Final

2009 Biological Monitoring Report for Burn Units 14, 18, 19, 22 and MRS-16 Former Fort Ord

Prepared for

Department of the Army
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Acronyms and Abbreviations

Army	U.S. Department of the Army
BO	Biological Opinion
BU	Burn Units
Burleson	Burleson Consulting, Inc.
cm	Centimeter
ft	Feet
GPS	Global Positioning System
HMP	Habitat Management Plan
L	Left side
m	Meter
MRS	Munitions Response Site
p	Statistical Significance
p-value	Measure of significance
R	Right side
t-test	Paired-comparison between means
USACE	U. S. Army Corps of Engineers
USFWS	U. S. Fish and Wildlife Service
VMP	Vegetation Monitoring Protocol

SECTION 1

Introduction

1.1 Introduction

This report presents the results of biological monitoring conducted at Burn Units (BU) 14, 18, 19, 22 and Munitions Response Site (MRS) 16 at former Fort Ord. Monitoring was completed using methodology presented in the Vegetation Monitoring Protocol (VMP) (Burleson, 2006). In April and May 2009, Burleson Consulting, Inc. (Burleson) conducted baseline, pre-treatment monitoring for BU 14 and 19, first year follow-up monitoring for BU 18 and 22, and year 3 monitoring for MRS-16. All the sites are located on former Fort Ord, located about eight miles north of Monterey, California (Maps 1, Appendix A). Baseline monitoring of BU 14 and 19 included monitoring of annual species, shrubs and perennials, and non-native annual grasses (Maps 2 through 11, Appendix A). First year monitoring of BU 18 and 22 included monitoring of annual species and non-native annual grasses (Maps 12 through 19, Appendix A). Third year monitoring of MRS-16 included monitoring of annual species, shrubs and perennials, and non-native annual grasses (Maps 20 through 23, Appendix A).

This 2009 biological monitoring study was conducted as a requirement of the *Installation-Wide Multispecies Habitat Management Plan for Former Fort Ord* (HMP) [United States Army Corps of Engineers 1997] and biological opinions (BO) issued by the United States Fish and Wildlife Service (USFWS) [1999, 2002, and 2005]. The HMP identifies rare, threatened, or endangered species and habitats designated for protection and future management after completion of munitions removal and other clean-up operations. The HMP also outlines mitigation measures necessary if Army-related munitions cleanup activities have significantly impacted rare species and habitats. This annual monitoring report presents the results of monitoring for HMP annuals, shrubs, and exotic plants.

Burleson was contracted by the U.S. Army Corps of Engineers (USACE) to complete the annual botanical monitoring for BU 14, 18, 19, 22 and MRS-16 in 2009 (Map 1, Appendix A). Before and after the completion of munitions removal, soil remediation, and other related environmental cleanup operations, baseline biological and follow-up surveys are conducted to establish whether protected species are present prior to work operations, including location and abundance. Monitoring of protected species and habitat after completion of cleanup activities is conducted to determine whether cleanup activities significantly impacted rare species or habitat. The HMP outlines avoidance measures, and mitigation measures such as habitat restoration, which would be necessary if U.S. Department of the Army (Army) cleanup activities significantly impact protected species or habitats. Terrain over most of the sites consists of rolling hills with elevations ranging from 375 to 550 feet (ft). The vegetation type is primarily central maritime chaparral with patches of annual grasslands. Central maritime chaparral is a vegetation type protected under the HMP because of its association with significant numbers of rare, threatened, and endangered species.

1.2 Species Included in 2009 Habitat and Rare Species Monitoring

The primary habitat of concern on the BU 14, 18, 19, 22 and MRS-16 is central maritime chaparral. These plant species, listed in Table 1 of Appendix C, include a variety of shrub and annual plants such as sandmat manzanita (*Arctostaphylos pumila*), Monterey ceanothus (*Ceanothus cuneatus* var. *rigidus*), Eastwood's golden fleece (*Ericameria fasciculata*), sand gilia (*Gilia tenuiflora* ssp. *arenaria*), Monterey spineflower (*Chorizanthe pungens* var. *pungens*), and seaside bird's-beak (*Cordylanthus rigidus* ssp. *littoralis*). BU 14, 18, 19, 22 and MRS-16 are within designated critical habitat for Monterey spineflower (*Chorizanthe pungens* var. *pungens*). The densities of sand gilia, seaside bird's-beak, and Monterey spineflower recorded within each of the sites monitored are presented in Tables 2 through 6 in Appendix C. Total percent cover of shrubs and perennial species are presented in Tables 7, 8, and 9 in Appendix C.

1.3 Previous Surveys Conducted on the Sites

1996 Harding Lawson Associates completed baseline surveys in MRS-16 for HMP annuals sand gilia, Monterey spineflower, and seaside bird's-beak, as well as transect surveys for HMP shrub species.

1998 Harding Lawson Associates completed baseline surveys in MRS-16 for HMP annuals. However, only Monterey spineflower was observed during surveys. Transect monitoring for shrub and perennial species was not conducted at this time.

2006 Shaw Environmental, Inc. completed baseline surveys in MRS-16. The surveys focused on rare HMP annuals: sand gilia and Monterey spineflower, as well as transect monitoring for shrub and perennial species. Seaside bird's-beak was not found to occur at this site in previous surveys.

2007 Shaw Environmental, Inc. completed the first year annual biological survey for MRS-16. The survey focused on rare HMP annuals: sand gilia and Monterey spineflower. Seaside bird's-beak was not found to occur at this site in previous surveys and was not observed at the time. Transect monitoring for shrub and perennial species was not conducted at this time since a prescribed burn had been conducted a few months prior to the survey.

2008 Shaw Environmental, Inc. completed an Annual Biological Monitoring Report for BU 18 and 22. This report included baseline survey results for rare HMP annuals: sand gilia, seaside bird's-beak, and Monterey spineflower, as well as transect surveys for shrubs and perennials.

SECTION 2

Baseline Vegetation Surveys – Burn Units 14 and 19

2.1 Burn Units 14 and 19 – Introduction

A baseline vegetation survey was conducted on BU 14 and 19 in the spring of 2009. These areas were selected for a prescribed burn to remove vegetation in support of munitions and explosives of concern removal. BU 14 and 19 were burned in October and November, 2009, respectively.

The area of the two burn units combined is 522 acres. Prior to the burn, the sites consisted primarily of mature maritime chaparral on sandy soils in gently rolling terrain. The two dominant shrub species throughout the sites were sandmat manzanita and shaggy-barked manzanita. A previous survey for HMP annual plant species, sand gilia, Monterey spineflower, and Seaside bird's-beak was conducted in 1992 by Jones and Stokes (USACE, 1992).

The 2009 vegetation monitoring consisted of a transect survey to characterize the site's shrub diversity and abundance, and surveys for three HMP annual plant species: sand gilia, Monterey spineflower, and seaside bird's-beak.

The vegetation survey also included mapping of non-native annual grass species on the site in order to document the location and density of these species prior to burn or burn-related disturbance such as primary containment line mowing or foam applications. Location of BU 14 and 19 are shown in Map 1 in Appendix A.

Photographs 1 through 8 in Appendix D show several views of the site, and transect sampling locations in the spring of 2009 prior to the burn. Map 1 in Appendix A shows the location this site.

2.2 Burn Units 14 and 19 – Methods

2.2.1 HMP Annuals Monitoring

Burleson monitored for abundance of HMP annuals within a stratified random sample of plots. Aerial photographs were used to identify naturally occurring gaps in the maritime chaparral. Plots were selected from areas of bare ground that provide suitable habitat. Monitoring was completed using the methodology presented in the VMP (Burleson, 2006).

The sand gilia and Monterey spineflower were surveyed between April 27 and April 29, 2009 during the peak bloom period for these species. Seaside bird's-beak populations were also surveyed during this time; however, the plants had not yet flowered. The site was subdivided into 100-ft square grids to provide a reasonable sample area. These plots were selected prior to conducting the surveys and were overlaid on maps and used as background layers on the Global Positioning System (GPS) units. Twenty percent of the 100- by 100-ft plot that contained suitable habitat were randomly selected to be surveyed for each of the HMP annuals. The entire 100- by 100-ft plot was surveyed to identify a representative area.

The center point of a circle plot was placed within a homogeneous concentration of the HMP annuals to determine the density within areas of representative habitat within the 100- by 100-ft plot. The plants were counted within a circular plot by scribing a 2.5-meter (m) radius around a point. The density class of HMP annuals within the 100- by 100-ft plot was determined by extrapolation. Each 100-ft plot was assigned a density class based on the number of individual plants per grid as follows:

0 = 0 plants
1 = 1 to 50 plants
2 = 51 to 100 plants
3 = 101 to 500 plants
4 = >500 plants

Density of plants for each 100- by 100-ft plot were estimates made by multiplying the density of annuals within the circle plots by the amount of suitable habitat present in the plots. The area of suitable habitat for each 100- by 100-ft plot was determined by visually inspecting the plot and aerial maps. For comparison purposes, the density of plants per acre was determined by the following equation: number of plants/0.00485 (area of circle plot in acres) X number of circle plots containing HMP plants.

2.2.2 Shrub and Perennial Transect Monitoring

Vegetation transect sampling was conducted between April 29 and May 1, 2009. The line-intercept method was used to collect percent cover of vegetation for baseline data in BU 14 and 19 as described in the VMP (Burleson, 2006).

A stratified random sampling technique was used to establish the transect locations because truly randomizing a sample regime may omit sampling areas important to HMP goals. The survey areas were stratified into 100- by 100-ft plots. The areas of homogenous, representative stands were identified on aerial maps and the ecotones between the stands was avoided. Then within each area of homogenous vegetation, the transect placement was randomized by assigning each plot a number and randomly selecting plots using a random number program. The orientation of the transects was determined in the field to representative of the surrounding area.

Twenty-two and 25 baseline transects were established in BU 14 and 19, respectively. A 50-m measuring tape was laid between the transect endpoints and the length along the transect occupied by each shrub species, bare ground, or herbaceous vegetation was recorded.

The species listed are shrubs and woody perennial plants that occur in maritime chaparral or in associated grassland areas. These species were recorded and include several special-status species as noted in Table 1 (Appendix C).

2.2.3 Annual Grass Monitoring

The annual grass locations and density along the primary containment lines were mapped by hand onto aerial maps and identified by walking along the site perimeters. Grass density was visually estimated and assigned to one of several density classes and mapped.

Density classes were as follows:

Low = 1-5 percent
Medium = 6-25 percent
High = >25 percent

2.3 Burn Units 14 and 19 – Results and Discussion

2.3.1 Sand Gilia

Sand gilia was present in 111 of the 259 plots on BU 14 and 19 combined. Forty-seven plots contained sand gilia in density class 1 (1-50 plants); 18 plots in density class 2 (51-100 plants); 41 plots in density class 3 (101-500 plants); and five in density class 4 (>500 plants). The distribution and abundance in BU 14 and 19 are shown on Maps 2 and 7, respectively (Appendix A).

Sand Gilia - Number of Plots* per Density Class

Density Class	BU 14 Plots	Estimated Acres of Suitable Habitat	BU 19 Plots	Estimated Acres of Suitable Habitat
0 plants/grid	76	15.38	72	18.19
1-50 plants/grid	22	8.90	25	6.82
51-100 plants/grid	6	3.63	12	4.30
101-500 plants/grid	19	11.19	22	10.04
>500 plants/grid	2	0.86	3	0.40

*Each plot is 100- × 100- feet or 10,000 square feet.

2.3.2 Seaside Bird's-Beak

Seaside bird's-beak was present in eight of the 259 plots on BU 14 and 19 combined. Three plots contained Seaside bird's-beak in density class 1 (1-50 plants); two plots in density class 2 (51-100 plants); and three plots in density class 3 (101-500 plants). The distribution and abundance in BU 14 and 19 are shown on Maps 3 and 8, respectively (Appendix A).

Seaside Bird's-Beak - Number of Plots* per Density Class

Density Class	BU 14 Plots	Estimated Acres of Suitable Habitat	BU 19 Plots	Estimated Acres of Suitable Habitat
0 plants/grid	118	36.23	133	40.68
1-50 plants/grid	2	0.75	1	0.17
51-100 plants/grid	2	0.75	0	0
101-500 plants/grid	3	1.38	0	0
>500 plants/grid	0	0	0	0

*Each plot is 100- × 100- feet or 10,000 square feet.

2.3.3 Monterey Spineflower

Monterey spineflower was present in 202 of the 259 plots on BU 14 and 19 combined. Fifty plots contained Monterey spineflower in density class 1 (1-50 plants); 20 plots in density class 2 (51-100 plants); 52 plots in density class 3 (101-500 plants); and 80 plots in density class 4 (>500 plants). The distribution and abundance for BU 14 and 19 are shown on Maps 4 and 9, respectively (Appendix A).

Monterey Spineflower - Number of Plots* per Density Class

Density Class	BU 14 Plots	Estimated Acres of Suitable Habitat	BU 19 Plots	Estimated Acres of Suitable Habitat
0 plants/grid	31	2.18	26	2.47
1-50 plants/grid	23	4.30	27	5.44
51-100 plants/grid	6	1.26	14	3.67
101-500 plants/grid	21	7.76	31	11.13
>500 plants/grid	44	23.93	36	18.08

*Each plot is 100- × 100- feet or 10,000 square feet.

2.3.4 Shrub Transect Monitoring

The locations of the transects established in BU 14 are presented in Map 5 of Appendix A. Total percent cover averaged in BU 14 are compared graphically in Figure 4 of Appendix B and percent cover of each transect by species is presented in Table 7 of Appendix C. Average percent cover for the transects was as follows:

Percent Live Perennial Vegetation: 110.86 (± 19.67)
Percent Live Herbaceous Vegetation: 2.18 (± 5.40)
Percent Desiccated Vegetation: 7.51 (± 8.52)
Percent Bare Ground: 8.45 (± 6.49)

The species that had the greatest percent cover in BU 14 were (average percent cover in parentheses): shaggy-barked manzanita (39.04%), sandmat manzanita (25.61%), chamise (20.77%), black sage (8.65%), Monterey ceanothus (6.14%), poison oak (4.05%), Hooker's manzanita (1.91%), and mock heather (1.34%). These species accounted for about 107 percent of the total vegetation cover. Each of the other species observed within the transects averaged less than 1% of the total cover.

The locations of the transects established in BU 19 are presented in Map 10 of Appendix A. Total percent cover averaged in BU 19 are compared graphically in Figure 4 of Appendix B and percent cover of each transect by species is presented in Table 8 of Appendix C. Average percent cover for the transects was as follows:

Percent Live Perennial Vegetation: 99.81 (± 19.98)
Percent Live Herbaceous Vegetation: 1.77 (± 2.71)
Percent Desiccated Vegetation: 9.28 (± 6.13)
Percent Bare Ground: 11.77 (± 8.66)

The species that had the greatest percent cover in BU 19 were (average percent cover in parentheses): sandmat manzanita (26.65%), chamise (25.35%), shaggy-barked manzanita (23.46%), Monterey ceanothus (8.72%), black sage (4.56%), Hooker's manzanita (2.06%), poison oak (1.93%), deerweed (1.80%), Eastwood's golden fleece (1.78%). These species accounted for about 96 percent of the total vegetation cover. Each of the other species observed within the transects averaged less than 1% of the total cover.

The most commonly encountered perennial shrub species within BU 14 and 19 were shaggy-bark Manzanita, sandmat Manzanita, and chamise. Each of these species form underground woody burls, from which new shoots will typically re-sprout quickly following a burn.

Table 7 in Appendix C presents the baseline percent cover for each transect in BU 14. The baseline data for BU 19 is presented in Table 8 in Appendix C. Numbers shown are the percent cover for each plant species observed within each 50-m transect and total percent cover for the entire transect. Greater than 20 percent herbaceous vegetation was not observed; therefore, quadrats along transects were not used.

2.3.5 Annual Grass Monitoring

Non-native grass locations and densities in BU 14 and 19 are shown in Maps 6 and 11, respectively. Non-native grasses were mapped within 200 feet of the site border prior to the 200-ft fire containment line being established around the borders of both sites.

The following numbers indicate the acres within the primary containment line of BU 14 occupied by non-native annual grass at varying densities:

Area at Low density (1-5 percent) = 0.67 Acre
Area at Medium density (5-25 percent) = 0.74 Acre
Area at High density (>25 percent) = 0.85 Acre

The following numbers indicate the acres within the primary containment line of BU 19 occupied by non-native annual grass which was only medium density:

Area at Medium density (5-25 percent) = 5.71 Acres

The total area of non-native grasses between the two sites was 7.97 acres or 11.7 percent of the combined primary containment areas.

SECTION 3

First Year Follow-up Monitoring – Burn Units 18 and 22

3.1 Burn Units 18 and 22 – Introduction

A baseline vegetation monitoring survey was conducted on Burn Units 18 and 22 in the spring of 2008. These areas were selected for a prescribed burn to remove vegetation in support of munitions and explosives of concern removal. The burn was conducted in December of 2008. A previous baseline survey was conducted for rare HMP annuals: sand gilia, seaside bird's-beak, and Monterey spineflower, as well as transect surveys for shrubs and perennials (USACE, 2009).

The area of the two burn units combined is 209 acres. Prior to the burn, the sites consisted primarily of intermediate-aged maritime chaparral on sandy soils in gently rolling terrain. The two dominant shrub species throughout the sites were sandmat manzanita and shaggy-barked manzanita. Other significant habitat types on the sites include a wetland /vernal pond within Burn Unit 22 with associated grassland uplands, and scattered patches of coastal sage scrub and coast live oak.

The 2009 vegetation monitoring consisted of surveys for three HMP annual plant species: sand gilia, Monterey spineflower, and Seaside bird's beak.

The vegetation survey also included mapping of non-native annual grass species on the site in order to document whether these species became established as a result of the burn or burn-related disturbance such as primary containment line mowing. Locations of BU 18 and 22 are shown in Map 1 of Appendix A. Photographs 9 through 20 in Appendix D show several views of the site and plot monitoring locations in the spring of 2009 after the burn.

3.2 Burn Units 18 and 22 – Methods

3.2.1 HMP Annuals Monitoring

Burleson monitored for abundance of HMP annuals within a stratified random sample of grids located within and directly adjacent to habitat previously occupied by sand gilia, Monterey spineflower, and seaside bird's-beak. Monitoring was completed using the methodology presented in the VMP (Burleson, 2006).

The sand gilia and Monterey spineflower were surveyed between April 22 and April 27, 2009 during the peak bloom period for these species. Seaside bird's-beak populations were also surveyed during this time; however, the plants had not yet flowered. The site was subdivided into 100-ft square grids. Twenty percent of the previously occupied 100-ft square grids were randomly selected and surveyed for each of the HMP annuals. Additionally, ten percent of the plots along the outer boundary were also surveyed to determine if the populations were spreading. The surveys were conducted within a circular plot by scribing a 2.5-m radius around a point within the 100- by 100-ft grid. The center point of a circle plot

was placed within representative habitat of the 100- by 100-ft plot to determine the density of HMP annuals. The density class of HMP annuals within the 100- by 100-ft plot was determined by extrapolating density of annuals within the circle plots. Each 100- by 100-ft plot was assigned a density class based on the number of individual plants per plot as follows:

0 = 0
1 = 1 to 50
2 = 51 to 100
3 = 101 to 500
4 = >500

The area of suitable habitat for each 100- by 100-ft plot was determined by estimating the area of bare ground within each plot. Density class for each 100- by 100-ft plot were calculated by multiplying the density of annuals within the circle plots by the amount of suitable habitat present in the plots. For comparison purposes, the density of plants per acre was determined by the following equation: number of plants/0.00485 (area of circle plot in acres) X number of circle plots containing HMP plants.

3.2.2 Annual Grass Monitoring

The annual grass locations and density along the primary containment lines were mapped by hand onto aerial maps, while walking along the site perimeters. Grass density was visually estimated and sections, consisting of road lengths, were mapped and assigned to one of several density classes.

Density classes were as follows:

Low = 1-5 percent
Medium = 6-25 percent
High = >25 percent

3.3 Burn Units 18 and 22 – Results and Discussion

3.3.1 Sand Gilia

Sand gilia was present in 95 of the 113 plots surveyed on BU 18 and 22 combined. Thirteen plots contained sand gilia in density class 1 (1-50 plants); eight plots in density class 2 (51-100 plants); 31 plots in density class 3 (101-500 plants); and 43 plots in density class 4 (>500 plants). The distribution and abundance in BU 18 and 22 are shown on Maps 12 and 16, respectively (Appendix A).

Sand Gilia - Number of Plots* per Density Class				
Density Class	**BU 18 Plots**	**Estimated Acres of Suitable Habitat**	**BU 22 Plots**	**Estimated Acres of Suitable Habitat**
0 plants/grid	15	7.06	3	1.35
1-50 plants/grid	10	5.12	3	1.01
51-100 plants/grid	4	3.33	4	1.57
101-500 plants/grid	20	15.67	11	3.71
>500 plants/grid	17	13.72	26	12.08
*Each plot is 100- × 100- feet or 10,000 square feet.				

The total area occupied by sand gilia was estimated to be 56.21 acres within BU 18 and 22 combined. This is an increase from the baseline data collected in 2007, which estimated 47.3 acres. In 2008, 0 acres were recorded that contained very high densities of sand gilia. The increase in high density populations is likely due to the prescribed burn and the lack of competition for resources.

3.3.2 Seaside Bird's-Beak

Seaside bird's-beak was present in 36 of the 85 plots surveyed on BU 18 and 22 combined. Nine plots contained Seaside bird's-beak in density class 1 (1-50 plants); five plots in density class 2 (51-100 plants); 14 plots in density class 3 (101-500 plants); and eight plots in density class 4 (>500 plants). The distribution and abundance in BU 18 and 22 are shown on Maps 13 and 17, respectively (Appendix A).

Seaside Bird's-Beak - Number of Plots* per Density Class				
Density Class	**BU 18 Plots**	**Estimated Acres of Suitable Habitat**	**BU 22 Plots**	**Estimated Acres of Suitable Habitat**
0 plants/grid	31	8.16	18	2.17
1-50 plants/grid	3	0.58	6	0.88
51-100 plants/grid	2	0.42	3	0.44
101-500 plants/grid	6	1.86	8	1.48
>500 plants/grid	0	0	8	1.34
*Each plot is 100- × 100- feet or 10,000 square feet.				

The total area occupied by seaside bird's-beak was estimated to be 7.0 acres within BU 18 and 22 combined. This is a decrease from the baseline data collected in 2008, which estimated 10.1 acres. In 2007, 8.9 acres were recorded that contained low densities of seaside bird's-beak and 0.7 contained high densities. The 2009 survey recorded 1.34 acres of very high density; however, the total acreage was only estimated 7.0 acres. The increase in high density populations is likely due to the prescribed burn and the lack of competition for resources. The 2009 survey may have been conducted too early in the season to detect peak seaside bird's-beak populations.

3.3.3 Monterey Spineflower

Monterey spineflower was present in 108 of the 140 plots surveyed on BU 18 and 22 combined. Eleven plots contained Monterey spineflower in density class 1 (1-50 plants); 11 plots in density class 2 (51-100 plants); 26 plots in density class 3 (101-500 plants); and 60 plots in density class 4 (>500 plants). The distribution and abundance of Monterey spineflower present in BU 18 and 22 is shown on Maps 14 and Map 18, respectively (Appendix A).

Monterey Spineflower - Number of Plots* per Density Class

Density Class	BU 18 Plots	Estimated Acres of Suitable Habitat	BU 22 Plots	Estimated Acres of Suitable Habitat
0 plants/grid	23	12.57	9	5.93
1-50 plants/grid	10	6.83	1	0.77
51-100 plants/grid	9	5.85	2	1.05
101-500 plants/grid	16	10.50	10	5.64
>500 plants/grid	32	23.93	28	17.84

*Each plot is 100- × 100- feet or 10,000 square feet.

The total area occupied by Monterey spineflower was estimated to be 72.41 acres within BU 18 and 22 combined. This is an increase from the baseline data collected in 2007, which estimated 70.2 acres. In 2008, Monterey spineflower was recorded as percent cover. Density classes reflected percent cover, 41 acres were classified as low density, 8.2 acres high density, and 21 acres very high density. The 2009 survey was conducted earlier in the season and Monterey spineflower were counted as individuals. Therefore, direct comparison is not possible. The 2009 survey estimated 41.77 acres of very high density Monterey spineflower. The high density populations are likely due to the prescribed burn and the lack of competition for resources.

3.3.4 Annual Grass Monitoring

Non-native grass location and densities in BU 18 and 22 are shown in Maps 15 and 19, respectively. Photograph 15 show medium-density areas adjacent to the site boundaries and along a road. Non-native grasses were mapped throughout both sites.

The following numbers indicate the acres within the primary containment line of BU 18 occupied by non-native annual grass at varying densities:

Area at Medium density (5-25 percent) = 4.16 Acres
Area at High density (>25 percent) = 2.10 Acres

The following numbers indicate the acres within the primary containment line of BU 22 occupied by non-native annual grass at varying densities:

Area at Medium density (5-25 percent) = 1.70 Acres
Area at High density (>25 percent) = 0.19 Acre

The total area of non-native grasses between the two sites was 8.15 acres or 11.8 percent of the combined primary containment area. This is higher than the baseline which recorded 4.24 acres or 6.1 percent of the combined primary containment area. Grassland dominated areas were located in and around the wetland of BU 22 and in other low-lying areas in BU 18, where the ground is likely seasonally too moist to support shrub cover. Other grassy areas were located along roads, primary containment lines, and disturbed areas.

SECTION 4

Year 3 Vegetation Monitoring – MRS-16

4.1 MRS-16 – Introduction

MRS-16 was burned on October 19 and 20, 2006 for removal of the maritime chaparral vegetation to facilitate remediation of munitions and explosives of concern. Baseline surveys were conducted on MRS-16 in 1996 and 1998, and within the primary containment lines in 2006 (USACE, 2007) and first year annual monitoring was conducted for HMP annual plants in 2007 (USACE, 2008).

The 2007 vegetation monitoring consisted of a survey for two HMP annual species. These species were the federally endangered sand gilia (*Gilia tenuiflora arenaria*) and federally threatened Monterey spineflower (*Chorizanthe pungens pungens*). The California endangered seaside bird's beak (*Cordylanthus rigidus littoralis*) was not found to be present on the site.

This 2009 survey was year 3 following the prescribed burn at MRS-16. Shrub species had become established and transects and HMP annuals were surveyed. The vegetation survey also included mapping of non-native annual grass species on the site in order to document whether these species have established as a result of the burn or burn-related disturbance such as primary containment line mowing or foam applications. Map 1 of Appendix A shows the location of MRS-16. Photographs 21 through 25 in Appendix D show several views of the site and transects monitored in the spring of 2009 after the burn.

4.2 MRS-16 – Methods

4.2.1 HMP Annuals Monitoring

Burleson monitored for abundance of HMP annuals within a stratified random sample of plots. Plots were selected from areas were HMP annuals had been recorded previously. Monitoring was completed using the methodology presented in the VMP (Burleson, 2006).

The sand gilia and Monterey spineflower were surveyed between April 20 and April 22, 2009 during the peak bloom period for these species. Seaside bird's-beak had not been observed during past surveys. The plots were selected prior to conducting the surveys and were overlaid on maps and background layers on the GPS units. All of the 100- by 100-ft grids where sand gilia had been recorded and 20 percent of the grids previously occupied by Monterey spineflower were surveyed. Additional plots along the border of previously identified populations were also surveyed to determine if the populations were spreading. The surveys were conducted within a circular plot by scribing a 2.5-m radius around a point within the 100- by 100-ft grid. The center point of a circle plot was placed within representative habitat of the 100- by 100-ft plot to determine the density of HMP annuals. The density class of HMP annuals within the 100- by 100-ft plot was determined by extrapolating density of annuals within the circle plots. Each 100-ft grid was assigned a density class based on the number of individual plants per grid as follows:

0 = 0
1 = 1 to 50
2 = 51 to 100
3 = 101 to 500
4 = >500

The area of suitable habitat for each 100- by 100-ft plot was determined by estimating the area of bare ground within each plot. Density class for each 100- by 100-ft plot were calculated by multiplying the density of annuals within the circle plots by the amount of suitable habitat present in the plots. For comparison purposes, the density of plants per acre was determined by the following equation: number of plants/0.00485 (area of circle plot in acres) X number of circle plots containing HMP plants.

4.2.2 Shrub and Perennial Transect Monitoring

Vegetation transect sampling was conducted between April 20 and April 22, 2009. The line-intercept method was used to collect percent cover data for the third year post burn in MRS-16 as described in the VMP (Burleson, 2006).

The nine MRS-16 baseline transect locations established in 1996 were monitored during this 2009 event in addition to eight transects established in 2006. A 50-m measuring tape was laid between the transect endpoints and maritime chaparral shrubs and perennial species were measured using the line intercept method. Quadrat surveys along transects were conducted when herbaceous vegetation was estimated to be greater than 20 percent. The one-quarter meter square (50×50 centimeters [cm]) quadrats were placed at 10m intervals along the tape, alternating left and right sides of the tape, at 0m (L), 10m (R), 20m (L), 30m (R), 40m (L) and 50m (R).

Percent cover of live vegetation, dead vegetation, and bare ground was also estimated within each quadrat. The species listed are shrubs and woody perennial plants that occur in maritime chaparral or in associated grassland areas. These species were evaluated in the baseline surveys and include several special-status species as noted in Table 1 (Appendix C).

Analysis of the total percent cover within transects was conducted by testing between groups (2009 data and 1996 baseline data) with a paired-comparison between means (t-test). The statistical significance (p) of the t-test is illustrated by $p<0.05$. The p-value of 0.05 (i.e.,1/20) indicates that there is less than 5% probability that the relation between the variables occurred by pure chance.

4.2.3 Annual Grass Monitoring

The annual grass locations and density along the primary containment lines were mapped by hand onto aerial maps, while walking along the site perimeters. Grass density was visually estimated and sections, consisting of road lengths, were mapped and assigned to one of several density classes.

Density classes were as follows:

Low = 1-5 percent
Medium = 6-25 percent
High = >25 percent

4.3 MRS-16 – Results and Discussion

4.3.1 Sand Gilia

Sand gilia was observed in 20 of the 30 plots surveyed on the MRS-16 site. Five plots contained sand gilia in density class 1 (1-50 plants); 0 plots were in density class 2 (51-100 plants); five plots in density class 3 (101-500 plants); and 10 plots in density class 4 (>500 plants). The distribution and abundance in MRS-16 are shown on Map 20 (Appendix A).

Sand Gilia - Number of Plots* per Density Class

Density Class	MRS-16 Plots	Estimated Acres of Suitable Habitat
0 plants/grid	10	1.03
1-50 plants/grid	5	0.48
51-100 plants/grid	0	0
101-500 plants/grid	5	0.44
>500 plants/grid	10	1.11

*Each plot is 100- × 100- feet or 10,000 square feet.

The density of sand gilia (plants per acre) increased from 5,783 per acre in 2007 to 12,546 per acre in 2009. The total area occupied by sand gilia was estimated to be 2.03 acres within MRS-16. This is an increase from the year 1 data collected in 2007, which estimated 0.3 acre. In 2007, several small patches (<10 individuals) were documented that were not observed in 2009; however, new densely populated patches were recorded in 2009.

4.3.2 Seaside Bird's-Beak

Seaside bird's-beak was not observed any plots surveyed on the MRS-16 site.

4.3.3 Monterey Spineflower

Monterey spineflower was observed in 31 of the 44 plots that were surveyed in MRS-16. Zero plots contained Monterey spineflower in density class 1 (1-50 plants); one plot in density class 2 (51-100 plants); seven plots in density class 3 (101-500 plants); and 23 plots in density class 4 (>500 plants). The distribution and abundance of Monterey spineflower present in MRS-16 is shown on Map 21 (Appendix A).

Monterey Spineflower - Number of Plots* per Density Class		
Density Class	**MRS-16 Plots**	**Estimated Acres of Suitable Habitat**
0 plants/grid	11	1.90
1-50 plants/grid	0	0
51-100 plants/grid	1	0.32
101-500 plants/grid	7	1.59
>500 plants/grid	23	7.51
*Each plot is 100- × 100- feet or 10,000 square feet.		

The total area occupied by Monterey spineflower was estimated to be 9.42 acres within MRS-16. This is an increase from the baseline data collected in 2007, which estimated 6.85 acres. In 2007, Monterey spineflower was recorded as percent cover. Density classes reflected percent cover; 6.5 acres were classified as low density, 0.7 acre medium density, 0.2 acre high density, and 0.04 acre very high density. The 2009 survey was conducted earlier in the season. Monterey spineflower were counted as individuals; therefore, direct comparison is not possible. The 2009 survey recorded 7.51 acres of very high density.

4.3.4 Shrub Transect Monitoring

The locations of the transects established in BU 19 are presented in Map 22 of Appendix A. Total percent cover averaged in MRS-16 are compared graphically in Figure 4 of Appendix B and percent cover of each transect by species is presented in Table 9 of Appendix C. Average percent cover for the transects was as follows:

% Live Perennial Vegetation: 70.29 (± 22.20)
% Live Herbaceous Vegetation: 15.13 (± 12.54)
% Desiccated Vegetation: 14.37 (± 8.51)
% Bare Ground: 18.80 (± 11.32)

The most commonly encountered perennial shrub was shaggy-bark manzanita. This species forms underground woody burls, from which new shoots will typically re-sprout quickly following a burn. The species that had the greatest percent cover in MRS-16 were (average percent cover in parentheses): shaggy-barked manzanita (15.81%), dwarf ceanothus (13.87%), rushrose (13.65%), chamise (6.28%), Monterey ceanothus (4.96%), woodbalm (2.29%), sandmat manzanita (1.99%), black sage (1.49%), golden yarrow (1.39%), blueblossom (1.36%), Hooker's manzanita (1.3%), wedge-leaved horkelia (1.11%), and coyote brush (1.06%). These species accounted for about 67 percent of the total vegetation cover. Each of the other species observed within the transects averaged less than 1% of the total cover.

Percent cover within quadrats was measured along transects with herbaceous vegetation estimated to be greater than 20 percent. The herbaceous vegetation within these transects was typically dominated by non-native grasses. Total percent cover for quadrats along eight transects are presented in Table 10 in Appendix C.

4.3.5 Annual Grass Monitoring

Areas containing non-native annual grass are shown on Map 23. These locations were areas of pre-existing grassland before the burn, or areas that were adjacent to pre-existing grassland. Besides pre-existing grasslands on the site, other grassy areas were located along roads, fence lines, and previously disturbed mounds existing on the north side of site.

The following numbers indicate the acres within the primary containment line of MRS-16 occupied by non-native annual grass at varying densities:

Area at Medium density (5-25 percent) = 10.85 Acres
Area at High density (>25 percent) = 3.61 Acres

The total area of non-native grasses at the site was 14.46 acres or 51.6 percent of the primary containment line. Comparison to the 2006 baseline and the 2007 first year data within the primary containment line shows an increase in the area of medium and high density grass. The increase is approximately 11.46 acres since 2007. This increase is evident in the primary containment lines, as well as along roads and other disturbed areas.

The increase in grass occurrence in the site is likely related to disturbance from brush cutting to establish the primary containment line, as well as burning, both of which are disturbances that tend to induce an increase in annual grasses when grasses were originally present.

SECTION 5

Conclusions

5.1 Sand Gilia, Seaside Bird's-Beak, and Monterey Spineflower Surveys

In April and May 2009, Burleson conducted baseline monitoring for BU 14 and 19, first year follow-up annual monitoring for BU 18 and 22, and year 3 monitoring for MRS-16.

Baseline surveys conducted at BU 14 and 19 determined that these sites had the lowest densities of sand gilia and spineflower compared to the other sites. This was expected because these sites are comprised of mature chaparral dominated by shrubs and less habitat is available for annual species compared to BU 18, 22, and MRS-16. Within BU 14 and 19, sand gilia and Monterey spineflower were distributed across the sites and were more abundant within open sandy areas. The total area occupied by sand gilia was estimated to be 46.14 acres within BU 14 and 19 combined. Seaside bird's-beak was found in two localized locations in BU 14 and 19. The total area occupied by seaside bird's-beak was estimated to be 3.05 acres within BU 14 and 19 combined. The total area occupied by Monterey spineflower was estimated to be 75.5714 acres within BU 14 and 19 combined.

The 2009 surveys were the first year of monitoring following the prescribed burn at BU 18 and 22. The ground cover consisted largely of bare ground and desiccated vegetation left by mowing and burning the sites. Sand gilia and Monterey spineflower were distributed across the sites, and seaside bird's-beak was restricted to three localized locations in BU 18 and two locations in BU 22. The survey was conducted during the peak blooming period of sand gilia and Monterey spineflower. The plants were robust and flowering. However, the seaside bird's-beak had not started flowering at the time of the survey. Therefore, the distribution of seaside bird's-beak may be underestimated.

Sand gilia and Monterey spineflower had been previously recorded within MRS-16. Seaside bird's-beak had not been previously recorded and was not observed during the 2009 surveys in MRS-16. Sand gilia was estimated to occupy 0.3 acre in 2007 and was estimated to occupy 2.03 acres in 2009. The density was greater in 2009 with 12,546 plants per acre compared to a density of 5,783 plants per acre in 2007. Monterey spineflower was observed primarily along the southern portion of the MRS-16 site. This is a prostrate species that forms low growing mats along the ground; however, surveys conducted early in the blooming period can readily count individual plants. Monterey spineflower densities in 2009 were determined to be 48,670 plants per acre and were observed in 78 percent of the plots where it had been recorded in 2007. Spineflower was found to have the highest density at MRS-16 compared to the other sites monitored in 2009.

5.2 Vegetation Transect Survey

Transects were established within dense chaparral in BU 14 and 19. Burleson monitored 22 and 25 transects within BU 14 and 19, respectively. Twenty-one species were observed

within BU 14 transects and 22 species were observed within BU 19 transects. Species richness in BU 14 and 19 are expected to increase during monitoring in 2012.

All 16 transects within MRS-16 were monitored. As expected, shrubs and perennial species are increasing in MRS-16 and are approaching baseline values for percent cover. Twenty-eight species were observed within MRS-16 transects. Species richness was higher in MRS-16 three years after being burned compared to MRS-16 baseline, and BU 14 and 19, which was a mature chaparral stand. This is expected because successional vegetation change in chaparral after fire is unlike other habitat types. Shrubs that composed the mature community are typically present in the first year after disturbance in addition to opportunistic species that become established in recently disturbed areas. There is a gradual elimination of individuals present from the beginning rather than a replacement of initial shrubs by new species (Hanes, 1971). During the monitoring in 2011, species richness in MRS-16 is expected to be lower because of the gradual elimination of initial species by slower growing shrubs.

5.3 Percent Cover

BU 14 and 19 consisted of mature chaparral shrub and perennial species comprising of 110 and 100 percent total cover, respectively. The total percent cover in BU 14 and 19 is expected to be lower in 2012 because these areas will be recovering from the prescribed burn conducted in 2009. Table 11 in Appendix A shows the average percent cover of BU 14 and 19 during the baseline, and MRS-16 which is year 3.

Comparisons were made between transects 16-1 through 16-9 at MRS-16 only because the other transects were not established until 2006 and the data was not yet available. There was not a significant difference ($p<0.05$) in total percent cover or bare ground between the 1996 baseline and year 3 monitoring. The mean total percent cover within transects at MRS-16 was 80 percent in 1996 and 84 percent in 2009.

Shrubs that composed the mature community before a disturbance are typically present in the vegetation the first year after disturbance. The dominant species at MRS-16 in 1996 were chamise, shaggy-barked manazanita, Monterey ceanothus, and dwarf ceanothus. These species were also among the most dominant at the site in 2009. However, each of these species had a lower total percent cover in 2009 compared to 1996, with the exception of dwarf ceanothus. Rushrose was not present in the transects in 1996, but comprised 15 percent cover in 2009 and added a considerable amount to the total cover. The average percent cover of shrub and perennial vegetation has exceeded 1996 baseline conditions. The average percent cover is expected to increase by 2011 as the dominant shrubs continue to increase in size.

The 2009 transect data for MRS-16 was analyzed for differences between transects established within the primary containment line and transects within the burn area. There was a significant difference ($p<0.05$) in percent cover of shrubs and perennial species between the transects located within the primary containment line, which had a mean percent cover of 52 percent, and the transects located within the burn area, which had a mean percent cover of 84 percent. This suggests that the shrubs are recovering quickly within the burned area compared to the primary containment line. During the 2006 baseline monitoring

conducted within the primary containment line, the vegetation community was classified primarily as central maritime chaparral with a few small patches of annual grassland along the south and southeast sides of the site, and a significant oak woodland area along the site's northwest and west sides. Coastal scrub patches were documented on the north side, along with stands of blueblossom ceanothus. In 2006, bare ground was relatively high in all transects, accounting for an average of 24 percent of the total cover. The primary containment line was determined to be disturbed to intermediate in age because of the percentage of bare ground and high diversity. The varying ecotones and baseline conditions within the primary containment line likely contribute to the low percent cover of shrubs.

5.4 Annual Grasses

Non-native grasses have increased at each of the areas monitored; however, the most dramatic increase was observed at MRS-16 within the primary containment line and along roads. Non-native grasses were recorded in medium and high densities in 14.46 acres compared to 3.0 acres in 2007. Spread or increase of annual grasses within sites is common after disturbances such as burns. Annual grasses tend to compete aggressively with native annual plants such as sand gilia and Monterey spineflower, and have the potential to reduce habitat quality for these protected species. Monitoring of annual grasses should continue concurrently with HMP annuals during future surveys. This monitoring is important within the first five years before shrubs become established to document the extent of non-native annual grass encroachment.

SECTION 6

Recommendations

6.1 Evaluation of Sampling Methods Used in 2009

Burleson monitored for abundance of HMP annuals within a randomly selected sub-sample of grids at MRS-16, BU 14, 18, 19, and 22. The circular plot method was sufficient for monitoring HMP annuals. Density of HMP annuals was recorded within areas of presence and recorded as absent when not observed within the grid. However, in cases where there are very few individuals within a grid (i.e., 1 individual) or the plants were not normally distributed within the open spaces, this method may have overestimated the number of individuals present within the grid. It is recommended that this methodology be followed in 2010 and 2011 and the data be compared to other sites to measure consistency.

The line-intercept method was used to collect percent cover data for the third year post-burn at MRS-16 and baseline for BU 14 and 19. The line-intercept method is robust and provided sufficient information about trends in total cover, cover of the dominant species, and cover of the HMP shrubs. It is recommended that this method continue to be used for monitoring of shrubs.

Quadrat sampling was conducted along 8 transects in MRS-16 that appeared to contain more than 20% herbaceous vegetation. The transect surveys were conducted early in the year which allowed for herbaceous vegetation to be accurately identified.

Non-native annual grasses have increased most dramatically within MRS-16. Medium and high densities were observed within 14.46 acres of the primary containment line. Future surveys will continue to monitor for the spread or increase of annual grasses within the site, especially within the first five years. Annual grasses tend to compete aggressively with native annual plants such as sand gilia and Monterey spineflower, and have the potential to reduce habitat quality for these protected species. Future monitoring efforts should continue to map both annual grass distribution and density and to make a comparison to past data, and to determine if native species are being outcompeted by non-native annual grasses.

SECTION 7

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APPENDIX A

Maps

APPENDIX B

Figures

APPENDIX C

Tables

APPENDIX D

Photographs