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2019 ANNUAL RARE PLANT SURVEY  
FOR THE  
ENHANCED IN SITU BIOREMEDIATION (EISB)  
DEPLOYMENT AREA 3A  
AT THE  
OPERABLE UNIT CARBON TETRACHLORIDE  
PLUME (OUCTP)

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## ATTACHMENTS

**Attachment A:** 2016 Habitat Checklist

**Attachment B:** 2019 Rare Plant Survey Results Overview and Detail Maps

# 1 INTRODUCTION

Denise Duffy and Associates, Inc. (DD&A) was contracted by Ahtna Environmental, Inc. (Ahtna) to conduct baseline surveys and complete annual follow-up surveys within the University of California Fort Ord Natural Reserve (FONR) in support of the 2016 Enhanced In Situ Bioremediation (EISB) Deployment Area 3A construction (Figure 1). Following the installation of wells and support facilities, in accordance with the governing documents, DD&A was scheduled to conduct three annual follow-up surveys for three special-status plant species: federally Threatened Monterey spineflower (*Chorizanthe pungens* var. *pungens*), federally Endangered and state Threatened Monterey gilia (*Gilia tenuiflora* ssp. *arenaria*), and federally Endangered Yadon's piperia (*Piperia yadonii*). This report details the results of the Year 3 follow-up survey (annual survey) for the 2016 construction of EISB Deployment Area 3A within FONR North and compares the results to the 2016 baseline, as well as the 2017/2018 annual surveys.

## 1.1 BACKGROUND AND PROJECT INITIATION

FONR North is located on the former Fort Ord, Marina, California and is adjacent to the Marina Municipal Airport (the former Fritzsche Army Airfield) (Figure 1). A portion of the Operable Unit Carbon Tetrachloride Plume (OUCTP) in the A-Aquifer underlies FONR North. The chemicals of concern associated with OUCTP in the A-Aquifer are carbon tetrachloride (CT), tetrachloroethene, chloroform, 1,1-dichloroethene, total-1,2-dichloroethene, methylene chloride, vinyl chloride, and trichloroethene. The presence and concentration levels of CT are used to define the extent of OUCTP. The remedy for OUCTP in the A-Aquifer is EISB, which has been implemented at three deployment areas in FONR. In 2014 the U.S. Army Corps of Engineers (USACE) contracted with Ahtna to conduct fieldwork to collect additional site information to further characterize groundwater gradients and chemistry in the north and northeastern portions of the OUCTP to support the design and implementation of additional EISB deployment area(s), if necessary.

Rare plant surveys are required by the Installation-Wide Multispecies Habitat Management Plan (HMP) for Former Fort Ord, California (USACE, 1997) and the Programmatic Biological Opinion for Cleanup and Property Transfer Actions Conducted at the Former Fort Ord, Monterey County, California (PBO; USFWS, 2017) in areas that are disturbed during groundwater remediation effort related construction activities. Project activities undertaken must protect and maintain the special-status species found within FONR. Efforts are taken to avoid or minimize impacts to all HMP species, with emphasis on three federally listed plant species: Monterey spineflower, Monterey gilia, and Yadon's piperia.

Special-status species listed in the HMP and PBOs that occur or may occur on FONR include:

- Monterey gilia (*Gilia tenuiflora* ssp. *arenaria*) – federally endangered, state threatened
- Monterey spineflower (*Chorizanthe pungens* var. *pungens*) – federally threatened
- Seaside bird's beak (*Cordylanthus rigidus* ssp. *littoralis*) – state endangered
- Sandmat manzanita (*Arctostaphylos pumila*)
- Monterey manzanita (*A. montereyensis*)
- Monterey ceanothus (*Ceanothus rigidus*)
- Eastwood's goldenbush (*Ericameria fasciculata*)
- Yadon's piperia (*Piperia yadonii*) – federally endangered

- Coast wallflower (*Erysimum ammophilum*)
- California black legless lizard (*Anniella pulchra nigra*; BLL) – state species of concern
- California tiger salamander (*Ambystoma californiense*; CTS) – federally threatened, state threatened
- Monterey ornate shrew (*Sorex ornatus salarius*) – state species of concern

Monterey gilia, Monterey spineflower, Seaside bird’s beak, and coast wallflower are annual herb species that may occur within openings of maritime chaparral, grasslands or disturbed areas. Sandmat manzanita, Monterey manzanita, Monterey ceanothus, and Eastwood’s goldenbush are perennial shrub species that typically occur in maritime chaparral, but individuals can also be found within oak woodland. Yadon’s piperia is a perennial herb that is typically found in maritime chaparral and Monterey pine habitats.

The BLL is a rare variety of the California legless lizard (*A. pulchra*) that inhabits areas with sandy soils on the former Fort Ord. The Monterey ornate shrew is a rare variety of the ornate shrew (*S. ornatus*) found in riparian forest and oak woodland habitats. CTS are typically found in vernal or seasonal ponds on the former Fort Ord, during the breeding season. CTS may also be found in small mammal burrows or under logs in upland areas within 2.2 kilometers of vernal ponds, outside of the breeding season.

As identified in the 2017 PBO success criteria for the activities required to remediate contaminated groundwater are as follows:

*After the final monitoring period for each of the federally listed species or designated Monterey spineflower critical habitat, species reestablishment will be considered successful when:*

1. *densities and acreage of HMP annual species are within a normal range compared with information from reference sites, and;*
2. *the number of wells where HMP annual species are detected in follow-up surveys will be the same or greater than the number of wells where these species were found in baseline surveys.*

If the success criteria are not met, then corrective measures will be developed and applied on a case-by-case basis in coordination with the United States Fish and Wildlife Service (USFWS), as described in the 2017 PBO.

DD&A met and coordinated with Ahtna, USACE, U.S. Army Base Realignment and Closure (BRAC) Fort Ord Field Office, and FONR staff to finalize the scope and project path, as well as identify project boundaries, project footprint, and site access.

## **1.2 SITE DESCRIPTION**

This report describes activities that have occurred within FONR, which is approximately 605 acres in size. The habitats present within FONR include coast live oak woodland, maritime chaparral, coastal scrub, disturbed/developed land, and annual grassland. The area surveyed as part of the 2016 construction of an EISB

deployment area (approximately six acres)<sup>1</sup> and access routes (approximately five acres) included coast live oak woodland, disturbed/developed land, and annual grassland.

### 1.2.1 OUCTP EISB DEPLOYMENT AREA 3A

OUCTP EISB Deployment Area 3A, in the FONR North, included ten extraction wells, ten injection wells, pipelines, conduits, and corresponding potential access routes. EISB Deployment Area 3A included the following components (Figure 2):

<p>Extraction wells</p> <ul style="list-style-type: none"> <li>▪ EW-BW-160-A</li> <li>▪ EW-BW-161-A</li> <li>▪ EW-BW-162-A</li> <li>▪ EW-BW-163-A</li> <li>▪ EW-BW-164-A</li> <li>▪ EW-BW-165-A</li> <li>▪ EW-BW-166-A</li> <li>▪ EW-BW-167-A</li> <li>▪ EW-BW-168-A</li> <li>▪ EW-BW-169-A</li> </ul>	<p>Injection wells</p> <ul style="list-style-type: none"> <li>▪ IW-BW-159-A</li> <li>▪ IW-BW-160-A</li> <li>▪ IW-BW-161-A</li> <li>▪ IW-BW-162-A</li> <li>▪ IW-BW-163-A</li> <li>▪ IW-BW-164-A</li> <li>▪ IW-BW-165-A</li> <li>▪ IW-BW-166-A</li> <li>▪ IW-BW-167-A</li> <li>▪ IW-BW-168-A</li> </ul>	<p>Pipelines</p> <ul style="list-style-type: none"> <li>▪ Injection</li> <li>▪ Extraction</li> </ul> <p>Conduits</p> <ul style="list-style-type: none"> <li>▪ Electrical</li> <li>▪ Communication</li> </ul>
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As required by the HMP, and PBO, a habitat checklist was prepared prior to well installation which identified natural resources present and restrictions to minimize impacts to those resources (Attachment A). These restrictions included, but were not limited to, using existing roads to the greatest extent feasible for potential access routes, and pressure washing equipment coming from offsite to minimize the potential of spreading invasive species.

## 1.3 METHODOLOGY

### 1.3.1 HMP PLANT SURVEYS

The Scope of Work (SOW) provided by Ahtna to DD&A was intended to comply with the HMP and the PBOs. The SOW required that annual biological surveys be conducted to determine the effects of groundwater remediation activities on three federally listed HMP species: Monterey spineflower, Monterey gilia, and Yadon’s piperia. Rare plant survey methods were based on methods DD&A used previously for vegetation surveys at FONR on behalf of HydroGeoLogic, Inc. (HGL 2008, 2009a, 2009b, 2011, 2012, 2013a, 2013b, 2014 & 2015). In 2016 Yadon’s piperia was added to the species surveyed, at the request of the USFWS and BRAC (HGL 2016).

Monterey spineflower, Monterey gilia, and Yadon’s piperia are annual plant species that must be blooming to make a positive identification. DD&A conducts a minimum of two survey efforts per year at each site for the required monitoring period. DD&A used several reference sites and conferred with other local experts to ensure

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<sup>1</sup> This acreage is the survey area for EISB Deployment Area 3A located on FONR. Please see Section 1.3.1.1.1 below for additional information.

that surveys for Monterey spineflower and Monterey gilia were conducted within the appropriate blooming period. Of the three special-status plant species included in the survey efforts, the Yadon's piperia blooming period is later in the year, typically May through August. Annual plant surveys did not occur within the appropriate blooming period for Yadon's piperia. DD&A biologists surveyed for potential piperia basal rosettes and, if observed, relayed the location(s) to the BRAC Biologist so that additional surveys may be conducted during the appropriate blooming period for Yadon's piperia, if necessary. All known piperia species on FONR were identified to be Michael's rein orchid (*Piperia michaelii*) by University of California Santa Cruz (UCSC) staff.

Where identified, the locations of the three rare plant species were mapped using a Trimble® Geo 7 Series global positioning system (GPS) with an external Zephyr Model 2 antenna or delineated on an aerial and digitized in office. Large areas of Monterey spineflower, Monterey gilia, and piperia, when observed, were mapped as polygons, with attributes to identify the number of individuals for Monterey gilia and piperia or percent absolute cover for Monterey spineflower. Smaller groups and individuals, when observed, were mapped as points with attributes to identify the number of individuals at each location.

Individual counts were made for all Monterey gilia and piperia populations, whether they were mapped using points (population  $\leq 5$ ) or polygons (population  $> 5$ ). However, Monterey spineflower were only counted as individuals when groups of five or less were mapped. Monterey spineflower populations consisting of greater than five individuals were mapped as polygons and characterized according to the percent of cover. The density classes used for percent cover were:

- Very Sparse (<3 percent absolute cover),
- Sparse (3-25 percent absolute cover),
- Medium-Low (26-50 percent absolute cover),
- Medium (51-75 percent absolute cover),
- Medium-High (76-97 percent absolute cover), and
- Very High (>97-100 percent absolute cover).

GPS data, defining the population boundaries and/or point location(s), were exported to shapefile format. Shapefiles were then imported into the Geographic Information System (GIS) ESRI® ArcGIS 10.6 software platform and overlaid on high-resolution aerial photography/satellite imagery.

#### 1.3.1.1 EISB SURVEY AREA

The survey area consisted of EISB Deployment Area 3A within the FONR North site and connecting access routes, as shown in Figures 1 and 2.<sup>2</sup> Specifically, the EISB survey area was defined using a 50-foot buffer area around the extraction and injection wells and a 20-foot buffer around access routes, identified above. The presence of UCSC study plots and transects required, that in some instances, the typical buffer area around wells and access routes be reduced to avoid impacts to these study areas. Additionally, the buffer along a

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<sup>2</sup> The location of treatment plant and the associated access route are outside of FONR in adjacent development property.



section of pipeline between wells IW-BW-162-A and IW-BW-160-A was reduced as impacts from installation resulted in less disturbance to ground cover.<sup>3</sup>

## **1.4 PREVIOUS MONITORING**

A baseline survey for the EISB survey area was conducted in 2016, the Year 1 follow-up survey was conducted in 2017, and the Year 2 follow-up survey was conducted in 2018. A comparison of survey results from previous years for the EISB survey area is included in Section 4 (Discussion).

### **1.4.1 2016 BASELINE SURVEY RESULTS – EISB SURVEY AREA**

In 2016, DD&A conducted baseline surveys for Monterey spineflower, Monterey gilia, and Yadon's piperia within the EISB survey area. 76 populations of Monterey spineflower (117,397 square feet [ft<sup>2</sup>] of polygons and 22 points) were identified in the EISB survey area. Monterey spineflower was found at fourteen of the twenty well locations (EW-BW-160-A, EW-BW-161-A, EW-BW-162-A, EW-BW-164-A, EW-BW-165-A, EW-BW-166-A, EW-BW-168-A, EW-BW-169-A, IW-BW-159-A, IW-BW-160-A, IW-BW-161-A, IW-BW-162-A, IW-BW-163-A, and IW-BW-165-A) and along access routes. One population of Monterey gilia (36 individual plants) was identified in the EISB survey area. The population of Monterey gilia was located along the access route to well installation location IW-BW-160-A.

### **1.4.2 2017 YEAR 1 FOLLOW-UP SURVEY – EISB SURVEY AREA**

DD&A conducted the Year 1 follow-up survey for the EISB survey area in 2017. 62 populations of Monterey spineflower (89,649 ft<sup>2</sup> of polygons and 31 points) were identified in the EISB survey area. Monterey spineflower was found at fifteen of the twenty well locations (EW-BW-160-A, EW-BW-161-A, EW-BW-164-A, EW-BW-165-A, EW-BW-166-A, EW-BW-168-A, EW-BW-169-A, IW-BW-159-A, IW-BW-160-A, IW-BW-161-A, IW-BW-162-A, IW-BW-163-A, IW-BW-165-A, IW-BW-166-A, and IW-BW-168-A) and along access routes. One population of Monterey gilia (7 individual plants) was identified in the EISB survey area. The population of Monterey gilia was identified and mapped along the access route to well installation location IW-BW-160-A.

#### **1.4.2.1 2018 YEAR 2 FOLLOW-UP SURVEY – EISB SURVEY AREA**

DD&A conducted the Year 2 follow-up survey for the EISB survey area in 2018. 104 populations of Monterey spineflower (72,816 ft<sup>2</sup> of polygons and 58 points) were identified in the EISB survey area. Monterey spineflower was found at fifteen of the twenty well locations (EW-BW-160-A, EW-BW-161-A, EW-BW-164-A, EW-BW-165-A, EW-BW-166-A, EW-BW-168-A, EW-BW-169-A, IW-BW-159-A, IW-BW-160-A, IW-BW-161-A, IW-BW-162-A, IW-BW-163-A, IW-BW-165-A, IW-BW-166-A, and IW-BW-168-A) and along access routes.

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<sup>3</sup> No mowing occurred along this section of pipeline. With the exception of the access routes and this area of pipeline mowing of herbaceous ground cover occurred prior to installation of EISB Deployment Area 3A.

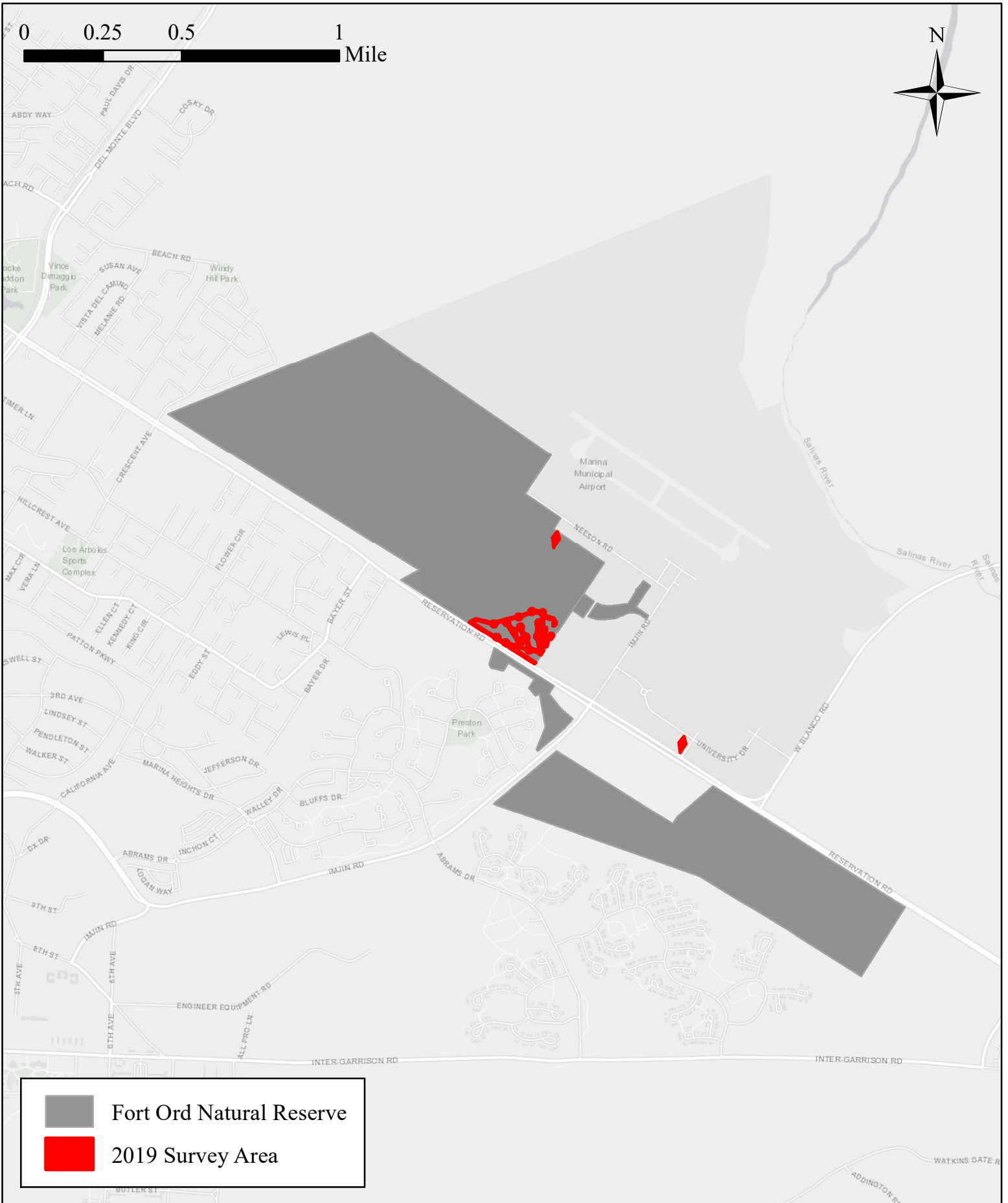


Figure 1. 2019 Survey Area Overview Map



Figure 2. EISB Survey Area



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## 2 RESULTS

DD&A conducted a survey for the three HMP species identified above at a previously identified reference site (Reference Site 1, Figure 3), which is conducted every year as part of the survey effort. Prior to the 2019 survey effort DD&A, working with the BRAC Biologist, CDFW, and UC FONR staff, established a second reference site (Reference Site 2, Figure 3), located on FONR North. Reference Site 2 was established in response to an anecdotal observation, reported by DD&A in previous rare plant reports, of invasive non-native grasses colonizing Reference Site 1 and reducing the amount of open space. DD&A conducted a baseline survey for Reference Site 2 in 2019. DD&A also conducted the Year 3 follow-up survey for the EISB survey area.

### 2.1 2019 REFERENCE SITE 1 SURVEY RESULTS

Reference Site 1 was surveyed for Monterey gilia on April 10 and 11, 2019; and Monterey spineflower on May 10, 2019.

#### 2.1.1 MONTEREY SPINEFLOWER

In 2019, Monterey spineflower occupied approximately 2,283 ft<sup>2</sup> at Reference Site 1 (Table 2.1.1 and Figure 4).

**Table 2.1.1 Monterey Spineflower at Reference Site 1 - 2019.**

**Polygon Density Class: Very Sparse (<3 percent cover), Sparse (3-25 percent cover), and Medium-Low (26-50 percent cover).**

Year	# of Populations	# of Points	# of Polygons	Polygons per Density Class			Total Area of Polygons (ft <sup>2</sup> )
				Very Sparse	Medium-Low	Sparse	
2019	12	4	8	1	6	1	2,283

#### 2.1.2 MONTEREY GILIA

In 2019, a total of 3,065 individual Monterey gilia plants were observed at Reference Site 1 (Table 2.1.2 and Figure 4).

**Table 2.1.2 Monterey Gilia at Reference Site 1 - 2019**

Year	# of Populations	Individual Plants	# of Points	# of Polygons	Total Area of Polygons (ft <sup>2</sup> )
2019	18	3,065	8	10	717

## 2.2 2019 REFERENCE SITE 2 SURVEY RESULTS

Reference Site 2 was surveyed for Monterey gilia on April 10, 2019 and Monterey spineflower on May 10, 2019.

### 2.2.1 MONTEREY SPINEFLOWER

In 2019, Monterey spineflower occupied approximately 7,616 ft<sup>2</sup> at Reference Site 2 (Table 2.2.1 and Figure 5).

**Table 2.2.1 Monterey Spineflower at DD&A Reference Site 2 - 2019**

**Polygon Density Class: Very Sparse (<3 percent cover), Sparse (3-25 percent cover), and Medium-Low (26-50 percent cover).**

Year	# of Populations	# of Points	# of Polygons	Polygons per Density Class		Total Area of Polygons (ft <sup>2</sup> )
				Very Sparse		
2019	4	0	4	4		7,614

### 2.2.2 MONTEREY GILIA

In 2019, a total of 1,509 individual Monterey gilia plants were observed at Reference Site 2 (Table 2.2.2 and Figure 5).

**Table 2.2.2 Monterey Gilia at DD&A Reference Site 2 - 2019**

Year	# of Populations	Individual Plants	# of Points	# of Polygons	Total Area of Polygons (ft <sup>2</sup> )
2019	22	1,509	5	17	476

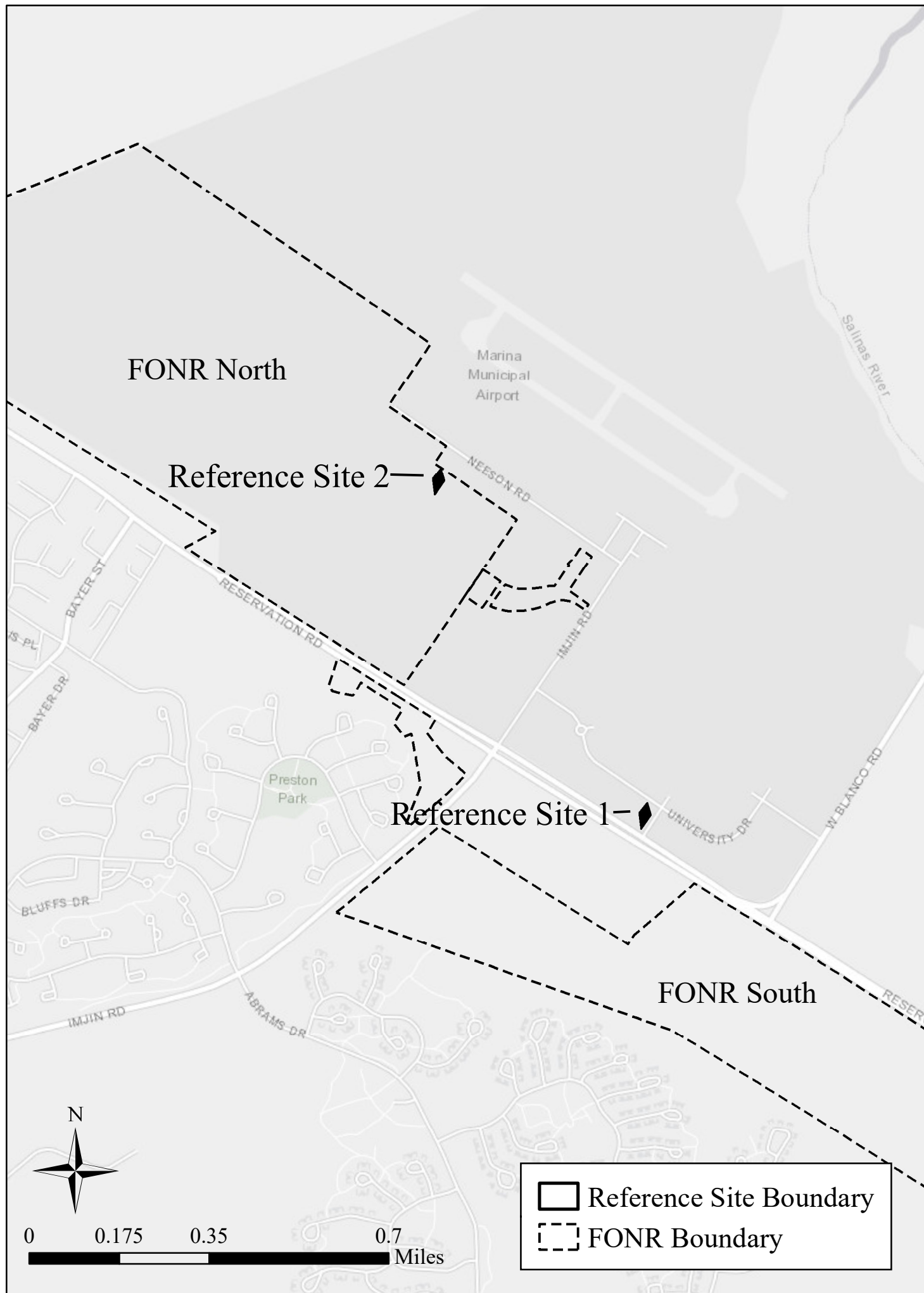
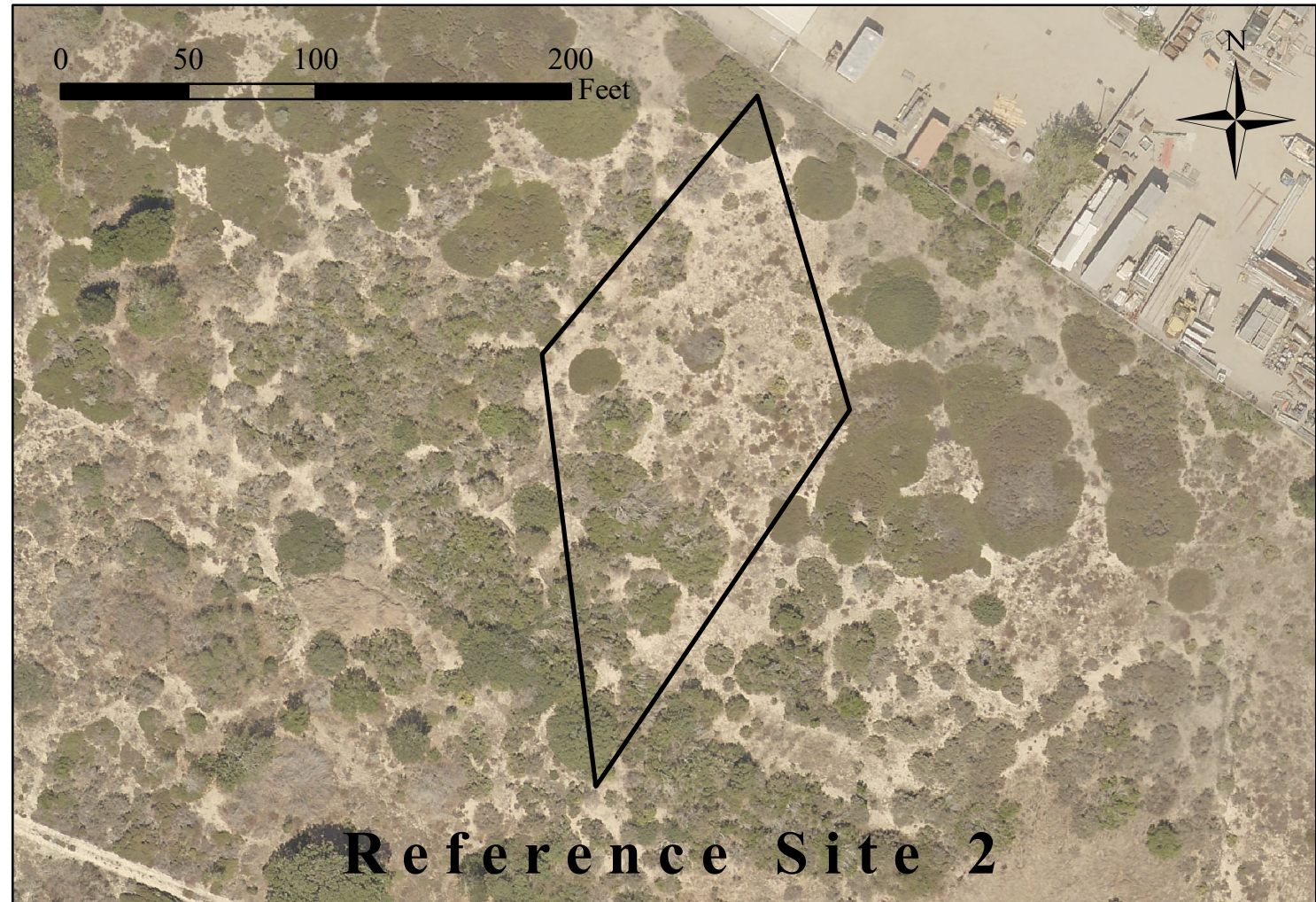
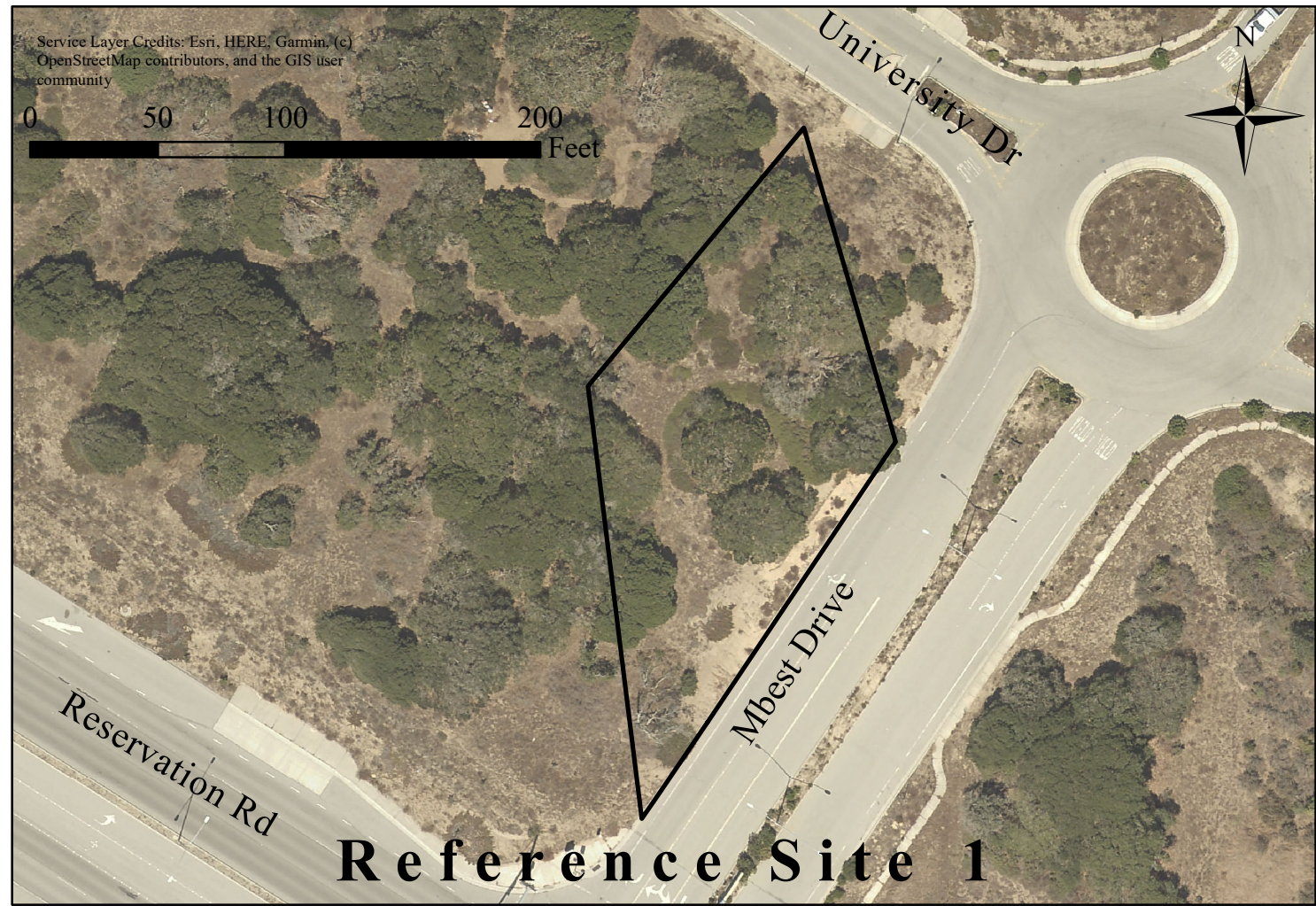
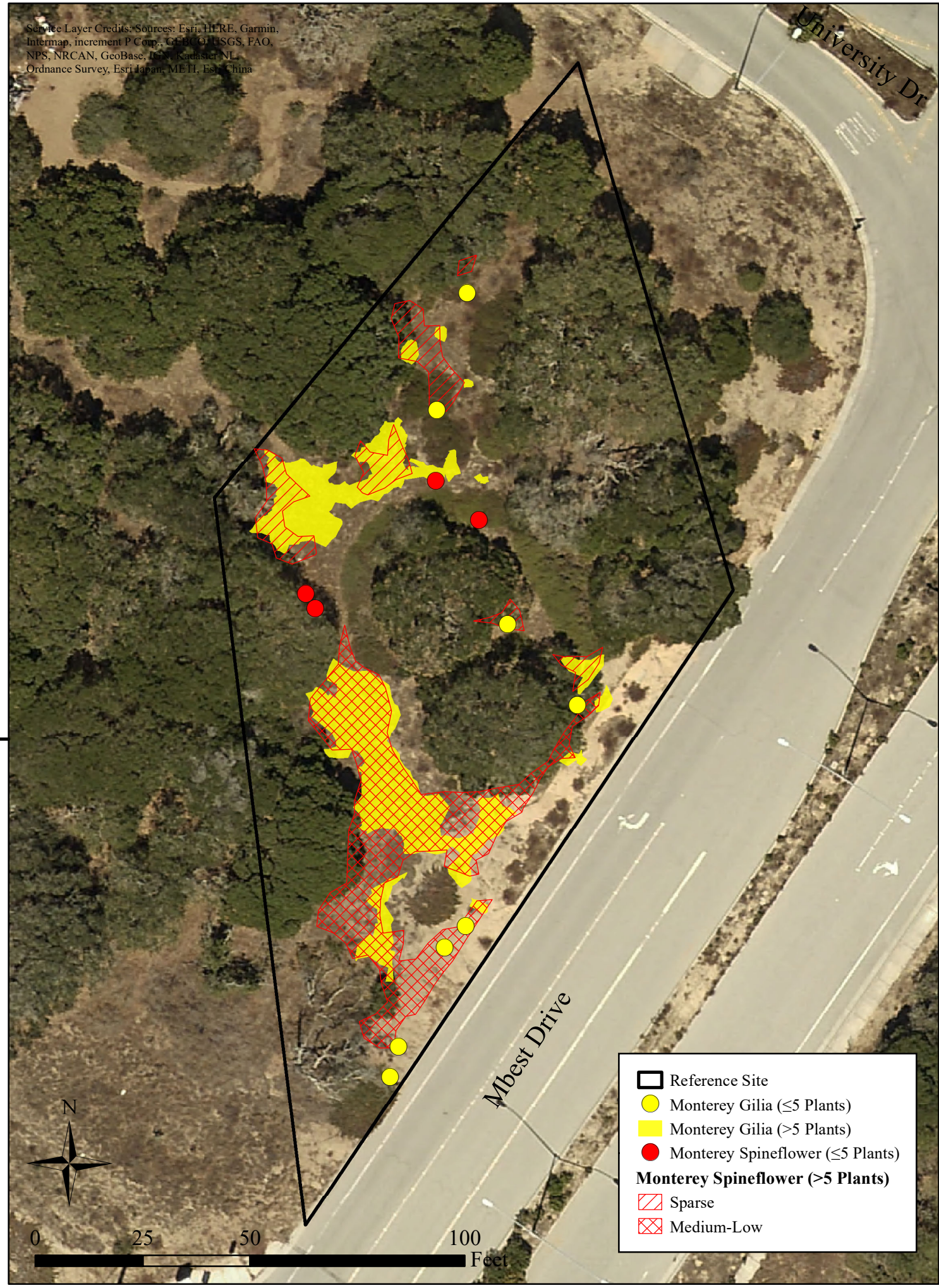
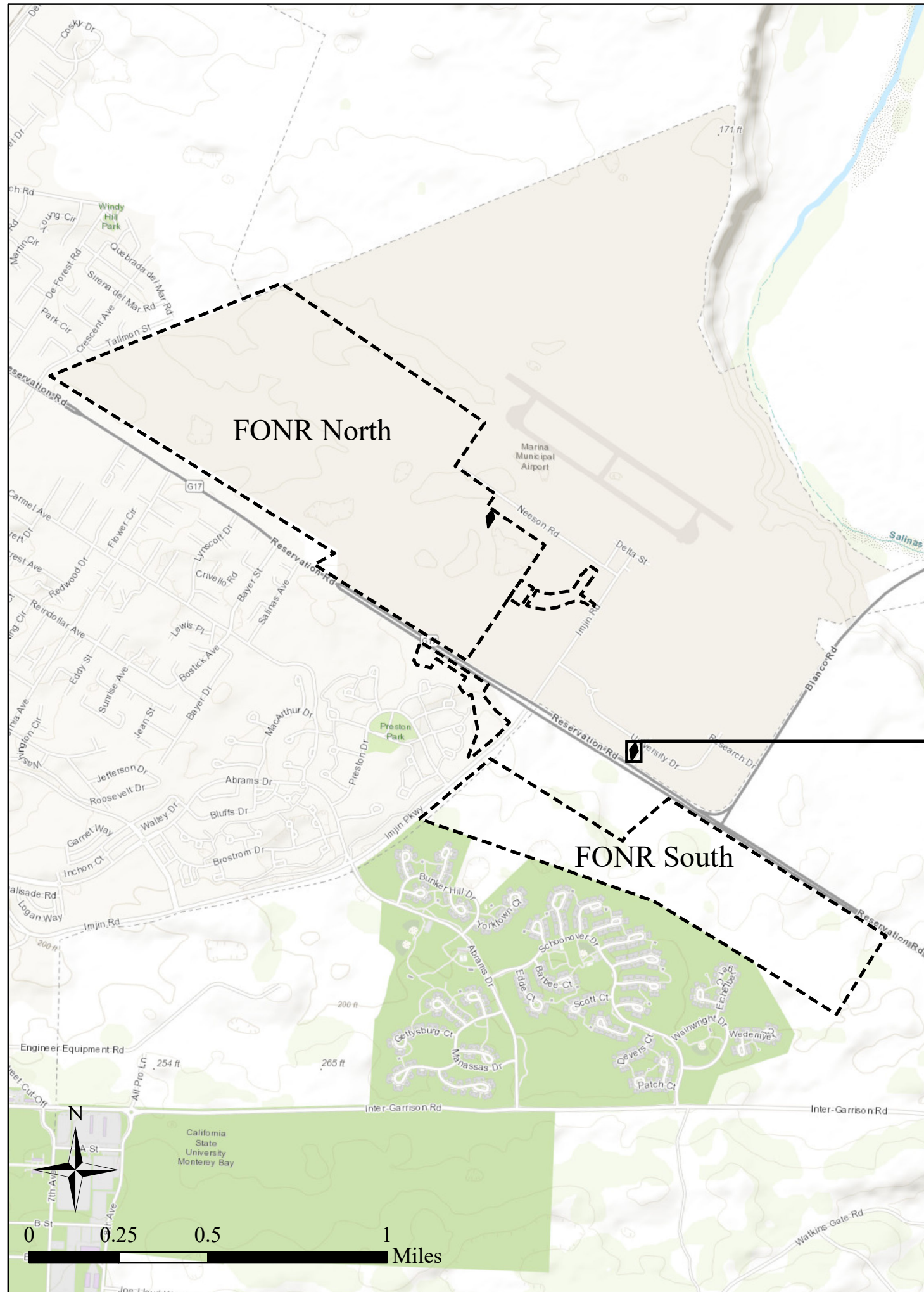


Figure 3. EISB Reference Sites



Figure 4. 2019 Reference Site 1 Survey Results



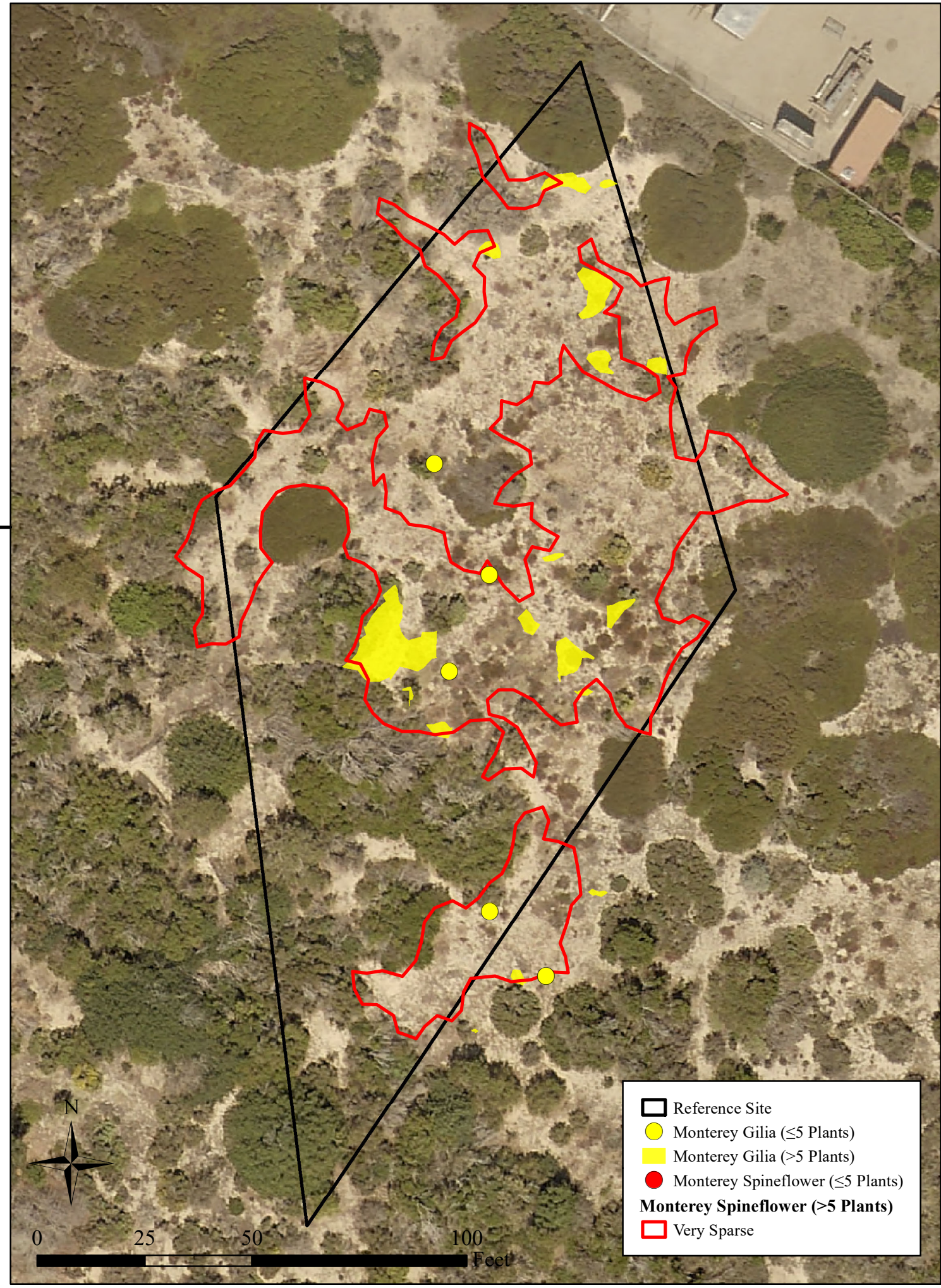
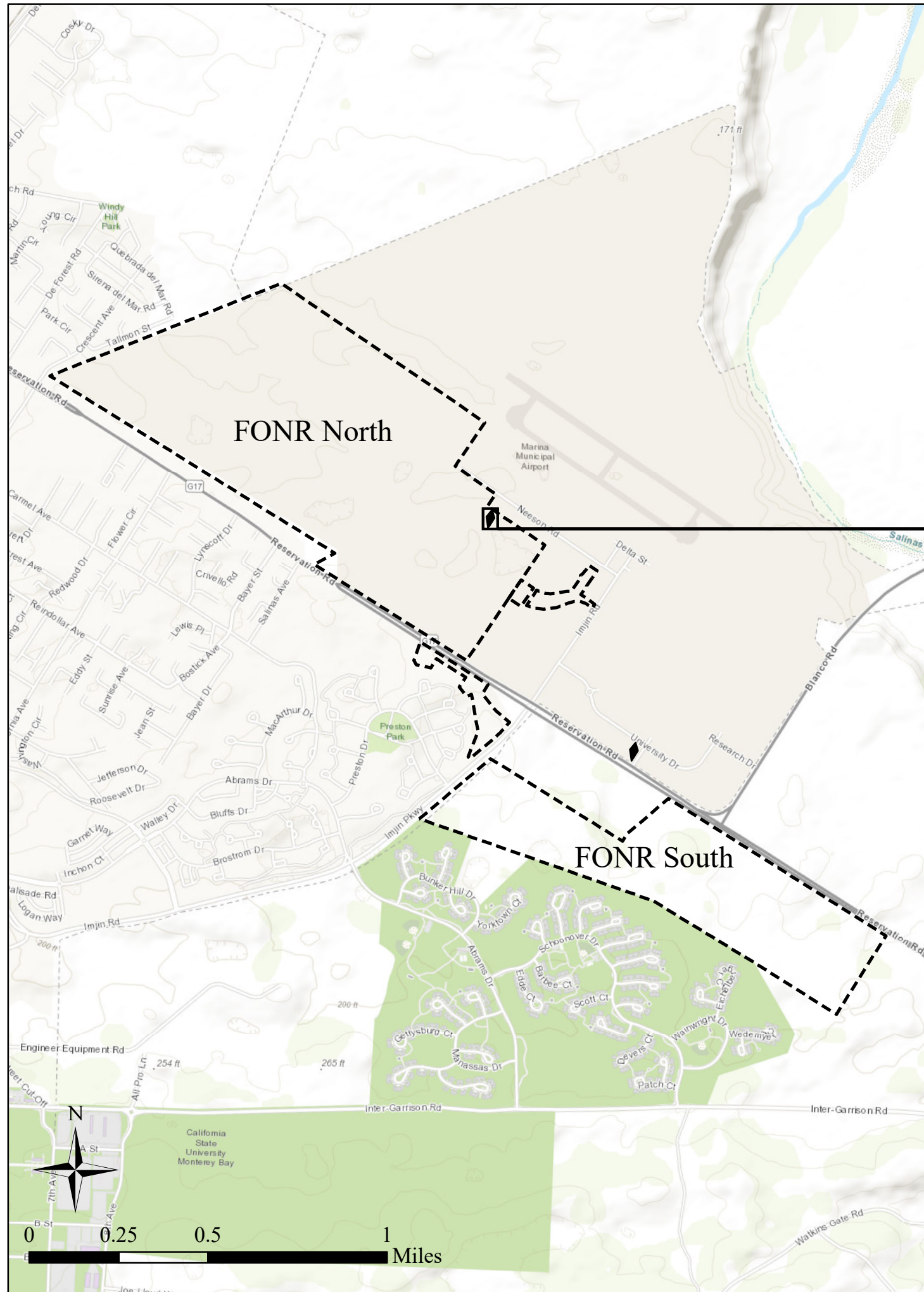
Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China

- Reference Site
- Monterey Gilia ( $\leq 5$  Plants)
- Monterey Gilia ( $> 5$  Plants)
- Monterey Spineflower ( $\leq 5$  Plants)
- Monterey Spineflower ( $> 5$  Plants)
- Sparse
- Medium-Low





Figure 5. 2019 Reference Site 2 Survey Results



## 2.3 2019 SURVEY RESULTS

### 2.3.1 2019 YEAR 3 FOLLOW-UP SURVEY RESULTS – EISB SURVEY AREA

DD&A conducted the Year 3 survey for Monterey spineflower, Monterey gilia, and Yadon’s piperia within the EISB survey area on April 29 and May 10, 2019 (Figure 2). Attachment B includes a map of the survey results within the EISB survey area.

#### 2.3.1.1 MONTEREY SPINEFLOWER

In 2019, 188 populations of Monterey spineflower (30,203 ft<sup>2</sup> of polygons and 109 points) were identified in the EISB survey area. Monterey spineflower was found at fifteen of the twenty well locations (EW-BW-160-A, EW-BW-161-A, EW-BW-164-A, EW-BW-165-A, EW-BW-166-A, EW-BW-168-A, EW-BW-169-A, IW-BW-159-A, IW-BW-160-A, IW-BW-161-A, IW-BW-162-A, IW-BW-163-A, IW-BW-165-A, IW-BW-166-A, and IW-BW-168-A) and along access routes.

**Table 2.3.1.1 Monterey Spineflower at EISB Survey Area – Year 3 Survey Results**

**Polygon Density Class: Very Sparse (<3 percent cover), Sparse (3-25 percent cover), and Medium-Low (26-50 percent cover).**

Year	# of Populations	# of Points	# of Polygons	Polygons per Density Class			Total Area of Polygons (ft <sup>2</sup> )
				Very Sparse	Medium-Sparse	Low	
2019	188	109	79	16	53	8	30,203

#### 2.3.1.2 MONTEREY GILIA

In 2019, one (1) population of Monterey gilia (one [1] point, four [4] individuals) was identified in the EISB survey area. The gilia population was found at well EW-BW-169-A.

#### 2.3.1.1 YADON’S PIPERIA

In 2019, DD&A surveyed for piperia within the EISB survey area. No piperia basal rosettes were observed.

### 3 DISCUSSION

#### 3.1 RARE PLANT POPULATIONS

As required by the PBO, baseline surveys are conducted prior to a disturbance due to groundwater remediation effort and for three years after. Disturbance is considered activities related to installation or decommissioning of the monitoring wells or related infrastructure.

##### 3.1.1 REFERENCE SITE 1

###### 3.1.1.1 MONTEREY SPINEFLOWER

Table 3.1.1.1 below shows the survey results for Monterey spineflower at the Reference Site 1 for surveys conducted from 2010 to 2019. Between 2010 and 2019, the total area of Monterey spineflower polygons at Reference Site 1 fluctuated annually with increases and decreases as much as 89% and 60% respectively. Between 2016 and 2019, total area of Monterey spineflower decreased by approximately 30%. The density class of the polygons in 2018 and 2019 were on average lower than they had been in the first two years of surveys. Several environmental variables can influence the distribution and abundance of Monterey spineflower in a particular year (USFWS, 2002). During the 2017 survey effort, DD&A anecdotally observed that non-native invasive grasses were colonizing Reference Site 1 more aggressively than previous years. The abundance of non-native invasive grass species resulted in a reduction of open space. The reduction in open space lowers the quality of habitat for Monterey spineflower. This does not necessarily disqualify this site as a compatible reference site for the EISB survey area since the majority of the EISB survey area is also dominated by non-native grasses and the influence of non-native invasive grasses is only one of several environmental variables that can influence Monterey spineflower populations.

**Table 3.1.1.1 Monterey Spineflower Population at Reference Site 1 2010 - 2019**

**Polygon Density Class: Very Sparse (<3 percent cover), Sparse (3-25 percent cover), Medium-Low (26-50 percent cover), and Medium (51-75 percent cover).**

Year	# of Populations	# of Points	# of Polygons	Polygons per Density Class						Total Area of Polygons (ft <sup>2</sup> )	Area Percent Change
				Very Sparse	Sparse	Medium-Low	Medium	Medium-High	High		
2010	2	0	2	1	0	1	0	0	2,846	N/A	
2011	1	0	1	0	1	0	0	0	2,865	1%	
2012	3	1	2	0	2	0	0	0	1,494	-48%	
2013	7	0	7	0	6	1	0	0	2,813	88%	
2014	7	1	6	0	6	0	0	0	1,119	-60%	
2015	4	1	3	0	1	1	1	0	2,114	89%	
2016	2	0	2	0	0	1	1	0	3,241	53%	
2017	4	0	4	0	3	1	0	0	2,855	-12%	
2018	5	2	3	1	2	0	0	0	3,078	8%	
2019	12	4	8	1	6	1	0	0	2,283	-26%	

### 3.1.1.2 MONTEREY GILIA

Table 3.1.1.2 below shows the survey results for Monterey gilia at Reference Site 1 for surveys conducted from 2010 to 2019. Within Reference Site 1, individual Monterey gilia plants numbers fluctuated annually by as much as 1,011% (2014 to 2015). Between 2016 and 2017, Reference Site 1 showed a decrease in the number of individual Monterey gilia plants from 946 to 463; however, the total area of the polygons increased (452 ft<sup>2</sup>, approximately 30%). Between 2017 and 2018, the number of individual gilia plants once again decreased from 463 to 352 individuals, or approximately 24%, and the total area of gilia polygons decreased substantially from 1,950 ft<sup>2</sup> to 481 ft<sup>2</sup>, or approximately 75%. Between 2018 and 2019, the number of individual gilia plants increased from 352 to 3,065 individuals, or approximately 771%, and the total area of gilia polygons increased from 481 ft<sup>2</sup> to 717 ft<sup>2</sup>, or approximately 49%. Several environmental variables can influence the distribution and abundance of Monterey gilia in a particular year (USFWS, 2008). The 2018/19 rain year (October 2018-March 2019) was above average when compared to normal for the NOAA Monterey Weather Station (NOAA 2019). The normal precipitation for that period is 18.49 inches (in), during the same period in 2018/19 the Monterey Weather Station received 19.08 in of precipitation. Approximately 40% of the precipitation occurred in February (7.75 in), which is almost double the normal precipitation (3.92 in) observed in February historically. Over half of the precipitation observed (4.76 in) in February occurred within the first ten (10) days<sup>4</sup>. Following this large storm event, the maximum temperature on February 12, 13, and 14 exceeded the normal maximum by 0.5°, 11.5°, and 8.4° F, respectively. Population fluctuations have been shown to correlate with the temperature after the first major storm event of the season, a germination cue for annual plants (Levine et al. 2008). This specific weather pattern may have influenced the 771% increase in Monterey gilia individuals observed at Reference Site 1, between 2018 and 2019. As mentioned above, in 2017 DD&A anecdotally observed that non-native invasive grasses were colonizing previously open areas within the Reference Site 1 more aggressively than previous years. While not as abundant in 2019, non-native grasses within Reference Site 1 were observed within areas that were previously, in surveys prior to 2017, sparsely vegetated (with non-native grasses).

**Table 3.1.1.2 Monterey Gilia at DD&A Reference Site 1 2010 - 2019**

<b>Year</b>	<b># of Populations</b>	<b>Individual Plants</b>	<b># of Points</b>	<b># of Polygons</b>	<b>Total Area of Polygons (ft<sup>2</sup>)</b>	<b>Area Percent Change</b>	<b>Individual Percent Change</b>
2010	14	1,086	7	7	1,715	N/A	N/A
2011	16	318	4	12	1,410	-18%	-71%
2012	16	70	12	4	210	-85%	-78%
2013	20	736	7	13	1,281	511%	951%
2014	4	97	2	2	370	-71%	-87%
2015	11	1,078	4	7	1,512	309%	1011%
2016	12	1,090	6	3	1,964	30%	1%
2017	8	463	6	2	1,950	-1%	-58%
2018	21	352	8	13	481	-75%	-24%
2019	18	3,065	8	10	717	49%	771%

<sup>4</sup> When January 30 and 31 is included the total precipitation is 5.54".

### 3.1.2 YEAR 3 FOLLOW-UP SURVEY 2019 – EISB SURVEY AREA

The 2019 survey effort represented the last of three annual surveys, required by the PBO, following the disturbance within the EISB survey area where construction activities associated with the groundwater remediation occurred in 2016.

#### 3.1.2.1 MONTEREY SPINEFLOWER

As stated in Section 2.3.1.1, 188 populations (109 points and 79 polygons) of Monterey spineflower were identified in 2019 within the EISB survey area. Of the polygons mapped in 2019, the majority (53 polygons) were identified as having a density class of sparse (5-25 percent cover of Monterey spineflower). The total area of Monterey spineflower polygons decreased from 117,397 ft<sup>2</sup> in 2016 to 89,649 ft<sup>2</sup> in 2017, then to 72,816 ft<sup>2</sup> in 2018, and finally to 30,203 ft<sup>2</sup> in 2019 (Table 3.1.2.1). Decreases of approximately 24%, 19%, and 59%, respectively. The total area of Monterey spineflower polygons has decreased by approximately 75% since the baseline survey in 2016.

**Table 3.1.2.1 Monterey Spineflower within the EISB Survey Area 2016 - 2019**

**Polygon Density Class: Very Sparse (3-25 percent cover), Sparse (5-25 percent cover), Medium-Low (26-50 percent cover), and Medium (51-75 percent cover).**

Year	# of Populations	# of Points	Polygons per Density Class				Total Area of Polygon	Area Percent Change
			Very Sparse	Sparse	Medium-Low	Medium		
2016	76	22	0	39	12	3	117,397	N/A
2017	62	31	0	26	5	0	89,649	-24%
2018	104	58	2	34	10	0	72,816	-19%
2019	188	109	16	53	8	2	30,203	-59%

As mentioned above, several environmental variables can influence the distribution and abundance of Monterey spineflower in a particular year. Some combination of these environmental variables is likely responsible for the decrease in Monterey spineflower populations observed at the EISB survey area from 2016-2019. A decrease in total area of polygons was observed during all three annual survey efforts. A decrease in total area of Monterey spineflower was observed at both the EISB survey area and Reference Site 1 when compared to the baseline survey.

If the results of the survey are limited to the boundaries of the EISB deployment area<sup>5</sup>, the total area of Monterey spineflower polygons was approximately 52,188 ft<sup>2</sup> in 2016, prior to EISB deployment. This is approximately 44% of the total documented area of Monterey spineflower polygons. In 2017 the total area of Monterey spineflower polygons just within the boundaries of the EISB deployment area was 73,973 ft<sup>2</sup>, following EISB deployment, which represents approximately 83% of the total documented area of Monterey spineflower polygons. The change amounts to approximately 42% increase in Monterey spineflower area following the vegetation removal associated with the installation of EISB components. This increase is in contrast to the total area of Monterey spineflower documented using the established methodology. It has been

<sup>5</sup> As opposed to the methodology described above which includes continuing to collect Monterey spineflower populations when they exceed the boundaries of the survey area as long as the distance between individuals does not exceed 3 feet.

suggested that Ben Lomond spineflower (*Chorizanthe pungens* var. *hartwegiana*), a species closely related to Monterey spineflower, benefits from soil disturbance in both density and fecundity (McGraw 2004). Experimental manipulations conducted by McGraw (2004) revealed the removal of leaf litter and reduction of exotic plant density, increased spineflower performance.

In March of 2016, the Monterey weather station recorded 5.16” of precipitation, approximately 3.67” above average in March (1.49”) (National Weather Service 2019). The disturbance associated with the installation and the greater than average spring rainfall are two environmental variables that could have positively affected Monterey spineflower populations at EISB Deployment Area 3A in 2016, resulting in a relatively high baseline for Monterey spineflower within EISB Deployment Area 3A. Between 2010 and 2019, Monterey spineflower area was greatest in 2016 at Reference Site 1 (Table 3.1.1.1; HGL 2018). This suggests that although Monterey spineflower populations within EISB Deployment Area 3A have decreased, they are still within the normal range.

### 3.1.2.2 MONTEREY GILIA

As stated in Section 2.3.1.2, one (1) population of Monterey gilia (1 point, 4 individuals) was identified in the EISB survey area in 2019, at well location EW-BW-169-A. Between 2016 and 2019, the number of individual plants observed within the EISB survey area decreased from thirty-six (36) to four (4). The Monterey gilia population was observed along an access route and was not associated with a well location during the 2016 or 2017 survey effort. Monterey gilia was not found within fifty (50) feet of any well locations or on access roads connecting well locations in 2018.

**Table 3.1.2.2 Monterey Gilia within the EISB Survey Area 2016 - 2019**

Year	# of Populations	Individual Plants	Indiv. Plant	# of Points	# of Polygons	Area of Polygons (ft <sup>2</sup> )	Area Percent Change
			Percent Change				
2016	1	36	N/A	0	1	84	N/A
2017	1	7	-81%	0	1	29	-65%
2018	0	0	-100%	0	0	0	-100%
2019	1	4	400%	1	0	0	N/A

As mentioned above, several environmental variables can influence the distribution and abundance of Monterey gilia in a particular year. Some combination of these variables is likely responsible for the decreased Monterey gilia populations observed at the EISB survey area. The pattern of Monterey gilia population fluctuation at EISB Deployment Area 3A was similar to Reference Site 1, where after a sharp decline in 2018 the population increased in 2019, although not nearly as dramatically as it did at Reference Site 1. Because of the small sample size of Monterey gilia observed in the EISB survey area, any changes to the populations within this population result in large percent change of the total population.

## 4 CONCLUSION AND RECOMMENDATIONS

In 2019, Monterey spineflower was present throughout the EISB survey area and both reference sites. Monterey gilia was identified at one (1) well within the EISB survey area and both reference sites. The populations of Monterey gilia and Monterey spineflower observed in 2019 within the EISB survey area were less than those observed in the 2016 baseline survey. Monterey spineflower populations also decreased at Reference Site 1 when compared to the 2016 survey. Conversely Monterey gilia plants increased from 2016 to 2019 at Reference Site 1. Survey data from 2010 to 2019 at Reference Site 1 have shown large fluctuations in both directions for both Monterey spineflower and Monterey gilia populations (Tables 3.1.1.1 and 3.1.1.2). Additionally, because of the low population count in the EISB survey area, any increase in Monterey gilia population would have a dramatic effect on percent increase and is not necessarily a reliable indicator of overall population change. No piperia rosettes were identified in 2019.

This was the third and final survey for the EISB survey area. As required by the 2017 PBO, following the third monitoring event an evaluation of the success criteria is applied to determine if criteria have been met or if additional corrective actions are necessary. The success criteria for HMP annual species are identified in the 2017 PBO as:

1. *Densities and acreage of HMP annual species are within normal range compared with information from reference sites.*
2. *The number of wells where HMP annual species are detected in follow-up surveys will be the same or greater than the number of wells where these species were found in baseline surveys.*

### 4.1 SUCCESS CRITERIA 1

#### 4.1.1 MONTEREY SPINEFLOWER

Monterey spineflower total area has decreased (-74%) since the 2016 baseline survey in the EISB survey area (Table 4.1.1). Monterey spineflower total area has decreased (-30%) since 2016 at Reference Site 1. Several environmental factors, some of which have been discussed above, contribute to the germination and fecundity of Monterey spineflower in any given year. A review of surveys conducted at Reference Site 1 from 2010 to 2019 (Table 3.1.1.1) show populations fluctuations as large as 89%, suggesting that, although when compared to baseline the total area of Monterey spineflower within the EISB survey area decreased by a larger percentage than at Reference Site 1, it is not outside of the normal range.

**Table 4.1.1 Monterey Spineflower EISB Survey Area 2016 & 2019**

Year	# of Populations	# of Points	Polygons per Density Class				Total Area of Polygon	Area Percent Change
			Very Sparse	Sparse	Medium-Low	Medium		
2016	76	22	0	39	12	3	117,397	N/A
2019	188	109	16	53	8	2	30,203	-74%

#### 4.1.2 MONTEREY GILIA

Monterey gilia individual plants have decreased since the 2016 baseline survey in the EISB survey area (Table 4.1.2). Monterey gilia individuals have increased since the 2016 baseline survey at Reference Site 1. From 2010 to 2019 at Reference Site 1 (Table 3.1.1.2), Monterey gilia individual counts have fluctuated drastically with increases as much as 1,011% and decreases as much as 94%. This documented variation in Monterey gilia populations suggests that the decrease observed within the EISB survey area is within the normal range for this species. Additionally, the size of the Monterey gilia population within the EISB survey area is relatively small. The margin of error from a relatively small sample size limits the ability to glean any meaningful analysis. Therefore, the mere persistence of this population suggests a successful application of protective measures during groundwater remediation activities, regardless of whether the decrease in total individuals is within a normal range. Recommendations have been suggested below to ensure that this population persists during ongoing groundwater remediation activities.

**Table 4.1.2 Monterey Gilia EISB Survey Area 2016 & 2019**

<b>Year</b>	<b># of Populations</b>	<b>Individual Plants</b>	<b>Indiv. Plant Percent Change</b>	<b># of Points</b>	<b># of Polygons</b>	<b>Area of Polygons (ft<sup>2</sup>)</b>	<b>Area Percent Change</b>
2016	1	36	N/A	0	1	84	N/A
2019	1	4	-89%	1	0	0	N/A

## 4.2 SUCCESS CRITERIA 2

#### 4.2.1 MONTEREY SPINEFLOWER

Monterey spineflower was found at fourteen of the twenty well locations (Table 4.2.1) in 2016 during the baseline survey. In 2019, Monterey spineflower was found at fifteen of the twenty well locations (Table 4.2.1). The number of wells where Monterey spineflower was detected increased when compared to baseline surveys. Therefore, success criteria 2 from the PBO for groundwater remediation activities has been met.

**Table 4.2.1 Monterey Spineflower Detected at EISB Well Locations 2016 & 2019**

	<b>EW-BW</b>									
	<b>160-A</b>	<b>161-A</b>	<b>162-A</b>	<b>163-A</b>	<b>164-A</b>	<b>165-A</b>	<b>166-A</b>	<b>167-A</b>	<b>168-A</b>	<b>169-A</b>
2016	Y	Y	Y	N	Y	Y	N	Y	Y	Y
2019	Y	Y	N	N	Y	Y	Y	N	Y	Y
	<b>IW-BW</b>									
	<b>159-A</b>	<b>160-A</b>	<b>161-A</b>	<b>162-A</b>	<b>163-A</b>	<b>164-A</b>	<b>165-A</b>	<b>166-A</b>	<b>167-A</b>	<b>168-A</b>
2016	Y	Y	Y	Y	Y	N	Y	N	N	N
2019	Y	Y	Y	Y	Y	N	Y	Y	N	Y



#### **4.2.2 MONTEREY GILIA**

In 2016, Monterey gilia was not observed within 50 feet any of the well locations, but it was observed on the access route in between IW-BW-166-A and IW-BW-160-A. In 2019, Monterey gilia was identified at well EW-BW-169-A. The number of wells where Monterey gilia was detected increased when compared to baseline surveys. Therefore, success criteria 2 from the PBO for groundwater remediation activities has been met.

#### **4.3 RECOMMENDATIONS**

To ensure the persistence of Monterey gilia located within EISB Deployment Area 3A, avoidance materials should be installed to deter well monitoring personnel from disturbing the seedbank location. Well monitoring for the OUCTP involves driving or walking to the monitoring well location and collecting a water level measurement and groundwater samples from the well using passive diffusion bags. To reduce the number of potential impacts to seedbank of rare annual plants or actual individuals of rare annual plants during the blooming period, walking would be the preferred method to access the monitoring well locations from the main thoroughfares whenever possible. To reduce the potential for impacts to rare annual plant species seed banks located along the main access roads, it is recommended that vehicle traffic be limited to the minimum necessary to conduct groundwater remediation activities, and vehicle speeds should remain under 15 miles per hour. Four-wheel or all-wheel drive vehicles should be employed to conduct groundwater remediation activities to reduce the likelihood of vehicles becoming stuck and causing excess erosion. Coordination for the avoidance of UCSC study plots should continue with FONR staff and the BRAC Biologist. Habitat checklists and tailgate meetings with the on-site biologists and drilling personnel prior to mobilization at each well location will ensure that drilling equipment is placed to avoid HMP species to the greatest extent possible.

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## 5 REFERENCES

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<sup>6</sup> Attachment F to the Final Operable Unit Carbon Tetrachloride Plume Evaluation Technical Memorandum, A-Aquifer, Former Fort Ord, California. January 2016. Administrative Record Series Number [OUCTP-0070](#).

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ATTACHMENT A  
2016 HABITAT CHECKLIST

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- No pets, firearms, or hunting are allowed.
- No fires are allowed. Report any smoke or open flame immediately to the Ahtna Field Supervisor. Keep firefighting equipment in good operating order and readily available.
- Clean up and report all hazardous material spills immediately.
- Do not discharge any water or drill cuttings into unapproved areas.
- Holes and trenches left at the end of each work day should be covered or escape ramps shall be built to allow wildlife to exit.
- Report trapped, injured, or dead wildlife to the Ahtna Biologist.
- Keep all equipment either in approved work areas or travel corridors, or in approved staging/storage areas.
- Keep fluid spill containment and clean up materials readily available.

<b>4. VERNAL POOLS/PONDS PRESENT</b>		<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Flagged/Marked
<b>Location:</b>				
<b>Grid Numbers:</b>				
<b>Work Can Proceed in Pools/Ponds:</b>		<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	
<b>Restrictions:</b>				

<b>5. VEGETATION REMOVAL</b>	
<input type="checkbox"/> No Removal Needed	<b>Location:</b>
<input type="checkbox"/> Manual Removal Needed	<b>Location:</b>
<input checked="" type="checkbox"/> Mechanical Removal Needed	<b>Location:</b> All secondary access routes and proposed well locations.
<b>Vegetation Removal Restrictions:</b>	
<ul style="list-style-type: none"> <li>▪ Keep trimming/removal of vegetation to the minimum necessary to complete well installation.</li> <li>▪ Delineate area to be mowed prior to vegetation removal.</li> </ul>	


<b>6. EROSION CONCERNS/SITE RESTORATION:</b>
<ul style="list-style-type: none"> <li>▪ Following the well installation activities, disturbed land around the wells will be restored as closely as possible to its original condition by limited grading after coordination with the BRAC Biologist.</li> </ul>


<b>7. SITE ACCESS:</b>
<ul style="list-style-type: none"> <li>▪ FONR access should be limited to the gate adjacent to Reservation Road.</li> <li>▪ Access to work areas shall be along approved travel corridors.</li> </ul>


<b>8. INVASIVE SPECIES:</b>
<ul style="list-style-type: none"> <li>▪ All equipment coming from off-site must be pressure washed prior to entering FONR to reduce the potential to spread non-native invasive plant species.</li> </ul>

<b>9. ADDITIONAL SITE CONCERNS:</b>
<ul style="list-style-type: none"> <li>▪ Matting to reduce the level of soil disturbance may be required to access some of the well installation locations.</li> </ul>

**This checklist has been read, approved, and signed by the following:**

DDA Biologist:  Date: 7-25-2016

Ahtna Project Manager:  Date: 7/27/2016

Ahtna Field Supervisor:  Date: 7/27/2016

KOWALSKI.BARTHOLOMEW.L.1387978115

Digitally signed by KOWALSKI.BARTHOLOMEW.L.1387978115  
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=CONTRACTOR,  
cn=KOWALSKI.BARTHOLOMEW.L.1387978115  
Date: 2016.07.27 09:42:31 -0700

**BRAC Biologist:** \_\_\_\_\_ **Date:** \_\_\_\_\_



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ATTACHMENT B

2019 ANNUAL RARE PLANT SURVEY RESULTS  
OVERVIEW AND DETAIL MAPS

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2

1

1

3

2

3

Reservation Rd

EW-BW-164-A

EW-BW-163-A

EW-BW-165-A

EW-BW-167-A

EW-BW-166-A

IW-BW-168-A

EW-BW-162-A

IW-BW-167-A

EW-BW-168-A

EW-BW-160-A

IW-BW-163-A

IW-BW-166-A

IW-BW-165-A

IW-BW-164-A

EW-BW-169-A

EW-BW-161-A

IW-BW-162-A

IW-BW-161-A

IW-BW-160-A

IW-BW-159-A

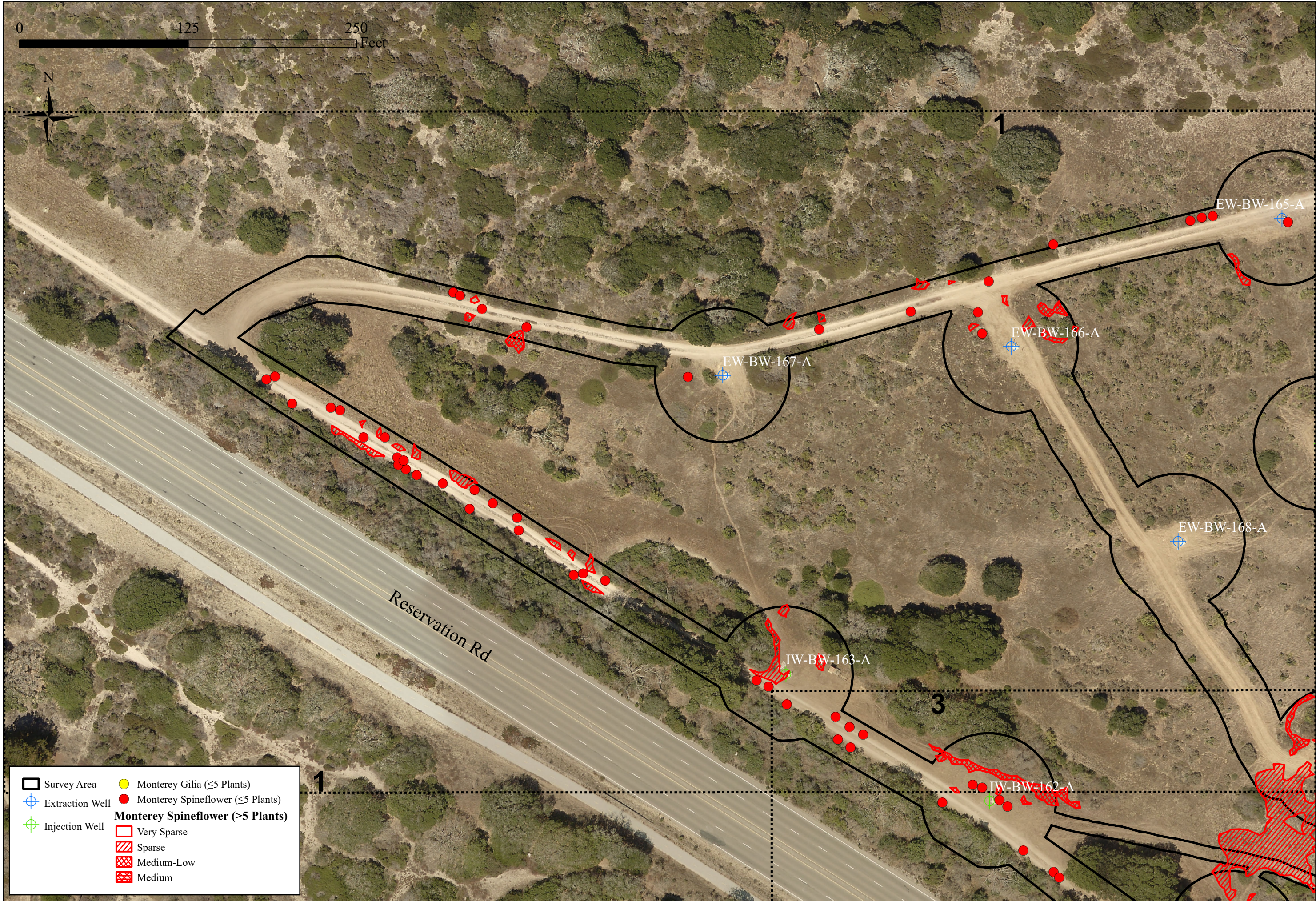
	Extraction Well		Monterey Gilia ( $\leq 5$ Plants)
	Injection Well		Monterey Spineflower ( $\leq 5$ Plants)
	Survey Area	<b>Monterey Spineflower (<math>&gt; 5</math> Plants)</b>	
			Very Sparse
			Sparse
			Medium-Low
			Medium



Attachment B. 2019 Rare Plant Survey Results Overview and Details Map



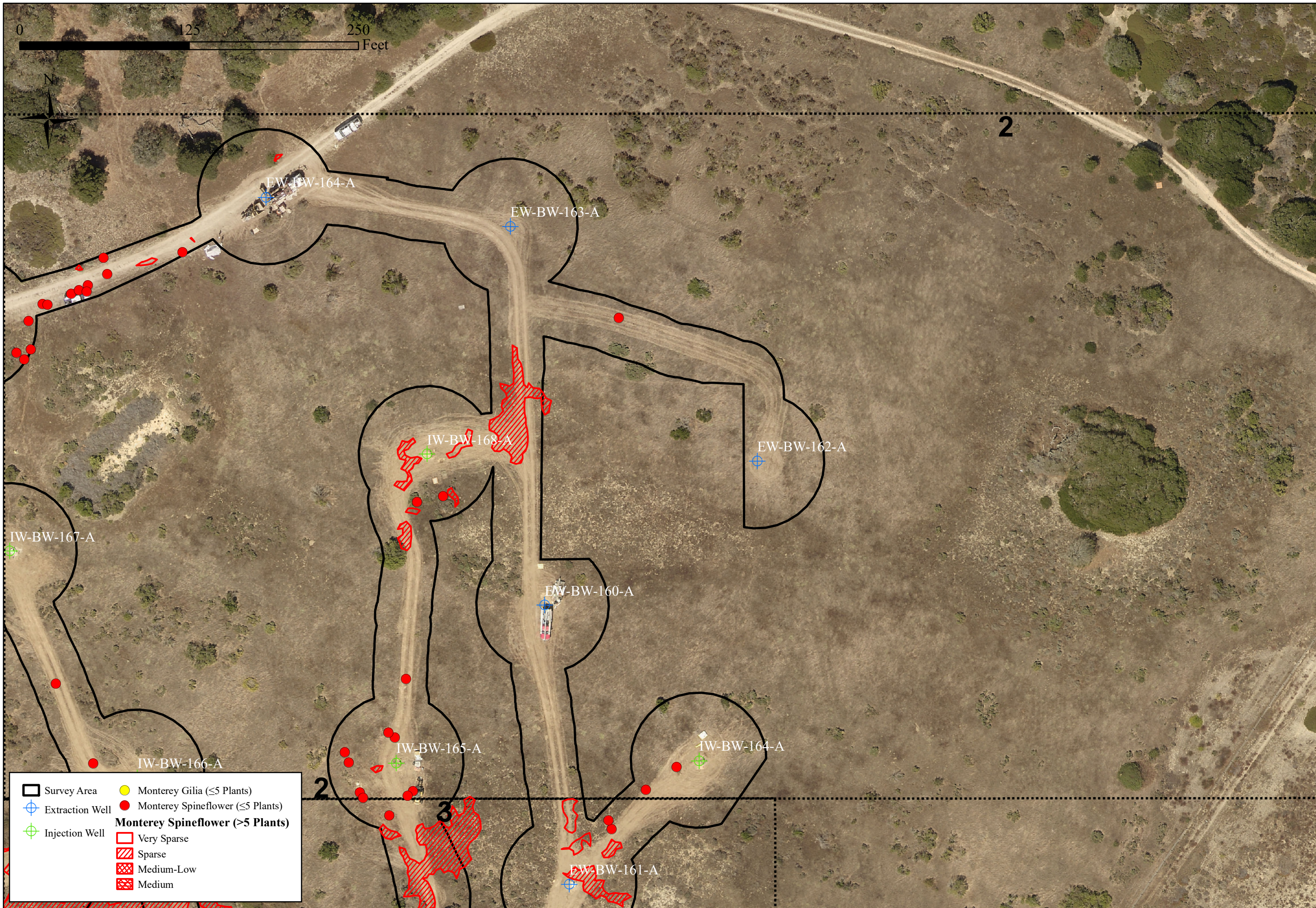
# Attachment B. 2019 Rare Plant Survey Results Overview and Details Map



	Survey Area		Monterey Gilia (≤5 Plants)
	Extraction Well		Monterey Spineflower (≤5 Plants)
	Injection Well	<b>Monterey Spineflower (&gt;5 Plants)</b>	
			Very Sparse
			Sparse
			Medium-Low
			Medium



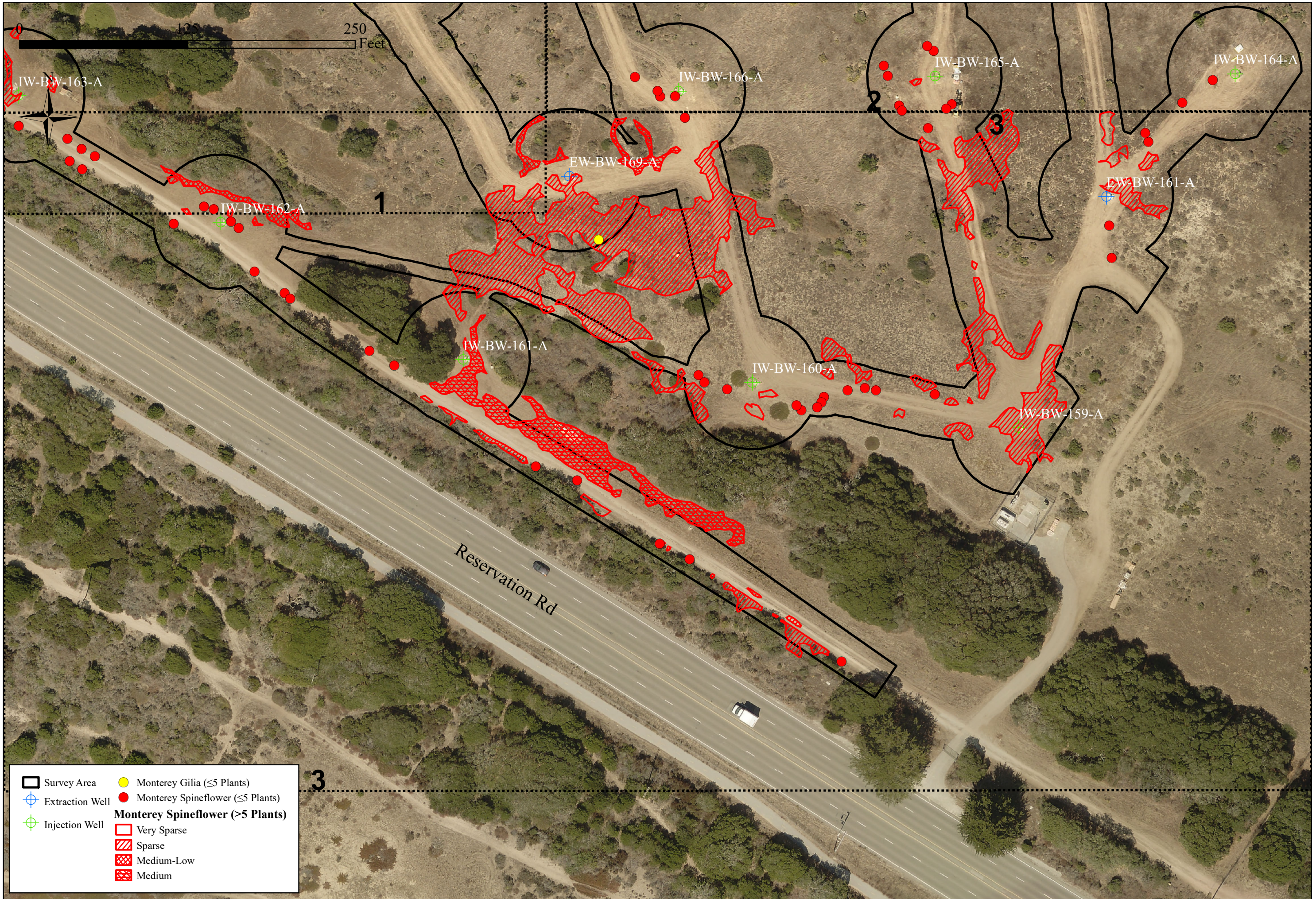
# Attachment B. 2019 Rare Plant Survey Results Overview and Details Map



Survey Area	Monterey Gilia ( $\leq 5$ Plants)
Extraction Well	Monterey Spineflower ( $\leq 5$ Plants)
Injection Well	<b>Monterey Spineflower (<math>&gt; 5</math> Plants)</b>
	Very Sparse
	Sparse
	Medium-Low
	Medium



# Attachment B. 2019 Rare Plant Survey Results Overview and Details Map



	Survey Area		Monterey Gilia ( $\leq 5$ Plants)
	Extraction Well		Monterey Spineflower ( $\leq 5$ Plants)
	Injection Well	<b>Monterey Spineflower (<math>&gt; 5</math> Plants)</b>	
			Very Sparse
			Sparse
			Medium-Low
			Medium

