

DRAFT ENVIRONMENTAL ASSESSMENT
PROPOSED SAHARA MUSTARD CONTROL
BARRY M. GOLDWATER RANGE – EAST

1.0 PURPOSE AND NEED FOR ACTION

1.1 INTRODUCTION

This environmental assessment (EA) addresses the potential environmental impacts of a proposed U.S. Air Force action to reduce wildfire risk and improve range quality for wildlife including habitats used by the endangered Sonoran pronghorn (*Antilocapra americana sonoriensis*) on the Barry M. Goldwater Range – East (BMGR-E). The BMGR-E is a military aviation training range assigned to the Air Force located in southwestern Arizona. The 56th Fighter Wing/Range Management Office (56 RMO) at Luke Air Force Base (AFB) is responsible for providing and maintaining the range conditions needed for the military training mission at BMGR-E, as well as managing and protecting natural resources in accordance with the Military Land Withdrawal Act (MILWA) of 1999 [P.L. 106-65 §3031(b)(3)(D)] and the Sikes Act [16 U.S.C. § 670a-f, as amended].

The Air Force proposes to implement a program to control Sahara mustard (*Brassica tournefortii*) on the Barry M. Goldwater Range – East (BMGR-E), Arizona based on the principles of Integrated Pest Management. Control strategies would include the physical removal of plants, and the application of herbicide using ground equipment and aircraft. This environmental assessment was prepared in accordance with the following:

National Environmental Policy Act (NEPA) of 1969, the Council on Environmental Quality (CEQ) implementing regulations set forth in 40 CFR § 1500-1508

AFI 32-7061, *Air Force Environmental Impact Analysis Process* set forth in 32 CFR § 989

DoD Instruction 4150.7, *Department of Defense Pest Management Program*

AFI 32-7064, *Integrated Natural Resources Management*

AFI 32-1074, *Aerial Application of Pesticides*

1.2 PURPOSE AND NEED

The purpose of the proposed action is to reduce the risk of wildfires and improve wildlife habitat quality on the BMGR-E. This action is necessary due to the establishment and continued expansion of invasive weeds, particularly Sahara mustard, on the range.

1.3 SCOPE OF THE ENVIRONMENTAL REVIEW

Based on Air Force understanding of potential environmental issues of concern in accordance with NEPA regulations, the scope of this EA has been focused in terms of study region, resource categories to be considered, and level of detail. The general study region for this EA includes the area potentially affected by the proposed action and no-action alternative. The proposal to implement an invasive weed management program on the BMGR-E encompasses approximately 736,430 acres (298,023 hectares) west of AZ Route 85. The proposed action includes aerial applications of herbicide on up to 4000 acres (1619 hectares) using an Air Force C-130 aircraft outfitted to disperse pesticides.

Environmental resource categories addressed in this EA include but are not limited to biological resources, land jurisdiction and use, socioeconomics, public and occupational health and safety, noise, air quality, earth, cultural, water, and hazardous materials and waste. Additionally, potential aggregate effects (that is, additive or interactive effects that would result from the incremental impact of the proposed actions when added to other past, present, and reasonably foreseeable future actions) are also evaluated.

1.4 REQUIRED PERMITS, LICENSES, OR ENTITLEMENTS

Implementation of the proposed action requires review and consultations with state and federal agencies with regard to the requirement of permits, licenses, or entitlements. Specifically, the following issues must be addressed in the process of preparing this EA to ensure compliance with applicable laws.

- Special Status Species – the proposed invasive weed management actions, including the application of herbicide, are located within the known range and habitat of the Sonoran pronghorn, a federally listed endangered species. In addition, federally endangered lesser long-nosed bat (*Leptonycteris curasoae*) has the potential to occupy the proposed action area. Consequently, consultation pursuant to Section 7 of the Endangered Species Act will be required for these species.
- Cultural Resources – The proposed action has the potential to affect both historic and prehistoric cultural resources located within the proposed action area. Therefore, National Historic Preservation Act, Section 106, must be completed prior to any action
- Pesticide Applicator Certification – All personnel who apply pesticides would require pesticide applicator certification in accordance with the Federal Insecticide, Fungicide, and Rodenticide Act [7U.S.C. §136 et seq. 91996)], DoD Instruction 4150.07 *DoD Pest Management Program* (29 May 2008), DoD Manual 4150.07-M *DoD Pest Management Training: The DoD Plan for the Certification of Pesticide Applicators* (12 Dec 2008), Air

Force Instruction 32-1053 *Integrated Pest Management Program* (23 Jun 2009), and AFI 32-1074, *Aerial Application of Pesticides* (27 Aug 2009).

1.5 BACKGROUND

The Barry M. Goldwater Range in southwestern Arizona has served as a military training base since 1941. The Military Lands Withdrawal Act of 1999, which renewed the 1.7 million acre (688,000 hectares) military range, assigned natural and cultural resource management to the Secretary of the Air Force (eastern 1.05 million acres / 407,000 hectares) and Secretary of the Navy (western 650,000 acres / 263,000 hectares), and returned approximately 112,000 acres (45,300 hectares) to public lands managed by the Bureau of Land Management (BLM).

Approximately 135,000 acres (54,600 hectares) of withdrawn lands are available to the public by permit for recreation including hiking, hunting, and camping. The remaining land is closed to the public for military training or as a safety buffer.

Air-to-ground combat training occurs on three tactical ranges. These are designated as North Tactical Range (NTAC) and South Tactical Range (STAC) west of AZ State Route 85, and East Tactical Range (ETAC) east of AZ Route 85. There are numerous targets scattered throughout these ranges, including simulated convoys, air fields, rail yards, and bridges. These targets are attacked with a variety of weapons, including strafe, inert bombs and inert rockets. In recent years, there has been increasing use of simulated laser targeting systems. There are also three targets that have been designated for dropping live bombs, one for each tactical range, and two live maverick missile ranges, one on NTAC and one on ETAC. In addition to the tactical ranges, there are four manned ranges on which pilots are scored for their accuracy in hitting targets with strafe, inert bombs, and rockets.

Native vegetation in infested areas is characterized by widely scattered forbs and woody shrubs including creosotebush (*Larrea tridentate*), ratany (*Krameria spp.*), salt bush *Atriplex spp.*, white bursage (*Ambrosia dumosa*), and triangle leaf bursage (*A. deltoidea*). There are also mesquite (*Prosopis spp.*), palo verde (*Parkinsonia spp.*), and ironwood (*Olneya tesota*) trees along washes. Barrel cactus (*Ferocactus spp.*), hedgehog cactus (*Echinocereus engelmannii*), and other cacti are also scattered throughout the area. Saguaro cactus (*Carnegiea gigantea*) and cholla cacti (*Cylindropuntia spp.*) are concentrated on *bajadas* and rocky slopes.

Invasive weeds, particularly Sahara mustard, have become established on the ranges west of AZ State Route 85. They are most common along roadway margins and in several of the most disturbed target areas. Ranges west of State Route 85 are generally drier and the soil is sandier than those to the east of the highway. Sahara mustard is a non-native, invasive weed that has the potential to produce a dense monoculture ground cover that is highly flammable and can alter native plant diversity. Plant communities in the Sonoran Desert are not adapted to fires, so wildfires typically have devastating results, and recovery takes many years. Burned

areas are more susceptible to invasion by fire adapted exotic weeds, such as Sahara mustard. Furthermore, fires can interfere with Air Force training activities and readiness.

Sahara mustard also has the potential to out-compete native plant species for available resources (i.e., water, nutrients, and sunlight) and reduce plant diversity. Because it has little or no value as a forage plant, Sahara mustard can degrade the value of infested ranges for numerous native wildlife species including the federally endangered Sonoran pronghorn. The seed bank for Sahara mustard can persist as long as 5 years. A single application of control efforts would have little or no impact on the long-term presence of Sahara mustard on the range. Therefore, this will be a multiyear program that will require annual herbicide applications for a total of five years.

2.0 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

2.1 PROPOSED ACTION

The proposed action would implement an integrated pest management program (IPM) for the control of Sahara mustard on BMGR-East. The control program would consist of a combination of physical removal of plants by hand and applications of herbicide by ground equipment and aircraft including the Air Force C-130 outfitted for pesticide dispersal.

Personnel on the ground would hand pull plants in small (< 100 acres), environmentally sensitive areas (e.g., sand dunes located in the San Cristobal Valley). This technique would require complete removal of plants from the ground including the root systems. Plants would be removed or left on-site to desiccate. Removal would occur early in the spring after most plants had emerged but had not yet produced seeds.

Herbicide would be applied by ground equipment for low density stands of invasive weeds in areas that are accessible by vehicles and foot (e.g., small target sets). Ground based equipment could also be used to make targeted applications in accessible infested areas with high densities of environmentally sensitive species.

Herbicide would be applied by aircraft on larger areas. Approximately 7800 acres (3157 hectares) within NTAC and STAC Ranges and Manned Ranges 1 and 2 have high densities of Sahara mustard and few environmentally sensitive plant species.

Herbicide control would entail the following actions:

- Purchase of herbicide to treat up to 7800 acres
- Preparation and storage which would require mixing and transport of herbicide to flight line, and uploading of chemical onto aircraft and loading the herbicide onto ground dispersal equipment.
- Treatment of infested areas in accordance with label directions with aerial and ground based equipment. DoD Certified Pest Management Personnel or commercial pesticide applicators who are certified in all applicable EPA categories will conduct all herbicide applications. Prior to all applications, on-site personnel will determine that atmospheric conditions exist to maximize treatment efficacy and minimize the potential for pesticide drift.
- Notification of the public of aerial spray missions using local media channels.
- Proper disposal of waste generated during the spray operations.

The seed bank for Sahara mustard can persist as long as five years. Therefore this will be a multiyear program that would require that herbicide applications be repeated annually for a total of five years.

2.2 ALTERNATIVE ACTIONS

Two alternative invasive weed management actions on BMGR-E and a no-action alternative were analyzed for efficacy, efficiency, cost, and environmental impacts.

2.2.1 Alternative Action 1 – Hand Removal of Plants

Personnel on the ground would remove plants in target areas by hand pulling. This technique would require complete removal of plants from the ground including the root systems. Plants would be bagged and taken off the range for disposal in a landfill or left on-site to desiccate. Removal would occur early in the spring after most plants had emerged but had not yet produced seed. This alternative is highly selective for Sahara mustard and would not require specialized equipment or personnel certification/licensure. However, it would be extremely time consuming and labor intensive. Ground personnel would have only limited spatial and temporal access to the proposed treatment areas. Control efforts could not interfere with scheduled training activities. Because several proposed treatment areas are active military training targets, ground-based control personnel would not have ready access to them due to the high tempo of military flight training and the potential for unexploded

ordnance. Due to its large size, this control strategy would be very inefficient and would impact only a very small percentage of the proposed treatment area.

2.2.2 Alternative Action 2 – Physical Removal and Application of Herbicide with Ground Based Equipment

Personnel would physically remove plants as in the proposed action and certified pest control personnel would use a combination of hand-held and vehicle mounted pesticide dispersal equipment to apply herbicide to control Sahara mustard on proposed treatment areas. This alternative would be highly selective for the target weed, and there would be a low risk for drift to non-target native vegetation. However, ground herbicide applications would be time consuming and labor intensive. Ground personnel would have limited spatial and temporal access to proposed treatment areas. The proposed target areas are on active ranges, and control efforts could not interfere with scheduled training activities. Because several proposed treatment areas are active military training targets, personnel would not have ready access to them due to the high tempo of military flight training and the potential for unexploded ordnance. The logistics for transporting the large amounts of water and herbicide required for this action alternative make it impractical for large, remote infestations.

This alternative would entail the following actions:

- Purchase of herbicide to treat infested areas that are accessible to ground equipment. This would require the storage, mixing, uploading of herbicide onto ground application equipment, and transportation to treatment sites.
- Application of herbicide to ground accessible Sahara mustard infestations in accordance with label directions using ground based application equipment. Either DoD Certified Pest Management Personnel or commercial pesticide applicators who are certified in all applicable EPA categories would conduct all herbicide applications. Prior to all applications, on-site personnel would determine that atmospheric conditions exist to maximize treatment efficacy and minimize the potential for pesticide drift.
- Proper disposal of waste generated during the spray operations.

2.2.3 No Action Alternative

A no action alternative would result in no benefit to rangeland health or native plant and wildlife species. There would be no reduction of continuous fuels and resulting fire potentials. Continued expansion of invasive weeds, particularly Sahara mustard, would further degrade the quality of the range for native plant species and wildlife, and increase the risk for future wildfires.

2.2.4 Comparison of Action Alternatives

The proposed action alternatives were compared according to each of 4 Issue Indicators and given a score of 1 to 3, with 1 representing the lowest ranking and 3 the highest. Scores were then totaled (Table 2-1)

Table 2-1 Comparison of Action Alternatives			
Issue Indicators	Proposed Action: IPM Control Strategy	Physical Removal Alternative	Physical Removal and Ground Herbicide Application Alternative
Target Weed Selectivity	2	3	2
Action Efficiency (= area treated/man-hour)	3	1	2
Cost/Acre	3	1	2
Access to infested areas	3	1	2
TOTAL SCORE	11	6	8

Action Alternatives were given a score of 1 – 3 for each Issue Indicator based on the relative value/merit of the alternative with 1 representing lowest relative value and 3 representing the highest relative value.

2.2.5 Herbicide Selection

The herbicide to be applied in the proposed and alternative actions would be effective for controlling broad-leaf weeds, have very low vertebrate toxicity, have a relatively short half life, and have low risk for entering ground water. Toxicity comparisons of three products with the desired characteristics are compared in Table 2-2.

Table 2-2 Toxicity Comparisons of Three Herbicides¹			
	RoundUp Pro[®]	Telar XP[®]	Escort XP[®]
LD₅₀ Dermal²	> 5000 mg/kg, rat	> 5000 mg/kg, rabbit	> 2000 mg/kg, rabbit
LD₅₀ Oral	> 5000 mg/kg, rat	> 2000 mg/kg, rat	> 5000 mg/kg, rat
LC₅₀ Inhalation	2.9 mg/l, rat	>5.5 mg/l, rat	>5.3 mg/l, rat
Eye Irritation (Rabbit)	Slight	Slight	Slight

¹ Toxicity levels are taken from the Manufacturer's Material Safety Data Sheet (MSDS).

² LD₅₀ is defined as the amount of chemical that results in mortality to 50% of an experimental animal.

3.0 AFFECTED ENVIRONMENT

3.1 LAND USE

North and South TAC Ranges and Manned Ranges 1, 2, and 4 are primarily used for Air-To-Ground combat training. This includes strafing, dropping live and simulated bombs, and firing rockets on a variety of targets. Targets and service roads comprise less than 7% of the total range area. The remainder of these ranges is a relatively undisturbed ecological interface between Arizona Upland and Lower Colorado River Valley subdivisions of the Sonoran Desert.

3.1.1 Definition of Resource

The two primary categories of land use are natural and human-modified. Natural land use includes rangeland and other open or undeveloped areas. Human modified land use can be further defined as residential, commercial, industrial, agricultural, institutional, recreational, or any area upon which development has altered the land use from its natural state.

Land use is regulated by management plans, policies, regulations, and ordinances that determine the type and extent of land use allowable in specific areas. These plans are also designed to protect specially designated environmentally or culturally sensitive areas from incompatible use. The applicable plans for the BMGR-E are the Comprehensive Range Plan and the Integrated Natural Resources Management Plan.

3.1.2 Regional Location

BMGR-E is located in southwest Arizona and encompasses approximately 1.05 million acres (407,000 hectares) in portions of 3 counties; Maricopa, Pima, and Yuma (Figure 3-1). That part of the BMGR-E proposed for aerial herbicide treatment is west of AZ Hwy 85, and is comprised of the NTAC and STAC Ranges, and Manned Ranges 1, 2, and 4 (Figure 3-2). Ground application of herbicide and physical removal of plants would occur as needed throughout the BMGR-E.

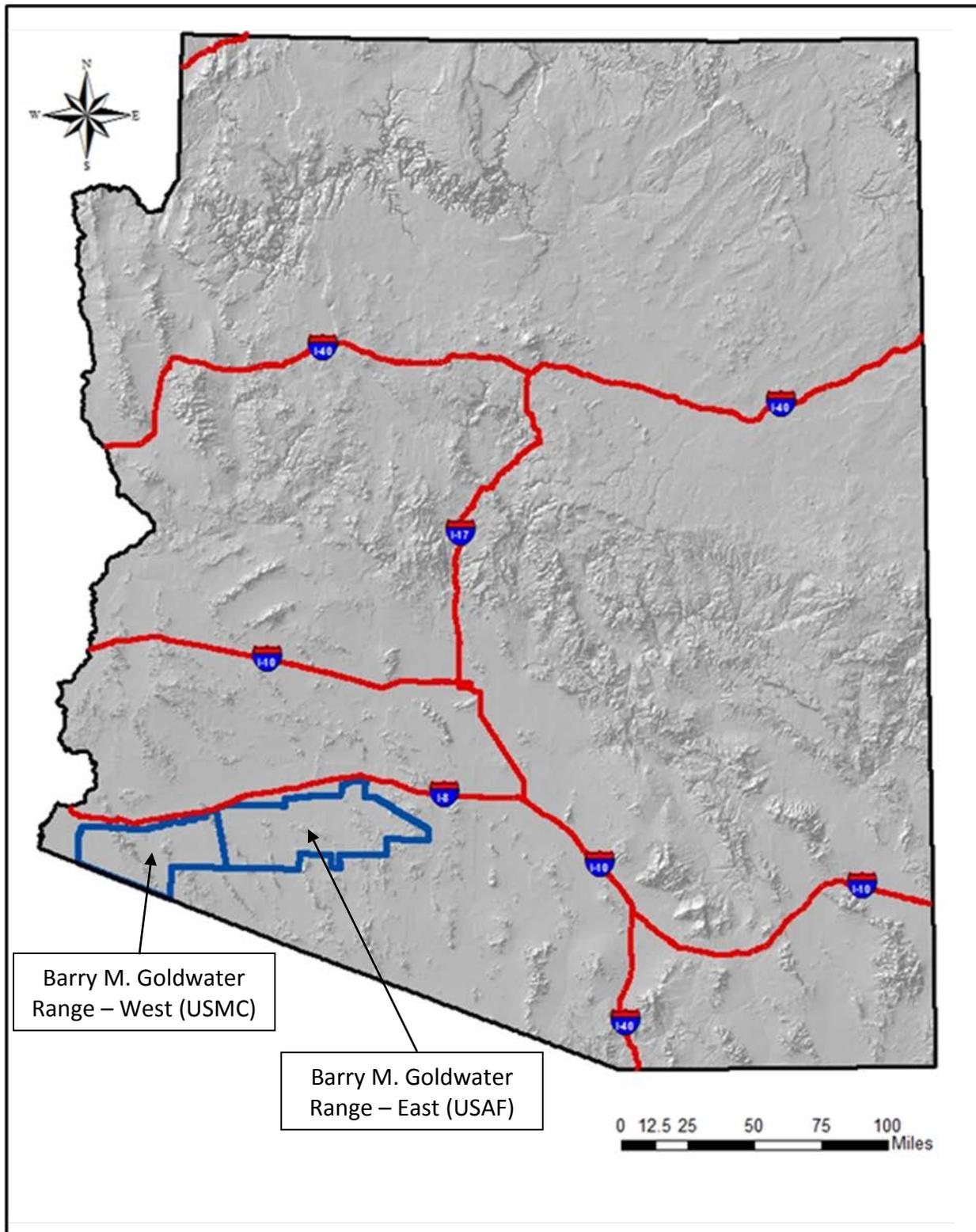


Figure 1-1. Barry M. Goldwater Range – East

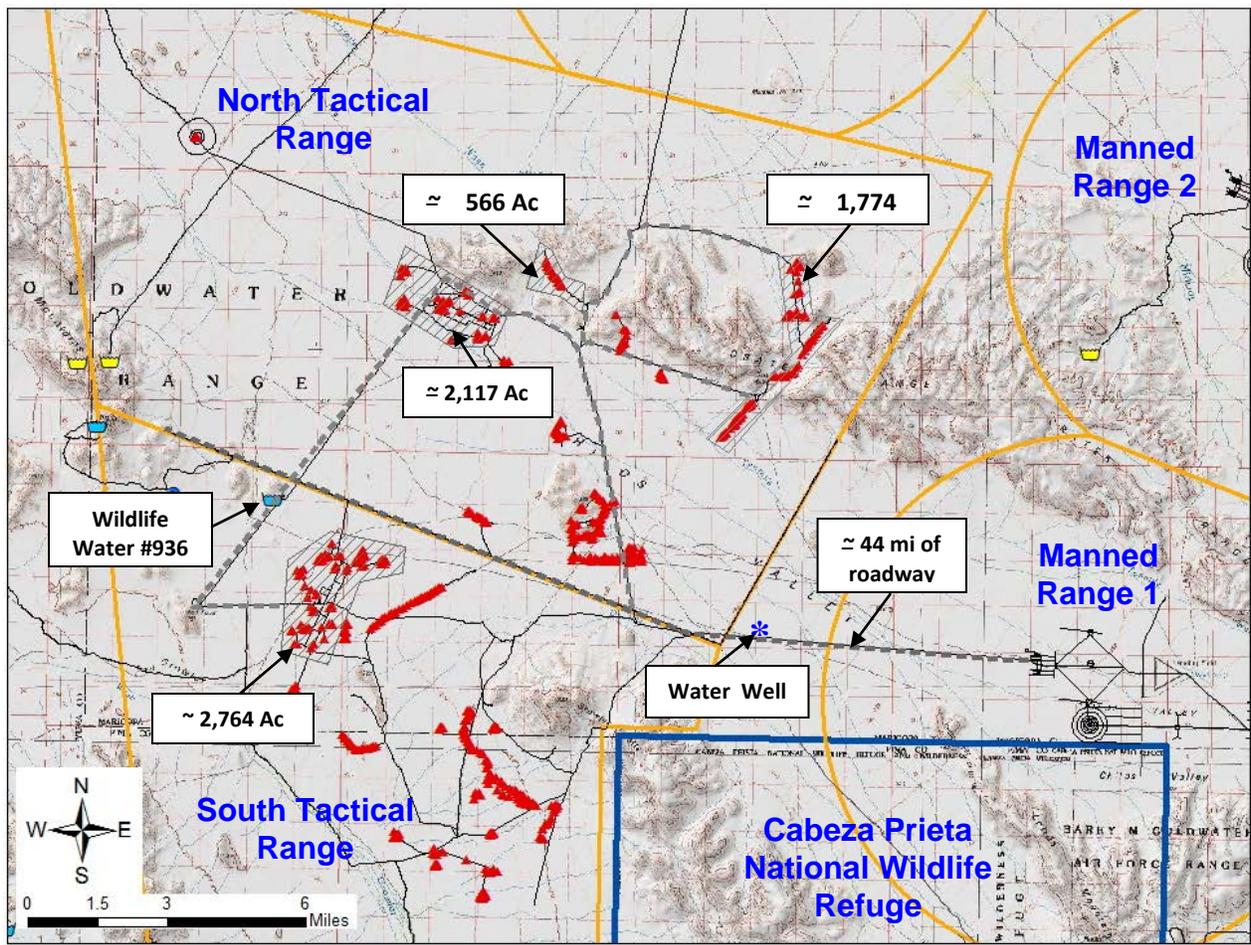


Figure 1-2. Proposed Areas for Aerial Application of Herbicide

3.1.3 Existing Land Use

Tactical and manned ranges are primarily used for Air-to-Ground combat training using a variety of aircraft including the F-16, A-10, and attack helicopters. Surface activities include annual clearance of expended munitions and maintenance of target areas.

3.2 AIR QUALITY

3.2.1 Definition of Resource

Air quality in a given location is described by the concentration of various pollutants in the atmosphere. National Ambient Air Quality Standards (NAAQS) are established by the U.S. Environmental Protection Agency (USEPA) for criteria pollutants including ozone (O₃), carbon monoxide (CO), nitrogen dioxide (NO₂), sulfur dioxide (SO₂), particulate matter equal to or less than ten micrometers in diameter (PM₁₀), particulate matter equal to or less than 2.5 micrometers in diameter (PM_{2.5}), and lead (Pb). NAAQS (Table 3-1) represent the maximum levels of background pollution that are considered safe, with an adequate margin of safety, to protect public health and welfare. Total project emissions include both direct and indirect emissions that can be controlled by a federal agency.

3.2.2 Local Air Quality

Air quality is of concern relative to the proposed actions because implementation has the potential to introduce some of the above-described air pollutants to the atmosphere. The current attainment status designations for areas within Arizona are summarized in 40 CFR Part 81.303. BMGR-E lies in an area that is listed as either better than national standards, or nonclassifiable/attainment for all criteria pollutants. Air quality over the study area is considered good to excellent. Data collected at four locations near the BMGR-E in 1985 and 1998-2000 revealed that ozone was the only pollutant that approached NAAQS.

Table 3-1 National and Arizona Ambient Air Quality Standards

Pollutant ¹	Primary Standards		Secondary Standards	
	Level	Averaging Time	Level	Averaging Time
Carbon Monoxide (CO)	29 ppm (10 mg/m ³)	8-hour	None	
	35 ppm (40 mg/m ³)	1-hour		
Lead (Pb)	0.15 µg/m ³	Rolling 3-Month Avg	Same as Primary	
	² 1.5 µg/m ³	Quarterly Avg	Same as Primary	
Nitrogen Dioxide (NO ₂)	53 ppb	1-hour	Same as Primary	
	100 ppb	1-hour	None	
Particulate Matter (PM ₁₀)	150 µg/m ³	24-hour	Same as Primary	
Particulate Matter (PM _{2.5})	15.0 µg/m ³	Annual (Arithmetic Avg)	Same as Primary	
	35.0 µg/m ³	24-hour	Same as Primary	
Ozone (O ₃)	0.075 ppm (2008 std)	8-hour	Same as Primary	
	0.08 ppm (1997 std)	8-hour	Same as Primary	
	0.12 ppm	1-hour	Same as Primary	
Sulfur Dioxide (SO ₂)	0.03 ppm	Annual Arithmetic Avg	0.5ppm	3-hour
	0.14 ppm	24-hour		
	75 ppb	1-hour	None	

¹ These standards, other than for ozone and those based on annual averages, must not be exceeded more than once per year. The ozone standard is attained when the expected number of days per calendar year with a maximum hourly average concentration above the standard is equal to or less than one.

² ppm = parts per million by volume; mg/m³ = milligrams per cubic meter; µg/m³ = micrograms per cubic meter.

3.3 WATER RESOURCES

3.3.1 Definition of Resource

For the purpose of the analysis, water resources include all surface and groundwater features located within the NTAC and STAC Ranges and Manned Ranges 1, 2, and 4 of the Barry M. Goldwater Range East. Flood hazards associated with 100-year floodplains, and quality and availability of surface and groundwater are addressed in this section.

3.3.2 Surface Water

The only standing surface water within 5 miles of the proposed treatment areas is contained in five Arizona Game and Fish Department wildlife waters (Figure 1-2). One of these (Wildlife Water #936) is less than 200 feet from a roadway proposed for treatment. It consists of a corrugated sheet metal water collection apron that diverts rainfall to a 5000 gallon subterranean ring tank reservoir. Water from the reservoir is fed to an above ground 40 gallon concrete drinking trough through a PVC pipe. The drinking trough would be covered with

plywood and plastic tarp during aerial herbicide applications on the adjacent road. The remaining 4 wildlife waters are more than 1 mile from proposed treatment areas and are not expected to be exposed to herbicide. Two of these are dammed *tinajas* (natural potholes) with holding capacities of 3000 and 3,900 gallons, respectively. One consists of a closed above ground 500 gallon polyethylene reservoir that supplies an in-ground 40 gallon drinking trough, and one consists of a 5000 gallon above ground covered ring tank reservoir that supplies a drinking trough with a holding capacity of less than 50 gallons.

There are also numerous small ephemeral drainages scattered throughout the ranges. These could potentially drain into the Gila River following heavy runoff events. There are no intermittent or perennial streams or floodplains within the treatment areas.

3.3.3 Groundwater

The BMGR includes portions of two major groundwater basins within the Arizona Department of Water Resources (ADWR) Lower Colorado River Planning Area: the Yuma and Lower Gila Basins. Within both of these basins, groundwater occurs in both floodplain and basin fill deposits. Streambed or floodplain deposits (consisting of sand, gravel, cobbles, and boulders) range from about 10 feet thick in the smaller washes to as much as 110 feet thick in the Gila River floodplain. The basin fill deposits may be divided into three separate units: an upper sandy unit, a middle fine-grained unit, and a lower coarse-grained unit. These units vary in thickness and may not be present at all locations. Groundwater recharge on the BMGR is from infiltration of rainfall runoff and underflow from groundwater basins that are hydraulically upgradient.

A single water well is located within the proposed treatment area (Figure 2). The bore hole is encased by steel pipe and water is drawn to the surface with an electric pump. Well water is stored in an above ground closed steel reservoir.

3.4 HAZARDOUS MATERIALS AND WASTE

3.4.1 Definition of Resource

Hazardous materials are substances with strong chemical and/or physical properties, which may pose a substantial threat to human health and the environment. Hazardous wastes are waste products that have similar properties. Use of hazardous materials on the BMGR-E is primarily associated with aircraft training operations (e.g., fuel, hydraulic fluids, etc.). To a lesser extent, target maintenance activities also require hazardous materials (e.g., paint).

3.5 SOLID WASTE

Solid waste is generated on the BMGR-E as a result of activities associated with day to day training activities. Each training range is closed annually for maintenance. During the closures,

Explosive Ordnance Disposal (EOD) personnel render any unexploded and partially exploded ordnance inert and nonhazardous, and remove the remaining residue to a central collection point to be processed for recycling. A small amount of debris, mainly wood targets and sea-land container liners are either ground in place as mulch or removed for disposal in a sanitary landfill off the BMGR.

3.6 BIOLOGICAL RESOURCES

3.6.1 Definition of Resource

Biological resources include four major categories: vegetation, wildlife, wetlands, and threatened and endangered species. These categories are described in detail below.

For this analysis, vegetation includes plant communities and terrestrial plants. A plant community is a combination of plants that depend on their environment, modify their environment, and influence one another. Together with their common habitat and other associated organisms, communities form an ecosystem, which is, in turn, related to neighboring ecosystems and to the micro-climate of the region.

Wildlife resources comprise terrestrial and aquatic fauna. Wildlife habitat consists of all environmental attributes required by an animal species to survive and reproduce (e.g., food, water, and cover). Geographical species distribution and abundance depends on the quality, quantity, and distribution of available habitat.

The US Army Corps of Engineers (USACOE), US Environmental Protection Agency (USEPA), US Fish and Wildlife Service (USFWS), and Natural Resource Conservation Service (NRCS) are responsible for identifying and delineating jurisdictional wetlands. The USACOE manual currently required for wetland identification is the *Corps of Engineers Wetlands Delineation Manual (Environmental Laboratory 1987)*. Wetlands are typically identified in terms of three characteristics: vegetation (hydrophytes), soils (hydric), and hydrology (frequency of flooding or soil saturation).

Threatened and endangered species include plants and animals considered to be rare, threatened, or endangered and protected by federal regulations. For this EA, the category also includes those species considered rare, threatened or endangered by the State of Arizona. Federally listed and proposed threatened and endangered species are provided statutory protection under the Endangered Species Act of 1973. While candidate and sensitive species are not, many land and resource managers use these classifications in order to manage their activities such that they do not degrade the status of candidate or sensitive species. Furthermore, because lists of special status wildlife may change during the life of a project, candidate and sensitive species are often assessed and managed as if they were federally protected.

3.6.2 Vegetation

Vegetation at the BMGR-E is described in the Barry M. Goldwater Range Integrated Natural Resource Management Plan, March 2007. Two natural plant community subdivisions are represented on the BMGR-E. The plant communities of most of the BMGR-E are best characterized as being within the Lower Colorado River Valley Subdivision. Those within the extreme eastern portion of BMGR-E best represent the Arizona Upland Subdivision. Vegetation density and diversity tends to increase from west to east throughout the BMGR-E. There is no known plant species federally listed as threatened or endangered within the proposed treatment areas.

Exotic invasive weeds are relatively rare on the BMGR-E. Sahara mustard (*B. tournefortii*) occurs on much of the range and is concentrated along roadways and highly disturbed areas around targets, especially west of AZ State Route 85. Schismus grasses (*Schismus aribicus* and *S. barbatus*) are widely scattered throughout the range. Isolated infestations of Russian thistle (*Salsola sp.*) have also been observed and eradicated on the range, and buffelgrass (*Pennisetum ciliare*) occurs along the AZ State Route 85 right-of-way and two small adjacent areas inside the BMGR-E fence line. Sahara mustard is a good candidate for control efforts using aerial herbicide applications. It tends to be concentrated along roadways and in highly disturbed soils over very large areas, and it is one of the first plants to emerge in the spring. The proposed herbicide applications would occur in early March when most native perennials are still dormant and most native annuals have not yet emerged.

3.6.3 Wildlife

The proposed treatment areas are within the geographic range of numerous wildlife species. This includes two species that are federally listed as Endangered, the Sonoran pronghorn (*Antilocapra americana sonoriensis*) and the lesser long nosed bat (*Leptonycteris curasoae*). The Sonoran pronghorn may be present on the proposed treatment areas during all months of the year. The lesser long nosed bat may enter the range to forage when suitable food plants are flowering. Columnar cacti (e.g., saguaro cactus), favored forage plants, are widely scattered within the treatment area and will not be in bloom during proposed herbicide application operations. There are no known maternity or roosting caves in the proposed treatment areas. The desert tortoise (*Gopherus agassizii*), an Arizona state protected species and candidate for federal listing, may also occur in proposed treatment areas in very low numbers.

3.7 CULTURAL RESOURCES

3.7.1 Definition of Resources

Cultural resources include “historic properties” as defined in the National Historic Preservation Act (NHPA), (16 U.S.C. section 470, et seq.); “cultural items” as defined in the

Native American Graves Protection and Repatriation Act (NAGPRA), (25 U.S.C. §§ 3001-3013); “archaeological resources” as defined in the Archaeological Resources Protection Act (ARPA), (16 U.S.C. sections 470aa-470mm); and “sacred sites” as defined in Executive Order 13007, Indian Sacred Sites (May 24, 1996). Cultural resources are often generally referred to as “heritage resources”. “Historic properties” are cultural resources that are eligible for listing on the National Register of Historic Places (NRHP) (36 CFR Part 60). “Historic properties” consist of prehistoric and historical-period artifacts, sites, structures, buildings and other physical evidence of human activity considered important to a culture, subculture, or community for scientific, traditional, religious, or other reasons. Cultural resources can be divided into three major categories: archaeological resources (prehistoric and historical-period), architectural resources, and traditional cultural places (TCPs).

Archaeological resources are locations where human activity measurably altered the earth or left deposits of physical remains (e.g. pottery, roasting pits, stone flakes, projectile points, or bottles). Archaeological resources may be either prehistoric or historic and can include habitation sites, resource procurement and processing, roads and trails, ranches, mines, and World War II and Cold War features. Recorded archaeological resources on the BMGR-E are associated with both historical-period Euro-American activities and a much longer history of Native American use of the region. The most commonly recorded historical period sites in the area are small trash heaps, cultural deposits, corrals, tanks, windmills, and other features associated with ranching activities of the Childs, Stout, Bender, Pettit, and Price families, and others. The vast majority of cultural resources recorded on the BMGR-E are prehistoric archaeological sites that include artifacts from the Paleo-Indian period through the historical period—ranging in age from over 15,000 years old to less than a hundred. While some sites consist of only a few artifacts or a single archaeological feature such as a trail or a hearth; others cover a large area and include many different features and artifact types. World War II and Cold War sites on BMGR-E include AUX-6, six other auxiliary airfields, and inactive targets and range facilities (Luke AFB 2009). *Architectural resources* include standing buildings, dams, canals, bridges, and other structures of historic or aesthetic significance. On BMGR-E, architectural resources include historical-period sites with structures, including wells, corrals, windmills, house foundations, and canals.

Traditional Cultural Properties (TCPs) are defined as places eligible for inclusion in the NRHP for their traditional cultural value. TCPs can include archaeological resources, buildings, neighborhoods, prominent topographic features, habitats, plants, animals, and minerals that Native Americans and other groups consider essential for the continuance of traditional cultures. In the project area, TCPs are usually associated with Native American groups. The NHPA requires federal agencies to consider the effects of their actions on *historic* and *traditional cultural properties* (that is, properties listed or eligible for inclusion in the NRHP because of their historic or cultural significance). In general, these resources must be more than 50 years old to be considered for protection under the NHPA. However, more recent structures, such as Cold War era military buildings, may warrant protection if they are “exceptionally significant”. Resources must meet one or more criteria as defined in 36 CFR

60.4 for inclusion in the NRHP. These criteria include association with important events on broad patterns of history, association with a famous individual, embodiment of the characteristics of important methods, type styles, or periods in history, or the ability to contribute to scientific research. Resources must also possess integrity (i.e., important historic features must be present and recognizable). TCPs must also be evaluated for NRHP eligibility. However, even if a traditional resource is determined to be not eligible for the NRHP, it may still be significant to a particular community or Native American tribe and protected under other laws and regulations discussed herein. The significance of a TCP is determined by consulting with the appropriate group.

Sacred Sites are identified as any specific, discrete, narrowly delineated location that is identified by an Indian tribe or individual as sacred by virtue of its established religious significance to or ceremonial use by an Indian religion and the agency has been informed of the existence of such a site. Such sites are protected by Executive Order 13007, *Indian Sacred Sites*, which requires agencies to accommodate access to and ceremonial use of sacred sites by Indian religious practitioners and avoid adversely affecting the physical integrity. Similar to TCPs, sacred site may not meet criteria for listing in the NRHP and, conversely, a historic property identified under the NHPA may not meet the criteria for a sacred site. Federal agencies can use the Section 106 process to ensure that the requirements of Executive Order 13007 are met.

Several other federal laws and regulations have been established to manage cultural resources, including the Archaeological and Historic Resources Preservation Act (1974), the ARPA (1979), and the NAGPRA (1990). In addition, coordination with federally recognized Native American tribes must occur in accordance with the American Indian Religious Freedom Act (1978); Executive Order 13007, *Indian Sacred Sites*; Executive Order 13175, *Consultation and Coordination with Indian Tribal Governments*; and the DoD requirements relating to the *Annotated American Indian and Alaska Native Policy* (1999), which emphasizes the importance of respecting and consulting with tribal governments on a government-to-government basis. This policy requires an assessment through consultation of the effect of proposed DOD actions that could significantly affect tribal resources, tribal rights, and Indian lands before decisions are made by the respective services.

3.7.2 Historic Setting

The Papaguería is a unique geographic area in southwestern Arizona and northwestern Sonora, Mexico, that extends from south of the Gila River on the north to the Gulf of California on the south, and from the Colorado River on the west to Three Points (west of Tucson) on the east. This region is subdivided into the eastern and western Papaguería based on cultural and environmental factors: the boundary between two Piman-speaking O’odham groups, and the juncture of two biotic communities coupled with a marked change in annual rainfall. The boundary between these areas is located near and roughly parallels the eastern boundary of BMGR-E. The term Western Papaguería is used extensively in archaeological literature,

including this EA, to identify a geographic region, an environment, and a cultural area. The cultural history of the Western Papaguería can be divided into seven periods, which are described in Appendix A.

3.7.3 Inventoried Cultural Resources

Intensive archaeological surveys on the BMGR-E have been conducted to locate and identify cultural resources (including prehistoric and historical-period cultural resources, buildings, structures, objects, and TCPs). Thus far, approximately 196,480 acres (or 19 percent) of BMGR-E has been surveyed and more than 1,200 prehistoric and historical-period cultural resources have been identified and recorded. Archaeological surveys conducted since 1993 have been intensive surveys, with crew members spaced at no greater an interval than 15 to 20 meters. This survey intensity is considered to be a 100 percent survey according to the standards of the Arizona State Museum. Surveys completed between 1993 and 1995 recorded basic site condition and surface disturbance. Surveys conducted since 1996 have included a detailed description of site condition/disturbance. This description has focused on the types and degree of disturbance from military operations as well as natural disturbance. The site conditions are quite detailed, particularly with reference to three major categories of military-related disturbance: ordnance delivery (e.g., bomb craters, surface munitions debris); EOD activities associated with bomb retrieval (e.g., vehicle tracks, bomb drags); and construction and maintenance activities (e.g., construction of in-place targets, roads, target debris, etc).

The majority of recorded cultural resources have been recommended eligible to the NRHP. However, they have not yet been determined eligible by the Air Force. The majority of the recorded sites reflect Native American use of the area from the Paleo-Indian through historic periods. Features found on aboriginal sites include scatters of flaked and ground stone artifacts, ceramics, thermal features such as hearths, roasting pits, and fire-affected rock, cleared areas or sleeping circles, linear and circular rock alignments, rock cairns, trails, petroglyphs, pictographs, and geoglyphs. Historical period sites include post- A.D. 1700 aboriginal resource procurement and processing locales that reflect Native American cactus gathering and hunting.

Historic Euro-American sites include mining features, structures and buildings, roads, ranching features, water features, trash features, cemeteries, and military facilities such as World War II auxiliary airfields and Cold War Era Ranges and various target arrays. Features found at Euro-American sites include mine adits and shafts, ranch house foundations, corrals, cisterns, windmills, fences, irrigation ditches, and numerous trash dumps that contain cans, glass, ceramics, and metal. Military features include tent foundations, auxiliary airfields and various structures associated with them, target arrays, ranges, and a number of other features.

3.7.4 Description of the Action and Area of Potential Effect (APE)

The proposed action includes aerial application of herbicide on five different locations on the NTAC and STAC Ranges to control the invasive weed Sahara mustard. The herbicide will be applied on up to 7,800 acres by a C-130 equipped with an aerial spray apparatus. The herbicide will be applied when winds are less than 10 miles per hour in order to minimize chemical drift into other areas.

The Area of Potential Effect (APE) extends 15 meters on either side of the underlying acreage where the herbicide may come to rest on artifacts and features identified on the surface of archaeological sites in five different locations: STAC Airfield, STAC AUX Field, NTAC AUX Field, NTAC-East Pass, NTAC-Convoy (Figure 3-1).

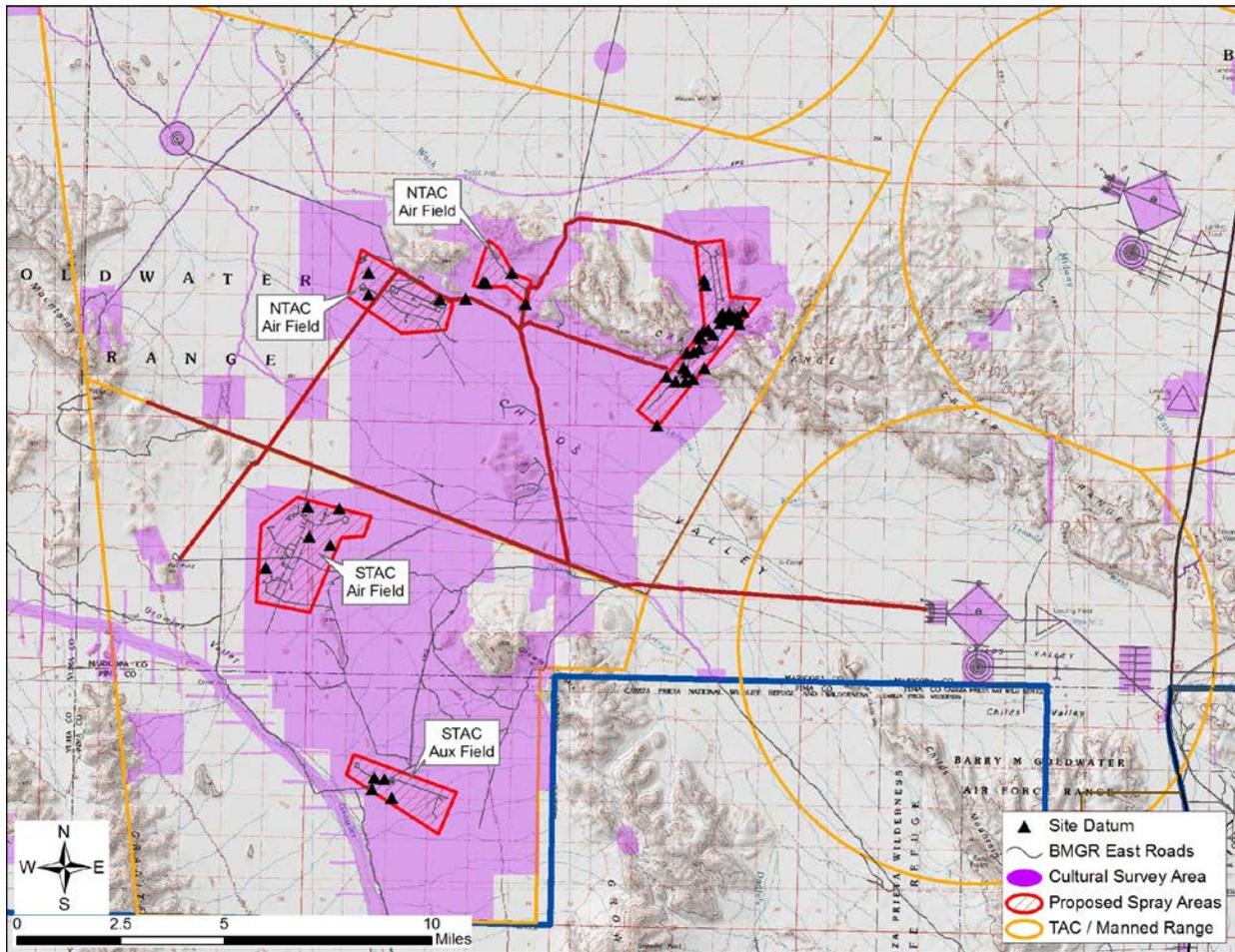


Figure 3-1. 44 Prehistoric Sites Recommended for the National Register Located within 15 meters of Areas Proposed for Aerial Application of Herbicide.

3.7.5 Cultural Resources in the Project Area

All of the five proposed locations and roads have been 100% surveyed for cultural resources and 44 sites have been recorded within the APE for this project (Appendix B). All of the sites have been recommended eligible to the National Register of Historic Places. However formal AF determinations of eligibility are pending. Sites include artifact scatters with and without features and sites that contain features only (such as petroglyphs or thermal features). Thermal features, indicated by the presence of fire-affected rock concentrations, are the most prevalent feature on the range and are found at sites within NTAC and STAC Ranges. Lineal and circular rock alignments and rock cairns are also prevalent on NTAC but are rare on STAC. Cultural resources identified are prehistoric-historical period Native American locales. Many of the cultural resources are Native American sites of undetermined date and cultural affiliation; however, diagnostic artifacts at sites indicate use from 12,000 B.P., during the Paleo-indian period, through historic O'odham groups prior to 1925.

STAC

STAC Airfield

The APE for the STAC Airfield has been completely surveyed and five prehistoric archaeological sites have been recorded (Table 3-2). These sites are recommended eligible for the National Register of Historic Places (NRHP). Four of the sites are small low density artifact scatters with thermal features. The fifth site, BMGR-03-F-15, consists entirely of thermal features. The sites are of undetermined cultural affiliation due to the lack of diagnostic (dateable) artifacts. Radiocarbon dates, obtained from thermal features indicates that BMGR-00-D-01 dates to AD 1400-1600 and BMGR-00-D-02 dates to AD 1300-1500. The presence of thermal features suggests that resource preparation, such as roasting of plants and animals, occurred at this location.

STAC AUX Airfield

The APE for the STAC AUX Airfield has been completely surveyed and four prehistoric sites have been recorded. These sites are recommended eligible for to the NRHP. Three of the sites contain a sparse scatter of artifacts along with thermal features. Diagnostic artifacts were not found at any of these sites. Both cultural affiliation and temporal affiliation are undetermined. The fourth site consists of petroglyphs, located on a small rock-strewn hill northwest of the airfield.

NTAC

NTAC Airfield

The APE of the airfield has been completely surveyed and three prehistoric sites have been recorded. Two sites, Y:8:01 (ASM) and Y:8:02 (ASM) have been determined eligible for the NRHP and the other site is recommended eligible for the NRHP. Two sites, Y:8:01 (ASM) and Y:8:02 (ASM), are prehistoric artifact scatters with thermal features. These sites were recorded and excavated in 1978 to mitigate the adverse effects from construction of the airfield. Site AZ Y:8:01 (ASM) also contained a cremation that was contained in a Tanque Verde red-on-brown bowl. The presence of diagnostic artifacts at this site suggests that it was used by at least two archaeological cultures (Huckell, 1979).

NTAC—East Pass

The APE in East Pass has been completely surveyed and twenty-five sites have been recorded. All of sites have been recommended eligible to the NRHP. East Pass has the highest density of sites on the BMGR East. Sites in this area are large, unlike other areas on NTAC or STAC, contain multiple feature types, and indications of use by various groups over time. Many of the sites contain diagnostic artifacts that indicate use during the late Pleistocene (10,000 BC) by hunters of now extinct mammoth through historic Native American use of the area. A number of sites were re-occupied between 8500 BC-AD 150 by Archaic period hunters and gatherers. During this period the desert evolved from pinyon-juniper woodland and grasslands to the Sonoran desert that we see today. This was an innovative time when people developed new tool kits to deal with the ever changing environment. During the Ceramic period (AD 150-AD 1450), two and possible three distinct archaeological cultures, the Hohokam, Patayan, and the Arenenos, used this area. Historically, the area was used between AD 1600-1900 by O'odham groups (Tohono and Hia C-ed O'odham) and Yuman speaking groups. All of these sites have been recommended eligible to the NRHP.

Features include circular, semicircular and linear rock alignments that may have been structures. The majority of the sites also contain thermal features indicating resource processing. Two sites contain rock cairns without the presence of artifacts. These sites are in a narrow pass and are associated with a travel corridor through this area. These sites are interpreted as ritual placement of rock cairns marking trips along the route.

NTAC—Convoy

The entire convoy target area has been surveyed and 4 sites identified. One (two) site contains thermal features but no artifacts. Features include thermal features, rock alignments, and rock cairns.

NTAC Roads

The entire road network on NTAC has been surveyed and 10 sites identified within 50 meters of a road. Only 1 site, Y:8:039, is within the aerial spraying APE for the road. The site is an artifact scatter with a thermal feature. The cultural and temporal affiliations are undetermined due to a lack of diagnostic artifacts.

3.8 GEOLOGICAL RESOURCES

The geologic resources of an area consist of all soil and bedrock material. For the purpose of this study, the terms soil and rock refer to unconsolidated and consolidated earth materials, respectively. Discussion of geological resources includes topography, tectonic features, fossil remains (paleontological resources), and soils. Soils are described according to their type and physical characteristics. These resources serve as indicators of the general suitability of land for potential development, and may also possess aesthetic, economic, or recreational values.

The Region of Influence for geological resources is the area within which the proposed action has the potential to affect existing geologic resources. The Region of Influence for the purpose of this analysis is defined as the immediate environs of select roadways and target sets within North and South TAC Ranges and Manned Ranges 1, 2, and 4 (Figure 2). This section describes the topographic and geological setting to provide a context for several other resources (e.g., biological resources).

3.8.1 Topography

The general topography of the proposed treatment areas is characterized by broad generally flat valley floors ranging from approximately 575 – 820 feet (175 – 275 meters) elevation. These are bordered by rugged volcanic mountains generally extending northwest to southeast ranging to an elevation of more than 1,886 feet (575 meters). There are two major ephemeral drainages in the vicinity of the proposed treatment areas, Ten Mile Wash and Growler Wash.

3.8.1.1 Childs Valley

Childs Valley lies east of the Aguila Mountains, to the north of the Growler Mountains and Growler Valley. Ten Mile Wash, extending in a generally north west direction through Childs Valley ending in the Gila River, is the predominant drainage. There is a small playa located in Childs Valley southeast of the Aguila Mountains.

3.8.1.2 Growler Valley

Growler Valley lies west of the Growler Mountains and east of the Granite Mountains and reaches its northern limit on the STAC Range of the BMGR-E where it merges with the Childs

Valley. The Growler Wash is the predominate drainage. It enters the BMGR-E from the Cabeza Prieta National Wildlife Refuge (CPNWR) to the south, and runs in a generally northerly direction before bending to the northwest to enter the San Cristobal Valley and merging with San Cristobal Wash.

3.8.1.3 Crater Range

This heavily eroded mountain range consisting primarily of volcanic material reaches a height of 533 meters (1,749 feet) and is wholly contained within the BMGR-E. It is characterized by jagged peaks and ridges exhibiting rock outcrops and a variety of eroded and smooth slopes. The predominant soil association is the Lithic Camborthids-Rock Outcrop-Lithic Haplargids Association, and is subject to slight water erosion.

3.8.1.4 Aguila Mountains

The Aguila Mountains are also wholly contained within the BMGR-E. This range is composed of two different landforms within the same landscape feature. The northern portion is made up of mesa-type horizontally bedded volcanic mountains that are blocky and uniform in shape with relatively flat top surfaces. The mesa gently slopes up to the south to high point of 1,800 feet (549 meters). The southern portion of the range consists of jagged, sharply crested and eroded slopes that transition into smooth rounded-top foothills at their bases. The Aguila Mountains are composed principally of the Lithic Camborthids-Rock Outcrop-Lithic Halargids Association and have a slight potential for water erosion.

3.8.1.5 Granite Mountains

The northern portion of this mountain range extends onto the BMGR-E from the CPNWR. The range is made up of several sharp jagged peaks reaching 2,490 feet (759 meters) and steep eroded slopes. The Granite Mountains are composed of the Lithic Caborthids-Rock Outcrop-Lithic Haplargids Association and have a slight potential for water erosion.

3.8.1.6 Growler Mountains

The extreme northern end of this mountain range extends on to the BMGR-E STAC from the CPNWR. The dominant ridge line and eroding escarpments of these mountains transition into smooth slopes and rounded foothills near the west-facing mountain front. The highest point, Growler Peak (3,018 feet / 920 meters), occurs on the CPNWR. The highest peak on the BMGR-E is 2,063 feet (629 meters). The soils of the range are principally of the Lithic Camborthids-Rock Outcrop-Lithic Haplargids Association and have a slight potential for water erosion.

3.8.2 Geology

The BMGR is located within the Basin and Range Physiographic Province of the western United States. This province is characterized by steep rocky, discontinuous subparallel mountain ranges that trend northwest to southeast and are separated by broad, gently sloping to nearly flat deep, alluvial valleys or basins.

The BMGR is located in the Southern Basin and Range seismic source zone, which extends from Mexico into southern California and includes most of southwestern and central Arizona. The maximum earthquake magnitude that has been estimated for this seismic source zone is 6.0 on the Richter Scale. Except for the influence of the San Andreas Fault activity, the Sonoran Desert is relatively seismically quiet, with noticeable earthquakes felt less than once per few decades. The area subject to the most prevalent seismic activity in the region generally runs parallel to the Colorado River and along a northwest to southeast through Yuma and is outside the proposed treatment areas.

3.8.3. Soils

A variety of soils, ranging from fine-grained sands and silts on the valley floors to very gravelly soils in the mountainous regions have formed on the BMGR, including the proposed treatment area. All of the soils on the BMGR fall within two taxonomic soil orders, Aridisols and Entisols. Aridisols are soils of arid regions that exhibit at least a minimal amount of subsurface horizon development. They usually occur on the high to intermediate alluvial fans that flank major mountain ranges. Entisols are younger soils that are developed in unconsolidated parent material. They are often formed from freshly deposited or heavily reworked material. Flood deposits and sand dunes are good examples of entisols.

3.8.4 Paleontological Resources

The fossil remains of an extinct horse have been found in the East Pass of the Crater Range, and fossil tortoise remains are found in the intermontane valleys in the eastern portion of the Crater Range.

3.9 SOCIOECONOMICS, ENVIRONMENTAL JUSTICE, AND PROTECTION OF CHILDREN

3.9.1 Definition of Resource

3.9.1.1 Socioeconomics

Socioeconomics is defined as the basic attributes and resources associated with the human environment, particularly population and economic activity. Economic activity typically encompasses employment, personal income, and industrial growth. Impacts on these

fundamental socioeconomic components also influence other issues such as housing availability and provision of public service and utilities.

3.9.1.2 Environmental Justice

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, was signed into law on 11 February 1994. The Executive Order establishes environmental justice as a regulatory objective pertaining to the proportional distribution of adverse environmental effects that would be experienced by minority communities and low-income socioeconomic groups. In particular, environmental justice is achieved if low-income and minority communities are not subjected to disproportionately high and adverse environmental effects.

3.9.1.3 Protection of Children

Executive Order 13045, *Protection of Children from Environmental Health Risks and Safety Risks*, was signed into law 21 April 1997. This Executive Order requires that to the extent permitted by law and appropriate, and consistent with the agency's missions, each Federal agency: Shall make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children; and (b) shall ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks

3.10 NOISE

3.10.1 Definition of Resource

Noise is defined as any undesirable sound that interferes with communication or the conduct of human activity, is intense enough to cause physical discomfort, or is otherwise annoying. Perception of noise depends on the source of sound; the characteristics of the sound, and the context of the sound.

Noise is measured in decibels, (dB). For purposes of comparison noise levels are typically averaged over a 24 hour time period with a significant penalty assigned to all noise occurring between 10:00 pm and 7:00 am. This average is called a day night average level and is annotated by the symbol L_{dn} .

3.10.2 Ambient Noise

Ambient noise in urbanized areas typically ranges from 60 to 70 dB. The Gila Bend Air Force Auxiliary Field environment has been characterized by an Air Installation Compatible Use Zone (AICUZ) study. The AICUZ accounts for the effects of aircraft operations on ambient noise

levels. It specifically delineates averaged noise levels in L_{dn} at the base and in the surrounding area. The proposed herbicide treatment sites are approximately 20 miles from the GBAFAF.

4.0 ENVIRONMENTAL CONSEQUENCES

This section analyzes, compares, and explains the effects of the alternatives. Direct, indirect, connected, and cumulative effects are described. An emphasis is placed on resources related to the significant issues. There are no wetlands within any of the proposed treatment areas, and none lie within a 100-year floodplain (FEMA 1988). Therefore these were not included in the environmental analyses.

4.1 PROPOSED AND ALTERNATIVE ACTIONS

4.1.1 Land Use

The proposed action and alternative actions would not result in a land use change.

4.1.2 Air Quality

The proposed action and alternative actions would not result in a violation of NAAQS.

Green House Gas emissions. GHG emissions resulting from the proposed and alternate actions will not be large enough to have an appreciable effect on climate change.

On October 5, 2009, President Obama signed Executive Order 13514. This Order directs and specifies timelines for Federal agencies to report, inventory, and reduce GHG emissions (74 Federal Register 52117). Currently, there are no formally adopted or published NEPA thresholds of significance for GHG emissions stemming from proposed actions. On February 11, 2010, the council on Environmental Quality released *Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions* that suggests that “25,000 metric tons may provide a useful, presumptive threshold for discussion and disclosure of GHG emissions” and that “This rationale is pertinent to the presentation of NEPA analysis as well”.

GHG emissions were calculated for jet fuel consumption associated with the proposed action, and for gasoline consumption associated with the proposed and alternative actions (Table 4-1). The estimate for 5-year cumulative GHG emissions resulting from the proposed action would be 3.08% of the 25,000 metric tons discussion threshold, and therefore can be construed as negligible. The estimate for cumulative GHG emissions resulting from gasoline consumption associated with Alternative Action 1 and Alternative Action 2 would be 0.02% of the 25,000 metric tons discussion threshold.

Table 4 – 1
Total GHG Emissions

	Annual CO ₂ Emissions			5-Year Cumulative CO ₂ Emissions		
	Proposed Action (kg /year)	Alternative Action 1 (kg/year)	Alternative Action 2 (kg/year)	Proposed Action (kg/5 years)	Alternative Action 1 (kg/5 years)	Alternative Action 2 (kg/5 years)
Jet Fuel	153,120	-	-	765,600	-	-
Gasoline	891	891	891	4,555	4,555	4,555
Aggregate	154,011	891	891	770,055	4,555	4,555

4.1.3 Water Resources

4.1.3.1 Surface Water

The proposed action and alternative actions would not affect surface water. The only surface water source within one mile of an area proposed for aerial herbicide applications (Water #936, Figure 2) would be covered during aerial operations. There are no known *tinajas* within 1 mile of areas proposed for aerial herbicide applications.

4.1.3.2 Ground Water

The proposed action and alternative actions would not affect ground water. It is unlikely that the herbicide applied in accordance with label directions will enter ground water.

4.1.4 Hazardous Material and Waste

All Hazardous material and waste will be stored and disposed of properly. Tanks used to mix the selected herbicide will not be used for other chemical mixtures. All containers will be triple rinsed as per label directions and disposed of properly. Hazardous material and waste management guidelines on the label will be strictly followed. Therefore, we expect no related impacts with the implementation of the proposed or alternative actions.

4.1.5 Solid Waste

Very little solid waste will be generated by the proposed or alternative actions. All solid wastes would be disposed of in an approved land fill. Any solid waste produced as result of herbicide applications would be disposed of in accordance with the pesticide label.

4.1.6 Biological Resources

4.1.6.1 Vegetation

Reduction of the Sahara mustard infestation would be expected to enhance native plant diversity and the overall quality of the range. Sahara mustard has the potential to create dense monoculture stands that compete with native vegetation for available resources. It also creates the risk for wildfires in plant communities that are not fire adapted and may take many years to recover.

The proposed action would not likely have a significant an adverse effect on native vegetation outside treated areas. The potential for damage to native vegetation during aerial application of herbicide would be minimized. Aerial herbicide applications would occur in early to mid-March when Sahara mustard will be most vulnerable to treatment. Sahara mustard is one of the first plants to emerge in the spring. Most native annual plants will not have emerged and most perennial plants will still be dormant during the proposed action. Proposed treatment areas are highly disturbed (i.e., roadsides and air-to-ground target sites) where early successional annual plants, including Sahara mustard, are the dominant vegetation. These plants typically have highly mobile seeds and readily re-establish on disturbed soils following herbicide applications. Prior to all applications, on-site personnel will determine that atmospheric conditions exist to maximize treatment efficacy and minimize the potential for herbicide drift outside proposed treatment areas. The proposed action would not affect agricultural crops or livestock feed because there are no agricultural or livestock grazing operations on the BMGR-E, and all of the areas proposed for aerial treatment are more than 1 mile from the BMGR-E border. In the event that herbicide did drift beyond targeted project boundaries, it would be confined within BMGR-E lands. Ground based herbicide applications and physical removal of plants would be highly targeted for Sahara mustard and would not affect native vegetation. With removal of non-native Sahara mustard, native plant species can be expected to become re-established in treated areas through natural seed dispersal.

Alternative Actions would not adversely affect native vegetation.

4.1.6.2 Wildlife

The proposed action and alternative actions may affect, but are not likely to adversely affect protected wildlife. The herbicide selected for use in the proposed action and Alternative Actions would be applied in accordance with the EPA label and be effectively nontoxic (Table 2-2). Any startle affect resulting from low flying aircraft and ground equipment would be temporary.

4.1.6.3 Threatened and Endangered Species

Lesser Long-Nose Bats

Because lesser long-nosed bat (*Leptonycteris curasoae*) will not be present in the spray area during herbicide applications, and no agave and very few columnar cacti will be exposed to herbicide or otherwise affected by the proposed or alternative actions, we conclude that these actions would have no effect on this federally listed Endangered species.

Sonoran Pronghorn

The proposed action and alternative actions may affect, but are not likely to adversely affect, the Sonoran pronghorn (*Antilocapra americana sonoriensis*), a federally listed Endangered species. Ground based vehicles used to transport personnel and ground-based herbicide applications would operate in accordance with USFWS Biological Opinion 2-21-96-F-094-R3, *Military Training on the Barry M. Goldwater Range East, May 4, 2010*, Biological Opinion 02-21-05-F-0492, *Integrated Natural Resource Management Plan for the Barry M. Goldwater Range, August 26, 2005*, and the 56th Range Management Office Operating Instruction 13-01, *Sonoran Pronghorn Monitoring, 2 December 2008* to minimize disturbance of SPH. SPH that are within 500 meters of ground-based vehicles or personnel on the ground may exhibit a temporary startle response and move from the immediate area. No ground based applications will occur within 1 mile of suspected does with fawns based on SPH monitor reports and AZGFD SPH telemetry reports.

Likewise, low flying C-130 aircraft could produce a startle response in SPH. The aircraft will maintain an airspeed of 150-200 knots (170-230 mph) while conducting low-altitude herbicide applications for a period of 3-4 minutes over roadways and 10-20 minutes over target arrays proposed for treatment. Therefore, high decibel noise exposure will be for very short duration. To avoid general disturbance to pronghorn, monitors will first observe for pronghorn on and near the areas to be sprayed that day and report occurrences and coordinates to the spray team who will plot them. Herbicide applications and low level flights (i.e., < 500 feet above ground altitude) will not occur within 500 meters (1640 feet) of pronghorn sightings. Herbicide applications and low level flights will not occur within one mile (1609 meters) of suspected pronghorn does with fawns as determined by monitor reports and/or AZGFD aerial telemetry reports. If the air crew observes an (deer or pronghorn) in those target arrays proposed for treatment, that spray mission will be aborted and an alternate spray area will be selected for that day. Should an SPH be exposed to the spray, glyphosate and polyvinyl polymer are effectively non-toxic to vertebrates in the concentrations and rates at which they would be applied.

Although glyphosate is a broad spectrum herbicide, we anticipate minimal loss of high value forage plants since the proposed target areas are highly disturbed with very few of these plant species present. Even though the proposed action may result in some disturbance to

Sonoran pronghorn, overall, we anticipate that it will benefit pronghorn by improving habitat function and reducing the risk of large wildfires. Clearing the road margins of vegetation would have the added benefit to pronghorn by making them more visible to ground vehicular traffic.

4.1.7 Cultural Resources

The proposed action and alternative actions would have no effect on the characteristics that qualify the 44 archaeological sites in the project area for the National Register of Historic Places. Should herbicide come in contact with a cultural feature it would not be expected to penetrate beyond the surface of the feature and confound possible radiometric dating.

4.1.8 Geological Resources

The proposed action and alternative actions would have no impact on geologic resources.

4.1.9 Socioeconomics, Environmental Justice, and Protection of Children

4.1.9.1 Socioeconomics

The proposed action and alternative actions would have no impact on the socioeconomics of Maricopa and Pima Counties. Purchase of the herbicide required for the Proposed and Alternative Actions would benefit the selected vendor but would not otherwise affect county economics.

4.1.9.2 Environmental Justice

The proposed action and alternative actions would create no Environmental Justice effects. All herbicide applications associated with the Proposed Action and Alternative Action 2 would occur on portions of the BMGR-E that are closed to public access. Flights to and from the areas targeted for aerial herbicide applications in the Proposed Action would be on established military routes.

4.1.9.3 Protection of Children

The proposed action and alternative actions would pose no environmental or safety risks for children. All herbicide applications associated with the Proposed Action and Alternative Action 2 could occur on portions of the BMGR-E that are closed to public access. Flights to and from the areas targeted for aerial herbicide applications in the Proposed Action would be on established military routes.

4.1.10 Noise

4.1.10.1 Proposed Action Noise Affects

Aerial application of herbicide associated with the proposed action would not be expected to result in a change in the day/night average noise levels in Maricopa, Pima, or Pinal County. The C-130 aircraft used to make aerial herbicide applications would use established military routes to move from the staging point (Luke AFB or Davis-Monthan AFB) to the treatment sites. There would be no more than 4 sorties per day lasting approximately 1 hour per sortie for 7-10 days. Low level flight (approximately 100 feet) would only occur on portions of the BMGR-E closed to public access.

Ground based application of herbicides would have no affect on noise levels. The battery driven electric motors used to power dispersal equipment make little noise.

4.1.10.2 Alternative Actions Noise Affects

Alternative Actions 1 and 2 would have no affect on noise levels.

4.1.11 Cumulative Effects

Cumulative effects are those additive or interactive effects that would result from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes other such actions. Interactive effects may be either counteracting—where the net adverse cumulative effect is less than the sum of the individual effects—or synergistic—where the net adverse cumulative effect is greater than the sum of the individual effects. Cumulative impacts may result from individually minor but collectively significant actions taking place over a period of time.

Air Quality – The proposed actions in combination with normal AF training activities could result short term cumulative effects to air quality. Sorties required for aerial herbicide applications would be in addition to regular AF training sorties. Likewise, surface disturbance resulting from herbicide applications by ground vehicles could result in an increase in airborne particulates. However, these effects would be temporary and would not exceed NAAQS.

Noise – Noise resulting from low level aerial applications of herbicide in the proposed action would be in addition to normal AF training activities. However, any response by wildlife in the vicinity of flight paths is expected to minor and temporary. Aerial herbicide applications will occur in the early morning before scheduled training flights, and wildlife on the BMGR-E are accustomed to military aircraft including low-level overflights. The C-130 aircraft used for aerial applications will use established military routes to travel to the BMGR-E and return to Luke AFB or Davis-Monthan AFB

Herbicide accumulation – No environmental accumulation of herbicide is expected over the course of this action. The herbicides under consideration for application have relatively short duration in soils, with half lives averaging 51-60 days, and the active ingredients do not bioaccumulate in either warm or cold blooded animals.

4.2 NO ACTION ALTERNATIVE

Under the No Action Alternative, the invasive weed infestation would be expected to continue its expansion in both area and density on the BMGR-E. Wildfire risk from dense monoculture stands of Sahara mustard would increase and result in a potential threat to the USAF training mission. Wildlife habitat would continue to be degraded by the displacement native vegetation through competition and wildfires should they occur.

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6.0 REFERENCES

Relevant Statutes, Regulations, and Guidelines

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16 U.S.C. 470aa-470mm, *Archaeological Resources Protection Act (ARPA)*.

25 U.S.C. 3001-3013, *Native American Graves Protection and Repatriation Act of 1960*.

42 U.S.C. 4321-4347, *National Environmental Policy Act of 1969*.

Code of Federal Regulations (CFR)

32 CFR 989, *Air Force Environmental Impact Analysis Process*.

36 CFR 60, *National Register of Historic Places*

40 CFR 1500-1508. *National Environmental Policy Act Regulations*.

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Executive Order 13175, *Consultation and Coordination with Indian Tribal Governments*,
6 November 2000.

Executive Order 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*, 5 October 2009.

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APPENDIX A

Description of Seven Periods of Western Papgueria Culture History

Western Papagueria Culture History

Period	Summary of Characteristics
Paleo-Indian Period circa 15,000-9,000 B.C.	Characterized by reliance on native plants and animals and mobile settlement systems. Refers to the initial pre-Ceramic period occupation (although some consider the Malpais archaeological complex to be an even earlier occupation). Represented by the San Dieguito and Clovis archaeological complexes, which are each characterized by a distinctive tool kit. Associated with the hunting of now extinct big game species, including mammoths.
Archaic Period 8,500 B.C. – A.D. 300	Represented by two archaeological complexes (Amargosa and Cochise) and chronologically subdivided into Early, Middle and Late periods. Until the very end of the period, Archaic populations collected a broad spectrum of native plant and animal foods with seasonal movements. Agricultural villages were established during the end of this period in the Eastern Papaguería; this pattern is not as apparent in the Western Papaguería, which maintained a longer period of pre-ceramic hunter-gatherer cultural continuity.
Formative Period circa A.D. 150-1500	<p>The Hohokam (centered in the Gila-Salt Basin to the east) and Patayan (along the lower Colorado River) cultural traditions are represented in the Western Papaguería during this period. Trincheras was centered to the southeast in northern Sonora, and may also be represented on the BMGR. The presence of a fourth archaeological culture, the Arenenos, was first proposed in the 1950s and 1960s. Areneno material culture is an amalgam plain and red ware pottery, Hohokam and Patayan painter pottery, walk-in wells and reservoirs, house-in-pits, and cremation of Hohokam and Patayan traits along with the possible presence of locally made plain ware pottery. Recognized principally on the basis of pottery styles that mirror better-known changes through time in ceramic manufacture in the Gila-Salt and Tucson basins. The question of which subsistence-settlement systems were adopted by Hohokam occupants of the Western Papaguería is of considerable interest, but more excavation data are needed. New data suggests that maize played a role in subsistence at these sites, but the intensity of farming remains a major question.</p> <p>The Patayan cultural tradition is not well understood; the tradition is divided into three phases, defined principally on the basis of changes in the Lower Colorado Buff Ware pottery (which is found throughout the Western Papaguería). It seems clear that the Patayan people were present in Western Papaguería, but patterns of contact and exchange between Patayan and Hohokam groups are unclear. Trincheras purple-on-red pottery also is present on some sites within the Western Papaguería. The Trincheras culture is best known in the Altar Valley.</p>

	<p>Rather than viewing formative period sites as representing one or the other of the riverine cultures, recent researchers have focused on the inhabitants of the Western Papagueria and their interactions with people in that region and beyond.</p>
<p>Early Historical Period A.D. 1540-1848</p>	<p>Spaniards used the Papaguería principally as a travel corridor, following two primary routes—El Camino del Diablo that runs between Caborca and Yuma, and a north-south route that connected settlements in Mexico with the Gila Bend area. The Spanish missionary Father Eusebio Kino traveled through the area in the late 1600s, and early 1700s noting that the Hia C-ed O’odham people occupied the Western area of the Papaguería. Today O’odham groups claim affinity with the prehistoric Hohokam. The Hopi also claim affinity with the prehistoric Hohokam. The Zuni have similar histories of migrations from southern Arizona.</p> <p>The Cocopah, Quechan, Halchidoma, Cohuana, Halyikwamai, Kaveltcadom, Maricopa, and Mojave occupied various areas along the Lower Colorado and Gila rivers, where they practiced floodwater farming. Internecine warfare led to frequent territorial shifts among these groups. The Yavapai ranged through a vast territory north of the Gila River and probably ventured south of the Gila River into the Western Papaguería at times. Apaches made brief forays to engage in raiding.</p>
<p>Late Historical Period A.D. 1848-1941</p>	<p>Characterized by intensifying contact among American Indian groups and Euro- Americans. As a result of the Mexican-American War in 1848, the United States acquired the territory north of the Gila River. The area to the south of the Gila River, which was home to the Hia C-ed and Tohono O’odham, was acquired through the Gadsden Purchase of 1853-1854, which was home to the Hia C-ed and Tohono O’odham. U.S. troops first traveled along the Gila River during the Mexican-American War. The “Forty-Niners” soon followed on their way to the newly discovered gold fields of California. El Camino del Diablo served as an alternate route for some Forty-Niners, and subsequently, various adventurers and scientists. Just the Cocopah and Quechan remained in residence along the lower Colorado River below the confluence with the Gila River, and no native groups resided on the lower Gila River. Remnants of several Yuman speaking people joined the Akimel O’odham (Pima) along the middle Gila River, where they became known as the Maricopa.</p> <p>The transcontinental Southern Pacific Railroad was constructed and copper mining at the New Cornelia Mine near Ajo stimulated construction of a spur line to connect with the Southern Pacific at Gila Bend. Gold was mined at the Fortuna Mine in the BMGR West, and evidence for smaller mining and prospecting endeavors is reported throughout the region. From the late 1800s to the early 1900s, ranching and homesteading also were pursued in the area that was to become the BMGR.</p>

<p>World War II Period A.D. 1941 – 1945</p>	<p>The BMGR of today is the result of a series of land withdrawals initiated during World War II. In May 1941, when Lt. Col. Ennis Whitehead first surveyed the land west of Phoenix for Luke Field, he also noted that public lands south and west of Gila Bend were ideal for a gunnery range, and Luke student pilots began training on the range in September 1941. During World War II, pilots from both Luke Field and Williams Field used BMGR East for gunnery training, and pilots from the Yuma Army Air Base, which was established between 1941 and 1943, trained on BMGR West. After World War II when Luke Field was closed from 1946 to 1951, Williams Field personnel managed BMGR East. The Yuma Army Airfield became Vincent AFB in 1956 and then in 1959, MCAS Yuma.</p>
<p>Cold War Period A.D. 1946-1989</p>	<p>The Cold War period is defined as extending from the establishment of the “Iron Curtain” in Europe in 1946 to the fall of the Berlin Wall in 1989. Since 1951, the BMGR has hosted air-to-air and air-to-ground bombing and gunnery training on both manned and tactical ranges as part of the Cold War program of military preparedness that remains in place today.</p>

APPENDIX B

Identified Cultural Resources Within Proposed Treatment Sites

Identified Cultural Resources within Proposed Treatment Sites				
Location	Site Number	Site Description	Cultural/temporal Affiliation	Reference
STAC Air Field	Y:8:226 (ASM) BMGR-00-D-01	Artifact scatter with 1 thermal feature	Undetermined/AD 1400-1600	Doolittle, Christopher J. and Stephanie M. Whittlesey. 2005. Intensive Archaeological Survey of 5,575 Acres on the South Tactical Range, Barry M Goldwater Range East, Arizona. Studies in the Western Papaguera 6. Luke AFB, Arizona.
	Y:8:227 (ASM) BMGR-00-D-02	Artifact scatter with 2 thermal features	Undetermined/AD 1300-1500	Doolittle, Christopher J. and Stephanie M. Whittlesey. 2005. Intensive Archaeological Survey of 5,575 Acres on the South Tactical Range, Barry M Goldwater Range East, Arizona. Studies in the Western Papaguera 6. Luke AFB, Arizona.
	Y:8:232 (ASM) BMGR-00-D-07	Ceramic scatter with 2 thermal features	Undetermined/Undetermined	Doolittle, Christopher J. and Stephanie M. Whittlesey. 2005. Intensive Archaeological Survey of 5,575 Acres on the South Tactical Range, Barry M Goldwater Range East, Arizona. Studies in the Western Papaguera 6. Luke AFB, Arizona.
	BMGR-03-F-15	Four thermal features	Undetermined/Undetermined	Tagg, Martyn D. and Michael P. Heilen. 2008. STAC 2003: Intensive Archaeological Survey of 4,945 Acres on the South Tactical Range, Barry M Goldwater Range East, Arizona. Cultural Resources Studies in the Western Papaguera 16. Luke AFB, Arizona.
	BMGR-03-F-31	Flake stone scatter with 1 thermal feature	Undetermined/Undetermined	Tagg, Martyn D. and Michael P. Heilen. 2008. STAC 2003: Intensive Archaeological Survey of 4,945 Acres on the South Tactical Range, Barry M Goldwater Range East, Arizona. Cultural Resources Studies in the Western Papaguera 16. Luke AFB, Arizona.
STAC Aux Field	Y:12:055 (ASM)	Petroglyphs	Undetermined/Undetermined	David B. Tucker, Editor. 2000. South TAC II: An Archaeological Survey of 7.083 Acres in the Northeastern Growler Valley on the Barry M. Goldwater Range in Southwestern Arizona. SWCA Cultural Resources Report No. 99-203. Tucson, Arizona.

	Y:12:056 (ASM)	Artifact scatter with 2 thermal features	Undetermined/Undetermined	David B. Tucker, Editor. 2000. South TAC II: An Archaeological Survey of 7,083 Acres in the Northeastern Growler Valley on the Barry M. Goldwater Range in Southwestern Arizona. SWCA Cultural Resources Report No. 99-203. Tucson, Arizona.
	BMGR-01-D-02	Ground stone scatter with 1 thermal feature	Undetermined/Undetermined	Doolittle, Christopher J., Gabrielle Duff, and Vincent M. LaMotta. 2006. NTAC 2001 Intensive Archaeological Survey of 8,434 Acres on the North Tactical Range, Barry M. Goldwater Range East, Arizona. Cultural Resource Studies in the Western Papagueria 9. Luke AFB, Arizona.
	BMGR-01-D-08	Artifact scatter with 1 thermal feature	Undetermined/Undetermined	Doolittle, Christopher J., Gabrielle Duff, and Vincent M. LaMotta. 2006. NTAC 2001 Intensive Archaeological Survey of 8,434 Acres on the North Tactical Range, Barry M. Goldwater Range East, Arizona. Cultural Resource Studies in the Western Papagueria 9. Luke AFB, Arizona.
NTAC Air Field	Y:8:001 (ASM)	Artifact scatter, thermal features, cremation	Hohokam/AD 1150-1450	Huckell. 1979. The Coronet Real Project: Archaeological Investigation on the Luke Range, Southwestern AZ. Archaeological Series No. 129. Arizona State Museum. Tucson, Arizona.
	Y:8:002 (ASM)		Archaic; Hohokam: 5000 BC-AD 150 AD 200-875, 1150-1450	Huckell. 1979. The Coronet Real Project: Archaeological Investigation on the Luke Range, Southwestern AZ. Archaeological Series No. 129. Arizona State Museum. Tucson, Arizona.
	Y:8:020 (ASM)	Three thermal features	Undetermined/Undetermined	David B. Tucker, Editor. 2000. Footsteps on the Bajada: An Archaeological Survey of 15,813 Acres on the North Tactical Range of the Barry M. Goldwater Range in Southwestern Arizona. SWCA Cultural Resources Report No. 99-140. Tucson, Arizona.

NTAC Convoy	Y:8:028 (ASM)	Five thermal features	Undetermined/Undetermined	David B. Tucker, Editor. 2000. Footsteps on the Bajada: An Archaeological Survey of 15,813 Acres on the North Tactical Range of the Barry M. Goldwater Range in Southwestern Arizona. SWCA Cultural Resources Report No. 99-140. Tucson, Arizona.
	Y:8:029 (ASM)	Eight rock cairns and one rock alignment	Undetermined/Undetermined	David B. Tucker, Editor. 2000. Footsteps on the Bajada: An Archaeological Survey of 15,813 Acres on the North Tactical Range of the Barry M. Goldwater Range in Southwestern Arizona. SWCA Cultural Resources Report No. 99-140. Tucson, Arizona.
	Y:8:030 (ASM)	One rock cluster and one U-shaped rock alignment	Undetermined/Undetermined	David B. Tucker, Editor. 2000. Footsteps on the Bajada: An Archaeological Survey of 15,813 Acres on the North Tactical Range of the Barry M. Goldwater Range in Southwestern Arizona. SWCA Cultural Resources Report No. 99-140. Tucson, Arizona.
	Y:8:041 (ASM)	Artifact scatter, thermal features	Undetermined/Undetermined	David B. Tucker, Editor. 2000. Footsteps on the Bajada: An Archaeological Survey of 15,813 Acres on the North Tactical Range of the Barry M. Goldwater Range in Southwestern Arizona. SWCA Cultural Resources Report No. 99-140. Tucson, Arizona.
NTAC East Pass	BMGR 03-A-16	Flaked stone scatter, petroglyphs	Undetermined/Undetermined	Tagg, Martyn D. and Michael P. Heilen. 2008. NTAC 2003: Intensive Archaeological Survey of 2,009 Acres on the North Tactical Range, Barry M Goldwater Range East, Arizona. Cultural Resources Studies in the Western Papagueria 15. Luke AFB, Arizona.
	BMGR 03-A-17	Artifact scatter, rock ring	Hohokam/AD 700-1450	Tagg, Martyn D. and Michael P. Heilen. 2008. NTAC 2003: Intensive Archaeological Survey of 2,009 Acres on the North Tactical Range, Barry M Goldwater Range East, Arizona. Cultural Resources Studies in the Western Papagueria 15. Luke AFB, Arizona.

	BMGR 02-A-44	Three thermal features	Undetermined/Undetermined	Tagg, Martyn D., Michael P. Heilen, and Kerry Sagebiel. 2007 NTAC 2002: Intensive Archaeological Survey of 5,594 Acres on the North Tactical Range, Barry M Goldwater Range East, Arizona. Cultural Resources Studies in the Western Papagueria 13. Luke AFB, Arizona.
	Y:8:072 (ASM)	Nine thermal features	Undetermined/Undetermined	David B. Tucker, Editor. 2000. Footsteps on the Bajada: An Archaeological Survey of 15,813 Acres on the North Tactical Range of the Barry M. Goldwater Range in Southwestern Arizona. SWCA Cultural Resources Report No. 99-140. Tucson, Arizona.
	Y:8:073 (ASM)	One thermal feature with two grinding slabs	Undetermined/Undetermined	David B. Tucker, Editor. 2000. Footsteps on the Bajada: An Archaeological Survey of 15,813 Acres on the North Tactical Range of the Barry M. Goldwater Range in Southwestern Arizona. SWCA Cultural Resources Report No. 99-140. Tucson, Arizona.
	Y:8:074 (ASM)	Six thermal features	Undetermined/Undetermined	David B. Tucker, Editor. 2000. Footsteps on the Bajada: An Archaeological Survey of 15,813 Acres on the North Tactical Range of the Barry M. Goldwater Range in Southwestern Arizona. SWCA Cultural Resources Report No. 99-140. Tucson, Arizona.
	Y:8:075 (ASM)	Rockshelter with artifact scatter	Hohokam & O'odham/ Prehistoric & post AD 1600	David B. Tucker, Editor. 2000. Footsteps on the Bajada: An Archaeological Survey of 15,813 Acres on the North Tactical Range of the Barry M. Goldwater Range in Southwestern Arizona. SWCA Cultural Resources Report No. 99-140. Tucson, Arizona.
	Y:8:076 (ASM)	Artifact scatter with 3 thermal features	Hohokam & O'odham/ Prehistoric & post AD 1600	David B. Tucker, Editor. 2000. Footsteps on the Bajada: An Archaeological Survey of 15,813 Acres on the North Tactical Range of the Barry M. Goldwater Range in Southwestern Arizona. SWCA Cultural Resources Report No. 99-140. Tucson, Arizona.

	Y:8:077 (ASM)	Rockshelter, artifact scatter	O'odham/post AD 1600	David B. Tucker, Editor 2000 Footsteps on the Bajada: An Archaeological Survey of 15,813 Acres on the North Tactical Range of the Barry M. Goldwater Range in Southwestern Arizona. SWCA Cultural Resources Report No. 99-140. Tucson, Arizona.
	Y:8:078 (ASM)	Artifact scatter with trail	O'odham/post AD 1600	David B. Tucker, Editor 2000 Footsteps on the Bajada: An Archaeological Survey of 15,813 Acres on the North Tactical Range of the Barry M. Goldwater Range in Southwestern Arizona. SWCA Cultural Resources Report No. 99-140. Tucson, Arizona.
	Y:8:079 (ASM)	Twenty rock cairns	Undetermined/Undetermined	David B. Tucker, Editor 2000 Footsteps on the Bajada: An Archaeological Survey of 15,813 Acres on the North Tactical Range of the Barry M. Goldwater Range in Southwestern Arizona. SWCA Cultural Resources Report No. 99-140. Tucson, Arizona.
	Y:8:081 (ASM)	Artifact scatter with 2 thermal features	Undetermined/Undetermined	David B. Tucker, Editor 2000 Footsteps on the Bajada: An Archaeological Survey of 15,813 Acres on the North Tactical Range of the Barry M. Goldwater Range in Southwestern Arizona. SWCA Cultural Resources Report No. 99-140. Tucson, Arizona.
	Y:8:082 (ASM)	Artifact scatter	Hohokam/AD 875-1150	David B. Tucker, Editor 2000 Footsteps on the Bajada: An Archaeological Survey of 15,813 Acres on the North Tactical Range of the Barry M. Goldwater Range in Southwestern Arizona. SWCA Cultural Resources Report No. 99-140. Tucson, Arizona.
	Y:8:083 (ASM)	Rockshelter: artifact scatter, thermal feature	Archaic; Hohokam; Historic/5000 BC-AD 150, AD 200-875, 1150-1450; post AD 1600	David B. Tucker, Editor 2000 Footsteps on the Bajada: An Archaeological Survey of 15,813 Acres on the North Tactical Range of the Barry M. Goldwater Range in Southwestern Arizona. SWCA Cultural Resources Report No. 99-140. Tucson, Arizona.

	Y:8:87 (ASM)	Artifact scatter, thermal feature, rock alignment	Prior to AD 1150	David B. Tucker, Editor 2000 Footsteps on the Bajada: An Archaeological Survey of 15,813 Acres on the North Tactical Range of the Barry M. Goldwater Range in Southwestern Arizona. SWCA Cultural Resources Report No. 99-140. Tucson, Arizona.
	Y:8:088 (ASM)	Rockshelter with artifact scatter and 1 thermal feature	Hohokam & O'odham/ Undetermined & post AD 1600	David B. Tucker, Editor 2000 Footsteps on the Bajada: An Archaeological Survey of 15,813 Acres on the North Tactical Range of the Barry M. Goldwater Range in Southwestern Arizona. SWCA Cultural Resources Report No. 99-140. Tucson, Arizona.
	Y:8:093 (ASM)	Artifact scatter with 4 thermal features	O'odham/post AD 1600	David B. Tucker, Editor 2000 Footsteps on the Bajada: An Archaeological Survey of 15,813 Acres on the North Tactical Range of the Barry M. Goldwater Range in Southwestern Arizona. SWCA Cultural Resources Report No. 99-140. Tucson, Arizona.
	Y:8:094 (ASM)	One thermal feature	Undetermined/Undetermined	David B. Tucker, Editor 2000 Footsteps on the Bajada: An Archaeological Survey of 15,813 Acres on the North Tactical Range of the Barry M. Goldwater Range in Southwestern Arizona. SWCA Cultural Resources Report No. 99-140. Tucson, Arizona.
	Y:8:095 (ASM)	Artifact scatter, 2 circular rock alignments, and 2 nonthermal features	Hohokam/AD 875-975	David B. Tucker, Editor 2000 Footsteps on the Bajada: An Archaeological Survey of 15,813 Acres on the North Tactical Range of the Barry M. Goldwater Range in Southwestern Arizona. SWCA Cultural Resources Report No. 99-140. Tucson, Arizona.
	Y:8:096 (ASM)	Artifact scatter	Hohokam & O'odham/ Undetermined & post AD 1600	David B. Tucker, Editor 2000 Footsteps on the Bajada: An Archaeological Survey of 15,813 Acres on the North Tactical Range of the Barry M. Goldwater Range in Southwestern Arizona. SWCA Cultural Resources Report No. 99-140. Tucson, Arizona.

	Y:8:097 (ASM)	Artifact scatter	Hohokam/AD 1150-1450	David B. Tucker, Editor 2000 Footsteps on the Bajada: An Archaeological Survey of 15,813 Acres on the North Tactical Range of the Barry M. Goldwater Range in Southwestern Arizona. SWCA Cultural Resources Report No. 99-140. Tucson, Arizona.
	Y:8:098 (ASM)	Artifact scatter	Hohokam/AD 975-1150	David B. Tucker, Editor 2000 Footsteps on the Bajada: An Archaeological Survey of 15,813 Acres on the North Tactical Range of the Barry M. Goldwater Range in Southwestern Arizona. SWCA Cultural Resources Report No. 99-140. Tucson, Arizona.
	Y:8:099 (ASM)	Artifact scatter with 2 rock clusters	Hohokam/AD 975-1150	David B. Tucker, Editor 2000 Footsteps on the Bajada: An Archaeological Survey of 15,813 Acres on the North Tactical Range of the Barry M. Goldwater Range in Southwestern Arizona. SWCA Cultural Resources Report No. 99-140. Tucson, Arizona.
	Y:8:100 (ASM)	Artifact scatter with 4 rock clusters, 1 thermal feature, 7 circular rock alignments	Paleoindian; Archaic; Hohokam/ ca 10,000 BC; 7,000 BC-5,000; AD 975-1150	David B. Tucker, Editor 2000 Footsteps on the Bajada: An Archaeological Survey of 15,813 Acres on the North Tactical Range of the Barry M. Goldwater Range in Southwestern Arizona. SWCA Cultural Resources Report No. 99-140. Tucson, Arizona.
	Y:8:101 (ASM)	Artifact scatter with circular rock alignment	Paleoindian; Archaic; Hohokam; O'odham/ ca 10,000 BC; 7,000 -5,000 BC; AD 150-1450; post AD 1600	David B. Tucker, Editor 2000 Footsteps on the Bajada: An Archaeological Survey of 15,813 Acres on the North Tactical Range of the Barry M. Goldwater Range in Southwestern Arizona. SWCA Cultural Resources Report No. 99-140. Tucson, Arizona.
	Y:8:102 (ASM)	Artifact scatter with 1 rock cairn	Paleoindian; Archaic; Hohokam; O'odham/ ca 10,000 BC; 7,000 BC-5,000; AD 150-1150; post AD 1600	David B. Tucker, Editor 2000 Footsteps on the Bajada: An Archaeological Survey of 15,813 Acres on the North Tactical Range of the Barry M. Goldwater Range in Southwestern Arizona. SWCA Cultural Resources Report No. 99-140. Tucson, Arizona.

	Y:8:103 (ASM)	Artifact scatter	Archaic; Hohokam; O'odham;/7,000 BC-2,000; AD 875-1150; post AD 1600	David B. Tucker, Editor 2000 Footsteps on the Bajada: An Archaeological Survey of 15,813 Acres on the North Tactical Range of the Barry M. Goldwater Range in Southwestern Arizona. SWCA Cultural Resources Report No. 99-140. Tucson, Arizona.
	Y:8:106 (ASM)	Artifact scatter with 3 circular rock alignments and 3 rock clusters	Archaic; O'odham; Historic Patayan/ 7,000 BC-2,000; post AD 1600	David B. Tucker, Editor 2000 Footsteps on the Bajada: An Archaeological Survey of 15,813 Acres on the North Tactical Range of the Barry M. Goldwater Range in Southwestern Arizona. SWCA Cultural Resources Report No. 99-140. Tucson, Arizona.
Roads	Y:8:039	Artifact scatter, thermal feature	Patayan/Undetermined	David B. Tucker, Editor 2000 Footsteps on the Bajada: An Archaeological Survey of 15,813 Acres on the North Tactical Range of the Barry M. Goldwater Range in Southwestern Arizona. SWCA Cultural Resources Report No. 99-140. Tucson, Arizona.