



**US Army Corps  
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Engineer Research and  
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## The Military Landscape

Why US Military Installations Are Located Where They Are

Harold E. Balbach, William D. Goran, and Anthony R. Latino

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## **Final Report**

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## Abstract

In its 235 year history, the US military has experienced many changes in the lands and facilities required to address evolving military threats and missions. Each century has presented distinct challenges as determined by the needs of the era, e.g., to counter external or internal threats, to achieve materiel production, to establish leadership and training, to protect the coastlines, to secure internal travel routes, or to prepare for the projection of force hundreds or thousands of miles outside the United States. At any given time, one or more of these differing concerns were the driving reasons behind the establishment of each military installation. The current “landscape” of installations reflects a response to these differing threats across the entire nation’s history.

The US Department of Defense has recently been reviewing the inventory of military bases to determine if they are all still relevant and useful, if there are too many or too few installations, and if they are well located to respond to current and emerging threats. This review will also address what happens when an installation is believed to no longer be needed, i.e., when and how that installation may be converted to another purpose. This report informs that review by providing an historical context that focuses on when, where, and why military installations were created and placed on the landscape.

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## Preface

This study was conducted for the US Army Corps of Engineers, Engineer Research and Development Center (ERDC), Center for the Advancement of Sustainability Innovations (CASI). CASI was established by ERDC, in October 2006, to help enable the US military to proactively respond to current and emerging sustainability challenges. Ecosystem services are one of the CASI technology focus areas. This publication is one of a number of studies managed or facilitated by the ERDC Center for the Advancement of Sustainability Innovations (CASI) as an ERDC contribution to the Army Environmental History Project.\* The technical monitor was John Fittipaldi, Senior Fellow at the US Army Environmental Policy Institute and manager of the Army Environmental History Project.

The work was performed by the Ecological Processes Branch (CN-N) of the Installations Division (CN), Construction Engineering Research Laboratory (CERL), US Army Engineer Research and Development Center (ERDC). This work was coordinated by the CASI Director, William D. Goran. The Principal Investigator (PI) was Dr. Harold Balbach, CEERD-CN-N. Preliminary report investigation and preparation was performed by Anthony R. Latino of the University of Illinois at Urbana-Champaign under Contract W9132T-06-C-0025. At the time of this writing, Michael Denight was Acting Chief, CEERD-CN-N, and Dr. John T. Bandy was Chief, CEERD-CN. The Deputy Director of ERDC-CERL was Dr. Kirankumar Topudurti and the Director was Dr. Ilker Adiguzel.

CERL is an element of the US Army Engineer Research and Development Center (ERDC), US Army Corps of Engineers. The Commander and Executive Director of ERDC is COL Gary E. Johnston, and the Director of ERDC is Dr. Jeffery P. Holland.

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\* The Army Environmental History web page is accessible through URL:  
<https://eko.usace.army.mil/fa/envhistory/>

## Unit Conversion Factors

Multiply	By	To Obtain
acres	4,046.873	square meters
cubic feet	0.02831685	cubic meters
cubic inches	1.6387064 E-05	cubic meters
cubic yards	0.7645549	cubic meters
degrees (angle)	0.01745329	radians
degrees Fahrenheit	(F-32)/1.8	degrees Celsius
fathoms	1.8288	meters
feet	0.3048	meters
gallons (US liquid)	3.785412 E-03	cubic meters
hectares	1.0 E+04	square meters
inches	0.0254	meters
miles (US statute)	1,609.347	meters
miles per hour	0.44704	meters per second
mils	0.0254	millimeters
ounces (mass)	0.02834952	kilograms
ounces (US fluid)	2.957353 E-05	cubic meters
pints (US liquid)	4.73176 E-04	cubic meters
pints (US liquid)	0.473176	liters
pounds (mass)	0.45359237	kilograms
quarts (US liquid)	9.463529 E-04	cubic meters
square feet	0.09290304	square meters
square inches	6.4516 E-04	square meters
square miles	2.589998 E+06	square meters
square yards	0.8361274	square meters
yards	0.9144	meters



# 1 Introduction

## Background

In its 235 year history, the US military has experienced many changes in the lands and facilities required to address evolving military threats and missions. As these threats and missions have changed, so too have the number, type, size and purposes of military bases.\* From the birth of the nation until the 1890s, military facilities were focused on protecting strategic locations and populations along the coasts, the inland waterways, and the routes west, from Pittsburgh to the Pacific. Then, towards the end of the 19<sup>th</sup> century, the US military began to focus outward; force was projected to conflicts in distant locations beyond US borders. In this projection phase, new factors affected military base locations: access to transportation routes and infrastructure to project force; and access to sufficient land and, later, airspace resources to accommodate the increasingly far ranging weapon systems and increasingly complex military training requirements.

The US Department of Defense has recently been reviewing the inventory of military bases to determine if they are all still relevant and useful, if there are too many or too few installations, and if they are well located to respond to current and emerging threats. The historical context that reveals the reasons underlying the establishment of US military installations provides groundwork information to inform that review.

## Objectives

The objective of this work was to provide an historical context underlying the driving reasons behind the establishment of military installations within the United States, e.g., their relevance and usefulness, their number (too many or too few), their location (in relation to current and emerging threats), and ultimately, when an installation is believed to no longer be needed, the manner in which it may be converted to another life.

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\* Note that the majority of relevant installation establishment dates were obtained from: Goodwin et al. (1995) and Cragg (1997).

**Approach**

This historical review was accomplished by synthesis and summary of the results of a literature search.

**Mode of technology transfer**

This report will be made accessible through the World Wide Web (WWW) at URL: <http://www.cecer.army.mil>

## 2 Historical Issues

### Protection: 1780–1880

#### The Federal period: 1780–1830

The earliest US “military installations” were truly forts. Starting in the colonial period, through the Revolutionary War and the Federal era, the oldest installations were forts that easily meet that definition. Numerous fortified locations were known, and some were formally called “forts” before independence, which were established before the United States of America came into existence. Following independence, many of these locations were maintained, to some degree, by the US government as places where soldiers and equipment were housed.

Along with defensive measures came another clear need for the young country, which was to establish a manufacturing base for a reliable supply of armaments to defend itself during conflicts. The establishment of the Springfield, MA Armory in 1794, and the Harper’s Ferry, WV (at that time, still part of Virginia) Armory in 1798 occurred after the first Congressional session. The Springfield Armory continued to manufacture rifles until its closure in 1968. (The site is now a National Register historic site operated by the National Park Service. The Harpers Ferry arsenal was destroyed in 1861 during the Civil War.) Another specialized need of the Federal period was the need for production facilities for cannon barrels, the heavy weapons of the time. Construction of a Federal arsenal at Watervliet, NY, was begun in 1813, while the country was deeply involved in the War of 1812 against Great Britain. This facility is the oldest arsenal in the US Army, and has kept its original mission, manufacturing large gun tubes for US artillery, tanks, and ships. (Such specialized needs are seen in some of the other oldest military installations.) One example, Carlisle Barracks, Carlisle, PA, had been a military encampment since 1757. It was recommended as a site for the US Military Academy, but West Point, NY was selected. In 1801, the government purchased the original 11 ha Carlisle Barracks site, and it was later used for cavalry training. The US government established a War College in 1901, immediately after the Spanish-American War. The War College moved among several locations before finding a permanent home at Carlisle Barracks in 1951. Its campus is now 200 ha.

## **Coastal forts**

Coastal defense was not the only installation mission of the Federal era, nor was the perceived need restricted to the Atlantic coast, but it was one of the greatest concerns. At various times, forts have been placed along the coasts of the Gulf of Mexico, and at the entrance to the Golden Gate in San Francisco, as well as on the Great Lakes. In each instance, the threat was the possibility of an enemy fleet. One of the first defensive systems to be established by the United States was a system of coastal fortifications. Early emphasis on protection of shipping ports from enemy fleets was the impetus for the creation of the Coastal Artillery Corps, founded in 1794, as one of the first specialized branches of the Army. (The Coastal Artillery Corps was largely shifted from anti-shipping to anti-aircraft duties during and after World War II, and was disbanded as a separate entity in the 1950s.)

The first system was initially designed to protect the eastern coast of the country and its strategic ports and population centers from attacks from either foreign nations or Native Americans. The earliest locations were built by the British, which were taken over by the US government and improved upon and redeveloped in multiple stages. Following America's Independence, the new US government initiated a fortification program to protect harbors at 21 strategic locations along the Atlantic Coast. Examples of port fortifications include Fort Jay, on Governors Island in New York harbor (1794); its Brooklyn counterpart across the East River, Fort Hamilton (1825); and Fort Hancock (1813), on the New Jersey side of New York harbor.

Later examples include Fort Morgan (1819) and Fort Gaines, AL (1822), and the Pensacola Navy Yard (1825) at a time when Spain was considered a major threat to the Gulf Coast. These fortifications used traditional methods and techniques of low sloped earthworks protecting wood or masonry walls to form battlements surrounding a central space. Many of these old coastal defense forts, such as Fort Hamilton, NY, are still in use in some way and many have been converted to historic monuments. Fort Monroe, for example, was still occupied in 2009, but it was in the process of being closed and re-cast as a historic monument (a transition that has occurred for many former military facilities). The perceived threats at the time were those of fleets of enemy warships that might sail into ports to either destroy shipping and goods warehouses, or even stage a landing to occupy a city to establish a land-based foothold of operation.

In 1802, President Jefferson, fearing another conflict with the British, initiated a program designed to develop more permanent fortifications, using masonry, which could better endure bombardments than earthen works.



Figure 1. Aerial view of Fort Monroe, VA (US Department of the Army, “Fort Monroe Aerial,” 2007).

After the War of 1812, President

Madison initiated another more comprehensive upgrade to the nation’s military fortifications. He commissioned a study that identified 50 locations for protection, which was later expanded to over 200 locations. Forty-two of these locations were eventually fortified following this study. One of these sites was Fort Monroe, built in 1819 to protect the Hampton Roads estuary in Virginia from seaward attacks, which was the epitome of US fortress defenses (Figure 1). This program also developed Fort Pulaski, in 1847 in Savannah, GA to protect the Savannah River and the first fort on the west coast, Fort Point, in 1853, to protect the San Francisco Bay.

Beginning in 1885, the “Endicott System” of fortifications was begun on both sides of the continent to strengthen America’s defenses. This program modernized many coastal fortifications already in place and recommended 22 locations for new defenses. This system included the construction of new concrete emplacements, breech-loading cannons and mortars, floating batteries and submarine mines and the addition of more barracks for troops at locations such as Fort Baker and Fort MacArthur in California.

#### **Era of westward expansion: 1830–1880**

As threats to the United States changed, so too did the placement of its defensive facilities. As the threat of attacks from abroad diminished and the movement of America’s population westward increased, new threats emerged from Native Americans displaced by the westward expansion. Early in the 19<sup>th</sup> century, protective fortifications were focused along the major inland waterways, such as Jefferson Barracks, founded in 1826 in St. Louis, MO, and Fort Leavenworth, KS, placed on the west bank of the Missouri River in 1827. The perceived need was to protect the increasingly

populous Mississippi/Missouri river valley, the adventurous river traders and the trickle of trans-Mississippian settlers heading for the unknown lands to the west. Fort Scott (1842) was placed in southeastern Kansas to protect settlers at the interface between the Indian Frontier and the more settled lands to the east. Fort Scott was abandoned in 1853 and converted to civilian use in 1855, but Fort Scott, the town, became one of the largest in Kansas for many years.

As expansion continued, numerous forts were established along major westward routes across the plains and mountains. Fort Bliss was founded in 1848 in El Paso, TX, immediately after the land was acquired from Mexico (Goodwin et al. 1995, p 36). Fort Yuma, CA, across the Colorado River from Yuma, AZ, was established in 1848 to protect travelers on the southern trail to California. It was later moved to the Arizona bank of the river, and, although the fort itself was abandoned in 1883, the present Yuma Proving Ground traces its origin to Fort Yuma. Fort Laramie, WY (1849) was another outpost for the purpose of protecting settlers and travelers on the treks to the west, which increased steadily, even before the news of the California gold rush in 1849. The establishment of frontier fortifications was not just on the plains or the Mexican border. The Vancouver Barracks, in southernmost Washington, on the Columbia River, were also established in 1849, followed by Fort Townsend, WA in 1856, at the entrance to Puget Sound. These two forts were strategically located at these waterways to protect shipping, as well as to collect duties from commerce.\*

As the number of settlers moving west increased, conflicts with Native Americans transitioned from small skirmishes into larger and more organized battles. While initial fighting was largely confined to attacks on road travelers (the “wagon train” attack), toward the end of this period the attacks evolved into conflicts involving thousands of men. To address this threat, Fort Harker, Fort Dodge, Fort Hays, and Fort Wallace, KS were all formed in the 1864–1865 period, just as the Civil War was ending. Fort Russell, WY (1867) and Fort Sill, OK (1869) were added after the war to further secure the westward trails. Fort Sam Houston, at San Antonio, TX (1876), and Fort Huachuca, AZ (1877) became garrisons holding large troop units that then conducted campaigns against tribes not accepting US government authority.

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\* Both of these are now historic sites, with reconstructions of the original installation presented to visitors. Fort Bridger, WY (1857) and Camp Douglas, UT (1862) are other examples of installations established to protect overland routes to the Pacific Northwest.

The Civil War decade shows a doubling of installation establishment, but an examination of the actual locations shows that Kansas, Wyoming, and California were the focus, and that the pre-war installations were largely adequate for the needs of the Union Army. The only really

large installations created during the Civil War were temporary prison camps, several of which held more than 5000 prisoners. From 1890 through 1919, however, the pace of installation establishment tripled.

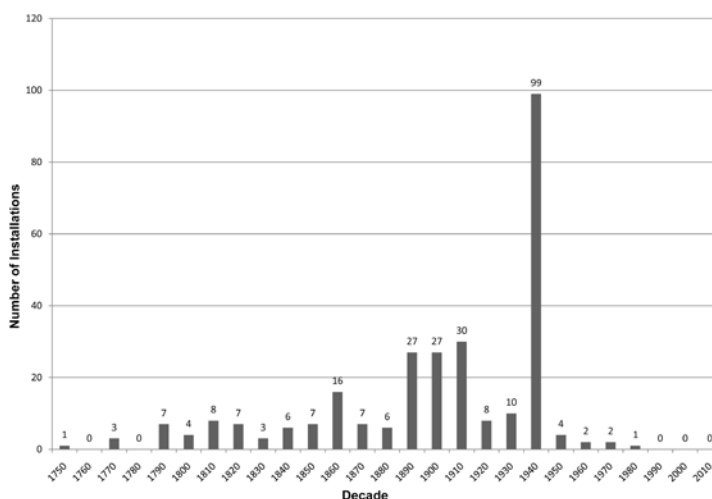


Figure 2. Army installations established per decade – 1750–1990 (Graphic developed from Goodwin et al. 1995).

Starting roughly after the Civil War, larger installations were developed to house large numbers of troops, horses, and equipment. These were mostly expansions of existing locations. Fort Riley and Fort Sill are two existing installations that added land, as did many others. By the end of this expansion era (in the 1890s), many western installations grew to 2000 to 5000 hectares. Many of these locations had artillery ranges, maneuver areas, multiple rifle ranges, and other facilities sized for horse-powered units. Although the Army was still characterized by having many small locations, toward the end of the nineteenth century there were many larger installations (Kreidberg and Henry 1861). Generally, by the end of this era, instead of the scores of locations with 50–100 troops per location, that characterized 1850s installations, the nation had 40 or 50 locations with 500 to 1000 troops each (Goodwin et al. 1995). Figure 2 shows the number of installations created in each decade from the 1750s to the 1990s.

Land in the new United States was not legally owned by any person, and the government claimed jurisdiction over this “Public Domain” land to establish many military locations. Other land needs were fairly modest, and purchases from private owners were usually small and uncomplicated. As noted above, Carlisle Barracks was originally 11 ha, more than sufficient for housing a few hundred troops and their horses. So far as can be determined, all of the trans-Mississippi forts were placed into the title records as withdrawals from this public domain.

### Training: 1790–1880

The US military leadership realized early the need for trained officers in the services, especially officers trained in engineering. This led to the founding of the US Military Academy at West Point, NY, an action initiated by President Jefferson in 1802 (Stewart 2005). West Point had been a fortified place during the Revolutionary War in 1779 and is now considered the oldest continuously-occupied military installation in the United States (US Military Academy 2009).

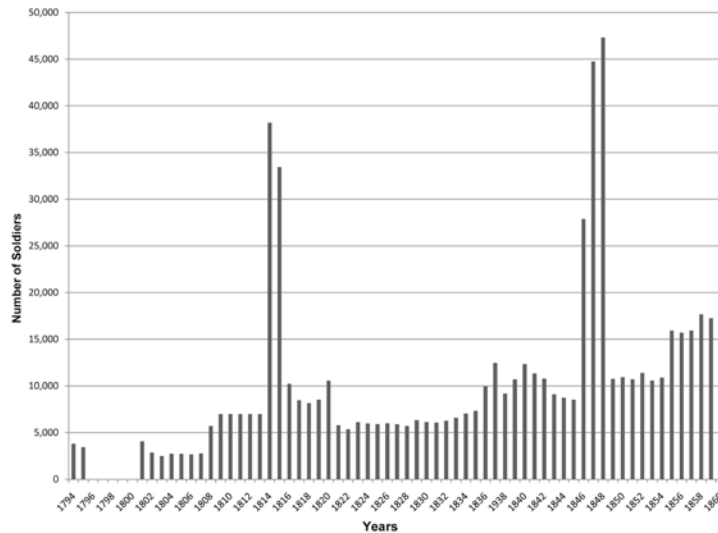


Figure 3. Army personnel strength 1794 to the Civil War (Graphic developed from US Department of Manpower Data 2009).

The Military Academy, as well as the arsenals and armories, have a clear and specialized function. In its simplest sense, these installations served to warehouse military material, arms, and ammunition while others provided housing for the troops as well as office space for the command staff. The overarching purpose of installations of this type was to train troops and officers, but the Army was relatively small for most of this period, no more than a few thousand at most (Figure 3), so large installations were not needed for housing. Army “training” through the years from the Colonial era through 1850–1860 did not change a great deal. Training for battle conditions did not require large land areas for practice and the units so equipped were often stationed on the plains where wide open spaces were typical.

While officer training did involve the study of battle tactics (Crakel 1812), as well as historic battles and strategies for both offence and defense, there was simply no tradition of physically having troops “practice” an advance or execute different types of defensive moves. Predominantly, troops were shown how to wear their uniform, load and fire their musket or rifle, and how to march in step with their squads (Crakel 1812).



The American Civil War was the Army's introduction into warfare where the improvements in equipment went beyond the capabilities of individual humans. Advances such as the rifled barrel made shoulder weapons more reliable and deadlier. Soldiers could now reliably strike a human target at 200 m or more and shots were lethal to 1000 m (Robertson 1861). Later, metallic cartridges allowed even lesser-skilled troops to load and fire rapidly. Self-loading weapons and revolvers increased the firepower of both foot and mounted troops. Marksmanship was the most common skill needed, but the weapons of the time did not lend themselves to extensive accuracy training. Most emphasis was on the ability to fire then reload to fire again as rapidly as possible. Targets in battle were assumed to be no more than 100 m distant and often much less (Bauer 1846, p 59). The lighter cannon with which the Army land units were equipped before 1860 also had limited range, not much more than 500 m, and 150–200 m was more common practice. Training for these battle conditions did not require large land areas for practice, and the units so equipped were often stationed on the plains where wide open spaces were the norm.

Until the 1898 Spanish war (restricted to a few Spanish colonies such as Cuba, Guam, and the Philippines), the United States had yet to meet a “modern” European power in battle. The traditional practice of marching forward until you could fire at the enemy while still advancing became obsolete within minutes on the Civil War battlefield (Robertson 1986, p 86). The Franco-Prussian war of 10 years later added automatic firing weapons, rifled cannons, and reliably bursting shells to the arsenal (Cosmas 1986). War would never be the same and the Army's need for land and the necessity to manage that land would change as well.

### **Projection: 1880–present**

Beginning with the Spanish-American War of 1898, America began projecting its military influence abroad. This new political stance was later exemplified by the US involvement in the First World War and its increased military footprint to support this effort. Figure 2 shows that the rate of new installation formation was remarkably steady from 1790 through the 1880s, at about six or eight per decade. In the decades from 1890 through 1919, however, the pace of installation establishment tripled. Many of these installations reflected new global concerns and new missions, with numerous installations throughout California and Washington, as well as several in Hawaii, one on Guam, and at Guantanamo Bay, Cuba. These latter two followed the Spanish-American conflict, when Spain transferred several colonial locations to US jurisdiction.

## World War I

The run-up to the First World War generated the need for many large mobilization training locations in the United States. Instead of recruiting thousands of soldiers, the Army had to prepare for the millions of recruits believed necessary to engage large European armies. Realistic field training, especially in the use of modern equipment and weapons, was becoming a necessity. It was no longer possible to simply send a soldier into battle with a rifle and expect him to learn how to fight on the battlefield. Trucks, tanks, aircraft, and radios were all a part of the Army now, and brought with them the need for better and more comprehensive training and a need for much larger land areas on which to train. Materiel such as longer range artillery (up to 5–10+km), aircraft, machine guns, trucks, armored cars, etc. required dedicated training areas separated from the civilian community. Figure 2 shows that the rate of new installation formation was remarkably steady from 1790 through the 1880s, at about 6 or 8 a year.

Figure 4 shows the notional land area of responsibility that a typical battalion size unit was expected to operate within from 1865 to the 1980s. Many new and large posts were established during this time frame, including Fort Monmouth, Fort Dix, Fort Benning, Fort McClellan, Fort Drum (originally Pine Camp), and Fort Shelby. To expand or establish new installations for WWI, purchase of civilian-owned land became the normal means of acquisition east of the Mississippi. There was no more “free” Federal or public domain land in the east. Most land acquisitions were from private owners through appropriations for that purpose. Much of the land, especially in the southeastern states, was of a very poor quality (Richter 2000); cutover timber was the norm, as was abandoned farmland that was so badly eroded it would not return a paying crop (Phillips and Sweet 1926, p 1143).

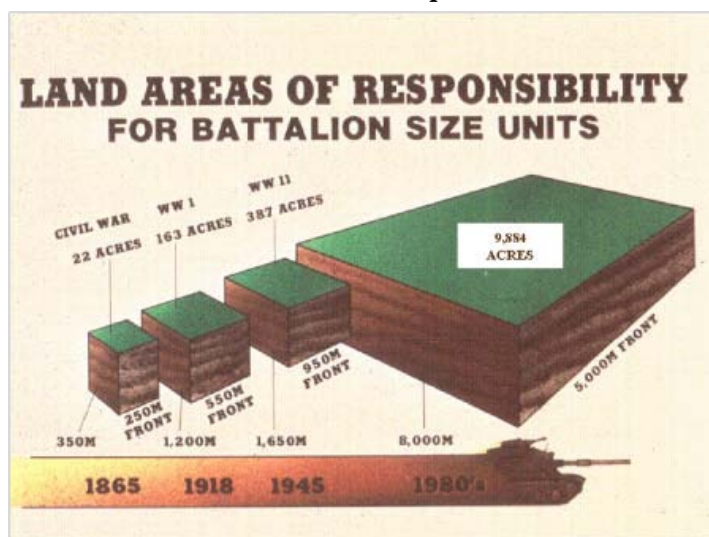


Figure 4. Army battalion size unit area of responsibility from 1865 to 1980 (Graphic developed from HQDA 1978).

The tracts of land acquired were also much larger than previously believed necessary; much of this increase was to accommodate longer range weapons, and field maneuver training. “Unit Training,” as it is now known, had its beginnings at this time, although US participation in WWI was so brief that many of the plans for performing this type of training were not actually implemented. Others were established – but later transitioned to other uses. For example, Camp Upton, on Long Island, NY was a WWI mobilization station, and is now the site of the Brookhaven National Laboratory.

Between WWI and WWII most Army installation activities dealt with disposal or consolidation of lands that were deemed to be no longer necessary. “The war to end all wars” was now over. Many of the relatively unused portions of those larger tracts, purchased in 1918, were declared surplus and transferred, if they were forested, to the newly created US Forest Service. Some of the more remote posts were also transferred to the state adjutants general, to become training bases for state militias, which are now state National Guards.

## **World War II**

While the United States did not formally enter World War II until December 1941, it had become clear several years earlier that a major conflict on the global stage involving the United States was inevitable. This is clearly highlighted in the creation of installations to support a build-up towards conflict as seen in the pre-WWI buildup. Starting around 1939, the need to develop numerous large mobilization and training installations was recognized by Congress and many new, much larger, sites were purchased, almost all from private owners. Fort Hood (1942), Fort Campbell (1942), Fort Carson (1942), and Fort Polk (1941) were part of this acquisition, and all are inland sites that utilized and required railroad access for transporting troops and equipment. The use of tanks, mechanized forces, aircraft bombing ranges, and other military equipment and activities meant that large tracts of land were needed. Installations’ initial sizes ranged from 10,000 up to 50,000 ha, roughly 10 times the land area that had been considered sufficient only 25 years earlier. Since the Army Air Corps had the aviation mission until the Air Force was separated in 1947, airfields were a major part of the additional land area requirement. Many older installations, including those formed for WWI, added land area for the same reasons.

To meet changing needs, the Army added industrial facilities with specific capabilities believed necessary to support the large war effort (Table 1). Clearly, if a war needed to be fought, ammunition and explosives would be needed in quantities many orders of magnitude greater than could be procured from existing contracts with private businesses. These plants were generally brought into production on a Government Owned, Contractor Operated (GOCO) basis (Connor 1991, pp 1-2), a plan still in use in the 21<sup>st</sup> century. The Army owns the land, facilities, and production equipment, but operations are managed by a private business, which actually employs the personnel. Some plants produced gunpowder, TNT and other explosives. Others used these explosives to load ammunition, from rifle and machine gun ammunition to artillery shells and bombs. The function of a depot was to safely store munitions and equipment until it was needed in theatre. While several of these ammunition plants have closed since WWII, many continued production, or were reactivated from time to time as munitions were needed, from 1945 to the present. Many of the plants were generally active more or less continually up to the base closures of the post Cold War era.

Table 1. Establishment of WWII Army industrial facilities (adapted from Goodwin et al. 1995).

Years	Plants	Arsenal	Depot
1939	Stratford, CT Engine Plant		
1940	Joliet, IL Army Ammunition Plant	Detroit Arsenal	Umatilla, OR Depot
	Radford, VA Army Ammunition Plant		
1941	Badger (Baraboo, WI) Army Ammunition Plant		Anniston Depot
	Indiana Army Ammunition Plant		Alabama Depot
	Iowa Army Ammunition Plant		Bluegrass, KY Depot
	Kansas Army Ammunition Plant		
	Lake City, MO Army Ammunition Plant		
	Longhorn, TX, Army Ammunition Plant		
	Milan and Volunteer, TN Army Ammunition Plants		
	Twin Cities, MN Army Ammunition Plant		
1942	Holston, TN, Ammunition Plant	Rocky Mountain Arsenal	Pueblo, CO Army Depot
	Lima, OH Tank Plant		Letterkenny, PA Army Depot
			Alton, IL Army Depot
			Tooele, UT Army Depot
			Sacramento, Sierra and Tracy, CA Army Depots

The potential for explosions was always present, but was greater at locations where TNT was manufactured or used to load shells. Depending on the specific mission of these plants, there might be significant land area set aside for safety purposes to minimize induced explosions in case of an accident. These safety areas were 5,000 to 10,000 ha in many cases. Thus the potential for land management concerns was present and were a responsibility of the operating contractor. There is little evidence of significant formal management programs during this early period, aside from clearing vegetation away storage bunkers as a fire prevention measure. Woody vegetation was regularly removed from the vicinity of the storage and production buildings, and grass and weeds were rigorously mowed, or in some cases, grazed by domestic animals. This grazing, by sheep, goats, or sometimes cattle, was an early example of land management activity, especially at the munitions plants and depots. The practice continues to this day at many locations.

Another category of ordnance-related installation expanded early in WWII was proving grounds. The first to be added was the Jefferson Proving Ground, near Madison, IN, in 1941, which was followed by Dugway Proving Ground, UT, in 1942. They joined the oldest proving ground, formed in 1917 at Aberdeen, MD. Proving grounds are important in Army materiel development, providing a place to test, that is “prove,” that the munitions and equipment function as planned. What is unique about them is that they typically require substantial land area, but people do not actually set foot on most of it. Jefferson Proving ground was 23,000 ha, and Dugway was originally 52,500 ha, and has since been expanded to 332,000 ha. Aberdeen Proving Ground is 29,530 ha. Since one major function is to test-fire sample rounds from every batch of loaded ammunition to ensure that they function correctly, millions of shells may be fired across these terrains, while leaving the land under the trajectory relatively untouched. Thus this type of facility may support extensive plant and animal communities in a relatively pristine state, presenting interesting management challenges such as providing for human access to monitor these populations. Jefferson Proving Ground was closed in 1995; most of the former installation is now managed by the US Fish and Wildlife Service as the Big Oaks National Wildlife Refuge even though an estimated 1 million rounds of unexploded ordnance (Jefferson Proving Ground 2009) and thousands of rounds of depleted uranium munitions remain on the site (Dycus 1996, p 100).

Geographical considerations and concerns also created another expansion of installations during World War II. The threat of Japanese invasion was very real early in the war and the far northwest Alaskan “frontier” had been a forgotten territory and considerable effort went into fortifying it and expanding the Army’s presence across the future state. Fort Wainwright in Fairbanks was established in 1939, followed in 1940 by Fort Richardson, in Anchorage, AK. This was followed by the creation of Fort Mears and Fort Ray (in 1941), of Fort Greeley, Fort Morrow, Fort Randall, Fort Babcock, Fort Brumbeck, Fort Bulkley, and Fort Rousseau (in 1942), and Fort Pierce and Fort Schwatka (in 1943), all in Alaska. In mid-1942, a Japanese fleet attacked the Aleutian Islands, bombing some Alaskan cities, and enemy forces occupied several of the westernmost islands for more than a year. This “back door” had clearly been neglected and an intense effort, including the building of the ALCAN Highway to allow land transport to reach Alaska, resulted from this incursion into US territory (Weil 2005).

Figure 2 shows this intensive response to the threat of another World War; more installations were formed from 1940 to 1950 period than any other decade, almost as many as the previous total of Army installations. The increase in the number of installations was accompanied by an exponential increase in the number of soldiers on active duty (Figure 5). This property acquisition left the Army with more than 5 million ha of land area in the United States and its territories, tracts that would become the land basis, a decade or more later, of formal land management programs.

#### **Post-war actions: 1946–1950**

Following the Allied victories in Europe (May 1945) and the Pacific (August 1945), the Army clearly had more facilities than were necessary for its peacetime missions. The numbers of soldiers were also more than needed for conflict-free times, although many thousands served on occupation duty in Germany and Japan for the next 5 years. Many of the ammunition plants were closed and the production machinery was either sold or placed in mothballs. The land areas were not, however, generally excessed in large quantity. Most of the new facilities, aside from those in Alaska, had been purchased in fee and were no longer in the public domain.

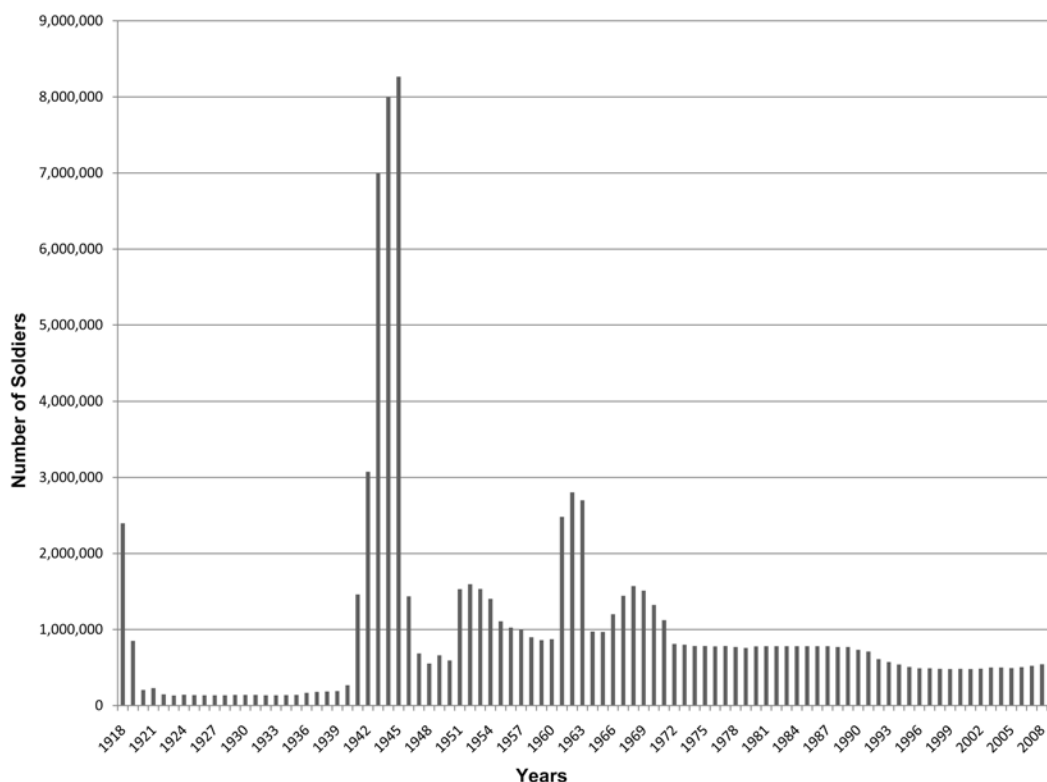


Figure 5. Army personnel strength from 1918 to 2009 (Graphic developed from US Department of Manpower Data 1996).

Air warfare had become integral to the US arsenal during WWII, to support this, a separate branch and independent installations were established. This led to a truly significant “closure” in 1947, when those installations that had been primarily constructed for use by the Army Air Corps were transferred in their entirety to the newly formed US Air Force.\* In other cases, the property was split between the services, resulting in paired Army and Air Force installations. Many of these still exist today and continue to support the US mission through the rapid deployment of troops to home or abroad. Some examples are Pope AFB and Fort Bragg, NC, McChord AFB and Fort Lewis, WA, and Elmendorf AFB and Fort Richardson, AK.†

\* Some of the many examples were Eglin AFB, Tyndall AFB, and Homestead AFB, FL, Offutt AFB, NE, Grand Forks AFB, ND, and Kelly AFB, Randolph AFB, Lackland AFB, Shepherd AFB, and Brooks AFB, TX, Beale AFB, Travis AFB, March AFB, Castle AFB, George AFB, Mather AFB, McClellan AFB, and Norton AFB, CA. Note that many of these bases were closed in later years.

† One interesting case presented itself when Fort Dix, NJ and McGuire AFB could not be separated by a single demarcation line. Fort Dix’s cantonment area was on the west side of the airfield, while most of its training land area was east of the field. The separation was effected by making the McGuire property into a V, where the Air Force facilities and flight areas are within the upper part of the “V” and the point cuts Fort Dix almost into two parts, with a small neck and a road connecting east and west Fort Dix.

One significant new installation was established in mid-1945 following the victory in Europe, though before that in the Pacific. This was White Sands Proving Grounds (now White Sands Missile Range, NM [WSMR]). The property encompasses 828,700 ha, making it the largest Army installation. As discussed earlier, proving grounds are used for testing weapons to ensure that they function correctly. Missile and rocket testing was the focus of most of its activity at White Sands Proving Ground at that time, although the most significant weapons test in history took place in July 1945 when the first atomic weapon was detonated at this site. This represents another example of creation of an installation with a specialized function in response to the perceived threats of the time. In 1940, the need was for explosives and ammunition in huge quantity. In 1945, the need was to develop skills in operating rockets, and, eventually missiles. The WSMR was acquired almost totally as a withdrawal from the public domain of lands nominally managed by the Bureau of Land Management, which retains some management responsibility for the lands.

It was also during this period that inter-continental transportation came to the forefront of national attention. Several attempts had been made in previous years to create an efficient network of interstate highways to connect the country, but the proposals were stalled in Congress (Weingroff 2006, p 1). A 1939 report stated that a “system of direct interregional highways ... designed to meet the requirements of the national defense in time of war and the needs of a growing peacetime traffic of longer range” were needed to serve the United States (Weingroff 2006). Re-emerging in the early 1950s, President Dwight D. Eisenhower championed this issue and felt that it was in the national interest and vital to national defense to establish the interstate system to better connect the continent. Such a system could facilitate the rapid deployment, from either coast, of troops and equipment needed to project US forces abroad. While it took decades to build out the interstate system, most bases are in close proximity to its routes.

### **The iron curtain: 1950–1975**

During the period 1950 to 1975, the Army did not establish many new installations. However, a couple of new facilities that were established are worthy of mention. One purchase was the property to form the Pohakuloa Training Area, on the big island of Hawaii. Another facility, Hunter Army Air Field, near Savannah, GA, came full circle to be “added” to the list of Army installations. It had been an Army Air Corps facility during WWII,



and then returned to the city of Savannah for civil use. It was repurchased by the Air Force in 1950 for use as an Air Force base, then scheduled to be closed in 1966, at which time the Army acquired it to train helicopter pilots. It is now managed as a part of the Fort Stewart complex, and functions primarily as a mobility facility, with runways capable of loading personnel and equipment for deployments overseas.

It was in this period that all Army installations began to implement formal land management programs. Forest management, especially, became mandatory for all sites with at least 75 ha of forest with commercial potential. Larger installations supported major programs, often with 20 or more personnel involved that focused on the sale of forest products, of which the revenue was directly applied to program expenses (Department of the Army 1977). Excess funds from these programs were held in an account managed by the Office of the Chief of Engineers and were used to support smaller programs at installations that had forestry potential, but inadequate harvest and sales to support their own programs. At the beginning of this period, in the early and mid-1950s, active planting of commercial species such as loblolly pine emulated typical regional practices. By 1975 and beyond, however, concerns moved toward the need to use forest species, such as the longleaf pine, which better represented the original ecosystem.

This period was very much a transition to the more modern era. It was through these years that several key environmental laws were initially enacted. The National Historic Preservation Act (1966), the National Environmental Policy Act (1969), the Clean Air Act (1970), Clean Water Act (1972), and the Endangered Species Act (1973) were all passed during the same period, and each presented many new challenges to the Army's use of its lands. Each has been amended numerous times, adding more cautions and requirements. In many ways, the more modern concepts of ecosystem management had their beginnings by 1975.

### **3 Contemporary Issues**

#### **Land acquisitions: A mixed record**

While mission needs required few new installations, the demands associated with new weapons systems and new tactics caused the military to seek to enlarge many existing installations. An interesting picture appears when the land acquisition plans of three major training installations (Fort Hood, Fort Riley, and Fort Carson) are examined. In approximately the same period, each installation experienced one major “successful” land purchase. In later years, however, each also encountered enough opposition to cause another proposed major acquisition to fail. A few recent additions or expansions to these and other locations have been completed, but in a manner notably different from previous proposals.

In the successful additions, Fort Hood added approximately 60,000 acres from 1952–54 with little local or Congressional opposition. Fort Carson and Fort Riley each added roughly the same amount in the 1960s, Fort Carson in 1966 and Fort Riley about 2 years later. More local opposition, as expressed in newspaper stories and correspondence, was expressed for these public land acquisitions than for the Fort Hood expansion a decade earlier, but Congressional support was adequate, if not unanimous. Public and Congressional sentiment during this early Cold War period placed national defense very high, as was apparent in the Fort Hood expansion where only two land owners contested the action. This attitude changed rapidly over the following decade.

Associated with increasing US involvement in the Southeast Asian conflicts, increasing antipathy toward the Army expressed itself in opposition to use of land for military purposes. In the first of the three unsuccessful proposals, Fort Hood proposed a major addition several times, starting in 1968. This Fort Hood addition became a formal Army proposal in 1972, with a draft appropriation line item showing a start in 1976. Fort Carson proposed several different expansion programs in the period 1976–80 (Hughes 2007). Fort Riley first proposed its need for more land in 1978 and developed a formal plan, with alternatives, in 1986. Each of these proposals was strongly opposed by local interests. None gained more than lukewarm Congressional support and none ever reached legislative decision status, being withdrawn (or never formally proposed) before final

submission of the bills. Note that, as of 2009, new expansion proposals involving Fort Carson and Fort Riley are being evaluated (Roeder 2008).

In the mid-1950s, the role of the Federal government and Congress, with regard to decisions on the acquisition and use of military lands, was significantly changed. During this period, Congressman Clair Engel of California, in response to increased demands by the Department of Defense (DOD) for land, convened the first hearings, known as the Engel Hearings, to address withdrawals of land from the public domain. The eventual outcome of these hearings was the establishment of the Engel Act of 1958, which established a key principle that DOD withdrawals of areas in excess of 5000 acres required an Act of Congress, with the attendant public hearings. In short, this Act brought to a close the earlier eras in which military land transactions were conducted with little public scrutiny.

Two landmark military land acquisition issues arose during the late 1970s and mid 1980s. The first was in 1979 when the Carter Administration announced a plan to build the MX Intercontinental Ballistic Missile (ICBM) system on several “racetrack” sites arrayed across some 25 million acres in the Great Basin region of Nevada and Utah.\* This plan was opposed by both private landowners and environmental groups and was dropped in the 1980s following election of a new Congress. The second was in 1986 with the passing of the Military Lands Act (PL 99-606) authorizing DOD to make several large land withdrawals in the West, but limiting these withdrawals to 15 years before reauthorization and required the preparation of a comprehensive Environmental Impact Statement (EIS) for each action.

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\* The MX Intercontinental Ballistic Missile Program was first introduced by the Carter Administration in the late 1970's as a weapon system to compete with new Soviet ICBM rockets. It was felt that even a small number of the new Soviet SS-18 missiles were a threat to the fixed-site US Minuteman and Titan silos. Therefore, the US Air Force began researching mobile basing solutions as early as 1971 and later to design a new heavy ICBM to surpass the Minuteman, which led to the MX program to create options for mobile solutions. Several solutions were developed and researched, of which the Carter Administration favored the Multiple Protective Structure (MPS) system also known as the “racetrack.” This system would deploy an MX missile in a closed road loop that contained 23 horizontal shelters where the missiles would be transported randomly between shelters by a transporter-erector-launcher (TEL). The TELs would park inside a shelter with its cargo until it was time for the missile to be moved to another location to ensure location uncertainty or for maintenance. This process could be undertaken while protected from enemy surveillance, but ports on the roof of each structure could be opened for aerial inspection. Areas within eastern Nevada, western Utah and at a time, northern New Mexico were considered for basing the MPS system. The area located in Nevada and Utah, known as the Great Basin, was where the majority of local opposition arose. Locals were concerned that the influx of construction workers could potentially overwhelm existing services. Another concern from local ranchers was over the limited water supply and issues of public access to these lands for grazing. (Barlow, 1980)

The greatest area of Army land holdings remains in the West, with over 70 percent of the Army's lands in the mid-1980s located within 10 western States (Alaska, Arizona, California, Colorado, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming) (Cawley and Lawrence 1999). Many of the other services' large land holdings are also located in the western United States, such as the Navy's China Lake and Marine Corps' base at Twenty-nine Palms in California. Thus, this defense investment in the West spawned significant economic growth and urban development that defined much of the economic history of the West during this era, and established a patchwork of military installations of many varieties across the western landscape (Nash 1999).

Many current DOD land holdings have come under increasing political and social pressures from encroachment in the past decade as the US population has grown in many areas across the country. The DOD has worked closely with other Federal agencies to develop cooperative land use agreements for air and land space. While some recent land acquisitions have been successful, a new era of land conflict involving land acquisitions has begun to emerge in the early 21<sup>st</sup> century. For example, during the 1990s, and extending into the 21<sup>st</sup> century, the Army acquired approximately 20,000 additional acres in the Mojave Desert, adjacent to Fort Irwin, CA.

One recent tool to help relieve land conflict and land acquisition issues was the 2003 National Defense Authorization Act, which initiated the Readiness and Environmental Protection Initiative (REPI). REPI was created as part of the DOD's Sustainable Ranges Initiative to enable military services to partner with local and state governments, and with non-government agencies to establish conservation or use rights easements on lands outside the fence lines of their facilities (DOD 2007). The Sustainable Ranges Initiative (at the defense and the service levels) was also established to ensure that military readiness capabilities were "sustained,"\* and defense research laboratories developed tools to help evaluate land use threats, project potential land use scenarios, and share potential stakeholder approaches to sustain military land capacity into the future.†

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\* This initiative has grown in programs and reach throughout the first years of the 21<sup>st</sup> century. Activities have included partnering programs with other Federal agencies, non-government organizations, states and local governments. The Sustainable Range Initiative's programs, activities, and meetings are all highlighted on the Defense Environmental Network and Information Exchange (DENIX) at: <https://www.denix.osd.mil/portal/page/portal/denix/range/Home>

† These include the Sustainable Installation Regional Resource Assessment (SIRRA) database, the Land Evolution and Assessment Model (LEAM) and the military adaptations to this model (mLEAM), the Pro-

## **New laws, changing threats: 1975–1990**

In many ways, the historic transitions after 1975 were important for the defense mission overall, as well as for attitudes toward the management of Army lands. The year 1975 marked the start of active cooperation with the Soviet Union in space programs and 1990 marked the end of the Soviet Bloc as a formal enemy. As noted earlier, a host of legislation requiring more attention to the environment was enacted just before, or early into, this period. In some ways, this shifted the public focus from the enemy outside the country toward how the government was managing public lands. During this time, the Army developed the Integrated Training Area Management (ITAM) program, as a monitoring and land rehabilitation effort to ensure sustained use of military training and testing lands (DOD 2009).

In the late 1980s and early 1990s as the Cold War era came to an end, the US Congress and political leaders took bipartisan, proactive steps intended to reduce the costs associated with the defense budget through a reduction in the number of military installations. There was strong pressure to close as many installations as possible, and as soon as possible. In addition, it was originally believed that the land could be sold or leased for significant added income to the government. At the same time, the military, and especially the Army, received intensive criticism related to almost every aspect of installation management. Non-governmental organizations, as well as ad-hoc groups formed around local issues, focused variously on issues such as soil erosion, smoke, noise, dust, forest management, and protection of endangered species. In one way or another, each of these issues created the need for a research program to address concerns and to develop guidance to better manage each of these concerns. The formal base closure process became law toward the end of this period, and some Army installations, created to meet older demands, would be declared to be unneeded.

The Carter Administration required Congressional approval for all base closings and realignments with Public Law 95-82, approved 1 August 1977; in 1988 the Secretary of Defense chartered the Commission on Base Realignment and Closure (BRAC) as a nonpartisan, independent commission, to study US military bases and recommend realignment or closure. BRAC

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active Options with Neighbors for Defense installations Sustainability (PONDS). These tools have been incorporated into a process framework entitled Strategic Sustainability Assessment (SSA) that involves forecasts of trends and plans against “goals” and a variety of backcasting “what if” scenarios relating potential “interventions.” Access to information about these tools can be found at the Engineering Knowledge Online (EKO) website, under sustainable regional planning, at: <https://eko.usace.army.mil/fa/serm/>.

committees convened in 1988, 1991, 1993, 1995, and 2005 to make realignment and closure recommendations (GlobalSecurity.Org 2009)

At the same time, the military, and especially the Army, received intensive criticism related to almost every aspect of installation management. Non-governmental organizations, as well as ad-hoc groups formed around local issues, focused variously on issues such as soil erosion, smoke, noise, dust, forest management, and protection of endangered species. In one way or another, each of these issues created the need for a research program to address concerns and to develop guidance to better manage each of these concerns. Some are discussed in more detail below.

### **Closing bases: The BRAC experience**

In the late 1980s and early 1990s as the Cold War era came to an end the US Congress and political leaders took bipartisan, proactive steps to reduce the costs associated with the defense budget through a reduction in the number of military installations. This process became known as “base realignment and closure,” or BRAC. This process was codified by the Defense Base Closure and Realignment Act of 1990 (the so-called “BRAC law”). The BRAC law governs actions taken to close military installations where 300 civilian personnel are authorized to be employed, realignments at installations that create a reduction of more than 1000 employees or by more than 50 percent of the existing workforce, and any construction resulting from closures or realignments (Wilcox 2007). With respect to any closures, the military services must comply with the provisions of the National Environmental Policy Act (NEPA) to ensure that all environmental impacts associated with military use are mitigated. This requirement, which effectively meant that munitions and chemical contamination must be removed before closure, turned the “money making” closure process into an immense and costly cleanup process; one which is not yet complete and may never be fully implemented.

The BRAC process can have a significant impact on local communities. Thus, the process, particularly in its early stages, created significant Congressional response. To soften the economic impacts of base closure, Congress passed the Base Closure Community Assistance Act in 1993 to assist communities with identifying and implementing means of reutilization or redevelopment of these properties to spur economic prosperity (Wilcox 2007). The most recent BRAC round occurred in 2005 and was predicted to be the largest ever, with up to 20 percent of DOD installations on the

“chopping block” for closure. However, because of the Overseas Contingency Operation and DOD commitments abroad, this round, although the largest, did not result in significant closures. Rather, it became known as the “Big R, little c” BRAC round because it involved the realignment and restationing of many Army forces, rather than the closure of installations in total. The missions and personnel at closed installations, in almost all cases, were moved to an installation that remained open. This realignment has spurred a significant demand for construction at those installations, such as Fort Bragg, Fort Carson, Fort Bliss, and Fort Benning, which are receiving the missions of the realigned posts (Wilcox 2007, p 177).

### **CONUS Consolidation: 1991–2001**

Many important philosophical changes in this decade affected Army land management. On the one hand, the importance of installations as “power projection platforms” was recognized. This meant that the function of these major installations was to support units being trained for deployment, and to allow them to train to the highest possible skill level. On the other hand, though, installation environmental and natural resources management was recognized to be one that emphasized support for endangered species rather than ignoring everything but military needs. The pressure to close installations continued, and BRAC increased in tempo, as noted above. One change, however, was that the missions and personnel at closed installations did not disappear. In almost all cases, they were moved to an installation that remained open. This increased pressure on each of the places that had to absorb them and presents greater challenges to the installation’s environmental management as well.

Another issue that came to light in this period (even though it had certainly been taking place for decades) was that of civilian housing and commercial development gradually surrounding Army installations. Those places that had been an hour’s train ride outside of town in 1940 were now engulfed by “bedroom suburbs.” In many cases the noise from all aspects of Army training caused these nearby communities to react with annoyance and even anger. This phenomenon of the adjacent civilian community growing to surround an installation gave rise to the use of the term “encroachment” in its original sense. Whatever term is used, it is a problem and makes it increasingly difficult to implement many important land management programs such as use of prescribed fire. Other usages of the term “encroachment” have been applied recently, some of which are discussed below.

## Who's encroaching upon whom?

It was not until the late 1990s that the word “encroachment” started receiving widespread use within the Department of Defense. The concept behind the word related to readiness – and how “external” factors were impacting the readiness of the military because of constraints imposed on training and testing activities. A 2006 Government Accountability Office (GAO) report, discussing this issue, states:

Recent operations in Iraq, Afghanistan, and other locations around the world have highlighted the need for US forces to train as they intend to fight. The use of military training ranges enhances the success of the training by providing realistic, hand-on experience. However, the military services report they have increasingly lost training range capabilities due to encroachment and other factors (GAO 2006).

The official Department of Defense definition, crafted by a Defense Senior Readiness Oversight Committee as: *the cumulative result of any and all outside influences that inhibit normal military training and testing* (GAO 2003). Another perspective might be that the evolution of military training doctrine and weapon systems has increasingly required more space for air flights, convoy simulations, weapons testing, and maneuver events. While many installations were built with enough “buffer” space for training given a World War II footprint, the expanding footprint of each new generation of military weapon and vehicles continuously eroded this “buffer” space (Lachman, Wong, and Resetar 2007). As a result, buffer space was now needed beyond the fence line, exactly where new housing developments are being created (Deal, Timlin, and Goran 2002).

## The sound of freedom

The evolution of weapon systems throughout the 20<sup>th</sup> and into the 21<sup>st</sup> century has trended toward much noisier guns and aircraft. Modern weapons not only shoot farther, but they generate more noise both where fired and where their projectiles strike. Planes have not only increased in size and volume on takeoff, but can also be very loud in flight. This is especially true for low level jet flights. While ground weapons are generally only fired (in training/testing) from the confines of military bases, aircraft have extensive military operating areas that extend over large areas of land beyond military bases. These defined military operating areas where military aircraft fly were originally selected to be largely over sparsely-populated areas, but land uses beneath these areas continue to change, and the grow-



ing populations are affected by military aircraft areas and routes. Military personnel may speak of these noises as “the sound of freedom,” but these sounds of freedom can be unwelcome and unnerving when they reach the homes of nearby residents. \*

While there are no national laws that constrain military noise, the military has been sensitive to the potential for military noise to disrupt proximate populations, therefore they have developed capabilities and procedures to minimize noise disruptions. Instructions were issued by the Department of Defense on “air compatible use zones” (ACUZ) in November 1977 (DOD 1977). Besides these instructions, the Department of Defense established a coordinated planning approach between military installations and their surrounding communities entitled *Joint Land Use Study (JLUS)*. JLUS is administered by the Department of Defense Office of Economic Adjustment (Office of Economic Adjustment 2006). These JLUS studies are structured to identify areas with high military noise exposure, and to provide resources for communities and installations/ranges to plan together to avoid potential conflicts in these areas.

The encroachment issue was also, in part, a response by the Department of Defense to a series of environmental legislative actions that were perceived, at least by some within the Department, to unnecessarily constrain military readiness. These acts, such as the Endangered Species Act and others cited earlier, at times have caused the military to create “workarounds” to accomplish certain unit exercises. Relief was also sought from other acts – including the Coastal Zone Management Act, Clean Air Act, and the Marine Mammal Protection Act. The calls, within the military, for relief from overly burdensome regulation, increased after the 2000 presidential elections and especially after the events of 11 September 2001 and the initiation of the Overseas Contingency Operation. A quote by James Gibbons (R-NV) during a congressional hearing on this issue, articulates this viewpoint: “we owe our service members and their [families] at least the same consideration and protection we give to the Fairy Shrimp, Tidewater Goby, and any other creature” (Durant 2007, p 228).

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\* “The Sound of Freedom” has been used to reference military noise for several decades. The earliest that this phrase was cited, in reference to military noise, was in the 1960s by US personnel describing military noise from training aircraft as the “sound of freedom” to their German soldiers and citizens. This phrase gained widespread use in the 1980s by the Reagan Administration to evoke patriotism as a way to rationalize military expansion and the noise associated with military bases.

Actual regulatory relief was, for the most part, modest; the Department of Defense was still accountable for stewardship and protection of the resources within the Department's control and influence. However, the need to ensure sustainable mission capabilities did result in an important new authority for the military services. A solution arrived with the 2003 Defense authorization, which, as discussed earlier, included an authority, REPI and the Sustainable Ranges Initiative to allow for partnerships and research to alleviate land issues on and surrounding military installations.

### **New threats: 2001–2008**

Following the terrorist attacks of 2001 and the ensuing Overseas Contingency Operation, the management of the environment on Army installations has taken on still another focus. Instead of being satisfied to be seen to be doing an adequate job of managing resources, military land managers are increasingly being asked to be examples of the highest standards of public resource management. Military land management resources are focused on mission and environmental goals, such as endangered species support, rather than traditional productivity of forests or grasslands.

### **Globalization and new pressures on military lands**

The US defense establishment's engagement in the Overseas Contingency Operation since 9-11, including operations in Iraq and Afghanistan, has dramatically impacted its land use and stationing of forces. Many US forces are currently deployed overseas in over 120 countries, requiring the establishment of infrastructure and training areas in these countries, particularly in southwest Asia. This includes the establishment of air bases, naval support facilities, and combat force bases to support the over 140,000 soldiers and sailors in country forces. This overseas growth is accompanied by increases in force size (e.g., the "Grow the Army" initiative to increase Army active duty strength by 65,000 soldiers) (US Army 2009).

Defense transformation has called for a permanent restationing of forces in the United States, rather than abroad. Thus, forces previously stationed in Europe, particularly Germany, are returning to installations in the United States, leaving a significantly reduced footprint in Europe. Additionally, forces stationed in South Korea will relocate to the south, farther from the Demilitarized Zone (DMZ) and some forces will return stateside. The long-term stationing of forces in Iraq and Afghanistan is unknown at this time,

but it is likely that some forces will remain, requiring installations and forward operating bases.

Eventually, the return of forces from abroad to the United States will have a significant impact on land requirements within the United States. Since the establishment of new installations is not envisioned, these additional forces must be restationed to existing installations, increasing the need for housing, basic services, firing ranges, and training lands. One example is the anticipated growth of Army forces at Fort Carson in Colorado Springs, CO. The demand for additional training space has initiated the quest for more training land at the Piñon Canyon Maneuver Site in southern Colorado, triggering intense opposition from local land owners and ranchers (Yoanna 2006).\*

The future of US defense land acquisition remains uncertain. It is clear that the DOD must sustain its current land inventory amidst increasing external pressures. However, its ability and need to expand these land holdings, in light of restationing of its forces back to the United States, presents a continuing challenge. As a result of BRAC and restationing, Fort Benning, GA, is a prime example of an Army installation facing major challenges, as it plans to receive the Armor School from Fort Knox, KY. Construction of new ranges and other facilities necessary to accommodate the school are already impacting critical habitat for protected species. Despite sophisticated approaches to land management stewardship, it may not be possible for Fort Benning to achieve fully goals of supporting an enlarging military mission and also sustain habitat for protected species. However, with the establishment of “off post” easements the Army may be able to expand the habitat area for the protected species outside its fenceline, while devoting more of their “inside the fenceline” resources to meeting military mission goals. Some may see this as a puzzling strategy. They question why the Army should be involved in securing endangered species habitat beyond Army-managed borders. Yet, the Endangered Species Act provides strong regulatory authority over Federal lands, and military lands often provide critical habitat for protected species, so any loss of this habitat may seriously impact a species’ survival.

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\* Piñon Canyon Maneuver Site (PCMS) is located 150 miles southeast of Fort Carson, it was opened in 1985 to provide critical manoeuvre lands for larger units on the installation and from other installations in the area. PCSM supports non-live-fire training areas allowing for force-on-force, mechanized brigade training exercises. The area of PCMS encompasses a diverse ecosystem of large and small game, fisheries, and forests, which include species considered endangered, threatened or of “special concern,” such as the Bald Eagle, Whooping Crane, Mountain Plover, Lesser Prairie Chicken, and the Garter Snake.

Expansion of military mission activities is also taking place south of Fort Benning and at Eglin AFB in North-western Florida. The Air Force realigned this base to be home to the new F-35 Joint Strike Fighter Program, which involves the creation of a joint training and maintenance centre to train pilots



Figure 6. Women signing billboard supporting the F-35 Joint Strike Fighter (Brooks 2009).

from the Air Force, Navy, Marines, and allied countries. The initial BRAC reports offered a conservative estimate on the noise levels that would be created by the newly developed jets. After further testing was completed, it has been recorded that the levels are above the 65 decibel level for residential areas, which is almost twice that previously estimated (Alaimo 2008).

This has local residents concerned that the area will be uninhabitable due to the cost to add sound abatement and would lower property values. This situation leaves local residents in a quandary. They can either stay and deal with the noise issues, or move elsewhere. While some residents in the region oppose this new mission at the base (especially those in the path of the runways to be used) other residents have expressed the need to support the base despite the increased noise levels (Figure 6).

Multiple law suits are currently in progress to determine the fate of the local communities and the Joint Strike Fighter program (Brooks 2009). The pressures being experienced at Fort Benning and Eglin Air Force Base are symptoms of problems that will persist for the US military in the decades ahead. Emerging weapon systems and complex and rapidly evolving threats will require diverse capabilities for military training and future force projection. Future training will be multi-dimensional and multi-service (coordinated land, sea and air space) during an era of increasing competition for land, sea and air space. The military will need strong justifications to convince politicians, stakeholders and neighbors that any addi-

tional land, sea or air access is needed. These persistent constraints will force military planners to pursue creative approaches. The use of training simulators will likely increase, and be integrated into live training. In addition, the military may develop approaches for “temporary” access to land, sea, and airspace resources (such as the use of shared transportation facilities like interstate highways) in the United States and beyond US borders. Perhaps, also, these competitive pressures for earth-based resources will also be one of many contributing factors to spur military activities in space.

## **4 Conclusion**

The information provided in this report is meant to inform the US Defense Department's review of its inventory of military bases by providing an historical context underlying the driving reasons behind the establishment of military installations within the United States, e.g., their relevance and usefulness, their number (too many or too few), their location (in relation to current and emerging threats), and ultimately, when an installation is believed to no longer be needed, the manner in which it may be converted to another life.

## Acronyms and Abbreviations

Term	Spellout
ACUZ	Air Compatible Use Zone
AFB	Air Force Base
BRAC	Base Realignment and Closure
CASI	Center for the Advancement of Sustainability Innovations
CEERD	US Army Corps of Engineers, Engineer Research and Development Center
CERL	Construction Engineering Research Laboratory
CONUS	Continental United States
DC	District of Columbia
DMZ	Demilitarized Zone
DOD	US Department of Defense
EIS	Environmental Impact Statement
ERDC	Engineer Research and Development Center
ERDC-CERL	Engineer Research and Development Center, Construction Engineering Research Laboratory
GAO	Government Accountability Office
GOCO	government owed, contractor-operated
GPO	Government Printing Office
ICBM	Intercontinental Ballistic Missile
ITAM	Integrated Training Area Management (Program)
JLUS	Joint Land Use Study
NEPA	National Environmental Policy Act
PDF	Portable Document Format
PI	Principal Investigator
PL	Public Law
REPI	Readiness and Environmental Protection Initiative
TNT	trinitrotoluene
TR	Technical Report
URL	Universal Resource Locator
WSMR	White Sands Missile Range
WWI	World War I
WWII	World War II
WWW	World Wide Web

## References

- Alaimo, Carol Ann. 2008. Noisy F-35 still without a home. *Arizona Daily Star*. 30 November 2008, <http://www.azstarnet.com>
- Barlow, J. G. 1980. Insuring survivability: Basing the MX missile. Washington, DC: The Heritage Foundation, 2–18.
- Bauer, K. J. The Battles on the Rio Grande: Palo Alto and Resaca da la Palma, 8-9 May 1846. in C. E. Heller and W. A. Stofft, eds. *America's First Battles: 1776-1965*. Lawrence, KS: University of Kansas Press.
- Brookhaven National Laboratory. 2009. Brookhaven History. Website. Upton, NY: Brookhaven National Laboratory, <http://www.bnl.gov/bnlweb/history/>
- Brooks, Robin. 2009. A sign of the times Residents add names to billboard to support Joint Strike Fighters. *Northwest Florida Daily News*. 14 March 2009.
- Cawley, R. M. and R. M. Lawrence. 1999. The interface of National security policy and Federal lands policy, or, The greening of the pentagon. in W. Crotty, ed. *Post-cold war policy, The social and domestic context*. Chicago, IL: Nelson-Hall Publishers, 274–292.
- Connor, Maj M. J. 1991. Government owned-contractor operated munitions facilities, are they appropriate in the age of strict environmental compliance and liability: *Military law review*, 131:1–2.
- Cosmas, G. A. 1986. San Juan Hill and El Caney, 1-2 July 1898. in C. E. Heller and W. A. Stofft, eds. *America's first battles: 1776-1965*. Lawrence, KS: University of Kansas Press, 109-148.
- Cragg, D. 1997. *Guide to military installations*. 5<sup>th</sup> ed. Mechanicsburg, PA: Stackpole Books.
- Crakel, T. J. 1986. The battle of Queenston Heights, 13 October 1812. in C. E. Heller and W. A. Stofft, eds. *America's first battles: 1776-1965*. Lawrence, KS: University of Kansas Press, 33-56.
- Deal, Brian M., Diane Timlin, and William D. Goran. 2002. *Urban encroachment of military lands: Military installations at risk*. ERDC/CERL TR-02-3/ADA401147. Champaign IL: Engineer Research and Development Center-Construction Engineering Research Laboratory (ERDC-CERL).
- Durant, Robert F. 2007. *The greening of the US Military*. Washington DC: Georgetown University Press.
- Dycus, S. 1996. *National defense and the environment*. Hanover, CT: University of New England Press, 80–135.



- GlobalSecurity.Org. 2005. Military, base realignment and closure (BRAC). Webpage.  
<http://www.globalsecurity.org/military/facility/brac.htm>
- Goodwin, C. R., D. K. Cannan, K. E. Grandine, L. Hirrel, K. M. Kuranda, H. B. McAloon, B. M. Usher, and M. R. Williams. 1995. National historic context for Department of Defense Installations, 1790 – 1940. Baltimore, MD: US Army Corps of Engineers, Baltimore District. vol. 1.,  
[http://aec.army.mil/usaec/cultural/nhc\\_01.doc](http://aec.army.mil/usaec/cultural/nhc_01.doc)
- Hughes, D. 2007. Let Army use the land it needs or let it leave. Rocky mountain news. Web blog,  
[http://blogs.rockymountainnews.com/denver/speakout/2007/03/let\\_army\\_use\\_the\\_land\\_it\\_needs.html](http://blogs.rockymountainnews.com/denver/speakout/2007/03/let_army_use_the_land_it_needs.html)
- Jefferson Proving Ground. 2009. Jefferson Proving Ground, Installation Support Management Agency. History, operations. Webpage.  
<http://www.jpghrac.com/history/operations.htm>
- Kreidberg, M. A. and M. G. Henry. 1955. History of military mobilization in the United States Army, 1775-1945. Department of the Army Pamphlet No. 20-212. Washington, DC: US Government Printing Office.
- Lachman, Beth, Anny Wong, and Susan A. Resetar. 2007. The thin green line: An assessment of DOD's readiness and environmental protection initiative to buffer installation encroachment. Santa Monica, CA: RAND National Defense Research Institute.
- Nash, G. D. 1999. The Federal landscape, An economic history of the twentieth-century West. Tucson, AZ: University of Arizona Press, 214.
- Phillips, S. W. and A. T. Sweet. 1926. Soil survey of Muscogee County GA. Washington, DC: US Department of Agriculture Bureau of Soils.
- Richter, D. D., P. R. Heine, V. Jin, J. Raikes, Kun Tian, D. Markewitz, and C. G. Wells. 2000. Legacies of agriculture and forest regrowth in the nitrogen of old-field soils. *Forest Ecology and Management*, 138:1-3, 233–248.
- Robertson, W. G. 1986. First bull run, 19 July 1861. in C.E. Heller and W. A. Stofft, eds., *America's first battles: 1776-1965*. Lawrence, KS: University of Kansas Press, 81-108.
- Roeder, T. 2008. Past Army dealings color expansion negotiations. The Colorado Springs gazette. 21 September 2008,  
[http://findarticles.com/p/articles/mi\\_qn4191/is\\_20080921/ai\\_n29494749](http://findarticles.com/p/articles/mi_qn4191/is_20080921/ai_n29494749)
- Stewart, R. W., ed. 2005. The formative years, 1783-1812. in *Army historical series, American military history, The United States Army and the forging of a nation, 1775-1917*. Washington, DC: US Army Center of Military History, 1, 107–130  
<http://www.history.army.mil/books/AMH-V1/ch05.htm>
- Headquarters, US Department of the Army (HQDA). 1977. Facilities engineering: Natural resources land, forest, and wildlife management. Pamphlet 420–7. Washington DC.: Government Printing Office.

- . Fort Monroe Aerial. 2007. Washington, DC: HQDA.
- . 2007. Grow the Army. Army Growth Plan as of 19 Dec. 2007. Washington, DC: HQDA, <http://www.army.mil/growthearmy>
- . 2009. Integrated Training Area Management. Washington, DC: HQDA, [http://www.sustainability.army.mil/function/training\\_itam.cfm](http://www.sustainability.army.mil/function/training_itam.cfm)
- . 1978. Training Land. Training Circular TC 25-1. Washington, DC: US Government Printing Office.
- US Department of Defense (DOD). 2007. Readiness and environmental protection initiative. Fact sheet. Washington, DC: DOD <https://www.denix.osd.mil/portal/page/portal/content/range/Compatible/REPI/REPIFACTSHEET.PDF>
- U.S Department of Defense (DOD) Office of Economic Adjustment, 2006. Joint Land Use Study Program Guidance Manual. Washington, DC: DOD .
- US Department of Manpower Data, Statistical Information Analysis Division, Personnel and Procurement Statistics. 1996. Table 2-11, Department of Defense Active Duty Military Personnel, 1789 Through Present. Washington, DC: DOD, <http://siadapp.dmdc.osd.mil/personnel/M01/FY96/sms211r.htm>
- US General Accounting Office (GAO). 2006. Improvement continues in DOD: Reporting on sustainable ranges but additional time is needed to fully implement key initiative. GAO-06-725R Military Training. 20 June 2006. Washington, DC: Government Printing Office (GPO), <http://www.gao.gov/news.items/do6725r.pdf>
- . 2003. Military training: DOD approach to managing encroachment on training ranges still evolving. GAO-03-621T Defense Infrastructure Issues. 02 April 2003, <http://www.gao.gov/new.items/d03621t.pdf>
- US Military Academy. 2009. United States Military Academy History. Web page. West Point, NY: US Military Academy, <http://www.usma.edu/publicaffairs/history%5Fnot%5Fin%5Fuse/default.htm>
- Weil, G. L. 2005. America answers a sneak attack, Alcan and Al Qaeda. Los Angeles, CA: The Americas Group, 18– 19.
- Weingroff, R. F. 2006. Essential to the National Interest: Public roads. 69:5, 7.
- Wilcox Jr., W. A., 2007. The modern military and the environment. The laws of peace and war. Lanham, MD: Government Institutes.
- Yoanna, Michael De. 2006. Targeting paradise: Fort Carson expansion could swallow history, wildlife and a way of life. Colorado Springs Independent. 10 August 2006, <http://www.csindy.com/colorado/Home>

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