FINAL

INTEGRATED WILDLAND FIRE MANAGEMENT PLAN
BARRY M. GOLDWATER RANGE - WEST
Marine Corps Air Station Yuma
Yuma, Arizona

Contract Number N62473-14-D-1424
Contract Task Order N6247317F4047

Hercules JV Project No. 1455404047

November 2018

Submitted to:

Naval Facilities Engineering Command, Southwest
1220 Pacific Highway
San Diego, California 92132-5190

Submitted by:

Hercules Joint Venture (JV)
2423 Hoover Avenue
National City, California 91950

Final

Integrated Wildland Fire Management Plan for the BARRY M. GOLDWATER RANGE - WEST Marine Corps Air Station Yuma

November 2018

Prepared for:

Marine Corps Air Station Yuma
Range Management Division
P.O. Box 99134/Building 151
Yuma, Arizona 85369-9134
Station Technical Representative: Bobby Law

Under Contract with:

Naval Facilities Engineering Command, Southwest
1220 Pacific Highway
San Diego, California 92132-5190
Contracting Officer Representative: Cece Dahlstrom

Prepared by:

Carol Rice
Wildland Resource Management
and
Hercules JV
2423 Hoover Avenue
National City, California 91950
(858) 300-4325
Project Manager: Erika Eidson

Prepared under:

Contract Number N62473-14-D-1424
Contract Task Order N6247317F4047

Hercules JV Project No. 1455404047

Recommended Citation: Hercules JV. 2018. Integrated Wildland Fire Management Plan for BARRY M. GOLDWATER RANGE - WEST, Marine Corps Air Station Yuma. Unpublished report submitted by Hercules JV to Marine Corps Air Station Yuma, Arizona and Naval Facilities Engineering Command, Southwest, California.

This page intentionally left blank

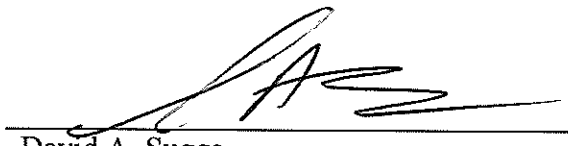
INTEGRATED WILDLAND FIRE MANAGEMENT PLAN

Barry M. Goldwater Range - West

Yuma County, Arizona

APPROVAL

This Integrated Wildland Fire Management Plan (IWFMP) meets the requirements of the Integrated Natural Resources Management Plan, Fiscal Years 2018-2023. The plan complies with Department of Defense Instruction (DoDI) 6055.06, MCO 5090.2, and the Sikes Act (16 USC 670a-670o, 74 Stat. 1052, As Amended through P.L. 113–291, Enacted December 19, 2014).



David A. Suggs
Colonel, USMC
Commanding Officer
Barry M. Goldwater Range – West
Marine Corps Air Station Yuma, AZ

4 Dec 2018
Date

This page intentionally left blank

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

This page intentionally left blank

ACRONYMS AND ABBREVIATIONS

ACEC	Area of Critical Environmental Concern
ADEQ	Arizona Department of Environmental Quality
AGFD	Arizona Game and Fish Department
BLM	Bureau of Land Management
BMGR	Barry M. Goldwater Range
BMGRW	Barry M. Goldwater Range – West
BOR	Bureau of Reclamation
CH/HR	Chains per Hour
CLEO	Conservation Law Enforcement Officer
CM	Conservation Manager
CO	Commanding Officer
CPR	Cardio-Pulmonary Resuscitation
DoD	Department of Defense
DoDD	Department of Defense Directive
DoDI	Department of Defense Instruction
DSCA	Defense of Civil Authorities
EA	Environmental Assessment
EIS	Environmental Impact Study
EVT	Existing Vegetation
FDRS	Fire Danger Rating System
FMD	Facilities Maintenance Division
FONSI	Finding of No Significant Impact
FTHL	Flat-Tailed Horned Lizard
HQMC	Marine Corps Headquarters
INRMP	Integrated Natural Resource Management Plan
IWFMP	Integrated Wildland Fire Management Plan
JDOMS	Joint Directorate of Military Support
LAFB	Luke Air Force Base, Arizona
LBS	Pounds
m	Meter(s)
MAGTF	Marine Air Ground Task Force
MCAS	Marine Corps Air Station
MCIW	Marine Corps Installations West
MCO	Marine Corps Order
MIST	Minimum Impact Suppression Tactics
MLWA	Military Lands Withdraw Act
NAVFAC SW	Naval Facilities Engineering Command Southwest
NCO	Natural and Conservation Officer
NEPA	National Environmental Policy Act
NFIRS	National Fire Incident Reporting System
NFPA	National Fire Protection Association
NIFC	National Interagency Fire Center
NM	National Monument
NPS	National Park Service

ACRONYMS AND ABBREVIATIONS (CONTINUED)

NRCS	Natural Resources Conservation Service
NWCG	National Wildfire Coordinating Group
NWR	National Wildlife Refuge
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WFMP	Wildland Fire Management Plan
WRCC	Western Regional Climate Center

EXECUTIVE SUMMARY

This Integrated Wildland Fire Management Plan (IWFMP) provides the justification and foundation of a fire management program for the Barry M. Goldwater Range West (BMGRW) in southwestern Arizona. The plan's focus is to provide recommendations for minimizing the threat of wildfire on the approximately 700,000 acres that comprise the BMGRW while following management objectives, and to outline a methodology for the implementation of these recommendations.

This IWFMP analyzes the level of risk posed by wildland fire in order to provide recommendations regarding fire suppression. It also addresses wildfire occurrences in the range training areas, necessary pre-fire preparations, wildfire control methods, and coordination among multiple fire-fighting entities.

Wildland fires on military lands are a risk to human lives, natural resources, military assets, and the military mission. However, wildfires have not been and do not present a significant concern on this range. Approximately seventy-five percent of the range is classified as unburnable; no fires are expected to burn with flames longer than eight feet. There has been meager history of wildfire in the records for the range.

The IWFMP describes the actions to be taken and defines the responsibilities of all offices, departments, and agencies involved. It includes information about land use and current biotic and abiotic conditions, fuels, weather, values at risk, relevant policies, organization, and specifics on pre-suppression and maintenance actions.

This IWFMP satisfies the requirement for a wildland fire management plan as established in the Federal Wildland Fire Management Policy. The plan complies with Department of Defense Instruction (DoDI) 6055.06, MCO 5090.2, and the Sikes Act (16 USC 670a-670o, 74 Stat. 1052, As Amended Through P.L. 113–291, Enacted December 19, 2014).

The IWFMP recommends the establishment and strengthening of cooperative agreements for wildland fire response. It also recommends that wildland fuels be monitored after years where exceptional rainfall has occurred.

This page intentionally left blank

1.0 INTRODUCTION

The Barry M. Goldwater Range (BMGR) is a military training range located in southwestern Arizona and is divided into two administrative units. BMGR East (BMGRE) is administered by Luke Air Force Base, Arizona (LAFB) while BMGR West (BMGRW) is administered by Marine Corps Air Station Yuma, Arizona (MCAS Yuma). BMGRW is configured principally to support the training needs of the aviation element of the Marine Air Ground Task Forces (MAGTF), but also provides weapons ranges and other sites that support the training of those ground elements that serve as the primary points of integration between its air and ground forces.

The Integrated Natural Resource Management Plan (INRMP) for BMGR was completed in March 2007 and revised in June 2013. One of the requirements of that document was to create and implement a Wildland Fire Management Plan (WFMP). This Integrated Wildland Fire Management Plan (IWFMP), which addresses BMGRW, complies with applicable laws and regulations, and fulfills the direction established by DoDI 6055.06, MCO 5090.2, and the Sikes Act.

The goal of this IWFMP is to provide for firefighter and public safety and to maximize military training operations, prior to and during wildland fire events. It provides specific guidance, procedures, and protocols for the management of wildland fires on all BMGRW lands. This plan defines the responsibilities of the offices, departments, and agencies involved, and describes fire pre-suppression and suppression actions to be taken on a strategic as well as tactical basis.

1.1 Planning Considerations and Authority

The Federal Wildland Fire Management Policy sets forth the guiding principle that, "Fire Management Plans, programs, and activities support land and resource management plans and their implementation (National Wildfire Coordinating Group 2009)." The Barry M. Goldwater Range (BMGR) INRMP is the plan that this IWFMP supports.

Recommendations will be implemented under the INRMP and the associated Environmental Impact Statement, and in accordance with the National Environmental Policy Act (NEPA). The INRMP prescribes natural resource conservation/management on the BMGR that is: 1) sustainable; 2) in accordance with laws and regulations; and 3) integrated with existing military installation plans and mission requirements. The INRMP will ensure that lands remain available and in good condition to support the BMGR's military mission with "no net loss" of military training capability. This IWFMP is consistent with the direction of the INRMP.

In addition, this plan is being conducted in accordance with NEPA of 1969, the Sikes Act Improvement Act as Amended through 2003 and the Military Lands Withdraw Act (MLWA) 1999. Also applicable is MCAS Yuma, Range and Training Areas Standard Operating Procedures (Station Order 3710.6J, Chapter 2 Environmental Procedures) and the Station Environmental Compliance and Protection Standard Operating Procedures (Station Order 5090.2A July 2018).

The ultimate drivers for this Wildfire Management Plan are:

- The Sikes Act – legally mandates no net loss in the capability of military installation lands to support its mission;
- Executive Order 13112 – which directs federal agencies to prevent the introduction of invasive species; and
- The Endangered Species Act – directs federal agencies to conserve endangered and threatened species.

Wildfires can remove land from training both during a fire and afterwards, due to allowances for habitat recovery. Wildfires also cause disturbances that allow invasive species to become established, threaten plant communities, and damage habitat causing wildlife to be negatively affected. The effects of wildfires demand a comprehensive plan to be used to minimize the impacts from a wildfire, and ensure BMGR operates within legal requirements.

1.2 Compliance with Department of Defense Policy

This Integrated Wildland Fire Management Plan is in compliance with:

- DoDI 6055.06, dated 21 Dec 2006 *DoD Fire and Emergency Service Program,*
- Marine Corps Order (MCO) 11000.11A Marine Corps Fire Protection and Emergency Services Program (16 Aug 2017),
- MCO 5090.2, Environmental Compliance and Protection Program,
- BMGR Integrated Natural Resources Management Plan (INRMP), February 2013,
- Federal Wildland Fire Management Policy and Program Review, 2009,
- Sikes Act, as amended.

2.0 AFFECTED AREA

The western portion of the BMGR consists of approximately 700,000 acres located entirely in southwestern Yuma County, Arizona (Figure 1). The BMGRW is bounded by the international United States/Mexican border to the south, the Cabeza Prieta National Wildlife Refuge (NWR) to the south-east, and Bureau of Reclamation (BOR) and State Trust land to the west. To the north, a mix of private, State Trust Land, and Bureau of Land Management (BLM) parcels border the BMGRW.

The range is used for a variety of military training activities (e.g. live fire, inert, laser, troop movements, etc.). However, the predominant use of BMGRW is to provide land and airspace for air combat training.

2.1 Location

The BMGRW lies on a west-east axis and falls entirely in Yuma County (Figure 2). The range includes a majority of the Gila Mountain Range, the Lechuguilla Desert, and the Mohawk Valley. To the southeast, the range is bordered by the Cabeza Prieta Mountains. To the north, the range is bounded by Interstate Highway 8.

2.2 Topography

The BMGRW is located in the Sonoran Desert, encompassing much of the Gila Mountains, the Tinajas Atlas Mountains, the Copper Mountains, and a portion of the Mohawk Mountains. It also includes vast stretches of the Yuma Desert, the Lechuguilla Desert and Mohawk Valley. Its terrain is characterized by large, broad sweeps of relatively flat land bisected or interrupted by small mountain ranges. The range lies between 180 and 3,143 feet above mean sea level.

The Sonoran Desert of Arizona is situated in the southwestern portion of the Basin and Range physiographic province. This area is characterized by generally steep, subparallel, discontinuous mountain ranges that trend northwest to southeast separated by broad, gently sloping to nearly flat, deep alluvial basins. The BMGRW is characterized by the rugged Gila and Copper Mountains, lands that rise abruptly from broad alluvium-filled desert basins. Landforms are typically rounded hills and plains that form a flat to rolling topography.

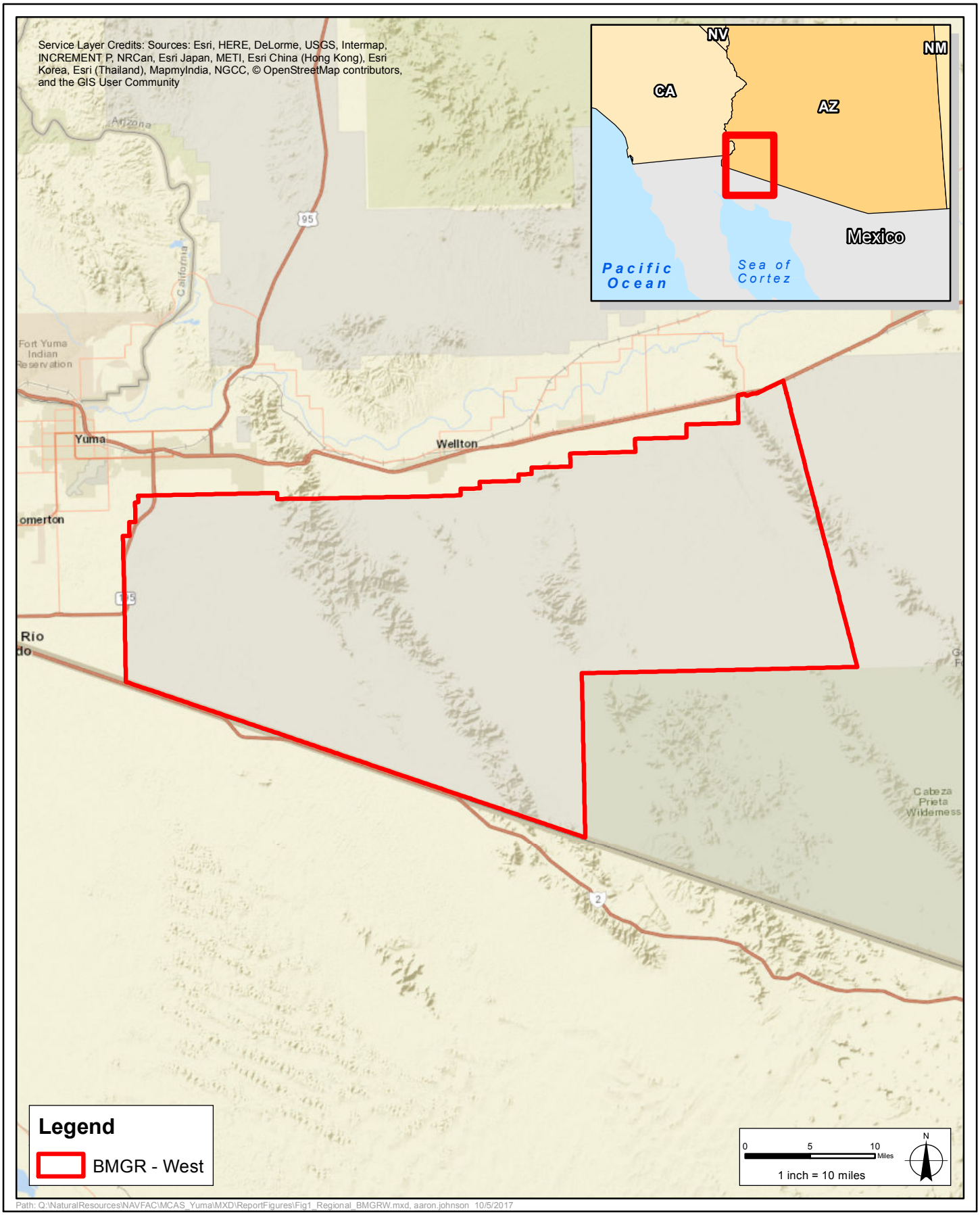
2.3 Geology/Soils

Though range-wide soil mapping has been identified as an Action Item in BMGRW's INRMP (page 6-9), a geologic and/or soil survey has not been completed for the range. However, a soil survey has been completed for the region just north of the range (National Resource Conservation Service (NRCS) 2011). Presumably, the soils identified along the range's boundary extend into the BMGRW. While we cannot describe anything within the interior of the range, based on the surrounding survey, we can assume the following soil characteristics for portions of the range.

The following soil types have been identified surrounding the range:

- Antho fine sandy loam (deep, well drained, nearly level soil on flood plains and low terraces; permeability is moderately rapid; non-irrigated areas of this soil have poor potential for rangeland wildlife habitat; hazard of soil blowing is increased if plant cover is not preserved)
- Antho sandy loam (deep, well drained, nearly level soil on flood plains and low terraces; permeability is moderately rapid; non-irrigated areas of this soil have poor potential for rangeland wildlife habitat)
- Carrizo very gravelly sand (deep, nearly level of moderately sloping, excessively drained soil is on flood plains and recent alluvial fans; permeability is very rapid; the hazard of erosion is high during torrential showers; flooding hazard)
- Dateland fine loamy sand (deep, well-drained soil on broad alluvial fans; permeability is moderately rapid; non-irrigated areas of this soil have poor potential for rangeland wildlife habitat)
- Harqua-Tremant complex (deep, well drained, gently sloping soils on alluvia fans and low terraces; permeability is moderately slow; non-irrigated areas have poor potential for wildlife habitat and fair potential for wetland wildlife habitat)
- Laposa-Rock outcrop complex, 15-75 percent slopes (scattered throughout mountains and hills; Laposa soil is moderately deep and well drained and permeability is moderate; Rockcrop consists of exposed areas of granite, gneiss, schist, andesite, and rhyolite with runoff rapid; very poor potential for rangeland wildlife habitat)
- Ligurta-Cristobal complex, 2-6 percent slopes (deep, well drained, strongly saline soils on old alluvial fans and low terraces; permeability is moderately slow with surface runoff that is rapid, though the hazard for water erosion is slight; these soils have very poor potential for rangeland and wetland wildlife habitat)
- Rositas sand (deep, excessively drained, nearly level to rolling soil on terraces, alluvial fans, and sand dunes; formed in mixed, sandy, windblown material; permeability is rapid; used mainly as range; nonirrigated areas are very poor for rangeland wildlife habitat)
- Rositas-Ligurta complex (soils consist of deep, gently sloping soils on low terraces and sand dunes; somewhat excessively drained; wind-deposited dunes; permeability is rapid; mainly used as range; soils are highly susceptible to soil blowing)
- Tremant-Rositas complex (deep, well drained and somewhat excessively drained, level to gently sloping soils on low terraces, old alluvial fans, and sand dunes; formed in mixed gravelly alluvium and mixed, sandy, windblown material; permeability is moderately slow; surface runoff is mediums and hazard of water erosion is slight)
- Wellton loamy sand (deep, well drained, nearly level to gently sloping soil is on broad alluvial fans and terraces; permeability is moderately rapid; surface runoff is slow and hazard of water erosion is slight)
- Wellton-Dateland-Rositas complex (deep, gently sloping to moderately sloping soils on old alluvial fans and sand dunes; permeability is moderately rapid with surface runoff is slow and the hazard is water erosion is slight; the hazard of soil blowing is high)

Many of the soils described exhibit a slight to high wind and water erosion hazard. Coupled with the range's identified challenges with off-road soil disturbances due to driving associated with cross-border travel, there is a reasonable potential for post-fire erosion to occur if significant plant cover is removed by a fire or from fire suppression activities.



Path: Q:\NaturalResources\NAVFAC\MCAS_Yuma\MXD\ReportFigures\Fig1_Regional_BMGRW.mxd, aaron.johnson 10/5/2017

Hercules JOINT VENTURE

Regional Map
BMGR - West
MCAS Yuma
Yuma, Arizona

FIGURE
1

This page intentionally left blank

Fort Yuma Indian Reservation
Ross Rd
York Rd
CALIFORNIA
ARIZONA
Winterhaven
Zona Federal Vicente Guerrero
Kumeyaay Hwy
W 1st St
I-8 BL
S Picacho Rd
W 8th St
S Pacific Ave
E County 9th St S
Yuma
W 24th St
I-8 BL E
E 32nd St
S Somerton Ave
W County 12th St
S Avenue 3 E
Somerton
W County 19th St S
S Avenue B
S Avenue J
E Juan Sanchez Blvd
San Luis
San Luis Rio Colorado
Barrio Aviación
Del Bosque
Libertad
Calle 17
Calle 26
Calle 34
México
Mezquite
Reforma
UNITED STATES
MEXICO MEXICO
Fortuna Foothills
E 40th St
S Avenue 20 E
Wellton
Old US 80
Roll
S Avenue 40 E
E County 4th St S
Tacna
S Avenue 45 E
E County 1st St S
E County 2nd St
S Avenue 52 E
Dateland
Mohawk/Papago Wall Rd
Papago Road
MOHAWK VALLEY
Military Drag
Tule Road
Hobbs Drag
Mohawk Drag
Little Pass
El Camino Del Diablo East
Cipriano Pass
Camino del Diablo West
Canon Way
Ave 10E
Radar Road
Foothills Blvd
Dripping Springs Road
Ranger Trail
Target Road
Range Road
GILA MOUNTAINS
Border Road
LECHUGUILLA DESERT
Tinajas Altas Pass
El Camino Del Diablo
Cabeza Prieta National Wildlife Refuge

Legend

- BMGR - West

Authorized Roads - BMGRW

Category

- SECONDARY
- TERTIARY
- TRAIL
- OTHER
- UNKNOWN

Path: Q:\3554_NaturalResources\NAVFAC_MCAS_Yuma_Hercules_WildfirePlan\MXD\ReportFigures\WildfirePlan_BMGRW\Fig2_Vicinity_BMGRW.mxd, aaron.johnson 7/25/2018

Hercules JOINT VENTURE

Vicinity Map
BMGR - West
MCAS Yuma
Yuma, Arizona

1 inch = 5 miles
0 2.5 5 Miles
N

FIGURE
2

This page intentionally left blank

2.4 Natural Resources

2.4.1 Climate

Average rainfall over the entire range, based on long-term weather patterns, is less than 5 inches per year. Rainfall in the western extremes of the range averages no more than 3 inches annually. Annual rainfall within the Sonoran Desert is highly variable in terms of its amount, seasonal timing, and geographic distribution. Most of the annual precipitation typically occurs during mid-winter from frontal types of storms or during a late summer monsoon-type of rainfall period. Because of the irregularity of rainfall patterns, some range locations may receive little or no rain during the same year in which other areas receive average or above-average precipitation.

The overall effects of the prevailing low rainfall patterns are exacerbated by high temperatures and regional evaporation potentials that greatly exceed other rainfall regimes. Summer daytime temperatures on the range often are in excess of 110 degrees Fahrenheit and annual evaporation potentials can be greater than 86 inches in the western part of the range.

Climatic conditions tend to be persistent, but as noted, rainfall patterns are highly irregular. The region has experienced persistent and reoccurring drought for more than a decade, and some climate models predict continued drought as a result of global climatic change (Seager et al. 2007 in Villarreal, Miguel L. et al. 2013). Increased temperatures and variable precipitation events related to drought and climate change could affect the BMGRW by decreasing soil moisture, increasing drought stress in vegetation and wildlife, and decreasing the availability of surface-water resources.

2.4.2 Water Resources

2.4.2.1 Surface Water

Surface water at the BMGRW is very limited. There are no perennial or intermittent streams present on the range and ephemeral stream flow occurs only in immediate response to sizable rainfall events. Surface water drainage on the BMGRW is outward from the mountain ranges and, for most of the area, ultimately northward by numerous feeder washes into the larger washes that flow to the Gila River, which in turn flows west into the Colorado River. Some storms cause flash flooding in the smaller mountain drainages and short-term flooding in the larger valley washes and floodplains.

Natural flooding events are highly variable in frequency and intensity and can have a large effect on natural community composition, structure, and function. Some rain water collects in natural rock catchments (also known as tanks or tinajas), human-modified natural catchments, or artificially constructed tanks where the water may persist for weeks or months without recharge until it eventually evaporates or is consumed by wildlife.

Currently, many roads are intercepting the natural ephemeral washes, and serve as man-made drainage channels for the watershed. Because of steep slope and frequent motorized vehicles, many roads surfaces are severely incised. Those incised roads separate the lower and upper portions of the watershed, and disconnect the lower watershed from receiving water flow from the upper watershed.

At present, the lower and upper watersheds have distinct vegetation covers as woody riparian vegetation types are disappearing in the lower watershed. The incised roads have also caused headcuts extending to the upper watershed. Drag road operations create berms along the road sides that interrupt and divert overland flows. A number of drag roads in BMGRW exhibit the effects of this phenomenon. In places where roads have been repeatedly drug, the road beds have receded below grade and become small washes during storm events as runoff is captured from multiple natural drainages that are traversed by the road. Drag road berms also act to dam surface runoff in a number of BMGRW locations, which cause runoff from small and moderate storms to pond on the upstream side of the road. As a result, thick stands of vegetation develop in response to the increase soil moisture on the upstream side of the road and the natural vegetation community declines for some distance on the drier downstream side of the road.

Similarly, the consequence of the numerous cross-country vehicle routes that have been created over the last five years as a result of illegal cross-border traffic and law enforcement reactions have not been assessed. In some heavily-used traffic corridors, which are affected by multiple vehicle trails, drainage impacts may be concentrated, but localized effects on surface drainage from cross-country vehicle use are scattered in many locations of BMGRW.

2.4.2.2 Ground Water

Due to high evaporation rates, low rainfall, and rapid runoff, the BMGRW's groundwater resources are extremely limited. In the general region, groundwater reservoir consists of two major sub-divisions: poor water-bearing rocks of Tertiary age and water-bearing deposits of Pliocene to Holocene age. These sub-divisions contain some water, but much of it is highly mineralized and the rocks are too poorly permeable or lie at too great a depth beneath most of the area to be significant sources of groundwater.

2.4.3 Vegetation

Vegetation in the BMGRW is defined by the physiography of the area and the availability of water, with broad desert bajadas[1] and valleys separating largely bare, rocky mountain ranges, with extensive reticulating wash systems lacing the slopes of the washes and valley bottoms. The region is part of the Lower Colorado River Valley subdivision of the western Sonoran Desert (Phillips *et al.* 2015). The western side of the ranges on the BMGRW are catchments for sand, with extensive sand and dune systems.

The BMGR INRMP (2007) broadly defines the vegetation communities of the BMGRW in thirteen categories, based upon an earlier work by The Nature Conservancy (TNC) (Hall *et al.* 2001). This report categorizes the vegetation into:

1. Valley Bottom Floodplain Complex
2. Dune Complex and Dune Endemics
3. Creosotebush-Bursage Desertscrub

[1] A broad slope of alluvial material at the foot of an escarpment or mountain.

4. Creosotebush-Big Galleta Scrub
5. Paloverde-Mixed Cacti-Mixed Scrub on Bajadas
6. Paloverde-Mixed Cacti-Mixed Scrub on Rocky Slopes
7. Sand Tank Mountains Uplands
8. Elephant Tree-Limberbush on Xeric Rocky Slopes
9. Desert Playa
10. Valley Xeroriparian Scrub
11. Mountain Xeroriparian Scrub
12. Salt Desertscrub
13. Desert Tinajas/Springs

Malusa and Sundt (2015) provide a much more detailed view of vegetation, characterizing seven vegetation alliances (creosote, bursage, saltbush, brittlebush, Mormon tea, watercourse, and blue paloverde, plus barren and disturbed lands), with 25 vegetation associations and 42 sub-associations that roughly correspond with the earlier classification scheme. The following commentary is based upon the latter work.

Creosote alliance associations and sub-associations which occur mostly on bajadas and valleys comprise 77 percent of the vegetation on the BMGRW, thus creosote bush scrub in one form or another is the dominant vegetation of the range. These are typically wide-spaced shrub communities whose composition can range from relatively simple (only creosote is dominant, 14 percent of cover) to low diversity (*i.e.,* creosote-bursage, which is the most extensive association on the BMGRW at 40 percent coverage) to relatively high diversity (*i.e.,* where creosote overlaps with a watercourse or other community such as creosote-bursage/palo verde-ironwood, 14 percent coverage). Diversity can also increase with elevation, where stem succulents such as agaves and cacti (including teddy bear cholla [*Cylindropuntia bigelovii*] and saguaro [*Carnegiea gigantea*]) are more common.

Bursage alliance associations and sub-associations comprise 16 percent of the vegetation cover on the BMGRW. These fall generally within the creosote bush-bursage category of the earlier TNC classification, but also extend into the xeric mountains. White bursage is by far the most common and dominant species. Bursage associations are often intimately associated with related creosote associations, but are also common in the rocky mountain and sandy areas where creosote may be limited, and where associates include such species as big galleta grass (*Pleuraphis rigida*) on sand, and elephant tree and brittlebrush (*Encelia farinosa*) in the mountains. The most common bursage associations include white bursage-creosote (4 percent coverage), white bursage-elephant tree (7 percent coverage) and white bursage-big galleta (4 percent).

Brittlebrush alliance associations, which are often associated with creosote and/or white bursage, comprise about 2.5 percent of the vegetative cover on the BMGRW. These are generally associated with dark rock or dark substrates in the mountains (particularly in the Mohawks) and are also common along washes. Mormon tea (*Ephedra* spp.) associations are also found on mountain slopes and in washes, and account for 0.7 percent. Both of these alliances would fall geographically in the xeric mountain elephant tree-limber bush category of the TNC classification.

The mountain and valley xeroriparian scrub categories (Hall *et al.* 2001) roughly correspond to the watercourse alliance associations and various floodplain associations of Malusa and Sundt (2015).

These basically linear features total over 2,725 miles in the BMGR as a whole (INRMP 2007). Watercourse alliance associations account for slightly more than 2 percent of the BMGRW, and fall from the mountains to dissect the broad bajadas and valleys. They include such tree species as ironwood (*Olneya tesota*), mesquite (*Prosopis glandulosa*), and blue palo verde (*Parkinsonia florida*), and shrubs such as wolfberry (*Lycium* spp.), desert lavender (*Hyptis emoryii*), catclaw acacia (*Acacia greggii*), cheesebush (*Hymenoclea salsola*) and brittlebrush. Physically, wash systems can range from a simple, shallow single channel (a stringer wash) to broad, well-developed relatively diverse arroyos with several to many braided channels. These are easily recognizable by the increased density of shrubs along their courses, particularly with the taller tree species in better developed washes. Wash species can extend into and overlap with those of intimately associated neighboring stands of "upland" vegetation. A great number of washes can sometimes present the illusion of a near continuous stand of riparian species (Shreve and Wiggins 1964).

Barren lands without vegetation account for about 0.1 percent of the BMGRW, while human disturbance has drastically affected only about 0.5 percent despite public access and military use. The remaining vegetation alliances (blue palo verde and saltbush) on the BMGRW account for less than 0.05 percent of the vegetation, thus representing fairly rare associations for the region, and are more typical of southeastern California (Malusa and Sundt, 2015).

Sahara mustard (*Brassica tournefortii*) was by far the most common non-native invasive species detected by Malusa and Sundt (2015) on the BMGRW, and can form extensive stands in several habitats, but especially in floodplains and sand or other areas that are subject to regular natural or human disturbance. Though the often low-growing but relatively low impact Arabian or Mediterranean grasses (*Schismus* spp.) are common, they do not provide extensive cover, and other non-native grasses appear to be fairly rare.

2.5 Site-wide and Adjacent Values at Risk

2.5.1 Values at Risk within the BMGRW

There are several facilities on the BMGRW; however, only a few constitute a value at risk from wildfire, because of the non-combustible nature of the facilities. The non-ignitable values at risk are:

Rescue Beacons. There are 17 beacons located throughout the range. If activated, the U.S. Border Patrol will respond with life-saving provisions. The beacons themselves are completely non-combustible.

KNOZ/ALF Auxiliary Landing Field. This improvement, which is located on the northwest portion of the range at the eastern end of E. County 19th Street, is non-combustible.

"Yodaville Urban Target Complex". This is an urban close air support (CAS) target complex built with shipping containers; some structures are four stories high (Darack, 2009). The complex includes 178 mock buildings, 131 personnel targets, 31 vehicle targets, and is equipped with streetlights. There are four Tactical Air Control Party sites around the periphery (virtualglobetrotting.com/map/-urban-target-complex/view/google.

Fortuna Mine. Foundations and an occasional large timber are the only remains of the settlement.

2.5.2 Road Access

Approximately 75 percent of BMGRW is available for general public access. All or portions of the public use area continues to be subject to occasional temporary closures to support military activities that present safety hazards and/or have security requirements.

All visitors are required to obtain a BMGR Visitor's Permit, which is valid from 1 July to 30 June of the following year. BMGRW visitors are not required to view the Air Force Visitor Safety Video that is compulsory for visitors prior to entering BMGR East.

The active road system documented in the 2007 INRMP for BMGRW included a total of 636 miles of active roads, of which 427 miles are designated public access roads.

There are infrequent illegal entries into the BMGRW across the southern border. Due to this activity there is an ongoing presence of the U.S. Border Patrol. Officers traverse the BMGRW in vehicles and ATVs usually on the dirt roads, and occasionally off-road.

2.5.3 Off-site Values

Existing land use on the perimeter of the BMGRW includes communities, industry, range land for livestock grazing, agricultural land, Native American reservation land, public land with multiple uses including recreation, and undeveloped desert.

Three census designated places are located within a mile of the northern border. These are:

1. Wellton (2016 estimated population of 2,968),
2. Fortuna Hills (2010 estimated population 26,265)
3. Tacna (2010 estimated population 602)

The City of Yuma (2016 estimated population of 94,906), is located several miles northwest of the BMGRW.

Land use within most of these communities includes a mix of commercial (service stations, hotels, restaurants, grocery and souvenir stores, and other related service businesses), industrial, recreational (e.g. golf courses) and residential uses. Fortuna Foothills primarily attracts winter visitors.

Parcels are privately owned, while many vacant parcels are owned by the State of Arizona and the U.S. Department of Interior BLM.

Agricultural uses near the BMGRW include irrigated cropland and orchards with the most common crops including citrus, cotton, vegetables, and small grains. Agricultural land uses are most common in the fringes of the Yuma metropolitan area, but are also located north of the western half of the BMGR along Interstate 8.

The closest values at risk are private parcels located near what are known as the "orphaned parcels", which are situated in the northern and western extent of the range. These private parcels have several types of land use including pasture and agriculture, principally citrus groves, and vineyards. Residential structures are scattered throughout the adjacent parcels. Most of them are built with ignition-resistant construction and some have well-tended defensible space but other parcels contain flammable fuels (both vegetative and built). Churches and areas of large congregation are also located in the vicinity of the range's border.

The possibility of a fire moving off the range to adjacent values at risk in the "orphaned parcels" or other property is extremely small. Because the BMGRW abuts a relatively undeveloped portion of the BMGRE, the values at risk to the east are negligible. The southern property boundary is the International border with Mexico. The land use to the south is undeveloped desert.

Further away, large industrial land uses near the range include the Copper Mountain Landfill (near Wellton) and the Gila and North Gila electrical substations (east of Yuma). There are several canals, transmission lines, and pipelines on the lands adjacent to the range.

Lands adjacent to the BMGRW that offer the most recreational opportunity include the Sonoran Desert National Monument (NM), Cabeza Prieta NWR, and Reserva de la Biosfera de El Pinacate y El Gran Desierto de Altar. The Cabeza Prieta NWR (much of which is designated as Wilderness) is located along portions of the BMGRW's southern border. While this land is available to the public for recreation, motorized access is very limited so recreation is largely limited to persons with wild land skills who are seeking a primitive landscape for the recreational experience. Primitive camping and hiking opportunities are available immediately south of the international border in the Reserva de la Biosfera de El Pinacate y El Gran Desierto de Altar.

All of the areas in which recreation is most likely to occur are predominantly undeveloped desert. Most of the other non-agricultural areas also are undeveloped desert, including the land in Mexico that is south of the BMGRW boundary and much of the land north of the BMGRW along Interstate 8. These land uses do not pose additional risk of ignition nor risk of fire spread into the Range; the land use and the land itself do not constitute a significant value at risk.

3.0 GOALS AND OBJECTIVES

The BMGRW's INRMP states that the overall goal of the BMGR training range is "reserved for use by the Secretaries of the Air Force and Navy for:

- An armament and high-hazard testing area
- Training for aerial gunnery, rocketry, electronic warfare, and tactical maneuvering and air support
- Equipment and tactics development and testing; and other defense-related purposes consistent with those specified" in the MLWA act of 1999.

This IWFMP seeks to balance several goals: maximizing land use for BMGR's primary mission stated above, compliance with applicable laws and regulations, maximizing personnel safety, and maintaining native habitats.

Pertinent goals and objectives specific to the prevention and suppression of wildfires include:

Goal 1 Protect human life and property within and adjacent to BMGRW through the implementation of a comprehensive wildfire management program.

Objective 1. Minimize natural resource damage from wildfires with a minimum cost consistent with values at risk, and minimize the impacts from suppression activities.

Objective 2. Assess all wildfires with regards to unexploded ordnance risks to responding personnel, and risks to natural and cultural resources.

Goal 2 Monitor hazardous fuel accumulations in areas that could be susceptible to wildfire damage in order to determine the suppression strategy in the future IWFMP.

Objective 1. Monitor and evaluate the effects of fire management on the ecosystem in order to refine program objectives.

Objective 2. Facilitate scientific investigation and research to refine vegetative fuel characteristics (volume, continuity, moisture) in order to better assess risk, determine natural fire regimes, and assist in implementing the fire management program's goal.

4.0 ORGANIZATIONAL STRUCTURE

The BMGRW falls under the jurisdiction and control of the Commanding Officer (CO) of MCAS Yuma, Arizona, who reports to the Commanding General of Marine Corps Installations West (MCIW) at Marine Corps Base Camp Pendleton, California, for administrative and facilities support. The CO administers all actions on the range while other departments provide support to users, including tenants and other transient personnel and activities. The Fire Department at the MCAS in Yuma does not have a wildland firefighting mission. Regardless, the MCAS Yuma Fire Department is ultimately responsible for all wildfire suppression activities in the BMGRW. The department depends heavily on local mutual aid agreements for any wildland fire suppression activity. DoDI 6055.06, Enclosure 5, authorizes and permits routine assistance to and from local jurisdictions as defined by the mutual aid agreement. The MCAS Yuma Fire Department will be responsible for all current and future mutual aid agreements that support suppression activities in the BMGRW. This would include local fire departments such as the Yuma City Fire Department and federal firefighting agencies such as the BLM and/or the National Park Service.

4.1 Staffing

The following formal positions have direct responsibility for the implementation of the wildfire management program at BMGRW.

Commanding Officer, MCAS Yuma*:* Authority for the approval of this plan and responsible for the implementation of this plan. He/she will define the roles and responsibilities for personnel who implement wildland fire management on the installation, and program resources needed to implement the plan.

Range Management Department: Advises the Commanding Officer, MCAS Yuma, with regard to natural resource management, range safety, range operations, as well as the overall military mission of the BMGRW.

Conservation Law Enforcement Officer (CLEO): With the assistance of the Natural Resources Specialist, the Conservation Law Enforcement Officer, or Conservation Manager (CM) is responsible for assuring that a risk assessment for natural and cultural resources is performed before actions are taken.

Natural Resources Specialist: Will serve as Resource Advisor on all wildfires. Additionally, the Natural Resource Specialist will oversee the monitoring of fire effects of wildfires. He/she will develop rehabilitation and restoration plans following a wildland fire.

The decision to use military personnel will be determined by the CO. The CO will also decide upon the use of military aircraft for suppression activities as necessary to prevent the spread of fire onto or off the installation. The MCAS Yuma Fire Department will be responsible for coordinating with current and future participants of mutual aid agreements to suppress wildfires.

5.0 WILDLAND FIRE PROGRAM COMPONENTS

All fires that burn natural vegetation in the BMGRW are defined as wildland fires; however, these fires have not received immediate fire suppression actions to minimize the area burned because the vegetative fuels generally do not sustain fire spread. Wildfires are too infrequent and limited in extent to pose a significant threat to the sensitive ecosystems, cultural sites, and testing/training lands of BMGRW. The vast majority of BMGRW is unburnable except under extreme vegetation growth conditions. Even during unusual periods of excessive rainfall, very large and destructive wildfires are not possible due to the low vegetative fuel volume and discontinuous arrangement of fuels. As such, wildfires are usually not considered to be a hindrance to operations.

Modified suppression is an appropriate strategy when also considering the safety of firefighters in light of the unexploded ordnances. Even without action, the specific suppression objectives for individual fires is met due to vegetation's sparseness, discontinuous and of low volume condition of the fuels.

Because the MCAS Yuma fire department does not have a wildland firefighting mission, a crucial wildland fire management strategy will be to emphasize pre-fire actions to include ignition prevention, detection, reporting fuels management, and attentive monitoring of fuel conditions that may warrant suppression. Existing mutual aid agreements with local fire departments and other federal agencies with wildland firefighting capacity and mission will be relied upon.

5.1 Wildland Fire Suppression

5.1.1 Initial Attack

All wildfires on the BMGRW must be reported to Range Control (Leg Iron) (range radio or telephone). If a fire is reported to Range Control, Range Control will notify the MCAS Yuma Emergency Dispatch Center immediately. Fires may be reported by calling 911 as well, however, this option may result in a longer response time than calling Range Control directly. Reference DoDI 6055.06 and the Wildland/WUI Operations Fire and Emergency Services SOP (2016) for current wildfire response protocols at the BMGRW.

5.1.2 Extended Suppression

Because of the patchy arrangement and low fuel volumes, wildfires will not require suppression assistance; extended suppression is not required nor addressed in this IWFMP. Facility protection will not require extended suppression because of the ignition-resistant nature of the facilities, and because of the non-combustible nature of the areas surrounding the facilities.

All wildfires will be reported to the MCAS Yuma Natural Resources Specialist so that she/he can serve as Resource Advisor to the Incident Commander. After the incident, the MCASY Fire Department will report the incident to the National Fire Incident Reporting System (NFIRS) as per the current version of the NFIRS Complete Reference Guide, per DoDI 6055.06. All wildland fires will be investigated to determine point of origin and assignment of a fire cause classification (Incendiary, Accidental, Natural and/or Undetermined).

5.1.3 Minimum Impact Suppression Tactics (MIST) Requirements

Minimum Impact Suppression Tactics (MIST) are a specific set of practices used during fire suppression that lessen impacts to sensitive resources while still meeting fire management objectives. Reducing impacts to natural resources may reduce or eliminate the need for rehabilitation efforts after a fire.

In order to minimize the effects of fire suppression activities, it is recommended that the MCAS Yuma Fire Department request the responding agency to use MIST as its primary means to fight fire. Additionally, this plan and its intent to use MIST will be communicated to local fire departments that may respond to wildfires.

5.1.4 Other Fire Suppression Considerations

In addition to concerns regarding protection of special status species, fire suppression can cause an increase in road disturbance, and affect several types of values at risk, such as cultural resources, and the protected habitats themselves. The presence of special hazards, major utilities, and easements should be taken into account when suppression action is considered.

Because wildfires are expected to be rare and non-damaging, natural and cultural resources would not be affected by the limited fire suppression activities and the resulting associated negative impacts. The few locations where wildfires are most likely to spread are near roads where accumulated runoff produces enough continuity of fuel.

All ground-based wildland fire suppression activities will be delayed until the potential for unexploded ordnance hazards is assessed and mitigated. Air-based wildland fire suppression would be necessary until ground-based travel can be deemed safe. It is most likely fires would be self-extinguished by that time.

5.2 Wildland Fire Preparedness

The mission of the MCAS Yuma fire department does not include wildland fire suppression. In the unprecedented event of a wildfire that would require response, the nearest firefighting staff from participants in existing mutual aid agreements would be called upon. It is expected that responders would travel from Yuma, Arizona, with a response time of less than one hour or less via aerial response.

5.2.1 Fire Prevention, Community Education, Other Community Assistance Activities

Fire prevention includes minimizing combustible fuels and ensuring fire safe human behavior. Combustible fuels are being and will continue to be minimized as part of targets at the Rifle, Pistol/Shotgun, Range 1, Range 2, Panel Stager, Cactus West, Yodaville, and the Tracker Qhut sites as well as the Convoy Security Operations Course (CSOC), and as part of structures such as Qhuts, or the TACTS Laser Facility, and Yodaville Urban Target Complex. The material of the structures will be non-combustible such that embers will not ignite them. All fuels will need to be removed for

a distance that would prevent ignition from radiant or convective heat. This distance is estimated to be 100-foot radius from the outside perimeter of the structure. In addition, no flammable material may be left outside the Qhut structures or vehicles. The condition of the fuels will be inspected yearly by Range Management.

Some facilities have a potential for ignition that might spread into wildland vegetation. However, all these are situated in locations where external vegetative fuels are minimal; fire spread is expected to be insignificant:

- Qhuts. These are no longer used and are scheduled for demolition.
- TACTS Range, where surface-to-air threats are simulated. The propellant used to launch the targets is combustible. The locations where these are stored is a possible risk of ignition. Any ignition could be short-lived, but noticeable.
- Campsites. Because public use and campfires are allowed, these are all possible sources of wildfire.

Even though wildfires are not expected to spread in the vegetation at this time, several practices that limit ignitions are being followed:

- Targets are made of non-combustible material; this practice should continue
- Vehicles may not venture off road
- Only dead and down material is allowed as firewood
- Structures and targets are made of ignition-resistant construction.

Significant fire spread potential is low at BMGRW, a direct result of natural fuel gaps and discontinuity. As a result, there are no constructed firebreaks, fuel breaks, or fuels management areas throughout its landholdings, nor is there an intent to create any.

Because the public can recreate on the majority of BMGRW land base, public education is justified. The BMGRW has a public information program covering topics concerning the minimization of the chance of igniting or spreading and wildfires. This program should be continued.

All those who enter the Range must obtain a Range Permit. The Range Permit is accompanied by a large map with rules and warnings. The BMGRW requires special Use Permits for extended camping, scientific studies, and large groups.

The public is notified that they are responsible for their own safety and they must be aware of hazards and must take precautions to guard against them. Information on unexploded ordnance, the international border and habitat protection is also provided. A section of the permit and map is dedicated to camping. The permit states, “Make sure fires are completely out. Disperse fire rings and ashes, and rake out vehicle tracks at campsites before leaving.” Collecting dead and down wood for campfires is permitted in most locations; however, cutting or detaching dead standing trees is prohibited.

All members of the public must have a range permit on them with a copy of the permit on the dash of the vehicle; those under 18 years of age must be escorted by a person with a Range permit. Every user is provided a phone number to call when they enter the range. They will provide location

information and receive warnings the day of the entry. Members of the public who do not comply with regulations will be cited and fined and escorted off the range.

Public access to a portion of the range west of the Gila and Tinajas Altas mountains is strictly prohibited. This area consists of four Hazard Areas that directly support the military mission. This restricted access reduces fire prevention challenges due to lack of human-caused ignitions.

All roads are considered closed unless designated open by an official lettered/numbered 4X4 wooden intersection marker. All permit holders are provided a map of the locations of the makers. Range Permit and map also informs the permit holder that signs may not be present to prevent the user from inadvertently entering restricted areas, and that they are responsible for knowing their location at all times.

5.3 Annual Fire Training Activities

The MCAS Yuma Fire Chief and the Fire Chief of departments for which mutual aid agreements exist, will ensure all firefighters participating in wildfire responses through mutual aid agreements meet minimum National Wildfire Coordinating Group and/or DoDI 6055.06 training requirements. As part of this requirement, firefighters participating in fireline duties will annually participate in the RT-130 Annual Fireline Safety Refresher Training. Currently maintenance personnel are trained to the Fire Warden level. Additionally, existing structures on the BMGRW that require a periodic general fire safety inspection and fire protection system inspection are inspected no less than semi-annually. The MCAS Yuma fire department coordinates with the MAG or URS to conduct the inspections.

5.4 Wildland Fire Season Readiness (testing, inspection and annual review)

The MCAS Yuma Fire Chief, and Fire Chief of departments for which mutual aid agreements exist, shall ensure that these fire response protocols are up to date and in accordance with the latest wildland fire safety and firefighting techniques as defined by the National Wildfire Coordinating Group (NWCG) and/or National Fire Protection Association (NFPA), per DoDI 6055.06. This plan identifies proper communications procedures as well as general response procedures, which are to monitor the fire and deploy firefighters only when certain facilities are threatened. All firefighters participating in fireline duties will meet the physical fitness standards established in NFPA 1583, the NWCG Work Capacity Test per PMS 307, and/or the standards adopted by the organization with which mutual aid agreements exist.

An annual inspection of fuel conditions is the only pre-season activity that would be needed in addition to normal activity. If rainfall is exceptionally plentiful, surveys to determine volume and continuity of fuels would be warranted so that the MCAS Fire Department can prepare for the exceptional event.

5.5 Pre-Incident Plan

Because a wildfire of consequence (i.e. extended attack) is not anticipated, this IWFMP does not require preparation of a Pre-Incident Plan.

5.6 Interagency and Cooperative Agreements

Cooperative agreements are best made prior to a need for cooperation. There are several local, state and federal fire management agencies that could assist in response, monitoring, and rehabilitation should a wildfire ever spread on the BMGRW. These include Yuma County (rural Metro Fire) BLM, National Park Service (NPS) and USFWS.

The closest fire department is the Yuma City Fire Department: Rural Metro Fire Department Station #8 (on South Avenue A) just west of the range. There is also Rural Metro Fire Department Station #10 (on 44th Street) just north of the range.

Nearby federal lands include: Cabeza Prieta NWR (USFWS), BLM (located west and north of the BMGRW) and BOR (also west and north). These federal agencies can offer assistance and can engage in cooperative agreements if presented with the opportunity.

5.6.1 Cooperative Agreements

Per E2.5.21 of DoDI 6055.06, the DoD Components, under Chapter 15A of 42 U.S.C. – Reciprocal Fire Protection Agreements, as amended, the BMGRW is encouraged to enter into reciprocal agreements with local fire protection agencies for mutual fire response. Municipalities can be compensated for direct costs and losses sustained while fighting fire on Federal property, should the need arise. Section 1856a of Chapter 15A of 42 U.S.C. notes that "Any such agreement may provide for the reimbursement of any party for all or any part of the cost incurred by such party in furnishing fire protection for or on behalf of any other party".

These agreements should include cross-boundary agreements whereby the different agencies could enter property that would otherwise be closed. Agreements can address cost apportionment, whereby, for example, the local fire department can be compensated for providing fire suppression services for the time they spent on the BMGRW. Other tools for mutual benefit are Memorandum of Agreement and Emergency Response Contracts which are broadly written and offer a framework for more specific agreements.

5.6.2 Interagency Contacts

Name	Function	Work Phone
Arizona Interagency Dispatch Center (AIDC)	Dispatch	623-582-0911 1-800-309-7081
BLM Law Enforcement Dispatch	Law Enforcement	623-580-5635 / 5515 602-417-9600
U.S. Border Patrol Ajo Station	Immigration Law Enforcement	520-387-7002
U.S. Border Patrol Tucson Sector	Public Land Liaison Tucson Sector	520-514-4754
U.S. Border Patrol Yuma Sector	Public Land Liaison Yuma Sector	928-341-6509
Yuma County Sheriff's Office	Law Enforcement	928-783-4427
Arizona Department of Public Safety (Highway Patrol)	Highway Safety	Tucson 520-746-4500 Phoenix 602-223-2000
Arizona Department of Transportation	Highway Safety	Yuma District 928-317-2100
APS - Ajo	Power Lines / Safety	1-800-253-9405/7
Cabeza Prieta NWR Refuge Manager	U.S. FWS Administered Land	520-387-6483
U.S. FWS Ecological Services Office	Consultation	520-670-6150 Ext 238
Vacant	Phoenix District Fire Management Officer (FMO)	Vacant
Dan Philbin	Phoenix District Assistant Fire Management Officer (AFMO)	623-580-5591 602-316-5076 (cell)
Jeff Brown	AZ BLM Fire Business Lead/Agreements	602-417-9310 602-319-8132 (cell)
Shawna Rogers	AZ BLM Contracting Officer	602-417-9328
Steve Shaw	AZ BLM State Operations	602-417-9307 602-513-9276 (cell)

6.0 CERTIFICATION, TRAINING, AND FITNESS STANDARDS FOR WILDLAND FIRE MANAGEMENT PERSONNEL

6.1 Certification Standards

All civilian, contractor and emergency services personnel involved in wildland fire management must possess certifications appropriate for their expected level of involvement in the wildland fire organization.

Fire & Emergency Services contractors will meet the certification standards specified in NFPA 1051 (2016) - Standard for Wildland Fire Fighter Professional Qualifications and NFPA 1002 (2016) - Standard for Fire Apparatus Driver/Operator Professional Qualifications. Personnel in the natural resources job series (GS-0401 thru GS-0499), cultural resources (GS-0193), and natural/cultural resources contractors with jobs requiring wildland fire responsibilities, must meet either the NFPA 1051 and NFPA 1002 certifications or the equivalent certifications in NWCG Wildland Fire Qualification System Guide (Publication Management System 310-l/National Fire Equipment Catalogue 1414), as appropriate. Additionally, primary and secondary wildland firefighters will be required to be trained in MIST, as explained in NFES 1256, Wildland Fire Suppression Tactics Reference Guide.

GS-0081 job series and DoD contractor personnel that seek wildland fire certifications must comply with the appropriate NWCG criteria.

Position descriptions for new employees who will participate in wildland fire activities will reflect the expected level of involvement and required certifications. Position descriptions for natural/cultural resources personnel with wildland fire management duties must state if the position qualifies the position holder as a primary or secondary wildland firefighter, as described in Chapter 46 of the Office of Personnel Management Civil Service Retirement System and Federal Employees Retirement Services Handbook for Personnel and Payroll Offices. Natural resources personnel not classified as a primary or secondary wildland firefighter may perform collateral duty in wildland fire management activities as qualified.

The Headquarters Air Force Civil Engineering Support Agency/Civil Engineering Fire Protection is the executive agent for the DoD Fire Fighter Certification Program (FFCP) and will be responsible for issuing, maintaining, and tracking of NFPA wildland firefighter certifications. The installation Wildland Fire Program Manager is responsible for issuing, signing and tracking of NWCG Qualification Card/Incident Command System (also known as "red cards") for installation personnel.

7.0 INTERAGENCY COOPERATION AND MUTUAL AID AGREEMENTS

Cooperative agreements are best made prior to a need for cooperation. Per E2.5I of DoDI 6055.06, the DoD Components, under Chapter 15A, of 42 U.S.C. are encouraged to enter into reciprocal agreements with local fire protection agencies for mutual fire response. In addition, municipalities can be compensated for direct costs and losses sustained while fighting fire on Federal property, should the need arise (DoDI 6055.06 E5.1.4.3). These agreements include cross-boundary agreements whereby the different agencies could enter property that would otherwise be closed. Agreements can address cost apportionment, whereby, for example, the local fire department can be compensated for providing fire suppression services for the time they spent on the BMGRW. Another tool for mutual benefit are Memorandum of Agreement and Emergency Response Contracts which are broadly written and offer a framework for more specific agreements.

Installations are encouraged to develop regional partnerships for wildland fire management support, by means of reciprocal agreements with other federal, state, local and private entities, to share human, logistical, and operational resources. Emergency assistance and mutual aid agreements will conform to the guidelines stated in DoDI 6055.06 - DoD Fire and Emergency Services Program, and MCO 11000.11A - Marine Corps Fire Protection and Emergency Services Program.

This is especially appropriate for BMGRW because wildland fire suppression is not in the mission of the MCAS Yuma Fire Department. There are several local, state and federal fire management agencies that could assist in response, monitoring, and rehabilitation should a wildfire ever spread on the BMGRW. Federal agencies with wildland fire management capabilities are more nearby. Nearby federal lands include Organ Pipe National Monument (located just southeast of the BMGRW), USFWS National Wildlife Refuges (located northwest and in the southeast portion of the BMGRW) and BLM (located north and east of the BMGRW). These federal agencies can offer assistance and can engage in cooperative agreements if presented with the opportunity.

Following proper coordination with the Office of the Secretary of Defense through NORTHCOM and Joint Directorate of Military Support (JDOMS), military assistance (both military and civilian personnel) may be furnished to the National Interagency Fire Center (NIFC) in national fire emergencies, pursuant to the Interagency Agreement for the Provision of Temporary Support During Wildland Firefighting Operations among the Departments of Defense, Interior, and Agriculture (2005) and subsequent modifications. Support to NIFC is reimbursable under the Economy Act. Local area assistance included in existing agreements may be authorized by the installation/garrison commander. Immediate response requests will be handled per Department of Defense Directive (DODD) 3025.18 Defense of Civil Authorities (DSCA).

Although there is no written mutual-aid agreement, there are opportunities for interagency cooperation. The National Park Service (NPS) could provide base personnel with Wildland Firefighter training. The BLM could give 'Red Card' certification to enable biological monitoring of fire site resources by office staff. The BMGRW is encouraged to take advantage of these opportunities as they arise.

8.0 SMOKE MANAGEMENT AND AIR QUALITY

Given the small size of fires, their rarity, and the relatively remote location of BMGRW, smoke management is not a major priority for BMGRW resource managers. Smaller fires may affect Highway 8 (to the north) or Camino Del Diablo West (runs north-south through center of range), but are unlikely to affect any other sensitive resources due to the distance to them and dispersion in between. However, there are significant populations just north of the range: Yuma (population approximately 95,000), and Wellton (population approximately 3,000). The cities host hospitals, schools, nursing homes, and airports, all of which are primary concerns for smoke management.

8.1 Clean Air Act Requirements

Fire management activities which result in the discharge of air pollutants are subject to, and must comply with, all applicable federal, state, and local air pollution control requirements as specified by Section 118 of the Clean Air Act of 1997 as amended. All federal land managers must comply with Arizona Title 18, Chapter 2, Article 15 (consisting of R18-2-1501, adopted effective October 8, 1996 Supp. 96-4), when managing wildland fires, which include both wildfires and prescribed fires. This rule establishes guidelines for reporting smoke created by wildland fires.

In Arizona, the Arizona Department of Environmental Quality (ADEQ) administers the act, and is responsible for the preparation and submittal of an emissions inventory report to the United States Environmental Protection Agency (EPA). The Interagency Smoke Management Program was created in 1991 to support the ADEQ in the management of emissions from federal and state forest and range management burns. ADEQ has a mandate to protect the health and welfare of Arizona citizens from adverse air pollution impacts (CAA, Sec. 118; ARS 49:5011).

Since fires are not point sources, but rather tend to be spatially distributed singular events, temporary impacts to visibility must be recognized, expected and managed.

8.2 Smoke Monitoring During Wildfires

While extremely unlikely, the MCAS Environmental Department staff of BMGRW may need to submit forms to the ADEQ if a wildfire becomes large enough to product significant levels of smoke. For all wildfire incidents within the state of Arizona that meet Incident Command System 209 (Form ICS-209) submission requirements (greater than 100 acres in timber or greater than 300 acres in brush/grass, or that require a type 1 or 2 Incident Management Team), ADEQ requires the reporting of vegetation fuels information in Block 31 of each ICS-209. This allows the State to track smoke emissions in accordance with state and federal laws. The information must include:

a) A breakdown of the fire by fuel model, Fire Behavior Fuel Models 1-13.
b) The total fuel load in tons per acre for each fuel model. One can approximate the ton per acre based on the Fire Behavior Fuel Model Table which can be found here: http://www.fs.fed.us/rm/pubs_int/int_gtr122.pdf
c) The intensity at which the fire is burning in each fuel model (low=direct attack by firefighters with hand tools, flame lengths no higher than 4 ft., moderate=use of equipment to construct fire line, flame lengths 4-8 ft., high= spotting, crowning, major runs, flame lengths over 8 ft.)

ADEQ supports wildfire suppression activities in Arizona. They can monitor air quality in areas affected by the smoke plume and report air quality status to state, county, and local health officials for their use in issuing health advisories.

9.0 SAFETY AND EMERGENCY OPERATIONS

Personnel safety is paramount on BMGRW. Firefighters will not be sent onto live fire ranges to fight wildfires in areas where there is a significant probability of unexploded ordnance. This poses a tremendous risk to firefighter safety. Protection of structures is the next priority. The buildings will be protected, to the best ability of the firefighting crew, with the available resources. Equipment will also be protected where possible.

Wildland fires will be suppressed only if they threaten the few facilities listed in Section 5.0. Further, firefighters will take action only after the potential for unexploded ordnance has been assessed and mitigated.

9.1 Personal Protective Equipment

The IWFMP requires all personnel involved in wildland fire activities to be outfitted with protective clothing and equipment that meets NFPA 1977 - Standard on Protective Clothing and Equipment for Wildland Fire Fighting which establishes the requirements for protective clothing. Minimum gear includes: Nomex shirt, Nomex pants, helmet, leather gloves, eye protection, and work boots with Vibram© soles.

10.0 WILDLAND FIRE BEHAVIOR FACTORS

10.1 Range of Potential Fire Behavior

Within the BMGRW, land cover is predominantly unburnable, with bare ground accounting for over 47 percent of the range. The remainder is largely classified as moderate to high grass and shrub. Table 10.1 shows acres for each mapped fuel model along with its percent cover within BMGRW. Fire behavior fuel models (Scott and Burgan 2006) are denoted by their fire carrying fuel type (i.e., grass – G, grass / shrub – GS, timber – litter, TL) and a numerical identifier (e.g. 'GR2').

TABLE 10.1. FUEL MODEL ACRES TABLE (AS DEFINED BY LANDFIRE v1.4)

ID	Expected Fire Behavior	Acres	Percent
NB1 – Urban (91)	Un-burnable (within model)	253.75	~0.00 percent
NB3 – Agricultural (93)	Un-burnable (within model)	39.36	~0.00 percent
NB9 – Bare Ground (99)	Un-burnable	326,305.15	47 percent
GR1 – Short Grass (101)	Short, sparse dry climate grass is short, naturally or heavy grazing, predicted rate of fire spread and flame length low	4,240.61	~0.00 percent
GR2 – Moderate Grass (102)	Low load, dry climate grass primarily grass with some small amounts of fine, dead fuel, any shrubs do not affect fire behavior	398.975	~0.00 percent
GS1 – Low Grass/Shrub (121)	Low load, dry climate grass-shrub shrub about 1 foot high, grass load low, spread rate moderate and flame length low	376.51	~0.00 percent
GS2 – Moderate Grass/Shrub (122)	Moderate load, dry climate grass-shrub, shrubs are 1-3 feet high, grass load moderate, spread rate high, and flame length is moderate	163,980.66	24 percent
SH1 – Heavy Grass/Shrub (141)	High load, humid climate grass-shrub, heavy grass/shrub load, depth is greater than 2 feet, spread rate is high and flame length very high	198,389.01	29 percent
SH5 – Low Shrub (145)	Low load, humid climate timber shrub, woody shrubs and shrub litter, low to moderate load, possible pine overstory, fuelbed depth about 3 feet, spread rate high and flame moderate	7.78	~0.00 percent

These fuel models represent the potential range of fire behavior one can expect given the vegetation on the ground.

10.2 Expected Fire Behavior

FlamMap (Finney 2006) was used to determine likely fire behavior under typical fall (September - November) weather conditions. This model was constructed to determine the worst-case scenario wildland fire behavior across the entire range. This model does not determine whether a fire will spread from a single (or multiple) ignition points. Rather, this model only predicts whether any given location will burn given specific inputs (i.e. slope, elevation, aspect, fuel moisture, fuel type, etc.).

The area modeled was bounded by the following coordinates (GCS NAD83):

- North: 33.6 degrees latitude
- South: 33 degrees latitude
- West: -116 degrees longitude
- East: -114.6 degrees longitude

On January 14, 2018, six data layers were downloaded from the LANDFIRE website. The following list details the version and attribute definitions for each layer:

1. Existing Vegetation –or EVT is a data layer representing the current distribution of the terrestrial ecological systems classification developed by NatureServe for the western hemisphere. It is defined as a group of plant community types (associations) that tend to co-occur within landscapes with similar ecological processes, substrates, and/or environmental gradients. EVTs are mapped in LANDFIRE using decision tree models, field reference data, Landsat imagery, digital elevation model data, and biophysical gradient data.
2. Fuel Models – FBFM40 (LANDFIRE version 1.40). Initially, thirteen typical surface fuel arrangements or "collections of fuel properties" (Anderson 1982) were described to serve as input for Rothermel's mathematical surface fire behavior and spread model (Rothermel 1972). Since 2005, these initial models were refined to 40 additional models. These represent a more refined version of the basic 13 fuel models.
3. Canopy Cover – Described by percent cover of tree canopy in a stand.
4. Canopy Height – Described as the average height of the top of the canopy for a stand. Reported in meters (m)* 10.
5. Canopy Base Height – Described by the lowest point in a stand where there is sufficient available fuel (0.25 in diameter) to propagate fire vertically through the canopy. Reported in m * 10.
6. Canopy Base Density – Defined as the mass of available canopy fuel per unit canopy volume that would burn in a crown fire. Reported in kilogram/m^3*100.

The following parameters were used in the fire behavior run in FlamMap:

Though specific daily weather and wind data was used to condition the fuel moistures, 20-foot wind speed was set to 12 miles per hour. Direction was set to 270. Foliar Moisture Content was set to 100 percent. In addition, fuel moistures were set for all fuel models to the corresponding amounts shown in Table 10.2.

TABLE 10.2. FUEL MOISTURE PERCENTAGES USED

Class size	Percent
1hr fuels	3
10hr fuels	4
100hr fuels	5
Live herbaceous	70
Live woody	70

Outputs included Rate of Spread and Flame Length using the Scott and Reinhardt (2001) option under the Crown Fire Calculation Method. We used the default for the 'Options' parameter (Relative Spread Direction from Maximum).

Results are presented in the sections below.

10.2.1 Flame Length

Flame length (measured in feet) is the length of the flame at the head of the fire measured from the middle of the combustion zone to the average position of the flame tip (Andrews and Rothermel 1981).

Flame length is important because it is a fire behavior characteristic we most often associate with a wildfire. The height (or length) of flames is what is seen first and it can determine how a fire will be suppressed. The lower the flame length, the more approachable it is by hand crews.

The model predicted no fire for 76 percent of the BMGRW (Table 10.3). Where fire did occur, flame lengths were lower than 8 feet and occurred on all slopes in the higher elevations of the Gila, Copper, and Mohawk Mountains where sparse vegetation exists (Figure 3).

TABLE 10.3. PREDICTED FLAME LENGTH ACRES

Value	Acres	Percent
No Fire	524,990	76 percent
Less than 4 feet	9,124	1 percent
4.1 - 8	159,315	23 percent
Greater than 8 feet	563	~0 percent

Fires with flame lengths of 4 feet or lower can be suppressed by people on the ground using hand tools. A simple 'handline' of 1 to 2 feet wide should hold the fire. Once over 4 feet, the fire is too intense for confrontation with people and a handline is not reliable. Wider 'firelines' can be employed using heavy equipment.

Only 23 percent of the range may experience a fire with flame lengths between 4 and 8 feet. The vegetation and slopes that support this potential fire behavior is concentrated along the mountain sides.

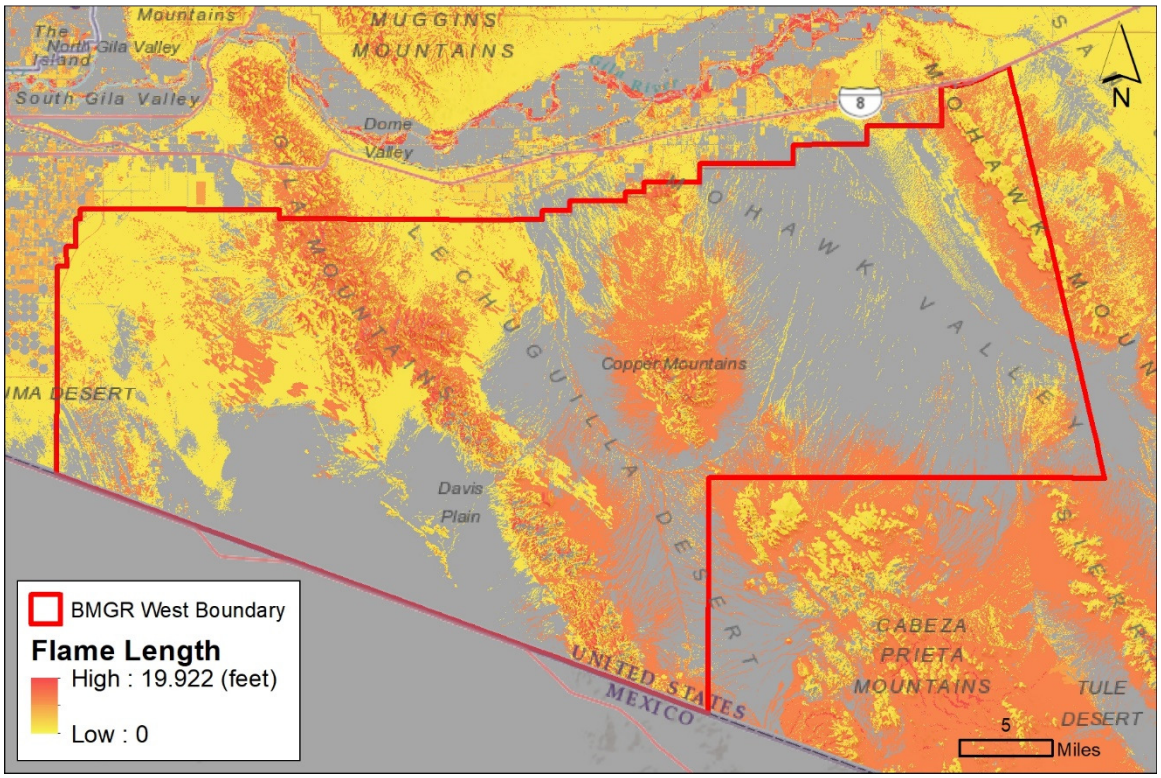


Figure 3. Map of flame length results for BMGRW

10.2.2 Rate of Spread

Rate of spread, which is measured in chains per hour (ch/hr), is the forward rate of spread at the head of a surface fire. Fire will not spread on 48 percent of the BMGRW (Table 10.4).

TABLE 10.4. ACRES OF RATE OF SPREAD CLASSIFICATION

Value	Acres	Percent
No Fire	328,358	48 percent
Less than 1.1 ch/hr	8,076	1 percent
1.1 – 5	189,249	27 percent
5.1 – 10	6,691	1 percent
10.1 - 20	134,286	19 percent
Greater than 20 ch/hr	27,332	4 percent

Only 4 percent of what is predicted to burn, experiences rates of spread greater than 20 ch/hr (one chain equals 66 feet). This relatively fast fire spread is predominately through fuel model GS2 – a

grass-shrub fuel model that typically experiences a high spread rate (Figure 4). While a fast rate of spread does not necessarily mean a problematic fire, coupled with high flame lengths, a fast-moving fire cannot be suppressed with a hand-crew. However, the spatial discontinuity of the burnable vegetation would indicate the fire would burn itself out quickly.

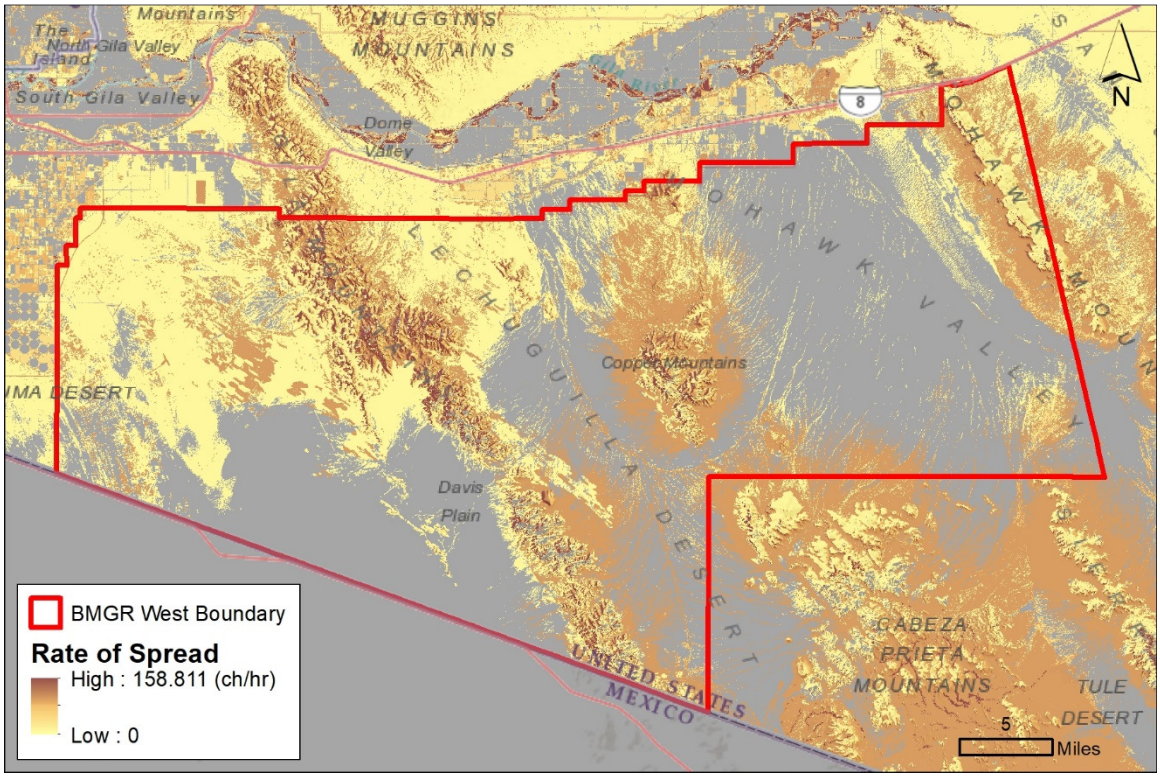


Figure 4. Predicted rate of spread for the existing conditions scenario

10.3 Wildland Fuels

The Sonoran Desert has had a very low fuel load. The distance between individual plants suffices to hinder fire proliferation. When fires do occur, they are limited to very small areas. Traditional fuel loads in the Sonoran Desert range from <50 pounds (lbs)/acre to <250 lbs/acre, depending on the habitat type, however, Brooks et al, 2001 reports that fuel loads have increased because of invasive species. On the western border of the BMGRW, invasive species have become established and have caused the fuel load to increase to ~750 to ~2500lbs/acre. These plants increase wildfire frequency and severity by adding to the amount of fast burning fuel and creating dense areas of vegetation. These areas become more prone to fire, exacerbating the problem.

The remainder of the BMGRW is unaffected by invasive plants, and the fuel load continues to be minimal, and discontinuous. The higher fuel loads at lower elevations occur near roads, where water is diverted and is concentrated. Other areas of greater fuel volumes occur in the three mountain ranges, at higher elevations.

10.4 Structural Fuels

The largest permanent structure is the Cannon Air Defense Complex located at the northwest corner of BMGRW. The complex is surrounded by fence and vegetation is cleared on an annual basis. Other permanent structures are associated with the TACTS laser hazard, and the CSOC, Firearms Range, CSOC, Rifle Range, and small Qhuts scattered throughout the Range. No combustible material was observed around any of the structures during a site visit in December 2017.

10.5 Wildland Fire Weather and Fire Danger

Currently there is no Fire Danger Rating System (FDRS) data specific to the BMGRW to manage wildfire ignitions. There are five weather stations on the BMGRW – the Yuma Auxiliary Air station located at longitude -114.45, latitude 32.50, 346 feet in elevation. Data from this weather station can be used to inform decisions regarding Special Orders and Closures. While not entirely representative of the entire range, the weather station does record continuous weather data. In the event of future changes that may increase wildland fire risk and potential, and for preparation purposes, data from this weather station can be used to determine expected fire danger.

Because there is no FDRS specific to the BMGRW to manage wildfire ignitions, and because fire prevention and response will not be based on NFDRS indices, this section is omitted from the INRMP and this IWFMP.

11.0 RISK ASSESSMENT / DECISION ANALYSIS PROCESSES

While the likelihood of a wildland fire burning through the range is limited, the listed facilities, power pole lines, generators, Qhuts, water storage facilities, and related equipment can be threatened by small wildland fires.

These assets will be prioritized by the asset holder. This plan recommends that the Facilities Maintenance Division (FMD) assign buffer zones to areas with a high threat to equipment and infrastructure, which could include the assets listed above. The risk assessment would evaluate the vulnerability of the asset along with its value and the probability of a threatening event. Because of the low fuel volume, fire intensity is predicted to be quite low; therefore the vulnerability of the facilities is not high.

11.1 Wildland Fire History

Very few wildland fires occur on the BMGRW. However, there is a record of one significant (over 100 acres) fire occurring within the range. The Triangle fire burned 410 acres in 2005 (Figure 5). It burned primarily in grass (FBFM13 Fuel Model 1). The cause is listed as 'Human' and it was extinguished the day it was reported (October 9, 2005).

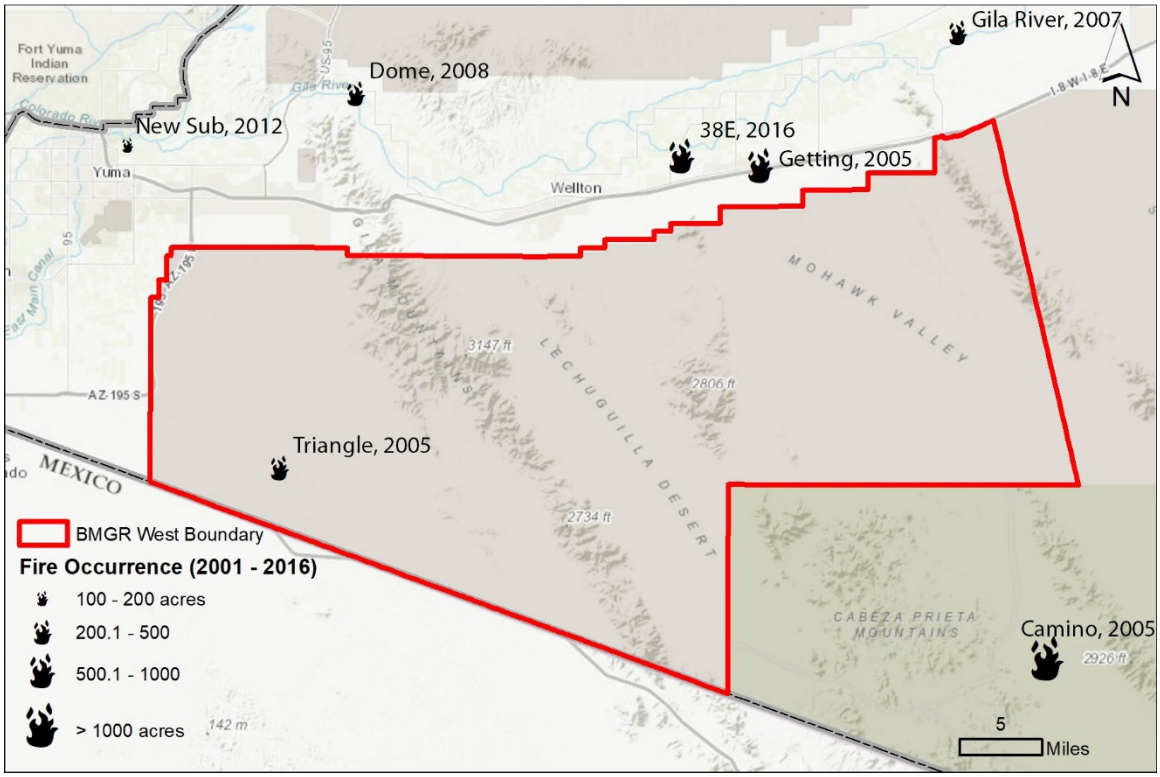


Figure 5. Wildland Fire History of the BMGRW

Fire data compiled from:
https://gacc.nifc.gov/swcc/predictive/intelligence/Historical/Fire_Data/Historical_Fires_Acres.htm

Historically, the Sonoran Desert has had a low incidence of wildfire. Human activities have increased fire frequencies in deserts elsewhere because of increasing invasion of exotic grass and shrub species, such as Mediterranean grass (*Schismus barbatus*), Saharan mustard (*Brassica tournefortii*), and Russian thistle (*Salsola tragus*), which increase fine-fuel loads and fuel continuity. However, these invasive species were not observed in quantity during a site visit December 2017. Portions of the Range closest to the western border are experiencing moderate levels of exotic plant establishment. The plants observed were Arabian schismus (*Schismus arabicus*) as well as Saharan mustard.

11.2 Likely Scenario

Recent fire history and the predictive model presented in this document show that if a wildland fire were to start on the BMGRW, it would likely burn a limited amount of vegetation before running out of fuel. The distance between burnable vegetation clusters is far enough that wildfires would not readily spread.

Because the predicted fire behavior under hot, dry conditions is low to moderate, in the event of a wildland fire, there will be no direct response to suppress the fire, with few exceptions. In addition, a threat of injury to wildland firefighters and equipment damage exists due to unexploded ordnance in areas of restricted public access. While military training may be impeded, it is likely training operations would be affected for hours, not days, and would be limited to the immediate area of the fire.

In the event of a structural fire, the Range Control will be notified, (Leg Iron) (range radio or telephone) which will notify the MCAS Yuma Emergency Dispatch Center immediately. Fires may be reported by calling 911 as well, however, this option may result in a longer response time than calling range control directly. The local Yuma City Fire Department will likely be notified to provide BMGRW personnel assistance.

11.3 Worst Case Scenario

The worst-case scenario was predicted in our model (see Section 10.2). Given the current vegetation type and distribution, the model shows that only 24 percent of the range is likely to burn in a wildland fire. During dry, hot conditions, though a fire can move relatively quickly through vegetation on the range, little, if any, of the expected fire would exceed what a hand crew or dozer crew can handle. In addition, because the burnable vegetation distribution is scattered, with unburnable ground between clumps, a fire is unlikely to spread very far.

At worst, localized areas will experience a loss of vegetative cover that could take years to restore due to low annual precipitation, leading to a potential for some soil erosion and a possible vegetation type change (if invasive species get established). A vegetation restoration program would help quicken restoration and stabilize soils.

12.0 NATURAL AND CULTURAL RESOURCE CONSIDERATIONS CHECKLIST

Before any major action on federal lands is implemented, NEPA requires federal agencies to consider environmental impacts of that action. NEPA applies to the approval of this plan.

The following sections briefly addresses each potential impact that implementing this plan may have on the BMGRW's environment.

12.1 Soils

Fire affects soils most when there is a high fuel buildup, leading to a longer residence time of the fire, leading to elevated heating of the soil. Also, if soil moisture is moderate to high, that heat can permeate into the soil profile. However, desert soils typically support low fuel mass and low soil moisture, which is the case throughout the BMGRW. Because of this, during normal dry conditions, it is expected that any wildfire will not contribute significantly to subsequent soil erosion potential. However, physical disturbance by fire suppression activity can potentially adversely affect fragile desert soils.

Drag-road developments and the proliferation of cross-country vehicle routes impact natural surface drainage at localized scales in many locations. Modifications to El Camino del Diablo during the construction of the border barrier fence has likely had a more substantial effect that impacts a larger region of BMGRW than the local road corridor. Soil compaction, erosion, and damage to native vegetation resulting from off-road driving can modify the distribution and pattern of overland flow during rain events, reducing available soil moisture for vegetation and causing further erosion by reducing soil cohesion (Brooks and Lair 2009). In the past decade, roads and increasing vehicular traffic have disturbed the naturally formed desert pavement and has resulted in watershed erosions.

A wildfire can impact roads in a number of ways. First and foremost, during a fire, activities to suppress it can exacerbate the ongoing soil erosion on the range in addition to limiting access to range facilities due to closures. After a fire, an increase in sediment production from unpaved roads in surface runoff can be expected. The lack of vegetation as well as the changes to soil's physical properties could be the primary cause of this increase.

12.2 Climate

BMGRW is located in the drier part of the Sonoran Desert. The area is an arid, upland desert climate, characterized by hot days with cool nights and low humidity. July is the hottest month (average maximum temperature of 104.9 degrees Fahrenheit (°F) (40.5 °C)), and January is the coolest month (average maximum temperature of 64.4°F (18°C)) (DoN 2010) (WRCC 2011). Average precipitation measured less than 3 inches per year.

The driest months are from April through June. August is the wettest month due to the influence of the summer monsoon rain pattern (DoN 2010).

While the hot, dry conditions support fire behavior, the arid conditions limit vegetation growth. A wildfire can contribute to vegetation-type change, especially in the presence of invasive species.

12.3 Hydrology

The presence of surface water on the BMGRW is very limited. There are no perennial or intermittent streams present on the range and ephemeral stream flow in otherwise dry stream beds occurs only in immediate response to sizable rainfall events. Surface water drainage on the BMGRW is outward from the mountain ranges and, for most of the area, ultimately northward by numerous feeder washes into the larger washes that flow to the Gila River, which in turn flows west into the Colorado River.

Some storms cause flash flooding in the smaller mountain drainages and short-term flooding in the larger valley washes and floodplains. Natural flooding events are highly variable in frequency and intensity and can have a large effect on natural community composition, structure, and function. With the exception of a few drainages that have been affected by backcountry earthen roads, most of the watersheds and drainage systems on the range are both unaltered and unregulated in any substantial way and lack impediments to natural surface water flows. A few drainages on the range are closed in that they empty into playas, or usually dry lakes, that hold water temporarily after substantial rains.

Some rain water collects in natural rock catchments (also known as tanks or tinajas), human-modified natural catchments, or artificially constructed tanks where the water may persist for weeks or months without recharge until it eventually evaporates or is consumed by wildlife.

The unlikely scenario of widespread wildfire can remove large swaths of vegetation that could lead to the long-term removal of vegetation. This, in turn, can increase soil erosion and therefore natural surface water flow. However, the fire model presented in this document does not support this scenario.

Some wildfire suppression activities may also affect local hydrology if significant road disturbance occurs in areas that historically have not had any disturbance.

12.4 Vegetation

Vegetation is described in more detail in Section 2.4.3. There are four main types of vegetation, as categorized by alliance associations, on the BMGRW: creosote bush, bursage, brittle brush, and Sahara mustard. Despite sparse vegetative cover, the BRGRW is classified as bare in only 1 percent of the area. Vegetative communities that include creosote bush dominates the BMGRW, covering more than three quarters of the range. The creosote bush alliance associations range in diversity, from widely-spaced vegetative cover with low diversity to areas near water or at higher elevations that have a complex and rich variety of species. Bursage alliance associations cover roughly 16 percent of the range, existing in more rocky and sandy locations than the creosote bush alliance. The brittle bush alliance associations cover only 2.5 percent of vegetative cover on the BMGRW. These are generally associated with dark rock or dark substrates in the mountains and along washes.

In the event of a widespread fire eliminating natural vegetation, invasive species can move in quicker than native species, taking advantage of the short, infrequent rain events. When this occurs, frequent

fires may become established in conjunction with the spread of continuous, fast-growing invasive species such as Sahara mustard.

12.5 Wildlife

The distributions of landforms, plant communities, and water catchments on the BMGRW provide diverse habitats that are used by many species of wildlife. The diversity and density of vegetation in upland areas and along washes provide habitat for a wide variety of birds. Examples include Harris' hawk (*Parabuteo unicinctus*), American kestrel (*Falco sparverius*), elf owl (*Micrathene whitneyi*), Gila woodpecker (*Melanerpes uropygialis*), cactus wren (*Campylorhynchus brunneicapillus*), curve-billed thrasher (*Toxostoma curvirostre*), Gambel's quail (*Callipepla gambelii*), white-winged dove (*Zenaida asiatica*), and greater roadrunner (*Geococcyx californianus*). Birds typically present in lowland areas include LeConte's thrasher (*Toxostoma lecontei*), black-throated sparrow (*Amphispiza bilineata*), and lesser nighthawk (*Chordeiles acutipennis*).

The known mammalian residents of the range include Sonoran pronghorn (*Antilocapra americana sonoriensis*), desert bighorn sheep (*Ovis canadensis mexicana*), javelina (*Tayassu tajacu*), mountain lion (*Felis concolor*), kit fox (*Vulpes macrotis*), coyote (*Canis latrans*), bobcat (*Felis rufus*), jackrabbit (*Lepus sp.*), and many species of bats, rodents and other small mammals.

Sonoran Desert toad (*Bufo alvarius*) and red-spotted toad (*Bufo punctatus*) are among the amphibians that are at least locally common on the range. Reptile species characteristic of the range include leopard lizard (*Gambelia wislizenii*), flat-tailed horned lizard (*Phrynosoma mcalli*), desert horned lizard (*Phrynosoma platyrhinos*), (Sonoran) desert tortoise (*Gopherus morafkai* [= *G. agassizii*]), collard lizard (*Crotaphytus collaris*), fringe-toed lizard (*Uma notata*), western diamondback rattlesnake (*Crotalus atrox*), sidewinder rattlesnake (*Crotalus cerastes*), Mojave rattlesnake (*Crotalus scutulatus*), and gopher snake (*Pituophis melanoleucus*).

A strong indicator of the health of the BMGRW ecosystem is that all of the wildlife species and plant communities believed to be present in 1941 when military use began are still found within the range today. These communities and nearly all species are also believed to be present in secure populations. The health of some of the natural plant communities has probably been enhanced by the elimination of livestock grazing within the BMGR, and eventually within the Cabeza Prieta NWR and Organ Pipe Cactus NM. The continued success of indigenous wildlife species is most likely attributable, in large part, to the conservation of the natural vegetative habitats within the range over the last 60 plus years with little or no adverse modification.

Although the current ecological health of the BMGRW is good and the foreseeable outlook for its continued health is generally positive, transportation, utility, and land use developments and other human activities within the local region have altered or otherwise affected the greater ecosystem in which the range is located.

According to the 2007 INRMP for the Barry M Goldwater Range, Arizona, U.S. Department of the Air Force, Luke Air Force Base, and U.S. Department of the Navy, Marine Corps Air Station Yuma, key developments and activities that have altered or otherwise affected the BMGRW ecosystem in some manner include:

- Highways, railroads, irrigation canals, fence lines, and land uses external to the BMGR, the Cabeza Prieta NWR, Organ Pipe Cactus NM, or Sonoran Desert NM curtail the natural movement patterns of some wildlife species to and from the range and these associated protected areas.
- Alteration or loss of plant communities, perennial rivers, other wildlife habitat components, and wildlife populations external to the BMGRW or the Cabeza Prieta NWR, Organ Pipe Cactus NM, or Sonoran Desert NM (e.g., agriculture, urban development, and the dewatering of rivers) that function or formerly functioned as a part of the greater ecosystem that these land units occupy.
- Alteration or loss of plant communities and other wildlife habitat components internal to the BMGRW or the Cabeza Prieta NWR, Organ Pipe Cactus NM, or Sonoran Desert NM as a result of activities such as past livestock grazing, mining, recreation, and military land use as well as current military and nonmilitary land uses.
- State Route 85, which is the only major continuous barrier within the BMGRW and Organ Pipe Cactus NM, that is curtailing movement of some wildlife species within the range, Cabeza Prieta NWR, and Organ Pipe Cactus NM.
- The spread of exotic, invasive, or noxious animal and plant species (such as trespass livestock, feral burros, and Sahara mustard) within the BMGRW, Cabeza Prieta NWR, Organ Pipe Cactus NM, and Sonoran Desert NM.

Predicted fire behavior on the range is none to relatively minor. While some direct mortality can be expected during any wildfire, it is anticipated that most wildlife species would only be temporarily affected by a wildfire. The main way a wildfire may affect wildlife species is in the destruction or alteration of its habitat. Because continuous, widespread wildfire has not been a problem on the range nor was it modeled to be so, wildland fire is not expected to impact any wildlife species on the range.

12.6 Threatened and Endangered Species

One federally listed endangered wildlife species, the Sonoran pronghorn, is known to occur on the BMGRW. In addition, the BMGRW supports appropriate habitat for Peirson's milkvetch (*Astragalus magdalenae* var. *peirsonii*), a federally listed threatened plant species. Of these, only the Sonoran pronghorn appears to be dependent upon habitats within the BMGRW and the adjacent Cabeza Prieta NWR for its continued survival.

The Sonoran pronghorn are free roaming and not limited to specific areas of the range. Though roads and fences may be a hindrance, presumably they can avoid direct effects of a wildfire by moving.

Although suitable habitat for Peirson’s milkvetch occurs within the Yuma dunes of the BMGRW, this species has not been documented within the range. Should milkvetch become established on sand dune habitat, impacts would be minimal since this habitat type supports a very low fuel load and fire spread is unlikely.

The USFWS withdrew the proposed rule to list flat-tailed horned lizard (FTHL) in 2011. This species is managed in accordance with an Interagency Conservation Agreement and FTHL Rangewide Management Strategy. The Yuma Desert Management Area includes about 114,800 acres of FTHL habitat in BMGRW. Even though the effects of fire on the FTHL have not been studied, the FTHL may be more adversely directly affected by wildfire (Flat-tailed Horned Lizard Interagency Coordinating Committee. 2003). However, since any fire is unlikely to be continuous, and therefore would be small, the effects would probably be minimal.

The Sonoran population of desert tortoise is covered by a Candidate Conservation Agreement (2015).This species is known to occur in the BMGRE. A desert tortoise was observed on BMGRW between 2008 and 2009. The desert tortoise may be more adversely directly affected by wildfire. However, since any fire is unlikely to be continuous, the affects would probably be minimal. For example, the threat of fire to desert tortoise on the Chocolate Mountain Aerial Gunnery Range (CMAGR), which has a similar fire threat as BMGRW, is not expected to put the species in jeopardy. The USFWS 1996 Biological Opinion for the Desert tortoise states that CMAGR activities would not jeopardize the desert tortoise or result in significant destruction or adverse modification of its critical habitat through its activities, a possible small, low-intensity wildfire is not likely to impact its habitat, nor would the limited suppression activity associated with the wildfire (USFWS 1996). While no Biological Opinion was prepared for the desert tortoise in the BMGRW, the same conclusion can be made because of the similarity of fuels.

12.7 Cultural Resources

The same factors that have helped to preserve the natural resources of the BMGR—exclusion of surface disturbing, non-military land uses and correspondingly limited land surface disturbance by military activities—have also helped to protect cultural resources. As a result, well-preserved cultural resources within the BMGRW provide a remarkable record that tells of thousands of years of human habitation and use of this region.

These resources include both prehistoric and historic sites and features. The most common type and greatest number of cultural resource sites on the BMGRW are from the prehistoric period. Most of these sites consist of small scatters of broken pottery and stone tools where Native American groups camped and gathered wild foods and other useful natural resources. Some larger sites may have been base camps or villages where people stayed for longer periods of time and where they may have farmed when the climate was favorable using dry land farming techniques that are still known to some contemporary Native Americans. Many prehistoric sites are widely scattered and isolated from other cultural sites. Some archaeological sites contain rock art including petroglyphs (designs pecked into a rock surface), pictographs (painted designs), or intaglios (ground drawings produced by either moving rocks into alignments or by clearing surface rocks to produce large designs on the ground surface). Additional artifacts or other evidence that may be found at prehistoric sites include roasting pits, cooking hearths, cleared circles, rock shelters, or rock cairns and shrines. Prehistoric foot trails, that provide evidence of travel routes followed by early Native Americans, can also still be found within the BMGRW.

The physical record of military training on the range (dating from World War II but also including evidence of the Korean, Vietnam, and Cold war eras) comes primarily in the forms of auxiliary airfields, targets, buildings, test facilities, and expended ordnance.

Because many of these cultural resources are not combustible and no large fuel buildups are known within the range, any wildfire activity is not expected to impact these cultural resources. However, wildfire suppression activity may accidentally disturb or damage cultural resources.

In order to minimize the effects of fire suppression activities, it is recommended that BMGRW adopt MIST as its primary means to fight fire. There are many actions that will help protect cultural resources from the effects of fires. However, fire suppression activities, including ground disturbance and the use of aerial retardants, can have adverse effects, including damage to or destruction of prehistoric and historical period cultural resources. The effects of fire suppression activities and protection must be weighed against the potential for loss of cultural resources due to fire.

Ground disturbance includes construction of fire breaks (hand and mechanical construction), use and alteration of roads, establishment of the command post, fire camps, and helicopter landing pads. The use of fire trucks, bulldozers and heavy equipment on roads requires oversight to ensure that cultural resources are not adversely affected. Roads should be used as firebreaks if possible. Fire engines should be used on established roads only.

Emergency fire suppression may occur in areas where cultural resource surveys have not been completed and there is the potential for undetected cultural resources. Bulldozers or heavy equipment use and construction of fire breaks in un-surveyed areas should be coordinated with cultural resource staff. In some cases, an archaeologist may need to survey some areas ahead of fire suppression activities.

Application of fire retardants and other chemical agents, such as long-term retardants, foam, and water enhancers, have the potential to affect cultural resources. Aerial drops of any fire retardants on hot surfaces may cause effects to cultural resources due to rapid temperature change. These retardants may cause breakage or displacement of artifacts and features. Long term retardants are the most destructive, with additives that cause most materials to turn red and metal to turn blue or black. These desiccants damage rock images, rock shelters, and historical period buildings, structures, and materials. The BMGRW should specify “fugitive” retardant, which has no color. If the colored fire retardant is used, the retardant should be wiped off as soon as possible.

12.8 Public Access and Safety

The basic purpose of the BMGRW is to provide a secure location in which military training activities can be freely conducted without endangering the safety of military personnel or civilians and without interference or interruption. The simplest way of accomplishing these safety and non-interference goals would be to close the BMGRW to all public access. However, the MLWA of 1999 and the Sikes Act both provide that sustainable use of the BMGRW environment should be supported subject to the safety and security requirements necessary to support the military purposes of the range.

In accordance with these provisions, public access to the BMGRW is supported under two conditions. First, public access is permissible only in those areas of the range where it is compatible with the safety or security requirements of military operations. Second, public access to the range is by permit only. All BMGRW visitors must obtain a range entry permit from an approved Marine Corps, Air Force, USFWS, or BLM office prior to entering those areas of the range that are open to public access. Persons wishing to access the BMGRW for recreation need to be aware that there may be different procedures for checking in and out of the range for each visit because of differences in the types of military operations that occur. The application of these terms is explained when the required range access permit is obtained.

In those areas that are open to general public access with a permit, there are safety hazards. Visitors are made aware of these hazards when they obtain their range entry permit. During past training activities dating from World War II, ordnance may have been inadvertently or purposefully dropped at locations that are now open to general public access. Microwave, radio, and radar energy is used at temporary and permanent instruments located throughout the range to support aircraft training missions. These energy sources may be a health risk to persons that come in close contact to the transmitting equipment; however, energy transmission is directed in a narrow beam and is not aimed at surface locations where it could be a hazard to recreationists.

Because public access to BMGRW is relatively extensive, it is recommended that some basic public notification system be developed to announce a wildfire or wildfire suppression activity. However, since wildfire is so infrequent and unlikely in the range, this would simply be a courtesy, rather than a crucial communication.

13.0 OTHER CONSIDERATIONS

13.1 Mission Impact Considerations

There are both direct and indirect effects of wildland fire on the military mission. Direct effects are the loss of military training during a wildfire. Fire carries economic costs for firefighting and loss of property. There are also direct and indirect effects on natural resources. For example, NPS and U.S. Geological Survey (USGS) researchers determined that 12 percent of desert tortoises died as a direct result of a fire in 1994 in Utah (Erickson, Jim. 1998), albeit likely more intense than a wildfire that would burn on the BMGRW. The immediate loss of vegetation may appear to be a minor effect; however, changes in plant communities caused by alien plants and recurrent fire may alter habitat structure and composition of native animals' food plants (Brooks and Esque, 2002). The repeated loss of vegetation will also alter the landscape and intensify the magnitude of flooding events and soil erosion.

While these effects are real, on the BMGRW, the potential for wildfire is also unlikely. Historical records show only one significant fire has been reported on the range. This 410-acre fire burned in 2005. In addition, predictive models confirm that much of the range is unburnable.

13.2 Monitoring Requirements

The main environmental concern that will be evaluated is the effect fires have on desert wildlife populations and their habitat. In addition, burned areas will be evaluated and monitored for invasive species establishment. Rehabilitation of these areas will happen on a site-specific basis. Seeding the area using native vegetation will assist with invasive species control. Site monitoring will help ensure the establishment of native species.

In years where rainfall is exceedingly plentiful, the quantity and continuity of fuels should be evaluated via an aerial/remote sensed survey.

13.2.1 Reporting of Wildland Fires

All wildfires on the BMGRW must be reported to Range Control (Leg Iron), (range radio or telephone). If a fire is reported to Range Control, Range Control will notify the MCAS Yuma Emergency Dispatch Center immediately. Fires may be reported by calling 911 as well, however, this option may result in a longer response time than calling range control directly. Reference DoDI 6055.06 and the Wildland/WUI Operations Fire and Emergency Services SOP (2016) for current wildfire response protocols at BMGRW.

All wildfires will be reported to the MCAS Yuma Natural Resources Specialist. If the fire is located in an area with valuable habitat with environmental concerns, the MCAS Yuma Natural Resources Specialist will notify the U.S. Fish and Wildlife Service (USFWS) by the most expeditious means available. In addition, the MCAS Yuma Fire Department will report the incident to NFIRS. According to DoDI 6055.06, all fire losses caused by wildland fires shall be investigated to determine point of origin and fire cause before initiating other safety or legal investigations. Point of origin and fire cause determination shall be provided for subsequent safety or legal investigations. For fire losses

meeting the Class A accident threshold defined by reference (e), an independent fire investigation and report shall be provided.

13.2.2 Emergency Stabilization, Rehabilitation and Restoration

This plan does not foresee a need for emergency stabilization, rehabilitation and restoration in light of the rare frequency, and insignificant areal extent of wildland fires.

13.3 Public Relations

The BMGRW is used seasonally by the public, primarily for camping, hunting, and other recreational activities. In the event of a wildfire, it will be reported to local media as necessary. Interests include local papers, radio stations, and television stations.

14.0 FUNDING REQUIREMENTS

The additional costs to contract wildland fire management activities is negligible, due to the lack of a need for major programs addressing fire prevention, public education and outreach, training, inspection and preparedness, and wildland fire suppression itself. The main additional cost would be staff time to develop cooperative agreements and to conduct surveys of fuels when rainfall is particularly plentiful. Should funds be required, they would be requested by the Installation through the normal fiscal processes.

15.0 NATIONAL ENVIRONMENTAL POLICY ACT PROCESS FOR WFMP IMPLEMENTATION

Actions proposed in any IWFMP may constitute a major federal action as defined in 40 CFR Part 1508.18 (b) (2). Major federal actions must be evaluated for potential environmental effects. The NEPA document conducted for the installation INRMP may also include and provide analysis of the IWFMP. This IWFMP does not anticipate significant effects of the implementation of this plan.

16.0 REFERENCES

Anderson, Hal. 1982. Aids to Determining Fuel Models for Estimating Fire Behavior. USDA Forest Service, Intermountain Forest and Range Experiment Station, General Technical Report INTl-122.

Andrews and Rothermel, 1981. Charts for Interpreting Wildland Fire Behavior Characteristics. USDA Forest Service, General Technical Report INT-131. September 1981.Intermountain Forest and Range Experiment Station. Forest Service. U.S. Department of Agriculture. Ogden, Utah 84401. 21p.

Barmore, Russel L. 1980. Soil Survey of Yuma-Wellton Area: Parts of Yuma County, Arizona and Imperial County, California. USDA Soil Conservation Service in cooperation with the Arizona Agricultural Experiment Station and the California Agricultural Experiment Station.

Brooks, M. L. and Esque, T. C. 2002. Alien plants and fire in Desert Tortoise (*Gopherus agassizii*) habitat of the Mojave and Colorado Deserts. Chelonian Conservation and Biology, 4(2):330-340.

Darack, Ed. 2009. Welcome to Yodaville. Population: Zero. Threat Level: High. Air and Space Magazine. March 26, 2009. https://www.airspacemag.com/military-aviation/welcome-to-yodaville-121614889/#yAC6rZxGYY5MJaaT.99

Department of Defense (DoD) 2000. Instruction 6055.6, DoD Fire and Emergency Service Program, 10 Oct 2000.

Erickson, Jim. 1998. Tortoises could lose race against wildfires in Arizona
 Changes in desert make it harder for species to survive Associated Press. https://www.deseretnews.com/article/667006/Tortoises-could-lose-race-against-wildfires-in-Arizona.html. Executive Order 13112. 1999. FederalRegister.gov.

Finney, M. A. 2006. An overview of FlamMap fire modeling capabilities. In: Fuels management—how to measure success: conference proceedings. 2006 March 28-30; Portland, Oregon. Proceedings RMRS-P-41. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 213-220. 13 pages.

Flat-tailed Horned Lizard Interagency Coordinating Committee. 2003. Flat-tailed Horned Lizard Rangewide Management Strategy, 2003 Revision. An Arizona-California Conservation Strategy. Arizona Game and Fish Department solicitation # QF02-040-S; funded by the U.S. Fish and Wildlife Service).

Hall, J.A., P. Comer, A. Gondor, R. Marshall, and S. Weinstein. 2001. Conservation Elements of and a Biodiversity Management Framework for the Barry M. Goldwater Range, Arizona. The Nature Conservancy of Arizona, Tucson. 199 p.

Malusa, Jim and Pete Sundt. 2015. Vegetation of the Barry M. Goldwater Range – West, Marine Corps Air Station, Yuma, Arizona. Technical Report Coop Agreement DACA87-05-H-0018. Available online at :https://www.researchgate.net /publication/278967083_Vegetation_of_the_Barry_M_Goldwater_Range_West_Marine_Corps_Air_Station_-_Yuma_Arizona_2015.

National Fire Protection Association. 2016. NFPA 1002 - Standard for Fire Apparatus Driver/Operator Professional Qualifications. Quincy, Massachusetts.

National Fire Protection Association. 2016. NFPA 1051 - Standard for Wildland Fire Fighter Professional Qualifications. Quincy, Massachusetts.

National Fire Protection Association. 2016. NFPA 1583 - Standard on Health-Related Fitness Programs for Fire Department Members. Quincy, Massachusetts.

National Fire Protection Association. 2016. NFPA 1977 - Standard on Protective Clothing and Equipment for Wildland Fire Fighting. Quincy, Massachusetts.

National Resource Conservation Service 2011. State Soil Geographic Database (STATSGO2). Available at https://datagateway.nrcs.usda.gov/Catalog/ProductDescription/GSMCLIP.html

National Wildfire Coordinating Group (NWCG). 2003. Work Capacity Test Administrators Guide, Great Basin Cache Supply Office, Boise, Idaho. NFES 1109, PMS 307.

National Wildfire Coordinating Group (NWCG). 2008. Wildland Fire Qualification System Guide (Publication Management System 310-l/National Fire Equipment Catalogue 1414). Great Basin Cache Supply Office, Boise, Idaho.

National Wildfire Coordinating Group (NWCG). 2009. Guidance for Implementation of Federal Wildland Fire Management Policy, 2009. NWCG#001-2009.

National Wildfire Coordinating Group (NWCG). 1996. Wildland Fire Suppression Tactics Reference Guide. Great Basin Cache Supply Office, Boise, Idaho. NFES 1256, PMS 465.

Rothermel, Richard C. 1972. A Mathematical Model for Predicting Fire Spread in Wildland Fuels. USDA Forest Service, Research Paper INT-115. Intermountain Forest and Range Experiment Station. Forest Service. U.S. Department of Agriculture. Ogden, Utah 84401. 40p.

Shreve, Forrest, and Ira L. Wiggins. 1964. Vegetation and flora of the Sonoran Desert, Vol. I. Stanford University Press, Stanford, California. 840 p.

Scott, Joe H. and Robert E. Burgan. 2005. Standard fire behavior fuel models: a comprehensive set for use with Rothermel's surface fire spread model. Gen. Tech. Rep. RMRS-GTR-153. Fort Collins, CO. USDA Forest Service, Rocky Mountain Research Station. 72 p.

Scott, Joe H. and Elizabeth Reinhart. 2001. Assessing crown fire potential by linking models of surface and crown fire behavior. Res. Pap. RMRS-RP-29. Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station. 59 p.

Seager, Richard, Mingfang Ting, Isaac Held, Yochanan Kushnir, Jian Lu, Gabriel Vecchi, Huei-Ping Huang, Nili Harnik, Ants Leetmaa, Ngar-Cheung Lau, Cuihua Li, Jennifer Velez, Naomi Naik. 2007. Model Projections of an Imminent Transition to a More Arid Climate in Southwestern North America. Science 25 May 2007: Vol. 316, Issue 5828, pp. 1181-1184 DOI: 10.1126/science.1139601

The Sikes Act, as amended Through PL 113-291. 2014, including the Improvement Act of 1997(P.L. 105-85).

U.S. Department of the Air Force, Luke Air Force Base, and U.S. Department of the Navy, Marine Corps Air Station Yuma. 2007. Integrated Natural Resources Management Plan (INRMP) for the Barry M Goldwater Range, California. 101 p.

U.S. Department of the Interior (BLM-FAD) Agreement No. L10PG00548, USDA (USFS-NIFC) Agreement No. 10-1A-11130206-008. 2005. Interagency Agreement for the Provision of Temporary Support During Wildland Firefighting Operations among the Departments of Defense, Interior, and Agriculture.

U.S. Department of the Navy (DoN). 2010. Final environmental impact statement for the West Coast basing of the F-35B.

U. S. Fish and Wildlife Service (USFWS). 1996. Biological opinion tor the military use of the Chocolate Mountain Aerial Gunnery Range, California. No. 1-6-95-F-40.

US Marine Corps Order (MCO) 11000.11 Marine Corps Fire Protection and Emergency Services Program (June 2010)

U.S. Marine Corps Order (MCO) P5090.2A w/changes 1-3 (Marine Corps Headquarters, HQMC 2013).

U.S. Marine Corps Order 5P5090.2A, Environmental Compliance and Protection Manual. Headquarters. United States Marine Corps, Washington, DC.

U.S. Marine Corps 2007. Draft Marine Corps Wildland Fire Policy. Headquarters. United States Marine Corps, Washington, DC.

U.S. Marine Corps Air Station Yuma, Range and Training Areas Standard Operating Procedures (Station Order 3710.6J). 2013. Chapter 2 Environmental Procedures. Yuma Range Management Department, MCAS Yuma, Yuma, AZ.

Villarreal, Miguel L., Laura M. Norman, Robert H. Webb and Raymond M. Turner. 2013. Historical and Contemporary Geographic Data Reveal Complex Spatial and Temporal Responses of Vegetation to Climate and Land Stewardship. Land 2013, 2(2), 194-224; doi:10.3390/land2020194

Western Regional Climate Center (WRCC). 2011. Period of record monthly climate summary, Eagle Mountain, California (042598): Period of Record: 9/1/1933 to 12/31/2010.