



# The Southwest Defense Complex

*The New First Line in the Nation's Defense*

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# The Southwest Defense Complex:

## *The New First Line in the Nation's Defense*

### Executive Summary

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It is a core principle of the U.S. military that you must train as you fight. One of the enduring advantages the U.S. military possesses is the quality of its personnel based largely on their training. Maintaining this advantage will depend heavily on access to a set of training, test and experimentation facilities that are part of what is called the Southwest Defense Complex which resides in six southwestern states: Arizona, California, Nevada, New Mexico, Utah and Texas. The Complex contains some of this nation's most sophisticated laboratories, defense industrial facilities and military bases allowing for the development and testing of many of the systems that won the Cold War.

The Complex is a true national treasure on a scale equal to that of the National Park system. The Southwest offers over 335 million acres of federally owned land. Some 490,000 square miles of restricted airspace and 484,000 square miles of sea are available for training activities. Its land, sea and dedicated air space provide a unique training environment unparalleled in the Free World. The Complex provides the only open instrumented land and air spaces in the United States of sufficient size to permit large-scale joint experiments and training activities. Many allied nations do virtually all their pilot training in the Complex because they lack similar open spaces in their own countries. The Southwest Defense Complex's contribution to the U.S. military's warfighting capabilities, military readiness, test and evaluation, and research and development is unparalleled.

Yet, given the fragmented way the Pentagon, Congress and the public tend to think about defense assets, they lack an adequate appreciation of the importance of this complex to U.S. national security. As pressure grows to address looming defense budget shortfalls through cuts to forces, readiness and infrastructure, the value of the Southwest Defense Complex as a whole is in danger of being underestimated. Pressure is growing for another round of base closures and realignment of facilities. Consequently, over time, the Complex could be weakened and even dismantled.

Preserving the array of unique facilities in the Complex and expanse of air and land critical to realistic testing and training will be of vital importance to U.S. security in the 21<sup>st</sup> Century. It is vitally important that the panoply of facilities and controlled spaces that are part of the Southwest Defense Complex be protected from encroachment, excessive regulations and prospective budget cuts. Once lost, these facilities and ranges cannot be reconstituted.

*On the Cover: Nevada Test and Training Range. (Image: Nellis Air Force Base)*

## The Origins of the Southwest Defense Complex

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Beginning in World War Two and extending for the duration of the Cold War, the United States built an array of military bases, training centers and installations, land, littoral and sea ranges, national laboratories, and test and industrial facilities that were critical to the American victory in both conflicts. Many of these were located in the Southwest United States. Some, such as Forts Huachuca and Bliss and the Yuma Proving Ground, were the outgrowth of Army bases built originally to secure the frontier of a westward moving nation. In the majority of cases, the U.S. military, needing at the start of World War Two large expanses of uncompromised land on which to train combat forces, conduct experiments and tests and create innovative new weapons systems – such as the first atomic bombs – in secrecy, found it in the states of the Southwest. Of particular importance was the ability to restrict access to the airspace associated with these training bases, test facilities and ranges.

The foundation of today's Southwest Defense Complex rests on a series of facilities, bases and ranges established in the period 1940-1942. These include the Army's Forts Irwin, Hood and Hunter Liggett and White Sands Missile Range, the Marine Corps' Base Camp Pendleton and Air-Ground Combat Center at Twentynine Palms, Air Corps/U.S. Air Force fields and bases such as Nellis, Holloman, Laughlin, Luke, Davis-Monthan, Travis, Kirtland, Beale and Edwards, and the Navy's China Lake Naval Air Weapons Station and Naval Air Station (NAS) Fallon. Two of the nation's premier national laboratories, Los Alamos and Sandia, where the nation's first atomic weapons were created, are part of the Southwest Defense Complex.

The 1940s also saw the creation of a massive privately-owned and operated aerospace and defense industrial base in the same region. Many iconic names in the area of aerospace such as Douglas Aircraft, Lockheed, Northrop, Rockwell, North American Aviation, Hughes Aerospace, Martin and Grumman Aircraft set up production and research and development facilities in the Southwest. Although most of these companies no longer exist, having succumbed to the waves of industry consolidation that occurred over the past two decades, many of the facilities originally built during World War Two continue to serve industry and the military.

The beginning of the Cold War and the introduction of jet aircraft, long-range rockets and electronic warfare systems resulted in a substantially increased requirement for large, secure and dispersed facilities, ranges and bases in the Southwest. The requirements for restricted access to large volumes of airspace also increased due to advances in aerospace technologies and the development of faster and longer range platforms and missiles.

The expansion of advanced military and space-related activities at government facilities in the Southwest was matched by the growth of the aerospace and defense sector. At the height of the Cold War, 15 of the 25 largest aerospace companies in the United States were based in the Southwest. In addition, the U.S. government invested in a series of complementary research and development facilities for advanced aerospace technologies in support of both the military and NASA. These included: the Armstrong (formerly Dryden) Flight Research Center, the Jet Propulsion Laboratory (created in 1936 as the Guggenheim Aeronautical Laboratory), Los Angeles Air Force Base and Vandenberg Air Force Base.

The military facilities in the Southwest played an absolutely critical role in supporting the development and fielding of platforms, systems and capabilities that allowed the U.S. Armed Forces to maintain a qualitative edge over all adversaries. Chuck Yeager broke the sound barrier in the Bell X-1 at Edwards Air Force Base (AFB). Edwards became the primary test and integration facility for virtually every U.S. Air Force jet aircraft for some 40 years. Vandenberg AFB provided launch facilities for testing and development of every major U.S. intercontinental ballistic missile (ICBM) and space launch vehicle.

The unequalled U-2 spy plane was developed at the world-renowned Lockheed Skunk Works in the Southwest Defense Complex and first tested on the range at Nellis AFB. The Complex enabled the development and testing of many of the systems that won the Cold War, like the F-117 stealth fighter, SR-71 reconnaissance aircraft and B-2 stealth bomber, as well as the precision weapons. In addition to its seminal role in the development of the atomic bomb, the Army's White Sands Missile Range supported the development of Army rockets, surface-to-air missiles and radars. The scientists and facilities at China Lake were instrumental in the development and testing of a range of air-delivered weapons including the AIM-9 Sidewinder and the Tomahawk cruise missile.

Other facilities in the Complex allowed the military to train in ways and to a degree of sophistication that made them virtually unmatched in the world. The National Training Center at Fort Irwin allowed for Army brigade combat teams to train under the most rigorous conditions. Unique among major Army training facilities, Fort Irwin provides a dedicated opposing force, the 11<sup>th</sup> Armored Cavalry Regiment (ACR). During the Cold War, the 11<sup>th</sup> ACR was equipped and operated as a Soviet motorized rifle regiment, allowing U.S. forces to hone their skills against the then-expected adversary. Camp Pendleton provided a primary base for training hundreds of thousands of Marines and Twentynine Palms served in a role for the Marine Corps similar to that of the National Training Center.

Two air-oriented facilities, NAS Fallon, and Nellis AFB, provided the airspace and sophisticated, instrumented training ranges on which Navy, Marine Corps and Air Force pilots could perfect their combat skills. Since 1996, Fallon has been home to the Naval Fighter Weapons School popularly known as TOPGUN. Nellis has long been home to the Air Force's premier air combat training center, the Air Force Weapons School. It conducts a number of complex exercises such as Red Flag and Green Flag that allow not only the Air Force but the other services and allied air units to hone their skills. During the Vietnam War, increasing losses of fighter pilots led to the creation of the extremely realistic Red Flag exercises at Nellis AFB in order to enhance pilots' warfighting skills prior to entering the war zone.

The Southwest Defense Complex not only is vital to the U.S. military but those of major friends and allies as well. Simply put, the U.S. alone among the North Atlantic Treaty Organization (NATO) nations and even most of its Pacific allies, possesses facilities of sufficient size and sophistication to support the necessary training for friendly forces. In 1981, the Euro-NATO Joint Jet Pilot Training program was initiated. The nations involved are Belgium, Canada, Denmark, the Federal Republic of Germany, Greece, Italy, the Netherlands, Norway, Portugal, Turkey, the United Kingdom and the United States. The German Air Force, or Luftwaffe, has been conducting basic pilot training in the United States since 1958.

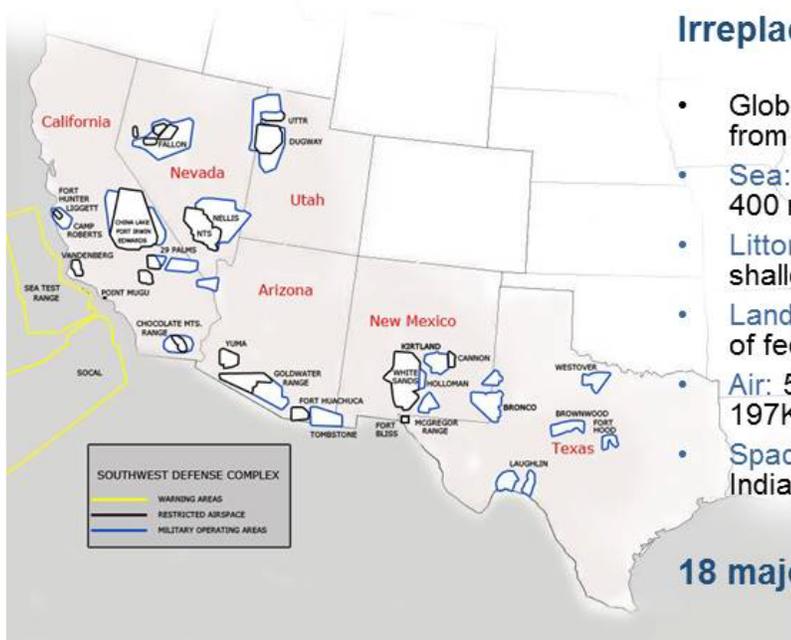
For some 70 years, these facilities played a central role in ensuring America's competitive advantage in advanced military technologies that counterbalanced adversaries' superiority in quantities of forces, proximity to the battle space, local geography and ideological fervor. For many decades, advances in

technology allowed the U.S. military to increase the effectiveness of individual weapons, platforms and even combatants, literally allowing it to do more with less. The wisdom of this approach was demonstrated in the demise of the former Soviet Union, which up to nearly its dying day had sought to pursue capacity, which is numbers, ahead of capability.

But over time, the number of facilities, bases and ranges was reduced as the size of the U.S. military shrank. After the Cold War a series of base realignment and closure (BRAC) commissions further reduced the Complex. Entire sections of the country, particularly New England, have been largely denuded of military facilities. Some of the most famous facilities and bases in the Southwest such as Fort Ord, the Presidio of San Francisco, Carswell and George AFBs, Marine Corps Air Station El Toro and the Navy shipyard in Long Beach were closed.

The 2005 BRAC round signaled the possibility that reductions in defense infrastructure had reached a practical limit given the size of the U.S. military and the increased demands for sophisticated training activities. Occurring in the midst of the wars in Iraq and Afghanistan, the 2005 BRAC commission rejected a number of Pentagon recommendations regarding bases that should be closed. The decision to retain the Sierra and Red River Army Depots turned out to be prescient since these facilities became major centers for the repair, storage and upgrading of Army vehicles.

## National Treasures



### Irreplaceable Test & Training Ranges

- Global spectrum-geo/climate features, free from encroachment
- **Sea:** 334K sq mi, 150 x 1300 mile area w/ 400 mi supersonic corridor
- **Littoral:** 70 mi of shore, island, cliffs, shallow & deep trench sub approach
- **Land:** 17M acres protected by 198M acres of federal lands buffer
- **Air:** 50K sq mi Restricted, 60K sq mi MOA, 197K sq mi Warning Areas
- **Space:** Western Launch Range, 9,000 to Indian Ocean, polar launch

**18 major DOD military installations**

## The Southwest Defense Complex Today

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“The six southwestern states – Arizona, California, Nevada, New Mexico, Texas and Utah – have a unique role in the training of our combined Armed Forces and the testing of new equipment and technologies essential to the protection of the nation. Located in this region are more than 120 military installations, air, land and sea ranges, skilled personnel, excellent research capabilities and a strong industrial base. These combined strengths, spread across the region, comprise a national asset that is irreplaceable.”<sup>1</sup>

Today, the core of the residual defense infrastructure on which the U.S. military depends resides in the Southwest Defense Complex. This geographic grouping contains some of the nation’s most sophisticated laboratories, defense industrial facilities and military bases. The Complex is a true national treasure on a scale equal to that of the National Park system. The Southwest offers over 335 million acres of federally owned land. Some 490,000 square miles of airspace and 484,000 square miles of sea are available for training activities. The land, sea and dedicated, restricted airspace it provides is a unique training environment unparalleled in the Free World. The Complex provides the only open instrumented land and airspaces in the United States of sufficient size to permit large-scale joint experiments and training activities. Its contribution to the U.S. military’s warfighting capabilities, military readiness, test and evaluation, and research and development is unparalleled. Many allied nations continue to do virtually all their pilot training in the Complex because they lack similar open spaces in their own countries.

The Southwest Defense Complex provides much more than specialized scientific, test and experimentation facilities. It contains a large proportion of the most important training facilities for each of the services. For example, Laughlin, Luke and Sheppard AFBs are devoted to the training of Air Force personnel. Laughlin AFB is the single largest pilot training facility in the Air Force, providing basic instruction for some 500 pilots annually. For three decades, Luke AFB has been responsible for training F-15 and F-16 pilots and crew chiefs; it is transitioning to training Air Force personnel on the F-35A Joint Strike Fighter. Luke also is home to the largest fighter wing in the U.S. Air Force. Sheppard AFB is the largest mixed facility run by Air Education and Training Command and provides specialized technical and field training for officers, airmen and civilians of all branches of the military, other Department of Defense agencies and foreign nationals. Sheppard hosts the Euro-NATO Joint Jet Pilot Training program, a multi-national flight training program for the purpose of producing combat pilots for both U.S. Air Force and NATO.

The Naval Air Station at Fallon is that service’s premier fighter training facility. It continues to be home to the Navy’s TOPGUN school where carrier pilots receive advanced training in air-to-air and air-to-ground tactics. Fallon also houses the Carrier Airborne Early Warning Weapons School (TOPDOME), the Navy Rotary Wing Weapons School and Navy SEAL Combat Search and Rescue training.

The Army and Marine Corps rely on their facilities in the Southwest Defense Complex for critical, large scale, realistic training. For the last 14 years, Fort Irwin, home of the National Training Center (NTC), has provided Active and National Guard brigade combat teams with a realistic training environment in order to prepare for operations in Iraq and Afghanistan. Recently, the NTC has begun conducting hybrid warfare training exercises reflecting the new challenges posed by Iran, North Korea, China and Eastern Europe.

Fort Bliss, adjoining the White Sands Missile Range, is home of the 1<sup>st</sup> Armored Division and several major air and missile defense units. Fort Bliss focuses on training for advanced maneuver warfare, missile defense operations and gunnery proficiency with virtually every large caliber weapon in the Army arsenal.

Marine Corps Base Camp Pendleton in California is the Marine Corps' principal training facility on the West Coast and home to the 1<sup>st</sup> Marine Division. It provides training at all levels from basic to advanced unit-level exercises. It is particularly well suited for amphibious exercises and training in ship-to-shore maneuver. Twentynine Palms, the Marine Corps' Air Ground Combat Center, provides a location for large-scale combined arms and air-ground training activities in a desert environment. Recently, Japanese ground self-defense forces joined with their U.S. counterparts at Twentynine Palms for the Iron Fist exercise.<sup>2</sup>

In addition to a wide range of training activities and pre-deployment exercises, facilities in the Southwest Defense Complex provide day-to-day support for U.S. military activities around the world. Davis-Monthan, Kirtland, Beale and Travis AFBs house combat and combat support units to serve global roles as part of the expeditionary Air Force. Davis-Monthan is home to the 355<sup>th</sup> Fighter Wing, equipped with A-10 close air support aircraft, as well as the 55<sup>th</sup> Electronic Combat Group and the 563<sup>rd</sup> Rescue Group. The Air Force Materiel Command's 309<sup>th</sup> Aerospace Maintenance and Regeneration Group manages the so-called aircraft boneyard. Kirtland AFB is one of U.S. Global Strike Command's primary facilities. It also conducts extensive training for Air Force Special Operations Command on its full range of aerial platforms. Beale AFB is home to several of the Air Force's premier reconnaissance and command and control units. Finally, Travis AFB is a linchpin in the aerial bridge to the Asia-Pacific region. The 60<sup>th</sup> Air Mobility Wing is the largest in the Air Force's Air Mobility Command and operates C-5 Galaxies, KC-10 Extenders and C-17 Globemaster IIIs.



*F-35A test aircraft completing the first aerial weapon release of an AIM-120 advanced air-to-air missile.  
(Image: with permission, Lockheed Martin Corporation Aeronautics Division)*

## Defense Innovation and the Third Offset Strategy

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The most important contributions of the Southwest Defense Complex in the decades ahead may well be in support of defense innovation and the Third Offset Strategy. The Complex will be a critical component in the Pentagon's efforts to compete for military and operational superiority in the 21<sup>st</sup> Century. In particular, the Complex will have a unique role in the areas of supporting innovation, providing a superb environment for experimentation and testing and enabling the development of advanced, complex operational concepts.

The problem with the previous U.S. strategy was that the Pentagon had to continually invest in new capabilities in order to stay ahead. But starting with the end of the Cold War, successive administrations took a modernization holiday while at the same time reducing the overall size of the U.S. military, i.e. its capacity. The George W. Bush Administration came into office with the intention of reversing this trend but got caught up in the wars in Iraq and Afghanistan. Tens of billions of dollars went into capabilities suitable for those conflicts while traditional areas of U.S. competitive advantage were starved for modernization funding.

Now an even more serious problem looms on the horizon. The era of U.S. competitive advantage in advanced technologies with military applications may be coming to an end. Senior Pentagon officials have been publicly stating their concerns. Simply put, the United States is losing its technological edge.<sup>3</sup>

This situation should not have come as a surprise to anyone. In part, it reflects the decision to skip a generation of modernization, failing to invest in new capabilities as the existing ones reached obsolescence. Admittedly, the acquisition system seemed to do its level best to sabotage what modernization programs there were.

The loss of competitive advantage also appears to be the result of massive commercial and military espionage by America's competitors. In July 2009, former Secretary of Defense Robert Gates canceled the F-22 program after contracting for 187 aircraft, largely on the grounds that the United States had the competitive advantage in stealth aircraft for the foreseeable future. Beijing unveiled its first fifth-generation stealth fighter, the J-31, in November 2014, well in advance of Gates' timeline for it.

China and Russia, in particular, have deployed a host of advanced military capabilities – many designed specifically to counter areas of traditional U.S. military advantage. Today, senior U.S. defense officials warn of a loss of military advantage and even a favorable balance of power in critical military areas. Space warfare, electronic combat, cyber, robotics, directed energy and precision strike are all areas where the trends are, to say the least, ominous. Frank Kendall, Under Secretary of Defense for Acquisition, Technology and Logistics, told the Senate Armed Services Committee, "I am very concerned about the increasing risk of loss of U.S. military technological superiority. We're at risk and the situation is getting worse."<sup>4</sup>

The U.S. response is centered in the so-called Defense Innovation Initiative (DII) and the Third Offset Strategy. As described by Deputy Secretary of Defense Robert Work, the DII is:

... a broad, Department-wide initiative to pursue innovative ways to sustain our military superiority for the 21<sup>st</sup> Century and improve business operations throughout the Department. We are entering an era where American dominance in key warfighting domains is eroding and we must find new and creative ways to sustain, and in some areas expand, our advantages even as

we deal with more limited resources. This will require a focus on new capabilities and on becoming more efficient in their development and fielding.<sup>5</sup>

As defined by Deputy Secretary Work, the Third Offset Strategy is focused on identifying and deploying enduring U.S. military-technical and operational advantage to counter evolving threats and deter conflict. Among the technology areas identified for exploitation are counters to anti-access and area denial capabilities, guided munitions, hypersonic aircraft and weapons, directed energy, undersea warfare, cyber and electronic warfare, human-machine teaming, advanced wargaming and the development of new operating concepts.

Deputy Secretary Work was quick to warn that the Third Offset Strategy is not primarily about technology. Rather, it will be strategy-based and technologically-oriented with operational and organizational constructs that give U.S. forces advantages that offset adversaries' superior numbers. A major reason for this approach is that future adversaries are likely to be able to close technological gaps with the U.S. rather quickly. But even if they can match the U.S. military in terms of systems and platforms, they lack America's advantage in people. According to Deputy Secretary Work, "... our greatest advantage is the vibrant technological community in the United States, and the vibrant technological communities in our defense industrial base. We will ride that advantage."<sup>6</sup> The Southwest Defense Complex is a critical, unique element of that vibrant technological community to which Deputy Secretary Work refers. The always essential role of the Complex in creating and sustaining U.S. military technical and operational advantages over some 70 years will, if anything, increase given the demands of the DII and the Third Offset Strategy. The one place in the world where such new military capabilities can be adequately developed and tested and applicable operational concepts and training performed is among that set of national jewels that constitute the Southwest Defense Complex.

## Key Activities and Locations

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In addition to providing a major portion of the overall national military training infrastructure and basing for critical units and functions, the Southwest Defense Complex will play a central role in supporting the defense department's plans and programs to retain and even extend its current military technical and operational superiority over prospective adversaries. Among the facilities, bases and ranges that constitute the Complex are a number that are already deeply involved in the processes of experimentation and innovation the Pentagon requires.

In addition to government facilities that play a critical role in ensuring U.S. military superiority, a significant fraction of the defense industrial base and national laboratory system are within the boundaries of the Complex. Much of the nation's advanced design, development and engineering on future aircraft, ballistic missiles, air and missile defense systems and space platforms occurs in the states that make up the Complex.

## Experimentation and Testing

The United States today is the world's dominant air power. It achieved this position of advantage, in part, by developing and acquiring many of the world's best military aircraft, weapons, sensors and communications systems. In part, this is a product of extremely rigorous and realistic training, the development of superior operational concepts and the ability to conduct large-scale and complex exercises.

The development of modern aircraft and air-delivered weapons requires an enormous amount of experimentation and testing at specialized places. The same is true when it comes to training pilots and aircrews, developing combat tactics and operational concepts, and conducting large-scale exercises. These activities require large amounts of land and overhead airspace free from intrusion. They also require a great deal of technical support, instrumentation, safety systems and high-end communications.

The United States maintains a unique array of ranges, bases and test facilities devoted to the development and maintenance of the world's best military air capabilities. Largely because they require so much land and airspace, the majority of these facilities are located on federal lands in the Southwest United States. This allows the Department of Defense to restrict access to the land, sea and airspaces associated with these facilities. In the words of former Chairman of the Joint Chiefs of Staff, General Colin Powell, "in the southwestern U.S. all four services have training, test and evaluation ranges that provide a land, airspace, sea area, and offshore supersonic operating domain that could accommodate a major portion of our joint test and evaluation needs."<sup>7</sup>

One of the most notable of these facilities is California's China Lake Naval Air Warfare Center. It is one of only three Navy open air test ranges and that service's premier land range and weapons development laboratory. Situated in the western Mojave Desert, north of Los Angeles, China Lake encompasses more than one million acres, an area larger than the state of Rhode Island. Its more than \$3 billion worth of infrastructure and installations include two of the world's best fully-instrumented ranges, airfields, dozens of high-tech laboratories, mission planning and support centers, fabrication facilities, hangars and offices. At China Lake, the Navy works on advanced capabilities and concepts in such areas as airborne electronic attack, directed energy, materials, explosives and propellants, munitions guidance systems, the suppression of enemy air defenses, robotics, software and even countering improvised explosive devices.

China Lake is close to other important southwest defense area assets, notably Edwards AFB and the Army's Fort Irwin. Edwards is a center of excellence for research and development of flight and for the test and evaluation of aerospace systems. Fort Irwin is home to the National Training Center, the Army's best and largest training facility where brigade combat teams are prepared for deployment overseas and where foreign concepts of operations, tactics and military systems are tested against our own.

These three entities jointly administer the R-2508 Special Use Airspace Complex. This complex encompasses Edwards AFB, China Lake and Fort Irwin along with a large amount of intervening land. The R-2508 Complex includes bombing ranges, supersonic corridors, low-altitude high-speed maneuvering areas, radar intercept zones and refueling areas. All of these require plenty of airspace and several need open lands distant from people and buildings. This is one of the most valuable features of the Southwest Defense Complex. The R-2508 Special Use Airspace Complex ensures that there is a significant volume of restricted airspace available to the U.S. military that can be employed for experimentation, weapons testing and complex, multi-platform air-ground training.

Edwards AFB houses the Air Force Test Center, the Test Pilot School and is the Air Force Materiel Command center of excellence for conducting and supporting research and development of flight. Air platforms currently entering the force such as the F-35 Joint Strike Fighter and the Global Hawk high-altitude unmanned aerial vehicle are currently being tested at Edwards. The Royal Air Force is testing its F-35B short take-off and vertical landing (STOVL) variant at Edwards. One can expect that aircraft currently beginning the development process, such as the new B-21 bomber, JSTARS radar system replacement and sixth-generation fighters, will all be tested at Edwards.

The White Sands Missile Range in New Mexico is primarily a test facility whose main function is to support missile development and test programs for the U.S. Army, Navy and Air Force, NASA, other government agencies and allied nations. It provides an unparalleled location for the testing of upgrades to current weapons systems as well as experimentation with innovative concepts for future capabilities. White Sands cooperates with its neighbor, Fort Bliss, in the conduct of Network Integration Evaluation (NIE). The latest NIE, conducted Fall 2015, tested a wide range of advanced systems and concepts including coalition network systems, expeditionary command posts, advanced, mobile operational energy systems and manned-unmanned teaming capabilities.<sup>8</sup>

A wide variety of systems have been tested at White Sands. The facility has specially constructed infrastructure and capabilities to test both surface-to-air and short-range missile defense systems. Multiple variants of the Patriot and Standard Missile systems have been tested there. Other systems tested at White Sands include: the nuclear-capable AGM-86 cruise missile, tactical lasers, the Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System, GPS receivers and Army missiles. White Sands provides accurate instrumentation for aircraft and missile flights as well as a variety of both ground and air targets.

Nellis AFB in Nevada conducts operational tests for Air Force platforms. It is currently the center for operational testing of the F-35 Joint Strike Fighter, a mission which includes designing air-to-air and air-to-surface combat tactics, determining how to integrate the F-35 with other aircraft in the Air Force inventory and developing training curricula for future F-35 pilots. Nellis also supports the testing of all new Air Force weapons and combat systems. It is expanding its activities in the fields of electronic and cyber warfare.

Vandenberg AFB on the California coast is primarily a space and missile testing base. It has the unique mission of placing classified satellites into polar orbit from the West Coast. Vandenberg also supports the Air Force's ICBM program and together with Kwajalein Atoll supports long-range ballistic missile



*U.S. Air Force F-16 Fighting Falcons assigned to the 64th Aggressor Squadron during Red Flag 15-4 at Nellis Air Force Base. (Image: Nellis Air Force Base)*

defense tests. In addition, Vandenberg houses four Ground-Based Interceptors as part of the Ground-based Midcourse Defense system. One of Vandenberg's great values is the ability to conduct extremely long range engagements. During these tests, the U.S. restricts access to the relevant Pacific airspace and waters.

Located close to Vandenberg AFB, Point Mugu is the Department of Defense's largest and most extensively instrumented over-water range that offers realistic, open-ocean and littoral operating environments. The Sea Range consists of 36,000 square miles of controlled sea and airspace. Temporary expansion of the area is possible through coordination with local Navy facilities and the Federal Aviation Administration. The combination of robust instrumentation, a varied coastline, a range of support facilities and restricted air and sea space allows Point Mugu to conduct a wide variety of tests and experiments, including multiple air and sea vehicles and different weapons in a dense electronic environment.<sup>9</sup>

Another facility that offers some 1,300 square miles of land area and 2,000 miles of restricted airspace for testing and experimentation is the U.S. Army's Yuma Proving Ground. The facilities and instrumented ranges at Yuma support the testing of a wide array of systems and capabilities in a realistic environment, such as artillery, manned and unmanned aviation systems, armor, tactical vehicle, electronic countermeasure and air delivery. Yuma houses three separate test ranges that provide unique environmental characteristics and numerous weapons-specific test areas. Yuma Proving Ground also includes the Army's desert, tropics and cold weather test centers.

The Buffalo Soldier Electronic Test Range at Fort Huachuca, Arizona illustrates the importance the military places on access to pristine environments and the ability to restrict access to the airspace above. The Electronic Test Range is one of the best in the world for testing command, communications, control, computer, and intelligence systems and equipment. In order to operate without radio-frequency interference, the Electronic Test Range is able to utilize the 76,000 acres of Fort Huachuca, associated airspace and other government and privately-owned land as needed.

### **Advanced Training and Operational Concept Development**

It is a core principle of the U.S. military that you must train as you fight. One of the enduring advantages the U.S. military possesses is the quality of its personnel and their training. Maintaining this advantage will depend heavily on access to the facilities that are part of the Southwest Defense Complex. Preserving the array of unique facilities in the Complex and expanse of air and land critical to realistic testing and training will be of vital importance to U.S. security in the 21<sup>st</sup> Century.

Naval Air Station Fallon in Nevada has long been the center of naval aviation training in both air-to-ground and air-to-air tactics. As the home of the famous TOPGUN school, Fallon helps make Navy pilots the best and most lethal in the world.

Now, Fallon is moving into the 21<sup>st</sup> century. The Navy is enhancing the facilities at Fallon in order to create a next-generation training center that will allow up to 80 fighters, reconnaissance aircraft and ship simulators to interact in a virtual environment with large numbers of live aircraft in a massive environment. According to published reports, by 2020 Fallon will establish an Integrated Training Facility that can simultaneously simulate cruisers, four E2-D radar planes, 12 F-18 fighters, eight F-35C Joint Strike Fighters and two Unmanned Carrier-Launched Airborne Surveillance and Strike (UCLASS) vehicles. In addition, the Integrated Training Facility will be able to bring in F-35A and F-22 flight simulators from Nellis AFB.<sup>10</sup> These enhancements will allow Fallon to support highly advanced and complex training and the development of innovative tactics for naval aviators for decades to come.

Like NAS Fallon, Nellis AFB supports the development of advanced tactics and operational concepts involving both new and existing platforms and systems. The restricted land area and controlled airspace associated with Nellis AFB form the core of what is often called the Nevada Test and Training Range (NTTR). The NTTR is one of two military training areas used by the U.S. Air Force Warfare Center (the other being Eglin AFB, Florida). According to the Air Force, the NTTR has the “largest contiguous air and ground space available for peacetime military operations in the free world.”<sup>11</sup> Nellis is also home to the Threat Training Facility which enables U.S. aircrews to learn how to counter a wide range of hostile aerial and surface-to-air threats.

The NTTR is uniquely suited to annually host a series of Red Flag exercises that bring together aircrews from the U.S. Air Force, Navy, Marine Corps and Army, NATO and other allied nations’ air forces to participate in large-scale, complex, realistic air combat situations. The Threat Training Facility supports these exercises by simulating prospective hostile forces. Red Flag allows for a level of realistic training and for mutual learning among air units from around the world that is attainable nowhere else. The NTTR includes a number of sophisticated electronic combat ranges, simulated adversary bases and complex air defense environments.

The Utah Test and Training Range (UTTR) associated with Hill AFB is currently the largest overland block of supersonic authorized restricted airspace in the contiguous United States. The range encompasses some 2,675 square miles of ground space and over 19,000 square miles of airspace. Over the decades, virtually every air delivered weapon the U.S. military created has been tested on the UTTR. The demands placed on pilot training and the development of advanced tactics by new aircraft such as the F-22 and F-35 have focused attention on the need to expand the UTTR. The senior senator from Utah, Orrin Hatch, has called on Congress to expand the UTTR’s footprint.<sup>12</sup>

In addition to its contribution to advanced training for air units, the Southwest Defense Complex includes facilities that perform a similar function for both the U.S. Army and Marine Corps. The



*A full battalion of Stryker vehicles at the Army’s Network Integration Evaluation 15.1 event at Fort Bliss and White Sands Missile Range. (Image: U.S. Army)*

National Training Center at Fort Irwin is unique in terms of both the range of physical environments it provides, but also the robust array of live, virtual and constructive assets employed to create a realistic and operational environment. The training uses simulated and live unmanned aircraft systems, a state-of-the-art instrumentation system (MILES) and incorporates joint enablers, multi-national forces, inter-agency integration, media and social media reports.

The Fort Irwin National Training Center is transitioning to the conflicts of the future. In 2015, for the first time in more than a decade, the focus of exercises shifted from the Middle East and counterinsurgency to Eastern Europe and the Russian military. But this is just one of the new threats that the NTC must prepare the U.S. Army to handle. According to Major General Ted Martin, the NTC's commanding general, "We have to be prepared for an uncertain future. If we see a new enemy tactic, we seek to train it here. Would you think that a brigade combat team would have to worry about cyberwarfare? Yes. So we train now, and I never would have thought 10 years ago that we would do that."<sup>13</sup>

The Marine Corps is experiencing a similar transition in advanced training and the development of new operational concepts. Next year at Twentynine Palms, the Marine Corps will conduct its largest-ever exercise involving not only current threats and scenarios but those anticipated in the near future. In order to create the appropriate operational environment, an additional 132,000 acres of federal land adjacent to Twentynine Palms will be made available for this exercise.<sup>14</sup>

The Southwest Defense Complex includes a number of less well-known but extremely valuable training ranges. For example, there are the Barry M. Goldwater Air Force Range in Arizona and the Chocolate Mountain Aerial Gunnery Range in California. The Goldwater Range encompasses nearly 2 million acres of largely unused land and some 57,000 cubic miles of airspace. The sheer size of the range permits simultaneous training activities on nine air-to-ground and two air-to-air ranges. Air Force units from Luke AFB and Marine Corps fliers from the Marine Corps Air Station Yuma routinely take advantage of the Goldwater Range to train for air-to-ground and air-to-air maneuvers. Air Force F-35As and Marine Corps STOVL F-35Bs are becoming common sights at the Goldwater Range. Marine aviators, Navy pilots and those from allied countries make extensive use of the nearly half a million acres that constitute the Chocolate Mountain Range for aerial bombing and live-fire aerial gunnery.

Davis-Monthan AFB, best known as the world's largest aircraft boneyard, is actually the primary training base for the A-10 ground attack aircraft. Davis-Monthan is particularly configured to support the unique tactical training requirements for the A-10.

## Risks and Requirements

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As threats to U.S. national security mount and the demands for new platforms and weapons grow, so does the importance of the entire set of training and test facilities in the Southwest United States. Unfortunately, a number of these facilities are under stress due to encroachment from civilian and commercial activities, federal land management regulations and a lack of adequate resources for infrastructure maintenance and upgrades. For example, the Navy only has a 25-year lease on China Lake from the Bureau of Land Management which can make it difficult to do long-range planning. Efforts to expand the area covered by China Lake to better match the R-2508 Complex and to make the Navy's ownership permanent have so far been rebuffed.

Many of the facilities in the Southwest Defense Complex face a continual challenge to maintain effective stewardship of their facilities while at the same time ensuring that experimentation, testing and training can continue. The 1960 Sikes Act requires the Department of Defense to develop and implement in cooperation with the Fish and Wildlife Service and State fish and wildlife agencies Integrated Natural Resources Management Plans for military installations across the United States. Endangered species in military installations require special consideration and protection.

Access to water has also become a challenge for base commanders. A protracted drought in parts of the Southwest has pitted competing interests against one another for access to fresh water. Water is certainly vital to the indigenous flora and fauna, the lives of the citizens of the Southwest region and to many businesses, particularly agriculture. But it is also important to the operations of the U.S. military.

It is possible for both conservation and national security concerns to be accommodated at facilities in the Complex. For example, the Barry M. Goldwater Air Force Range in southern Arizona was the recipient



*Fort Irwin National Training Center. (Image: Wikipedia)*

of the 2016 Military Conservation Partner Award for exemplary landscape-level stewardship for diverse and rare natural resources. The Range, employed by the military for bombing practice, provides 1.5 million acres of wildlife, supports conservation efforts for three federally-listed endangered species and harbors one of the largest, protected expanses of the Sonoran desert.

A number of states, including several in the Southwest Defense Complex have passed laws in order to minimize encroachment and related effects of the expansion of civilian activities and property near military facilities. These laws include requirements that local communities consult with military facilities before changing zoning laws in ways that would impact the base, the requirements for buffer zones around military installations and ranges, the allocation of funds to acquire private land where development threatens military facilities and even ordinances that require limits on light pollution.<sup>15</sup>

Changes in technologies, tactics and scenarios for future conflicts can lead to additional demands on facilities in the Complex for air and land usage. China Lake has sought to expand its air control space. Twentynine Palms received permission to exploit some 123,000 additional acres for its 2016 large-scale exercise. The Bureau of Land Management has often been reluctant to expand military control over additional air and surface spaces due to the high usage of adjacent areas by the public.

A future round of base realignments and closures poses yet another potential threat to the Complex. The future of conflict is so uncertain that it is difficult to anticipate future demand for facilities and ranges. Many of the facilities in the Complex clearly are unique and should be relatively immune from being closed. However, if they experience realignment, becoming the recipients of units and activities from other bases, there is immediate pressure on existing infrastructure and often a high cost to build new facilities.

This leads to the challenge for the Southwest Defense Complex of maintaining its unique roles and functions in an era of declining resources. The advent of new platforms and systems requiring testing, the existence of new threats, the changing scale of experiments and exercises and simply the need for new instruments and monitoring devices all place demands on facilities in the Complex to spend money on infrastructure. Competition for resources is increasingly fierce and it is easy for the Pentagon and the military services to underfund infrastructure in order to support operations, maintenance and procurement.

## Conclusions

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The Southwest Defense Complex constitutes a unique constellation of military, scientific and industrial facilities. What the U.S. military is today, the platforms, weapons and systems it deploys, the training it receives, the tactics each of the services employ and the operational concepts that animate the Joint Force, were developed, tested, conducted and refined in the Complex.

The Southwest Defense Complex is more than just facilities. The heart of the Complex is its natural assets, the great swathes of unoccupied land, controlled airspace and open oceans available for weapons testing, training and experimentation. Nowhere else in the Free World is there the sheer dimensional space and the variety of terrain that is available in the Complex.

This allows multiple simultaneous training or test activities to take place at a single facility. Facilities such as China Lake, the White Sands Missile Range, Buffalo Soldier Electronic Test Range, Point Mugu

and Vandenberg AFB are large enough to support highly sophisticated testing of virtually every conventional weapon in the U.S. arsenal. The Nevada and Utah Test and Training Ranges and the Barry Goldwater and Chocolate Mountain Ranges, for example, have the airspace and pristine land areas to support the training of hundreds of U.S. and allied pilots annually, as well as large scale exercises such as Red and Green Flag.

Fort Irwin, Fort Bliss and Twentynine Palms enable the Army and the Marine Corps, often in collaboration with other elements of the Joint Force, to conduct large scale, complex maneuvers and test systems and tactics in a variety of different physical and meteorological conditions. Fort Irwin, home of the National Training Center has the usable space that permits it to maintain training for units assigned to Afghanistan while in parallel conducting brigade combat team-level, high-end conventional training with a representative opposition force.

The United States has spent decades and invested billions of dollars to take advantage of the available spaces in the Complex by deploying sophisticated instrumentation and safety systems, unique test sites and specialized ranges, providing scientists, engineers and testers to collect enormous amounts of data on platforms, weapons and other systems. Similarly, these resources permit training and exercise participants to experience the full spectrum of modern battle space conditions and receive extremely detailed feedback on their performance.

The Southwest Defense Complex will be absolutely critical to the modernization of the military as well as to the maintenance of the highest quality training. Facilities such as Luke AFB, Marine Corps Air Station Yuma, NTTR and associated ranges are supporting the shift to the F-35 Joint Strike Fighter. Point Mugu, Vandenberg AFB and White Sands Missile Range are heavily engaged in the development of advanced air and missile defense systems including the Patriot Missile Segment Enhancement, Terminal High Altitude Area Defense, Ground Based Interceptor and even the Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System.

The role of the Complex will only grow as the Department of Defense pursues the so-called Third Offset Strategy. The ranges and test facilities in the Southwest will be critical to the development of long-range, semi-autonomous and extremely precise munitions, hypervelocity aircraft and weapons, future vertical lift, next generation unmanned aerial vehicles and directed energy weapons. The growing importance of electronic warfare and the need for U.S. forces to train in hostile electronic environments places a premium on test and training activities in the unique open spaces provided at China Lake, Fort Irwin and the Buffalo Soldier Electronic Test Range, for example. New tactics and operational concepts, particularly those involving integration of cross service capabilities, will need to be developed and tested.

The combination of largely unencumbered physical spaces, unique topographies, an enormous complement of military facilities, laboratories and private sector factories and an unrivaled workforce makes the Southwest Defense Complex of incomparable value to the U.S. military and this nation's security. The crown jewels of the Complex are the unique and irreplaceable bases, facilities and ranges – the most significant of which are NTTR, UTTR, China Lake, White Sands, Barry M. Goldwater, Vandenberg, Point Mugu and Edwards.

It is vitally important that the panoply of facilities and controlled spaces that are part of the Southwest Defense Complex be protected from encroachment, excessive regulations and prospective budget cuts. Once lost, these facilities and ranges cannot be reconstituted.

## Glossary of Terms

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ACR	Armored Cavalry Regiment
AFB	Air Force Base
BRAC	Base Realignment and Closure
DII	Defense Innovation Initiative
ICBM	Intercontinental Ballistic Missile
MILES	Multiple Integrated Laser Engagement System
MOA	Military Operations Area
NAS	Naval Air Station
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organization
NIE	Network Integration Evaluation
NTC	National Training Center
NTTR	Nevada Test and Training Range
STOVL	Short Take-Off Vertical Landing
TOPDOME	Carrier Airborne Early Warning Weapons School
TOPGUN	Navy Fighter Weapons School
UCLASS	Unmanned Carrier-Launched Airborne Surveillance and Strike
UTTR	Utah Test and Training Range

## End Notes

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*Vandenberg Air Force Base Space Launch Complex.  
(Image: Wikimedia)*



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