wind and hydropower; currently, these alternatives cost more than power from coal.

Fort Carson 25-Year Goals for Energy

To be determined by Fort Carson Command and staff, as advised by members of the local and regulatory communities, at the Installation Sustainability Workshop on 4-6 September 2002.

TRANSPORTATION

Challenge

The use of petroleum fuels for transportation contributes to regional air quality degradation. Further, the cost of fuel fluctuates and depends on its availability from foreign sources. How does Fort Carson reduce its transportation-related impacts on the air while meeting transportation needs?

Key Considerations

- **Community Pattern Transportation** – Air pollution is a function of miles traveled and vehicle use. Commuting options can reduce regional pollution due to transportation.

- **Fuel Efficiency** – The types of vehicles used in commuting and mission activities directly impacts air quality. Fuel efficient vehicles create less pollution.

- **Alternative Technologies** – Alternative fuels and new motors can reduce petroleum fuel consumption.

TRANSPORTATION

Importance to Fort Carson

Mission – Deployment and safe transportation of troops to the Installation and to the training grounds are essential to Fort Carson's mission to train, mobilize, and deploy Army ground forces in defense of the nation.

Quality of Life – Good quality of life depends on having convenient modes of transportation and clean air for the soldiers, their families, and people in the community. Workers who commute to Fort Carson travel an average of 12,750 miles per year.

Cost – The Installation spends a yearly average of $40,000 on gasoline; $130,000 on diesel distillate; and $1,400,000 on tactical fuels (JP-8).

Environment and the Community – While Fort Carson and the surrounding area are in an attainment area (violations of national air quality standards have not lasted longer than one day in the previous year), double-digit population growth in the region will affect the way Fort Carson's air permits are handled in the future. Additional people and vehicles will cause Fort Carson's permit limits to drop, affecting the method in which training is executed.

While there have been no air-related environmental enforcement actions at Fort Carson in the past five years, there are several other critical considerations when evaluating long-term transportation issues.

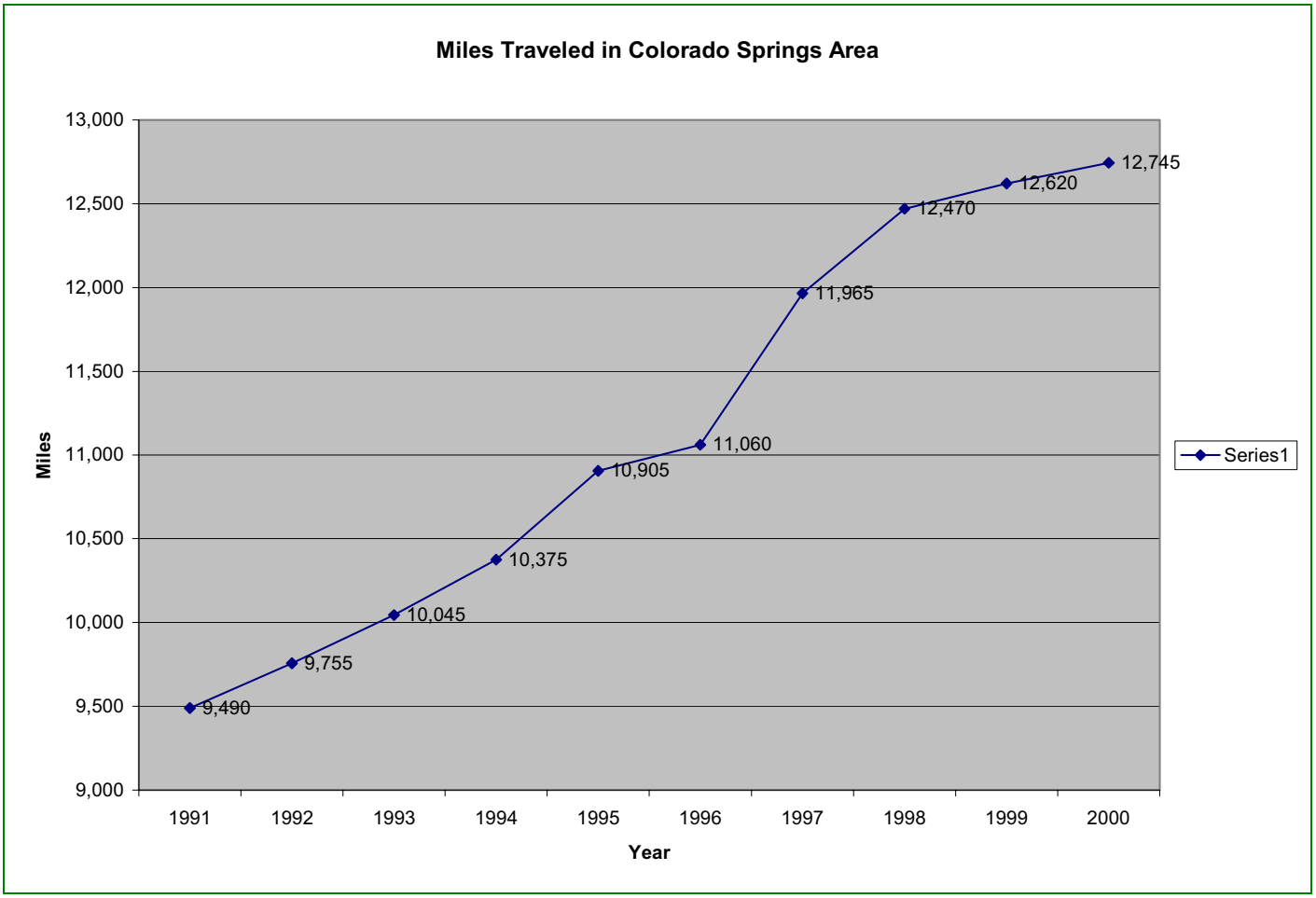
The Army's Tank-automotive and Armaments Command (TACOM) constantly works on innovative alternative technologies for Army systems. Influence on Army systems is most effective when sent through proper channels. Currently, the Directorate of Environmental Compliance and Management (DECAM) is working through the proper channels to elevate issues concerning tactical and fleet vehicles and ways to improve their use and repair.

TRANSPORTATION

Introduction

To accomplish its mission of training combat-ready forces, Fort Carson accommodates a population of 106,600 personnel and family members, 458 armored tactical vehicles, and numerous administrative and support vehicles. The fuel currently used to power those vehicles is nonrenewable; this is not a cost-effective or sustainable approach. Furthermore, fossil fuels add pollutants such as carbon monoxide and nitrogen dioxide to the atmosphere. In an area that is close to nonattainment status for many air pollutants and whose population is expected to grow 37 percent by 2025—according to the Pikes Peak Area Council of Governments (http://www.ppacg.org/25draftplan.htm)—alternatives that reduce pollutants caused by transportation activities will be needed. It is also in the country's best interests to reduce dependence on foreign sources of fuel. Figure 4.1 shows the increase in vehicle-miles traveled in the Colorado Springs area over the past nine years. More information on mobility data for Colorado Springs can be found at http://mobility.tamu.edu/ums/study/mobility_data/tables/colorado_springs.pdf.

Figure 4.1 – Vehicle Miles Traveled in Colorado Springs Area



TRANSPORTATION

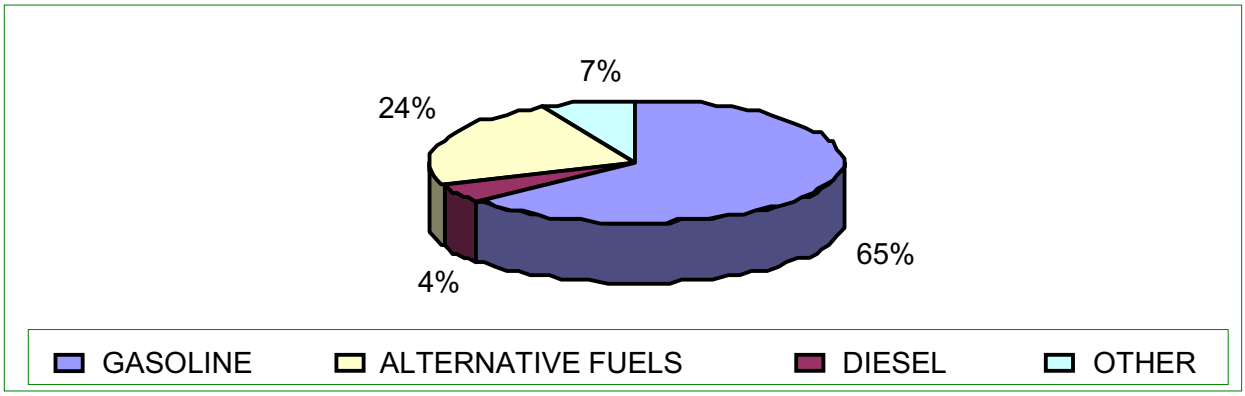
Background

Military vehicles vary in gas mileage. Vehicles with better mileage provide increased soldier safety during wartime maneuvers because an armored division followed by fuel tankers and supplemented by helicopters leaves a large footprint, which increases vulnerability to attacks on back-up logistics (tankers, etc.). Unfortunately, the substantive weight of armored vehicles and the large turbine engines that provide good mobility (up to 45 miles per hour) result in vehicles with low mileage. However, the weight and mobility of these vehicles protect soldiers and help win wars.

The government has made progress in fuel economy research. In October 2001, the Defense Energy Support Center contracted for a long-term supply of biodiesel. In addition, the Army's National Automotive Center has been working to expand use of hybrid propulsion systems in military ground vehicles. The Army is also working on a program to design a common engine for two major battle systems, including the main battle tank, which will save fuel and reduce operations and support required for the tank engine. The Department of Defense (DOD) and the Army have demonstrated that they recognize the need to reduce both dependence on foreign sources of fuel and air pollution. They are working to incorporate technologies to address these issues in their operations.

Most of the administrative vehicles on the Installation are standard fossil fuel vehicles (Figure 4.2). Many are Army-owned vehicles that are maintained long past the time when most consumers would have traded them in for newer vehicles. DECAM owns several alternatively fueled vehicles that run on gasoline or ethanol. These vehicles have been used successfully for over five years. As the largest fleet operator in the nation, the Federal government has the greatest opportunity to provide market incentives for development and manufacture of alternatively fueled vehicles and the infrastructure to support them. In fact, Executive Order 12844, entitled "Federal Use of Alternative Fueled Vehicles" requires it by reinforcing federal statutes, dependent on availability from the General Services Administration.

Figure 4.2 – Administrative Vehicle Fuel Types at Fort Carson (percent)

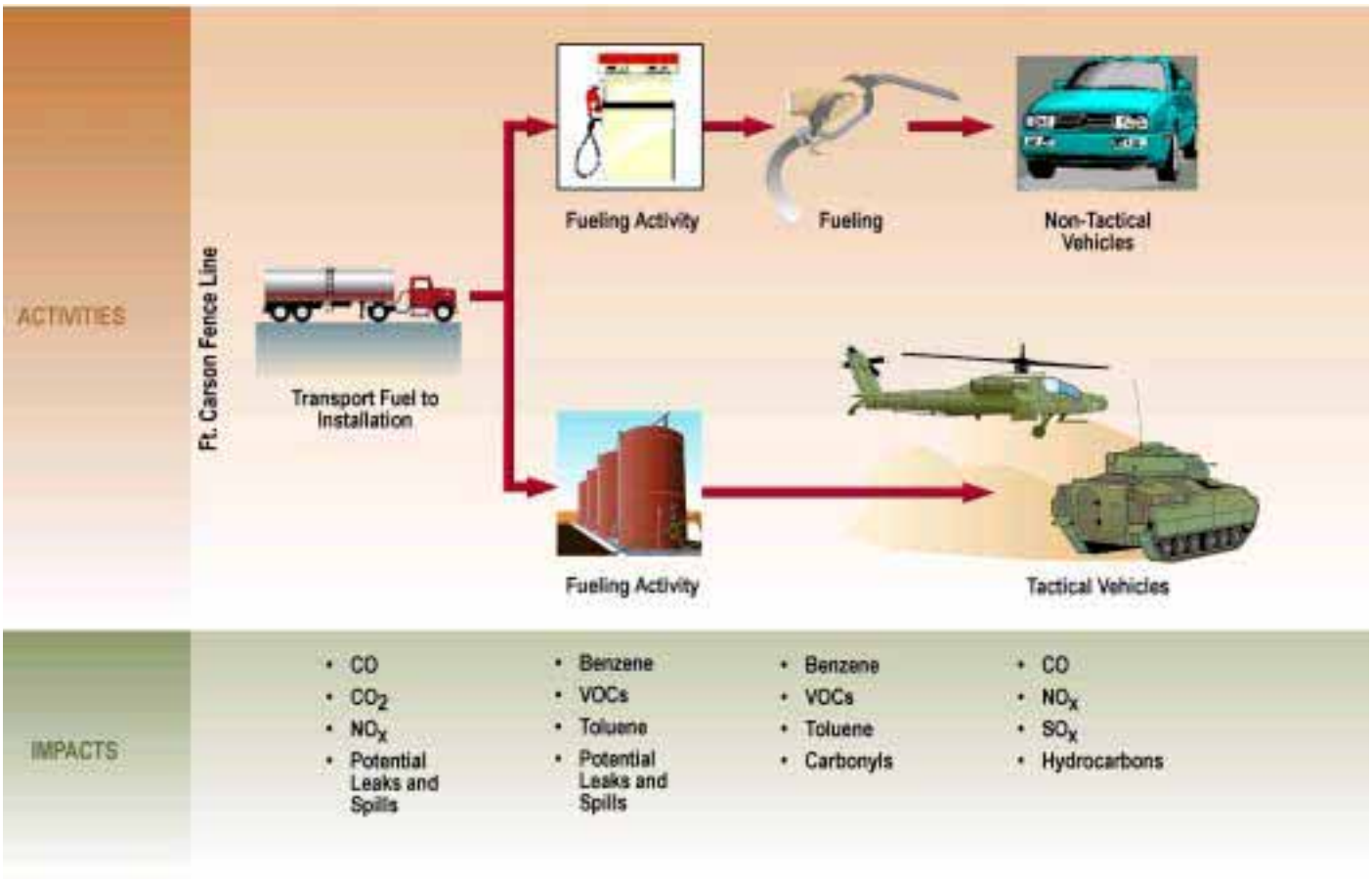


Helicopters allow commanders to move troops over long distances, observe enemy positions, evacuate wounded soldiers, and attack targets that are difficult for ground-based weapons to address. The Aviation Restructure Initiative will provide for the elimination of a number of helicopters and combine types to streamline maintenance. Currently, the U.S. Army Aviation Force Modernization Plan is addressing issues concerning helicopters in the Army and modernization of its fleet, with a primary goal of reducing costs.

Activities and Impacts

Fort Carson cannot accomplish its mission of training, mobilizing, and deploying combat-ready troops without fuel to move vehicles, material, troops, and equipment. Personnel and items need to arrive at their destinations safely and efficiently. Figure 4.3 provides a generic look at major transportation activities and some of the pollutants generated.

Figure 4.3 – Transportation Activities and Impacts



The Human Perspective

The evaporation and combustion of gasoline release toxic, smog-forming, and cancer-causing pollutants including volatile organic compounds, nitrogen oxides, benzene, 1,3-butadiene, carbon monoxide, and sulfur

dioxide. Many air pollutants cause cancer, and many of the carcinogens found in cigarettes are also found in vehicle exhaust fumes (cadmium, benzene, etc.). Air pollutants exacerbate heart disease, respiratory disorders—including asthma and bronchitis, and other health problems. In 2001, the National Center of Health Statistics reported that chronic lower respiratory conditions are the fourth leading cause of death in America (http://www.cdc.gov/nchs/fastats/deaths.htm). The relationship between asthma and vehicle emissions was demonstrated in Atlanta during the 1996 Olympic Games when the city of Atlanta provided extra public transit and blocked off downtown to automobile traffic; asthma-related emergency room visits among children in the area dropped by 42 percent (http://www.cdc.gov/od/oc/media/pressrel/r010221.htm).

Beyond the Pikes Peak Region

The United States is the world's largest emitter of carbon dioxide, the most significant greenhouse gas. If all other countries emitted carbon dioxide at the same rate as the United States, global warming would occur faster.

The World Health Organization points to respiratory disease as the leading cause of death among children worldwide. Many developing nations do not use even rudimentary emission controls on vehicle engines; it is clear that the U.S. needs to take the lead in reducing air pollution emissions from transportation sources.

Fossil fuel use damages the environment in several ways beyond vehicle emissions. The heavy equipment used to explore for, extract, and transport fossil fuels damages ecosystems. Transportation of fossil fuels adds to air pollution and spills, which also damage the environment. Pipelines disrupt ecosystems during construction and use. Demand for reliable, inexpensive sources of oil has led to wars and tensions between countries. The Gulf War resulted in marine environmental damage in the Persian Gulf, pollution from burning oil wells, and desert ecosystem damage due to movement of tanks and other heavy equipment.

Current Sustainability Activities

Purchase of Alternatively Fueled Vehicles – Currently, 24 percent of the administrative vehicles on the Installation are powered by alternative fuels (Figure 4.2). Fort Carson has a Compressed Natural Gas Station located at Building 250 on Chiles Avenue. A map of fueling locations for alternative fuels along the I-25 corridor may be downloaded from http://www.naturalfuels.com/fuel_I25.htm.

Cooperation with Ride Finders – DECAM is working with Ride Finders to create carpools for Installation users. An article was placed in the Mountaineer in late 2001 and Ride Finders developed a profile sheet specifically for Fort Carson users. Response has been limited; current gasoline prices do not provide sufficient incentives to soldiers and civilians to carpool on the Installation. In addition, many people still want the convenience afforded by driving their own vehicles.

M1 Tank Air Filter Cleaning Program – DECAM purchased and distributed two M1 Tank air filter-cleaning systems. The systems are being used at the Installation and overseas. It is anticipated that gas mileage on tanks may increase due to more frequent cleaning of air filters.

TRANSPORTATION

Installation Shuttle – Fort Carson runs a shuttle service to common areas. This service is advertised in the Mountaineer and in the Pollution Prevention Newsletter. Statistics on shuttle use are not gathered and service has been intermittent.

Telecommuting – In an attempt to alleviate air pollution and traffic congestion, a telecommuting program has been proposed for Fort Carson. The potential reduction in the number of vehicle-miles driven has not been estimated.

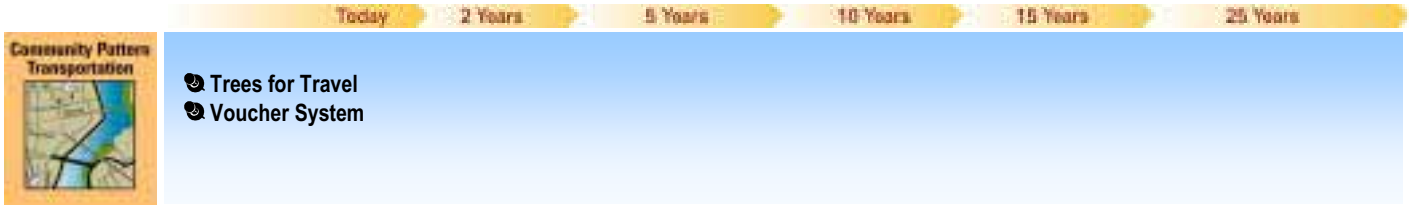
Clean Cities Program – Fort Carson is a stakeholder in the Department of Energy's Clean Cities Program, which is coordinated locally by the Colorado Clean Air Campaign. Quarterly meetings and special demonstration events are conducted through this program. Through participation in this program, stakeholders have had the opportunity to contribute to the State Implementation Plan, which addresses regional air quality issues, and transportation plans to improve and expand area roadways, transit and pedestrian/bicycle pathways.

City Buses – Despite the tighter restrictions to enter the Installation, soldiers and civilians take advantage of public transportation. The Installation does not currently track the number of commuters that use city buses.

The Realm of Possibility

To become sustainable, Fort Carson is encouraged to identify and plan for innovations that will support the goals established during the Installation Sustainability Workshop. To do this, participants should be exposed to the concepts and technologies that are within the realm of possibility now and in the future. This section provides a glimpse of what can be accomplished with existing technology and what can be expected from developing sustainability approaches.

Community Pattern Transportation

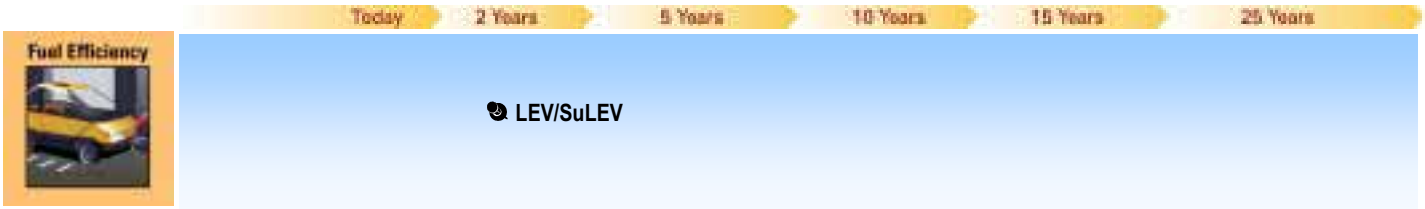


- **Trees for Travel** – Trees for the Future is a nonprofit organization that will plant trees to offset the pollutants caused by air and vehicle travel under the Trees for Travel program. Organizations can keep track of their mileage and send donations to Trees for the Future. Or, large land-owning organizations, such as Fort Carson, can start their own program to offset the vehicle emissions caused by transportation activities (http://www.treesftf.org/travel.htm).

- **Voucher System** – The new Mass Transit Voucher System requires government agencies to pay up to $65/month to cover the costs of employees who take mass transit or van pools to work.

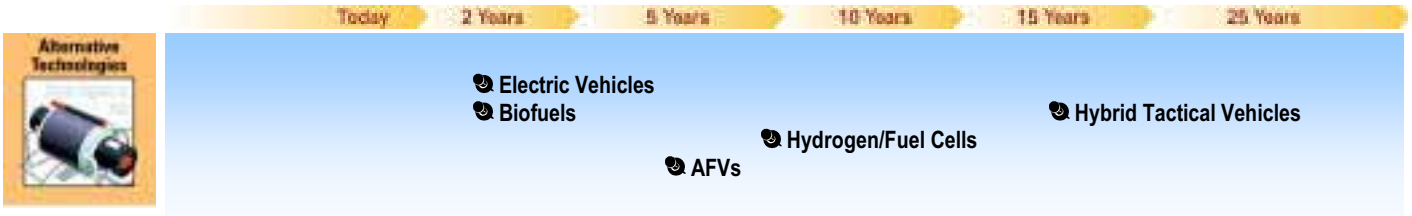
TRANSPORTATION

Fuel Efficiency



- **LEV/SuLEV** – Low-emission vehicles (LEV), super-low emission vehicles (SuLEV), and no-emission vehicles are on the market today in response to new laws in California. Many types of alternatively fueled vehicles are also available and should be investigated for possible use.

Alternative Technologies



- **Biofuels** – Biofuels are alcohols, ethers, and other chemicals made from renewable resources (e.g., fast-growing trees, grasses, and algae) and waste products (e.g., agricultural and forestry residues, and municipal and industrial wastes). It is estimated that domestically produced biomass resources could eventually provide at least half of the U.S. light duty vehicle (LDV) fuel requirement. In the not-too-distant future, biomass will be consumed in fuel cells in vehicles and stationary equipment to produce heat and electricity very efficiently, with virtually no pollution and no net increase in carbon emissions. Eventually, high-efficiency biomass power plants will allow any facility to generate its electricity on site.

  According to the Department of Energy, America's fastest growing alternative fuel is biodiesel. Fuel generated from surplus soybean crops can replace diesel in many applications. Biodiesel reduces diesel exhaust by 80 to 90 percent. The Defense Energy Support Center recently issued a long-term contract to purchase biodiesel for fleet vehicles including those of the Marines, Air Force, and Department of the Interior. Plant-based motor oil is in development for use in tactical vehicles.

- **Hydrogen/Fuel Cells** – Hydrogen is not a viable energy source since little free hydrogen is available. Instead, it is viewed by many as the ultimate energy storage and transmission medium. It will be extracted from hydrocarbons, biofuels, and even water, and shipped/piped to another location where it will be directly burned, or indirectly consumed in a fuel cell, producing only energy and water vapor. Iceland, which has rich geothermal and hydrologic resources that can be employed to extract hydrogen from seawater, recently set a goal of becoming the first hydrogen economy. Iceland New Energy, a consortium that includes Daimler Chrysler AG, Norsk Hydro AS of Norway, Royal Dutch Shell Group, and a Reykjavik-based venture capital fund, has launched projects aimed at promoting the hydrogen economy in Iceland. Three buses powered by hydrogen fuel cells will be introduced into Reykjavik's

city transport fleet by the end of 2002. A second project will begin replacing conventional chemical batteries with fuel cells in stationary power structures that are not currently on the regular electric grid.

Fuel cells convert fuel to power three times more efficiently than internal combustion engines; they also allow for a greater range of travel than electric vehicles and do not pollute at the point of use. Every major automobile manufacturer in the world is investing in fuel cell technology, and the Department of Energy supports fuel cell research and development.

- **AFVs –** Alternative fuel vehicles (AFVs) are available on a limited basis now, but it will be a few more years before they truly begin to capture market share in the public and private sectors. Honda is working on a zero-emission vehicle that uses fuel cells for power. The state of California will now give up to $9,000 in rebates to people who buy super-low emission vehicles (SuLEVs). With lower per-mile costs associated with fueling larger fleets, city bus fleets and commercial fleets are prime candidates for alternative fuels such as compressed natural gas. Colorado Springs Utilities runs over 90 vehicles on natural gas, reducing carbon monoxide emissions by 75 tons and nitrogen oxide emissions by 2,772 pounds per year. The General Services Administration (GSA) can provide a number of AFV options. See http://www.afdc.doe.gov/afvehicles.html and http://www.csu.org/environment/energy/vehicles.html for more information.

- **Hybrid Tactical Vehicles** – The Army's National Automotive Center is currently partnering with private firms to develop hybrid-electric systems for military tactical and combat vehicles. This type of system would save fuel and reduce air pollution.

- **Electric Vehicles** – The Advance Research Projects Agency established the Hawaii Electric Vehicle Demonstration Project to facilitate further applications of electrical vehicle technologies for commercial and military applications. The potential for creating jobs, broadening the use of electric and other alternatively fueled vehicles, developing infrastructures to support those vehicles, and maximizing the number of alternatively fueled vehicles on the road increases with partnerships of this type.

Fort Carson 25-Year Goals for Transportation

To be determined by Fort Carson Command and staff, as advised by members of the local and regulatory communities, at the Installation Sustainability Workshop on 4-6 September 2002.

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LANDS

Challenge

Sustaining Fort Carson's training areas is critical to the mission and to long-term viability of Fort Carson as a power projection platform. How can Fort Carson provide realistic training areas through environmental stewardship? How can Fort Carson continue to use its training lands while being a good neighbor to a growing community?

Key Considerations

- **Transformation** – As the Army transforms over the next 25 years, the systems and mission of Fort Carson are likely to change as well. More lethal systems that function at greater distances will need different types of areas for training. Land requirements for new systems and missions may have a profound impact on Fort Carson's sustainability.

- **Training Land Conditions** – Land conditions directly affect the ability of Fort Carson's units to conduct and sustain realistic readiness training and to protect and enhance ecosystem health. Environmental concerns include erosion, vegetation management, sediment movement, runoff, water quality, and wildlife habitat management. Sustaining the post's land in a high-quality condition may require that some land be used for purposes other than the primary mission—indefinite support of readiness training.

- **Noise** – Fort Carson is surrounded by an expanding Colorado Springs community (up 27.5 percent over the past 10 years). Close proximity of civilian lands generates infrequent noise complaints. Resolution of such complaints requires community education on the importance of Army training and the role of Fort Carson units in the Army's Strategic Plans. Common sense training plans support readiness requirements and alleviate some civilian nuisance concerns. Noise models should be incorporated into community and regional planning to ensure "smart growth."

- **Encroachment** – Fort Carson should continue to work with local communities to influence local land use management to minimize (1) impacts of adjacent community growth on readiness training and training land sustainment and (2) impacts that Army activities may have on adjacent communities. The lease or purchase of adjacent lands can expand species' habitats, reduce restrictions on training, and create buffers between Army activities and the desirable growth of surrounding communities. Realistic community zoning and real estate transactions should reflect and minimize the impacts of Fort Carson's training mission.

- **Water Quality** – Fort Carson must manage, repair, and sustain training lands to minimize training impacts on surface water and groundwater quality. This includes reducing sediment movement and removing munitions and metal contaminants from water sources.

- **Cultural Resources** – Fort Carson must manage, repair, and sustain training lands to minimize training impacts on cultural resources and to balance preservation and conservation with training requirements. The main restriction to training is digging within the boundaries of protected archaeological sites. Cultural resource staff must work closely with training staff, continually evaluating and protecting sites while supporting training requirements and priority work projects.

Importance to Fort Carson

Mission – Land for combat training and cantonment activities is vital to mission accomplishment and the survivability of soldiers. If the land degrades, the ability to train realistically also degrades. Personnel that use Fort Carson and the Piñon Canyon Maneuver Site include:

- 2,500 Department of the Army (DA) civilians
- 15,000 Active Duty Military personnel
- 12,000 Reserve and National Guard personnel

A total of 374,419 acres at Fort Carson and the Piñon Canyon Maneuver Site provide:

- 67 Firing Ranges
- 79 Training Areas
- Butts Army Airfield
- 2 Combat Assault (C-130H) Airstrips
- 16 Drop Zones
- Air Force Live-Fire Range

Quality of Life – An aesthetic installation with attractive, local landscaping enhances quality of life, promotes pride in the area's natural beauty, and attracts quality recruits to Fort Carson.

Costs

- In 2002, the estimated costs for training land maintenance and restoration, many of which will not be funded, include:
    - New Trees and Landscape Maintenance: $165,000
    - Wildfire Prevention: $20,000
    - Wetland Protection and Recovery: $95,000
    - Watershed Management: $765,000
    - Selenium Remediation: $74,000
    - Plant Materials Program: $25,000
    - Invasive Weeds Control: $100,000
    - ITAM/Range Maintenance Programs: $1,500,000
    - Wildlife/Endangered Species Management: $389,000

Environment and the Community – A community that sees the Installation caring for its lands will be more willing to support the continuation of activities and cooperate with the Installation when activities conflict. Ecosystems have no boundaries, so invasive weeds and other issues that affect Fort Carson and the Piñon Canyon Maneuver Site affect the surrounding communities. Therefore, cooperation is required to effectively care for the total ecosystem on the Installation and its major training areas.

LANDS

Introduction

Fort Carson's mission is to train, mobilize, sustain, and deploy combat-ready forces. Intense, realistic training is critical to maintaining the highest level of readiness for deployment to combat situations. To accomplish this mission, environmentally sound training sites, cantonment areas (administrative, virtual training, information systems, headquarters, vehicle repair facilities, etc.), downrange locations, and family housing areas are necessary. This section provides information on the various programs to conserve the lands on which all of these activities must take place: soil conservation, vegetation (noxious weeds, forestry, native grasslands, landscaping), wildfire management, and watersheds (including wetlands).

Background

Due to the dry climate and altitude, Fort Carson and the Piñon Canyon Maneuver Site (PCMS) need special care to maintain ecosystem viability. On the high-altitude prairies of Fort Carson and PCMS, the climate is dry, yet wet enough to grow specific and locally adapted plants. The delicate balance of plants, water, and soils on the land is required for sustainability of both the ecosystem and the military training mission. If vegetation is lost due to military maneuvers or other activities, erosion and soil loss will result.

Live-fire training is not allowed on the Piñon Canyon Maneuver Site, but many firing ranges are available downrange of the cantonment area on Fort Carson. Training area allocation and live-fire range scheduling are controlled by the G3; Directorate of Plans, Training and Mobilization; Range Control Office (G3, DPTM). After maneuvers, Directorate of Environmental Compliance and Management (DECAM) and Range Control personnel evaluate the areas to locate disturbed areas and determine appropriate remediation.

The Piñon Canyon Maneuver Site is the second largest Department of Defense training site within the United States, with 235,896 acres used for force-on-force mechanized brigade training. Fort Carson is also large, with 138,523 acres of wetlands, recreational sites, training areas, and cantonment areas (Figure 5.1). Hosting soldiers, families, civilian employees, military retirees, and contractors, the Fort Carson garrison is considered a small city (see inside cover for statistics). Maintaining soils, rangelands, forests, wetlands, and landscaping, while preventing wildfires and invasive weeds, are ongoing challenges.

Figure 5.1 – Some Land Uses at Fort Carson and the Piñon Canyon Maneuver Site*

Unit and Activity	Fort Carson	Piñon Canyon Maneuver Site
Number of Training Areas	56	23
Acres of Training Areas	82,000	220,000
Acres of Impact Areas	21,740	0
Recreation Acreage	2,268	0
Acres of Hunting and Nonconsumptive Wildlife Use**	All (seasonal)	All (seasonal)
Acres of Wetlands	1,076	4,776
Acres of Forest	40,000	65,730

*Not all acreage is categorized and some areas are covered under multiple uses.
** Recreational utilization/availability is dependent on military training.

In addition to the myriad of vehicles and equipment used for training, troops also must bivouac (camp out) just as they would in a war situation. Approximately one ton of trash per day is created by 500 troops in a bivouac field environment. Trash is temporarily collected before removal, using vehicles that could and should often be used for other mission-related purposes. In the cantonment area of the garrison, removal of trash is normally performed by contracted services.

The Integrated Training Area Management (ITAM) Program, which operates as a component of the Installation's Integrated Natural Resources Management Plan (INRMP) monitors and inventories the condition of training lands; provides education and awareness programs; rehabilitates and revegetates the land; and provides GIS capabilities. All of these activities integrate mission and natural resources programs. However, land management funding is limited and projects are prioritized.

Land management at Fort Carson and the Piñon Canyon Maneuver Site benefits the training mission by supporting the environment through vegetation and soil conservation, wildfire management, and watershed monitoring, among other activities. The Army Corps of Engineers Construction Engineering Research Laboratory conducted a Return On Investment study at Fort Carson to determine if land rehabilitation and management were cost effective for the Army. The study concluded that the benefits from land rehabilitation and management included cost savings in addition to environmental and training benefits. The study may be ordered at http://www.cecer.army.mil/td/tips/pub/details.cfm?PUBID=1245&LAB=1.

Activities and Impacts

Many training activities affect the health of the land. Training can extract a heavy toll on lands; movement to the range area and training activities disturb plants and soils. The Army studies impacts and takes many precautions, which include filing an After Action Report following every major training activity of Battalion strength or larger, implementing prescribed burning before training, detonating unexploded ordnance, and inspecting the land after training activities to ensure that excessive damage was not done. Figure 5.2 illustrates some of the major activities that impact the land during training maneuvers.

Figure 5.2 – Military Land Use: Activities and Impacts

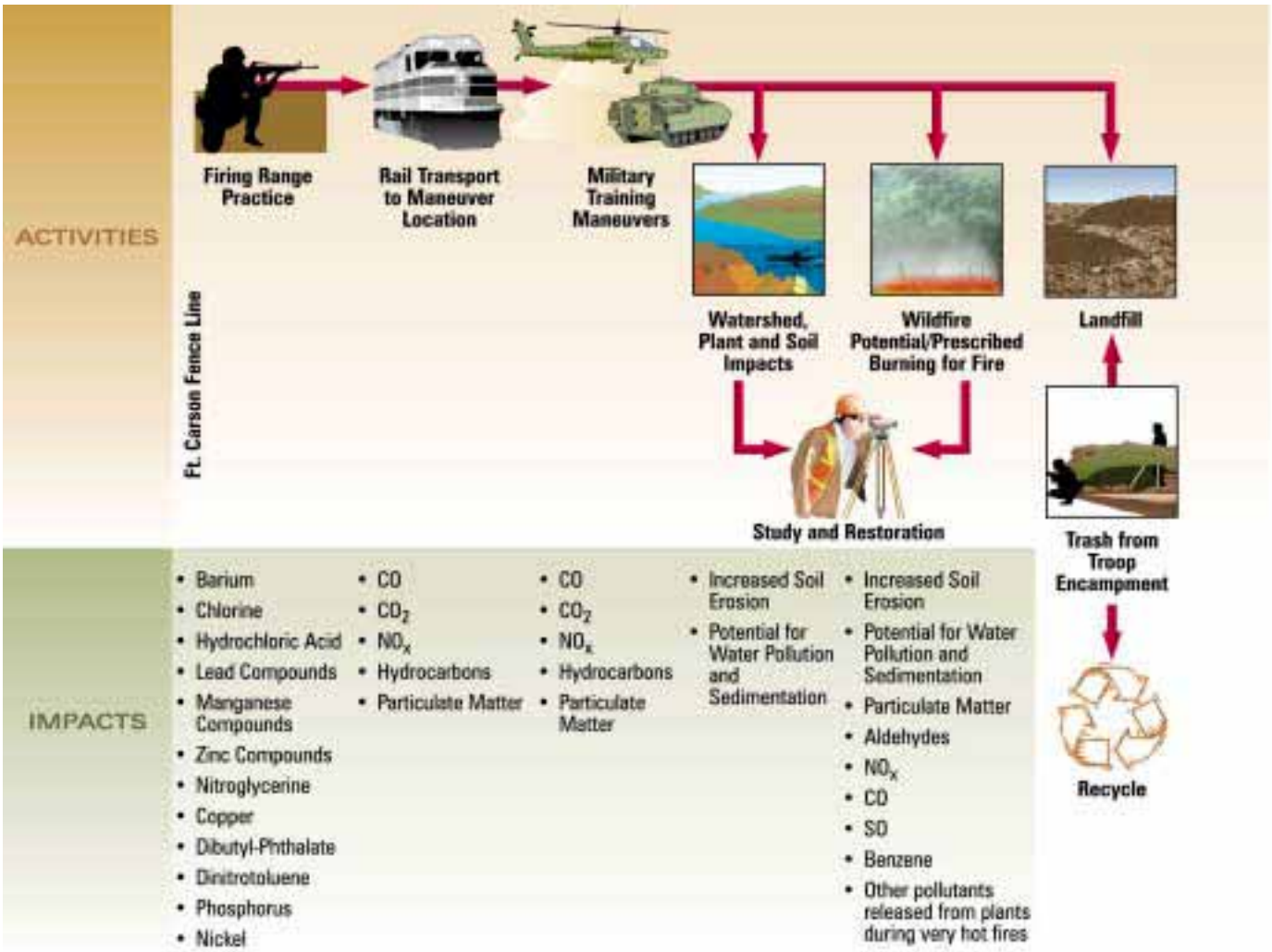


Figure 5.2 does not include details on solid or hazardous waste disposal and recycling. For more information on these activities, see the Materials section in this Baseline Document. For more information on open burning, open detonation, and smoke and obscurant training, see the Air Quality section.

The following sections provide more information on four major areas of land management: soil conservation, plant materials, wildfire management, and watersheds/wetlands. The DECAM and the G3, DPTM administer many of the land management activities in partnership because the programs are related and overlap in many respects. For both directorates, the mission is to conserve the land for future military training. Methods may vary and activity levels can be dissimilar, but the two groups must work together to maintain soil, water, and vegetation. The DECAM works with the Installation Fire Department to reduce and control wildfires.

Soil Conservation

Soil is the foundation upon which all training is performed and all activities take place. Soil origin, the semiarid climate, and intense, localized rainstorms shape the character of southern Colorado's high prairie soils. Parameters for training based on soil moisture exist and are heeded by training personnel. However, data on soil moisture is sparse, and often based on widely spaced weather stations. Fort Carson does take measures to prevent erosion and repair areas that have been damaged due to military maneuvers and previous poor land practices. Bank sloping, erosion-control dams, administrative controls (Limited Use Areas, for example), land rotation, seeding, hardened crossings, and incorporation of geotextiles are a few ways in which Fort Carson prevents or repairs erosion. Figure 5.3 is a list of the primary activities for erosion control practiced downrange at Fort Carson and the Piñon Canyon Maneuver Site.

Figure 5.3 – Primary Erosion-Control Activities

Soil Conservation Activity	Description	Fort Carson's Efforts
Map Overlays	Delineate Limited Use and Off Limits areas.	Provided to troops prior to submission of training plans.
Bank Sloping	Contour steep banks of erosion courses to an angle where vegetation can be established.	Ongoing. Evaluation continues to plan the best way to bank slopes while protecting species that use steep slopes for habitat and permit military training in an area.
Seeding	Perennial native grasses seeded to stabilize soil (prevent erosion).	Approximately 6,000 acres annually.
Erosion-Control Dams	Slow down runoff waters and cause sediment to drop out of runoff.	800 erosion-control dams completed.
Geotextiles	Placed under roads to maintain road integrity to support maneuvers and to absorb and slow the velocity of water down a slope.	Approximately 1,000 square yards.
Hardened Crossings	Help vehicles get across drainages with minimal damage to ecosystems.	3 to 25 per year are built.
Controlled Burning	Intentional lighting of fires to prevent out-of-control wildfires and give soil nutrients.	See Fire Section in this chapter.

Soil moisture is one of the most important factors related to erosion and military training. Training in extremely wet conditions can cause excessive impacts to the land—impacts that may take years to correct. Commanders are given "red," "green," and "amber" designations for training, based on field conditions. Soil moisture is difficult to measure over large areas. More instruments with better accuracy tied to a central database would improve communication and avoidance of training-related damage in extremely wet conditions. A weather station system with 12 soil moisture probes at the Piñon Canyon Maneuver Site and 5 probes at Fort Carson is nearly complete. This system will support the Maneuver Damage Control Program. However, due to the occurrence of localized rainstorms, the system will not provide full coverage of soil moisture conditions at the Installation.

On much of the high prairie in southern Colorado, erosion causes naturally occurring selenium to become available. Selenium attaches to eroding soil particles, which can be deposited in a single area, concentrating the selenium. Taken up by plants, selenium is toxic to wildlife in high concentrations. Even though no government standard for selenium in soil exists, Fort Carson recognized the potential hazard and proactively remediated 136,000 cubic yards of selenium-concentrated soil at a test site in a major training area during fiscal year 2001.

Range conservationists at Fort Carson have been creative in working with other agencies to carry out needed studies and monitoring with limited funding. Agreements have been made with the U.S. Geological Survey, the Natural Resources Conservation Service, and the Agricultural Research Service to study and assess erosion and sediment transport on the rangelands of Fort Carson and the Piñon Canyon Maneuver Site. The Massachusetts Institute of Technology and Oxford University are studying gullying processes at both sites. The University of Alaska and Shriever Air Force Base have used remote sensing imagery to study soil moisture at PCMS. This is only a partial list of studies and cooperative ventures accomplished between agencies and universities to enhance ecosystem sustainability.

Plant Materials

Semiarid plant communities such as those at PCMS and Fort Carson take many years to establish and grow. The Piñon pine produces seeds only once every two to five years. Juniper and prairie grasses cover large areas and stabilize soils, but with limited rainfall in intense bursts during the growing season, growth requires a delicate balance of soil nutrients, moisture, and minimal disturbance. Another issue is native plant species composition. Invasive plant species can degrade an ecosystem because they prevent native plants from growing, but lack the strong root system needed to stabilize soils. Invasive plants can also adversely affect wildlife health. Maintenance of native plant communities is critical to sustaining the military mission and the environment.

Trees and shrubs help reduce noise and improve air quality and military training. These forest resources help stabilize soils, provide concealment for tactical vehicles and personnel, and allow for realistic training by using the resources present in a given landscape. Trees damaged by maneuvers are inventoried and replaced where necessary to support both the ecosystem and accomplishment of the military mission. Forest inventory data taken in 2001 will be compared with earlier studies to determine to what extent the forest is changing as a result of military training and wildfires. Figure 5.4 details the costs for trees planted and maintained in 2001.

Figure 5.4 – Tree Expenses for 2001

Activity	Cost
Labor (watering, planting, pruning, and transplanting)	$71,260
Equipment and Maintenance (trucks, chippers, chainsaws)	$38,601
New Trees (tree, topsoil, mulch, etc.)	$22,080
Earth Day (42 new trees, topsoil, equipment, etc.)	$6,897
Total	$138,838

Trees can be damaged by the improper design of landscaping. In the Fort Carson cantonment area, some of the landscaping materials and methods used include rocks, xeriscape plant materials, and previously planted Kentucky bluegrass. Kentucky bluegrass must be watered one inch per week from May to September (about 22 inches is needed). The Pikes Peak region receives an average annual rainfall of approximately 12 inches (http://lwf.ncdc.noaa.gov/oa/ncdc.html); thus, the water needed to maintain Kentucky bluegrass is much greater than that which naturally falls. This is too much water for many native trees, and their roots will rot, so native trees should not be planted near areas with Kentucky bluegrass. Initial purchase and planting for xeriscaping is typically more expensive than for Kentucky bluegrass. However, life-cycle cost analysis of water requirements during the growth years indicates that bluegrass is much more expensive than xeriscaping or using native grasses.

A native grass and forbs mixture is used for reseeding training areas at both Fort Carson and PCMS. Areas requiring reseeding are prioritized based on percent disturbance, plant cover, native plant composition, and wildlife habitat conservation requirements.

Invasive plants have been referred to as a form of biological pollution. International travel for pleasure, work, and military activities has brought many species into the United States accidentally. However, many species that were imported for decorative and agricultural purposes have subsequently gotten out of control. Invasive plant species are a major ecological problem in the western United States. Plant species that are not native to the area can harm wildlife, cause soil erosion, compete with native species, consume wetlands, and affect the Army's ability to train. Five different invasive plants have caused the most problems, but ten others exist in the area and have the potential to spread. Invasive species are a larger problem at Fort Carson than at PCMS, due in part to prior management histories and to intensive native plant reseeding efforts during the 1980s and early 1990s at PCMS, which is more arid.

Fort Carson is using a variety of methods to control invasive species in accordance with its Integrated Pest Management Plan and INRMP. Education and biological, physical, chemical, and cultural controls are used where appropriate to prevent invasive plant species from spreading and to lessen their effects. Weed control costs average approximately $80,000 per year.

Wildfire Management

According to Todd Wilson, in an article titled "Prometheus Unbound" in the May/June 2001 issue of Nature Conservancy,

- approximately $1.6 billion was spent in 2000 to put out 90,000 wildfires in the United States; and
- for every dollar spent on prescribed burning, forest thinning, and fire personnel training, $7 are saved in wildfire fighting costs.

Preventing wildfires is important in the semiarid west. Wildfires burn off extensive areas of plant material, allowing excessive erosion of soils and damage to aquatic systems. Prior to the 1980s, wildfire management focused on preventing all fires at all costs. Subsequently, resource managers realized that preventing all fires allowed the accumulation of dead, dry fuel materials on the ground. In these circumstances, once a fire started, it raged out of control over large areas for days, aggravating existing air pollution conditions and putting firefighters in high-risk situations.

Controlled or prescribed burns are a preferred method for controlling wildfires; reducing soil damage and air and water pollution; and reducing the risk to firefighters. Prescribed fires are more than a way to prevent wildfires from raging out of control; small fires release important nutrients back into the soil, and reduce undergrowth and deadfall, which allows the remaining trees to grow and remain healthy for a greater number of years. Prescribed fires save hundreds of thousands of dollars in training time lost and in money required to fight wildfires. From a community perspective, prescribed fires reduce the impacts of smoke from wildfires and minimize the risk of wildfire damage to residential areas. For military training purposes, prescribed fires allow for increased training by creating buffer zones at live-fire ranges. In addition, prescribed fires control the growth of invasive plant species (removal of vegetation makes plant-specific herbicides more effective). Thus, prescribed burning is an environmentally sound way of clearing areas for training purposes and preventing training land losses due to wildfire degradation.

Prior to this year, El Paso County restricted prescribed burning from November through March due to air quality issues. Burning is not allowed on days when there are atmospheric inversions. These winter months are the best time to burn due to the fact most of the native grasses are dormant and will not be harmed by the fire, and the cold and dampness allow better fire control. Before control burn permits can be issued, very strict guidelines must be met. Fort Carson must coordinate all burns through both the affected County Health Department and the Colorado Department of Public Health and Environment (CDPHE) in order to abide by existing air quality regulations.

Approximately 26,000 acres are scheduled for prescribed burning annually. However, only 3,000 to 10,000 acres are actually burned due to weather conditions, training activities, and other factors. In compliance with legal requirements and sound management, Fort Carson does not perform prescribed burning unless all appropriate notifications have been made, fuel conditions and moisture are adequate, and weather conditions for proper smoke dispersal without high winds exist. Boundaries such as roadways, natural rock outcrops, and high expansion foam are used to contain prescribed fires. Studies are being coordinated with Utah State University to determine the feasibility and cost effectiveness of vegetative firebreaks, which are one of the tools being considered in Fort Carson's environmentally sound approach to ecosystem management.

New changes in the law for prescribed burning have just taken effect. Beginning in 2003, a fee must be paid to CDPHE for a prescribed burning permit. Additionally, a public comment period for each burn permit and a post burn report must be submitted. Fort Carson's Prescribed Fire Program has operated successfully without incident since 1989. It is unclear whether new regulations will aid or hamper burning activities at Fort Carson and the Piñon Canyon Maneuver Site, but it is certain that the additional coordination and fees will cause prescribed burning to cost quite a bit more.

Watersheds and Wetlands

A watershed is a drainage basin that divides the land into hydrologically defined areas. A wetland is an area that is inundated by enough water for a long enough period to support plants that require saturated soil conditions. Wetlands have been called "the kidneys of a watershed" because they filter and clean the water. Wetlands sustain plant and animal diversity; protect against flood and storm damage by absorbing large amounts of water; and increase groundwater availability through capture and filtration of

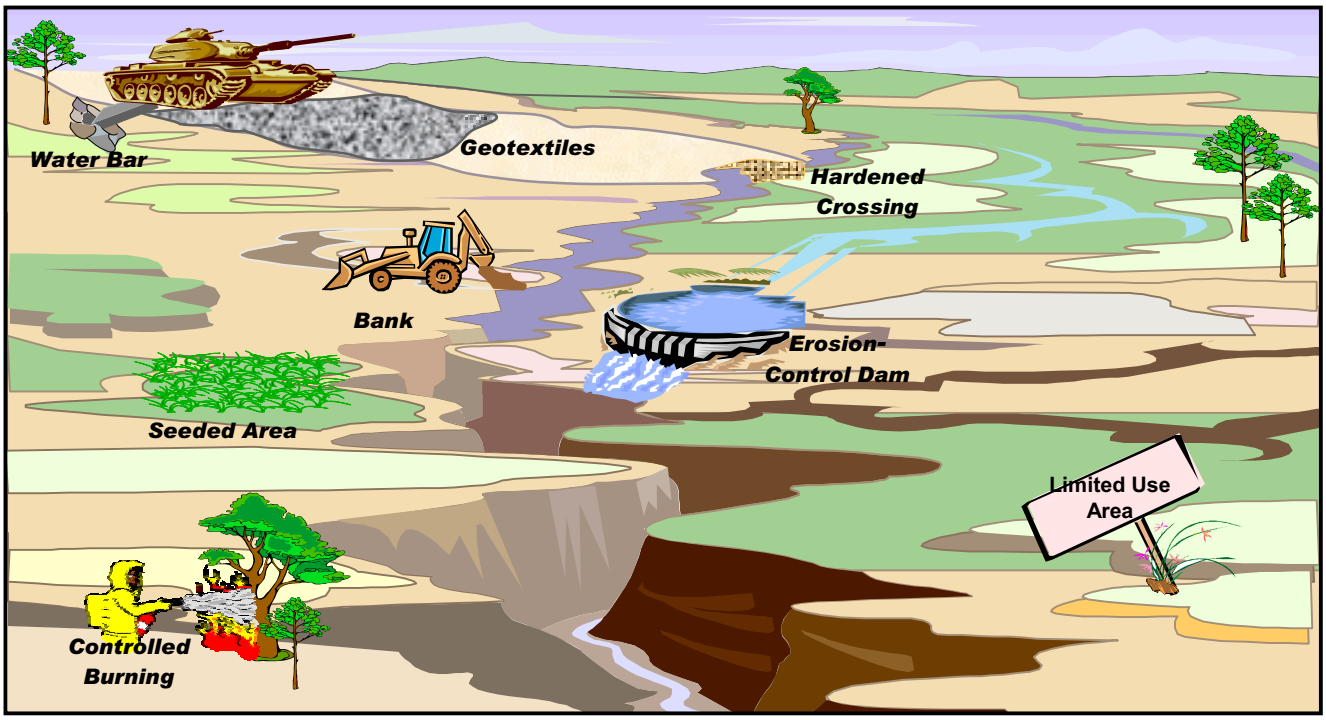
precipitation. Wetlands at PCMS include arroyo pools, ephemeral streams, and those created by erosion-control dams. Wetlands at Fort Carson include manmade areas, wetlands created by erosion-control dams, ditches, and areas associated with natural drainages.

Since the arrival of European settlers on the land that is now the United States, approximately 100 million acres of wetlands have disappeared due to draining and filling, primarily for agriculture purposes. Replacing wetlands is difficult and not always successful; thus, it is best to preserve natural wetlands and plan activities and structures around them.

The National Wetlands Inventory recognizes 40 categories and 1,076 acres of wetlands at Fort Carson and 31 categories and 4,776 acres of wetlands at the Piñon Canyon Maneuver Site. This data was gathered in 1993, and the survey will be repeated in order to determine if wetland areas are decreasing or increasing.

The Watershed Management Plan is implemented in part with soil conservation projects to conserve training lands. If soils are not protected, water will accelerate the natural erosion process. Some of the most important methods for conserving watersheds are listed in Figure 5.3 and shown graphically in Figure 5.5.

Figure 5.5 – Activities and Practices that Preserve Military Training Lands



Erosion-Control Dams – These and smaller "check dams" collect sediment and decrease water velocity, thus reducing water-generated erosion.

Water Bars – Water bars divert water from tank trails that have high erosion rates, thereby preventing excessive erosion and stabilizing the road.

Geotextiles – Geotextiles protect roads by allowing water movement while preventing movement of soils.

Hardened Crossings – When vehicles must pass through wet or muddy areas, damage is done in that area and beyond. Hardened, rock-lined crossings are passages through wet or muddy areas that reduce damage and confine traffic to a single area for crossing.

Bank Sloping – Contouring steep banks changes the slope of gully walls from near vertical to a much gentler slope, allowing passage of vehicular traffic and establishment of vegetation to stabilize gully walls.

Limited Use Areas – By limiting training in an area, lands are allowed to recover. During training, troops designate these areas as chemically contaminated or mined (that is, areas that would be avoided on a battlefield) to simulate conditions in real war and enhance training. Limited use areas are marked on maps and overlays and identified on site with signs and flagging.

Vegetation Establishment – Bare or inadequately protected soils are reseeded to prevent erosion. If the germinated seedlings survive for more than six months, they are considered established.

Most of the watershed protection projects are primarily reactive measures to control erosion. The production and use of real-time soil data could prevent some erosion from happening in the first place. If connected to a central information system that range managers and commanders accessed directly, the risk of training to a particular area could be determined immediately. Yearly aerial photographs would show where tree or vegetation lines are moving and if excessive losses are occurring in a particular area. Proactive conservation of available training lands will remain important in the coming years to sustain Fort Carson's limited resources.

The Human Perspective

As long as threats against the United States exist, soldiers will need places to train realistically and effectively. Simulations do not necessarily put the soldier in realistic war fighting situations with unpredictable conditions. The soldiers know they can always survive a simulation, and experience in coping with variability is key to building confidence in unknown situations. While learning to protect our country from external threats, soldiers must also learn how to prevent excess environmental damage to support the training mission in perpetuity. Soldiers care as much about the environment as any other citizen of this country. When provided with the proper education and tools, U.S. Army personnel have proven to be excellent stewards of the land.

Beyond the Pikes Peak Region

Respect for land at home will carry over to maneuvers at other installations and deployments to other countries. Good practices at both Fort Carson and the Piñon Canyon Maneuver Site create more environmental leadership within the Armed Forces. Foreign relations can only be improved by demonstrating care for other lands while fighting a war or performing peacekeeping missions.

Forecast

The Army has an ever-increasing need for versatile training that teaches soldiers how to respond to a variety of situations. Particularly important in coming years may be the ability to train in urban environments. This requirement may mean that troops will train less in open settings and more at a centralized camp converted to an urban warfare center. Alternatively, it may mean the conversion of some existing land at Fort Carson and Piñon Canyon Maneuver Site to urban warfare sites.

As the use of computer simulators increases, it would seem that the need for training lands would decrease. However, realistic outdoor training situations will always be necessary to prepare soldiers for war. Computer simulators are widely viewed as a supplemental training tool, not as a substitute training method.

Fort Carson billeting does not have the capacity for a large mobilization-training situation. This could mean the use of temporary tent quarters, which will require more intense study and care of the lands used for this purpose. Further, a large mobilization will require a more thorough and extensive use of training lands.

As weapons' maximum effective range increases, safety zones or "fans" will need to increase, requiring more land use. This development may be an asset to the land and its inhabitants, as more land is set aside for safety purposes, and used less for intense training, development, or other agricultural purposes.

Finally, the trend is for increasing environmental requirements, which will necessitate additional coordination among various agencies managing the Installation's natural resources and more environmental training for soldiers, civilian employees, and members of the public.

Current Sustainability Activities

Integrated Training Area Management (ITAM) – Aspects of this program include monitoring and inventory of training land conditions, an environmental awareness program, the Maneuver Damage Control Program, rehabilitation and revegetation programs, a computerized system for scheduling military and rehabilitation programs, a geographic information system, and integration of the mission and natural resources programs.

Land Condition Trend Analysis Program (LCTA) – Part of the Integrated Training Area Management Program, the Land Condition Trend Analysis Program provides information to assess the land's ability to support training. In accordance with this program, Fort Carson monitors the percent change in vegetative cover at the Piñon Canyon Maneuver Site and Fort Carson.

Land Rehabilitation and Maintenance Program (LRAM) – This program reduces the long-term impacts of training and testing on an installation by combining preventive and corrective land rehabilitation, repair, and/or maintenance practices. It includes training area redesign and/or reconfiguration to meet training requirements.

Watershed Management Program – The Watershed Management Program divides the Installation into its watersheds and manages them based on hydrology, soils, erosion status, wildlife, military training, and maneuver damage. In conjunction with the Wetland Monitoring Program, this program is used to define change on maneuver lands to the extent possible and to develop techniques for mitigating training impacts.

Awareness and Education Programs – Fort Carson personnel give tours, presentations at area community colleges, and instruct soldiers on the proper care and management of the land. They have created and distributed several educational videotapes.

Meteorological Monitoring Network – A network of 17 meteorological monitoring stations was established to monitor weather conditions and soil moisture. The stations provide continuous data on precipitation, temperature, wind, air pressure, solar radiation, and soil moisture.

Plant Materials Program – Cross breeding and selecting better plant varieties are methods used to produce plant materials that resist damage from military use.

Cooperation with Military Units – Fort Carson's land managers cooperate with military troop units, such as the 52nd Combat Engineer Battalion (Heavy), to perform work that supports the land and the military mission. The 52nd Engineers recently excavated sediment from the impaired areas of several erosion-control dams to learn how to perform similar operations as part of their tactical mission.

Computerized Water Monitoring System – The U.S. Geological Survey considers Fort Carson's water monitoring system as one of the best in the state of Colorado. This system was made even better by installing a computerized water monitoring system that provides extensive water flow data at Fort Carson.

Agreements with Other Agencies – Fort Carson makes every attempt to partner with other scientific and conservation agencies. A partial list of partners follows.

- Colorado College
- Colorado Division of Wildlife
- Colorado Division of Parks and Recreation
- Colorado State University
- El Paso County Parks
- El Paso County Soil Conservation District
- Fountain Creek Watershed Task Force
- Peterson Air Base
- Purgatoire River Soil Conservation District
- Schriever Air Force Base
- Texas A&M University
- Texas Regional Institute for Environmental Studies
- U.S. Agriculture Research Service
- U.S. Air Force Academy
- U.S. Army Corps of Engineers, Construction Engineering Research Laboratory and Waterways Experimental Station
- U.S. Bureau of Land Management
- U.S. Department of Agriculture
- U.S. Fish and Wildlife Service
- U.S. Geological Survey
- U.S. Natural Resource Conservation Service
- University of Wyoming

The Realm of Possibility

To become sustainable, Fort Carson is encouraged to identify and plan for innovations that will support the goals established during the Installation Sustainability Workshop. To do this, participants should review the concepts and technologies that are within the realm of possibility now and in the future. This section provides a glimpse of what can be accomplished with existing technology and what can be expected from developing sustainability approaches.

Training Land Conditions

- **Green Bullet** – The "Green Bullet" program is a Department of Defense (DOD) initiative to eliminate the use of hazardous materials in small caliber ammunition and during its manufacture. This fully integrated program, which is spearheaded by the Small Caliber Ammunition Group at the U.S. Army's Armament Research, Development, and Engineering Center (ARDEC), encompasses all environmental aspects of the small caliber ammunition from 5.56 mm through 0.50 caliber. Specific thrusts include the elimination of ozone-depleting chemicals (ODCs), volatile organic compounds (VOCs), and heavy metals in the manufacture of primers and projectiles in the entire family of small caliber ammunition. For more information, see the Green Ammo web site (https://www.pica.army.mil/greenammo/), which requires a secure channel.

- **Green Missile** – The Green Missile Program, an integrated pollution prevention research effort funded by the Strategic Environmental Research and Development Program (SERDP), is designed to develop alternative materials and technologies for solid rocket motor propulsion systems. The program has team members representing the Army, Navy, Air Force, National Aeronautics and Space Administration (NASA), Department of Energy (DOE), and Environmental Protection Agency (EPA). The specific objectives of the program are to (1) develop propellants for both extrudable and castable propellant processes that do not contain lead catalysts; (2) develop and demonstrate complete and clean hydrochloric acid-free combustion; and (3) develop and demonstrate the use of liquefied gases and supercritical fluids for environmentally friendly processing of energetic oxidizers and components, resulting in elimination of solvents and reduction of VOCs in the waste stream.

- **Virtual Training –** "Virtual training" is the next step in readiness training for the U.S. Army. While flight simulators and interactive shooting ranges have been in use for years, the next generation of virtual training systems will incorporate unprecedented realism and give soldiers the ability to experience complex and dangerous combat scenarios in a 100 percent controlled environment.

- **Decision Support Software –** Geographic Information System (GIS) decision support software, specifically designed to address military maneuvers with environmental conditions, is available.

Management tool software packages include maps, impact analysis, and a training area/range facility management support and scheduling system. Examples of available maps may be found at http://www.nobility.com/.

- **Range Facility Management Support System –** The Range Facility Management Support System (RFMSS) is an automated range and training area scheduling system currently used by the Army. This system provides centralized scheduling of range assets and detailed reporting capability. The system increases overall safety for the training soldier. This automated range scheduling capability increases range operation efficiency by replacing the previous paper-based system with a software package that incorporates current GIS software into a graphic user interface. RFMSS allows Range Control to coordinate all scheduling functions, including approval/disapproval of requests. The current-day approved requests are handled at the Firing Desk in a crucial, real-time module of RFMSS. All data is archived for future range utilization reporting. An online example of this software package may be found at http://rfmss.lmfs.belvoir.army.mil/.

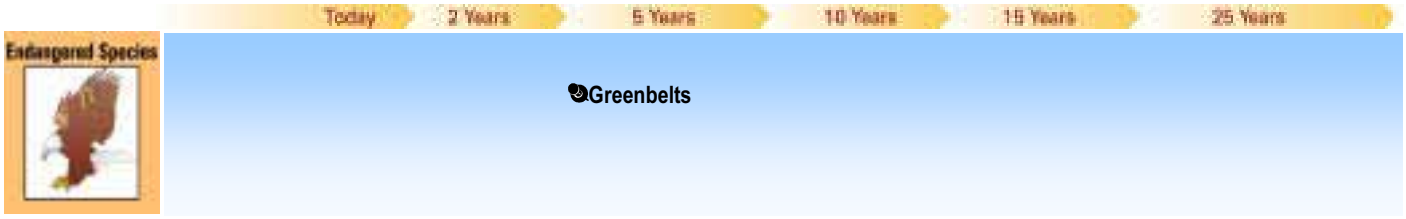
- **Sustainable Range Design –** The U.S. Army Corps of Engineers is currently exploring the connection between green building design concepts and sustainable range design.

- **Tactical Concealment Area Planning –** The Tactical Concealment Area Planning and Design Guidance Document, developed by the Army Environmental Center and the Army Engineer Research and Development Center, is an approach to designing training land that integrates training and environmental requirements to expand and improve training resources. Go to the following U.S. Army Environmental Center web site technology section for more information: http://aec.army.mil/usaec/technology/conservation06.html.

- **Camp Ripley Study –** A two-year study was conducted at Camp Ripley, Minnesota to determine the effects of tracked and wheeled tactical vehicles on soils and vegetation. The study provided scientific information concerning soil compaction and sensitivity of trees to intense military use (http://www.dma.state.mn.us/cpripley/envir/land_use_management.htm). While the environment in Minnesota is quite different from that of Colorado, the application and theory of the system is worthy of consideration.

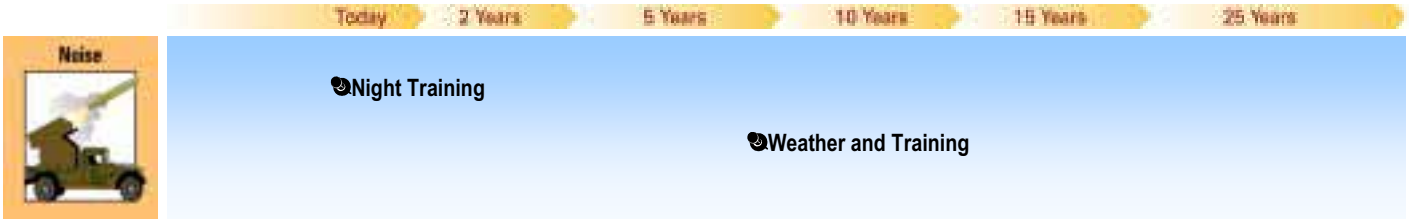
- **Zero Footprint Camp –** The Zero Footprint Camp was developed as a way to alleviate the logistics and tactical burden of deployment. Zero Footprint Camp is a method of identifying wastes as products to be used in other processes. For example, wastewater should be viewed as untreated, impure water that simply needs cleaning and disinfection for use. More information may be found at http://www.haifire.com/download/zfc.pdf.

Endangered Species



- **Greenbelts –** Fort Bragg has established a 5,538-acre "Greenbelt" on the southern border of the installation. Military training continues on this land but it is otherwise left undisturbed as habitat for the endangered red cockaded woodpecker. Similar greenbelts could be established at other installations to protect local endangered species.

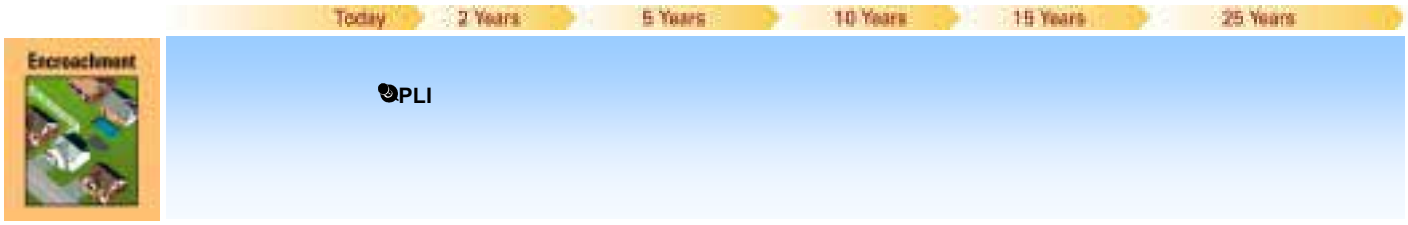
Noise



- **Weather and Training –** The rate at which wind speed and temperature change as a function of altitude can have profound effects on the behavior of high-energy sound waves as they propagate off-range and many miles into the surrounding area. As weather conditions change, noise monitoring many miles from the firing point and impact area has shown 30-decibel variations within just a few hours for a single weapon and firing point. For a local resident, this amounts to an eight-fold increase in loudness over a very short time period. Regular sampling of meteorological conditions and good record keeping can help identify adverse conditions and lead to strategies to avoid them. Disclosure of this information and the role that weather can play in noise levels at the point of reception can do a great deal to improve the trust and credibility accorded the leadership at the range.

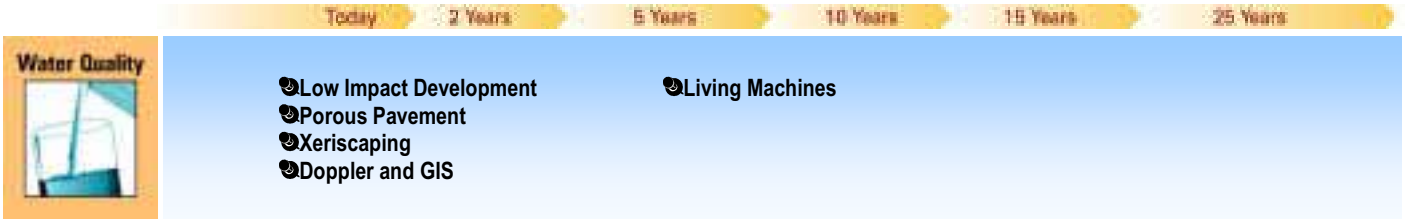
- **Night Training –** Training between 2200 and 0700 hours has noise impacts that are especially difficult for local residents to cope with because of the lower background noise at night and the probability of being awakened. Much of the night training serves to teach proficiency in the dark, which is not necessarily associated with the sensitive 2200 to 0700 period. Spring, fall, and winter months have many hours of darkness before 2200, and in many cases, it is possible to keep the large weapon component of the training in the period between sunset and 2200 hours.

Encroachment



- **Private Lands Initiative –** The Private Lands Initiative (PLI) is a cooperative effort between the U.S. Army Forces Command (FORSCOM), The Nature Conservancy, the U.S. Fish and Wildlife Service, and private landowners around the borders of an installation. By annexing land around the fence line and preventing that land from being developed, the PLI creates a "buffer zone" of sorts, which improves wildlife habitat around the edge of an installation. Increased habitat for endangered species outside the fence line decreases training constraints inside the fence line. The PLI, which has been active at Fort Bragg since 1995, is currently reviewing 10,000 to 20,000 acres of prime habitat of the red-cockaded woodpecker.

Water Quality



- **Living Machines –** Living Machines® use bacteria, plants, snails, and fish to treat sewage and other wastewater (http://www.livingmachines.com). The machines look like greenhouses and work by using plants and animals to break down wastes and digest organic pollutants. They are made by Living Technologies, Inc., and have been permitted at 23 locations in 7 different countries, including the United States. They offer better, more stable treatment at the same cost as traditional sewage treatment. It is possible that a similar technology could be developed to control the potential release of pollutants from ranges into groundwater and surface waters. The Army's Sustainable Range working group is charged to develop new ways to design the ranges of the future to reduce contamination by pollutants.

- **Low-Impact Development –** Low-impact development techniques can minimize impervious areas, thereby maximizing groundwater recharge (http://www.stormwater.net). Proper management of storm water protects surface water and groundwater from contamination, which is critical to Fort Carson and the surrounding region.

- **Porous Pavement –** Contaminants (oil, fuel, and sediments) that cause problems with storm water are eliminated if the storm water is retained on site and allowed to seep into the soil, rather than running off into streams. Many new building techniques and materials, such as porous pavement, allow for such natural drainage and on site water storage (http://www.stormwater.net).

- **Xeriscaping –** The Colorado Springs Water Resources Department has a Xeriscape Demonstration Garden at 2855 Mesa Road. The garden demonstrates how to plan the landscape, improve soil, select low water use plants, irrigate effectively, use mulches, and maintain the garden, all with low water consumption in mind.

- **Doppler and GIS –** The Doppler weather radar system can give full coverage of the weather in an area. Even small areas can be plotted on a GIS map to aid in predicting soil moisture, thereby determining the level of training the land will tolerate without significant damage.

Fort Carson 25-Year Goals for Lands

To be determined by Fort Carson Command and staff, as advised by members of the local and regulatory communities, at the Installation Sustainability Workshop on 4-6 September 2002.

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MATERIALS

Challenge

The large volume of products used at Fort Carson is the result of ingrained practices and habits relating to purchasing and use. Disposal of solid and hazardous materials is getting more expensive. The purchase and use of products add to environmental degradation through harvesting of natural resources, manufacturing, transportation emissions, and disposal. How can the Installation use less, purchase less, substitute more environmentally friendly products, and enhance recycling efforts while still maintaining the core mission of Fort Carson?

Key Considerations

- **Clean Products** – The use of materials that are nontoxic, made of renewable resources, produced in an environmentally friendly manner, and easily reused or recycled is critical to sustainability.

- **Product Leasing** – Fort Carson purchases many products such as carpeting, furniture, and appliances. Little or no consideration is given to what will happen to the product when it no longer meets its intended use. Companies now offer leasing of products where the supplier will take away and reuse/recycle the product when the user is finished with it.

- **Local Manufacture** – The purchase of locally manufactured products stimulates the regional economy, reduces transportation costs and environmental impacts, and helps sustain the community. In addition, the use of local manufacturers may increase the feasibility of creative product use approaches, such as product leasing or manufacturer buy-back in which the manufacturer buys back all of, or components of, the original product.

- **Use Reduction** – Sustainability depends on the ability to use the smallest quantities of products and materials needed to meet minimum requirements—in other words, not wasting resources. This includes reducing amounts used, spilled, and leaked to the environment.

- **Reuse and Recycling** – Material reuse and recycling reduces the costs and environmental impacts associated with processing virgin materials, transporting new products, and use/disposal of waste materials.

Importance to Fort Carson

Mission – The management of products, materials, and wastes requires many person-years of labor and represents a significant portion of the operating budget of Fort Carson. Additionally, the proper management of hazardous materials and wastes requires soldier time that could otherwise be spent on mission-related tasks.

Quality of Life – The use of hazardous materials can affect the health and safety of Fort Carson's soldiers, families, and workers. The release of hazardous materials and waste and the disposal of solid waste can contaminate air and water.

Costs for 2001

- New products and materials: Fort Carson purchased $110M
- Garbage disposal: $386,681
- Construction and demolition (C&D) debris management and disposal costs: $66,786
- Hazardous waste disposal costs: $60,000
- Hazardous Material Control Center (HMCC) operating cost: approximately $300,000 per year (actual costs are contractual and not for public dissemination)
- Treatment, Storage, and Disposal Facility (TSDF) permitting and Resource Conservation and Recovery Act (RCRA) compliance program cost: $20,000/yr
- Defense Reutilization and Marketing Office (DRMO) and reuse cost avoidances for hazardous materials: $222,000
- Landfill closure costs: $6M

Environment and the Community – Fort Carson has the potential to stimulate local economic growth by using local manufacturers and producers. Environmentally friendly purchasing could support community sustainability while improving the quality of life for the community and its resident soldiers.

While the Hazardous Materials Control Center has inducted nearly all applicable units and directorates on the Installation, it does not proactively service these units with visits and scheduled hazardous materials inventories. This reduces the amount of hazardous material that can be effectively tracked and managed. Therefore, while Fort Carson initially characterized, tracked, and modified its material purchasing to reduce environmental impacts, it is unknown whether stockpiling of hazardous materials and bypassing of the Hazardous Materials Control Center has occurred. The Hazardous Waste Compliance Assistance team does not work with the Hazardous Materials Control Center technicians to know whether the material they find is in excess of authorized use for the owners of the material; thus, they cannot tell if the material they find during an inspection is authorized or excess. The HMCC does conduct research to find less hazardous substitutes for materials used at the Installation.

Solid waste is currently shipped 15 miles to the Midway Landfill for disposal. With the closing of landfills at the Installation, costs to transport and dispose of solid waste will increase dramatically in the future.

Introduction

Fort Carson spends over $110 million/year in material purchases. Any large military installation makes significant purchases of many types of materials. For example, vehicle maintenance and repair use certain hazardous materials. The Federal government is the largest purchaser of materials in the country, and as such, has considerable influence on product development and the materials that go into products. This section addresses hazardous materials, nonhazardous materials, and procurement practices, which relate to recycling, waste prevention, and use reduction, all of which have economic impacts. In addition, purchasing decisions have other indirect impacts relating to the environment and to the well-being of society as a whole and individuals within the society.

Background

The purchase and use of products and materials creates some of the most significant impacts on the environment. The extraction and processing of raw materials, use of energy in manufacturing, transport of finished products, and ultimate use and disposal of these products present a great challenge to the sustainability of the operation purchasing the products and materials.

Construction and demolition debris and contaminated soils and sediments constitute by far the largest proportion of the solid waste stream at Fort Carson. These materials were disposed of on site until the landfill was closed on April 1, 2002. The remainder of the solid waste stream, household garbage, office waste, and cafeteria waste is shipped off site for disposal. Figure 6.1 summarizes solid waste amounts and disposal costs.

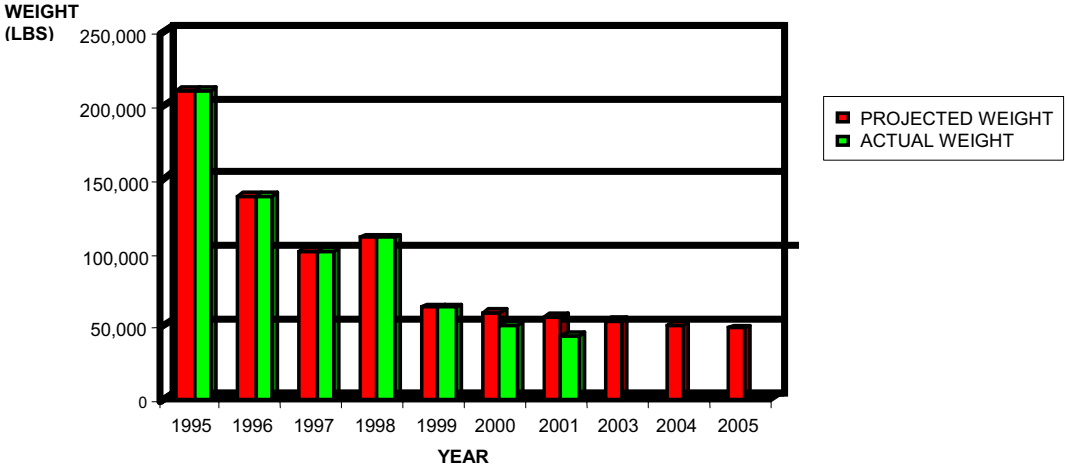
Figure 6.1– Fort Carson Solid Waste

Waste Stream	Amount Generated in 2001	Collection and Disposal Costs
Construction and demolition waste, Contaminated soils and sediments	297,867 tons	$66,786
Household, office, and cafeteria	8,935 tons	$386,681
Total	306,802 tons	$453,467

As Figure 6.1 indicates, only three percent of the solid waste stream was managed off site in 2001, at a cost of $386,681. If all waste generated during 2001 had been disposed of off site, the cost would have been nearly $3.4 million! Fort Carson no longer has use of an on-site landfill. Therefore, if extensive recycling and waste reduction measures are not implemented, costs for solid waste disposal at the Installation will increase significantly.

Hazardous waste disposal at the Installation has decreased dramatically since 1995 (Figure 6.2). This decrease is due in large part to the excellent Environmental Compliance Assistance Program and Pollution Prevention Projects such as the Hazardous Materials Control Center (HMCC). In 2001, 49,000 pounds (24.5 tons) of hazardous waste were disposed of through the Fort Carson hazardous materials staging and shipping site.

Figure 6.2 – Fort Carson Annual Hazardous Waste Disposal



The decision to purchase a specific item drives the future costs of using, managing, and disposing of the product. Manufacturing, transportation, storage, and use of products and materials cause negative environmental impacts both on and off post. Costs and environmental impacts associated with waste disposal include air and water contamination and undesirable land use.

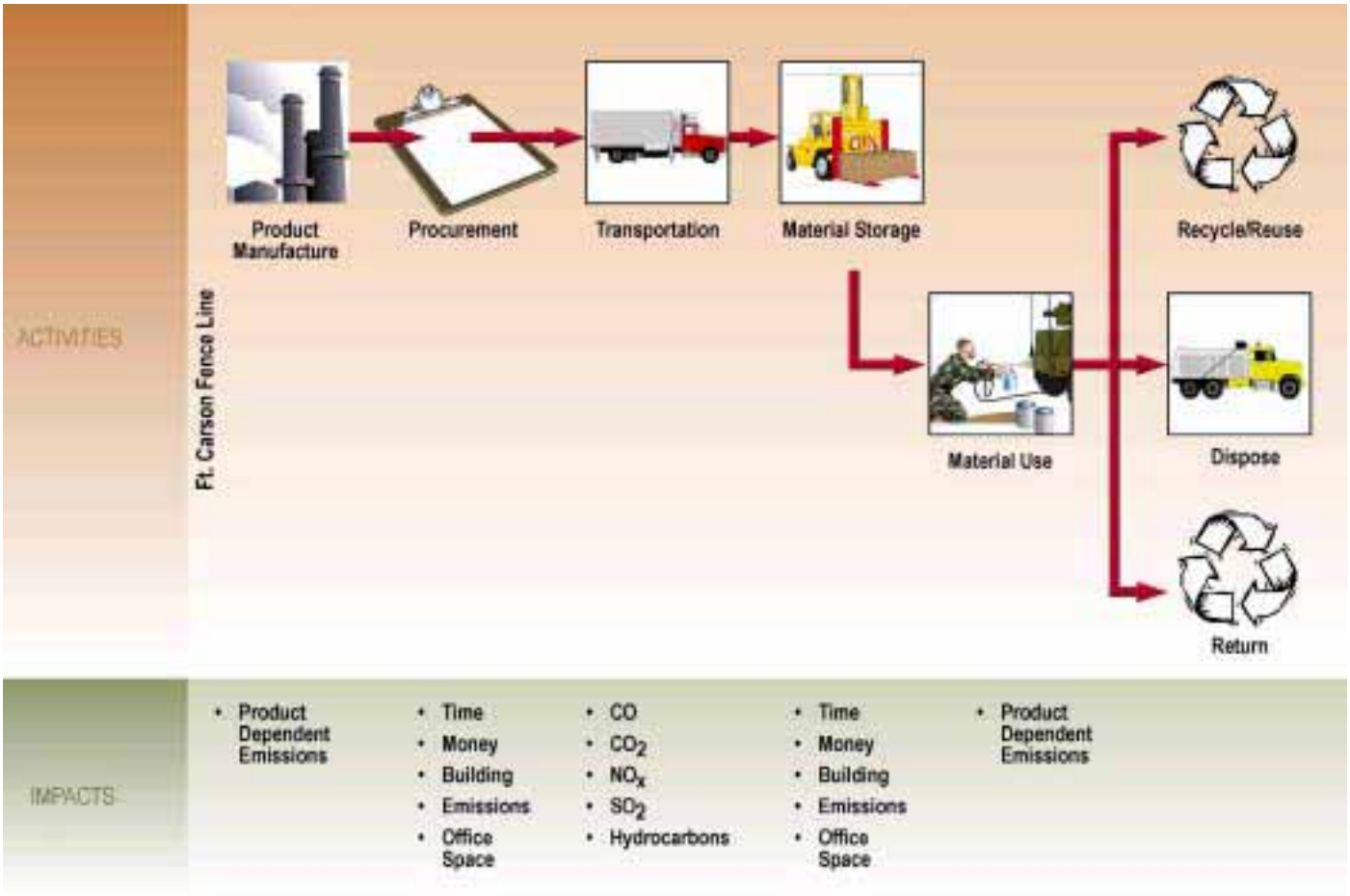
The federal government is committed to encouraging markets for environmentally preferable products, (EPPs)—products that contain or require less hazardous materials to produce or use, have fewer environmental impacts compared to similar products, and/or contain recycled materials. To that end, all federal installations are required to purchase EPPs such as recycled paper, re-refined oil, and retread tires. (A list of EPPs can be found at http://www.epa.gov/cpg/products.htm.) The General Services Administration Environmental Products and Services Guide provides a list of EPPs on http://www.gsa.gov (click "Buying through GSA" then "Environmental Products and Services"). Currently, there is no central monitoring or tracking of compliance with the EPP requirements at Fort Carson.

New construction contracts include a clause concerning the use of recycled materials. Also, the Directorate of Contracting is working to establish an Affirmative Procurement Program, which sets policy and steers future purchases in the direction of more environmentally friendly products. The first step in this process is the "Policy Plan," which is being developed by the Directorate of Contracting with input and commitment from all other Directorates. The Policy Plan should be complete in 2002.

Activities and Impacts

Figure 6.3 shows the life cycle of products and materials, and the environmental impacts associated with each stage in the life cycle. The buying decisions of Fort Carson consumers and contract officials have the potential to greatly limit environmental impacts and life-cycle costs. However, Fort Carson's current understanding of the environmental and cost impacts associated with product and material use is fragmented. Information on the amount of waste generated exists, as required under various laws, but information about product content and the resources used in production and distribution is lacking. Further, the long-term environmental impacts associated with the use of hazardous and nonhazardous products and materials are largely unknown.

Figure 6.3 – Product Life Cycle: Activities and Impacts



The following sections describe the specific environmental impacts associated with the purchase, use, reuse, and disposal of materials.

Purchase

The current accounting system at Fort Carson does not readily enable the calculation of resources spent annually on materials, products, and services. There are no data on Fort Carson's purchase of locally manufactured products. Also, Fort Carson has no method for tracking the purchase of materials/products that contain recycled materials.

Use

Fort Carson tracks and attempts to reduce its use of hazardous materials. The HMCC, established in 1997, serves as the Installation's central hazardous material issuing facility. This facility provides centralized hazardous material ordering, storage, and distribution; issuance to authorized users in quantities limited to immediate needs; tracking of hazardous materials; and collection and reissue of unused, serviceable hazardous material on a free-issue basis. Fort Carson's HMCC was the first in Forces Command to connect its operations to the Standard Army Retail Supply System. The HMCC currently serves 170 installation units/activities; services do not extend to directorates that do not purchase reportable hazardous materials. The only unit not yet inducted is the Army Reserve Maintenance Facility. The primary maintenance contractor for its entomology facility controls the facility's in-house stock of hazardous materials with a special permit. However, the HMCC tracks the entomology facility.

Figure 6.4 summarizes the actual and normalized cost-avoidance statistics due to the activities of the Hazardous Materials Control Center. This cost-avoidance information includes items that were collected by the HMCC and turned into the Defense Reutilization and Marketing Office (DRMO), materials whose lives were extended due to shelf-life management research (proving the product could still be used past its expiration date), and products not disposed of because they were reissued for use by someone else.

Regulations At A Glance

The following environmental regulations and requirements influence the purchase and disposition of materials and wastes at Fort Carson.

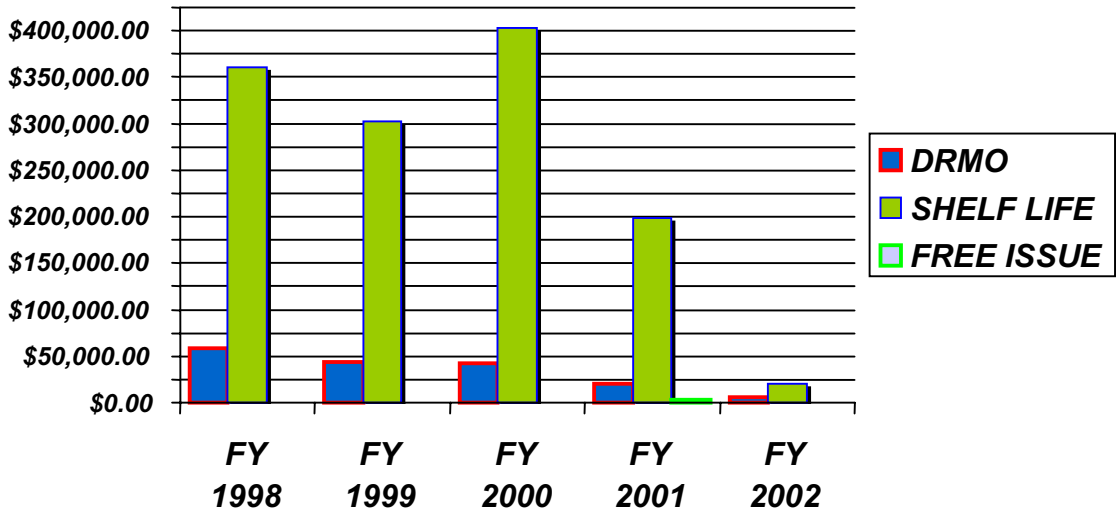
Resource Conservation and Recovery Act (RCRA) – This federal legislation's primary goals are to protect human health and the environment from the potential hazards of waste disposal, to conserve energy and natural resources, to reduce the amount of waste generated, and to ensure that wastes are managed in an environmentally sound manner. RCRA regulates the management of solid waste (e.g., garbage), hazardous waste, and underground storage tanks holding petroleum products or certain chemicals.

Executive Order (EO) 13101 – *Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition* (1998) – This Executive Order requires federal agencies to minimize negative environmental impacts caused by the ***whole life cycle*** of products, rather than focusing only on better waste management through recycling and reuse programs.

Emergency Planning and Community Right-to-Know Act (EPCRA) – This act requires reporting the storage and release of EPA-identified chemicals above threshold quantities.

Clean Air Act (CAA) – This federal legislation aims to protect air quality by limiting emissions from stationary and mobile sources. States implement many provisions of the CAA. For example, a state air pollution agency holds a hearing on a permit application by a power or chemical plant or fines a company for violating air pollution limits. In addition, states are responsible for preparing State Implementation Plans that contain strategies for meeting ambient air quality standards.

Figure 6.4 – Hazardous Materials Control Center Cost-Avoidance Data



	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	TOTALS
DRMO	$58,636.20	$44,118.21	$42,941.81	$20,289.12	$5,367.21	$171,352.55
SHELF LIFE	$360,782.78	$302,409.65	$403,717.08	$199,318.41	$20,540.01	$1,513,146.93
FREE ISSUE				$2,712.39	$138.76	$2,851.15
TOTAL	$419,418.98	$346,527.86	$446,658.89	$222,319.92	$26,045.98	$1,687,350.63

In addition to controlling the purchase, management, distribution, use, and reuse of hazardous materials, Fort Carson is trying to reduce the consumption of hazardous materials/products through pollution prevention initiatives such as contaminated fuel filtering, solvent recycling, technology changes (e.g., hydrogen peroxide system for ethylene oxide sterilization system), and good housekeeping methods. Fort Carson's declining hazardous material use can be attributed to several factors: increased user awareness, manufacturer responsiveness to reduce hazardous materials in formulations and to improve the "recyclability" of hazardous components, and numerous pollution prevention initiatives that support waste minimization through material management and recycling.

The International Merchant Purchase Authorization Card is a concern in the control of hazardous materials. Unfortunately, by using this credit card, Fort Carson account holders can circumvent the Hazardous Materials Control Center with ease. Even though credit card purchases of hazardous material without HMCC approval before requisition are against Installation policy, some cardholders simply do not call for preauthorization. This is a great concern with regard to reporting, waste, incompatible storage, and control of hazardous materials on the Installation.

Reuse

The Department of Defense (DOD) is one of the original "recyclers" in the nation. Through DRMO, almost every product and material that is no longer needed on a military installation is screened for reuse within

DOD, if possible. Items that DOD no longer needs are offered for resale to the general public. Through this system, the vast amount of material that Fort Carson no longer needs—office furniture, tires, tents, even scrap metal—is kept out of the solid waste stream and reused by someone else. The success of DRMO significantly limits the environmental impact and cost of waste disposal.

Disposal

When DRMO cannot reuse or sell certain materials, they become solid waste. The term solid waste includes household garbage (also known as municipal solid waste), construction and demolition waste, and hazardous waste (which must be managed separately from the other solid waste). In FY01, Fort Carson generated a total of 306,827 tons of solid waste, including hazardous waste. Recycling, treatment, and energy recovery opportunities allow for the diversion of some hazardous waste from disposal. Landfills result in various environmental impacts including use of open lands, habitat destruction, release of chemicals to the air and water, odor, impact to local species, and various health impacts. Figure 6.5 provides specific information on waste generated at Fort Carson.

Figure 6.5 – Waste Generation and Management Data (FY01)

Type	Amount (tons)	Amount (cubic yards)	Disposal Cost ($)
Construction and Demolition	295,222	679,012	Totaled with Sludge
Contaminated Soils	1,636	3,762	Totaled with Sludge
Sludge	1,009	2,321	$66,786
Hazardous Waste	25	n/a	$60,000
Refuse Collection and Disposal	8,935	28,591	$386,681
Total	306,827	713,686	$513,467

Municipal Solid Waste (MSW) – Solid waste generated from activities at Fort Carson historically has been landfilled on site. The Installation has closed nine landfills dating from the 1940s through the 1970s. Until it stopped receiving waste April 1, 2002, Landfill 1 (used to dispose of construction debris, sludge, and contaminated soils) was the only remaining landfill in use on the installation. All municipal solid waste must now be taken to a landfill off site, incurring much greater costs than on-site disposal. With no signs of decreasing amounts of debris, a large budget for solid waste is a necessity.

In the past, Fort Carson has operated an award-winning recycle operation for paper, plastics, metals, cardboard, glass, and other items as needed. Currently, the market for recycled goods has declined enough to make the recycling of brass and other metals the only profitable operations. The recycle center still accepts plastic, metal, and paper, but does not generate a profit from those items. The amount of diverted recycled materials is not currently tracked. No composting program for yard trimmings, land-clearing debris, or food waste is in place.

Military-Specific Waste – Fort Carson generates a variety of military wastes that may be disposed of as solid waste. In several cases, disposal has been avoided by recycling or reusing military training wastes.

Brass from munitions is profitable enough to justify the purchase of a brass deformer. This system, which brings a higher price for the brass, ensures that the munitions will not explode again. A recent innovative pollution-prevention project redirected over two million pounds of tank track from a landfill to stabilize slopes and for hardened water crossings on Fort Carson and around the Pikes Peak region. Tank track continues to be recycled for slope stabilization, rather than disposed of in a landfill (Figure 6.6).

Figure 6.6 – Use of Tank Track for Slope Stabilization Hardened Water Crossing

Although Fort Carson owns a fuel filtration system at the Hazardous Waste Staging Site, contaminated fuels continue to be shipped off site or diverted into the convaults used for the Re-Refined Oil Program. This diversion does not contaminate the used oils stored in the convaults, but it does add to an imbalance in the program, creating more material taken by the vendor than can be purchased back by the Installation.

Lithium batteries, which are lightweight and long lasting, are used in military radios. Unfortunately, when a battery's life is uncertain, it is disposed of in the trash. The batteries should be tested and returned before venting and disposed of as solid waste. Because Fort Carson does not own a testing system, 978 pounds of batteries (including nickel cadmium, nickel metal hydride, and mercury) were disposed of as hazardous waste in 2001. The Hazardous Waste Manager is attempting to purchase a testing system for the Pollution Prevention Center. Rechargeable nickel metal hydride batteries were tested at Fort Polk and determined to be too heavy for combat situations.

Hazardous Waste – The primary industrial operation on Fort Carson is repair and maintenance of vehicles and aircraft. This activity requires the use of degreasers, solvents, petroleum products, paint, and numerous other materials. Routine oil changes, vehicle cleaning, painting, refueling, battery repair and replacement, radiator servicing, brake repair, tune-ups, parts machining, and engine rebuilding require the use of many hazardous materials. Figure 6.7 lists hazardous materials disposed of on the Installation in 2001.

Figure 6.7 – Hazardous Waste Processed in 2001

General Waste Type	Pounds	Remarks
Landfill remediation analysis byproducts	13,299	Mostly lead, chromium, and selenium from purge wells.
Methyl ethyl ketone (paint thinner)	9,338	MEK can cause central nervous system damage and is flammable.
Paint and paint waste	8,399	Latex (1965 lbs), paint products (727 lbs), CARC and enamel (5707 lbs).
PCB ballast	8,370	Part of the PCB replacement program.
Silver from photography	7,652	Silver is recycled as a precious metal.
Blast media	7,560	Includes cadmium and chromium from CARC paint.
Fluorescent bulbs	7,058	All will be managed as Universal Waste in 2002.
Petroleum/oil/lubricant products	6,324	Includes corrosion prevention, contaminated fuels, grease, etc.
Solvents	5,158	Includes heptanes, chromium compounds, stoddard solvent, and toluene.
Cadmium and lead from smoke pots	3,313	For training activities.
Acetone	2,207	Primer; also found in contaminated fuels.
Fire protection supplies	2,200	Foam from fire extinguishers; lead and benzene from water sludge.
Warfare equipment	1,983	Gas mask filters with chromium and lead; super tropical bleach for decontamination.
Toluene and toluene compounds	1,267	Contaminated liquids.
Batteries	978	Universal Waste: NiCad, NiMH, Lithium, Mercury.
General cleaning	733	Floor polish remover, detergent, floor wax, etc.
Unknown	704	
Asphalt	454	
Adhesives	443	
Miscellaneous	367	Soldering flux, gasket remover spray, fingerprint remover, cutting fluid, etc.
Pesticides	347	This amount is larger than normal due to excess cleanup.
Acid	308	Chromic, perchloric, phosphoric, sulfuric, boric, citric, nitric, etc.
Aerosols	304	Varnish, lubricant, cleaners.
Medical	2,961	Xylene, potassium hydroxide, dental resin, hydroquinone, chloroform, etc. Approximately 2000 pounds of ethanol, alcohol, and xylene will be recycled in 2002.
Leftover kit items	238	Mostly mercury and cyanide from chemical detection kits.
Mercury from inside equipment	159	
Sealant	141	
Degreaser	104	
Freon	55	
Lab waste	10	

Fluorescent bulbs, some batteries, methanol, alcohol, xylene, silver, and many solvents are now recycled or sent as Universal Waste. Aerosol paints are vented and the cans recycled.

The DRMO at Fort Carson accepts hazardous materials from all other area military installations. If this material does not sell, expires, and becomes hazardous waste, Fort Carson must dispose of it and count it toward the total hazardous waste disposed of by the Installation.

Below is a discussion on the environmental impacts to air and water quality resulting from activities associated with products and materials.

Air Emissions

Purchasing and disposal methods for materials have a tremendous impact on air quality. Vehicle air emissions are associated with transporting products to the Installation and hauling waste off post. The storage and use of hazardous materials result in the release of pollutants to the air, which can contribute to local and regional air pollution. Some pollutants degrade stratospheric ozone. While air emissions are addressed in detail in the Air Quality section of this baseline document, it is important to understand the link between material purchase/use and air pollutant emissions.

Water Quality

A variety of products and materials contaminate water supplies. Water and solvents/soaps are used to clean vehicles, facilities, and equipment (e.g., paint guns). Water runs over the surface of the ground and picks up metals, organic compounds, oil, fuel, dirt, etc. Hazardous materials spilled into drains or streams contaminate surface water and groundwater. The chemical stew called "leachate" that is released when solid waste landfills leak—most eventually do—also contaminates water. Therefore, the products purchased and their associated disposal method have serious impacts on water quality. The Water section of this baseline document goes into more detail about the water-related issues facing Fort Carson.

The Human Perspective

Soldiers are concerned about the environment, and most are proactive in minimizing environmental damage. Most are aware of environmental laws and are careful with the products they use. With soldiers' input and consideration, the Directorate of Environmental Compliance and Management recommends new methods for pollution reduction and purchase reductions. The best way to get soldiers (or anyone) to use new products is to show them why the new products are better for them—from a health or cost perspective, for legal reasons, or simply to provide the legacy of a clean environment for their children.

Beyond the Pikes Peak Region

Environmental impact increases when materials are purchased from nonlocal vendors. Long-distance transport of products is accompanied by greater emission of carbon monoxide, carbon dioxide, nitrogen oxides, sulfur dioxide, hydrocarbon products, and other damaging substances. The Pikes Peak region has many local manufacturers of the goods used at Fort Carson (Figure 6.8). Use of these goods not only helps preserve the environment, but also stimulates the local economy.

Figure 6.8 – Sample List of Local Companies in the Pikes Peak Region

Company	Type of Business	Employees
Hewlett-Packard	Computers and data communications equipment	1,550
Current, Inc.	Mail order catalog sales; stationery; paper products	1,456
Schalge Lock Co.	Lock and door hardware	1,000
Western Forge Co.	Hand tools	996
Trane Co.	Heating, ventilation and air conditioning equipment	950
SCI Systems, Inc.	Computer parts manufacturer	928
Rocky Mountain Steel	Structural steel products	825
Mission Foods	Food products	300
B.F. Goodrich	Tires and rubber products	246

More comprehensive lists can be purchased for $10 to $80 by visiting the following links:

- http://mnistore.com/products.asp?STATE=CO
- http://www.amazon.com/exec/obidos/ISBN%3D0894781081/107-9845567-7986914

Forecast

Since the inception of the Hazardous Materials Control Center, the stockpiling of hazardous materials has decreased somewhat. The free issue of obsolete hazardous materials has reduced some purchases. However, a more comprehensive approach to the control of hazardous materials is warranted. Due to limited staff, visits by technicians to hazardous materials storage centers are few; thus, stockpiling may occur after a unit has been inducted into the Hazardous Materials Control Center. The use of International Purchase Authorization Cards enables the purchase of hazardous materials not accounted for in the tracking system. Even though circumvention of the HMCC is against Installation rules, Environmental Assistance Technicians have detected such activity.

Hazardous waste disposal is decreasing, although the limits to this reduction may be reached soon. Through better training, pollution prevention techniques, and regular inspections, disposal of hazardous waste has decreased dramatically over the past seven years (Figure 6.2). Fort Carson hazardous waste and pollution prevention personnel continually search for ways to reduce the amount of hazardous waste generated.

The Affirmative Procurement Plan is in progress and should make great strides toward creating markets for recyclables, encouraging more environmentally friendly manufacturing, and discouraging the use of nonrenewable resources. The Directorate of Contracting is writing the Plan in partnership with the Directorate of Environmental Compliance and Management; thus, the people who can significantly contribute to the success of the program are participating in Plan development. As the largest spender in the nation, the Federal Government should be the first to excel in the area of Affirmative Procurement.

Current Sustainability Activities

Re-refined Oil Program – The Directorate of Logistics has been in charge of the re-refined oil program at Fort Carson since 1998. Used oil is placed in convaults and picked up by Safety Kleen, which re-refines the oil and sells re-refined oil back to the Installation.

Hydrogen Peroxide Sterilization System – The Directorate of Environmental Compliance and Management replaced the ethylene oxide sterilization system at Evans Army Community Hospital. (Ethylene oxide is a carcinogen and upper respiratory irritant.) The new system uses low-temperature hydrogen peroxide gas plasma technology to sterilize equipment, and generates water vapor and oxygen as byproducts.

Alcohol and Xylene Recycling – The hospital uses a distillation system to recycle xylene and alcohol. The system saves money and reduces the purchase, transportation, and disposal of these hazardous substances.

Fuel Filtration System – When fuel is contaminated with water or dirt, it is no longer useable, especially for tactical or flying vehicles. The fuel filtration system at the Hazardous Waste Staging Facility provides recycled fuel for forklifts and other nonmission-essential ground vehicles.

Installation Design Guide – The Installation Design Guide recommends that local vendors and other environmentally preferable practices be used when building anything at Fort Carson.

Building Design Reviews – The Directorate of Environmental Compliance and Management reviews all building designs to make recommendations on environmentally friendly building practices, such as requiring construction companies to build in ways that reduce the amount of materials used and waste generated.

Fluorescent Bulb Crushing – The Hazardous Waste Staging Facility crushes fluorescent bulbs (after filtering for mercury and other hazardous materials) and sends the resultant glass and metal to be recycled.

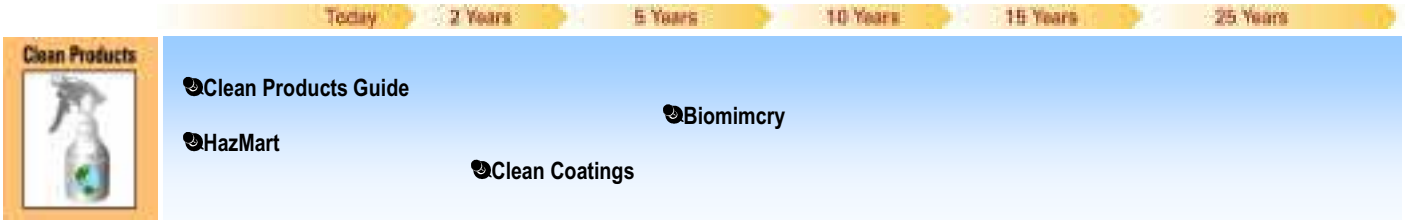
Aerosol Can Recycling – A special system at the Pollution Prevention Center punctures collected aerosol cans. The empty cans are then recycled and the remaining paint is sent out as waste.

Solargizers – Several vehicles at Fort Carson use solargizers. Charged by the sun, this equipment extends the life of batteries one to five years by preventing sulfate deposit buildup. (Sulfates are returned back to the battery acid as active electrolyte.)

The Realm of Possibility

To become sustainable, Fort Carson is encouraged to identify and plan for innovations that will support the goals established during the Installation Sustainability Workshop. To do this, participants should be exposed to the concepts and technologies that are within the realm of possibility now and in the future. This section provides a glimpse of what can be accomplished with existing technology and what can be expected from developing sustainability approaches.

Clean Products



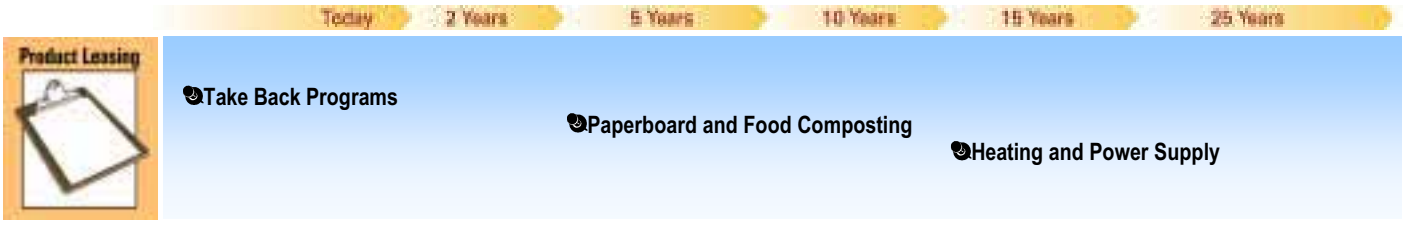
- **Clean Products Guide** – GSA maintains an extensive "Environmental Products and Services Guide" which lists all available "green" products. The guide can be found on the following websites: http://www.gsa.gov/attachments/GSA_PUBLICATIONS/pub/EPSG2001.pdf http://pub.fss.gsa.gov/environ

- **HazMart** – Hazardous material pharmacies help control the use of environmentally harmful materials by tracking the purchase and disposal of products in one central location. In this system, a worker who needs a certain chemical must "check-out" the substance from the central location and return the unused portion. This ensures that harmful chemicals are not improperly disposed of, and can save money by making sure that all purchases are of the correct amount for the required use.

- **Clean Coatings** – Researchers have developed alternative paint technologies to assist in reducing energy consumption for heating and cooling facilities. Thermal Diode Ceramic Coatings facilitate thermal control of buildings or other structures and components by creating a barrier between the external environment and the surface to which it is applied. The coating acts like a heat insulator in one direction and a conductor in the other; thus, keeping heat where it is needed and allowing its dissipation from the opposite side (Thermal Diode Publication by 27th Century Technologies, Inc.).

- **Biomimicry** – Biomimicry stems from the belief that the future of material design and use can be found in the design of the natural world around us. Abundant evidence indicates that nature has long ago mastered the problems that we still grapple with today. The silk from a spider's web is ***three times*** stronger than Kevlar, the material used in bulletproof vests. Slug mucous can withstand pressure up to 1500 times its weight without losing any of its fluid or lubricating properties. Termite mounds are marvels of design ingenuity, using passive cooling systems and venting to maintain constant interior temperatures regardless of exterior temperatures. See this web site for more information: http://www.natick.army.mil/warrior/97/nov/silk.htm.

Product Leasing

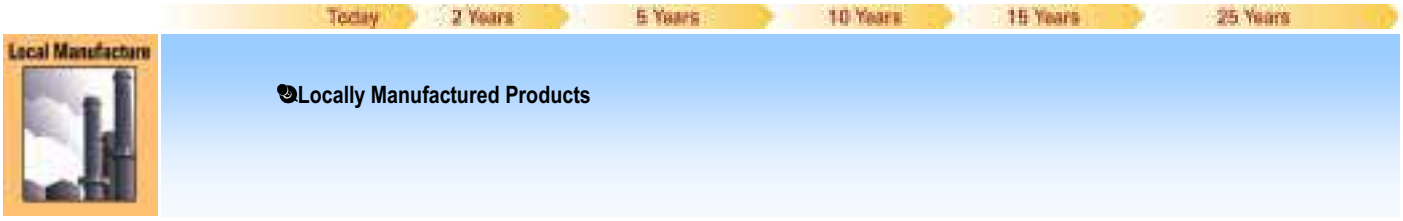


- **Take Back Programs** – One of the new business models taking hold in Europe and Asia is "manufacturer take back" programs. In such a program, the original manufacturer retains ownership and disposal responsibility for products. BMW automobiles are being built to be completely recyclable into new BMWs, as are Nike shoes. Interface, Inc. is the American manufacturer pioneering this concept. Interface's "Evergreen Lease" on commercial carpet provides a service in which worn carpet tiles are checked and replaced each month. The worn tiles are taken back and recycled 100 percent into new carpet. This business model is not new—think back to when the telephone company owned your old black phone, which never broke or had to be replaced. For more information on efforts world-wide, see Chapter 3, *Waste Not*, and Chapter 4, *Making the World*, in the book Natural Capitalism.

- **Paperboard and Food Composting** – Shredded paperboard can be used as a bulking agent for food composting. A food composting program, which may include preconsumer (i.e., kitchen waste) and/or post-consumer (e.g., food service waste from lunchrooms) waste, typically needs a bulking agent to absorb the excess water from food waste. Compost is a useable product that can be generated from such a venture.

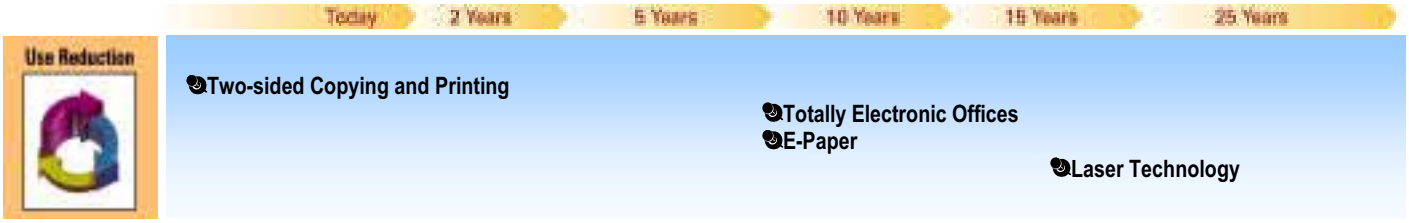
- **Heating and Power Supply** – Today, almost every home and business owns a hot water heater and heating, ventilation, and air conditioning (HVAC) unit. When these units fall out of service or need to be replaced, they are almost always disposed of in a local landfill. There is an alternative; Trane is starting to offer full-service leases to commercial clients at competitive monthly rates. In these arrangements, the customer provides the location for installation and Trane takes care of the rest. When the customer desires a new unit, the old unit is returned to the manufacturer and a new one is provided. In the future, home heating and electricity may be bundled in a fuel cell, further simplifying the process (http://www.trane.com/commercial/financing/leasing.asp).

Local Manufacture



- **Locally Manufactured Products** – The use of locally manufactured products reduces harmful air emissions by reducing the distance those products must be transported to their final destination. In addition, the purchase of these products stimulates local economies, providing more vital communities around the installation.

Use Reduction



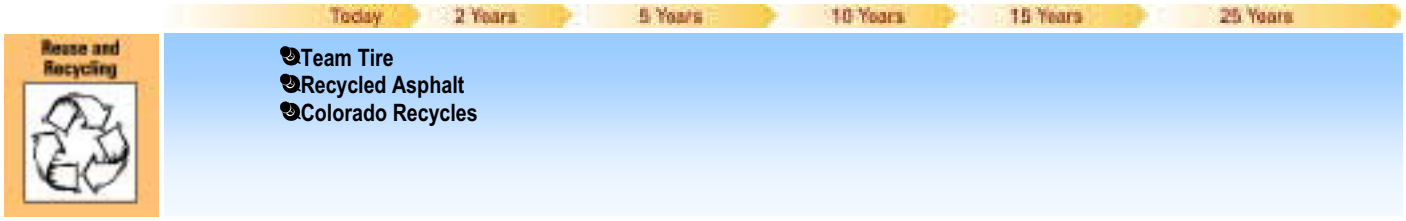
- **Laser Cleaning Technology** – Laser cleaning technology is being researched for possible application in maintaining military weapon systems and facility maintenance. Techniques for using laser cleaning on building materials have been standardized by companies that developed lasers for restoring historical buildings and artifacts. Laser cleaning technology eliminates the use of chemical paint strippers and reduces hazardous waste created during abrasive blasting. This technology has been used in other industries (e.g., automotive, mold release) for cleaning applications, reducing or eliminating the use of chemical cleaning compounds. With portable laser units, production time can be reduced due to the elimination of disassembly and assembly of the weapon system or facility components for maintenance. See these web sites for more information:
  http://www.jgpp.com/projects/projects_index.html
  http://www.lynton.co.uk/conservation/framesetversion/frameset.htm

- **Two-sided Copying and Printing** – Printing and copying on both sides of a sheet of paper is a fast and easy way to immediately reduce paper use by 50 percent. Printers can be used with little or no modification and overall printing speed is preserved.

- **Totally Electronic Offices** – In the next 10 years, offices will use less and less paper as workers become more dependent upon email, web pages, and other electronic means of doing business. This will reduce the overall flow of material into an office, and there will be fewer pens, staplers, tape, and plastic binders as well.

- **E-paper –** Lucent Technologies and E Ink Corp of Cambridge, Massachusetts, are developing e-paper. This paper may be used repeatedly to download daily newspapers and books.

Reuse and Recycling



- **Team Tire** – Several Department of Defense (DOD) and Army agencies and installations participate in the Army Tank-automotive and Armaments Command's (TACOM) "Team Tire" Program, in which vendors provide motor pools with retreaded tires in exchange for used tires. The used tires are retread by the vendor for reuse elsewhere. The cost of retread tires is significantly less than that of new tires—up to $200 less for certain tires.

- **Recycled Asphalt** – DOD and the U.S. Environmental Protection Agency (USEPA) conducted a joint parking lot repaving project for the Pentagon. The $1M project used 25 percent recycled asphalt.

- **Colorado Recycles** – The Denver Post publishes a yearly guide to recycling in Colorado. The phone number for Colorado Recycles is 303-231-9972.

Waste

- **Landfill Fluff** – Fort Campbell and the Army's Construction Engineering Research Lab are testing a new waste-reduction technology in partnership with its inventor, Bouldin-Lawson, Inc. Unsorted household garbage is fed into a grinder, hydrolyzed, and then flash-heated to kill germs. The resulting dry "fluff," which looks like cellulose insulation and contains many nutrients, has passed all toxicity tests and appears to pose no environmental hazard. The process reduces waste volume and weight by 90 percent. The entire process costs $30/ton—comparable to landfill disposal fees in most areas of the country. Testing at Fort Campbell will determine if the "fluff" is useful as a soil amendment and if it can be extruded into building materials (i.e., plastic lumber). If beneficial reuse for the "fluff" can be found, this technology has the potential to eliminate the need for landfilling household garbage.

- **Innovative Deconstruction** – Fort Knox sells the salvage rights to buildings that are on the demolition schedule. The purchaser of the rights can remove windows, doors, flooring, siding, plumbing, and copper wire, but must remove at least 50 percent of the volume of the building. The

installation makes about $100K/year on the sale of the salvage rights, but saves hundreds of thousands of dollars on reduced demolition and disposal costs. Fort McCoy has a similar program.

Redstone Arsenal has paid a local house mover and developer to move 89 two-story brick duplexes off the installation and into the local community, where they will be sold and reused. The cost was about $9,000/house versus the $12,000 it would have cost to demolish them—a total cost savings of $267,000.

The Army has signed a Memorandum of Agreement with Habitat for Humanity to allow Habitat to deconstruct buildings on the demolition schedule and sell the salvaged items to support Habitat home-building activities. A pilot project is being developed at Fort Hood with the Austin, Texas Habitat affiliate.

Researchers at the Georgia Institute of Technology are studying how to construct buildings so that they can be easily deconstructed and the building materials reused.

The Air Force has a pocket guide for construction and demolition waste management that is available at http://www.afcee.brooks.af.mil/gree/resources/resources.asp.

- **Zero Footprint Camp** – The U.S. Army Materiel Command (AMC) recognizes that traditional waste management methods used for base camp operations are resource-intensive and create a substantial burden on the camps. These traditional methods also depend on contracted civilian waste management services, posing potential risk to the physical security of the area from terrorist activities. In response to these concerns, AMC developed the Zero Footprint Camp (ZFC) initiative to reduce the logistics footprint, operations and support costs, and environmental impacts of base camp operations. This initiative minimizes waste by applying "whole-systems" approaches to resource management, thereby finding cost-effective and technically feasible ways to reprocess and/or reutilize trash, grey water, black water, and food garbage within the camp. While the current ZFC initiative focuses primarily on solid waste and wastewater management, it will be expanded to cover other aspects of base camp operations. See http://www.haifire.com/download/zfc.pdf.

- **Thermal Spray Vitrification** – An alternative method for removing lead-based paint is thermal spray vitrification. In this method, a specially formulated glass medium is flame sprayed onto the painted surface. Any lead in the paint is absorbed by the glass. After a post-removal heat treatment, the removed paint and used glass medium is reduced to benign waste. This technology allows for the safe removal of lead-based paint and a reduction in the disposal of hazardous waste (http://estcp.hgl.com/projects/compliance/199607v.cfm).

- **Combined HazMart** – Fort Campbell, Kentucky, shares resources between the Environmental Division and the Directorate of Logistics to provide the best Hazardous Materials Control Center service in the Army. The technicians go to the motor pools and stock materials, remove empty containers, conduct an environmental inspection, change out solvent tanks for recycling, and perform Pollution Prevention Opportunity Assessments. This service increases readiness and saves money.

- **Model Motor Pool** – Fort Lewis is experimenting with a "Model Motor Pool," where several low-cost and high-cost pollution prevention methods and pieces of equipment are used. They collect as many fluids as possible for recycling and implement practices that prevent spills and excessive use of materials.

Fort Carson 25-Year Goals for Materials

To be determined by Fort Carson Command and staff, as advised by members of the local and regulatory communities, at the Installation Sustainability Workshop on 4-6 September 2002.

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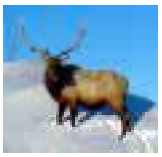


WILDLIFE

Challenge

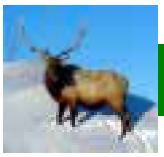
How can Fort Carson maintain habitat diversity for native fish and wildlife, while using the land for training and cantonment activities? What can Fort Carson do to help the surrounding community protect the wildlife that inhabits ecosystems surrounding the Installation borders?

Key Considerations

- **Development** – The borders of communities surrounding the Installation continue to expand. Development interrupts the habitation patterns of species vital to a healthy ecosystem.

- **Training** – Use of lands for training can disturb wildlife and impact habitats. Innovative land management and training schedules and rotation can minimize impacts.

- **Nontraining Land Use** – Agricultural and recreational use of lands can impact wildlife. Restricted access, oversight, and educational programs can reduce impacts while raising awareness of conservation efforts.



Importance to Fort Carson

Mission – An ecologically healthy landscape is required for training realism, and wildlife are essential to that landscape. Therefore, wildlife need to be protected in conjunction with conducting the military mission.

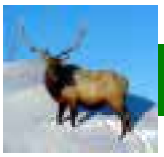
Quality of Life – The lives of Fort Carson soldiers, their families, and members of the surrounding community are enriched by the presence of natural areas and wildlife habitats on the Installation. Fish and wildlife species are an important part of many recreational activities at the Installation.

Costs

- The estimated costs for 2002:
  - Surveys and Protection of Mountain Plover: $20,000
  - Law Enforcement: $8,000
  - Recreation: $35,000
  - Educational Programs: $15,000
  - Troop Training: $1,000
  - Swift Fox Research: $86,000
  - Habitat Enhancement, Administrative Support, Listed Species Management Assistance, Land Rehabilitation and Environmental Assessment Support: $224,000
  - **Total: $389,000**

Environment and the Community – While wildlife are protected at Fort Carson and the Piñon Canyon Maneuver Site, wildlife passing through or living in areas outside the Installation property may not be protected. Wildlife cross county, city, and Installation boundaries and require protected corridors to move between supportive ecosystems for food and maintenance of healthy genetic diversity of species. Preserving the wildlife of Fort Carson and the Piñon Canyon Maneuver Site will require cooperation with all stakeholders that manage property adjacent to and near Fort Carson.

Short-term military disturbances do not affect wildlife to the same degree as development and road building. Damage from military maneuvers is normally temporary, and wildlife may use nearby lands during that time. Rotating land areas allows time for land areas to recover. Even while maneuvers are occurring, wildlife often stay safely in the area, and soldiers are trained to be aware of any wildlife in an area. Development alters habitats permanently and creates additional impermeable surfaces, increasing runoff, which increases erosion and sedimentation and adds contaminants and heat to nearby aquatic systems (from runoff across heated surfaces).



WILDLIFE

Introduction

Fort Carson and the Piñon Canyon Maneuver Site are blessed with abundant wildlife. As with most military installations, the need to maintain significant acreage for training purposes has provided a measure of protection for the habitats that sustain fish and wildlife. Military activities must be coordinated with protection of species in the cantonment, downrange of Fort Carson, and in the large land area of the Piñon Canyon Maneuver Site. The people who work at the Installation need to be aware that they live and work near wildlife habitat and should be aware of potential animal-people conflicts, including the potential for disease and animal attacks.

Background

Abundant and diverse wildlife species are vital to a healthy, productive environment that supports mankind. The condition of wildlife is a good indicator of the condition of the environment in an area. Because wildlife have the same basic needs as people (clean air, clean water, a place to live, food sources, diverse ecosystems), protecting wildlife protects humanity. Wildlife has important economic benefits; according to the Colorado Division of Wildlife, in 1996, out-of-state hunters and anglers spent $275 million in Colorado (http://www.wilderness.org/newsroom/pdf/co_state.pdf). Furthermore, the existence of diverse wildlife and wildlife habitats on training lands makes training exercises more realistic, providing better trained soldiers.

Fort Carson's wildlife program has four components: education, conservation, recreation, and enforcement. The major activities associated with wildlife issues on and off the Installation are military training and development. Wildlife-related issues include vehicle accidents involving wildlife; management of wildlife species including hunting and fishing; interactions between wildlife and humans in Installation housing and facilities; enforcement of state and federal laws that protect nesting migratory birds and enhance their habitats; monitoring and protection of threatened and endangered species; and education of trainers, schools, and housing residents about diseases such as hanta virus, bubonic plague, and rabies. The Fort Carson wildlife program, which is managed by the Directorate of Environmental Compliance and Management, provides plans to address all issues, cooperates with the Colorado Division of Wildlife, and partners with universities and other interested parties to implement its plans and accomplish its goals. The success of this program is demonstrated by the fact that conflicts between the military mission and wildlife management have occurred only rarely, even though Fort Carson and the Piñon Canyon Maneuver Site are home to several federal- and state-listed species.

Large training areas, such as those at Fort Carson and the Piñon Canyon Maneuver Site, have become havens for wildlife because military training activities promote a more diverse native habitat. Habitat encroachment by construction of new houses and other types of development on and off the Installation has pushed wildlife onto the less disturbed areas of Fort Carson and the Piñon Canyon Maneuver Site. Land use rotation and military training do not affect wildlife as much as development and agricultural use. Department of Defense (DOD) lands are home to a higher density of federally listed threatened and endangered species than lands owned by any other federal agency (Steve Getlein, Fall 2001 U.S. Army Environmental Center Environmental Update: Preserving Ranges Preserves Natural Legacy).

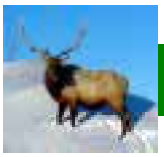
Regardless of the protection afforded by the Installation, roadways and development block important migration or emigration corridors that provide access to diverse ecosystems. Species that become

geographically isolated may experience restricted genetic diversity. In times of environmental stress, such as drought, fire, or extreme temperatures, wildlife will move to areas more suitable for their survival. As human encroachment pushes more and more wildlife into remaining natural areas, overpopulation of some species and more human-animal conflicts may occur.

The Installation is host to many species of wildlife, including threatened and endangered species. Currently, the black-tailed prairie dog is listed as "warranted, but precluded" and the mountain plover is proposed to be listed as threatened. Army regulations require that proposed species be treated as though they are listed as threatened. Fort Carson and the Piñon Canyon Maneuver Site provide varied habitats for many other less prominent species of macro- and microinvertebrates. Reptiles, birds, and fish species thrive at the Installation. At the last count by Fort Carson's Wildlife Office, Fort Carson hosts 8 reptile species, 104 bird species, and 18 fish species. The Piñon Canyon Maneuver Site has 27 reptile species, over 130 bird species, and 18 fish species. Figure 7.1 identifies the number and types of mammalian species found at each location.

Figure 7.1 – Mammalian Wildlife at Fort Carson, by Order

Mammalian Order	Examples	Number of Species at Piñon Canyon Maneuver Site	Number of Species at Fort Carson
Insectivora	Desert Shrew	2	1
Chiroptera	Bat	3	6
Lagomorpha	Rabbit	3	2
Rodentia	Chipmunk, Squirrel, Prairie Dog, Mouse, Porcupine	31	24
Carnivora	Coyote, Fox, Raccoon, Badger, Skunk, Mountain Lion	10	11
Artiodactyla	Elk, Mule Deer, Pronghorn, Mountain Sheep	5	5



WILDLIFE

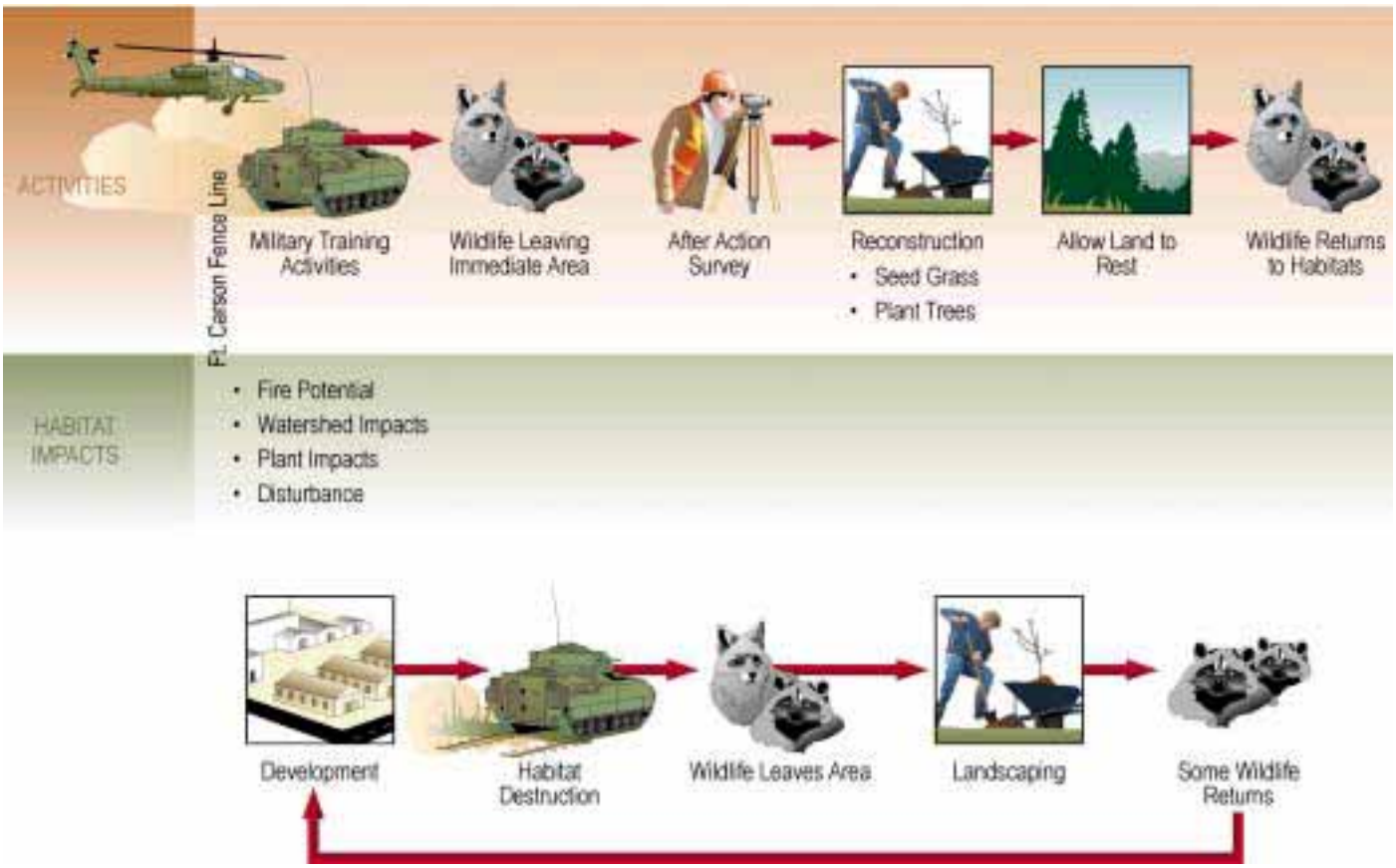
Wildlife species are an integral part of healthy ecosystems, which perform valuable functions such as filtration and storage of water. The loss of even one species could have serious repercussions to the function of an ecosystem. It is important to ensure that no species are lost to extinction.

Biodiversity is key to healthy ecosystems, just as healthy ecosystems support the variety of species that live in them. To sustain wildlife, land must be considered in units based on ecology rather than human-defined geopolitical boundaries. These ecologically based land units should be a combination of larger and smaller systems to ensure that unique sites are preserved and whole systems are maintained.

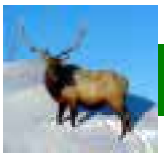
Activities and Impacts

Training and cantonment activities affect local wildlife (Figure 7.2). Training may force wildlife to temporarily relocate; development may alter habitats permanently. Training is a temporary, rotational activity that allows time for habitats to recover and for wildlife to return. Most of the building sites for the Installation are in place; however, several new buildings are planned.

Figure 7.2 – Wildlife: Activities and Impacts of Training and Development



*Air impacts of activities are detailed in the Air Quality section of this baseline document.
**Not all animals leave areas during training.



WILDLIFE

The following sections provide information on four major areas of the Wildlife Program at Fort Carson and the Piñon Canyon Maneuver Site: education, conservation, recreation, and enforcement. These focus areas overlap with each other and with many associated land management programs.

Education

Fort Carson's wildlife education program incorporates training and awareness for soldiers and the civilian communities. The purpose of the wildlife education program is to integrate conservation goals into the Installation's mission and build support within surrounding communities to buttress conservation efforts. To this end, the Installation sponsors several special interest areas and has a well-developed training program for soldiers.

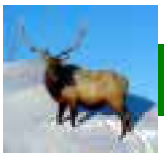
Fort Carson maintains several wildlife education areas, including a wildlife demonstration area, an endangered species area, a conservation area, and several recreation areas. Wildlife education activities include hosting visits from school and youth groups, providing wildlife information to the local media, and working with the creators of the Colorado Wildlife Viewing Guide. Fort Carson has set aside land for threatened and endangered species. These areas are "off-limits" to military training. They include natural wetlands used by school groups and ponds designated for threatened and endangered fish species.

The awareness program for soldiers is built into the Installation's Environmental Training Program. The wildlife component of the program is tailored to instruct soldiers on integrated natural resources management, wildlife management, wildlife recreation programs, nongame species programs, fisheries and aquatic resources, signage, actions to avoid injury to species or habitats, requirements of the Endangered Species Act, the importance of biological diversity, and Army Policy concerning wildlife. This training is conducted four times per year for Environmental Protection Officers, who assist the Directorate of Environmental Compliance and Management with wildlife education and conservation in their organizations.

Conservation

Under the Endangered Species Act, the Army has five primary responsibilities: 1) to conserve endangered species, 2) to not jeopardize endangered species, 3) to consult and confer with the U.S. Fish and Wildlife Service, 4) to evaluate the effects of projects on species and prepare written biological assessments, and 5) to not collect or destroy endangered species. Mission requirements must be accomplished in harmony with the legal mandates of the Endangered Species Act. The Installation Integrated Natural Resources Management Plan ensures compliance with the five primary requirements of the Endangered Species Act.

The Installation Integrated Natural Resources Management Plan outlines a comprehensive program of wildlife conservation, including protection of endangered species and sensitive habitats. The Plan requires monitoring, inventories, habitat management, and wildlife population management and protection. These measures would be meaningless without skilled personnel and funding, which are specified in the Plan. Because Fort Carson and the Piñon Canyon Maneuver Site are managed pursuant to the Plan, appropriate parameters, goals and objectives, provisions for monitoring, management, and progress reporting are in place. This precludes the need to designate areas as "critical habitat."



The Fort Carson Integrated Natural Resources Program, under which the wildlife program is managed, is certified with the Wildlife Habitat Council. Figure 7.3 lists the primary habitat protection measures used at Fort Carson and the Piñon Canyon Maneuver Site. Habitat maintenance and enhancement includes revegetation, fire management, invasive plant species control, water development for wildlife, and aquatic habitat enhancement.

Figure 7.3 – Habitat Protection Measures In Place at Fort Carson and the Piñon Canyon Maneuver Site

Location	Activity	Explanation
Fort Carson	Deferment Program	-Provides time for soil and plants to recover from maneuvers. -Allows time for the plantings of rehabilitation activities to establish.
Fort Carson	Off Limits Areas	-Prohibits mechanized military training in certain areas.
Piñon Canyon Maneuver Site	Training Rest/Rotation System	-Training lands are rested for two growing seasons and then rotated back into use.
Piñon Canyon Maneuver Site	Off Limits Areas	-Prohibits mechanized military training in certain areas.

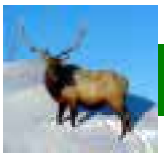
Recently, lawmakers in the House of Representatives encouraged the Department of Defense (DOD) to use a National Security Waiver provided in the Endangered Species Act. Cited in the explanation was the potential for military training activities to be disrupted because of the presence of a threatened or endangered species. Fort Carson is not, however, using the waiver because it is inconsistent with the goal of providing realistic training. Soldiers deployed to other parts of the world must know how to carry out their mission while respecting native wildlife and wildlife habitats.

Recreation

Recreational uses of wildlife resources, whether for hunting or nonconsumptive uses, allows the public to learn about, appreciate, and enjoy natural resources on military lands. While the military mission has priority over recreational use, and many areas are off-limits to the public, ample acreage is available for hunting, picnicking, bird watching, and hiking. Since the events of September 11, 2001, camping is not allowed at Fort Carson, and only limited camping is allowed at Piñon Canyon Maneuver Site during the big game seasons. Recreational opportunities at Fort Carson create alliances with stakeholders; the public can assist with Installation wildlife goals by providing data on wildlife hunted or viewed.

Permits are required for many activities, and restrictions exist, but the Recreation Center and the Directorate of Plans, Training, and Mobilization Range Control Offices work together to comply with state, federal, local, Army, and Fort Carson regulations. Littering is the primary problem caused by visitors to the Installation.

Providing quality experiences while sustaining ecosystem integrity are key goals of the outdoor recreation programs at Fort Carson. Recreation supports biodiversity at Fort Carson by providing the opportunity for people to understand the value of wildlife. People who value wildlife are more likely to help protect species,



which promotes biodiversity. Hunting programs control populations of certain species and assist with wildlife surveys, which assist biologists in their wildlife management decisions.

Enforcement

The Directorate of Environmental Compliance and Management is responsible for the enforcement of state and federal wildlife laws at Fort Carson and the Piñon Canyon Maneuver Site, with assistance from the Provost Marshal's office. The U.S. Fish and Wildlife Service and the Colorado Division of Wildlife commission wildlife officers. Due to extensive enforcement activities during the 1980s and early 1990s, major transgressions (e.g., poaching) have decreased. However, littering, trespassing, and occasional poaching violations continue. With over 340,000 acres of land and 17 miles of stream to manage, wildlife regulatory enforcement presents a substantial challenge.

The Human Perspective

Wildlife has intrinsic value as a critical component of ecosystems. The beauty and grace of wildlife inspire humans. Basic ethical values can be seen in cultures that care for the wildlife around them. Some wildlife serve as ecological indicators, as demonstrated by the bald eagle's response to DDT in the 1960s. Banned in 1972, DDT was recognized as a human carcinogen after studies that were prompted by decreasing bald eagle populations. Abundant biodiversity is key to the health of the planet's ecosystem. The limits to declining biodiversity are unknown, but decreases in biodiversity generally produce negative impacts.

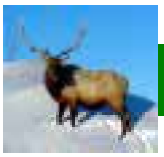
An emerging field called "biomimicry" is developing and it is producing a greater respect for the many adaptations of animals that promote survival. Biomimicry is an attempt to develop new products and processes based on phenomena in nature. Spider's silk is stronger than Kevlar; mollusks can stick to any surface with a force more powerful than any adhesive created by humans. The military is studying these secrets and others in an effort to mimic the wonderful "inventions" of the animal world. The recognition of this value allows for increased movement toward biodiversity preservation.

Beyond the Pikes Peak Region

Wildlife will inhabit any location where the species can survive. However, wildlife requires stable corridors to enhance genetic diversity, allow access to cover and food, and permit migration. Fort Carson and the Piñon Canyon Maneuver Site provide habitat for migrating wildlife, including waterfowl and other species. As such, the Installation needs clean water and healthy lands to ensure the viability of wildlife that spends most of its existence elsewhere. Monitoring the health of wildlife and associated habitats can provide needed information concerning the Pikes Peak region and beyond.

Chronic Wasting Disease is a fatal illness found in deer and elk. It has been seen in wild and captive animals from Canada to northeastern Colorado. In the same family as Mad Cow Disease, Chronic Wasting Disease causes animals to display abnormal behavior, lose bodily functions, and die. The disease has not yet affected the Pikes Peak region, but its distribution is spreading.

Whirling Disease is found in fish and is caused by a parasite accidentally introduced into Colorado by imported trout in the 1950s. This parasite deforms the spine of fish, causing them to swim in circles and



eventually die. Thirteen of Colorado's 15 major river drainages have been infected with the Whirling Disease parasite. This disease is an example of how introduction of a nonnative species can adversely affect local wildlife.

A balance exists between the care of wildlife and allowing for its survival. Human activities in Colorado may affect species far away and vice versa, as seen in the spread of diseases from wildlife to human populations, such as Bubonic Plague. Properly maintained and balanced ecosystems serve humans and wildlife in the Pikes Peak region and beyond.

Forecast

As areas surrounding Fort Carson continue to develop and push wildlife onto the Installation, habitat crowding and an increased need for wildlife and endangered species refuge are likely to occur. With the potential to use the military exemption of the Endangered Species Act gaining visibility, military lands may not serve as future havens for endangered species. If wildlife survives only on the Installation, genetic diversity within species may be lost.

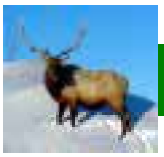
Despite the requirements of the Installation Integrated Natural Resources Management Plan and the education, conservation, recreation, and enforcement programs, data gaps concerning wildlife at the Installation exist. Historical trends and long-term studies would be beneficial to understanding the impacts of military training on wildlife, the role of fire in wildlife populations, and impacts of development on the wildlife of Fort Carson and the Piñon Canyon Maneuver Site. Furthermore, a central database of all research and survey information concerning wildlife would allow for better analysis in wildlife studies.

Historical Piñon Canyon Maneuver Site data provide a rare opportunity for the Army to understand the effects of military training on wildlife. Most military installations have wildlife data only for decades after military use began. Information is available for the Piñon Canyon Maneuver Site before the military took over the land and shortly thereafter. An evaluation of the effects of 20 years of military training on wildlife would facilitate studies such as a comparison of military use against other land uses (development, grazing, etc.) and could help guide future land use decisions.

Current Sustainability Activities

Agreements with Other Agencies – Fort Carson partners with other scientific and conservation agencies to gain specific expertise or take advantage of cooperative funding opportunities. The partners include:

- U.S. Fish and Wildlife Service
- Bureau of Land Management
- Colorado State University
- Pikes Peak Area Council of Governments
- University of Colorado at Colorado Springs
- Colorado College
- Wildlife Habitat Council
- The Nature Conservancy
- U.S. Geological Survey
- Texas A&M University
- Pikes Peak Community College
- University of Wyoming
- Utah State University
- School District 11
- Partners in Flight
- National Resources Conservation Service



Integrated Training Area Management – Reseeding activities, one part of this program, provide forage and cover for wildlife and habitat sustainability.

Awareness and Education Programs – Fort Carson representatives provide tours; give presentations at area elementary, junior high, and high schools; create videotaped presentations; teach at Pikes Peak Community College; and instruct soldiers on the proper care and sustainability of the land.

Facilitation of Long-Term Studies – Fort Carson has supported a four-year Swift Fox study with Utah State University and a grassland bird survey with Sam Houston State University. The University of Wyoming has conducted surveys on Fort Carson for the prevalence of selenium, which is toxic to wildlife in high levels. Since 1985, the U.S. Geological Survey has conducted sedimentation studies identifying erosion rates of soils with the potential for concentrating selenium.

Funding for Graduate Studies – Fort Carson partnered with the Colorado Air National Guard to assist with graduate research funding to determine the range of the Mexican Spotted Owl, a federally listed threatened species that is only a winter visitor to the Installation.

Elk Home Range Study – In cooperation with the Colorado Division of Wildlife, Fort Carson wildlife personnel attached radio collars to approximately 30 cow elk to determine their home range.

Conservation Easement – Fort Carson is negotiating with a private landowner, The Nature Conservancy, and the U.S. Fish and Wildlife Service to acquire a conservation easement that would conserve, in perpetuity, potential Mountain Plover and Black-tailed Prairie Dog habitat. This initiative would conserve these unique habitats beyond Installation boundaries, and provide protected habitat for other plant and animal species as well.

Mountain Plover Regional Management Plan – The Installation is working with representatives from Chico Basin, Colorado Springs, El Paso County, the state of Colorado, the Natural Resource Conservation Service, and the U.S. Fish and Wildlife Service to develop a regional management plan for the Mountain Plover.

Wildlife Habitat Council Membership – Fort Carson, the only military installation certified by the Wildlife Habitat Council, is an active member of this organization. The Wildlife Habitat Council is a nonprofit, nonlobbying group that helps large landowners manage lands to benefit wildlife in conjunction with the needs of the landowner.

Many other protection measures are in place at Fort Carson. Due to limited space in this document, all of the programs and measures could not be listed.

The Realm of Possibility

To become sustainable, Fort Carson is encouraged to identify and plan for innovations that will support the goals established during the Installation Sustainability Workshop. To do this, participants should be exposed to the concepts and technologies that are within the realm of possibility now and in the future. This

section provides a glimpse of what can be accomplished with existing technology and what can be expected from developing sustainability approaches.

- **Satellite Imagery** – A Canadian group uses satellite imagery to determine the effects of environmental changes on migratory paths and patterns of endangered species. For more information, go to http://www.space.gc.ca/whatsnew/releases/backgr/2001/011009.asp.

- **Habitat Restoration** – Stewart Brand—biologist, former Army officer, and founder of the Whole Earth Catalogue—suggests that a platoon of soldiers can quickly and easily complete extensive habitat restoration work. Incorporating habitat restoration in soldiers' training would assist environmental recovery in war-torn countries and create long-lasting friendships with countries that might otherwise continue to be enemies.

- **Computer Analyses** – Several nongovernment groups have partnered to develop innovative software programs that allow users to assess habitat parameters such as suitability of areas for certain animals, general health of habitats, restoration potential, and data gaps. Availability of this type of analysis may encourage groups such as universities to assist Fort Carson with conservation efforts.

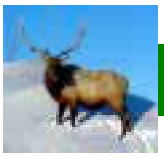
- **Public Education** – Educational centers demonstrate a commitment to the protection of wildlife and teach humans in nearby communities about sensitive habitats and endangered species. They also promote pride in the heritage of natural areas.

- **GIS Technology** – Geographic Information Systems (GIS) may be heavily used for wildlife studies. They enable collection, retrieval, and storage of spatial information; identification of locations within an area that meet specific criteria; analysis of spatial data about biological resources for management decisions; assessment of the impact of actions and alternatives; and measurement of the impacts of management decisions over time.

- **Indigenous Species Planting** – Fort Campbell is replacing nonnative pine species with indigenous hardwood species to restore natural habitats.

- **Wildlife Cloning** – Researchers at the American Museum of Natural History and the Zoological Society of San Diego among other institutions are working to establish DNA banks for endangered animals. The future use of these DNA banks could include "cryopreservation", where the frozen embryo of an endangered species could be implanted into a non-endangered host animal, thus preserving the donor species. Another possibility is nuclear replacement cloning where preserved cell lines for endangered animals could be replicated.

- **Private Lands Initiative** – The Private Lands Initiative (PLI) is a cooperative effort between FORSCOM, The Nature Conservancy, U.S. Fish and Wildlife Service, and private landowners around the borders of an installation. By annexing land around the fenceline and preventing that land from being developed, the PLI creates a "buffer zone" of sorts, allowing for better wildlife habitat around the edge of an installation. With increased habitat for endangered species outside the fenceline comes



decreased training constraints inside the fenceline. The PLI has been active at Fort Bragg since 1995 and is currently reviewing 10,000 to 20,000 acres of prime habitat of the red-cockaded woodpecker.

Fort Carson 25-Year Goals for Wildlife

To be determined by Fort Carson Command and staff, as advised by members of the local and regulatory communities, at the Installation Sustainability Workshop on 4-6 September 2002.

NOISE

Challenge

How can Fort Carson sustain its mission of training combat-ready forces in realistic settings that promote soldier survivability and meet defense needs of the United States, while minimizing noise issues with an ever-growing population moving close to its boundaries?

Key Considerations

- **Development Pressure** – Several factors combine to make development adjacent to Fort Carson attractive. The land in question is served by a major north-south interstate highway; other types of urban infrastructure are in place; the installation itself is a major regional employer; and less land is available in the corridor because most of the land has been removed from the private market for national defense purposes. Development pressures and eventual encroachment are natural consequences of the real estate market. Zoning, as an exercise of the local authorities, may not be a sustainable tool for achieving long-term land use compatibility because it cannot be so restrictive that it amounts to a "taking" of real property. When too much value is diminished, too many rights are taken and compensation is required. This compensation is paid by the regulating, local land use control authorities, not by the Department of Defense (DOD).

- **Local Planning** – Land use planning and control processes at the local level are very flexible, pursuant to state enabling legislation. Many administrative procedures are in place to provide for variances, exceptions, and conditional uses to make the zoning authority legal. Similarly, land use plans are adopted by local governing bodies and are subject to change with time as policies change along with elected representation.

- **Training at Night** – The same noise metric that is universally accepted for the characterization of noise impact and land use compatibility specifies a 10-decibel (dB) penalty for noise events occurring between 2200 and 0700 hours—"environmental night." This penalty is appropriate because ambient levels are typically about 10 dB lower during this period, when the residential population is sleeping. However, a considerable portion of military training at Fort Carson occurs at night, making this period problematic from a community relations perspective. Closer inspection will reveal that the driving requirement for such training is darkness, not the 2200 to 0700 time period. During the summer months, darkness is not available outside of this annoyance window; however, at other times of year, many dark training hours are available that do not conflict with the 2200 to 0700 window.

- **Vibration** – The firing of large military weapons and detonation of ordnance can generate sound pressure waves capable of causing structures to vibrate audibly. Because the sound waves are often below the threshold of human hearing, but the structure vibrations can be heard, this form of "referred noise" can be experienced as ground shaking. Claims for property damage can result, even though the structure vibration is far below the point where damage would occur.

- **Weather** – The impact and importance of loud, individual noise events and exercises is exacerbated by changing weather conditions, which can cause noise levels to increase as much as 30 dB over those experienced during favorable weather conditions.

- **Assessment Techniques** – All of the universally accepted criteria for assessing land use compatibility (FICUN, 1980) are based on noise metrics that are annual 24-hour averages of many individual noise events. However, it is the loud individual event, or set of events, that precipitates complaints. There are no land use compatibility guidelines for loud single events. Consequently, there seems to be very little connection to published average noise contours, which diminishes the credibility of the noise contouring and land use compatibility process.

Importance to Fort Carson

Mission – Fort Carson's mission sustainment requires a balance between the taxpayers' desire for a secure country and their wish to have minimal disturbances outside of their control. Maneuvers with artillery and heavy machinery will remain a crucial part of the Army's training mission. If training to standard is not allowed to continue, the Installation has no purpose.

Quality of Life – Training gives soldiers the skills and confidence they need to stay alive in combat situations. If noise impacts prevent training, soldiers' lives are at stake. The surrounding community must be made aware of the inevitable consequences of living near a military installation. If members of the community are informed about Fort Carson's noise management programs, they are less likely to perceive noise from the Installation to reduce their quality of life.

Costs

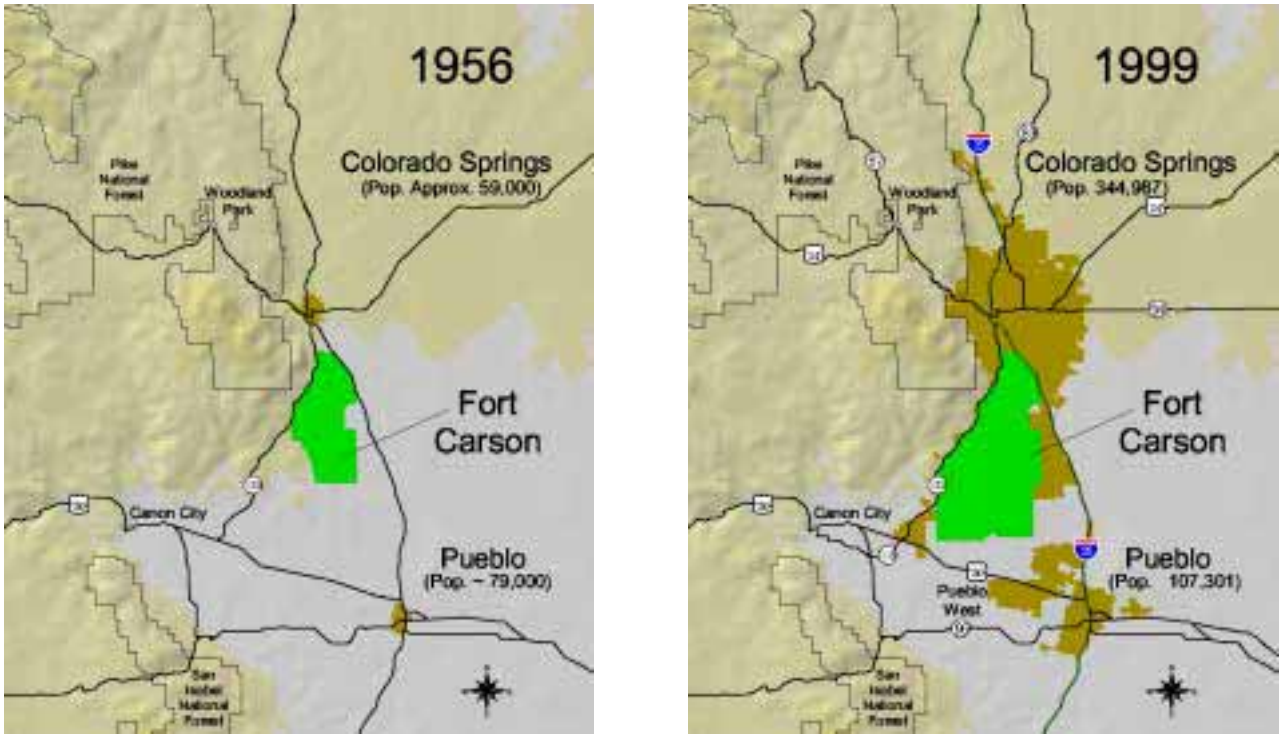
- The estimated costs of Fort Carson's noise control program for 2003:
    - Noise Contour Mapping: $4,000
    - Piñon Canyon Maneuver Site Noise Monitoring Program: $14,000
    - Fort Carson Noise Monitoring Program: $15,000
    - Feasibility Study for Land/Buffer Purchases: $125,000
    - Modification of Monitors to Incorporate Wind Data: $55,000
    - Atmospheric Data Software: $11,000
    - Electronic Sound Identification Package: $135,000
    - Ten Additional Noise Monitors: $100,000
    - Noise Data Geographic Display Software: $50,000
    - Update of Noise Contouring Software: $125,000
    - Proficiency Firing Optimization Determination Study: $108,000
    - Lighting Detector Monitors: $55,000
    - Noise Triangulation Module for Existing System: $59,000
    - **Total: $856,000**

Environment and the Community – The surrounding communities are expanding and developing adjacent to the Installation boundary. Public awareness concerning training activities is one tool used to inform the community about the Installation noise environment. The community should be better educated on the care the Army gives to its training lands, the importance of training to soldier survivability, and the fact that many of the people around them work at Fort Carson or have incomes influenced by the Installation. This type of education and awareness can contribute to a good working partnership between the Installation and its neighbors.

Introduction

Sustaining combat-ready forces is a noisy business that will likely get noisier as installations are consolidated, training standards change, weapon size increases, and new weapons are added to the inventory. As communities continue to grow near Fort Carson (Figure 8.1), noise issues are perceived to be worse than they have been historically. The type of growth near Fort Carson (single family homes) will cause land use incompatibility issues that affect these nearby communities, but will also affect the health and survivability of our nation's soldiers if complaints prevent soldiers from training to standard and peak performance.

Figure 8.1 – Development Around Fort Carson Over 43 Years



Background

To the Army, encroachment is any external factor that limits the ability of soldiers to train to standard. This Baseline Document includes many of those factors, and this chapter concerns the two most publicly visible encroachment issues the Army now faces: development near the Installation and resulting noise issues. While we are currently concerned about the growing potential for conflicting land use adjacent to and around the Installation, we also need to consider encroachment of internal Army activities, such as on-post housing and ranges, training of soldiers, and family quality of life.

The training required to win wars and give soldiers the best chance for survival involves weapons firing and ground and air maneuvers. The men and women assigned to Fort Carson as soldiers need maneuver lands and firing ranges to practice individual and group coordinated skills ranging from situations within their own units to coordinated efforts with other branches of the Armed Forces. Simulations are available, but they do

not provide the harsh environments and stress that training in a realistic environment provides. Simulations also do not provide for testing and skill development with some large weaponry. Increasingly, training must incorporate elements to prevent friendly fire deaths.

The Army has standards for the minimum number of times a certain weapon system must be fired to maintain proficiency. Limited funding, time, and facilities make the minimum standards difficult to meet; further limitations will create an Army that is not ready for combat situations. Equipment such as tanks require many hours of use in stressful situations to provide soldiers with the confidence and skill needed to survive battle. Realistic battle situations and outdoor firing practice cannot be sacrificed without doing a disservice to our country's soldiers.

When Fort Carson was established in 1942, it was located south of Colorado Springs in what was then a remote area. However, with a growing economy stimulating the development and expansion of communities, the Installation is no longer remote. If Fort Carson were forced to move, the relocation of training activities and the infrastructure that supports them would come at a huge cost to taxpayers. Cooperation between the Army and its neighbors is critical to satisfy different and potentially incompatible land uses.

The Noise Management Program at Fort Carson has five elements: noise assessments, noise education, complaint management, noise mitigation, and vibration information collection. Each element works in conjunction with the others to aid noise mitigation and public relations, and to support continued training. Sections following Figure 8.2 describe each element in greater detail.

Regulations At A Glance

Although there are no regulations applicable to noise levels normally associated with community annoyance, the following documents set federal policy concerning this issue.

- Federal Interagency Committee on Noise (FICON), *Federal Agency Review of Selected Airport Noise Analysis Issues*, 1992.
- U.S. Environmental Protection Agency, Report No. 550/9-74-004, *Information Levels of Environmental Noise Requisite to Protect Health and Welfare with an Adequate Margin of Safety*, 1974.
- Federal Interagency Committee on Urban Noise (FICUN), *Guidelines for Considering Noise in Land Use Planning and Control*, June 1980.
- AR 200-1, *Environmental Protection and Enhancement*, 23 April 1990.

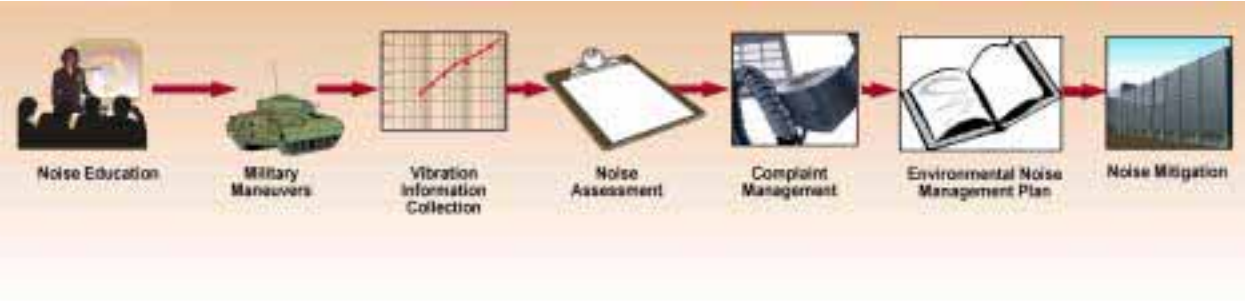
Very high levels of noise, which can cause hearing damage, are regulated by OSHA and associated Army regulations. Such noise levels occur only adjacent to military weapons and do not occur in the surrounding community.

Military training is not the only source of noise on Fort Carson, but it is by far the most significant. Other sources include construction, traffic, and the noise associated with any urban environment. The noise management program and its encroachment emphasis relates to noise from military training activities.

Activities and Impacts

The activities and impacts related to noise at Fort Carson are summarized in Figure 8.2. More detail on each portion of the program is given below. For more information, such as technical details on noise monitoring systems, consult the Environmental Noise Management Plan (ENMP), which was written in an effort to reduce the potential for conflict between the Installation and surrounding communities. The ENMP can evolve into an implementation plan for sustainability with respect to noise issues.

Figure 8.2 – Noise and Encroachment Activities and Flows at Fort Carson



Noise Education

Noise education involves Fort Carson soldiers and the communities near the Installation. The keys to community harmony are awareness and understanding: soldiers need to do all they can to ensure that unnecessary noise is not caused, and communities need to understand the goals of the Installation Noise Management Program. Further, public affairs officers need education in the noise field to avoid unwittingly communicating erroneous information to the public. An integral aspect of this program includes publishing the reasons for noise and identifying activities that will produce noise.

Soldiers are educated about noise through Standard Operating Procedures and during normal training as part of an environmental protection course. Classroom training is geared toward informing soldiers of policies and regulations. Soldiers need to be made aware of the potential for a reduced training schedule if unnecessary noise becomes significantly bothersome to surrounding communities.

Nearby communities are educated through the media and when Fort Carson personnel attend civic meetings. The Fort Carson Public Affairs Office works with local media to raise awareness of Fort Carson's mission and relay information about training schedules. Fort Carson personnel attend Pikes Peak Area Council of Government meetings to work with local planners and other local government personnel to create better zoning assignments and inform them of the magnitude of Fort Carson's activities.

Vibration Information Collection and Noise Assessments

Vibration is perceived as a shaking or rattling of windows and objects on shelves. The more solid a structure, the less vibration can be felt. Noise from Fort Carson that causes vibration results from the firing of large weapons such as artillery and tank main guns.

The noise monitoring system at Fort Carson consists of 23 monitors, 4 repeaters, and a computerized base station. The system measures noise and allows for the development of noise contour maps. It also gives noise management personnel the ability to compare complaints with real-time operational logs and noise measurements. The noise monitoring system at Fort Carson is currently in the developmental phase, but a fully functional system would include meteorological monitoring capabilities, identification of noise source, and the ability to perform scenario alternatives.

Noise Assessments

The noise monitoring system is used in conjunction with activity records and historical and current complaint records to assess the noise implications of activities on nearby existing and potential land use. Data is used to model the noise contours, which reflect an average level. Information gathered is also used to address National Environmental Policy Act requirements for new land uses on the Installation and to determine mitigation measures. Noise assessments are difficult to perform, because noise acceptability is based on individual perceptions and the noise levels associated with specific incidents.

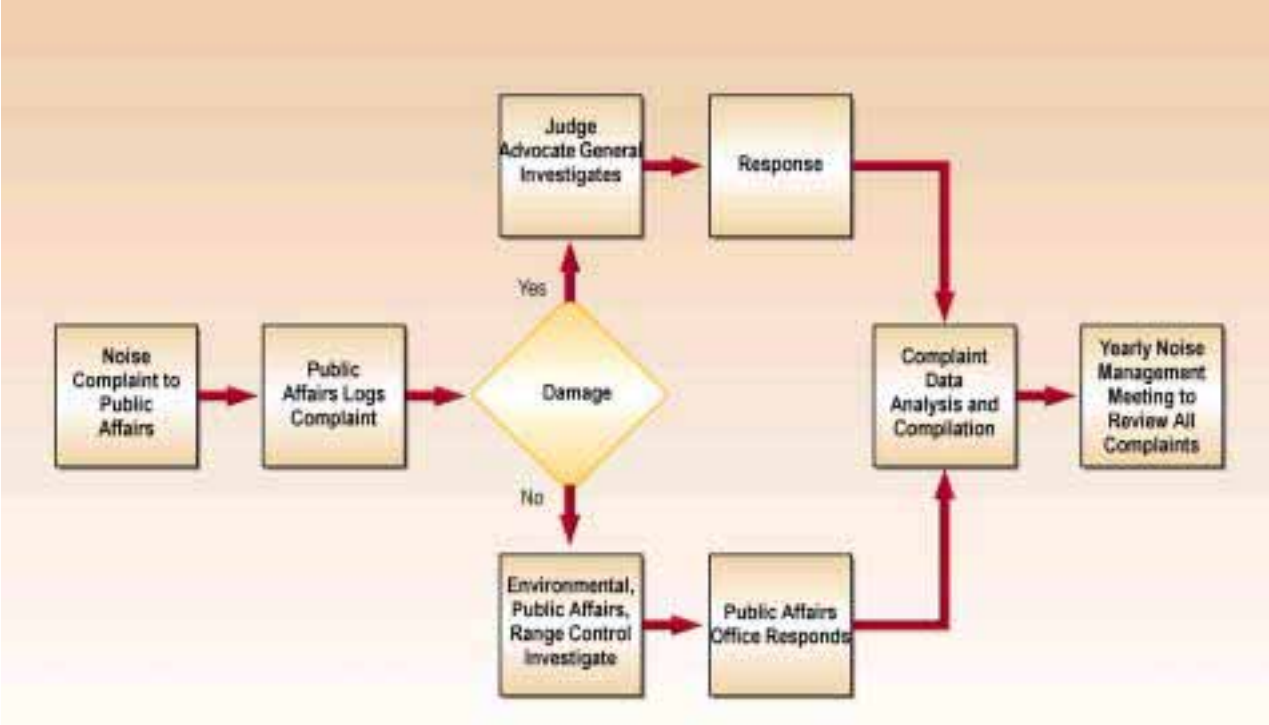
The Piñon Canyon Maneuver Site noise levels were studied in 1980 (as part of the Environmental Impact Statement to begin training at that location) and again in 1987. In the 1987 study, five locations along the boundary, including three private homes, were monitored. In the 1990s, noise levels on days with training activities were compared with noise levels on days with no training activities; noise increased approximately 10 decibels during training activities. Considering that the levels on nontraining days were approximately 47 decibels, these results indicated no significant changes in noise levels at the monitored locations. At this time, there are no noise-related land use incompatibilities for the Piñon Canyon Maneuver site.

The Fort Carson noise program has been evolving since the mid-1980s. In 1988, a seismic study was conducted on Fort Carson to determine the extent of ground movement associated with worst-case training scenarios. It was determined that no significant ground movement extended past the installation boundary. The original monitoring network consisted of 10 monitors developed by the Army's Construction Engineering Research Laboratory. The data was heavily contaminated with events caused by wind (95 percent). A new system consisting of 23 Blast Analysis Measurement (BLAM) System monitors, four repeaters, and a computerized base station has been installed. Data are passed to the environmental directorate via a radio telemetry network. This system is able to discriminate wind from blast events with a high degree of reliability. Currently, five of the BLAM units are located in surrounding communities, allowing real-time evaluation of the impacts caused by Fort Carson training activities. Software is currently being developed that will allow real-time graphic analysis of noise data. When development is complete, similar systems will be installed at the Public Affairs Office and Range Control. This will facilitate investigation of noise complaints and will allow trainers to evaluate the impact of training on surrounding communities. It also gives noise management personnel the ability to compare complaints with real-time operational logs and single-event noise measurements. The noise monitoring system at Fort Carson is currently in the development phase; when fully functional, its abilities will include meteorological monitoring, noise source identification, and scenario alternative presentation. At this time, there are noise-related land use incompatibilities at Fort Carson. Development along the eastern boundary presents the greatest concern. As the properties in Rancho and Midway Ranches are occupied, it will most certainly impact Fort Carson's ability to train. All ranges located along the eastern boundary of the Fort Carson large impact area are at risk. Noise also impacts development along the western boundary. In this area, noise issues can be mitigated through best management practices.

Complaint Management

All noise complaints concerning Fort Carson's activities are directed to the Public Affairs Office, but personnel from several activities on the Installation address each complaint. Complaints are handled with integrity and sensitivity by all involved. Figure 8.3 outlines Fort Carson's complaint management process.

Figure 8.3 – Noise Complaint Management Flow



Noise Mitigation

Noise from Fort Carson may be grouped into two types: repetitive and single-event. Repetitive noise is generated from firing ranges deep inside the Installation and is mainly an issue for those firing the weapons. Single-event noise tends to be louder and to propagate more readily. Single-event noise generated by large weaponry is the type of noise that is addressed with noise mitigation options when feasible.

For large weaponry, the only mitigation is to change the firing activity to a different location or time. Atmospheric conditions can contribute to containing or propagating noise; therefore, a change in schedule may mitigate some impacts of a particular exercise. However, atmospheric conditions are not predictable when planning activities several months in advance and the cost to taxpayers of shifting training schedules can be high. Consolidating locations for firing is unrealistic because the varied terrain of the Installation offers conditions that enable soldiers to learn versatility in operations. If restricted to only a few areas, soldiers may find themselves in a war situation for which they are unprepared.

Fort Carson is a participant in the "Fly Neighborly" program, developed to reduce helicopter and fighter/bomber noise impacts. Pilots are taught to ascend and descend at particular angles, to set power levels to reduce noise in certain areas, and to fly in a turning radius that generates the least amount of noise. Special fly routes have been designed to minimize conflicts with land uses.

The Human Perspective

From the perspective of the civilian, it is likely that noise is the most intrusive of Army activities. Noise from Army activities can penetrate buildings and disrupt lives at any time of day or night. Without an understanding of how the Army protects and cares for its lands, the importance of training to soldiers' lives and the protection of our country, and the economic contribution of military installations, the civilian population may merely view Fort Carson as a nuisance.

Interestingly, shortly after the events of September 11, 2001, noise complaints were nonexistent. Recently, they have increased to the yearly average of 5 to 12 complaints per year. This is a good example of how noise is an issue of perspective.

Communities near military installations have the responsibility of assisting with national security and ensuring the safety of our soldiers by supporting the training mission. Planning responsibilities include environmental protection and economic security, and assistance from local governments to plan in a manner that sustains economic input from installations into the community.

Forecast

Army transformation has the potential to change noise levels at the Installation, although it is unclear whether noise levels and the number of noise events will increase or decrease. The Army's goal is a 30-year transformation to a strategically responsive Army that has the capability of working easily with other branches of the U.S. Armed Forces and with multinational forces. A component of this goal includes advanced combat vehicles and maneuvers with weapons that better protect the individual soldier. Specific goals include the ability to place a division of troops on the ground anywhere in the world within 120 hours and creation of Interim Brigade Combat Teams centered around an Interim Armored Vehicle. Fort Carson is prepared to play a major role in Army transformation.

Two initiatives that have the potential to increase noise levels and noise duration at Fort Carson are new weapon systems and Base Realignment and Closure. Weapons with longer firing distances will require more land, or at least firing points and ranges of different configurations on existing military installations, and more training for use proficiency. Such weapons will likely be noisier. Typically, the longer the range of the weapon, the farther our soldiers are from the enemy; thus, development of these weapons is important to troop survivability. Changing doctrine requires larger ranges, which must typically be moved closer to Installation boundaries. Base Realignment and Closure will require cooperation between services and will increase pressure on existing installations. Combining troops and activities means more training time and larger areas of training, extending the duration of firing and maneuver noise. Cooperation between the

services means that increased aircraft training at Fort Carson is likely, adding more aircraft noise to the area. Both initiatives will require more coordination and cooperation between the Army and the public.

Growth patterns in surrounding communities are likely to create an increased perception of noise originating from Fort Carson. El Paso County is one of the fastest growing counties in the country; most of Fort Carson is located within El Paso County. While Pueblo County has experienced negative growth, the development area closest to Fort Carson's borders grew by 33 percent. Fremont County has grown below the national average, but is becoming less and less rural. These growth patterns will have different implications for Fort Carson that will require continued coordination and cooperation between the Installation and communities. Growth around PCMS has increased slightly, but it is not currently considered to be significant. Urban encroachment is just one of the many aspects of encroachment (Figure 8.4).

Figure 8.4 – Encroachment Pressures

Current Sustainability Activities

Agreements with Other Agencies – When funding or expertise is not available on site, Fort Carson makes every attempt to partner with other scientific or conservation agencies. A partial list of partners follows.

- U.S. Army Construction Engineering Research Laboratory
- U.S. Army Center for Health Promotion and Preventive Medicine (CHPPM)
- Although Fort Carson does not have formal agreements with adjacent communities, the Installation interacts with them in the spirit of partnership through both formal and informal mechanisms. This is accomplished by participation in planning and zoning meetings; informal meetings and presentations;

and education about Fort Carson's noise management program. Training schedules are announced through local media to notify the community of potentially noisy training events.

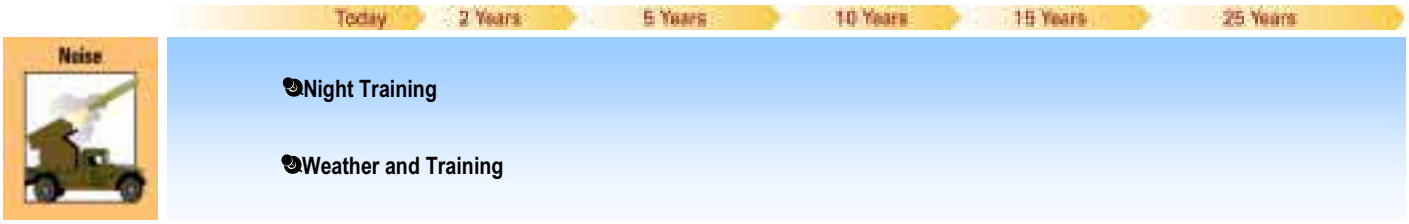
Environmental Noise Management Plan – Fort Carson's Environmental Noise Management Plan is a reference document and mission guide that provides information for decision making. The Plan is available to interested individuals.

Other Cooperative Ventures – Fort Carson is currently in discussions with private citizens and other federal, state, local, and nonprofit agencies to evaluate the potential for alternative real estate actions, such as conservation easements, which would provide greater training flexibility and a buffer around the Installation and PCMS.

The Realm of Possibility

To become sustainable, Fort Carson is encouraged to identify and plan for innovations that will support the goals established during the Installation Sustainability Workshop. To do this, participants should be exposed to concepts and technologies that are within the realm of possibility now and in the future. This section provides a glimpse of what can be accomplished with existing technology and what can be expected from developing sustainability approaches.

Noise



- **Weather and Training** – The rate at which wind speed and temperature change as a function of altitude can have profound effects on the behavior of high-energy sound waves as they propagate off range and many miles into the surrounding area. Noise monitoring many miles from firing points and impact areas has shown 30-decibel variations in just a few hours for a single weapon and firing point, as weather conditions change. For a local resident, this amounts to an eight-fold increase in loudness over a very short time period. Regular sampling of meteorological conditions and good record keeping can help identify adverse conditions and lead to avoidance strategies. Disclosure of this information and the role that weather can play in noise levels at the point of reception can do a great deal to improve the trust and credibility accorded the leadership at the range.

- **Night Training** – Training between 2200 and 0700 hours has noise impacts that are especially difficult for local residents to cope with because of the lower background noise at night and the probability of being awakened. Much of night training serves to teach proficiency in the dark, which is not necessarily associated with the sensitive 2200 to 0700 period. Spring, fall, and winter months have many hours of darkness before 2200. During these seasons, the large weapon component of the training often can be accomplished in the period between sunset and 2200 hours.

Other Activities

- **Public Involvement** – The U.S. Army Center for Health Promotion and Preventive Medicine has many recommendations for public involvement, including fact sheets, brochures, web sites, exhibit boards/displays, annual reports, meetings, tours, and open houses.

- **Noise Buffers** – Creative solutions to develop noise buffers include building industrial sites, scrap yards, or recycling centers on lands adjacent to Army installations. Wildlife easements may also prevent development on adjacent lands.

- **Joint Land Use Study** – The DOD Office of Economic Adjustment manages a special program available to Army Installations and nearby communities. The Joint Land Use Study is a method by which local governments work with installations to plan for more compatible development.

- **Disclosure Ordinances** – Disclosure ordinances require property sellers to provide information concerning the distance property is from an installation and the noise levels to be expected from installation activities. Not all communities have passed disclosure ordinances into local law. Colorado disclosure ordinances do not currently include noise as a disclosable condition.

- **Broadcast Radio** – At Camp Ripley, Minnesota, a local radio station has a regularly scheduled time for the Installation Commander or a representative to relay upcoming training schedules to area communities.

- **Development Planning Tools** – The U.S. Army Engineer Research and Development Center is developing tools to help installations understand the dynamics of urban change and how to develop better installation-community planning policies and forums. Some of this information may be found at http://www.denix.osd.mil/LMS.

Fort Carson 25-Year Goals for Noise

To be determined by Fort Carson Command and staff, as advised by members of the local and regulatory communities, at the Installation Sustainability Workshop on 4-6 September 2002.

CULTURAL RESOURCES

Challenge

How can Fort Carson protect significant cultural resources while maintaining the largest possible area for military training? How can Fort Carson maintain sensitivity to all cultures with traditional ties to lands currently used by the Installation while continuing its use of the land for military training purposes?

Key Considerations

- **Mission Activities –** Activities in close proximity to cultural sites must not disturb or destroy the site.
- **Preservation –** Fort Carson's cultural resources program is designed to maintain the integrity of all cultural sites and artifacts.
- **Identification –** The program actively seeks to identify and preserve any new cultural sites located in the course of mission or support activities.
- **Education –** It is critical that people working at Fort Carson be able to identify and understand the importance of all sites.

Importance to Fort Carson

Mission – Training activities are restricted by the presence of valuable cultural sites at Fort Carson. Training must be conducted in such a manner that protects these cultural resources.

Quality of Life – Preserving evidence of past cultures and history is an important part of our modern culture. Appreciation of past cultures enriches the lives of soldiers, their families, and members of the surrounding community.

Costs

- The estimated costs for Fort Carson's cultural preservation program for 2003:
  - Survey over 5,000 Acres: $430,000
  - Conduct Phase 2 Evaluations: $373,000
  - Mitigate Six Archeological Properties: $650,000
  - Evaluate Early Cold War Era Structures: $60,000
  - Develop Restoration Plans for World War II Hospital Complex: $66,000
  - Finalize Agreement for Turkey Creek Ranch: $75,000
  - Site Protection Efforts: $50,000
  - Identify Traditional Cultural Properties: $54,000
  - Manage Collections and Operate Curation Facility: $5,000
  - Expand the Curation Facility: $450,000
  - Re-evaluate Eligible Sites and Develop Mitigation/Management Plan: $300,000
  - Consult with Native American Tribes: $45,000
  - **Total: $2,504,000**

Environment and the Community – Fort Carson takes very good care of cultural resources located on the land on which it trains soldiers. Training programs include information concerning signage and other indicators of sensitive sites, and soldiers strive to follow these rules. Because cultural resources on Fort Carson and Piñon Canyon Maneuver Sites have been left undisturbed, analysis of these sites is possible. When sites are disturbed, the objects may be pulled out of place, rendering many areas scientifically unsuitable for study.

CULTURAL RESOURCES

Introduction

The 375,000 acres of land managed by the Cultural Resources Program for the Fort Carson Military Reservation and the Piñon Canyon Maneuver Site span a range of occupation in North America from approximately 12,000 years ago to the present. All major prehistoric and historic periods are represented. Because the cultural resources are nonrenewable, they must be carefully preserved.

Background

Nearly 6,000 cultural resource sites have been identified on Fort Carson and the Piñon Canyon Maneuver Site (Figure 9.1). From a possible Paleo-Indian mammoth kill site (dated to approximately 11,500 years ago) to Cold War housing structures, the Installation protects many valuable cultural resources. Maintaining these resources while supporting the primary training mission is a delicate task, requiring documentation, protection, education of soldiers and other land users, and coordination with appropriate agencies.

Figure 9.1 – Number and Types of Cultural Resources on Fort Carson and the Piñon Canyon Maneuver Site

Cultural Resources	Fort Carson	Piñon Canyon Maneuver Site	Total
Archaeological Sites	1,545	4,071	5,616
Sites Eligible for the National Register of Historic Places	100	761	861
Prehistoric Sites	1,262	2,996	4,258
Historic Sites, 1860s - Present	236	654	8,980
Multi-component Sites (both Prehistoric and Historic Components)	47	421	468

Cultural resources on Fort Carson and the Piñon Canyon Maneuver Site are divided into four broad groups: historic architectural buildings, archaeological sites, traditional cultural properties and sacred sites, and paleontological resources. Examples of historic architectural buildings include homestead structures (Figure 9.2), the World War II hospital complex, and Cold War family housing. Archaeological sites are those that are finite and bounded, such as a rock art site. Traditional cultural properties and sacred sites are areas with religious or ceremonial significance identified by a Native American tribe. Paleontological resources consist of dinosaur tracks and fossils of other plant and animal life.

Figure 9.2 – Moses B. Stevens Homestead

All artifacts collected are inventoried and permanently stored at Fort Carson's state-of-the-art curation facility. The facility meets or exceeds all criteria for federally owned archeological collections; Fort Carson has made the design available to other federal installations. The current facility is close to maximum capacity, but the building was designed to be expanded in order to provide adequate storage space for many years to come.

Activities and Impacts

Activities and impacts associated with cultural resources involve protection and documentation (Figure 9.3). When an activity is planned for Fort Carson or the Piñon Canyon Maneuver Site in a location that has not been surveyed for cultural resources, the area must be examined first. If cultural resources are found, the process of identification, evaluation, and documentation ensues. Activities that can affect cultural resources include training maneuvers, excavation or digging, vegetation removal, and construction. Unplanned and undesirable activities that can affect cultural resources include vandalism and erosion. Preservation and mitigation options include avoidance (resiting of the military project/activity), protection (fencing or signage), and data recovery (excavation and documentation).

Figure 9.3 – Cultural Resources Activities Flow at Fort Carson*

* Consultation with the Colorado State Historic Preservation Office is mandatory for all stages of cultural resources management.

Cultural Resources at Fort Carson and the Piñon Canyon Maneuver Site

Both Fort Carson and the Piñon Canyon Maneuver Site have all four types of cultural resources: historic architectural buildings, archaeological sites, traditional cultural properties/sacred sites, and paleontological resources. The Directorate of Environmental Compliance and Management manages all these resources.

Education and training are extremely important for cultural resources management to mitigate unnecessary damage and to help sustain these valuable resources. Soldiers need to be made aware of the potential for the loss of valuable data if cultural resources are damaged or disturbed, and the ensuing negative public opinion. Soldiers receive cultural resource education during normal training as part of an environmental protection course and through Standard Operating Procedures. Classroom training is geared to inform soldiers of policies and regulations. Some cultural sites are delineated with flags, fences, and signage, which are recognizable to soldiers during maneuvers.

Historical Architectural Buildings

Sites with architectural features are susceptible to weathering. Both Fort Carson and the Piñon Canyon Maneuver Site bear the remains of human habitation ranging from subterranean structures dating back 1,500 years to settlers' homes built in the 1930s. Due to settlement patterns in Colorado, newer buildings of architectural significance are found at Fort Carson, but older structures and remains may be found at both locations.

The Piñon Canyon Maneuver Site provides a historic record of the region with remnants of prehistoric, Native American, Hispanic, and Euro-American settlements. Historians and archaeologists use the artifacts, ruins, and remains associated with the architectural finds of the region to understand how people lived. Learning how past cultures used their environment to make the best of harsh conditions may be of use when developing sustainability projects. An understanding of local building materials, patterns of settlement, and home types may assist with energy conservation and use of natural resources.

Fort Carson's architectural sites provide information concerning early settlers and western expansion, while more recent structures provide insights into twentieth century society. During World War II, Fort Carson's hospital complex was the largest of nine such complexes built in the nation specifically for the care and rehabilitation of wounded soldiers. With 2,000 beds and 11 square miles of floor space, the hospital became a major training center for nurses in 1943. Several of the hospital buildings are used for administrative activities at the Installation. Other World War II architectural sites include a warehouse district and sewage treatment plant. Cold War housing at Fort Carson provides a history of contracting, Army policy, and neighborhood design of the 1950s. World War II and Cold War structures are currently being studied for historical significance and eventual disposition or long-term protection.

Traditional Cultural Properties and Sacred Sites

Fort Carson has made efforts to understand areas of significance to the 11 Native American Tribes with current ties to Fort Carson and the Piñon Canyon Maneuver Site. Newspaper article reviews and oral history interviews were done to locate sites and understand their history. In 2002, the Installation plans to initiate a program to extend oral history investigations so that additional cultural sites may be identified and managed.

Archaeological Sites

An archaeological site is a finite, bounded region of cultural activity, such as a rock art site. There are 27 rock art sites at Fort Carson and 126 at the Piñon Canyon Maneuver Site. Figure 9.4 provides a good example of rock art found in the area. Certain areas at the Piñon Canyon Maneuver Site contain high concentrations of rock art that need to be evaluated and documented further. Rock art can indicate past lifestyles and animals formerly hunted in the area. Because of the Army's stewardship and protection practices, some archaeological sites remain undisturbed, allowing for proper, in-context evaluation.

Figure 9.4 – The Korgel Deer Petroglyph

Paleontological Resources

While not considered a cultural resource, and not yet a federally protected resource category, the care and archiving of paleontological resources are similar to that of protected cultural resources. Paleontological resources are housed at Fort Carson's Curation Facility on a limited scale. Paleontological sites have been located in 53 areas on Fort Carson and 13 areas on the Piñon Canyon Maneuver Site. Fossil types include plants, animals, dinosaurs, fish, and coral.

The Human Perspective

Preserving cultural resources is important for several reasons. Knowledge of the past can assist in making informed decisions for the future. People understand themselves and others based on ethnic identities tied to cultural histories and shared experiences. Artifacts found at Fort Carson and on the Piñon Canyon Maneuver Site assist archaeologists in understanding past human activity. The study of these materials

serves as a bridge to the past by supporting, complementing, or contradicting previous interpretations. Archaeological investigations of past societies enable analysis of the transformation of cultures through time.

Using a preservation approach that balances and recognizes the complexity of human interaction, both physically and temporally, is a vital component of cultural resources management. Archaeological investigations and historic context studies are essential to the preservation efforts.

Beyond the Pikes Peak Region

When examining archaeological sites, concern for the artifacts, their position in the ground, and how the information gathered relates to a global historical context are all taken into consideration. Linking histories to show worldwide commonalities may provide an increased sense of community across cultures.

Forecast

For cultural resources, sustainability means protecting the resources. Fort Carson has taken many administrative and physical measures to ensure the protection of significant cultural resources on its properties. Management of cultural resources must include holistic approaches in environmental planning, especially in areas common to other resource management programs. For example, failure to minimize erosion in culturally sensitive areas could negatively impact not only the resources, but military training capabilities as well. Resource preservation is inherently a cooperative effort, thus management practices must be jointly developed and mutually enforced.

Current Sustainability Activities

Oral History Projects – A recent project involved interviewing Native Americans and former ranchers who lived on Fort Carson or the Piñon Canyon Maneuver Site to determine locations of Native American religious/ceremonial sites and other historic sites on the properties. A current oral history project is documenting the settlement patterns and practices of Turkey Creek Canyon on Fort Carson, an area significant to the development of southern Colorado.

Training Videos – Three thirty-minute videos have been developed to demonstrate the value of cultural resources on the Installation and assist soldiers and the public in understanding the cultural heritage of the lands on which they train, work, and play.

Front Range Eco-Regional Cooperative – A cooperative agreement between Department of Defense (DOD) installations analyzes management constraints and concerns by sharing manpower, equipment, information, and contracts to enhance missions and reduce costs for issues concerning cultural resources, among others.

Curation Facility – The Installation built a state-of-the-art building for archiving and conserving its extensive collection of cultural resources. Designs were made available to other installations to reduce their costs.

Cooperative Agreements and Interservice Support Agreements – Currently, Fort Carson has operational agreements with the Colorado State Historic Preservation Officer, the Advisory Council on Historic Preservation, the National Park Service, the U.S. Army Corps of Engineers, New Mexico State University, and Fort Lewis College.

The Integrated Cultural Resources Management Plan (ICRMP) – A five-year integrated plan has been developed to provide guidance and outline procedures that will enable Fort Carson to identify, evaluate, and protect cultural resources.

Environmental Protection Officer Program – This program, which is geared to Army unit and activity representatives, outlines cultural resource management concerns to ensure the continued protection of the resources and enhancement of training activities.

Geographic Information System (GIS) – The Cultural Resources Management Program's GIS platform complements current predictive modeling techniques used to identify areas of high probability for cultural resources. Use of the system helps to protect cultural resources and reduces restrictions on training lands, while facilitating the overall army management process by integrating available information into training mission development.

The Realm of Possibility

To become sustainable, Fort Carson is encouraged to identify and plan for innovations that will support the goals established during the Installation Sustainability Workshop. To do this, participants should be exposed to the concepts and technologies that are within the realm of possibility now and in the future. This section provides a glimpse of what can be accomplished with existing technology and what can be expected from developing sustainability approaches.

- **Geophysical Techniques** – The U.S. Army Construction Engineering Research Laboratory is conducting tests using geophysical techniques to make determinations on materials commonly buried at archaeological sites. Location, depth, dimensions, and position of historical objects are recorded and mapped using geophysical techniques and equipment. See http://www.cecer.army.mil/td/tips/product/details.cfm?ID=424.

- **Historic Preservation** – Historic preservation of buildings and sustainable design have complemented each other in many places. Window replacement, paint, and replacement of heating, ventilation, and air conditioning systems may allow for the incorporation of sustainable principles. For an example and more information, see http://www.saptek.com/sp/general/21-2-4.pdf.

- **Modeling Probability of Cultural Sites** – To guide archaeological investigations, the Center for Ecological Management of Military Lands (CEMML) at Colorado State University has developed a GIS-based model to identify areas of high, high-medium, medium, low-medium, and low probability for archaeological sites. Using remote sensing equipment, aerial photography technology, and modeling increases the likelihood of releasing and expanding land for military use (http://www.cemml.colostate.edu).

Fort Carson 25-Year Goals for Cultural Resources

To be determined by Fort Carson Command and staff, as advised by members of the local and regulatory communities, at the Installation Sustainability Workshop on 4-6 September 2002.

Appendix A
Acronyms and Abbreviations

AFVs	alternative fuel vehicles
AMC	Army Materiel Command (U.S. Army)
ASR	aquifer storage and recovery
ARDEC	Armament Research, Development, and Engineering Center (U.S. Army)
BBTU	billions of British Thermal Units
BLAM	Blast Analysis Measurement
C&D	construction and demolition
CARC	chemical agent resistant coating
CDM	Camp, Dresser and McKee
CEMML	Center for Ecological Management of Military Lands
CERL	Construction Engineering Research Laboratory (USACE)
CFLs	compact fluorescent lights
CHPPM	Center for Health Promotion and Preventive Medicine
CO_2	carbon dioxide
CSU	Colorado Springs Utilities
CWA	Clean Water Act
DA	Department of the Army
dB	decibel
DECAM	Directorate of Environmental Compliance and Management
DOD	Department of Defense
DOE	Department of Energy
DPW	Directorate of Public Works
DRMO	Defense Reutilization Marketing Office
DPTM	Directorate of Plans, Training, and Mobilization
ENMP	Environmental Noise Management Plan
EPA	Environmental Protection Agency (U.S.)
EPCRA	Emergency Planning and Community Right-to-Know Act
EPPs	environmentally preferable products
EQWG	Environmental Quality Working Group
FORSCOM	U.S. Army Forces Command
FY	fiscal year
GIS	Geographic Information System
GSA	General Services Administration
HAPs	Hazardous Air Pollutants
HAZMAT	hazardous material
HMCC	Hazardous Material Control Center
HVAC	heating, ventilation, and air conditioning
ICRMP	Integrated Cultural Resources Management Plan
IDG	Installation Design Guide
INRMP	Integrated Natural Resources Management Plan
ITAM	Integrated Training Area Management
JLUS	Joint Land Use Study
KWH	kilowatt-hour
LCTA	Land Condition Trend Analysis [Program]

LEED	Leadership in Energy and Environmental Design (USGBC)
LRAM	Land Rehabilitation and Maintenance [Program]
MW	megawatt
NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics and Space Administration
NESHAPs	National Emissions Standards for Hazardous Air Pollutants
NO_X	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NSPS	New Source Performance Standards
ODCs	ozone-depleting chemicals
PCMS	Piñon Canyon Maneuver Site
PLI	Private Lands Initiative
PNNL	Pacific Northwest National Laboratory
PV	photovoltaic
RCRA	Resource Conservation and Recovery Act
RFMSS	Range Facility Management Support System
RMI	Rocky Mountain Institute
SDWA	Safe Drinking Water Act
SERDP	Strategic Environmental Research and Development Program
SIP	State Implementation Plan
SO_X	sulfur oxides
SPiRiT	Sustainable Project Rating Tool (military adaptation of USGBC's LEED)
SuLEVs	super-low emission vehicles
TACOM	Tank-automotive and Armaments Command (U.S. Army)
TMDL	Total Maximum Daily Load
TSDF	Treatment, Storage, and Disposal Facility
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USGBC	U.S. Green Building Council
USGS	U.S. Geological Survey
UST	underground storage tank
VOCs	volatile organic compounds
ZFC	Zero Footprint Camp