A CONSERVATION MANAGEMENT STRATEGY

FOR NINE LOW ELEVATION RARE PLANTS

IN CLARK COUNTY, NEVADA


Photo of Mud Hills courtesy of Jan Nachlinger

THE NATURE CONSERVANCY
NEVADA FIELD OFFICE
RENO, NEVADA

FINAL REPORT
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The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

LOW ELEVATION RARE PLANT CONSERVATION MANAGEMENT STRATEGY
CLARK COUNTY, NEVADA

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Executive Summary

Low elevation landscapes in the Mojave Desert harbor numerous rare plant species covered under the Clark County Multiple Species Habitat Conservation Plan (MSHCP). Lower elevations in the County, whether public or private land, also receive enormous pressure from direct and indirect effects of human growth including loss, degradation, and fragmentation of habitat for rare plant species. Nine low elevation rare plants and their habitats were in need of a conservation management strategy (CMS) to meet goals of the MSHCP and secure greater likelihood of their long term persistence. This low elevation rare plant CMS:

- addresses sticky ringstem, Las Vegas bearpoppy, white bearpoppy, threecorner milkvetch, alkali mariposa lily, Pahrump Valley wild buckwheat, sticky wild buckwheat, white-margined beardtongue, and Parish phacelia (*Anulocaulis leiosolenus* var. *leiosolenus, Arctomecon californica, A. merriamii, Astragalus geyeri* var. *triquetrus, Calochortus striatus, Eriogonum bifurcatum, E. viscidulum, Penstemon albomarginatus,* and *Phacelia parishii*);
- reviews the literature and existing information on the biology and ecology of the nine rare plants and their habitats within the context of their global distributions;
- summarizes population viabilities and threats to the plants and their habitats, and links both to specific altered ecological attributes;
- reviews current management status across land ownerships;
- identifies conservation strategies in Clark County and adjacent areas with explicit outcomes and actions needed to improve long term plant viability and reduce critical threats;
- identifies priorities to accomplish the conservation strategy and MSHCP goals; and
- outlines a monitoring framework and an implementation plan using adaptive management.

None of the nine low elevation plant species as currently understood is endemic to Clark County, nor to Nevada. However, three have global distributions nearly confined to Clark County (Las Vegas bearpoppy, threecorner milkvetch, and sticky wild buckwheat), while Pahrump Valley wild buckwheat has a narrow distribution confined to the western boundary of the County and state line. Three other species exhibit global distributions centered on Clark County, although they extend well beyond it (white bearpoppy, white-margined beardtongue, and Parish phacelia). The remaining two species— sticky ringstem and alkali mariposa lily—have peripheral distributions in Clark County with the majority of their ranges far beyond it to the east and west, respectively. The taxonomic distinctiveness of two species, sticky ringstem and Las Vegas bearpoppy, is currently in question and their potentially revised interpretations may uniquely distinguish Clark County populations from those occurring further east.

The specific lower elevation habitats of these nine plant taxa are varied. Sticky ringstem and Las Vegas bearpoppy are essentially restricted to gypsum soils. White bearpoppy often occurs on gypsum soils, while also occurring occasionally on calcareous substrates. Three taxa—threecorner milkvetch, sticky wild buckwheat, and white-margined beardtongue—preferentially occur on sandy substrates comprising dunes and semi-stabilized sand sheets. The three remaining species occupy habitats where surface water and groundwater primarily control plant distribution and abundance. Margins of seasonally wet playas and open interstitial areas of adjacent desert scrub with fine textured soils are the typical habitats for Pahrump Valley wild buckwheat and Parish phacelia, while alkaline meadows associated with desert springs and seeps are the definitive habitat for alkali mariposa lily.

Las Vegas bearpoppy, and white bearpoppy by taxonomic association, have received the greatest relative biological and ecological research attention in the past. Many of the past studies concentrate on life history dynamics, genetics, reproductive biology, and their gypsum environments. White-margined beardtongue and alkali mariposa lily have benefited from just a few studies on genetics, life history, or reproductive biology. By and large their remains much uncertainty regarding habitat and ecological reproductive biology. By and large their remains much uncertainty regarding habitat and ecological system dynamics, population biology and genetics, biological and ecological thresholds, and definitive distributions (*e.g.* acreages/minimum dynamic area) for all nine plants. Important management questions, such as effective restoration techniques, need to be addressed with appropriately designed monitoring projects. Regardless, preliminary conceptual models for each species were developed with available information and can be improved over time through the adaptive management process.

Most populations of the nine rare plants in Clark County are managed by BLM (85%), NPS (3%), or are privately owned (10%). They primarily occur on multiple use land (MUMA=42%), followed by intensively managed areas (IMA=36%), then privately held land (UMA=10%) or occurring beyond Clark County (no MSHCP category=9%). The majority (n=41 or 66%) of rare plant population groups occurring on Federal lands in Clark County currently are assessed with fair overall viability based on defined indicators of size, condition, and landscape context (ecological processes and connectivity). Those population groups include all on Federal lands in Clark County for sticky ringstem, threecorner milkvetch, sticky wild buckwheat, and alkali mariposa lily, and a few for Las Vegas bearpoppy and white-margined beardtongue. The remaining (n=21 or 34%) population groups are assessed with good overall viability rankings, including all of those for white bearpoppy and Parish phacelia, and most of the population groups for Las Vegas bearpoppy and white-margined beardtongue. The population groups that largely occur on private lands in Clark County have fair to poor overall viability rankings. Reduced viabilities for rare plants are mainly because of habitat loss and fragmentation, or impairment of habitat condition, followed by alteration of several ecological processes necessary to maintain the varied habitats. Sources of the altered key ecological attributes (*i.e.* threats), in diminishing order, include casual OHV use, weeds, rural development, land disposal, fire, utility corridor and rights-of-way development, highway and road development, agricultural practices, military activities, Lake Mead inundation, gypsum mining, and commercial development. Both current and potential threats within the next ten years were considered for the relative rankings based on severity, scope, contribution, and reversibility. Viability and threat rankings are provided for population groups across MSHCP management categories for each species in the report.

The goal of the low elevation rare plant CMS is to provide a suite of priority conservation actions within an adaptive framework, which if successfully implemented would ensure long term viability of the nine plants and their habitats. We developed nineteen measurable objectives supported by strategic actions and action steps collectively designed to provide a protected conservation network on Federal lands, reduce existing and potential threats to the rare plants and their habitats, and improve current indicators of viability for populations of the nine rare plants. The first overarching proactive objective is a conservation strategy to protect and manage 21 core rare plant areas in Clark County under the scope of the MSHCP (with an additional nine areas recommended for action by others to address three species with limited opportunity for protection under the Clark County MSHCP). Thirteen multi-species and multi-site objectives address their critical threats while five additional objectives focus on single species issues (including two objectives for rare plant population groups either in Nye County or on Department of Defense jurisdiction). Conservation objectives, ordered by their expected conservation impact are:

1: Proactively protect and manage for long term viability of all populations of nine MSHCP covered rare plants on Federal lands (IMAs, LIMAs, MUMAs, and UMAs as appropriate) in Clark County;
2: Manage viable populations of sticky ringstem, LV bearpoppy, white bearpoppy, threecorner milkvetch, sticky wild buckwheat, white-margined beardtongue, Parish phacelia in IMAs, LIMAs and MUMAs by removing significant casual OHV impacts by 2020;
3: Control weeds in low elevation rare plant habitats in IMAs, LIMAs and MUMAs by

2020;
4: Ensure that long term viability of low elevation rare plants in IMAs, LIMAs and MUMAs is not significantly impacted by rural development and sprawl;
5: Ensure that disposal of Federal lands in Clark County will not significantly impact comprehensive conservation of low elevation rare plant populations;
6: Manage rare plants in sandy habitats in IMAs and MUMAs for long term viability by addressing altered fire regimes (increased fire frequency and intensity) over the next century;
7: Manage viable populations of all covered rare plants in utility corridors in IMAs and MUMAs (BLM lands), and within potential rights of way corridors at LMNRA;
8: Manage viable populations of LV bearpoppy, white bearpoppy, Pahrump Valley wild buckwheat, and white-margined beardtongue along Federal highways and county roads in MUMAs and Nye Co;
9: Manage populations of LV bearpoppy, white bearpoppy, and Parish phacelia at Nellis to ensure positive long term viability trend in IMAs, LIMAs and MUMAs within ten years;
10: Manage viable populations of alkali mariposa lily and white bearpoppy populations in LIMAs and MUMAs by removing wild horse and burro use and addressing impacts of rural sprawl by 2020;
11: Protect threecorner milkvetch and sticky wild buckwheat populations along Muddy and Virgin rivers in IMAs and MUMAs from significant agricultural impacts over the next fifty years;
12: Ensure conservation management for sticky wild buckwheat, threecorner milkvetch and LV bearpoppy populations at LMNRA (IMA) above high water line and manage populations below high water line during Lake Mead low water years;
13: Ensure gypsum mining will not significantly impact habitat of LV bearpoppy and sticky ringstem in IMAs and MUMAs by 2008;
14: Conserve LV bearpoppy's remaining genetic diversity in its western populations in Las Vegas Valley (MUMAs and UMAs) by 2015;
15: Ensure construction and maintenance of the Ivanpah Airport does not significantly impact viability of four white-margined beardtongue populations in MUMAs and county land in southern Clark County;
16: Ensure that disposal of Federal lands in Nye County will not significantly impact comprehensive conservation of Pahrump Valley wild buckwheat populations;
17: Ensure construction of the Mesquite Airport does not significantly impact viability of threecorner milkvetch and sticky wild buckwheat on public lands;
18: Alleviate loss of LV bearpoppy and habitat from BLM recreation management actions at Nellis (Las Vegas) Dunes; and,
19: Protect viable populations of sticky wild buckwheat in Gold Butte area (Lime Wash IMA populations) and Virgin River Dunes from trespass grazing and exotic plant impacts.

Indicators of key ecological attributes and direct measures of threat levels are identified for each objective to measure success of their associated strategic actions and action steps discussed in the CMS. To set priorities, 69 strategic actions were evaluated on several factors related to conservation benefits (threat abatement value, viability enhancement, contribution toward meeting objective, duration of outcome, leverage toward other strategies), feasibility (individual/institutional leadership, ease of implementation, ability to motivate), and overall cost. Based on the current assessment, the ten highest priority actions concentrate on the first three objectives (number and letter refer to objective and strategic action, respectively):

Proactive protection and management:
1.A. Designate specific rare plant populations for conservation management;
1.B. Coordinate MSHCP communications, funding, projects, monitoring, and adaptive management;
1.F. Continue botanical surveys on Federal lands;
1.H. Conduct research on pollinators; and,
1.I. Track cumulative loss of rare plant populations and habitats;

Removing significant casual OHV impacts:
2.B. Establish transportation network in MUMAs; and,
2.C. Maintain law enforcement in areas closed to OHVs;

Controlling weeds:
3.A. Identify weed treatment priorities for rare plant habitats;
3.B. Maintain weed mapping, early detection, and control program; and,
3.C. Coordinate weed treatments with other entities.

Specific areas to focus implementing strategic actions are summarized by population groups within the CMS. A large degree of conservation benefit to the nine rare plants and progress toward meeting goals of the low elevation rare plant CMS would be accomplished if Clark County Desert Conservation Program (DCP), cooperating agencies, and conservation partners initially focused efforts on funding and implementing these ten highest priority strategies. However, acknowledging that context can quickly change in the County because of its dynamic growth potential, a framework for evaluating priorities is provided to afford fresh rare plant situation analyses for future budget cycles. Strategic actions currently ranked third or lower priority levels may be ranked higher in future evaluations, particularly for single species strategies or where strong leadership roles for implementation are taken by agencies.

To ensure low elevation rare plant CMS accountability, the report includes recommendations for a monitoring framework to measure effectiveness of conservation actions and status monitoring of rare plant species and threats, as well as suggested components for useful monitoring plans. It concludes with an implementation framework grounded in adaptive management. The conservation planning and assessment process used in this CMS is applicable for other MSHCP covered and evaluation plant species, and a method for assessing conservation needs and potential inclusion of species not yet identified on these lists is outlined. Review and revision of the low elevation rare plant CMS is recommended after six years to coincide with three Clark County budget cycles.

INTRODUCTION

PURPOSE AND NEED

Clark County encompasses a large and biologically significant portion of the Mojave Desert where many rare plants, animals, and unique habitats are found. The county is Nevada's most populated and because its population continues to grow rapidly, humans are putting enormous pressure on the desert's natural systems and species, especially at lower elevations where the direct effects of human growth are greatest. There are several rare and sensitive plants that occur at lower elevations among Clark County's natural values. A conservation strategy is needed for these plants to secure their long term persistence within a growing human context and to ensure their contribution to quality of life in the County.

Conservation management strategies (CMSs[1]) are required for certain species covered by the permit issued under section 10(a) of the Endangered Species Act (ESA) of 1973, as amended, for the Clark County Multiple Species Habitat Conservation Plan (MSHCP). The strategies must identify management and monitoring actions required to ensure adequate conservation of covered species. To accomplish this, the County—acting through its MSHCP Implementation and Monitoring Committee—defined the purpose and need, and essential elements of a CMS. In addition to ensuring the conservation of species and their habitats to prevent future listings under the ESA, the strategies must carry out the conservation actions in an orderly, organized, and public fashion, as well as comply with permit conditions and meet the goals of the MSHCP. The key purposes of the MSHCP are to achieve a balance between:

- long-term conservation and recovery of the diversity of natural habitats and native species of plants and animals that make up an important part of the natural heritage of Clark County; and
- the orderly and beneficial use of land in order to promote the economy, health, well-being, and custom and culture of the growing population of Clark County (RECON 2000).

This CMS is designed to address rare species conservation needs within the context of a rapidly expanding urban environment and increased public use of the surrounding Federal landscape.
Of the 78 species covered under the MSCHP, 37 are vascular plants. Twenty of the 37 vascular plant species are addressed directly in a 1998 conservation agreement for the Spring Mountains National Recreation Area, while six more likely benefit from actions carried out for that conservation agreement (USDA Forest Service *et al.* 1998). Another covered plant species, the Blue Diamond cholla (*Opuntia whipplei* var. *multigeniculata)*, is addressed in its own species specific conservation agreement (USFWS 2000). Yet another, Red Rock Canyon aster (*Ionactis caelestis),* occurs only in a remote roadless section of Red Rock Canyon National Conservation Area, which was recently designated by Congress as the Rainbow Mountain Wilderness Area—so, although it is very restricted in distribution, its habitat has protective status and there are no current human threats to its long term viability.

In the process of permitting the MSHCP, the U.S. Fish and Wildlife Service (FWS) recognized that the nine remaining MSHCP covered vascular plants were not specifically the subject of any formal conservation management strategy or agreement. The permit thus required Clark County to develop a conservation management plan for these low elevation plant species. This low elevation rare plant CMS provides biological and other scientific information necessary to secure the conservation of nine rare plant species covered under Clark County's MSHCP. It reviews the literature and existing information on the biology and ecology of these plants and their habitats within the context of their global distributions. It reviews current management status across land ownerships. It summarizes population viabilities and threats to the plants and their habitats, and links both to specific altered ecological stresses. It identifies conservation strategies in Clark County and adjacent areas with explicit outcomes and actions needed to improve long term plant viability and reduce, if not eliminate, critical threats. Ultimately, the CMS

[1] See appendix 1 for a list of acronyms used in CMS.

identifies priorities to accomplish the strategy and MSHCP goals, outlines effectiveness monitoring, and an implementation plan, all within an adaptive management framework.

BACKGROUND, INVENTORY, AND ASSESSMENT

PLANNING AREA

Clark County is the southernmost of Nevada's counties, occupying approximately 7,900 square miles (20,500 square km, 5 million acres), comparable in size to Massachusetts. Its boundaries are mostly politically drawn, bordered by Lincoln County to the north, Nye County to the west, California (Inyo and San Bernardino counties) to the southwest, and Arizona (Mohave County) to the east. Only its southeastern boundary with Arizona is defined physiographically along the Colorado River. A Clark County planning area map for the low elevation rare plant CMS is depicted in figure 1 with shaded topography and place names.

All of Clark County lies within the Mojave Desert ecoregion, which is an ecologic and physiographic landscape interpretation defined by Bailey (1995) and modified by The Nature Conservancy (TNC 2001) for conservation planning purposes. The Mojave Desert differs from the Great Basin ecoregion to the north by its lower average elevations for basins and ranges, and its broader basins covered with vegetation characteristic of warmer climates. It sometimes is described as transitional from the cold, shrub-dominated Great Basin to the more southern hot Sonoran Desert.

Large variations in elevation, topography, geology, and climate across the eastern Mojave Desert—and Clark County—contribute to landscape and habitat diversity. Varied landscapes that have been subject to spatial isolation over time encourage ecosystem, plant community, species, and genetic diversity, and lead to unusual plant and animal distribution patterns, such as rarity and endemism (restricted distributions). Special habitats in Clark County that tend to harbor rare and unique species include alpine summits, limestone outcrops, sandstone cliffs, gypsum barrens, sand dunes and sand sheets, desert washes, and spring systems.

The Nevada Natural Heritage Program (NNHP) lists 194 currently known rare plants and animals for the County—second in the state only to larger Nye County (http://heritage.nv.gov/lists/counties.htm). Forty-two taxa (species or subspecies) are endemic to Clark County, including 21 plants, nine insects, five mollusks, five fishes, and two mammals. The two unparalleled Clark County hotspots of local endemism are the high elevations of the Spring Mountains for plants and terrestrial invertebrates, and the Upper Muddy River (Moapa Warm Springs) for aquatics—fishes, mollusks, and insects. Scientific discoveries continue today in this biologically rich county. Even in the last decade, plant species new to science have been discovered within sight of Las Vegas (Ertter 2000, Nesom and Leary 1992, Reveal 2003).

Species Addressed in the Low Elevation Rare Plant CMS

Nine low elevation rare plant species are addressed in this CMS:

- Sticky ringstem (*Anulocaulis leiosolenus* var. *leiosolenus*)
- Las Vegas bearpoppy (*Arctomecon californica*)
- White bearpoppy (*Arctomecon merriamii*)
- Threecorner milkvetch (*Astragalus geyeri* var. *triquetrus*)
- Alkali mariposa lily (*Calochortus striatus*)
- Pahrump Valley wild buckwheat (*Eriogonum bifurcatum*)
- Sticky wild buckwheat (*Eriogonum viscidulum*)
- White-margined beardtongue (*Penstemon albomarginatus*)
- Parish phacelia (*Phacelia parishii*)

Figure 1. Clark County planning area.

Three of these plants were identified among the seven MSHCP covered species of greatest concern to the FWS in their Biological Opinion (USFWS 2000). Las Vegas bearpoppy, threecorner milkvetch, and sticky wild buckwheat were so identified because they are State listed, exhibit low population numbers, extremely limited distribution, occur on specialized habitats, and are subject to substantial threats which may result in declining status.

The specific lower elevation habitats of these nine plant taxa are varied. Sticky ringstem and Las Vegas bearpoppy are essentially restricted to gypsum soils. White bearpoppy often occurs on gypsum soils, while also occurring occasionally on calcareous substrates. Three taxa—threecorner milkvetch, sticky wild buckwheat, and white-margined beardtongue—preferentially occur on sandy substrates comprising dunes and semi-stabilized sand sheets. Margins of playas and open interstitial areas of adjacent desert scrub with fine textured soils are the typical habitats for Pahrump Valley wild buckwheat and Parish phacelia. Alkaline meadows associated with desert springs and seeps are the definitive habitat for alkali mariposa lily.

Each species is specialized by unique adaptations to substrates and environmental conditions in which it is found. Each has developed plant morphologies, life history strategies, and in some cases, special physiologies, for taking advantage of a particular substrate and coping with water availability, or lack thereof, within its restricted habitats in the Mojave Desert environment. All of these specialized habitats occur as edaphically or hydrologically driven anomalies within the matrix forming ecological systems of the Mojave Desert. The lower elevation matrix forming ecological systems include Mojave desert scrub (also called creosote bush scrub), blackbrush, and salt desert scrub. Elevations in the County for these systems approximately range from 1,100 to 5,250 feet (335 to 1,600 meters).

Known distributions of the nine low elevation rare plants in Clark County are shown in figure 2. Their distributions overlap with lowlands that are the main concentrations of a growing Clark County population and industry, particularly in Las Vegas Valley, Pahrump Valley, Ivanpah Valley, and Virgin Valley. Only the southern tip of the County and higher elevations throughout it lack populations of these species.

Although this CMS ultimately concerns populations of the nine plants in Clark County, their global distributions and status serve to help prioritize conservation actions here. Accordingly, effort was spent on gathering background information for their known global distributions and status beyond the County planning area. In reality, the Clark County MSHCP may have some influence on conservation actions taken in landscapes closely adjacent to its boundaries, but that influence likely diminishes steeply with distance. Given that these species have habitat connectivity and are maintained by landscape scale ecological processes beyond Clark County boundaries, coordination among similar conservation planning efforts in adjacent counties is imperative.

None of the nine low elevation plant species as currently understood is endemic to Clark County, nor to Nevada. However, three have global distributions nearly confined to Clark County (Las Vegas bearpoppy, threecorner milkvetch, and sticky wild buckwheat), while Pahrump Valley wild buckwheat has a narrow distribution confined to the western boundary of the County and state line. Three other species exhibit global distributions centered on Clark County, although they extend well beyond it (white bearpoppy, white-margined beardtongue, and Parish phacelia). The remaining two species— sticky ringstem and alkali mariposa lily—have peripheral distributions in Clark County with the majority of their ranges far beyond it to the east and west, respectively. The taxonomic distinctiveness of two species, sticky ringstem and Las Vegas bearpoppy, is currently in question and their potentially revised interpretations may uniquely distinguish Clark County populations from those occurring further east.

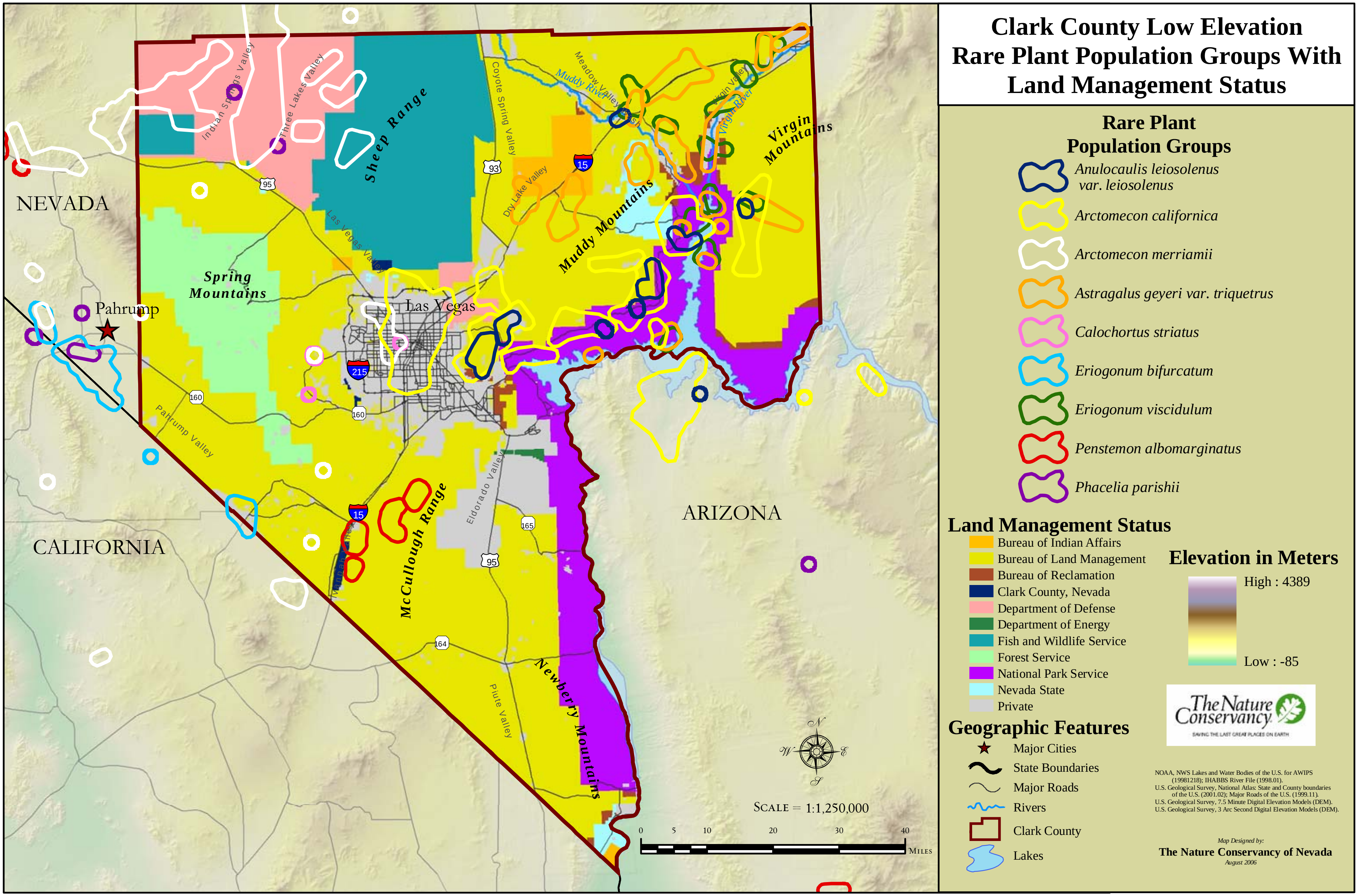

Figure 2. Clark County low elevation rare plant population groups and land management status.

Five of the plant species are endemic to the Mojave Desert (white bearpoppy, threecorner milkvetch, Pahrump Valley wild buckwheat, sticky wild buckwheat, and white-margined beardtongue). Las Vegas bearpoppy is nearly endemic to the Mojave Desert, with only small and possibly taxonomically discrete populations occurring in the Grand Canyon of the Colorado Plateau ecoregion. Similarly, alkali mariposa lily is nearly endemic to the Mojave Desert, with the exception of western disjunct populations in the southern Sierra Nevada and immediately adjacent ecoregions. Parish phacelia has a limited range with large known populations in Clark County, but extending considerably north into the central Great Basin. Of the nine species considered in this strategy, sticky ringstem has a relatively broad ecoregional distribution, appearing sporadically in four southwestern states and northern Mexico, with its main distribution in the Chihuahuan Desert ecoregion along the Texas-New Mexico-Mexico border and with remotely disjunct populations in Clark County.

EXISTING INFORMATION

Literature, Plans, and Reports

A diversity of data sources were used for this conservation management strategy. Relevant literature and information came from published articles and unpublished sources, including agency files, original field notes, expert interviews, biological databases, and web pages. An Endnote 8.0 library was developed to document all pertinent literature on the biology and ecology of the nine low elevation rare plants, management, threats, and non species specific supporting topics such as, plant genetics and population viability analysis. This bibliographic database of sources is provided as a separate electronic file to DCP in support of the CMS.

Species specific references organized by topic are summarized in table 1 for each of the nine plant taxa. The most informative literature and unpublished agency data available for this CMS listed under the first three topics (surveys and inventories, status reports and reviews, monitoring) are highlighted in bold in the table. Las Vegas bearpoppy has been the subject of far more research than any of the other species, and by virtue of its close relationship to this species, white bearpoppy also has benefited from some research. However, most of the other species have not been studied to any great extent.

Spatial Data

We acquired plant species spatial data from a number of sources. The data vary in spatial scale, precision, date of acquisition, and interpretation. The most recent plant information—when gathered with GPS technology— has a high confidence level for location accuracy. However, some of the information had been summarized with historic information and interpreted variously and not always consistently as sites, populations, or occurrences, which affect their level of confidence. Specific location information for the nine plant taxa came from four main sources, collectively accounting for 99% of all data points. In the order of total number of data points provided for this effort, those sources are Las Vegas BLM, Nevada Natural Heritage Program, Lake Mead NRA, and California Natural Diversity Data Base.

Replicate data points, an inevitable result of data acquisition from both original and summarized database sources, were painstakingly identified, documented, and removed from the primary dataset. An additional 97 data points, which were unique from the main source derived points, were gleaned from the literature, herbaria records, or recent field observation forms. An enumeration of data points for each species from all sources is provided in table 2. Point locations enumerated below represent from one to many individuals, which may have been censused or estimated. Missing from this data set are approximately 2,110 data points locations originally collected in 2005 for Las Vegas bearpoppy on BLM land in northern Las Vegas Valley when the plants were only vegetative (PBS&J 2005). BLM recently learned that once they flowered in 2006 some of these data points are actually white bearpoppy that were indistinguishable vegetatively and unexpected at that location (Marrs-Smith, personal communication). The new locations for both white bearpoppy and Las Vegas bearpoppy need to be incorporated into the two separate Las Vegas Valley population groups for these species in future CMS analyses.

Table 1. Species specific information sources for the low elevation rare plant conservation management strategy organized by topics.

(see next 5 pages)

Table 1. Species specific information sources for the low elevation rare plant conservation management strategy organized by topics. For the first three topics, boldface identifies the most informative sources; whereas for taxonomy, boldface indicates type publication for the taxon.

CMS Information Topics	Sticky ringstem, *Anulocaulis leiosolenus* var. *leiosolenus*	Las Vegas bearpoppy, *Arctomecon californica*	White bearpoppy, *Arctomecon merriamii*	Threecorner milkvetch, *Astragalus geyeri* var. *triquetrus*	Alkali mariposa lily, *Calochortus striatus*	Pahrump Valley wild buckwheat, *Eriogonum bifurcatum*	Sticky wild buckwheat, *Eriogonum viscidulum*	White-margined beardtongue, *Penstemon albomarginatus*	Parish phacelia, *Phacelia parishii*
Surveys and Inventories	BLM 2004 (H. Allen-Mead) **Niles *et al*.1999 (E Mojave Desert)** NPS 1997-1998 (LAME) BLM 1997	Klein 2005 **BLM 2004-5 (Disposal)** BLM 2004 (H. Allen-Mead) Nellis 2004 **BLM 2000-2002, 1996-1998, 1992-3** NDOT 2003 (Lamb) PBS&J 2000 (Beltway) **NPS 1998-2000 (LAME)** Glenne & Sawasaki 1999 (Nellis II) Leigh Fisher 1997 (N LV Airport) Niles *et al*.1996 (E Mojave Desert) Baepler 1994 (Lamb) Phillips 1994 (AZ) WESTEC 1980	BLM 1997-1998, 1993 Pritchett *et al*.1997 (Nellis) Knight *et al*.1997 (Nellis) Knight & Smith 1995 (Nellis) **Knight & Smith 1994 (Nellis)** Knight & Clemmer 1987 (Ash Mdws) Ackerman 1981 (DNWR) Rhoads *et al*.1978 (NTS) Rhoads & Williams 1977 (NTS)	BLM 2005, 2003, 2001, 1997, 1995 Powell 2001 (Sandy Cove) NPS 2000-2001, 1998 Powell 1999 (LAME) **Niles *et al*.1995 (E Mojave Desert)** Leary 1987 (Pecos Harrisberg) Holland *et al*.1979 (Lake Mead)	BLM 1997 Bagley 1989 (Fort Irwin CA) Knight & Clemmer 1987 (Ash Mdws)	BLM 1998 **Niles *et al*.1998 (E Mojave Desert)**	**NPS 1997-2000** Powell 1999 (LAME) Niles *et al*.1998 (E Mojave Desert) BLM 1997, 1995 Niles *et al*.1997 (E Mojave Desert) **Niles *et al*.1995 (E Mojave Desert)** Dames & Moore 1990 (Kern River ROW) Leary 1987 (Pecos Harrisberg) WESTEC 1980 Reveal & Ertter 1980 Reigla 1975 (LAME)	**Smith 1997-2001** BLM 1996-1997, 1994 **Sheldon 1994 (Hidden Valley)** Scogin 1989 (CA)	BLM 1998 Niles *et al*.1998 (E Mojave Desert) **Smith (1995) 1997** Chambers *et al*.1991 (Fort Irwin CA) Rutherford & Bransfield 1991 (Fort Irwin CA) Bagley 1989 (Fort Irwin CA) Ackerman 1981 (DNWR) Harrison 1980 (Ely BLM)

Table 1. Continued.

CMS Information Topics	Sticky ringstem, *Anulocaulis leiosolenus* var. *leiosolenus*	Las Vegas bearpoppy, *Arctomecon californica*	White bearpoppy, *Arctomecon merriamii*	Threecorner milkvetch, *Astragalus geyeri* var. *triquetrus*	Alkali mariposa lily, *Calochortus striatus*	Pahrump Valley wild buckwheat, *Eriogonum bifurcatum*	Sticky wild buckwheat, *Eriogonum viscidulum*	White-margined beardtongue, *Penstemon albomarginatus*	Parish phacelia, *Phacelia parishii*
Status Reports and Reviews	FWS 2000 RECON 2000	Klein 2006 Morefield 2001 (NV) FWS 2000 RECON 2000 Glenne 1998 Bair 1997 **Mistretta et al. 1996** Knight 1992 (LAME) Phillips & Phillips 1988 (AZ) Mozingo & Williams 1980 Holland 1979	Morefield 2001 (NV) FWS 2000 RECON 2000 Blomquist *et al.*1995 (NTS) Knight & Clemmer 1987 (Ash Mdws) Mozingo & Williams 1980 DeDecker 1977 (CA)	Morefield 2001 (NV) FWS 2000 RECON 2000 **Knight 1992 (LAME)** Knight 1990 Holland *et al.*1980 (Lake Mead) Mozingo & Williams 1980	Morefield 2001 (NV) FWS 2000 RECON 2000 Greene & Sanders 1998 (CA) Knight & Clemmer 1987 (Ash Mdws) Mozingo & Williams 1980	Morefield 2001 (NV) FWS 2000 RECON 2000 **Knight 1988** Mozingo & Williams 1980	Morefield 2001 (NV) FWS 2000 RECON 2000 **Knight 1992 (LAME)** Mozingo & Williams 1980 **Reveal 1978**	**Smith 2001** Morefield 2001 (NV) FWS 2000 RECON 2000 MacKay 1998 (CA)	Morefield 2001 (NV) FWS 2000 RECON 2000 White 1998 (CA) **Smith 1997** Mozingo & Williams 1980 Constance 1979 (CA)
Monitoring		**BLM/NPS 1998-2004 (seven sites across range in NV)** Powell 2004 Powell 2003 Powell 2002 Powell 2001 Powell & Marrs-Smith 2001 Powell 1999 Coffey Undated	Pritchett & Smith 1999 (Nellis)	**NPS 1998-2004 (Sandy Cove presence)** Powell 2003 (Sandy Cove)	Tollefson 1992 (CA)		**NPS 1998-2004 (4 LAME sites, presence)** Powell 2003 (LAME)	**BLM 1996-2004 (Jean Dry Lake)**	Pritchett & Smith 1999 (Nellis)
Species or Habitat Management Plans		BLM 2000 (Sunrise Area) Bardeen & Williams 2000 (LV Springs Preserve) Marrs-Smith 1998				Crampton *et al.* 2006 Krueger 1999 (Mesquite)		Anderson 2000 AZ	Krueger 1999 (Mesquite) – 9 occurrences

Table 1. Continued.

CMS Information Topics	Sticky ringstem, *Anulocaulis leiosolenus* var. *leiosolenus*	Las Vegas bearpoppy, *Arctomecon californica*	White bearpoppy, *Arctomecon merriamii*	Threecorner milkvetch, *Astragalus geyeri* var. *triquetrus*	Alkali mariposa lily, *Calochortus striatus*	Pahrump Valley wild buckwheat, *Eriogonum bifurcatum*	Sticky wild buckwheat, *Eriogonum viscidulum*	White-margined beardtongue, *Penstemon albomarginatus*	Parish phacelia, *Phacelia parishii*
Restoration		VonWinkel 2004 (LV Springs Preserve) BLM 2004 *SAIC 2000-2001* *Marble 1985* BLM (seed collection)	BLM (seed collection)	BLM (seed collection)	BLM (Red Spring) BLM (seed collection)	BLM (seed collection)	BLM (seed collection)	BLM (seed collection)	Hiatt *et al*. 1995 BLM (seed collection)
Biology & Ecology Research	Rubio & Escudero 2000 (soil)	Meyer & Forbis 2006 Powell 2003 (habitat & soils) Hickerson & Wolf 1998 (genetics) Tepedino & Kuta 1997 (reproductive ecology) Thompson & Smith 1997 (ecology) Meyer 1996 (seed germination ecology & seed bank dynamics) Tepedino & Hickerson 1996 (reproductive ecology) VanBuren & Harper 1996 (genetics) Harper & VanBuren 1996 (genetics) Hickerson *et al*.1995 (reproductive biology) Sheldon 1994 (life history & soils) Raynie *et al*.1991 (alkaloids) Raynie *et al*.1990 (alkaloids) Meyer 1987 (life history) Meyer 1986 (gypsophily) Meyer 1980 (gypsophily)	Harper & VanBuren 1996 (genetics) Sheldon 1994 (life history & soils) Raynie *et al*.1991 (alkaloids) Raynie *et al*.1990 (alkaloids) Meyer 1986 (gypsophily)	Powell 1998 (phenology)	Fiedler 1998 (rare plant demography) Fiedler 1986 (rarity) Fiedler 1985 (metal accumulation)			Scogin 1989 (soil, pollinators, reproductive biology, & propagation) Reveal 1974 (genetics)	

Table 1. Continued.

CMS Information Topics	Sticky ringstem, *Anulocaulis leiosolenus* var. *leiosolenus*	Las Vegas bearpoppy, *Arctomecon californica*	White bearpoppy, *Arctomecon merriamii*	Threecorner milkvetch, *Astragalus geyeri* var. *triquetrus*	Alkali mariposa lily, *Calochortus striatus*	Pahrump Valley wild buckwheat, *Eriogonum bifurcatum*	Sticky wild buckwheat, *Eriogonum viscidulum*	White-margined beardtongue, *Penstemon albomarginatus*	Parish phacelia, *Phacelia parishii*
Taxonomy	Spellenberg & Wooten 1999 Spellenberg 1993 Waterfall 1945 Standley 1909 **Torrey 1859**	Ownbey *et al* 1998 Tiehm 1996 Nelson & Welsh 1993 **Fremont 1845**	Tiehm 1996 Nelson & Welsh 1993 **Coville 1892**	Tiehm 1996 Barneby 1964 Rydberg 1929 **Jones 1923** Jones 1898 **Gray 1878**	Ownbey 1940 **Parish 1902**	Tiehm 1996 Reveal 1985 Reveal 1971	Tiehm 1996 Reveal 1985 Reveal 1969 **Howell 1942**	Tiehm 1996 **Jones 1908**	Atwood 1976 Howell 1943 **Gray 1883**
Floras	FNA 2003 (N Amer.) Kartesz 1987 (NV) Swearingen 1981 (Muddy Mtns.) Martin & Hutchins 1980 (NM) McDougall 1973 (No. AZ) Correll & Johnston 1970 (TX) Kearney *et al.*1960 (AZ)	FNA 1997 (N Amer.) Kartesz 1987 (NV) Swearingen 1981 (Muddy Mtns.) McDougall 1973 (No. AZ) Kearney *et al.*1960 (AZ) Abrams 1944 (Pacific States)	Ackerman 2003 (DNWR) Baldwin *et al.*2002 (SE CA) FNA 1997 (No. Amer) Hickman 1993 (CA) Kartesz 1987 (NV) Beatley 1976 (NTS) Munz 1974 (So. CA) Munz & Keck 1973 (CA) Clokey 1951 Abrams 1944 (Pacific States)	Kartesz 1987 (NV) Barneby 1989 (Intermountain) Swearingen 1981 (Muddy Mtns.)	FNA 2003 (N Amer.) Baldwin *et al.*2002 (SE CA) Cronquist *et al.*1997 (Intermountain) Hickman 1993 (CA) Leary & Niles 1991 (RRCNCA) Kartesz 1987 (NV) Munz 1974 (So. CA) Munz & Keck 1973 (CA) Abrams 1955 (Pacific States)	Baldwin *et al.*2002 (SE CA) Hickman 1993 (CA) Kartesz 1987 (NV) Munz 1974 (So. CA)	Kartesz 1987 (NV) Swearingen 1981 (Muddy Mtns.)	Baldwin *et al.*2002 (SE CA) Hickman 1993 (CA) Kartesz 1987 (NV) Munz 1974 (So. CA) Munz & Keck 1973 (CA) McDougall 1973 (No. AZ) Kearney *et al.*1960 (AZ) Abrams 1951 (Pacific States)	Ackerman 2003 (DNWR) Baldwin *et al.*2002 (SE CA) Hickman 1993 (CA) Kartesz 1987 (NV) Cronquist *et al.*1984 (Intermountain) Munz 1974 (So. CA) Munz & Keck 1973 (CA) Abrams 1951 (Pacific States)

Table 1. Continued.

CMS Information Topics	Sticky ringstem, *Anulocaulis leiosolenus* var. *leiosolenus*	Las Vegas bearpoppy, *Arctomecon californica*	White bearpoppy, *Arctomecon merriamii*	Threecorner milkvetch, *Astragalus geyeri* var. *triquetrus*	Alkali mariposa lily, *Calochortus striatus*	Pahrump Valley wild buckwheat, *Eriogonum bifurcatum*	Sticky wild buckwheat, *Eriogonum viscidulum*	White-margined beardtongue, *Penstemon albomarginatus*	Parish phacelia, *Phacelia parishii*
Area Check Lists	Hiatt & Boone 2003 (CC) Powell 2003 (LAME) Brian 2000 (GCNP) Holland *et al.*1979 (LAME) Niles *et al.*1977 (LAME)	Hiatt & Boone 2003 (CC) Powell 2001 (LAME) Brian 2000 (GCNP) Hazlett *et al.* 1997 (Nellis) Moore 1993 (LAME) Holland 1980 (LAME) Holland *et al.*1979 (LAME) Niles *et al.*1977 (LAME) Reigla 1975 (LAME)	Hiatt & Boone 2003 (CC) Beatley 1977 (NTS)	Hiatt & Boone 2003 (CC) Holland 1980 (LAME) Holland *et al.*1979 (LAME) Reigla 1975 (LAME)	Hiatt & Boone 2003 (CC)	Hiatt & Boone 2003 (CC)	Hiatt & Boone 2003 (CC) Holland 1980 (LAME) Holland *et al.*1979 (LAME) Reigla 1975 (LAME)	Hiatt & Boone 2003 (CC)	Hiatt & Boone 2003 (CC)

Table 2. Number of data point locations by source used in this conservation management strategy for the nine low elevation rare plant species.

Species Name	Point Locations from Las Vegas BLM	Point Locations from Nevada NHP	Point Locations from Lake Mead NRA	Point Locations from CNDDB	Point Locations from Misc. Sources
Sticky ringstem, *Anulocaulis leiosolenus* var. *leiosolenus*	53	0	43	0	19
Las Vegas bearpoppy, *Arctomecon californica*	2,580	116	256	0	13
White bearpoppy, *Arctomecon merriamii*	30	128	0	34	1
Threecorner milkvetch, *Astragalus geyeri* var. *triquetrus*	680	39	0	0	19
Alkali mariposa lily, *Calochortus striatus*	29	4	0	84	8
Pahrump Valley wild buckwheat, *Eriogonum bifurcatum*	589	56	0	1	0
Sticky wild buckwheat, *Eriogonum viscidulum*	30	39	27	0	7
White-margined beardtongue, *Penstemon albomarginatus*	5,664	12	0	4	28
Parish phacelia, *Phacelia parishii*	6	12	0	3	1
Total	9,661	409	303	126	96

We interpreted all available location information for the nine rare plant taxa into population groups. There were a number of reasons for doing so. Recent survey efforts for Las Vegas bearpoppy and white-margined beardtongue account for 83% of all known data points for the nine taxa, skewing size of precisely documented plant populations in their favor. Some plant location data were obtained as polygons, including those for white bearpoppy, alkali mariposa lily, Pahrump Valley wild buckwheat, white-margined beardtongue, and Parish phacelia from CNDDB; white-margined beardtongue from NNHP; and Las Vegas bearpoppy, threecorner milkvetch, and sticky wild buckwheat from Lake Mead NRA. Polygons from the state Natural Heritage Programs typically are occurrence interpretations from other source data points using either their one mile or one kilometer separation distance criteria.

Some individuals, agencies, and institutions are reluctant to use, share, and depict specific location information. As a result, we interpreted original and secondarily derived location information as population groups, in an effort to have a somewhat more comparable situation among the taxa and to depict the locations less specifically. The population groups are defined by geographic representation in which connectivity and topographic barriers were taken into account. They are typically delineated with about a one mile buffer around the known populations comprising the group. They may or may not represent biologically functioning metapopulations, and since metapopulation relationships have not been studied for these species, we chose to use the term population groups. Table 3 summarizes the total number of data points, number of state Natural Heritage Program occurrences (AZNHP, CNDDB, and NNHP), and number of CMS population groups for the nine plant taxa.

Table 3. Summary of original data points, interpreted occurrences, and inferred population groups for each of the nine low elevation rare plant species in this conservation management strategy.

Species Name	Number of Point Locations	Number of NHP Occurrences	Number of TNC Population Groups
Sticky ringstem, *Anulocaulis leiosolenus* var. *leiosolenus*	115	0	17
Las Vegas bearpoppy, *Arctomecon californica*	2,965	120	13
White bearpoppy, *Arctomecon merriamii*	193	162	33
Threecorner milkvetch, *Astragalus geyeri* var. *triquetrus*	738	40	17
Alkali mariposa lily, *Calochortus striatus*	125	88	15
Pahrump Valley wild buckwheat, *Eriogonum bifurcatum*	646	57	4
Sticky wild buckwheat, *Eriogonum viscidulum*	103	41	13
White-margined beardtongue, *Penstemon albomarginatus*	5,708	44	10
Parish phacelia, *Phacelia parishii*	23	19	16
Total	10,616	571	138

The high number of point locations relative to the number of our interpreted population groups indicates that Las Vegas bearpoppy, white-margined beardtongue, and Pahrump Valley wild buckwheat have been more intensively geospatially sampled than the other species. In contrast, the low ratio of point locations to population groups for white bearpoppy, sticky ringstem, alkali mariposa lily, and sticky wild buckwheat suggests that these species may have been less intensively sampled using GPS equipment. The extremely low ratio of point locations to population groups for Parish phacelia is because of 1995 field delineation of population polygons, rather than points locating individuals or clusters of individuals—a potentially daunting challenge for an annual that germinates by the millions in good years. In this case, the number of NNHP occurrences (many delineated by polygons) is closest to the number of our interpreted population groups.

Spatial data layers depicting management and threats information were obtained primarily from three sources, Las Vegas District BLM, Clark County DCP, and Lake Mead NRA. Appendix 2 is a list of all GIS layers used in analyses for this CMS along with associated metadata and notes.

Information Gaps

There are several baseline information gaps in the collective knowledge of the nine low elevation rare plants. Additionally, there are many uncertainties regarding species and habitat information acquired thus far. There is poor baseline species distribution and abundance information for Las Vegas Valley and some rural communities prior to development. Consequently, a complete range of habitat and population loss is unknown primarily for Las Vegas bearpoppy, white bearpoppy, threecorner milkvetch, sticky wild buckwheat, Pahrump Valley wild buckwheat, and alkali mariposa lily. Historical plant locations have known lower precision levels, which have been documented by state Natural Heritage Programs. Many plant populations have unknown acreages, and those with uncertain acreage predictions are reported in this CMS with low confidence. There are a few known inaccuracies of plant misidentifications, and location precisions and misinterpretations, which are addressed within the individual species accounts.

Our ability to predict potential habitat for the nine taxa currently is limited because of a dearth of reliable soils and vegetation maps at appropriate spatial scales. The recently completed vegetation mapping effort of the Southwest Regional Gap Analysis Project is an improvement of an earlier 1996 GAP vegetation mapping effort (USGS 2004). However, it is based on aerial photo identification of ecological systems at a minimum size that is often too large to capture the scale of anomalous ecological systems defining rare plant habitats. An updated soil survey for Clark County was completed in 2006 (Lato 2006). This is a third order survey, so many of the smaller specialized edaphic sites that harbor populations of these species are not resolved at this scale. Greater resolution soils data for the gypsum barren habitats in north Las Vegas Valley is underway by UNLV researchers (Marrs-Smith, personal communication 2005). Nevertheless, status reports and other documents for Las Vegas bearpoppy, threecorner milkvetch, sticky wild buckwheat, and white-margined beardtongue have identified additional areas for survey based on potential habitat, but the completeness and level of confidence of these predictions is unknown. The adaptive management framework proposed for this CMS should be able to test the accuracy of predictions and assumptions regarding rare plant distributions and viability.

Lacking refined spatial data layers to predict potential habitat impairs our ability to help identify specific priority areas for needed rare plant surveys and inventories in Clark County. It also limits our ability to identify additional unoccupied potential habitat beyond current known distributions of these plants, which could lead to range expansions and the possibility of alternative conservation management options. There was insufficient time and funding to perform a comprehensive geospatial-based threats analysis for this CMS, which has hindered our ability to accurately assess threats across their global distributions and within Clark County.

Population genetics, reproductive biology, and pollination ecology of most of the plant species is poorly known. Exploratory research on both *Arctomecon* species has been done, but additional work is needed, especially on biological interactions and habitat needs of the rare pollinator species that have been identified. For the other species, all of these topics remain unstudied and what is understood about their pollination ecology is mainly deduced from related species, which reduces the level of data reliability.

Essentially all species have inadequate, dated, missing, or confounded information to assess current viability of some populations under given climate conditions. This hinders our ability to accurately assess the relevance of Clark County populations with respect to local and global distributions. Other than for Las Vegas bearpoppy, there is a lack of detailed life history information, including demographic and seed bank information in particular, to determine minimum population sizes and minimum dynamic areas for habitat management. This lack of relevant information for population viability analyses is notable for the other perennials, and is especially acute for the annuals (threecorner milkvetch, Pahrump Valley wild buckwheat, sticky wild buckwheat, and Parish phacelia); to better understand stochastic risks to their long term persistence. The inability to do population viability analyses and predict potential habitat for the species, combined with insufficient geospatial threats analyses, cripples our ability to determine status and trends of the low elevation rare plant species of Clark County with high certainty.

To better understand habitat management needs for the nine species, additional landscape scale research is needed. For example, there is no information on habitat patch connectivity requirements and little on functional ecological processes and thresholds needed to maintain viable habitats. In particular, for the psammophytes (threecorner milkvetch, sticky wild buckwheat, and white-margined beardtongue), and possibly for white bearpoppy, Pahrump Valley wild buckwheat, and Parish phacelia, a better understanding of the role of exotics in resource competition, dune stabilization, and altering fire intensities and frequencies is needed to help prioritize strategies to reduce their threats. In addition, both habitat and species restoration techniques are in need of refinement to more accurately identify appropriate restoration activities which would improve condition of habitats and population viability. Importantly, study of potential changes to distribution and abundance of all nine low elevation plants in light of global climate change is needed. A summary of research and management needs follows in table 4. Priority rankings are classified from highest (1) to lower (3) and are based on filling information gaps needed to adaptively manage a given rare plant species. Ensuring identification of appropriate entities and their funding needs to undertake applied research, monitoring, and management studies on behalf of MSHCP-covered rare plant species is a responsibility of Clark County's DCP.

Table 4. Research and management needs of the nine low elevation rare plants and their priority rankings. (
(1 = Highest priority, 2 = Medium priority, 3 = Lower priority.)

Research and Management Topic	Sticky ringstem	Las Vegas bearpoppy	White bearpoppy	Threecorner milkvetch	Alkali mariposa lily	Pahrump Valley wild buckwheat	Sticky wild buckwheat	White-margined beardtongue	Parish phacelia
Species range distribution information	1	2	2	1	2	2	2	1	2
Smaller-scale soils and vegetation maps for predictive distribution mapping	1	2	2	1	1	1	1	1	1
Randomized surveys	3	3	3	3	3	3	3	3	3
Species extents and abundances	1	3	3	1	2	1	1	2	1
Population genetics	1	2	2	1	1	1	1	1	1
Reproductive biology	2	3	3	1	3	1	1	2	2
Pollination ecology	1	2	2	1	1	1	1	1	1
Current viability of populations under documented climate conditions	1	2	2	2	1	1	2	1	2
Seed bank research	1	2	2	1	2	2	2	1	2
Population viability analyses	2	3	3	1	2	1	1	1	1
Geospatial-based threats analysis	1	1	1	1	1	1	1	1	1
Effectiveness and status monitoring	1	1	1	1	1	1	1	1	1
Comprehensive conservation reports	1	3	2	1	2	1	1	3	3
Effects of fire and invasive plant species interactions (including dune stabilization)	3	3	1	1	2	2	1	1	2
Effective restoration techniques	1	1	1	1	1	1	1	1	1

Research and Management Topic	Sticky ringstem	Las Vegas bearpoppy	White bearpoppy	Threecorner milkvetch	Alkali mariposa lily	Pahrump Valley wild buckwheat	Sticky wild buckwheat	White-margined beardtongue	Parish phacelia
Role of exotics in resource competition	3	3	2	1	3	2	1	1	2
Habitat patch connectivity requirements	1	1	1	2	2	2	2	2	2
Impacts of global climate change	1	1	1	1	1	1	1	1	1

EXISTING ENVIRONMENT

Land and Resource Management

Federal Land Management

Approximately 90% of the lands in Clark County are managed by Federal agencies as multiple-use public land, forests, parks, and refuges. The majority of the populations and habitats for the rare plant species addressed in this CMS occur on these federal landscapes and several have been the focus of specific planning efforts. The Bureau of Land Management (BLM) and National Park Service (NPS) together manage 87.5% of all known global spatial data points for the nine rare plants (table 5) and 88.0% of known spatial data points in Clark County (table 6).

Table 5. Percent of known global spatial data points (n = 10,616) for each of the nine low elevation rare plants by major landowner category[1].

Landowner	Sticky ringstem	Las Vegas bearpoppy	White bearpoppy	Threecorner milkvetch	Alkali mariposa lily	Pahrump Valley wild buckwheat	Sticky wild buckwheat	White-margined beardtongue	Parish phacelia	Total
	Anulocaulis leiosolenus var. *leiosolenus*	*Arctomecon californica*	*Arctomecon merriamii*	*Astragalus geyeri* var. *triquetrus*	*Calochortus striatus*	*Eriogonum bifurcatum*	*Eriogonum viscidulum*	*Penstemon albomarginatus*	*Phacelia parishii*	
BLM	58.3	73.9	33.7	92.7	25.6	86.5	57.3	92.0	64.0	84.0
Private	2.6	14.2	9.3	0.5	24.0	13.5	3.9	7.9	16.0	9.6
NPS	28.7	9.2	9.3	2.0			20.4			3.4
DoD		2.1	38.3		43.2				8.0	1.8
BIA		0.1		3.9						0.3
Water	0.9	0.2		0.4			18.5			0.3
FWS			5.7						8.0	0.1
BoR		0.3		0.4						0.1
Other		0.1	3.6		7.2					0.1
Unknown	9.6								4.0	0.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.00	100.0	99.9

[1]Percents are rounded. Blank cells are zero percent. Water refers to Lake Mead so land manager may be NPS or BoR depending on fluctuating reservoir level. Unknowns are all out of state.

Table 6. Percent of known spatial data points in Clark County (n = 9,642) for each of the nine low elevation rare plants by landowner.

Landowner	Sticky ringstem	Las Vegas bearpoppy	White bearpoppy	Threecorner milkvetch	Alkali mariposa lily	Pahrump Valley wild buckwheat	Sticky wild buckwheat	White-margined beardtongue	Parish phacelia	Total
	Anulocaulis leiosolenus var. *leiosolenus*	*Arctomecon californica*	*Arctomecon merriamii*	*Astragalus geyeri* var. *triquetrus*	*Calochortus striatus*	*Eriogonum bifurcatum*	*Eriogonum viscidulum*	*Penstemon albomarginatus*	*Phacelia parishii*	
BLM	64.4	74.5	22.0	92.6	86.5	32.1	54.6	92.0		84.7
Private	2.9	14.3	13.8	0.5	13.5	67.9	4.1	8.0		9.9
NPS	31.7	8.5		2.0			21.6			3.3
DoD		2.1	54.1						100.0	1.3
BIA				4.0						0.3
Water	1.0	0.2		0.4			19.6			0.3
BoR		0.3		0.4						0.1
FWS			10.1							0.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

The BLM Las Vegas Resource Management Plan (RMP) provides management guidance for 2.9 million acres of public lands in Clark County (BLM 1998). These lands are managed under multiple use mandates. Resource and program emphases relevant to or affecting rare plant conservation include species and habitat management; soil, water, riparian, and vegetation management; land disposals and acquisitions, livestock grazing, wild horses and burros, rights-of-way management, recreation use, and minerals exploration and extraction. Stated objectives in the RMP for rare plants are to: 1) manage special status species habitat at the potential natural community or desired plant community, according to the need of the species; and 2) manage habitats for non-listed special status species to support viable populations so that future listing would not be necessary.

BLM's Red Rock Canyon National Conservation Area is substantially managed for recreation; however, the BLM General Management Plan for the area includes management prescriptions for protection of natural habitats and features, including sensitive wildlife and plants, and riparian areas (BLM 2000). The plan provides direction for monitoring populations of threatened, endangered, candidate, and other special status species in the NCA. Similarly, the Resource Management Plan for Sloan Canyon National Conservation Area provides management direction for the three special status species of *Penstemon* occurring within its boundaries, including white-margined beardtongue (BLM 2005).

Two additional BLM management plans are directly relevant to this CMS and address special status species and their habitats. The Las Vegas Bearpoppy Habitat Management Plan (1998) was developed with the overarching goal to manage its habitat for ecosystem, community, species, and genetic diversity, and to sustain viable populations of Las Vegas bearpoppy. Stated objectives are to maintain or improve 45,750 acres of habitat on four management areas and protect an additional population (at Apex); and allow no net loss of bearpoppy habitat on public land from Federally-approved projects through mitigative actions. This plan includes specific conservation actions and an implementation plan. Additionally, the Sunrise Management Area Interim Management Plan (2000) has a stated objective to protect sensitive species (Las Vegas bearpoppy and sticky ringstem) while also providing for recreational opportunities. It includes specific protection, habitat rehabilitation, and law enforcement measures, along with other multiple use management actions that would positively influence sensitive species management in this popular recreation area.

The BLM classifies certain areas as Areas of Critical Environmental Concern (ACEC). After adoption of the Desert Conservation Plan, tortoise and non-tortoise ACECs were established in Clark County. Of these, two of the non-tortoise ACECs (Rainbow Gardens and Virgin River) include habitat and populations of Las Vegas bearpoppy, sticky ringstem, sticky wild buckwheat, and threecorner milkvetch, while a few of the tortoise ACECs (i.e., Mormon Mesa, Gold Butte) include habitat and populations of threecorner milkvetch and sticky wild buckwheat.

The Lake Mead National Recreation Area (NRA) General Management Plan presents broad resource conservation goals and includes specific conservation actions for park lands in eastern Clark County (NPS 1986). The more recent Burro Management Plan (1995) provides specific conservation measures for additional resource protection benefiting rare plant habitat. Updated NPS policy guidelines relevant to this CMS include project planning, inventory, vital signs monitoring, resource protection, environmental restoration, and research (NPS 1999). The Lake Mead NRA general management plan has not been amended for NPS coordination with MSHCP implementation. However, the 2003 Lake Management Plan provides direction for management of sticky wild buckwheat, threecorner milkvetch, Las Vegas bearpoppy, and sticky ringstem occurring on sandy soils along the shoreline of Lake Mead in areas of heavy recreational use (NPS 2003).

In addition to BLM and NPS, the Department of Defense (DoD) and FWS manage smaller amounts of habitat for the MSHCP-covered low elevation rare plants. An Integrated Natural Resource Management

Plan (INRMP) for Nellis Air Force Base and Range addresses natural resource management activities (surveys, inventories, mapping, and data integration) on DoD lands in Clark County (Nellis 1999). Nellis currently is revising this plan; however, the draft has not yet been made available to the public. Nellis Air Force Base (NAFB) and Nellis Air Force Bombing and Gunnery Range (NAFBGR) are not signatories to the implementing agreement for MSHCP cooperators.

The Desert National Wildlife Refuge Complex is currently developing a Comprehensive Conservation Plan which would likely include coordination with MSHCP implementation and management guidance for rare plant species under FWS management. A draft of this plan is expected to be released for public review in 2007. The Desert National Wildlife Range (DNWR) includes 1.6 million acres managed by FWS primarily for species and recreation. Approximately half (840,000 acres) of the DNWR is overlain by Nellis AFBGR. Public access to this portion of the DNWR is restricted, and approximately 170,000 acres (below 3600 ft in Indian Springs Valley and 4000 ft in Three Lakes Valley) are specifically designated for defense related-training activities, including aerial gunnery and bombing activities. These areas are managed under the Nellis INRMP. Included within the boundaries of the DNWR are populations and habitats of white bearpoppy and Parish phacelia.

Land statistics for these and other entities that manage lands and resources within the range of the nine rare plant species are summarized in table 7.

Table 7. Number and percentage of data points for the nine plant taxa, by land ownership (n=10,609). Seven point locations for *Anulocaulis* in New Mexico, Texas, and Mexico are not included.

Landowner Type	Landowner Category	Sticky ringstem, *Anulocaulis leiosolenus* var. *leiosolenus*	Las Vegas bearpoppy, *Arctomecon californica*	White bearpoppy, *Arctomecon merriamii*	Threecorner milkvetch, *Astragalus geyeri* var. *triquetrus*	Alkali mariposa lily, *Calochortus striatus*	Pahrump Valley wild buckwheat, *Eriogonum bifurcatum*	Sticky wild buckwheat, *Eriogonum viscidulum*	White-margined beardtongue, *Penstemon albomarginatus*	Parish phacelia, *Phacelia parishii*
Federal	BIA		0.07% 2		3.93% 29					
	BLM	58.26% 67	73.86% 2190	33.68% 65	92.68% 684	25.60% 32	86.53% 559	57.28% 59	91.96% 5249	60.87% 14
	BR		0.30% 9		0.41% 3					
	DoD		2.12% 63	33.68% 65		43.20% 54				8.70% 2
	DoE			33.68% 65						
	FWS			33.68% 65						8.70% 2
	NPS	32.17% 37	9.21% 273	9.33% 33.68%	2.03% 15			20.39% 21		
	FS					1.60% 2				
State	Arizona		0.03% 1						0.04% 2	
	California			33.68% 65		3.20% 4				
	Nevada		0.03% 1							

Landowner Type	Landowner Category	Sticky ringstem, *Anulocaulis leiosolenus* var. *leiosolenus*	Las Vegas bearpoppy, *Arctomecon californica*	White bearpoppy, *Arctomecon merriamii*	Threecorner milkvetch, *Astragalus geyeri* var. *triquetrus*	Alkali mariposa lily, *Calochortus striatus*	Pahrump Valley wild buckwheat, *Eriogonum bifurcatum*	Sticky wild buckwheat, *Eriogonum viscidulum*	White-margined beardtongue, *Penstemon albomarginatus*	Parish phacelia, *Phacelia parishii*
	Water (NV)	0.87% 1	0.17% 5		0.41% 3			18.45% 19		
Private (and in combi-nation with others)	Private	2.61% 3	14.05% 416	9.33% 18	0.54% 4	26.40% 33	13.47% 87	3.88% 4	8.01% 457	21.74% 5
	Total Percent & Number	93.91% 108 of 115	100.00% 2965	100.00% 193	100.00% 738	100.00% 125	100.00% 646	100.00% 103	100.00% 5708	100.00% 23

Clark County Multiple Species Habitat Conservation Plan

As previously discussed, the MSHCP classifies lands in Clark County into four conservation management categories (RECON 2000) -- intensively managed areas (IMAs), less intensively managed areas (LIMAs), multiple use managed areas (MUMAs), and unmanaged areas (UMAs). IMAs have the highest level of conservation status and include wilderness study areas (WSAs), critical habitat for the desert tortoise (ACECs), National Recreation Area land (Lake Mead NRA), and National Wildlife Refuge land (Desert NWR co-managed by FWS and DoD). Management on LIMAs allows mainly light recreational uses or have restricted access, such as National Conservation Areas (Red Rock Canyon and Sloan Canyon NCAs) or areas at Nellis Air Force Range overlapping the Desert NWR. The IMAs and LIMAs together represent the biological reserve system within the County. MUMAs allow multiple uses on public land, which is undesignated land managed by BLM. These areas provide additional habitat, connectivity between species populations and habitats, and buffer areas between IMAs and LIMAs and the private or non-Federal lands. UMAs are dominated by human activities, and include private lands, Nellis Air Force Base, and tribal lands.

Table 8 provides an analysis of Clark County management categories for all documented locations of the rare plants within the 68 species population groups located wholly or mostly within Clark County. There are discrepancies between the MSHCP (RECON 2000) and BLM's updated 2004 land ownership information. The information in table 8 is based on the 2004 BLM's data incorporating lands identified for disposal under the Southern Nevada Public Lands Management Act in 1998 and the Clark County Conservation of Public Land and Natural Resources Act in 2002; and designation of the Sloan Canyon NCA, also under the Clark County act. As a result of this update, 7% of all data points (n=735) moved between management categories. Of these, the majority (60%) of the category changes were from multiple use lands to private lands, while 28% effectively retained high protection status because of National Conservation Area designation in 2002. Appendix 3 provides a more detailed explanation of the management situation relative to MSHCP land status across population groups of the nine species. Within the appendix is a table that shows original management category, the revised category, and rationale for change for the affected population groups.

Table 8. Number and percentage of data points for the nine plant taxa in each Clark County MSHCP land management category. Management categories are intensively managed area (IMA), less intensively managed area (LIMA), multiple use managed area (MUMA), and unmanaged area (UMA). "Not applicable" indicates row occur in another Nevada county (Lincoln, Nye, or White Pine) or out of state (Arizona, California, New Mexico, Texas, or Mexico).

MSHCP land management categories	Sticky ringstem	Las Vegas bearpoppy	White bearpoppy	Threecorner milkvetch	Alkali mariposa lily	Pahrump Valley wild buckwheat	Sticky wild buckwheat	White-margined beardtongue	Parish phacelia	All Taxa Combined
	Anulocaulis leiosolenus var. *leiosolenus*	*Arctomecon californica*	*Arctomecon merriamii*	*Astragalus geyeri* var. *triquetrus*	*Calochortus striatus*	*Eriogonum bifurcatum*	*Eriogonum viscidulum*	*Penstemon albomarginatus*	*Phacelia parishii*	
IMA	71.30%	71.37%	33.16%	12.87%			45.63%	25.30%	4.35%	36.25%
	82	2116	64	95			47	1444	1	3849
LIMA			12.44%		25.60%			3.63%	4.35%	2.49%
			24		32			207	1	264
MUMA	16.52%	11.60%	2.07%	81.98%		4.18%	44.66%	60.34%		42.28%
	19	344	4	605		27	46	3444		4489
UMA	2.61%	16.12%	8.81%	4.47%	4.00%	8.82%	3.88%	7.76%		9.79%
	3	478	17	33	5	57	4	443		1040
Not Applicable	9.57%	0.91%	43.52%	0.68%	70.40%	87.00%	5.83%	2.98%	91.30%	9.19%
	11	27	84	5	88	562	6	170	21	976
Total Percent & Number	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
	115	2965	193	738	125	646	103	5708	23	10616

As shown in table 8, most of globally known data points for the nine rare plants fall under the multiple use management category (MUMA), in Clark County. The second most common category for all data points is intensively managed land, IMAs. Less than 10% of all points occur beyond Clark County. It is unclear to what degree these results are skewed by potentially greater surveying efforts on BLM and NPS managed lands.

Three taxa—threecorner milkvetch, sticky wild buckwheat, and white-margined beardtongue typically inhabiting sandy substrates—have the majority of their known data points in Clark County MUMAs where little protective management occurs. Only two taxa, sticky ringstem and Las Vegas bearpoppy inhabiting gypsum substrates, have the majority of their known data points in the highest protective management category of IMAs, but neither occur on lands in the next level of protective management category, LIMAs. One species, Pahrump Valley wild buckwheat, has no populations in either IMA or LIMA management categories, so currently it is not afforded any MSHCP protection in the County. Also evident from this analysis is that, of the nine species, the majority of the populations of three taxa occur beyond Clark County. Most of Pahrump Valley wild buckwheat occurs in adjacent Nye County, Nevada. Adjacent Nevada and California counties more commonly harbor Parish phacelia than Clark County, while alkali mariposa lily primarily occurs to the west in California counties. Nevertheless, the MSHCP does provide opportunities for protective management for populations of these species in Clark County.

Other Habitat Conservation Plans and Conservation Management Strategies

The Lower Colorado River Multi-Species Conservation Plan (MSCP) includes conservation actions for species affected by river water management, including threecorner milkvetch and sticky wild buckwheat. Nye and Lincoln counties are currently developing Habitat Conservation Plans, which may include conservation measures for seven of the overlapping low elevation rare plants (white bearpoppy, threecorner milkvetch, alkali mariposa lily, sticky wild buckwheat, Pahrump Valley wild buckwheat, white-margined beardtongue, and Parish phacelia).

There are several other CMSs under development or recently completed that may benefit the rare plants addressed in this plan. The CMSs for Mormon Mesa Desert Wildlife Management Area (DWMA), and the Muddy and Virgin rivers cover habitat for threecorner milkvetch and sticky wild buckwheat. The Gold Butte-Pakoon DWMA overlaps with habitat for sticky ringstem, Las Vegas bearpoppy, threecorner milkvetch, and sticky wild buckwheat. The Mesquite and Acacia Woodlands CMS encompasses secondary habitat for Pahrump Valley wild buckwheat. The mesquite-acacia plan was reviewed to ensure consistency among strategies. Early versions of the DWMA plans were also reviewed for consistency.

Biotic and Abiotic Factors Affecting Low Elevation Rare Plant Distribution in Clark County

Climate

The Mojave Desert is a temperate desert with warm summers and cold winters. It is the driest of the four North American deserts and the biota it supports are subject to wild fluctuations in daily, seasonal, and annual temperature and precipitation extremes. Plants and animals native to upland habitats in Clark County must persist through years of sub-optimal conditions. For example, at the longest continuously operating weather station in the Las Vegas area (WSO Airport Las Vegas) the station recorded an average 4.19 inches precipitation from 1937-2003. Within this time frame, there were eight years in which less than two inches of precipitation fell and ten years in which more than six inches fell (WRCC 2004).

The timing of precipitation in the Mojave Desert is vitally important to plants. There are two peak precipitation times during the annual cycle for Las Vegas, one in January, and another in July when monsoonal effects occur (WRCC 2004). Both peaks and temporally associated precipitation events contribute roughly half of the annual average, but only winter precipitation allows most of the annual plant species to germinate, flower, and set seed. Native upland plants in the area must be able to survive or avoid dry years and have good reproductive success in wet years to maintain viable populations. These species have unique sets of morphological, physiological, and life history adaptations that allow them to do so.

Physiography

Clark County lies near the middle of the Basin and Range Physiographic Province—an enormous continental feature stretching from eastern Oregon to Central Mexico, which is characterized by alternating, north-south-trending, faulted mountains and flat valley floors (Hunt 1967). The county is almost entirely within the Great Basin Physiographic Section of this province, with only the far southeastern portions of the County outside this section. About half of Clark County lies within the hydrographic Great Basin—including Pahrump, Stewart, Piute, Dry Lake, Ivanpah, and El Dorado valleys, all closed basins. The other half drains to the Pacific Ocean by way of the Colorado River. The Virgin and Muddy rivers are important drainages that flow to the Colorado River system via the Overton Arm of Lake Mead. Elevations in Clark County range from about 500 ft (150 m) at the extreme southern tip of the state along the Colorado River, to 11,918 ft (3,632 m) at Charleston Peak in the Spring Mountains.

Geology

The geology of the County was mapped and described by Longwell et al. (1965). It is a complex geology which includes exposed igneous, metamorphic, and sedimentary rock types. The younger Quaternary alluvial deposits overlay more than half of the County at lower elevations. The oldest Precambrian rocks are scattered throughout the County, while rocks of Cambrian formations (greater than 500 million years old) comprise many of the ranges.

A notable geologic feature in the County—at Frenchman Mountain—is the Great Unconformity where Precambrian granite and schist meet Mesozoic sandstone of the Tapeats Formation. In Red Rock Canyon NCA, Goodsprings Dolomite from the late Cambrian Epoch overlay more recent Mesozoic Aztec Sandstone at Wilson Cliffs—a feature called the Keystone Thrust (Longwell et al. 1965).

Eight geologic formations of gypsiferous strata, which vary in age and geology, have been described (Longwell et al. 1965). The younger Las Vegas Formation is Quaternary alluvium, while the Muddy Creek, Horse Spring, Gale Hills, and Thumb formations are Tertiary volcanics. Older Chinle and Moenkopi formations are Triassic redbeds, and the Kaibab-Toroweap Formation is Permian marine carbonates.

A total of 24 geology types in the Nevada GIS layer were used for analysis of plant geologic substrates (Appendix 4). However, nearly 80% of all known plant locations for the nine taxa occurred on just three geologic types. By far, Quaternary alluvium was the most common geologic category with 65.5% of the mapped data point locations. All species had some occurrences on Quaternary alluvium. The Moenkopi Formation was a distant second most common with 8.4% of data point locations, and only the gypsum affiliated plant species—sticky ringstem and Las Vegas bearpoppy—occurred on this formation. Tuffaceous sedimentary rocks were the third most common substrate type with 5.7% of all mapped data point locations. This rock type harbored sticky ringstem, Las Vegas bearpoppy, threecorner milkvetch, and sticky wild buckwheat. The remaining 21 geology types collectively harbored another 18.1% of data point locations while 2.3% were either out of state or fell in Lake Mead.

Soils

Soils in the lower elevations of Clark County vary greatly with parent material, including granite, limestone, sand, gypsum, and volcanics; and landform position, *e.g.*, ridge, hill, bottom, outwash, slope, terrace, and streambank. Degree of soil development ranges from very shallow (tableland) to moderately deep (loam and loamy bottom). Shallow soils are more frequent and support the most extensive Mojave Desert vegetation communities.

Soils characterizing Mojave Desert scrub, the most common vegetation community in Clark County, are generally associated with a 3-10 inch precipitation zone. Soil types typically supporting creosote bush dominated plant communities at the lower precipitation zones include desert pavement, limy hills and fans, claypans, valley washes, gravelly hills, gravelly and calcareous loams, dry washes, and granitic fans in the 3-5inch zone. White bursage co-occurs with creosote in the 5-7 inch precipitation zones, on limy uplands and sands, balsaltic fans and slopes, cobbly loams, granitic fans and slopes, gravelly outwashes, ridge, and sands, quartzite outwashes, and stony limestone slopes.

Soils supporting the extensive stands of blackbrush vegetation in the eastern Mojave Desert are found at the upper end of low elevations systems within the 5-12inch precipitation zone and are present on shallow soils formed of granite, gravel, loam, or limestone located on slopes, hills, and alluvial fans.

Soils in the valley bottoms include loams, sandhills, sandy plains, sand dunes, dry floodplains, alluvial plains, and desert pavement. Sodic and saline soils in these bottoms include old playa shorelines, shallow and coarse silts, sodic and calcareous loams, loamy bottoms, and sodic terraces. These soils support saltbush communities and in some areas, patches of mesquite.

Appendix 4 includes a summary of rare plant species data point locations by soil type.These data illustrate that rare plants occur on many different soil types. However, general patterns of rare plant occurrence based on soil types are apparent. For example, sand-dominated bottom substrates varying in amounts of clay and loam support populations of white-margined beardtongue, threecorner milkvetch, and sticky wild buckwheat. Pahrump Valley buckwheat generally occurs on deep, well drained clays, loams, and sands derived from lucustrine sediments. Many of the known locations of three rare plants— Parish phacelia, white bearpoppy and alkali mariposa lily, are not located within areas where soil surveys have been completed. However, based on the limited information available, Parish phacelia generally occurs in valley bottom soils with a high content of clay and loam. White bearpoppy is often found in association with fine sandy loams, sometimes with a gravelly component or in association with rocky outcrops. Soils found in association with surface and near-surface waters support moisture-dependent plant species of alkaline seeps and meadows which in a few locations include alkali mariposa lily.

The data also illustrate the occurrence of gypsophiles (gypsum loving plants), including sticky ringstem and Las Vegas bearpoppy, on loams, sands, barrens, hill, and sodic loams with varying degrees of gypsum content. These gypsic soils generally occur as patches within a greater matrix of more widely distributed soil types, and are noticeable in the field, in that they typically support unique plant associations that include the ringstem and bearpoppy. Gypsum substrates are frequently covered with cryptobiotic crusts, which contribute soil fertility and soil moisture functions that enhance seed germination and growth for vascular plant communities (Nelson and Harper 1991, Rubio and Escudero 2000). The currently available soil surveys are third order, so many of the smaller specialized edaphic sites that harbor populations of these species are still not resolved at this scale. Greater resolution soils data for the gypsum barren habitats in north Las Vegas Valley is underway by UNLV researchers (Marrs-Smith, personal communication 2005).

Vegetation

The vegetation of Clark County is rich and complex, reflecting the area's modern harsh climate, diverse substrates, great elevation relief, and oscillations of regional climate during the Pleistocene Epoch. The general series of vegetation begins at the lowest elevations in the hydrographic Great Basin portion of the County, where flats of alkaline clays are virtually devoid of vegetation. These playas have been occupied by lakes and marshes for most of the past two million years (Grayson 1993, Szabo 1994, Tchakerian 2002). In a typical vegetation series in a Clark County valley, immediately above the playa is a plain dominated by shrublands of salt-tolerant plants termed halophytes. In some valleys and associated with higher soil moisture content, isolated patches of deciduous woodlands comprised of honey mesquite (*Prosopis glandulosa*), screwbean mesquite (*P. pubescens*), and catclaw acacia (*Acacia* greggii) are found within a larger matrix of Mojave Desert scrub vegetation. In some areas, shallow groundwater or spring outflow has increased soil moisture sufficiently to allow for growth of small stands of alkaline meadow vegetation, largely characterized largely by salt tolerant grasses such as desert saltgrass (*Distichlis spicata* var. *stricta*) and alkali sacaton (*Sporobolus airoides*). More extensive riparian vegetation characterized by the introduced invasive salt cedar (*Tamarix ramossissima*), Goodding willow (*Salix goodinggii*), coyote willow (*S. exigua*), arrowweed (*Pluchea sericea*) and in a few areas, velvet ash (*Fraxinus velutinus*), are largely associated with the Colorado River and its tributaries, the Virgin and Muddy rivers.

Moving up the piedmont, halophytes are abruptly replaced by shrublands dominated by creosote bush (*Larrea tridentata*), often associated with white bursage (*Ambrosia dumosa*). The transition between halophytes and creosote bush vegetation is one of the sharpest transitions between vegetation communities in the region. Throughout the creosote bush zone, dry washes support distinctively different plant communities that are often dominated by catclaw acacia and honey mesquite both of which provide critical resources to resident wildlife and birds as well as migrating birds. Creosote bush plant communities ascend piedmont slopes to the foothills of mountains, where their floristic and structural diversity is augmented by many species, including the arboreal yuccas -- Joshua tree (*Yucca brevifolia*), and Mojave yucca (*Yucca schidigera*).

Joshua tree rises into the mountains and is a conspicuous component of the Blackbrush Zone. Here, it often occurs in more mesic sites with a blackbrush (*Coleogyne ramosissimum*)/yucca (*Yucca baccata*) understory. Higher still, blackbrush co-occurs with conifers in the lowest elevations of the next vegetation zone, extensive woodlands of pinyon (*Pinus monophylla*) and juniper (*Juniperus osteosperma*). The highest mountains in the County have forests of montane conifers and a few support small areas of alpine vegetation. Rare plant conservation in these higher elevation communities are not addressed in this plan.

Vegetation spatial layers acquired from the Southwest Regional Gap Analysis Project (Southwest ReGAP) were overlain with rare plant data point locations to evaluate species distribution based on vegetation cover type (Appendix 4). Southwest ReGAP cover types were mapped at a fairly coarse ecological system classification level, however this was necessary to improve mapping accuracy at a regional scale. Accordingly, the overlay analysis revealed that the majority of data point locations (86%) for all rare species combined occur within Sonora-Mojave Creosotebush-White Bursage Desert Scrub.

This ecological system includes the vegetation present in broad valleys, lower bajadas, plains and low hills in the Mojave Desert, comprised of a sparse to moderately dense shrub layer with creosote bush and white bursage as the dominant shrub species. Seventy-five percent or greater of the data points for Las Vegas bearpoppy, threecorner milkvetch and white-margined beardtongue, and 65% or greater of the data points for sticky ringstem, Pahrump Valley wild buckwheat, and sticky wild buckwheat occur in this system.

Other Southwest ReGAP land cover types important for the nine rare plant species are Mojave Mid-elevation Mixed Desert Scrub (27% and 44% respectively, of the data points for white bearpoppy and alkali mariposa lily), North American Warm Desert Bedrock Cliff and Outcrop (18% of the data points for white bearpoppy), North American Warm Desert Pavement (14% and 11% respectively, of the data points for sticky ringstem and Las Vegas bearpoppy), Sonora Mojave Mixed Salt Desert Scrub (28% of the data points for Pahrump Valley wild buckwheat), and Intermountain Basins Greasewood Flat (28% of the data points for Parish phacelia). Interestingly, 17% of all known data points for sticky wild buckwheat occur within the Open Water land cover class. This is attributable to the occurrence of this species along the fluctuating shore of Lake Mead.

Wildfire Regime and Invasive Species

Non-native, invasive plants such as red brome (*Bromus madritenis* ssp. *rubens*), Mediterranean grass (*Schismus barbata*) and various species of mustards, including the recently increasing Sahara mustard (*Brassica tournefortii*) and African malcomia (*Malcomia africana*), are widely dispersed across the Mojave Desert and have increased the frequency and size of wildfires, particularly in the last two decades. These species can increase in density during years of heavy rainfall and their dry stalks may remain rooted in the ground for many years after they die, providing a lasting fuel source. The effects of a single desert fire on the native vegetation may persist for 50 years, or more. In some areas of Clark County, repeated burning has eliminated perennial plants and converted the native plant communities into annual exotic grasslands, perhaps irreversibly (Brooks and Matchett 2003, Brooks *et al.* 2003).

Resource Management

Urban and Rural Development

Unprecedented population growth in Clark County has been both a direct and indirect source of most adverse impacts to native species, their particular habitats, and ecological systems in Clark County. The County has been one of the most rapidly growing urban centers in the U.S. for several decades. The population began to grow rapidly starting in about 1950, from less than 50,000 to an estimated 1.9 million people in 2006 (figure 3; UNLV Center for Business and Economic Research , 2006). Population growth projections in the past have underestimated actual growth in the County. For example, Clark County estimated its population would increase by 63% from 1993 to 1.45 million in 2020, but that 27-year estimate was exceeded in less than seven years (Clark County Assessor 2004). Average annual forecasted growth rate for the next 30 years is approximately 2.3%, and at that rate, the population of Clark County is forecasted to reach 3.5 million by the year 2035 (figure3; UNLV Center for Business and Economic Research 2006).

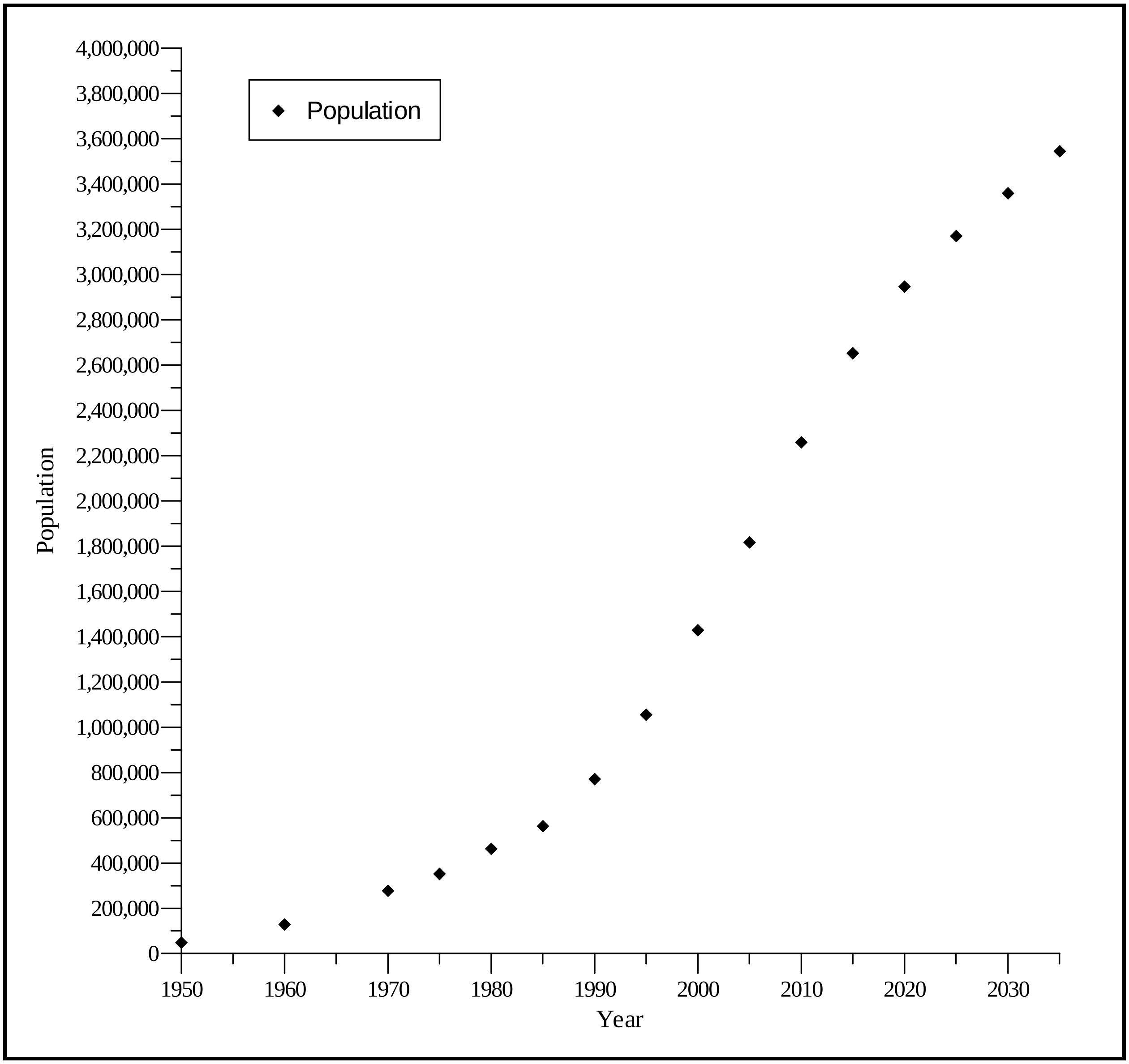

Figure 3. Population Growth Estimates and Forecast, 1950-2035 (Data Source: Nevada State Demographer and UNLV Center for Business and Economic Research).

Urban growth and development has occurred on private lands primarily in Las Vegas Valley, while rural development occurs near the towns of Mesquite and Boulder City, and a few other areas. Until the mid 1990s, the County's rapid growth was facilitated in part by numerous land exchanges conducted by BLM to dispose of federal parcels interspersed among private lands. Between 1987 and 1997, the BLM privatized approximately 17,380 acres of public lands in Clark County (BLM 2004).

In 1998, Congress enacted the Southern Nevada Public Lands Management Act, authorizing BLM to dispose of approximately 52,000 acres of public lands within a specific boundary in Las Vegas Valley. This Act was followed in 2002 by passage of the Clark County Conservation of Public Land and Natural Resources Act, authorizing disposal of an additional 22,000 acres. To accommodate anticipated growth, many large projects are planned in Clark County to provide power, water, and additional infrastructure to the growing community in the Las Vegas Valley.

While most of the growth in Clark County has been restricted to the Las Vegas Valley, effects of its growth are spreading fundamental changes to all of the valleys and most of the mountain ranges in the County. The intensity of human activity around Las Vegas Valley is significant and expanding and as a consequence, the federal landscape, on the urban fringe as well as further out, has been adversely affected. Sprawl is the collective loss, dedgradation, and fragmentation of landscapes which indirectly impairs viability of rare plant species along with other biological components of ecological systems. Sprawl from urban and rural areas in the County subjects adjacent public lands to surface disturbance, illegal dumping of household and construction debris, invasion by weeds and other exotic species, and illegal off-highway vehicle abuses. In addition, smaller pockets of development are appearing in the rural parts of the County, for example, in or near Glendale, Logandale, and Overton; Blue Diamond and Calico Basin; Jean and Primm; Indian Springs, and the Clark County portion of Pahrump Valley.

A number of major projects are planned on public lands that will remove or fragment vegetation, thereby having an adverse effect on some populations of rare plants:

Ivanpah Valley and Mesquite Airports

The Clark County Department of Aviation has proposed to construct and operate a new supplemental commercial service airport in the Ivanpah Valley, approximately 30 miles south of Las Vegas between the towns of Jean and Primm on the east side of I-15. The area to be developed is 6,000 acres in size, and will ultimately include runways, associated buildings and infrastructure, and an airport noise compatibility area. A large population of white-margined beardtongue occurs within and adjacent to the project area. Another proposed airport would be located southwest of the City of Mesquite on Mormon Mesa. This project area includes a 780-acre portion of a 2,622-acre parcel to be transferred from BLM to the City of Mesquite.

Public Land Rights-of-Way and R&PP Leases

BLM issued an average of 1,300 acres of right-of-way (ROW) grants and 440 acres of recreation and public purpose (R&PP) leases per year between 2001 and March 2004 to support infrastructure development for previously disposed land. ROWs are authorized for structures, pipelines, and facilities to store and transport water, sewer, electricity, and communication systems; for flood control facilities; and transportation corridors (BLM 2004). To the extent possible, BLM locates new ROWs within existing approved corridors and along existing alignments. However, many projects require their own unique alignment and these results in additional land disturbance and fragmentation of habitat.

Mining

Much of the BLM's Las Vegas District is open to mine exploration and development. Past and ongoing mining practices impact rare plant populations on gypsum substrates in several locations east of Las Vegas Valley. In 2000, BLM estimated that over a 20-year period between 14,500 and 41,500 acres could be disturbed by new mining activities. However, the Las Vegas RMP substantially limits new mining claims in ACECs, desert tortoise critical habitat, and near springs and riparian areas. These closures are intended to protect desert tortoise and other rare species occurring in these areas.

Three major mines currently operate in Clark County. Gypsum mining is currently occurring in Clark County at one mine – PABCO Gypsum, located east of Las Vegas and north of the Rainbow Gardens ACEC. Silica sand is mined along the Muddy River near Overton by Simplot Silica Products. Apex Quarry located northeast of Las Vegas on I-15 is mined for lime and limestone.

Clark County has several major sources of sand and gravel, the most important sources being the Lone Mountain area northwest of Las Vegas, and various pits in the southwest portion of Las Vegas Valley. Community pits are located throughout the County and are managed by BLM under salable minerals regulations. These pits are located both outside and within ACECs and are operated in accordance with BLM's 1998 Las Vegas District RMP. Within the ACECs pits are restricted to the area within 0.5 miles of State highways and County Roads. In addition, a pit immediately adjacent to Rainbow Gardens ACEC is allowed to operate under the 1998 RMP.

Grazing

Most grazing allotments in Clark County have been closed although several remain open to livestock grazing. Recent statistics compiled by the Nevada Department of Agriculture indicate that in 2005, there were 8000 head of cattle in Clark County, while in 2006, there were 4,000 head. This reduction is likely a function, at least in part, of the recent closure of the Jean Lake allotment. Grazing allotments overlapping the habitat of white-margined beardtongue in Hidden Valley, and threecorner milkvetch and sticky wild buckwheat near the city of Mesquite are still in use. There also remains a fair amount of trespass grazing in the Gold Butte area.

Wild Horses and Burros

Of the approximately 32,000 wild horses and burros that inhabit BLM-managed rangelands in the ten Western states, Nevada is home to about half of these individuals. Clark County likely supports 1,000 or fewer wild horses and burros in six Herd Management Areas. Wild horse and burro herds are present in the Spring, Muddy, and Eldorado mountains, the Gold Butte area, and the Red Rock Canyon area. If managed improperly, wild horses and burros can contribute significantly to resource damage, through trampling and grazing that may accelerate soil erosion and damage natural vegetation, particularly around water sources (RECON 2000).

Recreation

The extensive acreage and topographically diverse Federally managed lands of Clark County offer many opportunities for casual and organized outdoor recreation. There are many designated recreation sites in Clark County, including city, county, and state parks; the Red Rock Canyon and Sloan Canyon NCAs; Lake Mead NRA; the Spring Mountains NRA; and a number of Special Recreation Management Areas managed by BLM for off-road and off-highway vehicle events. These include Nellis Dunes, Sunrise Mountain, Nelson Hill/Eldorado, and Jean/Roach Special Recreation Management Areas. The Gold Butte and Bitter Spring Back Country Byways provide access for high clearance and four-wheel drive vehicle recreation to the more remote areas of the County.

There are many opportunities for casual and dispersed recreation in areas supporting the low elevation rare plants, for activities such as off-highway vehicle touring and racing, mountain biking, hiking and camping, and rock climbing. Off-highway vehicle use accounts for the greatest single recreational use of the public lands (RECON 2000). Demand for recreational opportunities is increasing with County's population expansion. One of the immediate effects of this increase in human population density is the increase in dispersed recreation activities in many areas of the County where the low elevation rare plants occur.

TNC CONSERVATION ACTION PLANNING (CAP) METHODOLOGY

TNC has developed a conservation action planning (CAP or enhanced 5S) framework for conservation practitioners (Low 2001, TNC 2005). This framework is described fully within appendix 5, and is briefly summarized here. Underlined terms are defined in a glossary attached to appendix 5.

The CAP approach first involves a project area description and identification of the conservation area's focal conservation targets, which may be the area's highest priority species, ecosystems, or natural communities. Both of these steps were previously determined by the Clark County MSHCP itself and a Rare Plant Working Group who identified the nine rare plant species for the focus of this conservation management strategy. Next, key ecological attributes and their indicators are selected for the species and ranking definitions for indicator values are sought to assist with measuring current and desired status of the species at various locations. Rankings take into consideration the acceptable range of variation for an attribute. Altered key ecological attributes are also known as stresses to the plant species, and these are rated for their scope and severity. Then, proximate sources of stress are determined and rated for their contribution and reversibility in degrading key attributes. Stresses and their sources of stress are threats and those that are ranked highest define the critical threats to the plant taxa.

When analyzed within the context of a given situation—for example, past and current land use, ownership patterns, partnering opportunities for taking management action, and stakeholder concerns—critical threats form the basis for identifying specific and measurable strategies for conservation. Objective-based strategies are then developed to address either threat abatement (ongoing activities) or ecological health of the plants (restoration), or both, if appropriate. Key measures of success are identified and monitored in an adaptive management manner to determine the effectiveness and accuracy of the identified conservation strategies. Thus, the approach provides a baseline—the initial assessment—and it spawns two specific products—conservation strategies and measures of conservation success.

An Excel-based software program has been developed by TNC to facilitate the CAP process, automate the roll-up of summary results, and serve as a consistent repository for CAP information. CAP workbooks document current conservation assessment information and one for each of the nine low elevation rare plants has been completed for this CMS. They are provided in digital format for updating as new information becomes available. An updated empty version of the workbook for conservation planning use and a User's Manual can be downloaded at http://conserveonline.org/workspaces/cbdgateway/cbdmain/cap/resources/.

The components of TNC's CAP framework are illustrated in figure 4 and are discussed in detail in specific sections of the species assessments that follow.

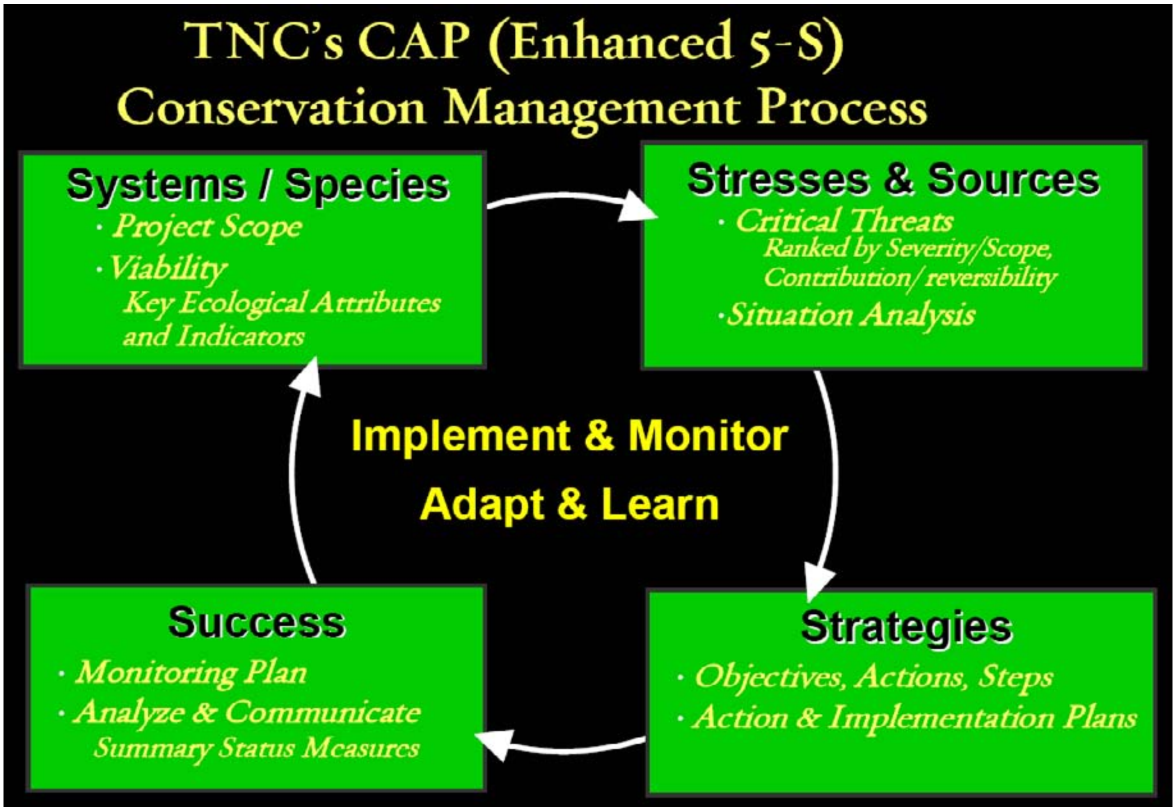

Figure 4. Diagram of TNC conservation action planning framework.

SPECIES ASSESSMENTS

A review of available information and a conservation assessment using TNC methods for each of the nine low elevation plant species is presented separately below. The taxa are organized alphabetically by genus within three general habitat groups, with the upland desert habitats presented first, followed by three plants in habitats primarily defined by hydrologic/soil regimes in valley bottom or associated spring environments. Thus, sticky ringstem, Las Vegas bearpoppy, and white bearpoppy, which typically occur on gypsum substrates (the gypsophytes) are reviewed first—although the latter species also is found often on limestone foothills; followed by threecorner milkvetch, sticky wild buckwheat, and white-margined beardtongue typically inhabiting sand sheets or sand dune habitats (the psammophytes); and finishing with Pahrump Valley wild buckwheat and Parish phacelia typically found on finer textured seasonally moist soils at playa margins, and alkali mariposa lily occurring in alkaline meadows associated with spring seeps. They are ordered in this manner because similar environmental conditions are associated with somewhat similar ecological, management, and threat issues.

Each species review begins with a brief summary of its generic and species significance with relevance to Clark County, and its current formal status determined by federal, state, and local entities. Its known geographic distribution—countywide and global—is then discussed and includes descriptions of the named population groups (**bold** font) used for the conservation assessment. Population groups as they have been defined for this CMS may or may not have biological significance, but they certainly have utility for spatially organizing location and occurrence information, which has been documented over time at varying spatial scales and degrees of precision by numerous sources. The term population group is used throughout this strategy, rather than metapopulation, because so little is known about the genetic and ecologic relationships among each species populations that it is unclear whether metapopulation dynamics are truly operating. Species population groups are categorized by their MSHCP management status for documentation purposes in the CAP/5S workbooks (appendix 6).

The distribution section is followed by descriptions of known habitats occupied by the species, with information gleaned from literature summarized first and followed by our own GIS spatial analyses of data points. Much information is summarized in terms of numbers/percentage of data points by population groups because acreage figures are often lacking altogether. A brief life history strategy for the species follows and is described in terms of its bearing on conservation management. A summary of plant surveys, inventories, and conservation status reports ensues.

The section on key ecological attributes provides preliminary attributes, indicators, and rough ranking definitions for four categories from poor to very good, which provides the basis for species status information given in a following section on viability. Current viability and species trend is enumerated to the extent known. Viability is assessed in terms of structure, composition, interactions, and both abiotic and biotic processes that enable a plant to persist through their influence on the species size, condition, and landscape context. The latter term, landscape context, includes ecosystem processes as well as patterns related to connectivity necessary for population persistence (see appendix 5 for glossary of terms). A review of any monitoring and research conducted on behalf of the species is discussed for conservation relevance. Historic and current management for the species is reviewed and includes any restoration activities and mitigation used for past actions that have impacted the species.

Next, the threats section begins with an overview of documented stressors for the species and its habitats as a whole, with a summary of stresses (altered key ecological attributes) to the species resulting from these threats. Discussion of threats at specific locations follow, which involves current threats as well as those expected to occur within the next ten years—a reasonable timeframe for strategy planning purposes. Threats are discussed with the five ESA listing factors in mind, which are: 1) destruction, modification or curtailment of the species' habitat or range; 2) utilization for commerce, recreation, science or education;

3) disease or predation; 4) inadequacy of existing regulatory mechanisms; and 5) other natural or manmade factors affecting the species' continued existence. Summary graphics of threats analyses are provided in appendix 6; however, cautious interpretation is advised as summary threat ranks are given for populations within MSHCP management categories and not for named population groups.

A concluding conservation assessment of species status, with data gaps, risks, and uncertainties is summarized in the final section for each species. A table of research and management needs and draft conceptual models for each species situation are included here. Summary tables extracted from the CAP/5S workbooks are shown in appropriate sections of the assessments.

***Anulocaulis leiosolenus* (Torr.) Standley var. *leiosolenus*, sticky ringstem**

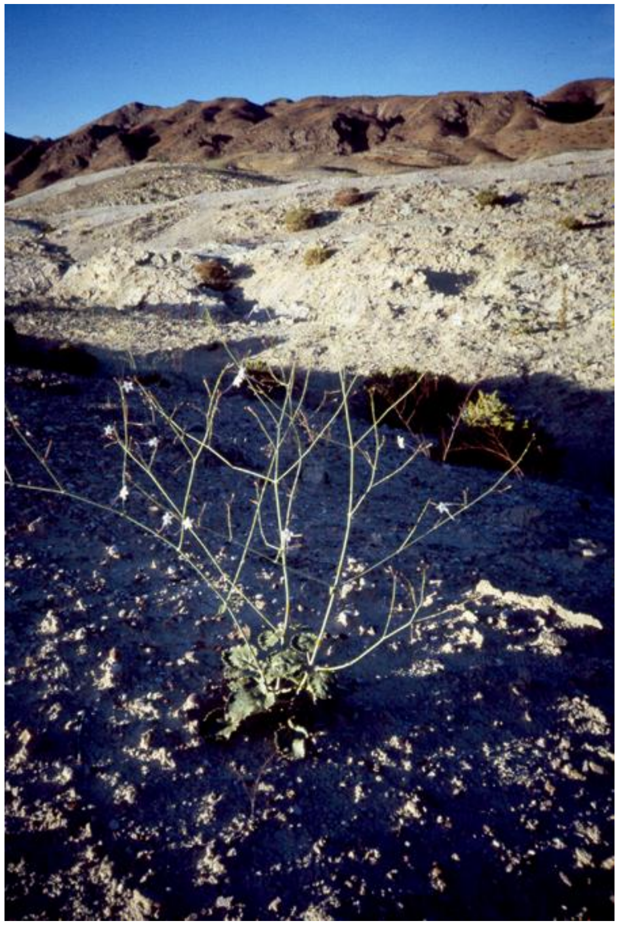

Photo courtesy of Gayle Marrs-Smith

Status, Trends, and Viability
Taxon Significance and Formal Status
Anulocaulis, a member of the four-o'clock family (Nyctaginaceae), is endemic to North America's southwestern deserts. It is a small genus comprised of five species and some of these are narrow endemics. Four of the five species are gypsophiles—plants essentially restricted to gypsum substrates (Meyer 1986, Spellenberg and Wooten 1999). In Nevada, the genus is represented by *Anulocaulis leiosolenus* var. *leiosolenus*, sticky ringstem. The plant is under current taxonomic review by Spellenberg in consideration of ecological and new genetic information.

Sticky ringstem has no formal status. It is not federally listed by USFWS under the ESA, and it is not state listed by Nevada under NRS 527.260 nor by the states of Arizona, New Mexico, or Texas where it also occurs. The global heritage status rank for sticky ringstem is vulnerable as denoted by its T3G4 rank. Its state rank in Nevada was reviewed recently in October 2004 and is now ranked imperiled, S2 (NatureServe 2006). However, the other state ranks are under review with no current rank (NatureServe 2006).

Geographic Distribution
As currently understood the global distribution for sticky ringstem takes in four states and immediately adjacent Mexico, while overlapping four ecoregions (figure 5). This is the broadest distribution of all species considered here. Sticky ringstem has a bicentric distribution with the western half in the eastern

Mojave Desert, western Colorado Plateau, and Apache Highlands ecoregions of Nevada and Arizona. Its eastern half is in the northwestern Chihuahuan Desert Ecoregion of New Mexico, Texas and Chihuahua, Mexico. About 350 intervening miles with no known populations separate the two geographic centers. We organized sticky ringstem's known global occurrences into 17 population groups (in **bold**) from northwest to southeast:

- nine population groups occur in the eastern Mojave Desert Ecoregion, with eight in Clark County north of the Colorado River (**Lava Butte, Gypsum Wash, West Black Mountains, East Black Mountains, Bitter Spring Valley, Overton Arm, Muddy River,** and **Gold Butte**), and one in Arizona on the south side of Lake Mead (**Big Gypsum Ledges**);
- three population groups in the Colorado Plateau Ecoregion along the Colorado River (**Havasupai Canyon, Little Colorado River,** and **Upper Colorado River**) based on collection records;
- one isolated population closer to the western population groups in the western Apache Highlands Ecoregion in central Arizona (**Yavapai County**); and,
- four population groups in the Chihuahuan Desert Ecoregion near the US-Mexico international border (**Rio Grande NW, Hudspeth County, Culberson County, Chihuahua)** defining the southeastern center of the species, as well as the southeastern extent of its distribution.

Sticky ringstem occurs in Nevada only in Clark County where it is limited to the eastern half. It occurs at Frenchman Mountain, Black Mountains, Bitter Spring Valley, Muddy Mountains, and in the Gold Butte area all north of the Colorado River. The Clark County populations represent the westernmost locations of several, extremely isolated populations, none of which are known to be abundant (figure 6).

The presently accepted peripheral nature of Clark County populations may be important for contributing genetic and ecotypic variation to the taxon's global population characteristics. Although Spellenberg (1993) states that there seems little utility in distinguishing the western race, he currently is reviewing the Clark County disjunction in light of its narrowly defined gypsum habitat and new genetic information. Recent unpublished work suggests to him that the Nevada populations may belong to *A. gypsogenus*, a closely related species occurring on gypsum in New Mexico and Texas (Spellenberg, personal communication 2004).

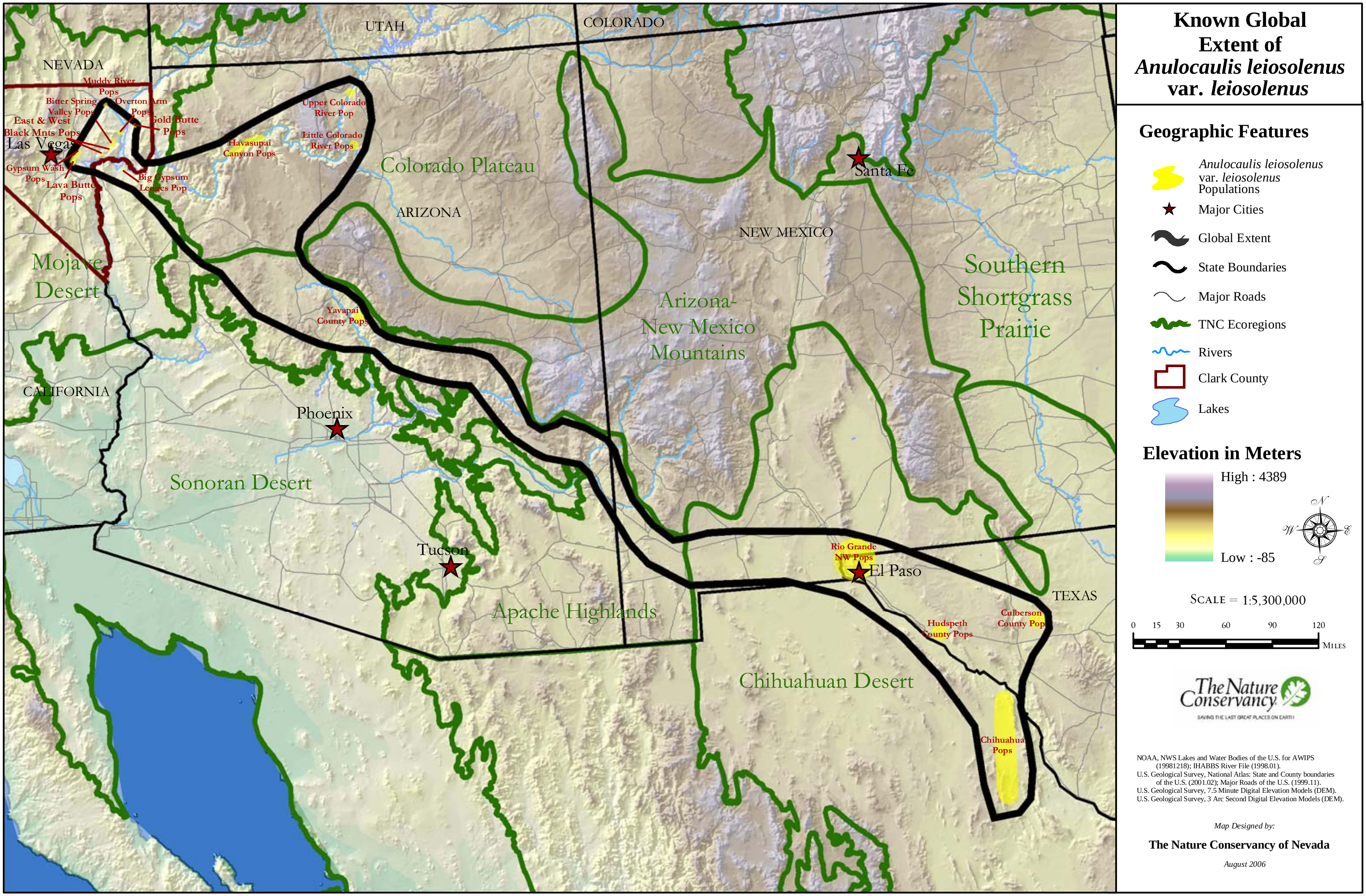

Figure 5. The known global extent of Anulocaulis leiosolenus var. leiosolenus, sticky ringstem.

Known Clark County Distribution of *Anulocaulis leiosolenus* var. *leiosolenus*

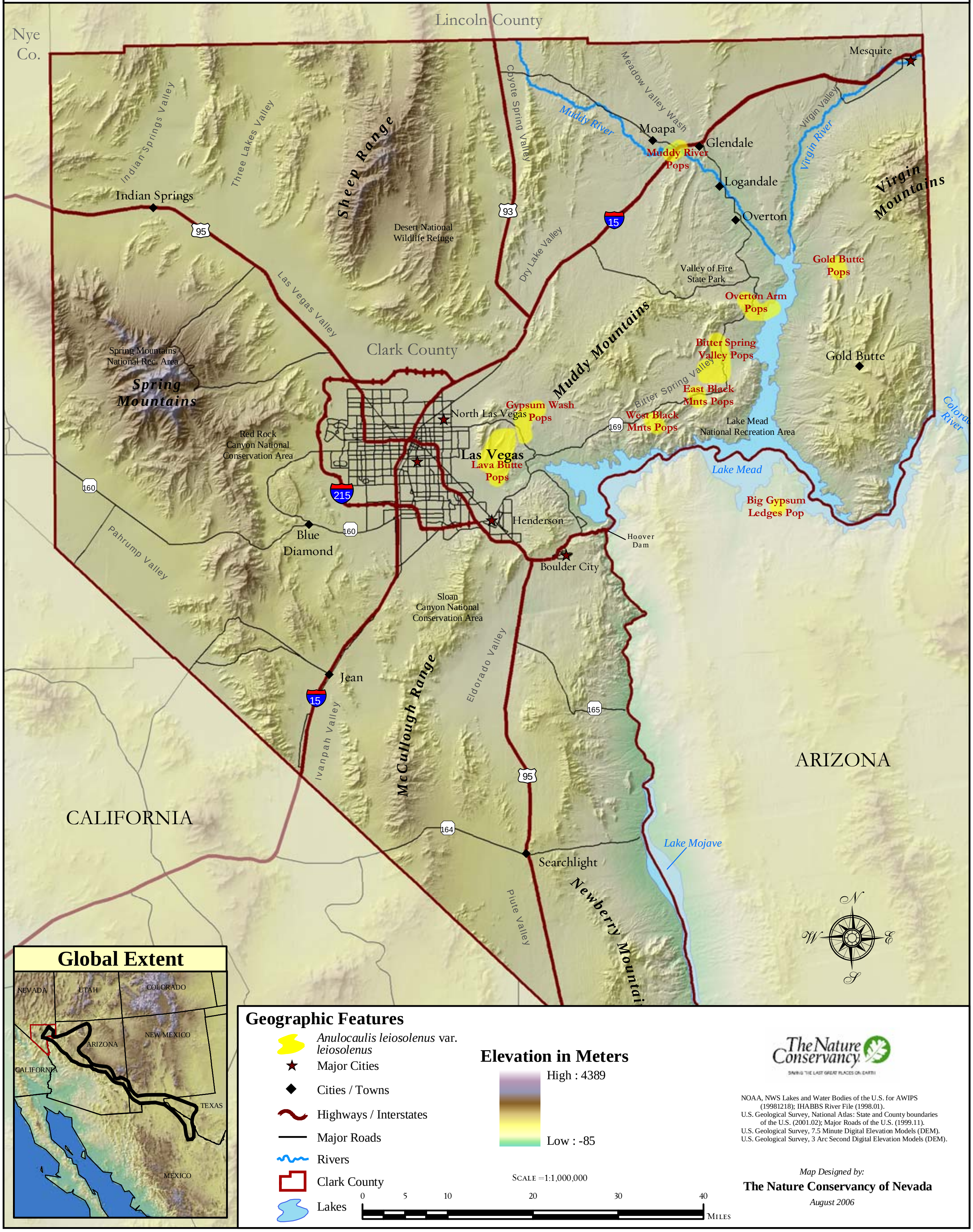

Figure 6. The known geographic distribution of Anulocaulis leiosolenus var. leiosolenus, sticky ringstem in Clark County.

Habitat Description
Sticky ringstem is restricted to gypsum outcrops, rolling hills, and terraces within Mojave desert scrub (primarily creosote bush-white bursage) and salt desert scrub matrix ecological systems (Niles *et al.* 1999). In Clark County, sticky ringstem is classified as a long-lived perennial gypsophile (Meyer 1986). It is associated with Las Vegas bearpoppy at many locations where they occur in a unique gypsum barrens plant community. Meyer (1986) measured only 14% constancy on gypsum sites for sticky ringstem in Clark County; thus, although it is restricted to gypsum it uncommonly occurs on this habitat. Beyond the Mojave Desert, sticky ringstem occurs on calcareous shales and clays (Spellenberg 1993).

Description of the vegetation from Mistretta *et al.* (1996) for Las Vegas bearpoppy is applicable for sticky ringstem It consists of sparse, mostly herbaceous associations of other gypsum-tolerant species, characteristically including Torrey ephedra, desert pepperweed, Parry sandpaper plant, Fremont dalea, Las Vegas bearpoppy, silverleaf sunray, wingseed blazingstar, matted crinklemat, ladder buckwheat, Palmer phacelia, beautiful phacelia, and hairybeast turtleback (*Ephedra torreyana, Lepidium fremontii, Petalonyx parryi, Psorothamnus fremontii, Arctomecon californica, Enceliopsis argophylla, Mentzelia pterosperma, Tiquilia latior, Eriogonum insigne, Phacelia palmeri, P. pulchella,* and *Psathyrotes pilifera*). At its eastern locations in New Mexico, Texas, and Chihuahua it occurs with *Acacia vernicosa, Hilaria, Larrea* and *Yucca torreyi* (Spellenberg 1993).

Cryptogamic crusts are strongly associated with the species with heavy cover at many sites. While these crusts are not well known, they are known to contribute to the viability of vascular plants that occur on them. Some of their functional roles include stabilization of soil (Ladyman *et al.* 1998), increased germination and seedling success (Harper and Pendleton 1993) and the release of essential nutrients, particularly nitrogen and chelating agents, in the soil (Harper and Pendleton 1993). Hypotheses concerning the role of these crusts in the regulation of soil temperatures indicate they may be a critical factor in germination and successful establishment of vascular plant species.

Sticky ringstem occurrences average 550 m in elevation with a range from 373 to 717 m (1223 to 2352 feet) in the Mojave Desert populations. It typically occurs on gentle slopes around four degrees and does not occur on slopes greater than 13 degrees. The majority of sticky ringstem occurrences in the Mojave Desert have north, northeast, east, southeast, and south exposures, while western exposures (northwest to southwest) and flat sites are rare to non-existent.

Sticky ringstem occurs in small outcrops of gypsum soils containing as much as 69% calcium sulfate (Niles *et al.* 1999). These small edaphic anomalies were not mapped by Longwell *et al.* (1965), nor in the third order soil survey. GIS analysis of sticky ringstem data points in Nevada maps them most commonly on continental sedimentary rocks and occasionally on tufaceous sedimentary rocks and the Moenkopi Formation, all of Triassic age. A few populations occur on Chinle Formation, Aztec Sandstone, and Quaternary alluvial deposits. Sticky ringstem occurs on several soils associations with the most common ones derived from gypsum rocks. The soil series comprising the soil associations most commonly include Drygyp, Guardian, Baseline, Callville, Badland, Bluegyp, Aztec-Bracken complex, Huevi-Cheme, and Huevi-Hiller.

Life History Strategy
Sticky ringstem is a robust herbaceous perennial with a gnarled woody root and thick, leathery leaves. The long tubular flowers are ephemeral, opening at sunset and closing early in the day. It flowers and sets fruit mid-summer and again in October long after most other herbaceous perennials (Spellenberg 1993). The white nocturnal flowers are visited by sphingid moths in the Chihuahuan Desert and likely are pollinated by moths in the Mojave Desert. Meyer (1987) notes that sticky ringstem has low seed output. Notably, this is in contrast to Las Vegas bearpoppy which has a high reproductive output strategy, even

though both are herbaceous perennials that occur on gypsum substrates. Its lifespan is not known although it is described as long-lived (Meyer 1987).

Surveys, Inventories, and Status Reports

The species was first collected in Nevada east of Las Vegas in 1938 by Percy Train and collections in the state since then have been few. Sticky ringstem was put on a list of plants for Lake Mead NRA by Holland in 1979 and documented in the Muddy Mountains (**Overton Arm**) during a comprehensive floristic survey of the area (Holland 1979, Swearingen 1981). Surveys for sticky ringstem have been sporadic and only a few inventories include it. One of a series of BLM-sponsored general floristic surveys found 100 plants in Echo Wash (**Bitter Spring Valley**) where heavy burro damage also was recorded (Niles *et al.* 1999). Later, at Lake Mead NRA, 43 documented locations were made during surveys and monitoring for Las Vegas bearpoppy (Powell 2004). Those notes included some site condition information and reported that it was abundant although no population size numbers are provided.

No conservation status report has been written for sticky ringstem, but there are brief summaries for it in FWS (2000) and RECON (2000). The Nevada Natural Heritage Program discontinued tracking the species in the early 1990s, but placed it on their watch list in 2004 (NNHP 2004) and that action may stimulate new survey information.

Key Ecological Attributes

Table 9 shows seven key ecological attributes and their indicators that have been initially identified for sticky ringstem. Attributes and indicators were ferreted based on a better understanding of its close associate, Las Vegas bearpoppy. Preliminary population numbers of plants are based on the few documented occurrences by the National Park Service and individuals, but areal extent of populations are lacking. Key ecological attributes and their indicators need refining as applied research and population monitoring provide improved and expanded information.

Table 9. Key ecological attributes, indicators, and their ranking definitions for sticky ringstem populations. Italics represent the ultimate goal of land managers.

Category	Key Attribute	Indicator	Sticky Ringstem (*Anulocaulis leiosolenus* var. *leiosolenus*) Indicator Rankings			
			Poor	Fair	Good	Very Good
Landscape Context	Ecological integrity of surrounding matrix systems and specific habitat	Density of vehicle tracks and animal (WHB/cattle) trails within habitat and matrix systems	High density or >50% scope of habitat impacted	Moderate density or >10<50% scope of habitat impacted (>1 mi / sq mi habitat)	Low density or <10% scope of habitat impacted (<1 mi / sq mi habitat)	*Virtually no vehicle tracks or animal trails*
Landscape Context	Soil moisture and nutrient regime	Degree of surface disturbance relative to presence of surface crusts and gravels on gypsum soils	High surface disturbance with only remnant cryptobiotic crusts/gravel surfaces present	Moderate surface disturbance with <20% cover of cryptobiotic crusts/gravel surfaces present	Low surface disturbance with >20% of cryptobiotic crusts/gravel surfaces present	*Surface disturbance virtually absent with intact cryptobiotic crusts/gravel surfaces present*

Category	Key Attribute	Indicator	**Sticky Ringstem (*Anulocaulis leiosolenus* var. *leiosolenus*) Indicator Rankings**			
			Poor	**Fair**	**Good**	**Very Good**
Condition	Characteristic native plant community	Native vs. exotic plant species composition	Many native species conspicuously absent, and exotics or habitat-altering invasives common	Some native species conspicuously absent, and several exotics or habitat-altering invasives present	Mostly native species composition, and with few exotics, although no habitat-altering invasives	*Native plant species composition with no habitat-altering exotic species present*
Condition	Soil structure and stability	Degree of soil erosion or soil compaction	High erosion or compaction	Moderate erosion or compaction	Low erosion or compaction	*Virtually absent*
Size	Minimum dynamic area	Number and average size of habitat patches	Large number of habitat patches with small average size	Moderate number of habitat patches with moderate average size	Small number of habitat patches with large average size per patch	*Few habitat patches with very large average size*
Size	Minimum dynamic area	Sufficient acreage for characteristic species and natural habitat disturbances within historic range of variability	Insufficient acreage for all sensitive species and severe disturbance likely to eliminate habitat	Insufficient acreage for most sensitive species and habitat susceptible to severe disturbance	Sufficient acreage for most sensitive species and habitat mostly resilient to severe disturbance	*Sufficient acreage for all sensitive species and severe disturbance*
Size	Population size & dynamics	Number of reproductive plants in non-drought years	Few	10s	100s	*>1000*

Viability and Trend Status
Scant specific data exists for sticky ringstem viability estimates. In the 1980s, Meyer measured its abundance where it occurs in areas with Las Vegas bearpoppy and noted average density of 0.6 plants per 100 m^2 (Meyer (1987). The westernmost **Lava Butte** population group is documented as the largest although plants are not abundant. It overlaps with the BLM managed population of Las Vegas bearpoppy at Sunrise Valley. One of a series of BLM-sponsored general floristic surveys made specific documentation of it east of Bitter Springs (Niles *et al.* 1999) which appears to have the greatest areal extent (**Bitter Spring Valley**). Later, documented occurrences were made during surveys and monitoring for Las Vegas bearpoppy which provided some population numbers (Powell 2004). The **Muddy River** population group was recently noted with intact habitat (Lund, personal communication 2005).

Undocumented extirpations in Clark County almost certainly occurred in the Boulder Basin and Overton Arm portions of Lake Mead. The rangewide trend for sticky ringstem is presumed stable (USFWS 2000), but there is too little population size information over time to determine its trend in Nevada. We relied on condition and functional viability information from locations where it occurs with the much more studied Las Vegas bearpoppy (table 10).

Table 10. Viability ranks for sticky ringstem populations grouped by MSHCP management category within Clark County and by all states beyond the County.

Sticky Ringstem (*Anulocaulis leiosolenus*)		Landscape Context	Condition	Size	Viability Rank
1	**East Black Mountains, Gold Butte, Lava Butte, West Black Mountains** (IMA)	Fair	Fair	Good	**Fair**
2	**Bitter Spring Valley, Gypsum Wash, Overton Arm Populations** (Mixed)	Poor	Fair	Good	**Fair**
3	**Muddy River Populations** (UMA)	Fair	Fair	Good	**Fair**
4	**Big Gypsum Ledges, Havasupai Canyon, Little Colorado River, Upper Colorado River, Yavapai County, Rio Grande NW, Culberson County, Hudspeth County, Chihuahua Populations** (ANMTM)	-	-	Good	**Good**

Monitoring and Research

No monitoring, whether status and trend or effectiveness measures, has been conducted specifically for sticky ringstem. However, NPS and BLM monitoring for Las Vegas bearpoppy notes habitat condition information over time for portions of **Lava Butte, West Black Mountains, East Black Mountains, Bitter Spring Valley,** and **Overton Arm** population groups.

Genetic research with possible taxonomic and global distribution relevance is underway (Spellenberg, personal communication 2004). No pollination studies have been done, although moths likely pollinate the species since they have been documented visiting flowers.

Management

About 70 percent of the known data points occur on IMA lands managed by BLM (**Lava Butte** and **Gold Butte**) and NPS or BoR (**Bitter Spring Valley, Overton Arm, East Black Mountains,** and **West Black Mountains**). The latter two population groups overlap with the Pinto Valley Wilderness at Lake Mead NRA. MUMAs account for about 17 percent of data points, which occur in **Bitter Spring Valley**, and it is possible that **Muddy River** population group harbors individuals on adjacent MUMA lands. The **Muddy River** and **Gypsum Wash** population groups include private lands (table 11). The species has not received specific management in the County, although populations that co-occur with Las Vegas bearpoppy are protected under measures taken to protect its gypsum habitat (*e.g.* **Lava Butte** at Las Vegas bearpoppy's **Sunrise Valley** group). Portions of **Gold Butte** and **Gypsum Wash** overlap designated ACECs established for other habitats while portions of **Bitter Spring Valley, Gold Butte, East Black Mountains,** and **West Black Mountains** overlap Wilderness Area designations. No measures have been taken to restore previously disturbed habitat for sticky ringstem in Clark County.

Table 11. Management of sticky ringstem in Clark County with percentages totaled for each population group provided above the number of data points. Eleven data points occurring out of state are not shown.

Sticky ringstem *Anulocaulis leiosolenus*	IMA		MUMA	UMA	Population Total
	BLM	NPS			
Lava Butte	90.91% 50				43.48% 50
Bitter Spring Valley		65.38% 19	100.00% 12		26.96% 31
Gold Butte	5.45% 3				2.61% 3
Overton Arm		7.69% 8			6.96% 8
East Black Mountains		19.23% 5			4.35% 5
West Black Mountains		7.69% 2			1.74% 2
Gypsum Wash	3.64% 2			33.33% 1	2.61% 3
Muddy River				66.67% 2	1.74% 2
Total % Total Count	100.00% 55	100.00% 26	100.00% 12	100.00% 3	100.00% 104

Threats
Identified threats to sticky ringstem and its habitats are many. In order of highest ranked threats, they include gypsum mining, casual vehicle use and trail development, rural/urban development and related sprawl, Federal land disposal, invasive plant species, wild horse and burro management, utility corridor construction and maintenance, legal recreation use, habitat inundation and shoreline fluctuation, and trespass grazing (table 12). These threats have reduced size and extent of populations and habitats by both direct mortality of individuals and loss or fragmentation of habitats. They have altered composition of the gypsum barren plant communities by aiding the spread of weeds along roads and trails. They have altered condition of substrates through soil erosion, compaction, and destruction of cryptobiotic crusts. The latter has played a role in altering soil moisture and nutrient regimes of its habitat.

Gypsum and cryptobiotic surface crusts found on soils harboring sticky ringstem at **Bitter Spring Valley** and **Gypsum Wash** are easily damaged by vehicles, burros, and humans. Once surface crusts are damaged they are susceptible to erosion (Niles *et al.* 1999). Habitat at **Lava Butte** benefits from OHV restrictions, but violations of off-highway vehicle regulations are commonplace and existing regulations are not effectively enforced. Wild horses and burros may graze sticky ringstem at least during dry years at Lake Mead NRA (Powell 2004).

Table 12. Threat ranks for sticky ringstem populations grouped by MSHCP management category within Clark County and by states elsewhere.

Sticky Ringstem (*Anulocaulis leiosolenus*) Threats Across Population Groups		East Black Mountains, Gold Butte, Lava Butte, West Black Mountains (IMA)	Bitter Spring Valley, Gypsum Wash, Overton Arm Populations (Mixed)	Muddy River Populations (UMA)	Big Gypsum Ledges, Havasupai Canyon, Little Colorado River, Upper Colorado River, Yavapai County, Rio Grande NW, Culberson County, Hudspeth County, Chihuahua Populations (ANMTM)	Overall Threat Rank
1	Gypsum mining	High	High	Medium	-	High
2	Casual OHV use and trail development	Medium	High	-	-	Medium
3	Rural development and sprawl	-	-	High	-	Medium
4	BLM land disposal to private development	-	-	High	-	Medium
5	Invasive exotic plant species competition	-	Medium	Medium	Medium	Medium
6	Wild horse and burro management	Medium	Medium	-	Low	Medium
7	Utility corridor construction and maintenance	Medium	Medium	-	-	Medium
8	Legal concentrated recreation use	Medium	Low	-	Low	Low
9	Lake Mead inundation and shoreline flux	-	-	-	Medium	Low
10	Livestock grazing management	-	-	Low	-	Low
11	Trespass grazing	Low	-	-	-	Low
Threat Status for Populations and Overall Distribution		Medium	High	High	Medium	High

Conservation Assessment
The seven known populations of sticky ringstem occurring on Federal lands in Clark County (**Lava Butte, Bitter Spring Valley, Gypsum Wash, Overton Arm, East Black Mountains, West Black Mountains,** and **Gold Butte**) are genetically significant and are a high priority for the species long term

viability for its disjunct western distribution. Populations overlapping private land (**Muddy River** and **Gypsum Wash**) should be investigated for acquisition and federally managed to mitigate for loss of gypsum habitat in its range (*e.g.* Frenchman Mountain and Boulder Basin). Much of sticky ringstem habitat overlaps with Las Vegas bearpoppy and benefits from management actions either in place now or planned for gypsum habitats on BLM. Gypsum habitats in Clark County afford landscape level opportunity to address this species while addressing needs of the better known two bearpoppy species. There is so little known about this species biology that an emphasis should be given to applied research (that answers viability gaps) and status monitoring to assist with an initial outline of management actions in the County. It is especially important to document new information for the species so that initial management is refined in a timely course. Table 13 lists general research and management topics for sticky ringstem and places priority for addressing them based on need to fill information gaps.

Table 13. Research and management needs for sticky ringstem by priority ranking.

Research and Management Need	Priority Rank
Species range distribution information	1
Species extents and abundances	1
Population genetics	1
Pollination ecology	1
Current viability of populations under documented climate conditions	1
Seed bank research	1
Geospatial-based threats analysis	1
Effectiveness and status monitoring	1
Comprehensive conservation report	1
Effective restoration techniques	1
Habitat patch connectivity requirements	1
Smaller-scale soils and vegetation maps for predictive distribution mapping	1
Impacts of global climate change	1
Reproductive biology	2
Population viability analyses	2
Randomized surveys	3
Effects of fire and invasive plant species interactions (including dune stabilization)	3
Role of exotics in resource competition	3

Seven conservation objectives address viability enhancement and threat abatement for sticky ringstem in the strategies section of this document. They include the multi-species and multi-site objectives 1-5, 7, and 13. A preliminary conceptual model for sticky ringstem follows (figure 7).

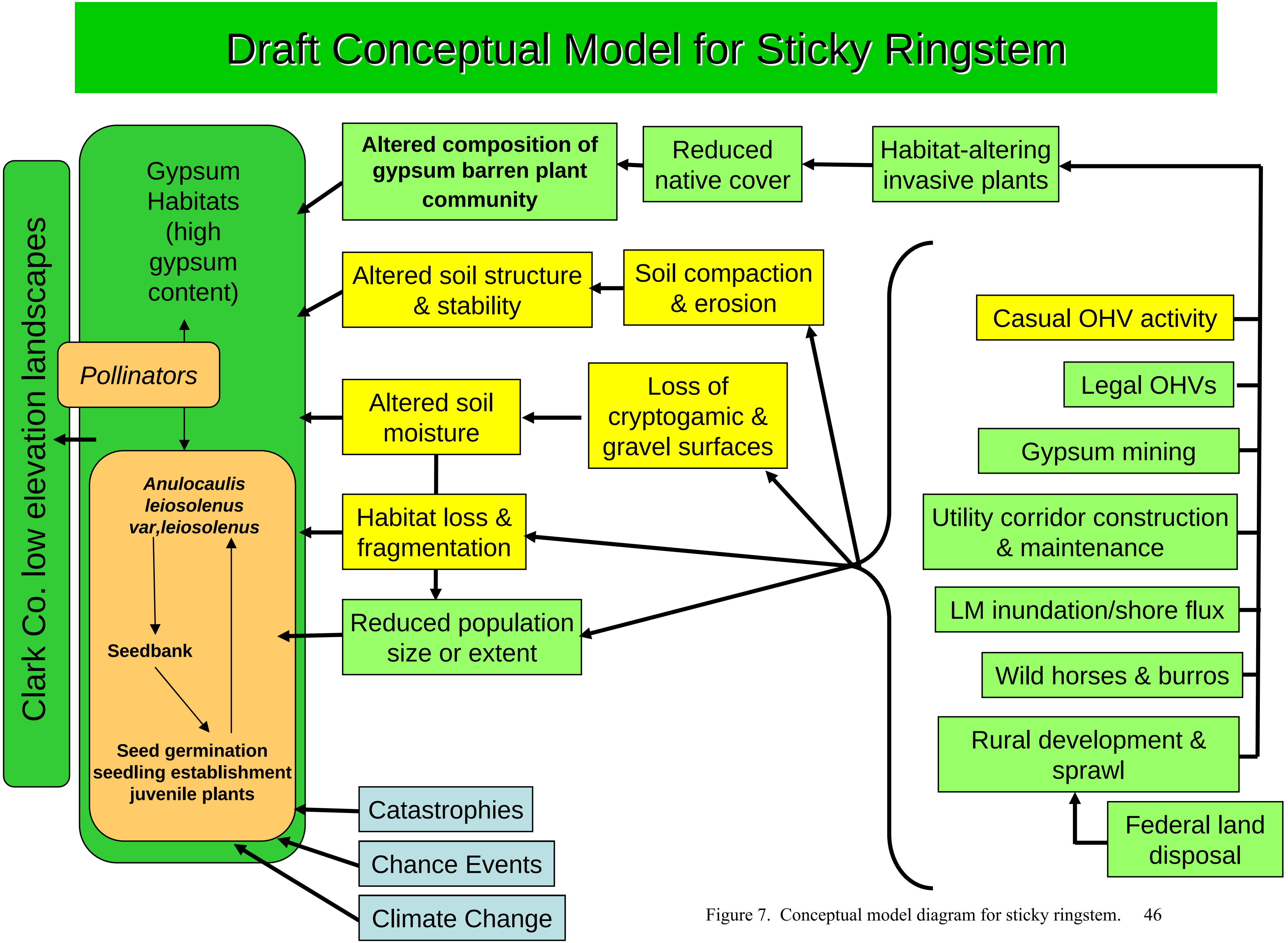

Figure 7. Conceptual model diagram for sticky ringstem.

***Arctomecon californica* Torr. & Frém., Las Vegas bearpoppy**

Photo courtesy of Jan Nachlinger

Status, Trends, and Viability

Taxon Significance and Formal Status

The genus *Arctomecon* is a member of the poppy family, Papaveraceae, first described by Torrey (1845) then later revised by Nelson and Welsh (1993). The genus consists of only three species with its distribution centered in southern Nevada where many of the known populations occur in Clark County (Nelson and Welsh 1993). All three species are known to occur on gypsum. Two of the species are endemic to the Mojave Desert while the third—Las Vegas bearpoppy (*Arctomecon californica*) —is nearly endemic to the ecoregion. A quarter century ago, Janish (1977) noted that the entire genus was at risk of extinction, and Nelson and Welsh (1993) recommended that all three species in the genus be covered under the ESA. Only one of the three has that status today—dwarf bearclaw poppy (*A. humilis*)—listed as an endangered species under the ESA. The rare white bearpoppy (*A merriamii*) is discussed next in this conservation management strategy.

Las Vegas bearpoppy was first collected on 3 May 1844 by Colonel John Charles Frémont in the Las Vegas Valley, which makes Clark County the type locality for the species (Tiehm 1996). The "*californica*" epithet is an artifact of the geographic name of the region at the time of his collection, as the area around present-day Las Vegas was Alta California, a part of Mexico until 1847. The species has never been found in present-day California, and is currently known only from Nevada and adjacent Arizona with its center of distribution in Clark County.

Botanists familiar with both Nevada and Arizona populations have questioned its taxonomic status based on morphological and ecological dissmimilarities. Until formal description of Grand Canyon plants and their habitat is published, they continue to be recognized as Las Vegas bearpoppy.

Las Vegas bearpoppy is not federally listed by USFWS under the ESA. It is state listed by Nevada under NRS 527.260 as critically endangered, and for this reason the BLM puts it on their special status species list. The Nevada Native Plant Society believes it meets the federal definition of Threatened under the ESA, and thus includes it on their list of threatened plant species. Las Vegas bearpoppy is protected as a state listed species in Arizona (Arizona Game and Fish Department 2003). The global heritage status rank for Las Vegas bearpoppy is vulnerable as denoted by its G3 rank. In Nevada it is state ranked vulnerable, S3, and in Arizona, it is state ranked imperiled, S2 (NatureServe 2006).

Geographic Distribution

Las Vegas bearpoppy occurs mainly north of Lake Mead and west of the Virgin River and Overton Arm (Lake Mead), with a few sites south of the reservoir in Arizona and a few locations east of Overton Arm in the Gold Butte area. In Nevada, the species occurs only in Clark County. Regardless of how the species is taxonomically defined, the main distribution of Las Vegas bearpoppy falls within Clark County, Nevada.

Las Vegas bearpoppy's currently understood global distribution spans two states and two ecoregions (figure 8). Its known global occurrences have been grouped into the following 13 fairly tightly clumped population groups (in **bold**) from west to east:

- three westernmost population groups comprised of one large population group centered in the Las Vegas Valley (**Las Vegas Valley**), and two population groups on the outskirts of Las Vegas Valley (**Las Vegas Dunes** and **Sunrise Valley**);
- six large population groups along the north and west side of Lake Mead (**Government Wash, Gale Hills, Bitter Spring Valley, Middle Point, White Basin**, and **Valley of Fire**);
- one extensive population group east of Lake Mead (**Gold Butte**) representing its northeastern extent;
- two population groups in the Arizona portion of the Mojave Desert Ecoregion—one extensive population group south of Lake Mead (**Arizona**) and one small historic population further east (**Meadview NW**); and,
- one more distant population group in the immediately adjacent Colorado Plateau Ecoregion in Arizona (**Grand Canyon**). The four known occurrences in this group are thought to be distinctive from the others morphologically, ecologically, geographically, and with possible taxonomic repercussions, but a peer-reviewed publication is lacking so the broader species interpretation prevails for now.

The distribution of Las Vegas bearpoppy in Clark County is limited to its central and eastern portions where ten of the 13 population groups occur (**Las Vegas Valley, Las Vegas Dunes, Sunrise Valley, Government Wash, Gale Hills, Bitter Spring Valley, Middle Point, White Basin, Valley of Fire,** and **Gold Butte**). The closest locations to California are in Las Vegas Valley about 30 miles east of the stateline. It once occupied Las Vegas Valley from north Las Vegas Wash south to the Warm Spring Road area. It occurs at Frenchman Mountain, Sunrise Mountain, Apex, Gale Hills (Lovell Wash), Black Mountains, Bitter Spring Valley, Echo Bay, Valley of Fire Wash, and Gold Butte (figure 9).

Grand Canyon populations sometimes are omitted from summaries of the species distribution and habitat, where phrases such as Mojave Desert endemic or growing only on gypsum soils are mistakenly used. Even with a broad species interpretation for Las Vegas bearpoppy, Clark County represents the vast majority of this species known global distribution. As such, Clark County populations are crucial for the species long term management and survival.

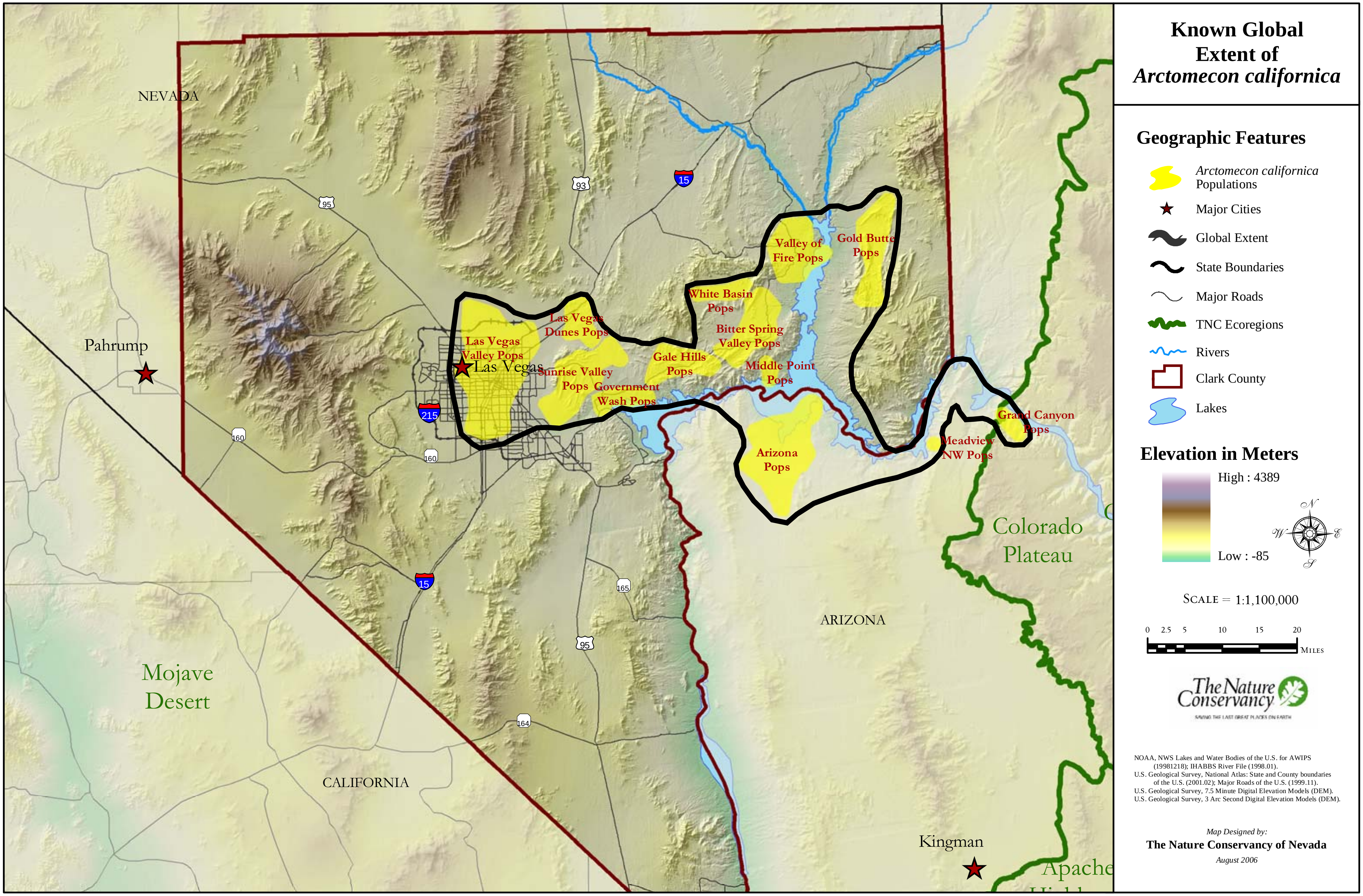

Figure 8. The known global extent of Arctomecon californica, Las Vegas bearpoppy.

Known Clark County Distribution of *Arctomecon californica*

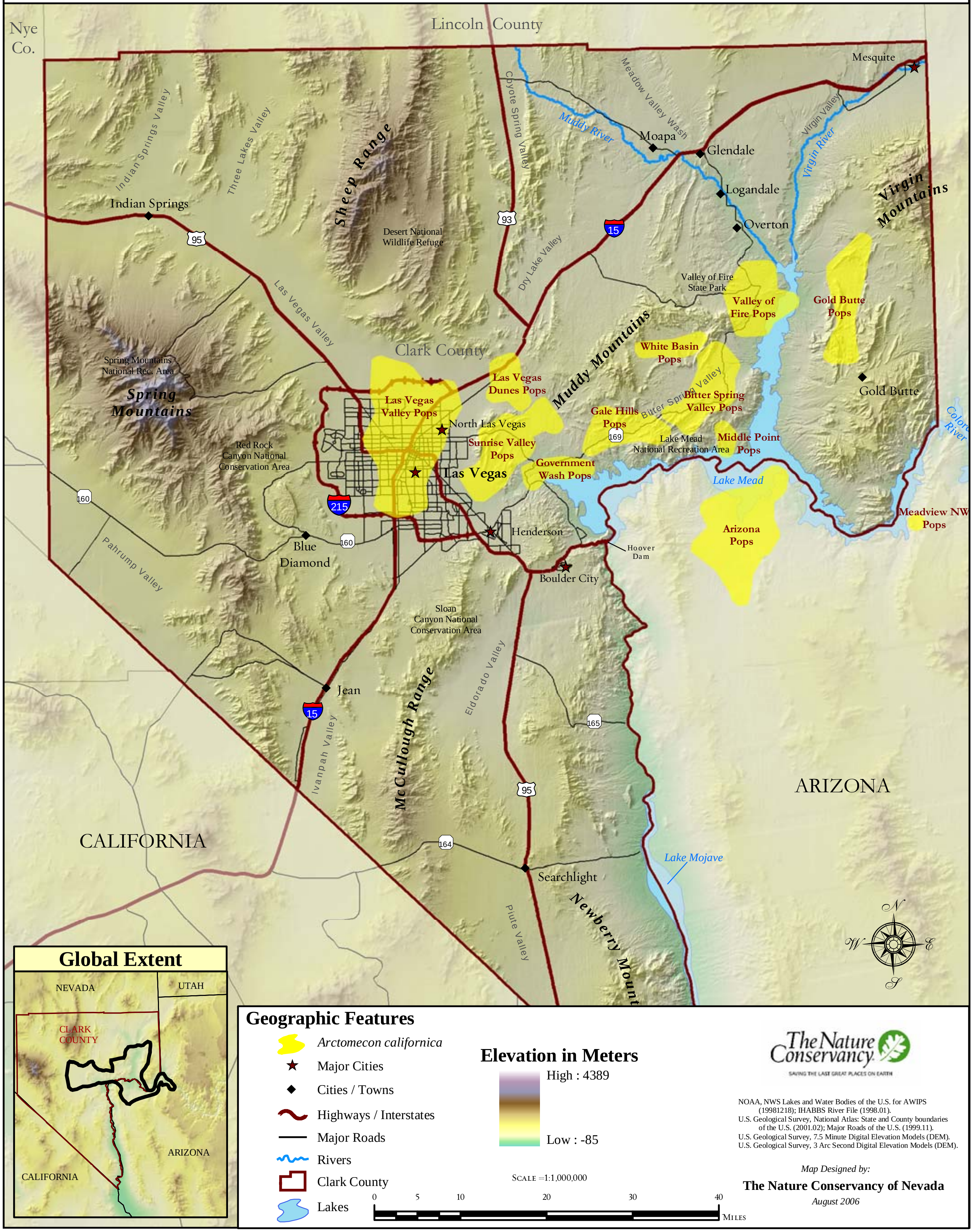

Figure 9. The known geographic distribution of Arctomecon californica, Las Vegas bearpoppy in Clark County. 50

Habitat Description
Las Vegas bearpoppy is restricted to gypsum and other chemically unusual soils containing high levels of boron or lithium (Meyer 1987). Mistretta *et al.* (1996) summarize habitats for Las Vegas bearpoppy as soils with high gypsum contents, measured between 36% and 69% at some sites (Meyer 1987). The often spongy, finely textured, and crusted gypsic soils form relatively barren, low-competition sites within creosote bush, saltbush, and rarely blackbrush ecological systems more typical of the Mojave Desert.

The specific gypsum barren plant communities in which it occurs consist of mostly herbaceous gypsum-tolerant species, characteristically including Torrey ephedra, desert pepperweed, Parry sandpaper plant, Fremont dalea, sticky ringstem, silverleaf sunray, wingseed blazingstar, matted crinklemat, ladder buckwheat, Palmer phacelia, beautiful phacelia, and hairybeast turtleback (*Ephedra torreyana, Lepidium fremontii, Petalonyx parryi, Psorothamnus fremontii, Anulocaulis leiosolenus, Enceliopsis argophylla, Mentzelia pterosperma, Tiquilia latior, Eriogonum insigne, Phacelia palmeri, P. pulchella*, and *Psathyrotes pilifera*). The sites are hot and dry except for low and variable incident precipitation, exhibit all aspects and slopes, generally occur in areas of low relief, but often have hummocked, dissected, or badland microtopography. High cryptogamic or gypsum crust cover is present at many sites.

Phillips and Phillips (1988) add that Las Vegas bearpoppy occurs in Arizona on openly vegetated sites in association with perennial shrubs and surface crusts. These plants are on gentle to moderate slopes with coarse, gravelly soils of limestone origin, while the gypsiferous clay soils typical of Nevada localities are not present. Meyer (1980, 1987) states that annual plant associates are largely absent on gypsum, but they tend to have greater total plant diversity than surrounding zonal vegetation.

GIS data points for Las Vegas bearpoppy average 600 m in elevation with a range from 335 to 1018 m (1100 to 3340 feet) in elevation. It typically occurs on gentle slopes around four degrees but slopes may be infrequently steep and up to 35 degrees. Las Vegas bearpoppy occurs on all exposures, although southeast, east, and south are most prevalent while north and northwest are least common exposures. It appears to have no preference for slopes providing cooler and moister conditions versus warmer and drier conditions, which is consistent with its C_4 physiology.

Meyer (1980) includes a map of gypsiferous strata which includes six formations (Las Vegas, Muddy Creek, Thumb, Chinle, Moenkopi and Kaibab) adapted from Longwell *et al.* (1965). Las Vegas bearpoppy occurrences map on several different rock types based on our GIS analysis of data points. Populations most commonly occur on Moenkopi Formation, Quaternary alluvial deposits, Permian cherty limestones, Triassic continental sedimentary rocks, Horse Spring Formation, tufaceous sedimentary rocks, and Chinle Formation, in order of prevalence. Las Vegas bearpoppy occur on many soil associations, many of which are comprised of soil series derived from gypsum rock. Across its distribution in Clark County, Las Vegas bearpoppy most commonly occurs on Guardian-Baseline and Baseline-Guardian soil associations.

Powell (2003) mapped both Las Vegas bearpoppy populations and gypsum soils at Lake Mead NRA. It most commonly occurs there on Baseline-Callville-Badland, Drygyp-BlueGyp, and Drygyp-Guardian-Baseline soil associations (Powell 2003). About 28,800 acres of Las Vegas bearpoppy populations and 11,072 acres of habitat are estimated from her effort totaling an estimated 39,872 acres of potential habitat at Lake Mead. BLM measured its population acreage in the mid-1990s using GPS and calculated a total of 7,480 acres on BLM, which represents 0.2 % of their Las Vegas District.

Life History Strategy
In earlier work, Meyer (1980) describes Las Vegas bearpoppy as a long-lived plant with rare seedling establishment resulting in episodic population turnover. However, in subsequent work she refers to it as relatively short-lived (four to five years on average) with drastic year-to-year fluctuations in population

density (Meyer 1987). The species has two types of plant morphologies, a small-rosette morph and a large-rosette morph, which correlates with number of stalks per plant, capsules per stalk, and seeds per capsule. Its reproductive biology resembles that of an annual plant—populations typically have high reproductive output by producing copious seed (Meyer 1987). Capsules contain approximately 100 to 160 seed (Holland 1979, Sheldon 1994, Hickerson 1996), although Meyer (2001) calculated a mean of 91 for use in population modeling. The seed has external structures which could function as elaiosomes, an edible lipid-rich body attached to seeds to attract dispersers, and Meyer observed ants dispersing seeds from under maternal plants (Meyer 1987, 2001). The species is self-incompatible and requires pollinators to transfer pollen (Tepedino and Hickerson 1996, Thompson and Smith 1997). With abundant rainfall, non-dormant seeds germinate en masse in spring and a new cohort is established from few surviving seedlings. Established populations experience gradual attrition over years, especially during periods of drought when many individuals lose vigor, and if drought is protracted eventually all plants succumb resulting in population dormancy. However, this condition is not local extirpation of a population, rather Las Vegas bearpoppy persists in the seed bank, avoiding extended drought, similar to an annual plant's strategy of avoiding summer drought.

Las Vegas bearpoppy seeds initially possess seed coat dormancy with a slow but progressive loss of dormancy over time (Meyer 2001). This appears to be an adaptation to variable precipitation which decreases the risk of seed bank loss from total germination in wet years. Local extirpation at sites with remaining habitat would occur only after the seed bank is completely exhausted. Equally, production of abundant seed to populate a persistent seed bank is critical for population permanence (Phillips and Phillips 1988). Meyer and Forbis (2006) summarize that reproductive output is dependent on 1) genetic variation which is correlated with plant morphology; 2) age of the plant; and, 3) the driving environmental variable, precipitation.

Las Vegas bearpoppy has Kranz anatomy, uses the C_4 photosynthetic pathway, and is pubescent, which increases reflectivity and lowers heat load (Meyer 1980). C_4 plants are most successful in hot, arid environments as they have the ability to efficiently fix carbon dioxide despite having high stomatal resistance, which reduces water loss. Typically, they bloom and set seed later when many other species have passed their peak level of activity. Las Vegas bearpoppy may have adapted to favorable water relations in summer relying more on water at depth in less competitive gypsum sites. Rock is usually absent in gypsum, but present on more competitive zonal sites, which trap water beneath rocks near the surface and provide favorable water relations earlier in winter and early spring. The presence of cryptogamic crust appears to serve a positive function for gypsophiles by creating a favorable environment for seedling establishment and survival. Cryptogamic crust is not always present on sites with Las Vegas bearpoppy, but it is positively correlated with low bulk density, lack of rock cover, intermediate gypsum content, and sufficient clay to permit development of a raincrust on the soil surface.

Surveys, Inventories, and Status Reports

Early surveys and inventories for Las Vegas bearpoppy occurred at Lake Mead NRA (Reigla 1975, Holland *et al.* 1979), and later in Arizona (Phillips 1994), in the eastern Mojave Desert (Niles *et al.* 1996), and at Nellis Air Force Base (Hazlett *et al.* 1997). Surveys associated with specific highway project areas in Las Vegas Valley documented populations and eventual habitat loss at Lamb Boulevard (Baepler 1994) and Lamb Interchange (NDOT 2003). Leigh Fisher (1997) surveyed the population at North Las Vegas Air Terminal prior to development of Las Vegas bearpoppy habitat there. Extensive agency surveys were made by BLM in 1993, 1996-1998, and 2000-2002 on public lands, and by NPS at Lake Mead NRA in 1998-2000.

The first comprehensive surveys for Las Vegas bearpoppy using GPS were done by BLM in 1993. That year and the previous year in 1992 had much above average precipitation at several climate stations in Clark County (Boulder City, Las Vegas WSO, North Las Vegas, Overton, and Pahrump) indicating favorable conditions for germination and establishment. The surveys were conducted across its Clark County distribution and involve six population groups. Total numbers of individuals estimated are likely underestimates of actual population sizes, but numbers of acres are reasonably accurate as they were calculated by planimetry.

Population Group Name	Estimated Number of Individuals (NNHP)	Range of Individuals Estimated (BLM Database)	Number of Acres
Las Vegas Valley	5,000+		78
Las Vegas Dunes	20,000+	1,787-5,359	240
Sunrise Valley	71,000+	21,376-52,054	3,940
Gale Hills	1,000+	668-1,925	446
Bitter Spring Valley	5,000+	1,204-4,375	860
Gold Butte	50,000+	2,658-9,425	1,620

A long term survey mapping effort for Las Vegas bearpoppy was initiated at Lake Mead NRA in 1998 (Powell 1999). That year had much above average precipitation at many climate stations in Clark County (Amargosa Farms, Boulder City, Las Vegas WSO, North Las Vegas, Overton, and Pahrump). Their 1998 surveys expanded the known distribution of Las Vegas bearpoppy at Lake Mead NRA beyond the range indicated in the conservation status report by Mistretta *et al.* (1996) which included survey data through 1994. They documented 174 sites with live plants and another four dormant sites (dead plants present) out of 199 potential habitat sites surveyed. See viability section for condition information generated from these surveys.

The first conservation status report was prepared for the species throughout its range by Holland (1979) and it was summarized in the early agency threatened and endangered plant report for Nevada (Mozingo and Williams 1980). Phillips and Phillips (1988) prepared a conservation status report for Las Vegas bearpoppy in Arizona, while Knight (1992) prepared one for the species at Lake Mead NRA. A more recent comprehensive status report was prepared by Mistretta *et al.* (1996) for its entire range. Agency updates since then has kept its status in Las Vegas Valley current (Bair 1997, Glenne 1998, Klein 2005). The USFWS Biological Opinion for the MSHCP permit provides the most recent comprehensive assessment, although it too is now dated (USFWS 2000). NNHP presents a summary fact sheet and general distribution map on their website (Morefield 2001, http://heritage.nv.gov/atlas/atlasndx.htm), which is updated periodically.

Declining trends for the **Las Vegas Valley** population group were summarized by USFWS from the Mistretta (*et al.* 1996) source by Bair (1997). With 108 total known occurrences on about 40,000 acres, 12% were presumed extirpated mostly from urban development, and another 16% were likely to be extirpated in foreseeable future as a result of continued urban development. Percentage data are tallied by land ownership with number of plants, habitat area, and number of sites with unimpacted, impacted, and extirpated populations. Glenne (1998) updated the status of the **Las Vegas Valley** populations. With 34 known historic populations, 22 were presumed extant in 1996, whereas 12 were presumed extant in 1998 and another 4 threatened with imminent extirpation. For Mistretta's 12 presumed extirpated in 1996, most extirpations occurred in the 1970s, but dates of last observations range from 1934 to 1990. Glenne's ten documented extirpations likely occurred in the period 1995 through 1998.

For most cases of known or assumed population extirpations habitat had been eliminated (Mistretta *et al.* 1996). However, because above ground populations can go dormant while remaining habitat likely has a seed bank present for future cohort germination under appropriate conditions, NDF made field checks in

2005 for all presumed extirpation locations in **Las Vegas Valley** to verify whether habitat or plants were still present (Klein 2005). The 2005 growing season offered favorable rains to search for germinated plants. Of 12 presumed extirpations documented in 1996, three have remaining habitat where they had been mapped historically, and two more have habitat adjacent to where they had been mapped (one location is mapped from an older source at the least precision). Of ten presumed extirpations documented in 1998, two have remaining habitat where they had been mapped historically, and three more have habitat adjacent to where they had been mapped. Of 15 additional sites identified in 1996 with extirpation imminent or likely in the foreseeable future, ten were documented as extirpated two years later in 1998, with one more extirpated in 2005 and another one sliding toward extirpation between March and May 2005 visits. However, for those ten extirpations noted in 1998, half of them had some remaining habitat in 2005 at their mapped locations. Although these remaining habitats at presumed extirpations in the valley are small, isolated, and highly unlikely to produce viable populations in the long term, they still may harbor a viable and germinable seed bank which could be salvaged and used for mitigation as Las Vegas continues to grow.

Key Ecological Attributes

Nine key ecological attributes and their indicators are listed for Las Vegas bearpoppy in table 14. A few rankings are quantitative definitions based on available research and monitoring of the species, but most are qualitative from local area expertise among BLM, NPS, and the academic community. Adaptive management of Las Vegas bearpoppy will assist in honing indicators and ranking definitions.

Table 14. Key ecological attributes, indicators, and their ranking definitions for Las Vegas bearpoppy populations. Italics represent the ultimate goal of land managers.

Category	Key Attribute	Indicator	Las Vegas Bearpoppy (*Arctomecon californica*) Indicator Rankings			
			Poor	Fair	Good	Very Good
Landscape Context	Ecological integrity of surrounding matrix systems and specific habitat	Density of vehicle tracks and animal (WHB/cattle) trails within habitat and matrix systems	High density or >50% scope of habitat impacted	Moderate density or >10<50% scope of habitat impacted (>1 mi / sq mi habitat)	Low density or <10% scope of habitat impacted (<1 mi / sq mi habitat)	*Virtually no vehicle tracks or animal trails*
Landscape Context	Pollination	Presence of characteristic pollinators	Exclusively generalist pollinator species	More generalist species than specialist pollinators	Specialist pollinators in healthy numbers although others may be present	*Dominated by specialist pollinators*
Landscape Context	Soil moisture and nutrient regime	Degree of surface disturbance relative to presence of surface crusts and gravels on gypsum soils	High surface disturbance with only remnant cryptobiotic crusts/gravel surfaces present	Moderate surface disturbance with <20% cover of cryptobiotic crusts/gravel surfaces present	Low surface disturbance with >20% of cryptobiotic crusts/gravel surfaces present	*Surface disturbance virtually absent with intact cryptobiotic crusts/gravel surfaces present*

Category	Key Attribute	Indicator	**Las Vegas Bearpoppy (*Arctomecon californica*) Indicator Rankings**			
			Poor	**Fair**	**Good**	**Very Good**
Condition	Soil structure and stability	Degree of soil erosion or soil compaction	High erosion or compaction	Moderate erosion or compaction	Low erosion or compaction	*Virtually absent*
Size	Minimum dynamic area	Number and average size of habitat patches	Large number of habitat patches with small average size	Moderate number of habitat patches with moderate average size	Small number of habitat patches with large average size per patch	*Few habitat patches with very large average size*
Size	Minimum dynamic area	Sufficient acreage for characteristic species and natural habitat disturbances within historic range of variability	Insufficient acreage for all sensitive species and severe disturbance likely to eliminate habitat	Insufficient acreage for most sensitive species and habitat susceptible to severe disturbance	Sufficient acreage for most sensitive species and habitat mostly resilient to severe disturbance	*Sufficient acreage for all sensitive species and severe disturbance*
Size	Population size & dynamics	Number of reproductive plants in non-drought years	few	<1000	10,000s	*>100,000*

Viability and Trend Status

Morefield (2001) summarizes the status of Las Vegas bearpoppy as of 2000 surveys with total estimated individuals at 445,000+, total estimated area of 20,614 acres, and a rapidly declining trend. The areal estimate is probably a more constant indication of size of populations over time than the number of individuals because Las Vegas bearpoppy numbers fluctuate from year to year. Also, the total individuals estimated were derived from numbers counted in surveys made over two or more years. At least some of the observed declines in population numbers are likely from regional drought cycles in addition to continued detrimental human activity resulting in habitat loss. More recent surveys in 2005 show populations present where they had not been seen in the late 1990s.

Twenty years ago, Meyer (1987) noted that recolonization of sites where local extinction has occurred is improbable because of apparently low dispersal ability of seeds, low probability of establishment from limited immigrant seed, and island-like distribution of gypsum habitats. This may be why apparently suitable sites are unoccupied and it suggests that Las Vegas bearpoppy does not possess a metapopulation dynamic. More recently, Meyer and Forbis (2006) present a PVA based on years of demographic data, seed bank study, and contemporary seed longevity work. Their preliminary PVA model runs indicate that small, fragmented populations (*e.g.* **Las Vegas Valley** remnants) suffer from severe pollen limitation and set little seed. Some of these populations appear extant solely as a consequence of seeds produced before habitat fragmentation occurred and they are predicted to have little chance of persistence once their seed bank diminishes. Meyer and Forbis (2006) conclude that long term species conservation lies in the protection of large tracts of occupied habitat, including adjacent non-gypsum habitat that can support pollinator populations during the frequently-occurring periods when Las Vegas bearpoppy is present only as a seed bank. A test of the PVA with independent data is desirable.

The **Sunrise Valley** population group is the largest found on BLM based on 1993 surveys. There are many maintained and unmaintained roads in the area and illegal OHV activity is ongoing although the BLM is attempting to restore the area. Further north, BLM built an effective three mile long fence, excluding OHV activity in the eastern portion of the Rainbow Gardens area. The population group includes a high density population on UNLV patented mining land. These factors reduce current viability rankings for the population group. The **Bitter Spring Valley** and **White Basin** population groups have fair viability where managed by BLM although the portion of **Bitter Spring Valley** on NPS lands is the largest and densest population (Marrs-Smith 1998). Ongoing legal OHV activity at the **Las Vegas Dunes** population group has caused population and habitat loss resulting in highly fragmented remnant populations in this area. The northern population at Apex was a high density significant population in 1993, but subsequent highway construction and transfer to private ownership in 1996 negatively affected long term viability. Today, the main population area at the dunes is a designated open OHV area with heavy use (Marrs-Smith 1998).

The first known human-caused extirpations of Las Vegas bearpoppy populations occurred with the construction of Hoover Dam and the creation of Lake Mead within the **Valley of Fire** population group. . This destroyed the Boulder Basin populations (Morefield 2001) and inundated potential habitat in the Overton Arm based on geology (Longwell et al. 1965). More recently, this and the **Bitter Spring Valley** population groups are at risk from invasive plants. Sahara mustard was observed in 2005 on gypsum substrates, and although weed treatment was accomplished, areas with lowered viability remain susceptible to competition by invasives (Powell, personal communication 2005). The **Gold Butte** population group is relatively remote and has good viability indicator ranks based on mid-90s surveys (Niles *et al.* 1996). Recreation activities have been increasing in the area though, so updated surveys are needed. The **Gale Hills** population group includes West End Wash, Lovell Wash, and Callville Wash, and some of these areas have reduced viability ranks because of past disturbance from mining on patented land (Marrs-Smith 1998). **Las Vegas Dunes** at one time had a significant number of the documented numbers of individuals but its open road status has diminished condition of habitat (BLM data 1993).

The **Las Vegas Valley** population group has 34 historically documented populations of Las Vegas bearpoppy according to Mistretta *et al.* (1996), in an area that was estimated to possess about 17% of the species native range (USFWS 2000). By 1996, 12 of these were extirpated from urban development, leaving 22 populations estimated at 996 acres and 66,525 plants in the Las Vegas Valley (Mistretta *et al.* 1996). Development continued to eliminate or disturb habitat and in 1998 ten more populations were documented extirpated and four populations were in imminent danger of extirpation (Glenne 1998). Some populations, including those on BLM land in the north portion of the valley, were possibly dormant as they could not be relocated in 1998. Today, two of the three Las Vegas Valley populations recommended for protection in Mistretta *et al.* (1996)—Las Vegas Springs Preserve and North Las Vegas Air Terminal—appear to have poor indicator ranks for viability.

A substantial population in **Las Vegas Valley** was recently documented in 2005 during surveys for environmental reviews of proposed disposal lands. This population is no longer to be disposed and is now referred to as the conservation transfer area (CTA) with ongoing plans for protective management by BLM. The area was not identified as significant during the 1990s, perhaps because it was dormant during that period, and it highlights the need to identify and protect suitable habitat rather than concentrating solely on extant populations (see Meyer and Forbis 2006). The CTA likely harbors unique genetic diversity from the once apparently large and relatively unfragmented **Las Vegas Valley** population group.

Lake Mead NRA surveys in 1998 noted viability (condition) information (Powell 1999). Cryptobiotic crust occurred on 71% of the sites and rocks were present on 46% of the sites. Disturbance was noted at most sites with 29% having heavier disturbance, 14% having moderate disturbance, and 57% with lighter disturbance. Most disturbance was from burros (65% of sites) and then from erosion (39% of sites), and they were frequent co-factors in over a quarter of all sites. Other disturbances noted in these sites (**Bitter Spring Valley** and **Valley of Fire**) included ORV use, human, horses, old roads, animal burrows, and trails. Exotics occurred on Las Vegas bearpoppy habitats, including red brome, Mediterranean grass, saltcedar, and the suspected exotic woolly plantain (*Bromus madritensis* ssp. *rubens, Schismus barbatus, Tamarix ramosissima*, and *Plantago ovata*).

In 2005, Sahara mustard was present at Bonelli Bar (**Arizona**), where the weed team did mechanical removal (Powell, personal communication 2005). Populations at **Grand Canyon** are in undisturbed condition (Phillips 1994, Powell 2003).

Las Vegas bearpoppy is the only species addressed here with adequate population data for PVA study Meyer and Forbis (2006). PVA argues for conservation of larger intact habitats. Loss and fragmentation of habitat negatively affects seed bank and pollinator viabilities.

We made viability estimates of landscape context, condition, and size criteria among all Las Vegas bearpoppy populations based on all available information and expert review. The estimates are organized and summarized in table 15 by MSHCP management category within Clark County and by state elsewhere.

Table 15. Viability ranks for Las Vegas bearpoppy populations grouped by MSHCP management category within Clark County and by states elsewhere.

Las Vegas Bearpoppy (*Arctomecon californica*)		Landscape Context	Condition	Size	Viability Rank
1	**Gold Butte, Government Wash, Middle Point, Sunrise Valley, Valley of Fire** (IMA)	Fair	Fair	Very Good	**Good**
2	**Bitter Spring Valley, Gale Hills** (Mixed)	Fair	Fair	Good	**Fair**
3	**Las Vegas Dunes, White Basin** (MUMA)	Fair	Fair	Fair	**Fair**
4	**Las Vegas Valley** (UMA)	Poor	Poor	Fair	**Poor**
5	**Arizona, Grand Canyon, Meadview NW Populations** (AZ)	Good	Very Good	Very Good	**Very Good**

Monitoring and Research

In 1977, Meyer initiated the first Las Vegas bearpoppy monitoring study across its distribution where she fully censused populations for eight years through 1984. She tagged plants and determined population densities, plant diameter, approximate number of rosettes, mean rosette diameter, inflorescence stalk and capsule numbers, seedling survival, and condition. Her studies link cohort establishment with years of above-average winter/spring rainfall. More recently, Las Vegas bearpoppy has been monitored by agency botanists at Lake Mead NRA and BLM lands, and at the North Las Vegas Air Terminal annually since 1998 (Powell and Marrs-Smith 2001). The data show widely fluctuating numbers which also link patterns to rainfall.

Las Vegas bearpoppy has been monitored by agency botanists at Lake Mead NRA and BLM lands, and at the North Las Vegas Airport population continuously since 1998 (Powell and Marrs-Smith 2001). Seven Las Vegas bearpoppy monitoring sites were set up in 1998 with three sites at Lake Mead NRA (Callville Wash, Road 100, Blue Point Spring), three sites on BLM (Sunrise Hills, Rainbow Gardens, Red Bowl), and one site on land owned by Clark County (North Las Vegas Airport). A fourth site at Lake Mead was added in 2003 (Stewart's Point). Size classes of plants in six categories, their reproductive condition, and disturbance in plots are recorded. The monitoring plots coincide with **Las Vegas Valley, Sunrise Valley, Gale Hills, Bitter Spring Valley,** and **Valley of Fire** population groups. Trend data for seven years indicated populations were declining while two areas went dormant (NLVAT in 2002 and Callville Wash in 2003). Both 2001 and 2005 documented seedling germination events in monitoring plots, but the drought of 2002 killed most and only 2005 reversed the declining trend as a cohort establishment year. These data also show consistently heavy or low fruit set for certain areas. They also indicate huge fluctuations in population estimates with as many as 800,000 in years of high precipitation and a few thousand in years of drought.

Populations have two contrasting rosette morphologies—small and large rosette morphs, which include the full range of intermediate morphologies—and they are correlated with reproductive output traits. Meyer (2001) discovered that populations differ in their combinations of rosette morph type, plant density, lifespan, stalk production, and fecundity, such that total lifetime seed production between populations were comparable. Small-rosette morphs have less fecundity (fewer stalks and seeds are produced), but seedlings are recruited more successfully and plants occur in greater densities. In contrast, large-rosette morphs have greater reproductive output by producing more stalks, capsules, and seeds per plant, but plants are in less dense populations, have a shorter lifespan, and seedlings have higher drought mortality. The large-rosette morphs tend to have especially high fecundity in their last year of reproduction prior to dying (Meyer, personal communication 2005). She concludes that Las Vegas bearpoppy has a tremendous range of phenotypic expression, with traits combining to maximize seed production and assure persistence in its highly variable environment. This information on reproductive output, along with additional population details, is currently being used to develop a population viability model for the Las Vegas bearpoppy (Meyer and Forbis 2006).

Seeds entering the seed bank do not germinate the first year because of seed coat dormancy (Meyer 1996). Alternatively, a morphological dormancy period may be required for the embryo to develop further prior to germination (Nancy Vivrette, personal communication). Meyer's field retrieval studies were initially set up for a ten year period, but with subsequent modification, a longer timeframe is hoped for since preliminary results indicate that seeds are germinable for a nineteen year span (Meyer, personal communication 2005). These data are incorporated into the PVA model (Meyer and Forbis 2006). First year mortality is high and most seedling deaths occur in the heat and drought of summer. Daily summer soil temperatures commonly reach 122°F (50°C) for hours, and temperatures over 140°F (60°C) are not uncommon (Meyer 2001). She estimated that in the 1978 cohort fewer than one in 200 seedlings survived to the next winter. She also estimated 13,900 mean (2,100 s.e.) number of seed per flowering plant, with one exceptionally fecund plant producing approximately 89,000 seeds.

Meyer (1986) suggests that surface effects may be more important in seedling establishment on gypsum soils than soil chemistry. Many sites have cryptogamic crust. Crusts have been shown to increase nutrient levels in the soil (Harper and Pendleton 1993) and they strongly influence infiltration of rainfall, thus surface water balance, and may protect the fluffy nature (low bulk density) of gypsum soils from wind erosion. She concludes that populations need to be managed to maximize plant survival to reproductive age so that seed bank is replenished, and unoccupied (dormant) gypsum outcrop habitats must be protected to insure survival.

Nevertheless, the relationship between soils and known bearpoppy populations was investigated at Lake Mead NRA using a soils map from NRCS (2000, Powell 2003). Although Las Vegas bearpoppy occurrences overlay with 23 different soils map units, 90% (n=212) were on 13 soil map units and 66% were on only six soil map units. Gypsum derived soils, specifically Drygyp, Callville, and Guardian soil series, were most often associated with larger bearpoppy locations. Some occurrences fell on soil series and map units derived from limestone or mixed rock sources, supporting Meyer (1986) in describing the plant as a gypsocline—one that primarily occurs on gypsum but is found on other unusual substrates as well.

Van Buren and Harper (1996) studied genetic variation among populations of all three species of *Arctomecon* based on RAPD (randomly amplified polymorphic DNA) analysis of genomic DNA. They sampled three populations each for Las Vegas bearpoppy (at **Las Vegas Valley, Sunrise Valley,** and **Las Vegas Dunes**). Populations of Las Vegas bearpoppy showed little genetic variation with 94% overall similarity (whereas populations of white bearpoppy averaged only about 68% similarity), and mean interspecific similarity among the three *Arctomecon* species was 15-23 percent. Hickerson and Wolf (1998) expanded Las Vegas bearpoppy sample sites east to include unfragmented sites at Lake Mead. They noted higher levels of genetic variability when eastern sites were included, but supported earlier findings of genetic impoverishment for fragmented populations in Las Vegas Valley. Populations expressing genetic variation are of conservation significance for their ability to survive environmental stresses. The ability of a species to survive various stresses may be limited by the genetic variability within its populations (Barrett and Kohn 1991, Hamrick *et al.* 1991, Schaal *et al.* 1991). Hickerson and Wolf conclude that remnant habitats are significant genetic resources and should not be considered lost causes if actions (*e.g.* introduce pollen and nectar resources, transplanting pollinators) can be taken to enhance and restore fragmented populations. However, protecting larger viable populations from fragmentation, native pollinator loss, and potential loss of genetic variation is a more efficient and sustainable alternative.

Pollinator ecology was studied and compared between fragmented (**Las Vegas Valley**) and unfragmented (**Gale Hills, Bitter Spring Valley,** and **Valley of Fire**) locations of Las Vegas bearpoppy (Tepedino and Hickerson 1996). Las Vegas bearpoppy flowers are underpollinated both in fragmented (n=4) and unfragmented (n=9) habitats, but much less successfully in fragmented populations. Sites in Lake Mead NRA produced significantly more seeds per fruit, on the order of two to three times more, but those sites tend to be small rosette morphs while those in Las Vegas Valley tend to be large rosette morphs and conclude that pollinator availability appears to limit seed production at least in some years. Unfragmented sites had greater numbers and diversity of pollinators, including specialists visiting plants. Among the solitary, ground nesting bees are two important pollinators: the rare specialized Mojave poppy bee, *Perdita meconis*, which visits plants in the poppy family only (including *Argemone*); and, the larger more common *Megandrena enceliae*, previously thought to specialize on creosote bush only. Two beetles were deemed important pollinators as well (*Schizopus laetus* and *Trichochroides* sp.). Griswold *et al.* (1999) characterize important pollinators as having high plant fidelity and efficiency—that is, they collect pollen from one plant species and visit multiple flowers on a single foraging trip). Fragmented sites had fewer pollinators, none of the specialized important pollinators, and with the pollinator role played by generalist bees that lack fidelity in foraging choices, waste pollen, and consequently are less effective pollinators. Nest sites and nectar plants for Las Vegas bearpoppy pollinators are complete unknowns.

Meyer (1996) investigated a possible cause for high adult plant mortality in wet years. In 1995, she took living tissue samples from dying plants to Dr. David Nelson, a plant pathologist, who cultured the tissue and identified *Alternaria* as the one pathogen present in every diseased tissue. This organism has related species which cause various leaf spot diseases in crop plants, and intriguingly, it infects plants via spores that require free water in order to germinate and penetrate the leaf surface suggesting why mortality is more evident in wet years. Recent germination studies at the Las Vegas Springs Preserve indicate that soil supporting Las Vegas bearpoppy appears to have important microbes which assist normal growth. Identification of soil mycorrhizae will be their next research step (Winkle, personal communication 2005).

Meyer and Forbis (2006) have synthesized thirty years of demographic information for Las Vegas bearpoppy into a life history model and PVA. Preliminary PVA model runs indicate that even large, intact populations are at considerable risk of local extinction due to environmental stochasticity alone. They note that small, fragmented populations are limited by pollen transfer and therefore set little seed (Hickerson and Wolf 1998). Some populations seem to be extant solely as a consequence of seeds produced before fragmentation occurred. Those populations are predicted to have little chance of persistence. Meyer and Forbis (2006) conclude that effective conservation hinges on protection of large tracts of occupied habitat, including adjacent matrix vegetation that can support pollinators when Las Vegas bearpoppy is present only as a seed bank. They hope to collaborate with other researchers on an independent test of the model.

Management
More than half of the documented data points for Las Vegas bearpoppy occur on IMA lands, and of those BLM manages all of **Gold Butte** and the majority of **Sunrise Valley** while NPS manages **Government Wash, Middle Point,** and **Valley of Fire** population groups. Management of the mixed **Bitter Spring Valley** and **Gale Hills** is roughly about half BLM (MUMA) and half NPS (IMA). The **Las Vegas Valley** is predominantly private land accounting for 13 percent of total data points for the species, but BLM manages about six percent of the population group mostly in the CTA (table 16).

Portions of **Bitter Spring Valley, Gale Hills, Gold Butte, Middle Point, Sunrise Valley,** and **White Basin** overlap with two designated ACECs and four Wilderness Areas. The BLM HMP for Las Vegas bearpoppy outlines actions to insure the long term survival and continued viability of Las Vegas bearpoppy on public lands. Two (Bitter Spring and Lovell Wash) of four BLM management areas to be protected specifically for Las Vegas bearpoppy conservation management have not received formal protection (**Bitter Spring Valley** and **Gale Hills**). The plan identifies bearpoppy management areas totaling 45,750 acres which include nearly 80% of surveyed populations on BLM. Thus, more than 20% of BLM populations remain outside the purview of the HMP and indicating that the plan is in need of updating to meet MSHCP goals for the species.

In the late 1960s, Jean Janish successfully grew two plants in gypsum soil from seed, and one produced a sterile capsule (Janish 1977, Knight, file notes), but ex situ germination and establishment has not been accomplished by anyone since even though a number of attempts have been made (Mistretta *et al*. 2001). In addition, no one has been able to successfully transplant individuals although many attempts have been made (BLM 2004, Klein 2005). There are at least two known sites (Boulder City and Washington County, Utah) beyond its historic distribution where cultivation appears successful although methods are unknown. Salvaging topsoil for post-project disturbance replacement is the only known successful habitat restoration technique for Las Vegas bearpoppy.

NDF has documented Nevada critically endangered permit applications/issues and any mitigation requirements for take of Las Vegas bearpoppy on both private and public lands. From 1988 through half of 2005 NDF issued 26 out of 27 applications for take of plants and/or habitat and required mitigation for 80% of them. Most (41%) permits were for pipelines (gas, power, water), housing development (22%), and mining (19%), with just a few for airport development, a communications site, highway alignment, and military activity. Mitigation in early years involved transplant studies, none of which were successful. Stockpiling soil for replacement or transfer offsite is the most common mitigation requirement. Other onsite habitat restoration is done on occasion. Avoidance and use of fencing to protect plants is uncommon. A few seed and root morphology studies have been conducted. A conservation area was protected by fencing habitat (110 ac at NLVAT) just once. No documentation of mitigation success by NDF is known although it is called for in recent permits. BLM required documentation of restoration actions and success at PabCo Road disturbance in 1998 by the mining company (SAIC 2001). Nearly a decade ago, the FWS expressed concern that the State law is ineffective in preventing destruction on private lands or in requiring appropriate mitigation for destruction (Bair 1997). Stronger mitigation measures, *e.g.* avoidance at defensible (viable) sites and protection of another viable site at indefensible populations, as well as supporting needed applied research studies should be required since they appear to be the only effective mitigation. Effectiveness of mitigation measures are clearly needed to learn from population and habitat disturbances.

Table 16. Management of Las Vegas bearpoppy in Clark County and beyond with percentages totaled for each population group provided above the number of data points.

Las Vegas bearpoppy ***Arctomecon californica***	IMA	MUMA	UMA	Not Applicable Arizona	Population Total
Sunrise Valley	72.50% 1534	0.29% 1	9.41% 45		53.29% 1580
Las Vegas Valley	0.28% 6	6.98% 24	74.90% 358		13.09% 388
Gold Butte	16.02% 339				11.43% 339
Bitter Spring Valley	4.82% 102	43.90% 151			8.53% 253
Las Vegas Dunes		26.16% 90	14.44% 69		5.36% 159
Gale Hills	2.69% 57	18.90% 65	0.84% 4		4.25% 126
Valley of Fire	3.02% 64	1.74% 6			2.36% 70
Government Wash	0.52% 11				0.37% 11
White Basin		2.03% 7	0.42% 2		0.30% 9
Middle Point	0.14% 3				0.10% 3
Arizona				81.48% 22	0.74% 22
Grand Canyon				14.81% 4	0.13% 4
Meadview NW				3.70% 1	0.03% 1
Total % Total Count	100.00% 2116	100.00% 344	100.00% 478	100.00% 27	100.00% 2965

Threats

Las Vegas bearpoppy populations and its habitats are subject to numerous threats. In order of highest ranked threats, they include casual vehicle use and trail development, highway and road construction and maintenance, urban development and sprawl, military training and facilities development, gypsum mining, Federal land disposal, inundation and shoreline fluctuation, utility corridor construction and maintenance, invasive plant species, wild horse and burro management, legal recreation use, plant collecting, and trespass grazing (table 17). These threats have reduced size and extent of populations and habitats by both direct mortality of individuals and loss or fragmentation of habitats. They have reduced pollinator populations, thus reducing efficiency of pollination and seed production. They have altered composition of its plant communities by reducing native plant cover and aiding the spread of weeds. They have altered condition of substrates through soil erosion, compaction, and destruction of cryptobiotic crusts. Destruction of soil crusts and surface gravels has played a role in altering soil moisture and soil fertility.

Table 17. Threat ranks for Las Vegas bearpoppy populations grouped by MSHCP management category within Clark County and by states elsewhere.

	Las Vegas Bearpoppy (*Arctomecon californica*) Threats Across Population Groups	**Gold Butte, Government Wash, Middle Point, Sunrise Valley, Valley of Fire** (IMA)	**Bitter Spring Valley, Gale Hills** (Mixed)	**Las Vegas Dunes, White Basin** (MUMA)	**Las Vegas Valley** (UMA)	**Arizona, Grand Canyon, Meadview NW Populations** (AZ)	**Overall Threat Rank**
1	Casual OHV use and trail development	Very High	High	High	High	-	Very High
2	Highway and road construction and maintenance	-	-	High	Very High	-	High
3	Urban development and sprawl	High	-	-	Very High	-	High
4	Legal OHV use	-	-	Very High	-	-	High
5	Military activities (training and facilities)	-	-	-	Very High	-	High
6	Gypsum mining	High	High	-	-	-	High
7	BLM land disposal to private development	Medium	-	Medium	High	-	Medium
8	Utility corridor construction and maintenance	High	-	Medium	-	-	Medium
9	Lake Mead inundation and shoreline flux	High	-	-	-	Medium	Medium
10	Invasive exotic plant species competition	Medium	Medium	-	Medium	Medium	Medium

Las Vegas Bearpoppy (*Arctomecon californica*) Threats Across Population Groups		Gold Butte, Government Wash, Middle Point, Sunrise Valley, Valley of Fire (IMA)	Bitter Spring Valley, Gale Hills (Mixed)	Las Vegas Dunes, White Basin (MUMA)	Las Vegas Valley (UMA)	Arizona, Grand Canyon, Meadview NW Populations (AZ)	Overall Threat Rank
11	Wild horse and burro management	Medium	Medium	Medium	-	Low	Medium
12	Legal concentrated recreation use	Medium	Low	-	-	Low	Low
13	Plant collecting during flowering	Low	-	-	Low	-	Low
14	Trespass grazing	Low	-	-	-	-	Low
Threat Status for Populations and Overall Distribution		Very High	High	High	Very High	Medium	Very High

Conservation Assessment
All populations of Las Vegas bearpoppy on Federal lands in Clark County are significant and high priority for the species long term viability for several reasons. Much of the **Sunrise Valley, Gale Hills,** western **Bitter Spring Valley,** and **Gold Butte** population groups currently receive protective habitat management through BLM's Las Vegas bearpoppy HMP. Each of these population groups is large in size and extent, and, collectively, they account for the majority of the habitat occurring on BLM. Additionally, the restorable **White Basin** and CTA (**Las Vegas Valley**) offer additional viable and genetically unique (in CTA) populations managed by BLM. The intended habitat acquisition for **White Basin** and proposed management at the CTA are worthy endeavors for the species long term prospects. Even **Las Vegas Dunes** contributes to the species long term outlook through mitigative management to offset past habitat loss and perhaps even provide refuge for it in the most remote areas of the dunes. **Valley of Fire, Middle Point**, eastern **Bitter Spring Valley**, and **Government Wash**, managed by NPS, offer good size/extent and populations in good condition at the core of its global distribution. Ongoing threats to Las Vegas bearpoppy's habitat loss and fragmentation need to be addressed to ensure long term prospects (*e.g.* burro management for NPS managed populations). Although the species was considered on the brink of extinction prior to the 1978 establishment episode (Janish 1977, Meyer 1987), and the most recent status report states that its trend for Nevada is declining rapidly (Mistretta *et al.* 1996), our assessment indicates perhaps a more stable trend on Federal lands when climate variability is factored.

The ecology and population biology of Las Vegas bearpoppy is better understood than for any other rare plant in Clark County. Nevertheless, there are some uncertainties in this assessment and information on specific indicator values for key ecological attributes need to be improved. Predicting additional suitable habitat needs modeling work and randomized surveys could support or call into question current assumptions regarding habitat specificity. Known habitat conditions for populations need updating as many are more than ten years old. Applied research studies on its seed bank, reproductive biology, and pollination ecology have contributed important information, so although more in depth work would fill so fill gaps (such as requirements of pollinators), we ranked them relatively lower in priority compared to the need for weed research and monitoring. Previous restoration studies show little advance and conclude the need for habitat protection. Finally, although PVA receives a lower priority rank overall for the species, an independent data test of the current PVA could serve adaptive management of Las Vegas bearpoppy in particular, and it importantly could contribute to conservation practitioners and stakeholders comfort with modeled data if assumptions were validated. Table 18 is a summary of research and management needs ordered by priority. Adaptive management is vitally important to improve knowledge of Las Vegas bearpoppy ecology and the draft conceptual model, which follows, can be refined as new information accrues (figure 10.

Table 18. Research and management needs for Las Vegas bearpoppy by priority ranking.

Research and Management Need	Priority Rank
Habitat patch connectivity requirements	1
Smaller-scale soils and vegetation maps for predictive distribution mapping	1
Randomized surveys	1
Role of exotics in resource competition	1
Impacts of global climate change	1
Species range distribution information	2
Species extents and abundances	2
Current viability of populations under documented climate conditions	2
Geospatial-based threats analysis	2
Effectiveness and status monitoring	2
Comprehensive conservation report	2
Population genetics	3
Pollination ecology	3
Seed bank research	3
Effective restoration techniques	3
Reproductive biology	3
Population viability analyses	3
Effects of fire and invasive plant species interactions (including dune stabilization)	3

Eleven conservation objectives address viability enhancement and threat abatement for Las Vegas bearpoppy in the strategies section of this document. They include the multi-species and multi-site objectives 1-3, 5, 7-9, 12, 13 and the species specific objectives 14 and 18.

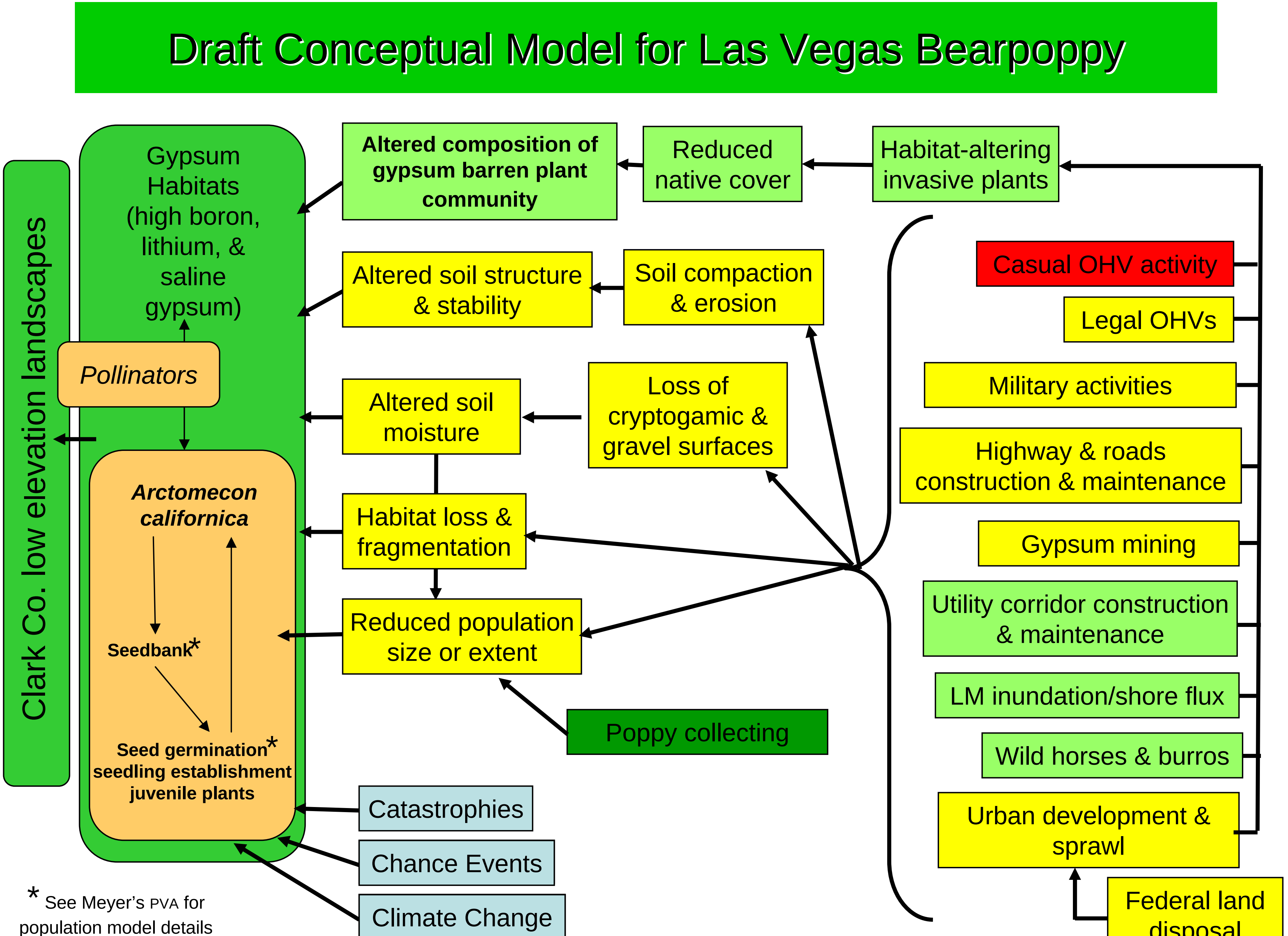

Figure 10. Conceptual model diagram for Las Vegas bearpoppy.

***Arctomecon merriamii* Coville, white bearpoppy**

Photo courtesy of Gina Glenne

Status, Trends, and Viability
Taxon Significance and Formal Status
For a review of generic significance see this same section under *Arctomecon californica*. The species was described and named by Coville (1892) from the type collection of Clinton Hart Merriam (who is commemorated in the species epithet) and Vernon Bailey in 1891 during the Death Valley Expedition. There has never been an alternative taxonomic interpretation for this accepted species.

White bearpoppy is neither federally listed by USFWS under the ESA, nor state listed by Nevada under NRS 527.260. The BLM considers it a sensitive species (BLM 2003). The global heritage status rank for white bearpoppy is vulnerable as denoted by its G3 rank. In Nevada it is state ranked vulnerable, S3, and in California, it is state ranked imperiled and threatened, S2.2 (NatureServe 2006).

Geographic Distribution
Although the known global distribution of white bearpoppy spans California and Nevada, it is wholly confined to the northern Mojave Desert Ecoregion (figure 11). Its known global occurrences are organized into 33 patchy population groups with the largest occurring in northwest Clark County and adjacent Nye and Lincoln counties. From west to east, there are:

- seven scattered population groups in the northern Death Valley region of Inyo County, California (**North Death Valley, Dry Mountain, Cottonwood Mountains, Racetrack Valley, Teakettle Junction, Grapevine Mountains,** and **Amargosa Range**) make up its northwestern most extent;
- three patchy population groups in the central Death Valley region of Inyo County (**Argus Range, Funeral Mountains,** and **Black Mountains**);
- five small and scattered population groups in southern Nye County from Ash Meadows to Pahrump (**Ash Meadows, Devils Hole, West of Last Chance Range, Stewart Valley,** and **Pahrump Valley**) with the latter straddling Clark County;

- two small distant population groups to the south in Inyo and San Bernardino counties (**Resting Spring** and **Silurian Hills**) defining its southwest extent;
- ten mostly large population groups in Nye, Clark, and Lincoln counties centered on Nellis Air Force Base and the Desert National Wildlife Refuge (**Specter Range, Spotted Range, Indian Springs, Pintwater Range, Desert Range, Black Hills, North Desert Range, Three Lakes Valley, East Desert Range,** and **Desert Hills**) representing the species stronghold;
- one distant population in Lincoln County (**South Delamar Mountains**) defining the species northeast extent; and
- five population groups east of the Spring Mountains—four in Clark County (**Las Vegas Valley, Calico Hills, Bird Spring Range,** and **Devil Canyon**) and one in San Bernardino County, California (**Clark Mountain Range**) defining its southeast extent.

The distribution of white bearpoppy in Clark County is limited to its western half (figure 12). Twelve population groups overlap Clark County and occur in three areas: north of the Spring Mountains (**Spotted Range, Indian Springs, Pintwater Range, Desert Range, Black Hills, North Desert Range, Three Lakes Valley**); west of the Spring Mountains (**Pahrump Valley**); and, east of the Spring Mountains (**Las Vegas Valley, Calico Hills, Bird Spring Range,** and **Devil Canyon**). Populations in northwest Clark County represent the largest known populations for the species, and thus, are important for the species long term survival.

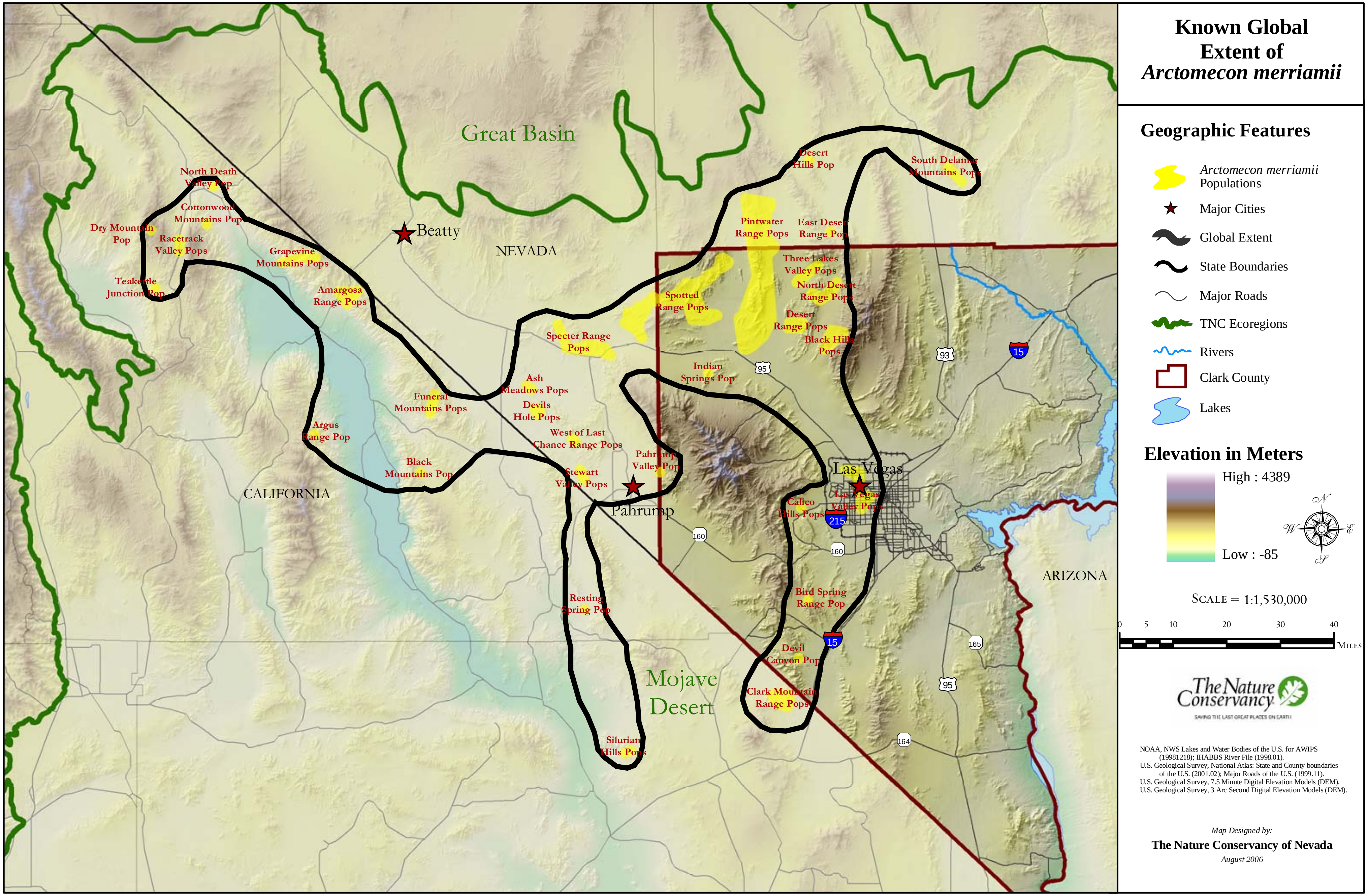

Figure 11. The known global extent of Arctomecon merriamii, white bearpoppy.

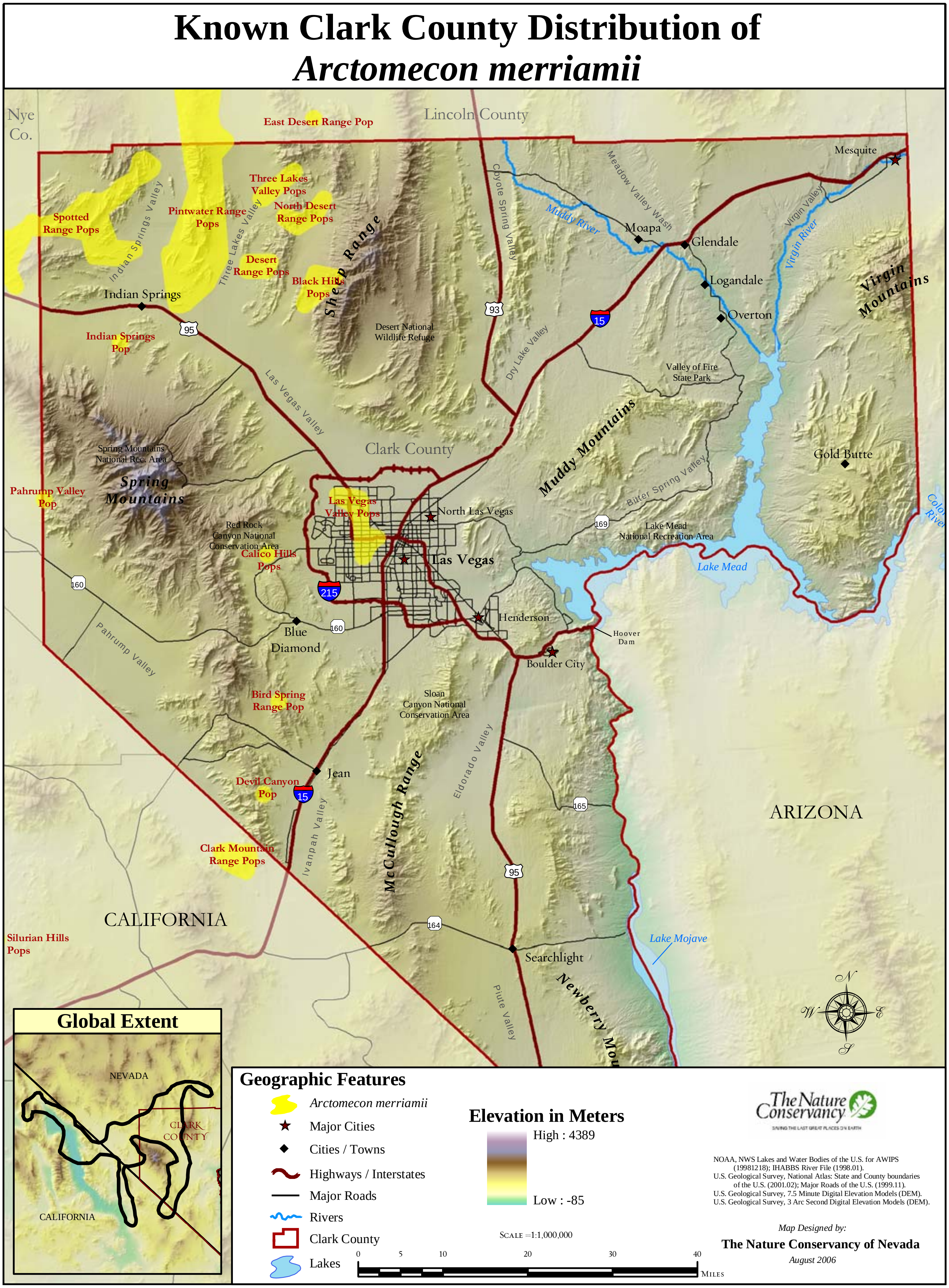

Figure 12. The known geographic distribution of Arctomecon merriamii, white bearpoppy, in Clark County.

Habitat Description
White bearpoppy occurs on a wide variety of basic soils, including alkaline clay, alkaline sand, gypsum, calcareous alluvial gravels, and carbonate rock outcrops (Morefield 2001). The species is associated with creosote bush, shadscale, blackbrush and mixed desert scrub plant communities. Its most commonly associated plants in the Spotted and Desert ranges include shadscale, desert globemallow, Torrey ephedra, goldenhead, and desert pepperweed (*Atriplex confertifolia, Sphaeralcea ambigua, Ephedra torreyana, Acamptopappus shockleyi*, and *Lepidium fremontii*; Pritchett and Smith 1999). Fairfax (1979) describes a specialized petrophile community in which it occurs on bedrock exposures within the creosote bush matrix ecological system.

White bearpoppy occurrences are at the highest relative elevations and steepest relative slopes among the nine low elevation rare plants. In our geospatial analysis of white bearpoppy locations they average 1148 m in elevation with a wide range from 538 to 2620 m (1765 to 8595 feet). Slopes average about 12 degrees, but plants are occasionally on slopes greater than 20 degrees and they can be as great as 47 degrees. White bearpoppy occurs on all exposures with southeast to northeast aspects the most common. West and southwest exposures are next common with south and northwest aspects the least common. It appears to have no preference for slopes providing cooler and moister conditions versus warmer and drier conditions.

White bearpoppy maps most commonly on Quaternary alluvial deposits, but it occasionally occurs on Aztec sandstone, and Paleozoic limestones and dolomites. In southern Nevada it typically maps on two soil associations: Rock outcrop-St. Thomas complex and association; and, Las Vegas-Destazo complex.

Life History Strategy
White bearpoppy is an herbaceous perennial with a stout taproot and a rosette of very hairy blue-green leaves. With adequate rainfall, they flower in their second year (Thompson and Smith 1997). Flowers are white and solitary at the end of leafless stalks. White bearpoppy both outcrosses and self-pollinates. Self-compatibility, which is an unusual strategy for the plant family, may be an adaptation to ecological isolation of its specific habitats (Thompson and Smith 1997). Many, small seed are produced in dehiscing capsules. Plants can live several years which continue to produce flowers and fruit. Similar to Las Vegas bearpoppy, white bearpoppy has kranz anatomy and uses the C4 photosynthetic pathway (Meyer in Knight and Clemmer 1987). Populations are comprised of low density plants often few in number (DeDecker 1977).

Surveys, Inventories, and Status Reports
Ackerman (1981) reported 110 sites and a total of 2,187 plants at DNWR in 1979. Knight and Smith (1994) found 25 new occurrences, documented 39 total (including prevoiously known), and estimated 11,600 individuals for the southern ranges of NAFB in 1993. No additional populations were documented for white bearpoppy at NAFB in subsequent inventory efforts (Knight and Smith 1995, Knight *et al.* 1997).

A dated and brief conservation status report for the species exists for California (DeDecker 1977). No recent comprehensive status report has been prepared for the species throughout its range or in Nevada.

Key Ecological Attributes
Table 19 provides eight preliminary key ecological attributes and their indicator rankings for white bearpoppy. Little is known of its pollination biology so we excluded an indicator for now unlike Las Vegas bearpoppy. Improvements in the rankings of indicators, as well as the attributes themselves, are expected to be made as adaptive management provides additional information from monitoring and appropriate applied research studies.

Table 19. Key ecological attributes, indicators, and their ranking definitions for white bearpoppy populations. Italics represent the ultimate goal of land managers.

Category	Key Attribute	Indicator	**White Bearpoppy** (*Arctomecon merriamii*) Indicator Rankings			
			Poor	**Fair**	**Good**	**Very Good**
Landscape Context	Ecological integrity of surrounding matrix systems and specific habitat	Density of vehicle tracks and animal (WHB/cattle) trails within habitat and matrix systems	High density or >50% scope of habitat impacted	Moderate density or >10<50% scope of habitat impacted (>1 mi / sq mi habitat)	Low density or <10% scope of habitat impacted (<1 mi / sq mi habitat)	*Virtually no vehicle tracks or animal trails*
Landscape Context	Pollination	Presence of characteristic pollinators	Exclusively generalist pollinator species	More generalist species than specialist pollinators	Specialist pollinators in healthy numbers although others may be present	*Dominated by specialist pollinators*
Landscape Context	Soil moisture and nutrient regime	Degree of surface disturbance relative to presence of surface crusts and gravels on gypsum soils	High surface disturbance with only remnant cryptobiotic crusts/gravel surfaces present	Moderate surface disturbance with <20% cover of cryptobiotic crusts/gravel surfaces present	Low surface disturbance with >20% of cryptobiotic crusts/gravel surfaces present	*Surface disturbance virtually absent with intact cryptobiotic crusts/gravel surfaces present*
Condition	Characteristic native plant community	Native vs. exotic plant species composition	Many native species conspicuously absent, and exotics or habitat-altering invasives common	Some native species conspicuously absent, and several exotics or habitat-altering invasives present	Mostly native species composition, and with few exotics, although no habitat-altering invasives	*Native plant species composition with no habitat-altering exotic species present*
Condition	Soil structure and stability	Degree of soil erosion or soil compaction	High erosion or compaction	Moderate erosion or compaction	Low erosion or compaction	*Virtually absent*
Size	Minimum dynamic area	Number and average size of habitat patches	Large number of habitat patches with small average size	Moderate number of habitat patches with moderate average size	Small number of habitat patches with large average size per patch	*Few habitat patches with very large average size*
Size	Minimum dynamic area	Sufficient acreage for characteristic species and natural habitat disturbances within historic range of	Insufficient acreage for all sensitive species and severe disturbance likely to eliminate	Insufficient acreage for most sensitive species and habitat susceptible to severe disturbance	Sufficient acreage for most sensitive species and habitat mostly resilient to severe disturbance	*Sufficient acreage for all sensitive species and severe disturbance*

Category	Key Attribute	Indicator	**White Bearpoppy** (*Arctomecon merriamii*) Indicator Rankings			
			Poor	**Fair**	**Good**	**Very Good**
		variability	habitat			
Size	Population size & dynamics	Number of reproductive plants in non-drought years	few	10s	100s	>*1000*

Viability and Trend Status
As of 2001, white bearpoppy populations were estimated to possess more than 20,000 individuals and occupy about 974 ac (394 ha) of habitat throughout Nevada (Morefield 2001). Most of the 11 California populations are small in number and limited in extent, except for a cluster of occurrences immediately south of the Clark County and California border defining the **Clark Mountain Range** population group. Knight and Smith (1994) reported four significant populations at NAFB that accounted for 65% of all individuals estimated in 1993. They include the **Pintwater Range** with more than 2,000 plants, **Three Lakes Valley** with more than 3,000 plants, and two combined in the **Spotted Range** population group with more than 2,500 individuals. There were 32 and 27 live plants at the **Spotted Range** and **Three Lakes Valley** population groups in 1998, respectively (Pritchett and Smith 1999). It is unknown whether additional surveys have been made at Nellis since the 1990s.

Las Vegas Valley has an undetermined number of plants that were identified vegetatively in 2005 and flowering in 2006 (Marrs-Smith, personal communication). These new locations for white bearpoppy need to be incorporated into the boundary for this population group in future CMS analyses (see page 7).

The rangewide trend for white bearpoppy is stable, but its trend in Las Vegas Valley is declining (FWS 2000). Its trend for Nevada is declining (Morefield 2001). Viability estimates from literature and expert review are organized and summarized in table 20 by MSHCP management category within Clark County and by state elsewhere.

Table 20. Viability ranks for white bearpoppy populations grouped by MSHCP management category within Clark County and by states elsewhere.

White Bearpoppy (*Arctomecon merriamii*)		**Landscape Context**	**Condition**	**Size**	**Viability Rank**
1	**Black Hills, Calico Hills, Desert Range, North Desert Range, Pintwater Range, Spotted Range, Three Lakes Valley** (IMA)	Fair	Good	Very Good	**Good**
2	**Bird Spring Range, Devil Canyon, Indian Springs, Pahrump Valley** (MUMA)	Good	Good	Fair	**Good**
3	**Las Vegas Valley** (UMA)	Fair	Fair	Poor	**Fair**
4	**Desert Hills, East Desert Range, South Delamar Mountains, Ash Meadows, Devils Hole, Specter**	Good	Good	Good	**Good**

White Bearpoppy (*Arctomecon merriamii*)		Landscape Context	Condition	Size	Viability Rank
	Range, Stewart Valley, West of Last Chance Range (Other NV)				
5	**Black Mountains, Clark Mountain Range, Cottonwood Mountains, Dry Mountain, Funeral Mountains, Grapevine Mountains, North Death Valley, Racetrack Valley, Resting Spring, Silurian Hills, Teakettle Junction** (CA)	Good	Good	Good	**Good**

Monitoring and Research

A long term monitoring program for the species was established at Nellis Air Force Base Gunnery and Bombing Range (NAFBGR) by Pritchett and Smith (1999). Monitoring was set up in May 1998 at two sites (**Spotted Range** and **Three Lakes Valley** population groups). The objective is to collect demographic data over a number of years, so individual plants were tagged and measured for plant diameter, number of buds, flowers and fruit, and nearest plant distance and identity. From 1998 baseline data collections they calculated a statistically positive relationship between mean rosette diameter and maximum potential reproductive output as measured by summing numbers of buds, flowers and fruits on a plant. The two sites had different age structures with a younger population structure at **Spotted Range**. They recommended biannual (mid and end growing season) monitoring at these populations if funding were available (Pritchett and Smith 1999). However, no data have been collected or reported to USFWS since this monitoring program began (Frank Smith, personal communication, 2004).

Van Buren and Harper (1996) studied genetic variation among populations of all three species of *Arctomecon* based on RAPD (randomly amplified polymorphic DNA) analysis of genomic DNA. They sampled three populations for white bearpoppy (**Las Vegas Valley, South Delamar Mountains** in Lincoln County, and **Ash Meadows** in Nye County). Populations of white bearpoppy averaged only about 68 percent similarity, in contrast to the other two species of bearpoppy which each had very little genetic variation.

Sheldon Thompson and Smith (1997) and Sheldon (1994) studied life history attributes, reproductive biology, vegetation associations, and soil requirements for white bearpoppy along with Las Vegas bearpoppy. Herbaceous perennials, can flower in their second year and continue for several more years, may become clonal and form multiple rosettes. Loss of reproductive potential was highest for white bearpoppy at bud and capsule stages. Highest post-reproductive mortality occurred during seedling stage when white bearpoppy had 39% seedling mortality. White bearpoppy can successfully self-pollinate, and in addition it outcrosses, which may be adaptive for its ecologically isolated nature of low plant density (in comparison to Las Vegas bearpoppy). White bearpoppy occurs in associations that are quantitatively distinct and relatively unique to typical Mojave Desert plant assemblages, although the relationship was weak. Gypsum-derived soils are different than off site locations, notably in higher sulfur and calcium contents, lower magnesium, much higher soluble salt contents (Sheldon 1994).

Management

In Clark County white bearpoppy populations are managed by BLM (**Bird Spring Range, Calico Hills, Devil Canyon, Indian Springs,** and **Pahrump Valley**), USFWS Desert National Wildlife Refuge (**Black Hills**), DoD (**Desert Range, Pintwater Range,** and **Three Lakes Valley**) or mostly DoD (with some data points managed by BLM, DoE, or USFWS (**Spotted Range**), or jointly by USFWS and DoD **North**

Desert Range). A newly found population in the CTA for Las Vegas bearpoppy (**Las Vegas Valley**) is managed by BLM and in need of documentation. Populations in Lincoln County are managed by DoD (**Desert Hills** and **East Desert Range**) or BLM (**South Delamar Mountains**). Populations in Nye County are managed by BLM (**Ash Meadows, Devils Hole, Specter Range, Stewart Valley,** and **West of Last Chance Range**). Most of the populations in California are in Death Valley National Park managed by NPS, but the two southernmost (**Clark Mountain Range** and **Silurian Hills**) are managed by BLM. Table 21 is a summary of management for white bearpoppy data points.

Table 21. Management of white bearpoppy in Clark County and beyond with percentages totaled for each population group provided above the number of data points.

White bearpoppy ***Arctomecon merriamii***	IMA	LIMA	MUMA	UMA	Not Applicable California	Population Total
Calico Hills		83.33% 20				10.36% 20
Three Lakes Valley	10.94% 7	4.17% 1				4.15% 8
Black Hills	4.69% 3					1.55% 3
Desert Range	10.94% 7					3.63% 7
North Desert Range	9.38% 6					3.11% 6
Spotted Range	46.88% 30	8.33% 2			13.10% 11	22.28% 43
Pintwater Range	17.19% 11	4.17% 1		11.76% 2	14.29% 12	13.47% 26
Pahrump Valley			25.00% 1			0.52% 1
Bird Spring Range			25.00% 1			0.52% 1
Devil Canyon			25.00% 1			0.52% 1
Indian Springs			25.00% 1			0.52% 1
Las Vegas Valley				88.24% 15		7.77% 15
Amargosa Range					5.95% 5	2.59% 5
Argus Range					1.19% 1	0.52% 1
Ash Meadows					2.38% 2	1.04% 2
Black					1.19%	0.52%

White bearpoppy *Arctomecon merriamii*	IMA	LIMA	MUMA	UMA	Not Applicable California	Population Total
Mountains					1	1
Stewart Valley					2.38% 2	1.04% 2
Clark Mountain Range					15.48% 13	6.74% 13
Cottonwood Mountains					1.19% 1	0.52% 1
Desert Hills					1.19% 1	0.52% 1
Devils Hole					5.95% 5	2.59% 5
Dry Mountain					1.19% 1	0.52% 1
East Desert Range					1.19% 1	0.52% 1
Funeral Mountains					2.38% 2	1.04% 2
Grapevine Mountains					3.57% 3	1.55% 3
North Death Valley					1.19% 1	0.52% 1
Racetrack Valley					2.38% 2	1.04% 2
Resting Spring					1.19% 1	0.52% 1
Silurian Hills					2.38% 2	1.04% 2
South Delamar Mountains					2.38% 2	1.04% 2
Specter Range					14.29% 12	6.22% 12
Teakettle Junction					1.19% 1	0.52% 1
West of Last Chance Range					2.38% 2	1.04% 2
Total % Total Count	100.00% 64	100.00% 24	100.00% 4	100.00% 17	100.00% 84	100.00% 193

Threats
Rural development and associated sprawl for populations managed by BLM as multiple use (MUMAs) and urban development for the new population at the CTA (**Las Vegas Valley**) are the highest (very high) ranked threats (table 22). There are many high ranked threats to white bearpoppy in Clark County and in order of their threat across the landscape they include: military activities, casual OHV use and trail development, invasive plant competition, wild horse and burro management, groundwater development, highway and road construction and maintenance, utility corridor construction and maintenance, and land disposal.

Table 22. Threat ranks for white bearpoppy populations grouped by MSHCP management category within Clark County and by states elsewhere.

White Bearpoppy (*Arctomecon merriamii*) **Threats Across Population Groups**		**Black Hills, Calico Hills, Desert Range, North Desert Range, Pintwater Range, Spotted Range, Three Lakes Valley** (IMA)	**Bird Spring Range, Devil Canyon, Indian Springs, Pahrump Valley** (MUMA)	**Las Vegas Valley** (UMA)	**Desert Hills, East Desert Range, South Delamar Mountains, Ash Meadows, Devils Hole, Specter Range, Stewart Valley, West of Last Chance Range** (Other NV)	**Black Mountains, Clark Mountain Range, Cottonwood Mountains, Dry Mountain, Funeral Mountains, Grapevine Mountains, North Death Valley, Racetrack Valley, Resting Spring, Silurian Hills, Teakettle Junction** (CA)	**Overall Threat Rank**
1	Rural development and sprawl	-	Very High	-	High	High	High
2	Military activities (training and facilities)	High	High	-	High	Medium	High
3	Casual OHV use and trail development	High	High	-	High	Medium	High
4	Invasive exotic plant species competition	High	High	-	High	-	High
5	Urban development and sprawl	-	-	Very High	-	-	High
6	Wild horse and burro management	-	High	-	High	Low	High
7	Groundwater developments	High	-	-	High	-	High
8	Highway and road construction and maintenance	-	-	High	High	-	High

White Bearpoppy (*Arctomecon merriamii*) Threats Across Population Groups		**Black Hills, Calico Hills, Desert Range, North Desert Range, Pintwater Range, Spotted Range, Three Lakes Valley** (IMA)	**Bird Spring Range, Devil Canyon, Indian Springs, Pahrump Valley** (MUMA)	**Las Vegas Valley** (UMA)	**Desert Hills, East Desert Range, South Delamar Mountains, Ash Meadows, Devils Hole, Specter Range, Stewart Valley, West of Last Chance Range** (Other NV)	**Black Mountains, Clark Mountain Range, Cottonwood Mountains, Dry Mountain, Funeral Mountains, Grapevine Mountains, North Death Valley, Racetrack Valley, Resting Spring, Silurian Hills, Teakettle Junction** (CA)	**Overall Threat Rank**
9	Utility corridor construction and maintenance	-	High	-	-	-	Medium
10	BLM land disposal to private development	-	-	High	-	-	Medium
11	Livestock grazing management	-	Medium	-	Low	-	Low
12	Legal OHV use	Medium	-	-	-	-	Low
13	Gypsum mining	-	-	-	-	Medium	Low
14	Legal concentrated recreation use	-	-	-	Low	-	Low
Threat Status for Populations and Overall Distribution		High	Very High	High	Very High	Medium	Very High

Conservation Assessment
The dozen population groups of white bearpoppy occurring in Clark County constitute much of its northern distribution and are known to harbor the largest populations documented. Concern for these populations is high because they primarilty are managed by DoD (a few are on FWS refuge land) who is not a signing cooperator for the MSHCP. Conservation of population groups at Nellis Air Force Range ultimately is the responsibility of DoD, yet the FWS has an important role in coordinating conservation management with DoD through its INRMP revision. That said, there are four population groups in the County managed fully or partially by BLM (**Calico Hills, Bird Spring Range, Devil Canyon, Indian Springs,** and **Pahrump Valley**) where changes in current management actions can improve viability and reduce threats, thus, adding to the species long term survivability. Conservation management for these populations is needed to meet MSHCP goals.

Much of the biology and ecology known for white bearpoppy is hinged on its close relationship to Las Vegas bearpoppy and that information can be adaptively applied for refined management. Still, many research gaps need filling to better understand its ecology (table 23). As adaptive management increases understanding of this species biology and ecology the preliminary conceptual model for white bearpoppy can be updated (figure 13).

Table 23. Research and management needs for white bearpoppy by priority ranking.

Research and Management Need	Priority Rank
Geospatial-based threats analysis	1
Effectiveness and status monitoring	1
Effects of fire and invasive plant species interactions (including dune stabilization)	1
Effective restoration techniques	1
Habitat patch connectivity requirements	1
Impacts of global climate change	1
Species range distribution information	2
Smaller-scale soils and vegetation maps for predictive distribution mapping	2
Population genetics	2
Pollination ecology	2
Current viability of populations under documented climate conditions	2
Seed bank research	2
Comprehensive conservation report	2
Role of exotics in resource competition	2
Randomized surveys	3
Species extents and abundances	3
Reproductive biology	3
Population viability analyses	3

Eight conservation objectives address viability enhancement and threat abatement for white bearpoppy in the strategies section of this document. They include the multi-species and multi-site objectives 1-4 and 7-10.

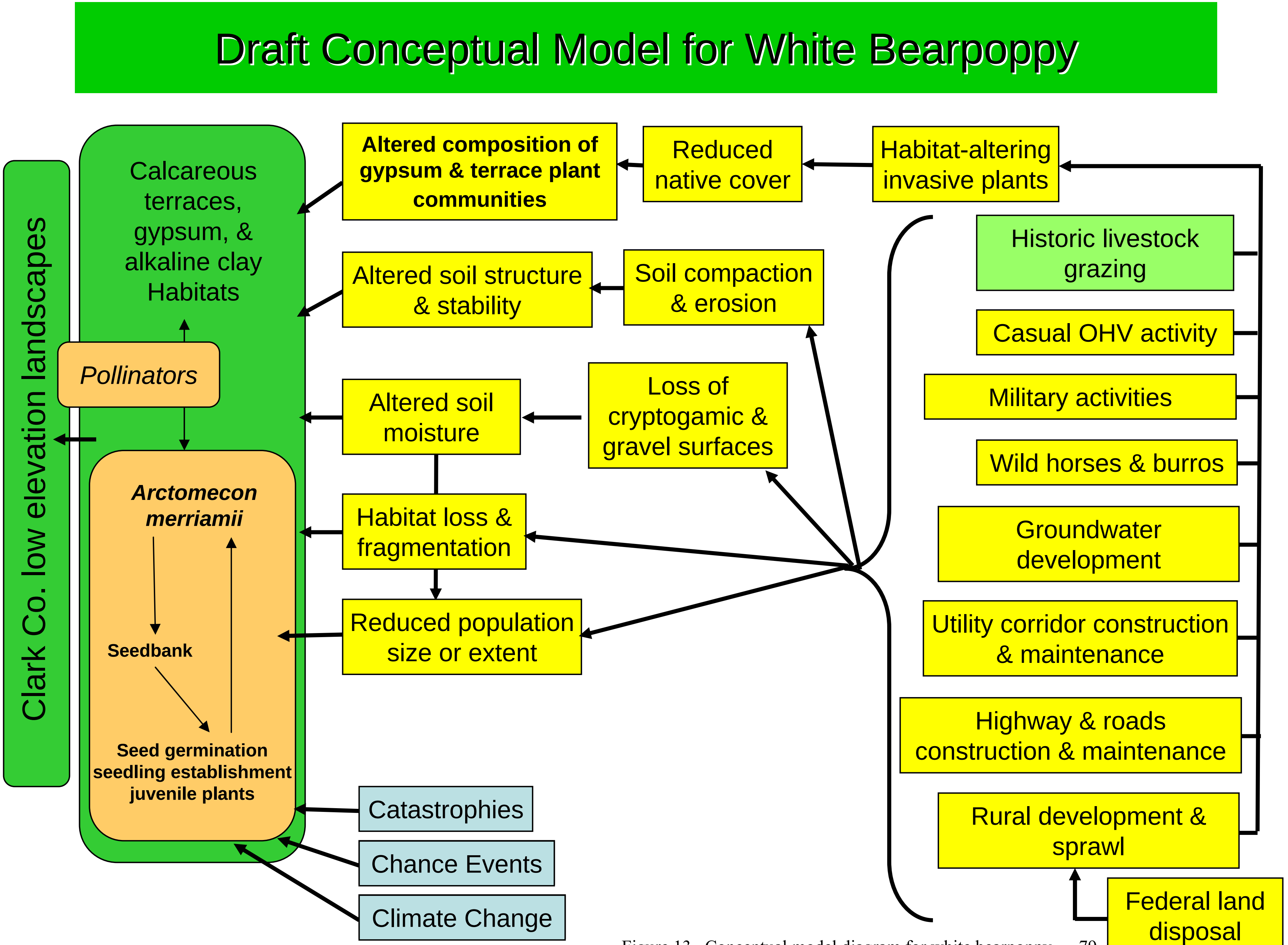

Figure 13. Conceptual model diagram for white bearpoppy.

***Astragalus geyeri* A. Gray var. *triquetrus* (A. Gray) M.E. Jones, threecorner milkvetch**

Photo courtesy of Gayle Marrs-Smith

Status, Trends, and Viability

Taxon Significance and Formal Status

Astragalus is the most diverse genus of any vascular plant in the world, possessing nearly 2500 species (Sanderson and Wojciechowski 1996). Nevada alone possesses at least 94 species (Kartesz 1987), with new species described and new state records being made at a steady pace for the past century (Ertter 2000). Of these 94 species, 37 (45 taxa) are rare and 13 rare taxa occur in Clark County (Nachlinger 1999).

The first collection of threecorner milkvetch was made by Edward Palmer in 1877 at St. Thomas, at the confluence of the Virgin and Muddy Rivers, a location now under Lake Mead. The varietal name "triquetrus" refers to the three-sided inflated seedpods of the variety. Although it was originally described as a species in 1878, Barneby treated it at the varietal level in two comprehensive taxonomic works (1964, 1989). He stated that this distinctive member of the section *Inflati* perhaps deserves its original specific status (Barneby 1989). The species is one of few annuals in the genus and is one of its tiniest taxa.

Threecorner milkvetch is not federally listed by USFWS under the ESA, but it is state listed by Nevada under NRS 527.260 as critically endangered. For the latter reason, BLM includes it on their special status species list. The Nevada Native Plant Society believes it meets the federal definition of Threatened under the ESA and thus, includes it on their list of threatened plant species. The global heritage status rank for threecorner milkvetch is imprecisely defined as imperiled to vulnerable as denoted by its T2T3G4? rank. In Nevada it has a heritage status state rank of imperiled to vulnerable, S2S3, while in Arizona, it is state ranked critically imperiled, S1 (NatureServe 2006).

Geographic Distribution

The known global distribution of threecorner milkvetch is nearly confined to Clark County, and although it spills into adjacent Mohave County, Arizona, it lies wholly within the northeastern Mojave Desert

Ecoregion (figure 14). Its known occurrences have been bundled into 17 population groups centered on the confluence of the Muddy and Virgin rivers. From north to south, the population groups include:

- four population groups along the Virgin River drainage—one in Mohave County, Arizona (Sand Hollow), and three in northeastern most Clark County (**Town Wash, Toquop Wash,** and **Virgin River**) representing its northeastern extent;
- four population groups near the Muddy River drainage (**Mormon Mesa, Weiser Wash, Muddy River,** and **Logandale**);
- two population groups west of the Muddy Mountains defining the species western extent (**Mud Lake** and **California Wash**);
- four small population groups around the confluence of the Muddy and Virgin rivers (**Bark Bay, TheMeadows, Valley of Fire Wash,** and **Lime Cove**), with another population group east of the confluence (**Mud Wash**); and,
- two population groups in the western portion of Lake Mead defining the species southern extent (**Sandy Cove** and **Ebony Cove**).

The distribution of threecorner milkvetch in Clark County is limited to its eastern portion (figure 15). It occurs along the Muddy and Virgin rivers and Overton Arm from Sandy Cove and Middlepoint to Mormon Mesa, in Dry Lake Valley, California Wash, Gold Butte, and Mesquite. With 16 of the 17 population groups Clark County represents the vast majority of this species known global distribution and, therefore, is crucial for its long term management and survival.

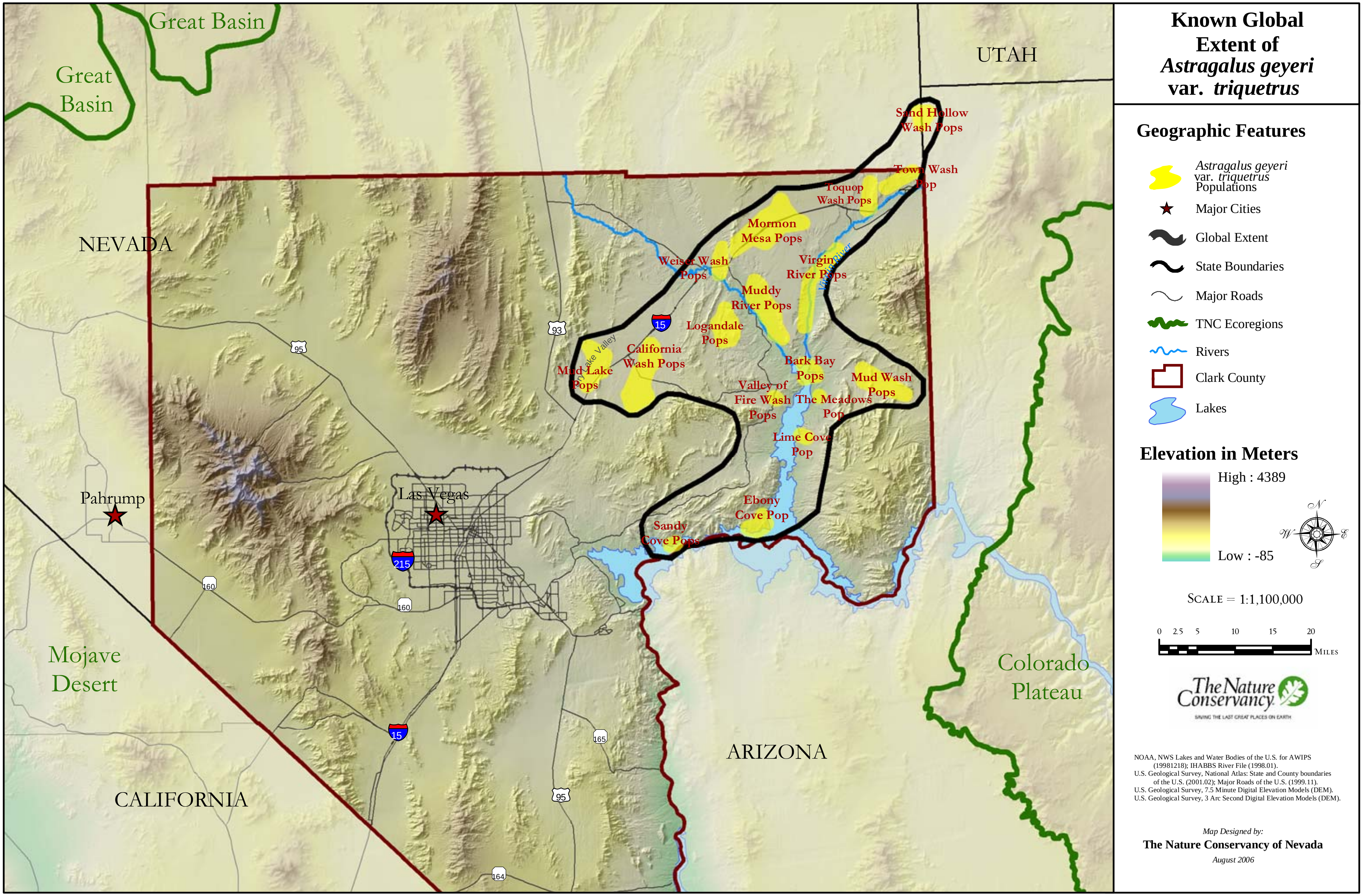

Figure 14. The known global extent of Astragalus geyeri var. triquetrus, threecorner milkvetch.

Known Clark County Distribution of *Astragalus geyeri* var. *triquetrus*

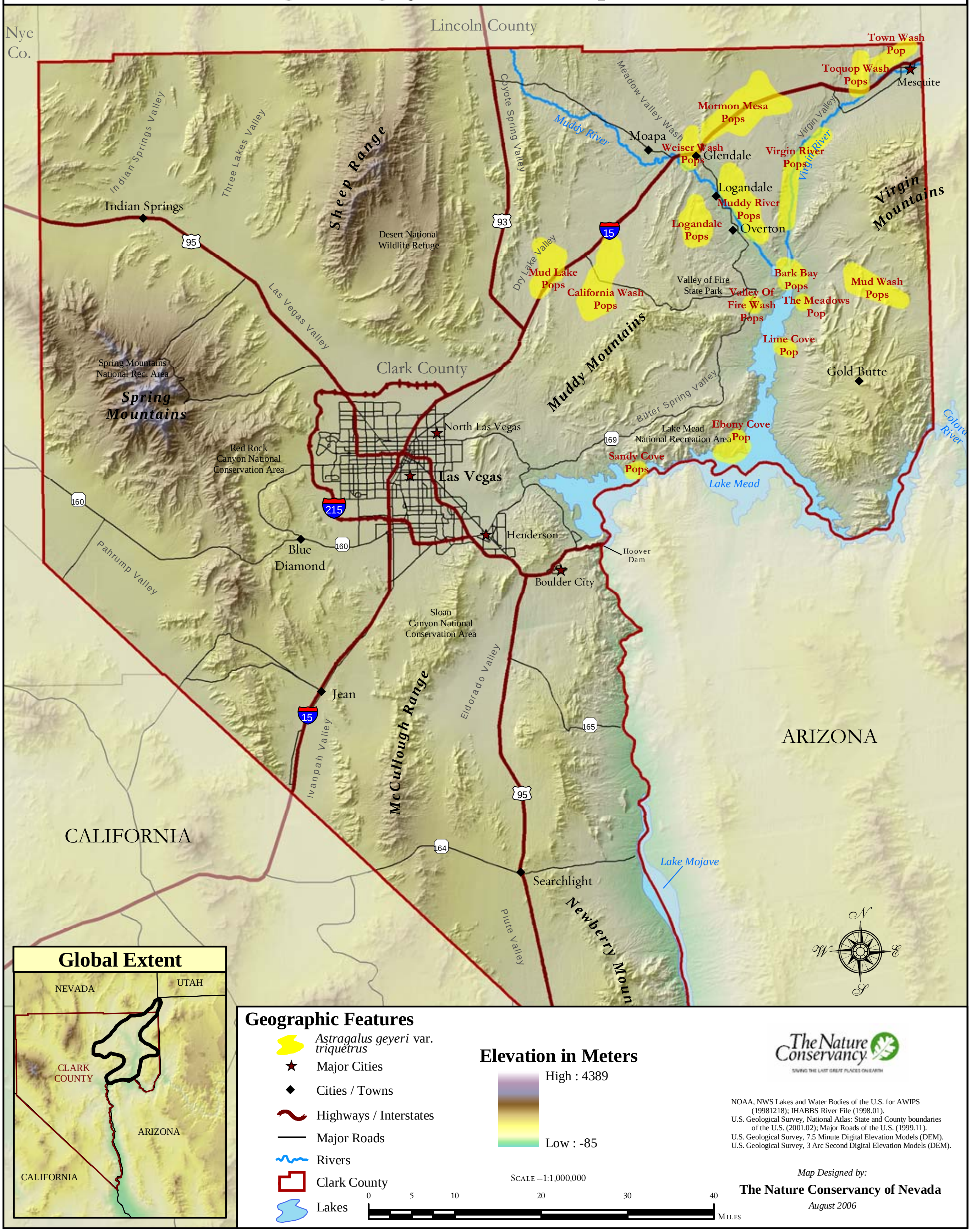

Figure 15. The known geographic distribution of Astragalus geyeri var. triquetrus, threecorner milkvetch, in Clark County.

Habitat Description

Threecorner milkvetch locations are closely related with the Muddy Creek Formation, a Tertiary aged sedimentary rock widely exposed along Lake Mead's portion of the Colorado River and its tributary valleys. Knight (1990) includes a map of known occurrences superimposed on a geology map highlighting the Muddy Creek Formation. Threecorner milkvetch occurs on deep sand and unconsolidated dunes weathered from this formation and deposited as aeolian or fluvial sand. Later, Niles *et al*. (1995) added that its habitat includes areas of stabilized sand that have a cemented or hardened surface, or a cryptogamic crust, and frequently with sparse gravel on the surface. It occurs at edges of dunes and in depressions or sand blow-outs. Powell describes the **Sandy Cove** populations as occurring in blow-out areas (2001). It less commonly occurs in deep, loose, unconsolidated dunes (Niles *et al*. 1995). Additional habitat descriptions include sand-clay with scattered gravel, disturbed sandy beach, and rolling calcareous hill.

The vast majority of threecorner milkvetch occurrences fall within the mapped Sonora-Mojave creosotebush-white bursage desert scrub matrix ecological system (USGS 2004). Species associated with the plant include: white bursage, creosote bush, littleleaf rattany, Torrey ephedra, woody crinklemat, beavertail pricklypear, Fremont dalea, smallseed sandmat, desert plantain, desert palafox, brittle spineflower, desert trumpet, and birdcage evening primrose (*Ambrosia dumosa, Larrea tridentata. Krameria erecta, Ephedra torreyana, Tiquilia canescens, Opuntia basilaris, Psorothamnus fremontii, Chamaesyce polycarpa, Plantago ovata, Palafoxia arida, Chorizanthe brevicornu, Eriogonum inflatum,* and *Oenothera deltoides*). Some populations are sometimes associated with warm desert wash or warm desert bedrock small patch ecological systems, *e.g.* **California Wash, Mud Wash, Mormon Mesa,** and **Logandale**.

Threecorner milkvetch occurrences average 562 m in elevation with a range from 366 to 747 m (1200 to 2450 feet) in elevation. They typically occur on very slight slopes less than two degrees, but they can be found uncommonly on slopes as great as 21 degrees. Threecorner milkvetch occurs on all exposures with west and southwest exposures the most common and east and northeast the least common. This pattern suggests that pods and seeds are wind transported in the prevailing wind direction to windward slopes.

More than half of threecorner milkvetch occurrences are mapped on Quaternary alluvial deposits, while much of the remaining occurrences fall on Triassic aged tufaceous sedimentary rocks. Soil associations most commonly mapped with threecorner milkvetch are fine sands, including Bard gravelly fine sand and fine sandy loam, Arada fine sand and fine sand gravelly substratum, and Mormon Mesa loamy fine sand and fine sandy loam. Sands can be delivered to its habitat by either fluvial or aeolian processes.

Life History Strategy

Threecorner milkvetch is one of four winter annuals addressed in this conservation management strategy. Herbaceous winter annuals of the Mojave Desert have life spans of less than one year and typically take five to eight months from seed germination to seed dissemination and plant death. Life span is dictated primarily by moisture and temperature. Seeds germinate following sufficient precipitation during winter months, which is about 15 to 25 mm in the northern Mojave Desert (Beatley 1967). With less precipitation they tend not to germinate. Powell (1999) noted that "abundant" rainfall is thought to stimulate germination and growth of threecorner milkvetch. This puts threecorner milkvetch at risk because accidental losses of habitat at undetected populations may occur (Morefield 2001).

In ideal growing conditions, winter annual plants grow vegetatively through the winter, then flower, fruit and produce seed in spring. They die soon thereafter, which is a life history strategy that avoids the extreme climatic conditions of the Mojave's summer heat and drought. It is not known whether the small white flowers are apomictic (producing seed from generative tissues without fertilization) or if pollinators are required to produce viable seed. The inflated pods are well suited for wind dispersal. The taxon's presence and abundance varies annually because size and numbers of plants are correlated with temperature and moisture. Wetter and cooler spring season conditions provide greater and longer annual plant displays than either wet and hot, dry and cool, or dry and hot growing conditions. Ideal conditions also provide greater reproductive output, which significantly replenishes seed banks. Seed bank longevity is unknown.

Surveys, Inventories, and Status Reports

The earliest survey was conducted at Lake Mead NRA (Reigla 1975). Prior to 1979 the taxon was believed to be extremely rare, and then several new locations documented by plant collections were found in 1979 and 1980 (Holland *et al.* 1979, Mozingo and Williams 1980). Threecorner milkvetch was found east of the Muddy Mountains (**Valley of Fire Wash**) during an inventory of the range (Swearingen 1981). Leary (1987) made a Rights-of-Way survey for the taxon along the Pecos Harrisburg corridor in northern Clark County documenting additional populations in the Glendale (**Weiser Wash**) and Dry Lake Valley (**Mud Lake**) areas.

Knight (1992) extended its known range considerably south in 1991 where she found it at **Lime Cove, The Meadows**, and Middle Point (**Ebony Cove**). In 1995, a survey for the variety was conducted throughout its range by Niles *et al.* (1995). These botanists extended its range into Lincoln County (**Sand Hollow Wash**) and southwest to **Sandy Cove**, and they provided detailed size and condition information for 19 sites across its range. In 1997, Powell searched for threecorner milkvetch at eight previously known sites and found it only at one, Sandy Cove. The following year she documented it at three sites at Lake Mead NRA (Powell 1999). 1997 was a severe drought year while 1998 was a much above normal precipitation year. BLM has conducted surveys for threecorner milkvetch irregularly since 1995 using presence of individuals in the **California Wash** population group to survey elsewhere because of its consistent emergence in years of adequate moisture (Marrs-Smith, personal communication 2005). Range surveys and area inventories have been opportunistic, rather than systematic, because of the ephemeral nature of the plant.

An early local status report for Lake Mead NRA was produced (Holland *et al.* 1980). A comprehensive conservation status report for the variety was prepared by Knight (1990), but this is a fairly dated assessment now and much of the information is superceded by more current and detailed information from BLM and NPS. Nevertheless, she documented its known distribution further west and south than where it had been previously summarized. More recently, Powell (2001) reviewed its conservation status and needs for its largest population at Lake Mead NRA, **Sandy Cove**.

Key Ecological Attributes

Ten key ecological attributes and their indicators have been identified for threecorner milkvetch (table 24). Preliminary population numbers of plants are based on documented occurrences by the National Park Service and BLM; however, acreage figures for populations are generally lacking. These key ecological attributes and their indicators need refining as appropriate applied research and population monitoring provide adaptive information.

Table 24. Key ecological attributes, indicators, and their ranking definitions for threecorner milkvetch populations. Italics represent the ultimate goal of land managers.

Category	Key Attribute	Indicator	Threecorner Milkvetch (*Astragalus geyeri triquetrus*) Indicator Rankings			
			Poor	Fair	Good	Very Good
Landscape Context	Aeolian deposition process	Aeolian deposition between source and sink areas	Virtually no germination in a good year	Little germination in >normal winter ppt years (70mm)	Good germination in >>normal winter ppt years (100mm), and sufficient germination in >normal winter ppt years (70mm)	*Relatively massive germination in >>normal winter ppt years (100mm), and very good germination in >normal winter ppt years (70mm)*
Landscape Context	Ecological integrity of surrounding matrix systems and specific habitat	Density of vehicle tracks and animal (WHB/cattle) trails within habitat and matrix systems	High erosion or compaction	Moderate erosion or compaction	Low erosion or compaction	*Virtually absent*
Landscape Context	Fire regime - (timing, frequency, intensity, extent)	FRCC of matrix community surrounding rare plant population and habitat	Large number of habitat patches with small average size	Moderate number of habitat patches with moderate average size	Small number of habitat patches with large average size per patch	*Few habitat patches with very large average size*
Landscape Context	Fluvial deposition process	River or stream "sediment carrying capacity" and deposition	Insufficient acreage for all sensitive species and severe disturbance likely to eliminate habitat	Insufficient acreage for most sensitive species and habitat susceptible to severe disturbance	Sufficient acreage for most sensitive species and habitat mostly resilient to severe disturbance	*Sufficient acreage for all sensitive species and severe disturbance*
Condition	Characteristic native plant community	Native vs. exotic plant species composition	few	10s	100s	*>1000*
Condition	Recruitment	Frequency and extent of germination events	Virtually no germination in a good year	Little germination in >normal winter ppt years (70mm)	Good germination in >>normal winter ppt years (100mm), and sufficient germination in >normal winter ppt years (70mm)	*Relatively massive germination in >>normal winter ppt years (100mm), and very good germination in >normal winter ppt years (70mm)*

Category	Key Attribute	Indicator	**Threecorner Milkvetch (*Astragalus geyeri triquetrus*) Indicator Rankings**			
			Poor	**Fair**	**Good**	**Very Good**
Condition	Soil structure and stability	Degree of soil erosion or soil compaction	High erosion or compaction	Moderate erosion or compaction	Low erosion or compaction	*Virtually absent*
Size	Minimum dynamic area	Number and average size of habitat patches	Large number of habitat patches with small average size	Moderate number of habitat patches with moderate average size	Small number of habitat patches with large average size per patch	*Few habitat patches with very large average size*
Size	Minimum dynamic area	Sufficient acreage for characteristic species and natural habitat disturbances within historic range of variability	Insufficient acreage for all sensitive species and severe disturbance likely to eliminate habitat	Insufficient acreage for most sensitive species and habitat susceptible to severe disturbance	Sufficient acreage for most sensitive species and habitat mostly resilient to severe disturbance	*Sufficient acreage for all sensitive species and severe disturbance*
Size	Population size & dynamics	Number of reproductive plants in non-drought periods	few	10s	100s	*>1000*

Viability and Trend Status
Summary information for threecorner milkvetch is dated. As of 2001, populations were estimated to possess more than 4,094 individuals at 39 sites with an unknown area of habitat throughout Nevada (Morefield 2001). Trend has remained unknown for both populations and habitat.

Populations along Lake Mead's shoreline on sand dunes and in sandy soils along the banks of the Muddy and Virgin rivers suggest better connectivity of habitat between them at earlier times when the Colorado River flowed freely and episodic floods delivered large amounts of sand to reaches of the rivers. Documented loss of habitat and extirpation of populations occurred at **Bark Bay, The Meadows,** and **Ebony Cove** from inundation of habitat by Lake Mead reservoir.

The largest known population of threecorner milkvetch is at **Sandy Cove**, Lake Mead NRA, where 8,000 plants were estimated in 2005 (Powell, personal communication). Most populations have highest numbers documented in 1995, a year with about average precipitation throughout the County. Some population groups had numbers in the several hundreds documented in 1995 (**Ebony Cove , Mormon Mesa,** and **Muddy River**) and in 1987 (**Mud Lake**). Several other populations are documented with fewer than one hundred plants in 1995 (**Bark Bay, California Wash, Mud Wash, Toquop Wash, Virgin River, Weiser Wash**, and in Arizona at **Sand Hollow Wash**). After more than a decade of surveys for the plant, BLM has found no evidence to explain its scarcity (Marrs-Smith, personal communication 2005). Recent discovery and documentation of the large **Logandale** population group with about 700 individuals in 2005 is testament to basic information gaps and the difficulty in assessing viability and trend for threecorner milkvetch.

Viability estimates from literature and expert review are organized and summarized in table 25 by MSHCP management category within Clark County and by state elsewhere.

Table 25. Viability ranks for threecorner milkvetch populations grouped by MSHCP management category within Clark County and by states elsewhere.

	Threecorner Milkvetch (*Astragalus geyeri triquetrus*)	Landscape Context	Condition	Size	Viability Rank
1	**Bark Bay, Ebony Cove, Lime Cove, Mormon Mesa, Sandy Cove, The Meadows, Valley Of Fire Wash** (IMA)	Fair	Fair	Fair	**Fair**
2	**Mud Wash, Virgin River ,** (Mixed)	Fair	Fair	Fair	**Fair**
3	**California Wash, Mud Lake, Muddy River, Toquop Wash, Town Wash, Weiser Wash, Logandale** (MUMA)	Fair	Fair	Good	**Fair**
4	**Sand Hollow Wash** (NV)	Fair	Good	Fair	**Fair**

Monitoring and Research

Only one site for threecorner milkvetch is monitored. The population of threecorner milkvetch at **Sandy Cove** in Lake Mead NRA has been monitored annually since 1997 (Powell 1999, 2001, 2003). This is the largest documented population known for the taxon (Powell 2001). Because the plant shifts locations on unstable sand from year to year, permanent transects are not used for this monitoring, rather a complete census of the approximately 150 acre dune habitat is made. Numbers are totaled collectively for the west dune and east dune areas, which are separated by Sandy Cove itself. Data extracted from survey and monitoring reports by Powell and Niles *et al.* (1995) shows high variability between years:

Year	Number of Plants
1995	1,500
1997	83
1998	131
1999	--
2000	1,578
2001	2,898
2002	0
2003	135
2005	8,000

Powell (2003) provides a map of locations of threecorner milkvetch on Sandy Cove for the years 2000-2003 and shows spatial variation from year to year. 2002 was an extreme drought year when few annual plant species germinated and survived, whereas 2005 was the third consecutive above average precipitation year recorded at several climate stations in the County (Overton, Las Vegas WSO, and Pahrump).

The phenology of the taxon at Lake Mead NRA was reported by Powell (1998). Conservation needs on exotic species competition, human caused threats, and monitoring were summarized in Powell (2001).

Management
BLM and NPS share much of the management of threecorner milkvetch habitat (table 26). Considerable effort has been made in recent years to fight aggressive Sahara mustard (*Brassica tournefortii*) infestation (Powell and Marrs-Smith, personal communications, 2004). Lake Mead is a major vector for weed dispersal to shoreline habitats. Estimates of the cost of managing Sahara mustard in threecorner milkvetch habitat at Sandy Cove have been done by Lake Mead NRA. They estimate that the cost per acre is about $197 and there were approximately 2,500 acres of Sahara mustard infestation there in 2004 (Powell, personal communication 2005). Two exotic weedy species, Mediterranean grass and Russian thistle (*Schismus barbata* and *Salsola iberica*) were in the area in 1997; however, aliens were not considered a threat at that time (Powell 1999). Exotic species of annual grasses are a major factor in stabilizing sand sheets and dune habitats throughout the range of threecorner milkvetch. In addition, the exotics play a role in altering soil moisture regimes and fire regimes within its specialized habitat as well as in surrounding matrix plant communities.

Although threecorner milkvetch is listed as critically endangered under Nevada State law, there are concerns that the effectiveness of the State's permit process yields inadequate protection and mitigation.

Four population groups overlap with designated ACECs on BLM (**Mormon Mesa, Mud Wash, Toquop Wash,** and **Weiser Wash**) and two overlap with Wilderness Areas at Lake Mead NRA (**Ebony Cove** and **Sandy Cove**). **Lime Cove, Bark Bay,** and Middle Point (**Ebony Cove**) were recommended for establishment of special botanical areas because of their population and habitat significance by Knight (1992).

Table 26. Management of threecorner milkvetch in Clark County and beyond with percentages totaled for each population group provided above the number of data points.

Threecorner milkvetch ***Astragalus geyeri* var. *triquetrus***	IMA	MUMA	UMA	Not Applicable	Population Total
Mormon Mesa	72.63% 69	0.66% 4			9.89% 73
Bark Bay	5.26% 5				0.68% 5
Ebony Cove	5.26% 5				0.68% 5
Virgin River	5.26% 5		9.09% 3		1.08% 8
Lime Cove	2.11% 2				0.27% 2
Mud Wash	3.16% 3	0.33% 2			0.68% 5
Valley Of Fire Wash	2.11% 2				0.27% 2
Sandy Cove	3.16% 3				0.41% 3
The Meadows	1.05% 1				0.14% 1
Logandale		30.91%			25.34%

Threecorner milkvetch *Astragalus geyeri* var. *triquetrus*	IMA	MUMA	UMA	Not Applicable	Population Total
		187			187
Muddy River		28.93% 175	3.03% 1		23.85% 176
Mud Lake		15.70% 95	6.06% 2		13.14% 97
California Wash		15.70% 95	81.82% 27		16.53% 122
Weiser Wash		4.79% 29			3.93% 29
Toquop Wash		2.64% 16			2.17% 16
Town Wash		0.33% 2			0.27% 2
Sand Hollow Wash				100.00% 5	0.68% 5
Total % Total Count	100.00% 95	100.00% 605	100.00% 33	100.00% 5	100.00% 738

Threats

Threecorner milkvetch populations and habitats have a high number of identified threats (table 27). In order of highest ranked threats, they include urban development and sprawl, casual vehicle use and trail development, energy development, surface water development, invasive plant species, utility corridor construction and maintenance, agriculture practices, inundation and shoreline fluctuation, Federal land disposal, commercial development, livestock grazing management, sand and gravel mining, wild horse and burro management, legal recreation use, and legal off-highway use. These threats have reduced size and extent of populations and habitats by both direct mortality of individuals and loss or fragmentation of habitats. They have altered composition of its plant communities by reducing native plants and spreading weeds. The latter plays a role in altering the fire regime of the matrix plant communities. They have altered condition of substrates through soil erosion and stabilization, or destruction of soil crusts. These threats importantly have caused interruption of sand deposition by wind and loss of sand deposition by fluvial processes.

The larger populations managed as multiple uses public land (**Mud Lake, Muddy River,** and **Logandale**) and smaller populations have high and very high threat concerns related to rural sprawl, casual OHV use, exotic species invasions, and potential energy development. Populations at Lake Mead NRA have many fewer current threats (burros, trespass grazing, shoreline exotic species, and recreation).

Table 27. Threat ranks for threecorner milkvetch populations grouped by MSHCP management category within Clark County and by states elsewhere.

Threecorner Milkvetch (*Astragalus geyeri triquetrus*) Threats Across Population Groups		**Bark Bay, Ebony Cove, Lime Cove, Mormon Mesa, Sandy Cove, The Meadows, Valley Of Fire Wash** (IMA)	**Mud Wash, Virgin River ,** (Mixed)	**California Wash, Mud Lake, Muddy River, Toquop Wash, Town Wash, Weiser Wash, Logandale** (MUMA)	**Sand Hollow Wash** (NV)	**Overall Threat Rank**
1	Rural development and sprawl	High	Very High	Very High	-	Very High
2	Casual OHV use and trail development	High	High	High	High	High
3	Increased fire frequency and intensity	High	High	High	Medium	High
4	Energy development	-	-	Very High	-	High
5	Surface water developments	High	High	High	-	High
6	Invasive exotic plant species competition	High	High	High	-	High
7	Utility corridor construction and maintenance	High	-	High	Medium	High
8	Lake Mead inundation and shoreline flux	High	High	-	-	High
9	Inappropriate agricultural practices (water intensive alfalfa production)	-	High	High	-	High
10	Commercial development	High	-	-	-	Medium
11	BLM land disposal to private development	-	-	High	-	Medium
12	Livestock grazing management	Low	Medium	Medium	Medium	Medium
13	Wild horse and burro management	Medium	Medium	-	-	Medium
14	Sand and gravel mining	Medium	-	Medium	-	Medium
15	Legal OHV use	-	-	Medium	-	Low
16	Legal concentrated recreation use	Low	-	-	-	Low
Threat Status for Populations and Overall Distribution		Very High	Very High	Very High	Medium	Very High

Conservation Assessment

All populations of threecorner milkvetch on Federal lands in Clark County are significant and high priority for the species long term viability. This is because populations in the County very nearly define the species restricted global distribution (with the exception of just one northeast population) and its biological rarity. These population groups include **California Wash, Mud Lake, Muddy River, Toquop Wash, Town Wash, Weiser Wash, Mud Wash, Virgin River, Bark Bay, Ebony Cove, Lime Cove, Mormon Mesa, Sandy Cove, The Meadows,** and **Valley Of Fire Wash**. Its annual habit with wildly fluctuating population numbers has been an impediment for understanding long term population viability. Table 28 outlines a number of priority research and management needs for threecorner milkvetch.

Table 28. Research and management needs for threecorner milkvetch by priority ranking.

Research and Management Need	Priority Rank
Species range distribution information	1
Smaller-scale soils and vegetation maps for predictive distribution mapping	1
Species extents and abundances	1
Population genetics	1
Reproductive biology	1
Pollination ecology	1
Seed bank research	1
Population viability analyses	1
Geospatial-based threats analysis	1
Effectiveness and status monitoring	1
Comprehensive conservation report	1
Effects of fire and invasive plant species interactions (including dune stabilization)	1
Effective restoration techniques	1
Role of exotics in resource competition	1
Impacts of global climate change	1
Current viability of populations under documented climate conditions	2
Habitat patch connectivity requirements	2
Randomized surveys	3

Ten conservation objectives address viability enhancement and threat abatement for threecorner milkvetch in the strategies section of this document. They include the multi-species and multi-site objectives 1-7, 11, 12 and 17. A preliminary conceptual model for threecorner milkvetch follows (figure 16).

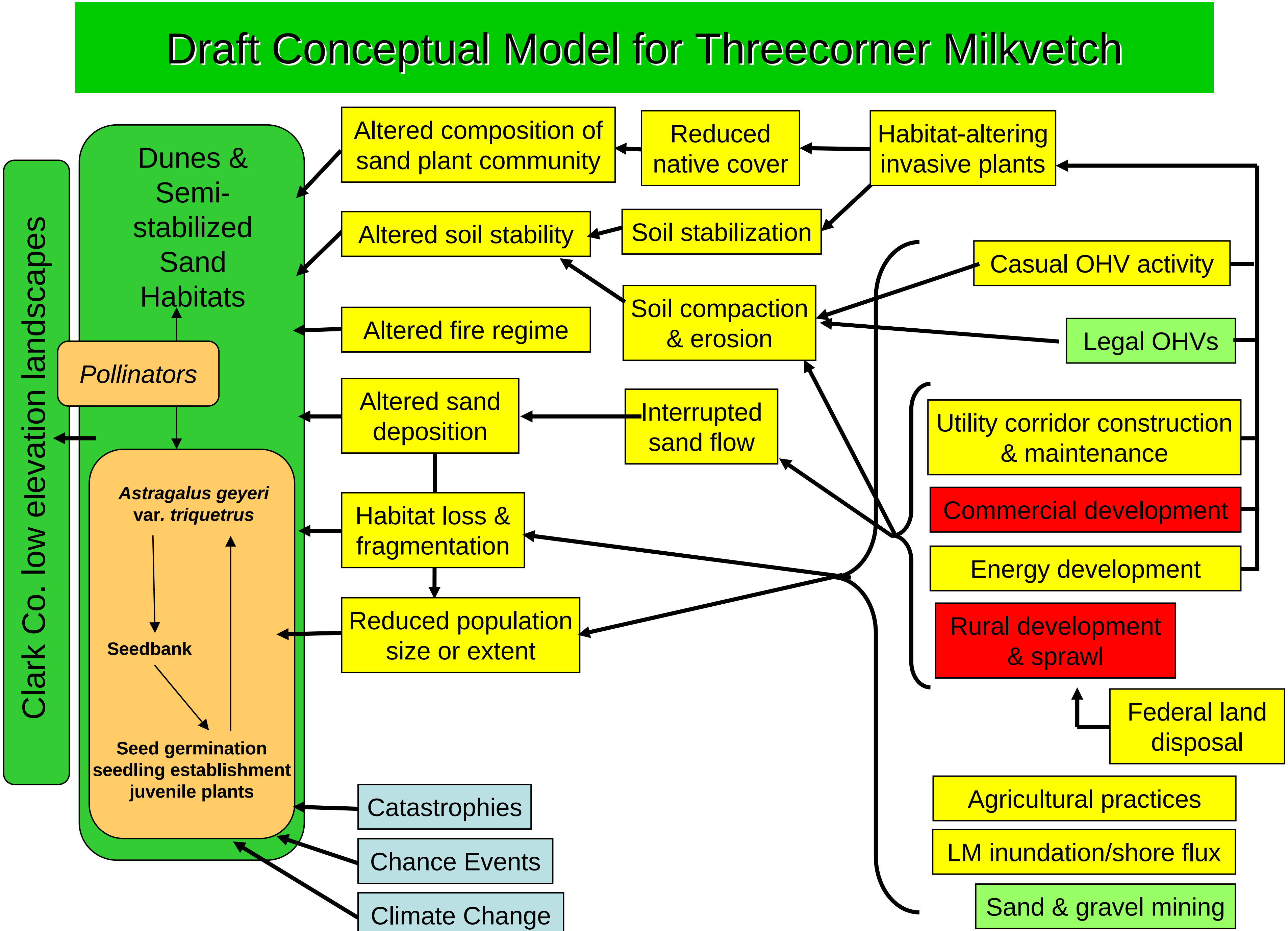

Figure 16. Conceptual model diagram for threecorner milkvetch.

Eriogonum viscidulum **J.T. Howell, sticky wild buckwheat**

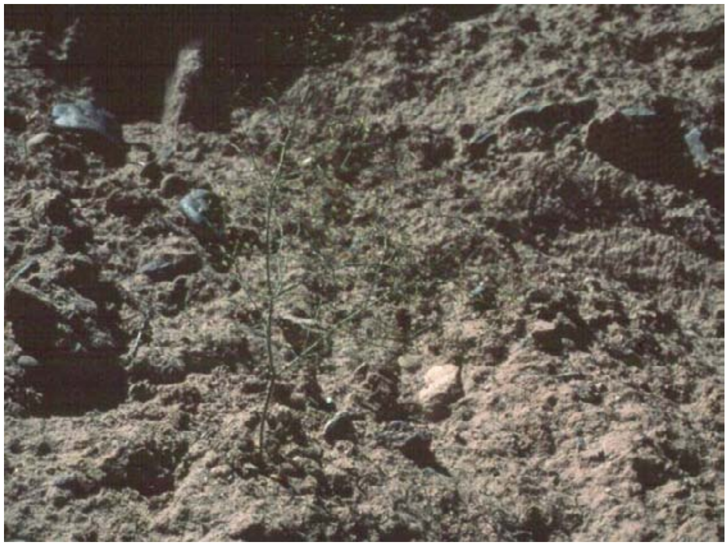
Photo courtesy of Gayle Marrs-Smith

Status, Trends, and Viability
Taxon Significance and Formal Status
The genus *Eriogonum* (Polygonaceae) is endemic to North America and most of its species occur in the west. It is one of the most common and diverse genera in western North America, yet about one third of its species are rare or uncommon (Reveal 2003). In Nevada, the genus ranks second to *Astragalus* for diversity of species. There were 73 species recognized in Nevada in 1985 (Reveal 1985), while currently there are 77 species and 119 infraspecific taxa known from the state with several rare ones (Nachlinger 1999). NNHP tracks 27 species (35% of Nevada species) on their sensitive and watch lists for the state. Clark County harbors 32 species (37 taxa; James Reveal, written communication 2004)—fully 42% of the *Eriogonum* species in Nevada—while six rare species are tracked in the County by NNHP.

Sticky wild buckwheat was originally described and published by Howell (1942) from the Clark County type collection made by Alice Eastwood and J.T. Howell at the Riverside Bridge southwest of Mesquite (Tiehm 1996). The species was not collected again until 1969 by Reveal and Matthews, and Reveal (1969) reported that the species was known only from the type location. The specific epithet *viscidulum* is the diminutive form of viscida (viscid), describing the sticky globules of brown, viscid liquid on the ends of stem hairs.

Sticky wild buckwheat is not federally listed by USFWS under the ESA. However, it is state listed by Nevada under NRS 527.260 as critically endangered and the BLM puts it on their special status species list. The Nevada Native Plant Society believes it meets the federal definition of Threatened under the ESA, and thus, they include it on their list of threatened plant species. The global heritage status rank for sticky wild buckwheat is imperiled as denoted by its G2 rank. In Nevada it is ranked imperiled, S2, and in Arizona it is state ranked critically imperiled, S1 (NatureServe 2006).

Geographic Distribution
The known global distribution of sticky wild buckwheat is quite restricted and nearly confined to Clark County, although it spills into adjacent Lincoln County, and Mohave County, Arizona (figure 17). It is endemic to the northeastern Mojave Desert Ecoregion. Sticky wild buckwheat is slightly narrower in its Clark County distribution than threecorner milkvetch, which extends both further west beyond the Muddy

and further east beyond the Virgin River. All of its known occurrences have been organized into 13 population groups centered on the confluence of the Muddy and Virgin rivers. From north to south, there are:

- two population groups north of the Virgin River drainage, one in Mohave County, Arizona (**Arizona**) and one in Lincoln County (**Eastern Lincoln County**) at the species northern extent;
- five population groups along the Virgin River drainage (**Toquop Wash, Upper Virgin Valley, Lower Virgin Valley, Lower Virgin River**, and **Virgin River Confluence**);
- two population groups along the Muddy River drainage (**Upper Muddy River** and **Middle Muddy River**) defining its northwestern distribution;
- two small population groups northeast and east of the Overton Arm of Lake Mead (**Bitter Ridge** and **Lime Wash**); and,
- two population groups west of the Overton Arm of Lake Mead (**Overton Arm** and **Black Mountains**), the latter defining the species southernmost extent.

The distribution of sticky wild buckwheat in Clark County is limited to its eastern portion and is centered on the confluence of the Muddy and Virgin rivers (figure 18). It occurs along the Muddy and Virgin rivers and Overton Arm from Middlepoint to Mormon Mesa, Gold Butte, and Mesquite. Clark County represents the vast majority of this species known global distribution and, therefore, is crucial for its management and long term survival.

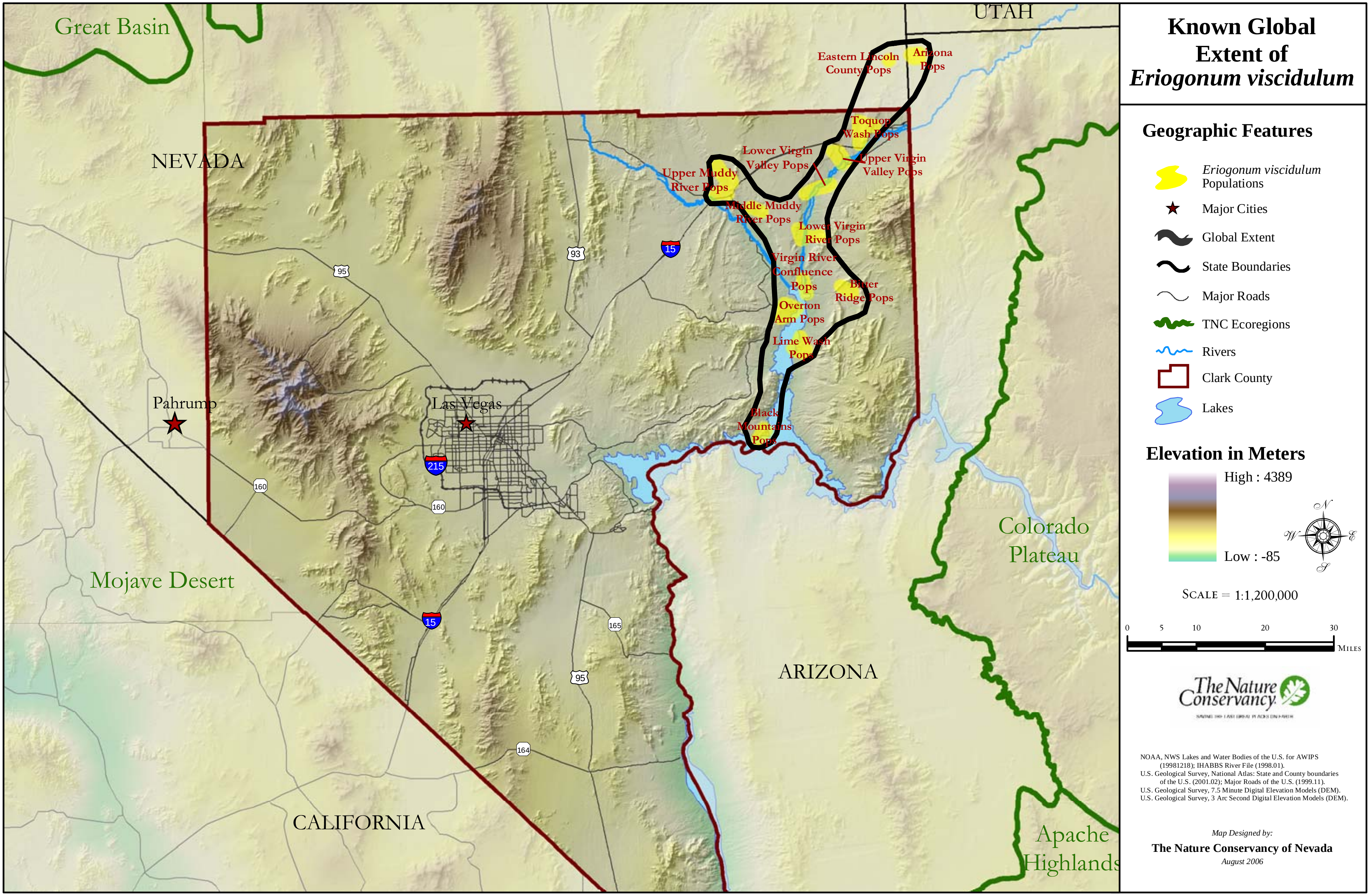

Figure 17. The known global extent of Eriogonum viscidulum, sticky wild buckwheat.

Known Clark County Distribution of *Eriogonum viscidulum*

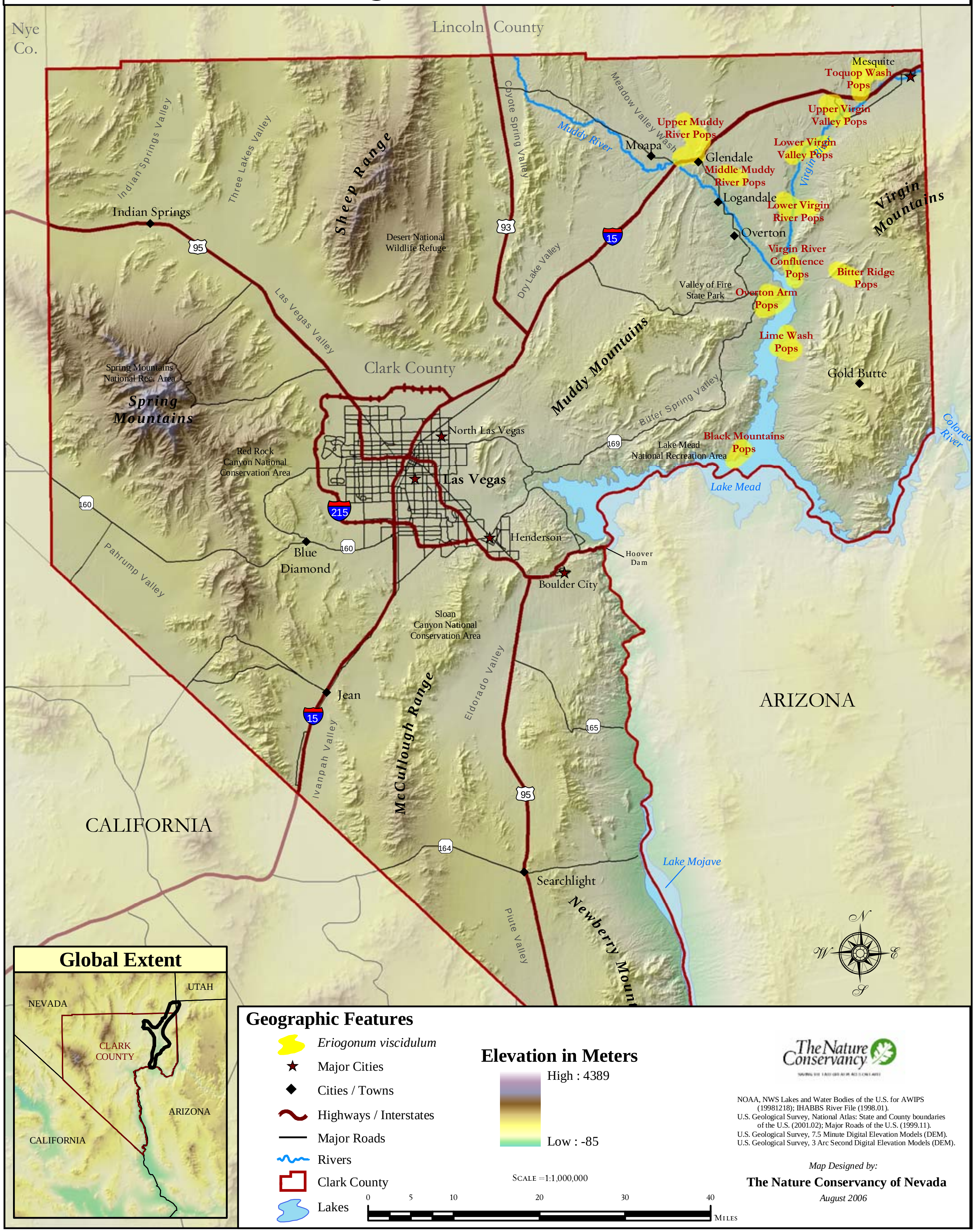

Figure 18. The known geographic distribution of Eriogonum viscidulum, sticky wild buckwheat, in Clark County.

Habitat Description
Sticky wild buckwheat includes typical dune formations, open beach sand at waterline and on adjacent sandy slopes of Lake Mead, solidified sands of dry wash channels, and sandy soils within matrix creosote bush ecological systems. Associated species include white bursage, rice-grass, big galleta, California croton, birdcage evening primrose, gravel milkvetch, redroot cryptantha, desert twinbugs, littleleaf ratany, and Torrey ephedra (*Ambrosia dumosa, Stipa hymenoides, Pleuraphis rigida, Croton californica, Oenothera deltoides, Astragalus sabulonum, Cryptantha micrantha, Dicoria canescens, Krameria erecta,* and *Ephedra torreyana*). Additional associated species for Lake Mead environs are listed in Powell (2003). Some locations map below the high waterline of Lake Mead where they established during years with low reservoir elevations in open, bedrock sites, *e.g*. **Lime Wash, Overton Arm, Black Mountains**, and **Virgin River Confluence**.

Sticky wild buckwheat occurrences average 520 m in elevation with a range from 366 to 767 m (1200 to 2515 feet) in elevation. They occur on slopes averaging about eight degrees, but they can be on slopes as great as 53 degrees. Sticky wild buckwheat occurs on all exposures with west and east exposures the most common. As with threecorner milkvetch, seed deposition by prevailing west winds may account for their most common aspects.

The majority of sticky wild buckwheat populations are mapped on Triassic tufaceous sedimentary rocks while some occasionally occur on alluvial deposits. Sticky wild buckwheat populations most commonly map on Badland and Toquop fine sand soil associations. It occurs at a few scattered sandy sites in the Tertiary Muddy Creek Formation and these locations often are capped by a caliche layer (Niles *et al.* 1995). Sands on which sticky wild buckwheat grow are delivered to its habitat primarily by fluvial transport.

Life History Strategy
Sticky wild buckwheat is one of four herbaceous winter annuals addressed in this conservation management strategy. It has a life span typically lasting five to eight months from seed germination to seed dissemination and death. Seeds germinate following sufficient precipitation during winter months (about 15 to 25 mm in the northern Mojave Desert, Beatley 1967). Years with above average and much above average winter rains yield very high germination rates and when adequate temperature and moisture follows during the growing season, sticky wild buckwheat produces high numbers of individuals—much higher than any documented for threecorner milkvetch which sometimes is associated with it. Their presence and abundance varies annually and is dictated by temperature and moisture. Seed banks replenish in years with wetter and cooler spring conditions. It is unknown how long seed banks remain viable without replenishment.

Surveys, Inventories, and Status Reports
Sticky wild buckwheat was included in the earliest plant survey of Lake Mead NRA (Reigla 1975) and the early inventory of the Muddy Mountains (Swearingen 1981). Holland (1980) documented new locations further south on the Virgin River (**Lower Virgin Valley**) and extended its known distribution 20 miles south onto Lake Mead NRA west of Overton Beach (**Overton Arm**). Westec (1980) found a small population in a poor year at a new location on the east side of the Virgin River (**Lower Virgin River**). More recently, Knight (1992) found two new sites and extended its known distribution 20 miles to Middle Point (**Black Mountains**) and LimeWash-Lime Cove and up canyon for a mile (**Lime Wash**). Sticky wild buckwheat was included in the eastern Mojave Desert surveys of Niles *et al.* (1995, 1998). In 1997, sticky wild buckwheat was searched for in sandy areas at Lake Mead NRA (Powell, 1999). It was found at eight sites, one along Overton Beach Road at the previously documented **Overton Arm** population and the others on the eastside of Overton Arm from the lower Virgin Valley (**Virgin River Confluence**) to **Lime Wash**. In 1998, the sites along the eastside of Overton Arm were inundated and not surveyed.

Reveal (1978) wrote an early conservation status report for sticky wild buckwheat in Nevada, and the species was included in the summaries of Nevada rare plants shortly thereafter (Mozingo and Williams 1980). The dated status report for the species in Nevada indicated an unknown trend (Reveal 1978). Knight included it in a conservation status report for rare plant species at Lake Mead NRA (1992). No recent comprehensive status report exists for the species in Nevada, or for the species' global distribution.

Key Ecological Attributes

Nine key ecological attributes and their indicators have been identified for sticky wild buckwheat (table 29). Preliminary population numbers of plants are based on documented occurrences by the National Park Service, but acreage figures for populations are lacking. These key ecological attributes and their indicators need refinement as appropriate applied research and population monitoring provide adaptive information.

Table 29. Key ecological attributes, indicators, and their ranking definitions for sticky wild buckwheat populations. Italics represent the ultimate goal of land managers.

Category	Key Attribute	Indicator	Sticky Wild Buckwheat (*Eriogonum viscidulum*) Indicator Rankings			
			Poor	**Fair**	**Good**	**Very Good**
Landscape Context	Ecological integrity of surrounding matrix systems and specific habitat	Density of vehicle tracks and animal (WHB/cattle) trails within habitat and matrix systems	High density or >50% scope of habitat impacted	Moderate density or >10<50% scope of habitat impacted (>1 mi / sq mi habitat)	Low density or <10% scope of habitat impacted (<1 mi / sq mi habitat)	*Virtually no vehicle tracks or animal trails*
Landscape Context	Fire regime - (timing, frequency, intensity, extent)	FRCC of matrix community surrounding rare plant population and habitat	Class 3 (highly departed)	Class 2 (moderately departed)	Low end of Class 1 (within range of natural variability)	*High end of Class 1 (within range of natural variability)*
Landscape Context	Fluvial deposition process	River or stream "sediment carrying capacity" and deposition	Virtually lost ability to carry and deposit sediment	Insufficient fluvial sand deposition in most habitats	Sufficient fluvial sand deposition in most habitats	*Sufficient fluvial sand deposition in all habitats*
Condition	Characteristic native plant community	Native vs. exotic plant species composition	Many native species conspicuously absent, and exotics or habitat-altering invasives common	Some native species conspicuously absent, and several exotics or habitat-altering invasives present	Mostly native species composition, and with few exotics, although no habitat-altering invasives	*Native plant species composition with no habitat-altering exotic species present*
Condition	Recruitment	Frequency and extent of germination events	Virtually no germination in a good year	Little germination in >normal winter ppt years (70mm)	Good germination in >>normal winter ppt years (100mm), and	*Relatively massive germination in >>normal winter ppt years*

Category	Key Attribute	Indicator	Sticky Wild Buckwheat (*Eriogonum viscidulum*) Indicator Rankings			
			Poor	**Fair**	**Good**	**Very Good**
					sufficient germination in >normal winter ppt years (70mm)	*(100mm), and very good germination in >normal winter ppt years (70mm)*
Condition	Soil structure and stability	Degree of soil erosion or soil compaction	High erosion or compaction	Moderate erosion or compaction	Low erosion or compaction	*Virtually absent*
Size	Minimum dynamic area	Number and average size of habitat patches	Large number of habitat patches with small average size	Moderate number of habitat patches with moderate average size	Small number of habitat patches with large average size per patch	*Few habitat patches with very large average size*
Size	Minimum dynamic area	Sufficient acreage for characteristic species and natural habitat disturbances within historic range of variability	Insufficient acreage for all sensitive species and severe disturbance likely to eliminate habitat	Insufficient acreage for most sensitive species and habitat susceptible to severe disturbance	Sufficient acreage for most sensitive species and habitat mostly resilient to severe disturbance	*Sufficient acreage for all sensitive species and severe disturbance*
Size	Population size & dynamics	Number of reproductive plants in non-drought periods	few	<1000	10,000s	*>50,000*

Viability and Trend Status
Sticky wild buckwheat was surveyed in the late 1970s at Lake Mead NRA and in the mid-1990s across BLM when initial documentation of some viability criteria was made. Monitoring was initiated at Lake Mead NRA recently (Powell 2003), but annual fluctuations from variable climate conditions have masked population trends. The dated status report for the species in Nevada indicated an unknown trend (Reveal 1978), and more recently stated unknown trends (USFWS 2000, Morefield 2001) suggest no alternate status. As of 2001, sticky buckwheat populations were estimated to possess more than 25,000 individuals in 29 mapped occurrences throughout Nevada with an unknown habitat extent (Morefield 2001).

Lime Wash and **Black Mountains** population groups have the highest recorded numbers of individuals from 1995 surveys (Niles *et al.* 1995). The habitat for an estimated 13,500 individuals at **Lime Wash** in 1995 was inundated in 1998. Few acreage figures have documented areal extents of sticky wild buckwheat populations. Condition of its habitats at Lake Mead NRA populations east of Overton Arm is negatively impacted by burro trampling and grazing (Powell, personal communication 2005). With recent water level declines, areas that previously supported sticky wild buckwheat have gravel substrates with much less or no sand present.

Westec (1980) noted ten individuals in a poor year at the **Lower Virgin River** population and they documented 30 individuals at the type locality (**Upper Virgin Valley**) in 1980. At the **Overton Arm** population they found the highest densities (3 per 10 m^2) but did not give total numbers or area covered.

Powell stated that this population has held fairly constant since 1997 at a few hundred (100-440) individuals since checking presence annually (Powell, personal communication, 2005). **Lower Virgin Valley** had an estimated 2,100 plants (with 1000 in Halfway Wash) in 1998 (Niles *et al.* 1998).

Upper Muddy River population group had an estimated 7,128 plants in 1995, including the expanded area from Weiser Wash to NE Glendale where the highest density plants occurred (Niles *et al.* 1995).

Viability estimates from literature and expert review are organized and summarized in table 30 by MSHCP management category within Clark County and by state elsewhere.

Table 30. Viability ranks for sticky wild buckwheat populations grouped by MSHCP management category within Clark County and by states elsewhere.

Sticky Wild Buckwheat (*Eriogonum viscidulum*)		Landscape Context	Condition	Size	Viability Rank
1	**Black Mountains, Lime Wash, Overton Arm, Virgin River Confluence** (IMA)	Fair	Fair	Fair	**Fair**
2	**Bitter Ridge, Lower Virgin River, Lower Virgin Valley** (Mixed)	Fair	Fair	Fair	**Fair**
3	**Middle Muddy River, Toquop Wash, Upper Muddy River, Upper Virgin Valley** (MUMA)	Fair	Fair	Fair	**Fair**
4	**Eastern Lincoln County, Arizona** (NV AZ)	Fair	Fair	Good	**Fair**

Management
The majority of sticky wild buckwheat occurs in Clark County and on land managed by BLM within IMAs and MUMAs, although about half of the data points falling in IMAS occur on land managed by Lake Mead NRA or Bureau of Reclamation (water) (table 31). BLM manages most or all of **Bitter Ridge, Lower Virgin Valley, Middle Muddy River, Toquop Wash, Upper Muddy River,** and **Upper Virgin Valley,** along with the two population groups outside of Clark County (**Eastern Lincoln County** and **Arizona**). The NPS (or BoR depending on lake level) manages most of the **Black Mountains, Lime Wash, Overton Arm,** and **Virgin River Confluence** population groups. Presence of sticky wild buckwheat along the Lake Mead shoreline varies with reservoir level, which sometimes inundates populations and habitat at higher levels. Recent work by Powell (1999, 2003) on Lake Mead NRA lands indicates that the species is responding to changing levels of Lake Mead. While sticky wild buckwheat is recovering much of its former habitat formerly occupied by the lake, invasive species (*e.g.*, Sahara mustard and salt cedar) are rapidly occupying new lakeshore sites as well.

Three population groups overlap with designated ACECs on BLM (**Bitter Ridge, Toquop Wash,** and **Upper Muddy River**) and one overlaps with Wilderness Area at Lake Mead NRA (**Black Mountains**). Some of **Lower Virgin River** and **Upper Virgin Valley** occur on private land. Although the species is listed as critically endangered under Nevada State law, there are concerns that the effectiveness of the State's permit process yields inadequate protection and mitigation.

Table 31. Management of sticky wild buckwheat in Clark County and beyond with percentages totaled for each population group provided above the number of data points.

Sticky wild buckwheat ***Eriogonum viscidulum***	IMA	MUMA	UMA	Not Applicable: Lincoln County	Not Applicable: Arizona	Population Total
Bitter Ridge	4.26% 2	4.35% 2				100.00% 4
Black Mountains	6.38% 3					100.00% 3
Lime Wash	59.57% 28					100.00% 28
Lower Virgin River	2.13% 1	2.17% 1	50.00% 2			100.00% 4
Lower Virgin Valley	8.51% 4	4.35% 2				100.00% 6
Middle Muddy River		4.35% 2				100.00% 2
Overton Arm	12.77% 6					100.00% 6
Toquop Wash		26.09% 12				100.00% 12
Upper Muddy River	2.13% 1	45.65% 21				100.00% 22
Upper Virgin Valley		13.04% 6	50.00% 2			100.00% 8
Virgin River Confluence	4.26% 2					100.00% 2
Eastern Lincoln County				33.33% 2		100.00% 2
Arizona					66.67% 4	100.00% 4
Total % Total Count	100.00% 47	100.00% 46	100.00% 4	100.00% 6	100.00% 4	100.00% 103

Threats

Similarly to threecorner milkvetch with which it sometimes occurs, sticky wild buckwheat populations and habitats have a high number of identified threats (table 32). They include rural development and sprawl, fire, energy development, invasive plant species, casual vehicle use and trail development, surface water development, agriculture practices, utility corridor construction and maintenance, Federal land disposal, commercial development, inundation and shoreline fluctuation, livestock grazing management, sand and gravel mining, legal recreation use, wild horse and burro management, trespass livestock, and highway and road construction and maintenance. These threats have reduced size and extent of populations and habitats both by direct mortality of individuals and loss or fragmentation of habitats. The composition of its plant communities have been altered by reducing native plant cover and spreading weeds. Invasives and exotic plants competing with sticky wild buckwheat include Sahara mustard, Russian thistle, salt cedar, Mediterranean grass, and red brome. The exotic annuals play a role in altering the fire regime of the matrix plant communities and increase the risk of type conversion. Combinations of these threats have altered habitat substrates through soil erosion and stabilization, and they have disrupted maintenance of habitat through loss of fluvial sand deposition.

Recent work by Powell (1999, 2003) on Lake Mead NRA lands indicates that the species is responding to changing levels of Lake Mead. While the species is recovering much of its habitat formerly occupied by the reservoir, invasive species, such as Sahara mustard and tamarisk (*Brassica tournefortii* and *Tamarix ramosissima*) are rapidly occupying and sometimes dominating these sites.

Table 32. Threat ranks for sticky wild buckwheat populations grouped by MSHCP management category within Clark County and by states elsewhere.

Sticky Wild Buckwheat (*Eriogonum viscidulum*) Threats Across Population Groups		**Black Mountains, Lime Wash, Overton Arm, Virgin River Confluence** (IMA)	**Bitter Ridge, Lower Virgin River, Lower Virgin Valley** (Mixed)	**Middle Muddy River, Toquop Wash, Upper Muddy River, Upper Virgin Valley** (MUMA)	**Eastern Lincoln County, Arizona** (NV AZ)	**Overall Threat Rank**
1	Rural development and sprawl	-	High	Very High	-	High
2	Increased fire frequency and intensity	High	High	High	Medium	High
3	Energy development	-	-	Very High	-	High
4	Invasive exotic plant species competition	High	High	High	-	High
5	Casual OHV use and trail development	-	High	High	High	High
6	Surface water developments	High	High	High	-	High
7	Inappropriate agricultural practices (water intensive alfalfa production)	-	High	High	-	High
8	Utility corridor construction and maintenance	-	-	High	Medium	Medium
9	Lake Mead inundation and shoreline flux	High	-	-	-	Medium
10	Commercial development	-	-	High	-	Medium
11	BLM land disposal to private development	-	-	High	-	Medium
12	Livestock grazing management	-	Medium	Medium	Medium	Medium
13	Sand and gravel mining	Medium	-	Medium	-	Medium
14	Legal concentrated recreation use	Medium	-	-	-	Low
15	Trespass grazing	-	Medium	-	-	Low

Sticky Wild Buckwheat (*Eriogonum viscidulum*) Threats Across Population Groups		Black Mountains, Lime Wash, Overton Arm, Virgin River Confluence (IMA)	Bitter Ridge, Lower Virgin River, Lower Virgin Valley (Mixed)	Middle Muddy River, Toquop Wash, Upper Muddy River, Upper Virgin Valley (MUMA)	Eastern Lincoln County, Arizona (NV AZ)	Overall Threat Rank
16	Wild horse and burro management	Medium	-	-	-	Low
Threat Status for Populations and Overall Distribution		High	Very High	Very High	Medium	Very High

Conservation Assessment
All populations of sticky wild buckwheat on Federal lands in Clark County are significant and high priority for the species long term viability. Populations in the County very nearly define the species restricted global distribution (**Bitter Ridge, Lower Virgin River, Lower Virgin Valley, Upper Virgin Valley, Virgin River Confluence, Upper Muddy River, Middle Muddy River, Toquop Wash, Lime Wash, Overton Arm,** and **Black Mountains**) with the exception of the two northeast populations just beyond the County line. Its annual habit with wildly fluctuating population numbers has been an impediment for understanding long term population viability. Conservation status reports are old and need updating. Table 33 outlines a number of priority research and management needs for sticky wild buckwheat.

Table 33. Research and management needs for sticky wild buckwheat by priority ranking.

Research and Management Need	Priority Rank
Smaller-scale soils and vegetation maps for predictive distribution mapping	1
Species extents and abundances	1
Population genetics	1
Reproductive biology	1
Pollination ecology	1
Population viability analyses	1
Geospatial-based threats analysis	1
Effectiveness and status monitoring	1
Comprehensive conservation report	1
Effects of fire and invasive plant species interactions (including dune stabilization)	1
Effective restoration techniques	1
Role of exotics in resource competition	1
Impacts of global climate change	1
Species range distribution information	2
Current viability of populations under documented climate conditions	2
Seed bank research	2
Habitat patch connectivity requirements	2
Randomized surveys	3

Eleven conservation objectives address viability enhancement and threat abatement for sticky wild buckwheat in the strategies section of this document. They include the multi-species and multi-site objectives 1-7, 12, 13, 17 and the species specific objective 19. A preliminary conceptual model for sticky wild buckwheat follows (figure 19).

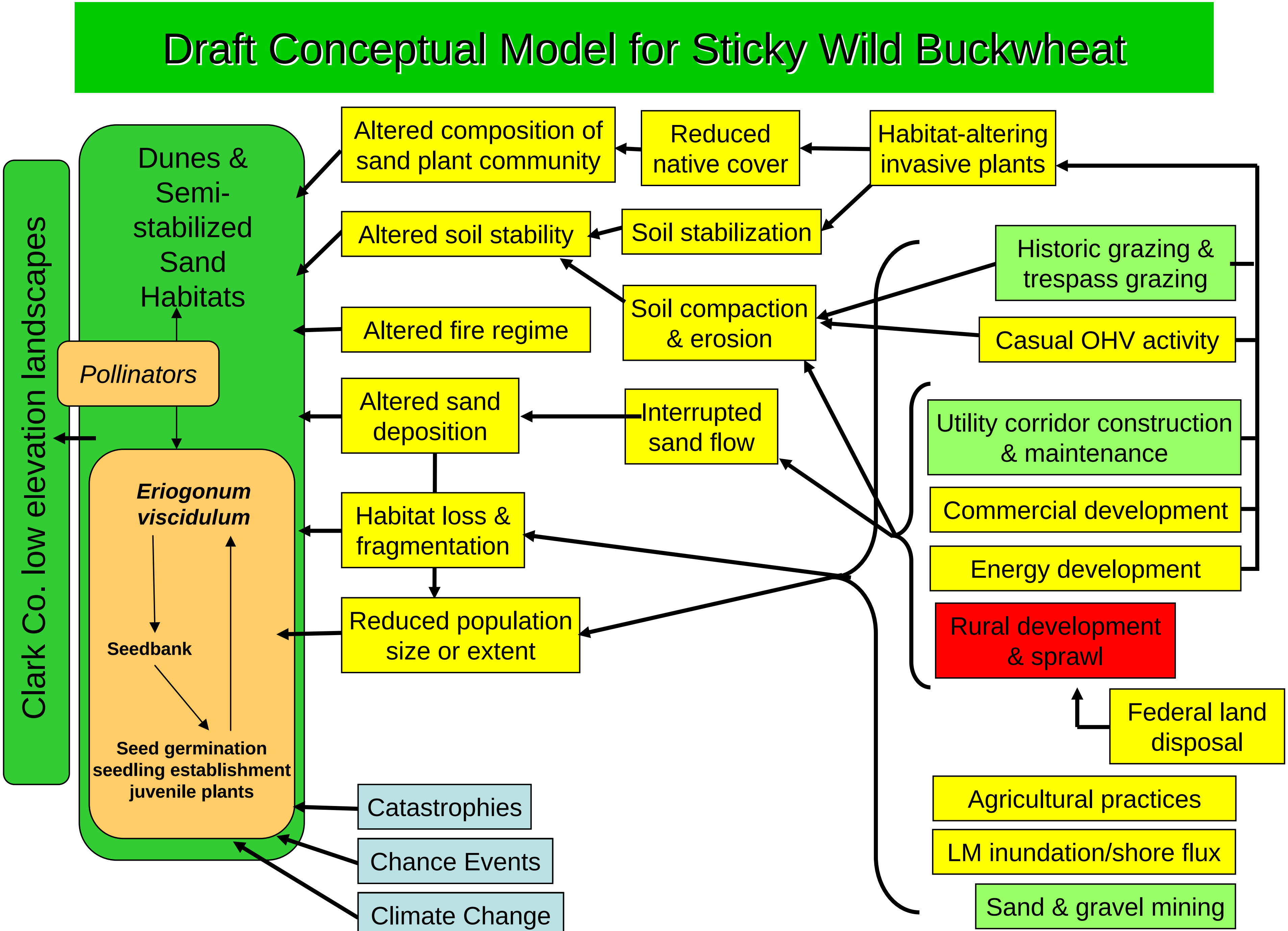

Figure 19. Conceptual model diagram for sticky wild buckwheat.

***Penstemon albomarginatus* M.E. Jones, white-margined beardtongue**

Photo courtesy of Gina Glenne

Status, Trends, and Viability

Taxon Significance and Formal Status

Penstemon is the largest genus of flowering plants endemic to North America with at least 250 species from Alaska to Guatemala (Holmgren 1984, 1993). In Nevada, there are at least 45 native species (Kartesz 1987), many of which are rare (Nachlinger 1998). Eighteen *Penstemon* species (20 taxa) are included on the Nevada At-Risk and Watch lists, and six of these are in Clark County (Morefield 2001).

White-margined beardtongue was described by Marcus E. Jones (1908) based on his 29 (or 30) April 1905 collection from Good Spring's Station, now called Jean Station (Smith 2001). The species epithet, "*albomarginatus*" means white (=albo) margin (=marginatus), referring to the white margins of leaves and sepals, a feature unique in Nevada's *Penstemon* species. There have been no alternative taxonomic interpretations of this plant—it is a distinctive species without question.

White-margined beardtongue is neither federally listed by USFWS under the ESA, nor state listed by Nevada under NRS 527.260. The BLM considers it a sensitive species (BLM 2003). The Nevada Native Plant Society believes it meets the federal definition of Threatened under the ESA and thus, includes it on their list of threatened plant species. The global heritage status rank for white-margined beardtongue is imperiled as denoted by its G2 rank. In Nevada and Arizona it is state ranked imperiled, S2, while in California, it is state ranked critically imperiled and very threatened, S1.1 (NatureServe 2006).

Geographic Distribution

The currently understood global distribution for white-margined beardtongue is restricted to the southeastern Mojave Desert Ecoregion even though it politically spans three states (figure 20). Southern Clark County appears to be its center of distribution while three arms radiating northwest into Nye County, southwest into California, and southeast into Arizona define its spatial extent. We assembled its known occurrences (NNHP = 44; CNDDB = 4; and ANHP = 28) into the following ten population groups, which are described from north to south:

- three smaller population groups (**Rock Valley, North of Ash Meadows**, and **Specter Range**) in southern Nye County represent the species northernmost extent;
- four centrally located population groups (**Hidden Valley, Jean Lake, Ivanpah Valley**, and **Roach Lake**) in southern Clark County mostly separated from one another by hill topography disconnecting the valley bottoms;
- two distant smaller population groups (**Lavic Lake** and **Fenner Valley**) in San Bernardino County, California representing the species southwestern most extent; and,
- one extensive population group (**Arizona**) in Mohave County, Arizona along the southeast boundary of the Mojave Desert Ecoregion.

The distribution of white-margined beardtongue in Clark County is limited to its southern portion (figure 21). It is comprised of four population groups (**Hidden Valley, Jean Lake, Ivanpah Valley**, and **Roach Lake**) in the southern portion of the County, mostly separated from one another by hill topography disconnecting the valley bottoms. Because southern Clark County is centrally located for this species limited global extent, maintaining these core populations and their habitat may be very important for providing connectivity for ecosystem functions within local (and possibly distant) populations and ultimately for the species long term survival.

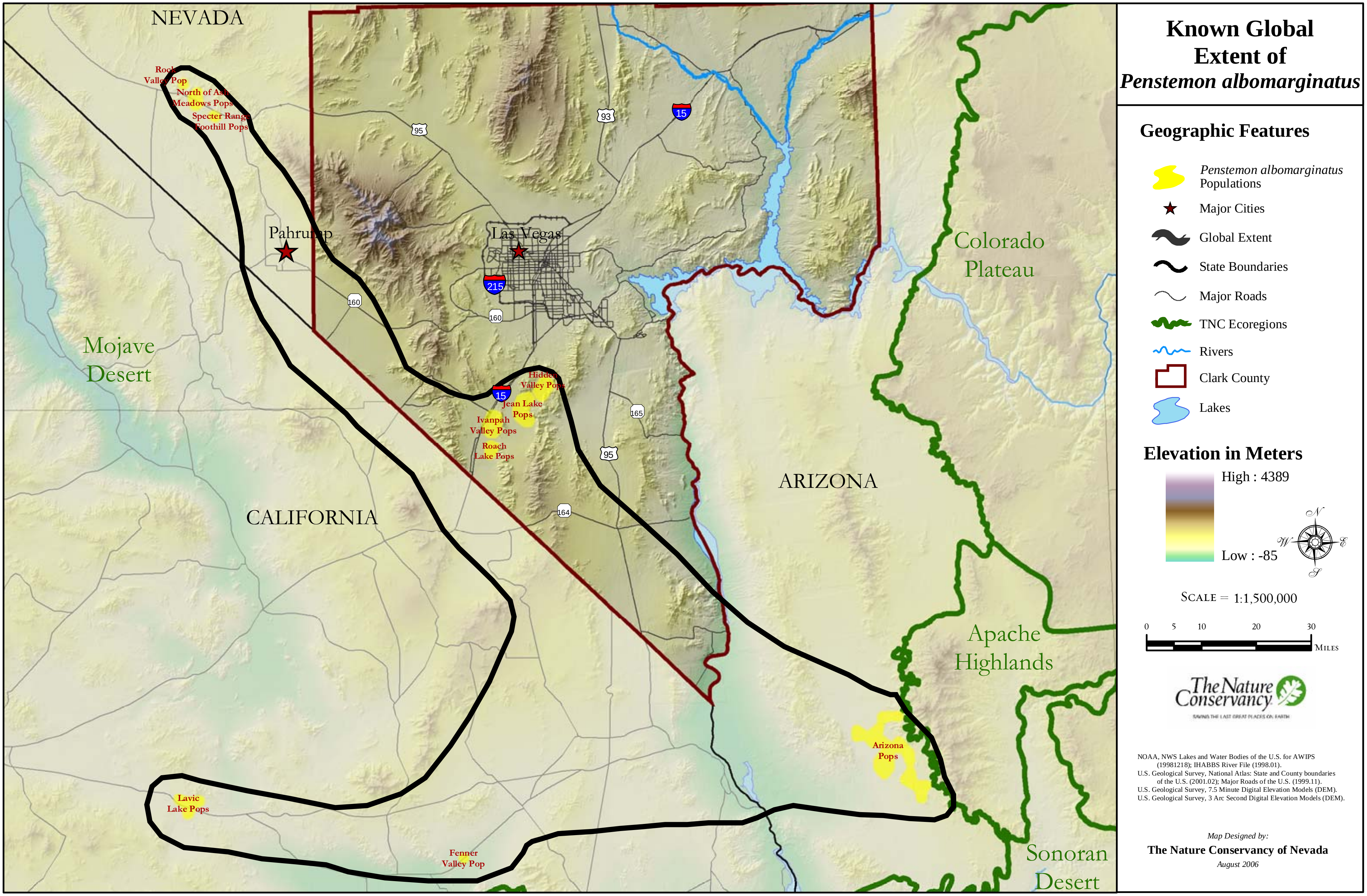

Figure 20. The known global extent of Penstemon albomarginatus, white-margined beardtongue.

Known Clark County Distribution of *Penstemon albomarginatus*

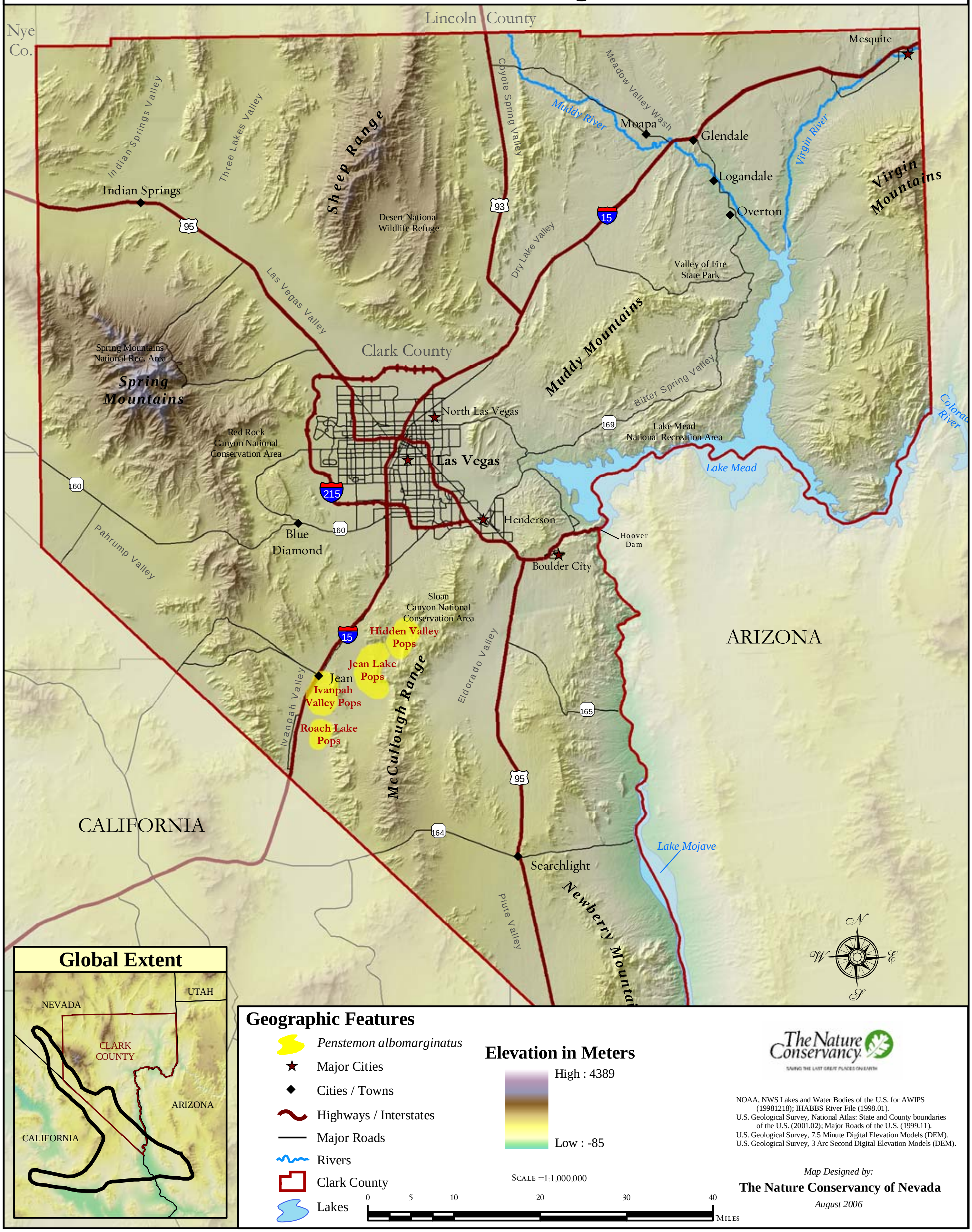

Figure 21. The known geographic distribution of Penstemon albomarginatus, white-margined beardtongue, in Clark County.

Scogin (1989) studied its California populations and suspects that habitat and plants must have been more widespread and continuous in the past to account for the isolated populations in its currently understood distribution. It is possible that suitable stabilized sand sheets currently are not available, and/or seeds may not be readily dispersed over longer distances. Alternatively, seeds may be capable of occasional long distance dispersal and may establish plants in discontinuous habitat.

Habitat Description

White-margined beardtongue is a psammophile restricted to sandy habitats—mostly deep, loose to stabilized sand, sometimes on sand dunes or in sandy to gravelly washes. In Nevada, plants are found on loose deposits of aeolian sand or sandy alluvium, particularly in or near small dry drainages, wash bottoms, on valley floors, gentle foot-slopes, or alluvial terraces (Smith 2001). There is little or no profile development of soils (Blomquist *et al.* 1995), and soil crust is present only in a few minimally disturbed areas (BLM notes). This specialized habitat is surrounded by zonal creosote bush-white bursage or salt desert scrub ecological systems in Clark County. Common associates include white bursage, galleta grass, rice-grass, creosote bush, range rattany, goldenhead, and winterfat (*Ambrosia dumosa, Pleuraphis rigida, Achnatherum hymenoides, Larrea tridentata, Krameria erecta, Acamptopappus shockleyi*, and *Krascheninnikovia lanata*). Additional associates for Nevada populations are listed in Smith (2001).

This specialized habitat is surrounded by zonal creosote bush-bursage or blackbrush vegetation in California and Nevada, and by Joshua tree-mixed shrub vegetation in Arizona. Common associates include white bursage, galleta grass, rice-grass, creosote bush, range rattany, goldenhead, and winterfat (*Ambrosia dumosa, Pleuraphis rigida, Achnatherum hymenoides, Larrea tridentata, Krameria erecta, Acamptopappus shockleyi*, and *Krascheninnikovia lanata*). Additional associates for Nevada populations are listed in Smith (2001). Beatley (1976) includes white-margined beardtongue as a predictable associated species in her *Larrea-Ambrosia* plant community in the northern Mojave Desert where soils are deep, loose, sands without a surface pavement.

In Nevada, white-margined beardtongue occurs on the lee side of valleys and in the lower foothill slopes on the western slopes of mountains where there is a sand source upwind of the site. Source areas for the wind blown sand are sparsely vegetated valley bottoms and barren playas, such as the Amargosa Valley, Ivanpah Valley, and Jean Lake.

Our geospatial analyses of known white-margined beardtongue point locations average 909 m in elevation with a range from 363 to 1057 m (1190 to 3467 feet). White-margined beardtongue occurrences have a marked preference for gentle slopes averaging about three degrees, but they may be found on slopes up to 29 degrees. Warmer western exposures (northwest to southwest) are most common while cooler east, southeast, northeast, and north exposures are least common. Prevailing western winds likely deposit seeds on windward slopes and plants apparently are able to grow and persist on warm exposures since the sandy substrate holds adequate moisture during its growing months.

White-margined beardtongue consistently occurs on mapped Quaternary alluvial deposits. The most commonly mapped soil associations at white-margined beardtongue locations include Prisonear fine sand, BluePoint-Grapevine, and BluePoint associations.

Life History Strategy

White-margined beardtongue is a perennial with a large taproot, one to four feet long. Permanent, non-shifting sand of sufficient depth is required to permit establishment and maintenance of such a deep root system (Scogin 1989). Mature plants have up to 15 shoots with the cluster measuring about a foot in diameter. After seed dispersal in June, plants dry and wither to a brown mat, which eventually become difficult to identify in winter. Established plants resprout annually, but because there is ample seed set, a large seed bank probably exists in the sandy substrate (Scogin 1989). However, seed bank studies are lacking. Flowering does not appear to be dependent on rainfall (extreme years excepted), as its large taproot may provide stored water and food resources for flowering in drier years (MacKay 1998). Most species of *Penstemon* are insect pollinated and this is likely true for white-margined beardtongue.

Surveys, Inventories, and Status Reports
In Nevada, surveys for white-margined beardtongue were made near the Nevada Test Site (NTS) in 1992 and 1994 (Blomquist *et al.* 1995), in Hidden Valley and adjacent areas in 1994 (Sheldon 1994), and elsewhere on the BLM Las Vegas District in 1994, 1996, and 1997. The latter surveys included more intensive inventories and locations documented by GPS data points. Most recently, population surveys were made across its range in the state from 1996 through 2001 for a Nevada conservation status report by Smith (2001). In California, older surveys in 1988 were conducted at the large Pisgah Siding site (**Lavic Lake** population group, Scogin 1989). Surveys in Arizona were made by BLM in 1990 and 1998 (ANHP 1998, Anderson 2000). Results of these surveys and inventories are summarized in the next section on population viability.

There is a relatively recent comprehensive conservation status report for the species in Nevada prepared by Smith (2001) for NNHP. This report includes detailed information on the plant's distribution, biology, and ecology. Additionally, white-margined beardtongue was summarized for the West Mojave habitat conservation plan by California BLM (MacKay 1998). Short status summary reports include those by Recon (2000), USFWS (2000), and Morefield (2001).

Key Ecological Attributes
The following table provides nine key ecological attributes identified for white-margined beardtongue and selected indicators for each (table 34). Because specific knowledge of the ecology and population biology of this species is scant, most indicators are qualitative within the categories of poor to very good rankings and rely on expert knowledge and comparisons among specific populations. For the populations in Clark and Nye counties this botanical expert knowledge is found within the BLM Las Vegas District and the local academic community. Population numbers of plants is an indicator for which there is sufficient data to provide quantitative measurements, whereas comparative values for habitat acreages are unavailable for many populations. Indicators of ecological attributes for white-margined beardtongue need refinement as monitoring and applied research provide additional information.

Table 34. Key ecological attributes, indicators, and their ranking definitions for white-margined beardtongue populations. Italics represent the ultimate goal of land managers.

Category	Key Attribute	Indicator	White-margined beardtongue (*Penstemon albomarginatus*) Indicator Rankings			
			Poor	Fair	Good	Very Good
Landscape Context	Aeolian deposition process	Aeolian deposition between source and sink areas	Virtually lost ability to move and deposit sands	Insufficient aeolian sand deposition into most habitats	Sufficient aeolian sand deposition into most habitats	*Sufficient aeolian sand deposition into all habitats*
Landscape Context	Ecological integrity of surrounding matrix systems and specific habitat	Density of vehicle tracks and animal (WHB/cattle) trails within habitat and matrix systems	High density or >50% scope of habitat impacted	Moderate density or >10<50% scope of habitat impacted (>1 mi / sq mi habitat)	Low density or <10% scope of habitat impacted (<1 mi / sq mi habitat)	*Virtually no vehicle tracks or animal trails*
Landscape Context	Fire regime - (timing, frequency,	FRCC of matrix community surrounding rare	Class 3 (highly departed)	Class 2 (moderately departed)	Low end of Class 1 (within range of natural	*High end of Class 1 (within range of*

Category	Key Attribute	Indicator	White-margined beardtongue (*Penstemon albomarginatus*) Indicator Rankings			
			Poor	Fair	Good	Very Good
	intensity, extent)	plant population and habitat			variability)	*natural variability)*
Condition	Characteristic native plant community	Native vs. exotic plant species composition	Many native species conspicuously absent, and exotics or habitat-altering invasives common	Some native species conspicuously absent, and several exotics or habitat-altering invasives present	Mostly native species composition, and with few exotics, although no habitat-altering invasives	*Native plant species composition with no habitat-altering exotic species present*
Condition	Pollination	Sufficient acreage and distribution of pollinator nectar and/or pollen producing plants	Insufficient acreage or inadequate distribution of pollinator nectar and/or pollen producing plants	Adequate acreage, but poor distribution (too far between patches) of pollinator nectar and/or pollen producing plants	Adequate acreage and distribution of pollinator nectar and pollen producing plants	*Diverse matrix community within which the target plants are nested alongside pollinator nectar and/or pollen producing plant species*
Condition	Soil structure and stability	Degree of soil erosion or soil compaction	High erosion or compaction	Moderate erosion or compaction	Low erosion or compaction	*Virtually absent*
Size	Minimum dynamic area	Number and average size of habitat patches	Large number of habitat patches with small average size	Moderate number of habitat patches with moderate average size	Small number of habitat patches with large average size per patch	*Few habitat patches with very large average size*
Size	Minimum dynamic area	Sufficient acreage for characteristic species and natural habitat disturbances within historic range of variability	Insufficient acreage for all sensitive species and severe disturbance likely to eliminate habitat	Insufficient acreage for most sensitive species and habitat susceptible to severe disturbance	Sufficient acreage for most sensitive species and habitat mostly resilient to severe disturbance	*Sufficient acreage for all sensitive species and severe disturbance*
Size	Population size & dynamics	Number of reproductive plants in non-drought periods	few	<1000	10,000s	*>50,000*

Viability and Trend Status

Smith (2001) estimated that all Nevada populations contain 68,164+ plants on 6,437 acres at 12 sites (10 sites with 1 km separation) among 23 patches of plants. These totals span population numbers documented across several years in the 1990s (1994-1998) and reflect a variable set of environmental growing conditions documented in average winter precipitation and temperature from NOAA stations across the County.

Clark County populations were surveyed in 1994, 1996, and 1997 by Las Vegas BLM. Sheldon (1994) surveyed Hidden Valley and adjacent areas in 1994 for the BLM and reported seven sites covering approximately 324 ha with 8,775 individuals. These sites include portions of all four population groups in this area. She described the vegetation of the valley, condition of habitat, and included a fairly complete plant species list.

The BLM surveys provided a range of population size estimates for given GPS data points. BLM also documented the relative degree of disturbance, which provides qualitative information on condition of habitats. Subsequent NNHP occurrence data provide estimates of areal extent for these populations based on GIS polygons drawn around the BLM data points. Of the Clark County population groups, **Hidden Valley** harbored a large number of individuals with a range of 3,053-14,235 estimated plants, in 1994. Its population extent was about 1,155 acres. About 85 % of the data points collected in Hidden Valley were described as heavily disturbed. Many fewer plants were surveyed in 1996 and 1997. The greatest size estimates for the **Jean Lake** population group were from 1996 and ranged from 2,381-13,456 individuals, while their extent covered about 2,188 acres. At Jean Lake about 53 % of the data points had no disturbance, 29 % had slight to moderate disturbance, and 18 % had heavy disturbance. Surveys made in the **Ivanpah Valley** population group were from 1996 with an estimated 3,201-13,917 range of individuals. This population has the largest estimated extent at 2,465 acres. In contrast with Hidden Valley, about 89 % of the data points collected in Ivanpah Valley had no disturbance to its habitat. Sheldon (1994) identified about 8,200 acres of potential habitat in Clark County southeast of Roach Lake on the west side of the Lucy Gray Mountains; however, a much smaller acreage of occupied habitat was discovered when BLM conducted surveys later. **Roach Lake** survey numbers were taken in 1997 and ranged from 217-989 individuals, with a smaller areal extent at 157 acres. This population had 58 % of the data points categorized with slight to moderate disturbance and 24% with heavy disturbance. No information on ecological functionality was noted for any of these populations, but sand movement from source areas in Ivanpah Valley to occupied habitats are assumed to have been functioning adequately as there are few current barriers to moving sands. Based on these surveys from the mid-1990s of Clark County populations of white-margined beardtongue, it appears that the **Ivanpah Valley** population group exhibits the best overall viability, although its size and extent are similar to both **Hidden Valley** and **Jean Lake**.

Beyond Clark County, Blomquist *et al.* (1995) reports that the species does not occur on the NTS, but they documented five locations in Nye County 0.6 to 6.8 miles from its southern boundary. The populations in the Striped Hills (**Rock Valley**) had 600-1,900 plants in 1992 and 1994 (not specified). Altogether the five sites had an estimated 6,200 plants and covered about 54 ha (133 ac). These populations were later surveyed in 1997 by BLM and Smith (2001). **Rock Valley** was the largest population group among the Nye County populations with an estimated 20,000 individuals on 236 acres. The **North of Ash Meadows** group had an estimated 13,200+ individuals in four occurrences on 190 acres bisected by Hwy 95, while the **Specter Range** group had an estimated 9,000 individuals in two populations across 47 acres. Earlier, Beatley (1976) states that white-margined beardtongue was abundant in sandy soils of the Larrea-Ambrosia plant community at the **Specter Range** population group location. A documented roadside waif occurrence just east of the **Specter Range** population, possibly spread by highway maintenance work was erroneously interpreted to have wrong collection label information by Smith (2001).

In California, at Pisgah Siding near Twenty-nine Palms, there was six miles of occupied wash habitat on both sides of Interstate 40 in the late 1980s (**Lavic Lake** population group). The area south of I40 provided the highest density population, which adjoins the Twentynine Palms Marine Corp Training Center to the south, although no plants are known from there (Scogin 1989). Disturbance from military activity occurred in habitat here in 1988 where 200 plants were present the previous spring of 1987 (Rutherford 1988). CNDDB tallied 458 plants at this population group in 1989 and again the populations had been disturbed in 1990-1991 by military activity. Bransfield and Rutherford found about 200 plants in a different area to the north in 1993, however, Sheldon (1994) notes that the population had 4,420 plants that same year with information provided by California BLM in a personal communication (no acreage figure given). A second California population near Cadiz Summit, **Fenner Valley**, is considered an historic occurrence which has not been relocated since 1941. No plants were found at this site in 1988 and 1989 surveys (Scogin 1989), but it is unknown if the population is extirpated. Smith (2001) reported potential habitat for future surveys in California in the Cady Mountains, Devils Playground, and Cadiz Basin via Andre (personal communication).

The **Arizona** population group was documented as 16 sites in Sacramento Valley and Dutch Flat areas east of Yucca, Arizona, in 1990. There were 1,270 plants counted there in a BLM survey, although at one site it was noted that there were "too many to count". In 1998, occupied habitat was documented for 28 sites scattered across about 75 square miles with an estimated 100,000 total plants. The large area is not all suitable habitat for white-margined beardtongue (Anderson 2000). No additional information on viability is provided. The existence of this large population decreases the overall risk of random events to the species long term survival.

Based on all available information and expert review, we made ranking estimates of landscape context, condition, and size viability criteria among all white-margined beardtongue populations. Local botanical experts provided current rankings of indicators for key attributes of individual white-margined beardtongue populations for which they were familiar. We averaged viability rankings grouped by MSHCP management category within Clark County and by states elsewhere. The summary is provided in table 35 below.

Table 35. Viability ranks for white-margined beardtongue populations grouped by MSHCP management category within Clark County and by states elsewhere.

	White-margined beardtongue (*Penstemon albomarginatus*)	Landscape Context	Condition	Size	Viability Rank
1	**Hidden Valley** (IMA)	Fair	Fair	Good	**Fair**
2	**Ivanpah Valley, Jean Lake, Roach Lake** (MUMA)	Fair	Good	Good	**Good**
3	**North of Ash Meadows, Rock Valley, Specter Range** (NV)	Good	Good	Good	**Good**
4	**Arizona, Fenner Valley, Lavic Lake** (AZCA)	Fair	Fair	Good	**Fair**

The most recently stated rangewide trend for white-margined beardtongue is presumed stable, but possibly declining where intensively grazed (USFWS 2000). The most recent status report for the species in Nevada states that its trend is unknown (Smith 2001). This global assessment suggests that the species is currently stable across its known distribution. Within Clark County it also appears stable.

Monitoring and Research

Prompted by a sanctioned OHV race at the **Jean Lake** population in 1996, BLM conducted pre- and post-race population monitoring to measure OHV recreation impacts at a designated race pit (BLM unpublished data). They set up transects and collected basic demographic data within eight plots (including three controls). The first season measured OHV impacts at the race pit location within a period of a few days, while two subsequent years were sampled to measure plant recovery after the race pit was relocated elsewhere. These data are the only information available on direct impacts and recovery from approved OHV recreation for any of the nine MSHCP-covered low elevation rare plants. Precipitation data from the Las Vegas Airport shows that 1996 and 1997 were much below average winter precipitation years while 1998 was much above average. Post-race monitoring in 1996 had 19.7% fewer and 16.3% smaller average diameter plants than pre-race conditions. Condition of the 1996 post-race plants declined considerably with an average 41.8% damaged to severely-damaged and 46% dead or dying, while only 21% of plants had pre-race conditions. Clearly, one OHV racing event in white-margined beardtongue habitat dramatically affected population size and condition viability criteria. In 1997 and 1998, there were 2% and 146% fewer plants, and 16% and 48 % larger average diameter plants, compared to the 1996 pre-race baseline. Lack of competition from other plants post-race and favorable growing conditions in 1998 may have helped white-margined beardtongue to quickly recover in the absence of OHV traffic.

Las Vegas BLM District has continued monitoring populations annually east of Jean Lake and in Hidden Valley since 1998, although no data were collected in the extreme drought year of 2002 when plants were virtually absent (Marrs-Smith, personal communication 2004). They collect demographic data inside and outside of two exclosures, which were built to protect habitat. A 50-acre exclosure is located in the **Hidden Valley** population group and a 30-acre exclosure is located in the easternmost portion of the **Jean Lake** population group. Although plants are identified by x and y coordinates within plots, they are not permanently marked making it difficult if not impossible to follow individuals. Thus, these data are currently useful for counts, but not for following cohort demographics.

Smith (2001) reports on a monitoring effort by Andre (personal communication to Frank Smith, 2001) conducted at the Pisgah site (**Lavic Lake** population group) from 1991 to present. Andre has been studying the demography of a series of cohorts that were avoided by construction of the Mojave Pipeline in 1991. Andre found that individual life spans from 1991 to 2000 average 3.3 years and have a maximum of seven years. Older plants are important to overall fecundity as 16 % of the plants contributed 78 % of seed production. Herbivory appeared to be the primary cause of mortality in this population. Additional monitoring design details and results are reported in Smith (2001).

Scogin (1989) studied substrate characteristics, pollination ecology, reproductive biology, and propagation of white-margined beardtongue in California's **Lavic Lake** population group. He observed that plants commonly flowered and set abundant seed in 1988 and 1989—both low rainfall years—but he noted very few seedlings and small stature plants. Still, threshold precipitation totals and seasonal regimes that lead to flowering and seed set are not known (Scogin 1989, MacKay 1998). Scogin hypothesized that a large seed bank is present and expected to see significantly more plants in years with higher rainfall. How long the seeds remain viable in the seed bank is unknown, as are climate conditions necessary for successful germination and establishment.

Scogin (1989) identified four groups of visiting insects and noted that a vespid wasp (unknown identity) accumulated pollen and is likely an effective pollinator, while a large blister beetle (*Epicauta puncticaulis*) is a significant herbivore as they were observed devouring leaves. Carabid beetles and large flies also visited white-margined beardtongue. This species is a small-flowered *Penstemon* so larger generalist bees (e.g., *Bombus* and *Xylocarpa* spp.) are not likely pollinators. Pollen/ovule ratios approach that of out-crossing species, but it also appears to be genetically self-compatible. Isolated and low density populations appear to self-pollinate naturally because typical seed set was observed under these conditions. Unfortunately, Scogin's self-fertilization studies were cut short when pollinator exclusion cages were removed. Additional studies on pollination ecology and population genetics would shed light on origins of its biogeographic distribution and maintenance of populations.

Scogin (1989) reported failure to successfully transplant this species and attributed it to the loss of sand falling away from the taproot during disturbance. He also reported failure to propagate it from vegetative cuttings, even though this technique works for other species of *Penstemon*. Seed germination and propagation by cuttings that include portions of the taproot remain unstudied.

Management

The BLM manages the vast majority (92 %) of white-margined beardtongue habitat across its global distribution (table 36.. In Clark County, BLM currently manages **Hidden Valley**, **Jean Lake**, and **Roach Lake** population groups entirely, while they manage about 80 % of **Ivanpah Valley** with the other 20 % in private ownership at Jean. Multiple use management predominates for much of these population groups, although 10 % of **Hidden Valley** lies within the Sloan Canyon NCA. The IMA portion of this population group was not designated wilderness in the 2002 Clark County Lands Act. Management of legal OHV recreation in **Jean Lake** and **Ivanpah Valley** has helped to minimized potential effects of vehicles on the species (Marrs-Smith, personal communication 2004). To reduce illegal OHV activity, the BLM posted signs and conducts law enforcement patrols; however, the infrequent patrols appear ineffective in stopping illegal off-highway driving. Clark County Department of Aviation has acquired more than 5,000 acres and plans to acquire and manage another 17,000 acres of the currently public land portion of **Ivanpah Valley** and all of **Roach Lake** as a managed area surrounding the future Ivanpah Valley Airport. Portions of **Ivanpah Valley** and **Jean Lake** currently are slated for BLM disposal.

Table 36. Management of white-margined beardtongue in Clark County and beyond with percentages totaled for each population group provided above the number of data points

White-margined beardtongue	IMA	LIMA	MUMA	UMA	Not Applicable				Population Total
Penstemon albomarginatus	BLM	BLM	BLM	PVT	AZST	BLM	PVT	PVT/ BLM	
Hidden Valley	71.49% 1444	10.25% 207	18.27% 369						100.00% 2020
Ivanpah Valley			79.64% 1733	20.36% 443					100.00% 2176
Jean Lake			100.00% 1202						100.00% 1202
Roach Lake			100.00% 140						100.00% 140
North of Ash Meadows						100.00% 135			100.00% 135
Rock Valley						100.00% 1			100.00% 1
Specter Range Foothill						100.00% 2			100.00% 2
Arizona					7.14% 2	57.14% 16	35.71% 10		100.00% 28
Fenner Valley, CA								100.00% 1	100.00% 1

White-margined beardtongue	IMA	LIMA	MUMA	UMA	Not Applicable				Population Total
Penstemon albomarginatus	BLM	BLM	BLM	PVT	AZST	BLM	PVT	PVT/ BLM	
Lavic Lake, CA								100.00% 3	100.00% 3
Total % Total Count	25.30% 1444	3.63% 207	60.34% 3444	7.76% 443	0.04% 2	2.70% 154	0.18% 10	0.07% 4	100.00% 5708

Sheldon (1994) made five management recommendations for the **Hidden Valley** population, some of which have been acted on. They include: 1) fencing 470 acres to protect most of the population from cattle grazing; 2) limiting road travel to existing roads and trails and close roads leading to North McCullough Wilderness Area (a WSA at the time) to protect from OHV use; 3) building an exclosure to monitor affects of cattle in the southwestern most area (built in 1998); 4) conducting searches at Jean and Roach dry lakes (done in 1996 and 1997); and, 5) developing a conservation agreement between the CA, NV, and AZ BLM District offices to protect it over its entire range.

The Nye County population groups (**North of Ash Meadows, Rock Valley**, and **Specter Range Foothill**) also are BLM multiple use lands. Both **Arizona** and California (**Fenner Valley** and **Lavic Lake**) population groups have portions in private ownership as well as BLM management.

The largest white-margined beardtongue population group is in neighboring Arizona where an ACEC designation in 1993 and a subsequent land exchange were positive management actions on its behalf (Anderson 2000). The Hualapai Mountains land exchange helped to consolidate some of the checkerboard ownership pattern in the ACEC. However, the **Arizona** population remains fraught with management complications. Oliva *et al*. (2004) reviewed BLM management of existing ACECs in the four corners states and they highlight several problems with the White-margined Penstemon Reserve ACEC managed by BLM Kingman Field Office. The ACEC has 16,803 acres of inholdings owned by private and state landowners, and although the ACEC has a directive to acquire these additional inholdings, no funds for land acquisition have been requested by the BLM District. In the meantime, a 150,000 acre ranchette subdivision called Stagecoach, is being developed on private lands within the ACEC. Also, Oliva *et al*. (2004) report unregulated ORV use from Lake Havasu recreationists, and existence of numerous crisscrossing roads and survey markers throughout the ACEC. They conclude that BLM appears ineffective in stopping the threat of rural development and sprawl in the area. Additionally, no site-specific management plan or monitoring plan exists for the ACEC 13 years after designation even though white-margined beardtongue was to be monitored.

Rutherford (1988) discusses the need to establish management guidelines and consider management options for the species on BLM lands in California prompted by significant military and camping impacts to the Pisgah (**Lavic Lake**) population. MacKay (1998) recommends active management of OHV use by recreationists and the military as the most important management need. Mitigation by transplanting individuals may be difficult since they have not been transplanted successfully. More propagation studies are needed to determine if seedlings, cuttings, or transplants could be used effectively for mitigation efforts (Mackay 1998). Both Scogin (1989) and MacKay (1998) recommend monitoring population status every two or three years and doing additional propagation studies.

Threats
Smith (2001) discusses many threats to this species although recent significant ones are not mentioned. Populations of white-margined beardtongue have been reduced in size and extent by direct mortality of individuals and loss or fragmentation of its habitats from a number of threats. The composition of its plant communities have been altered by reducing native plant cover and introducing weeds, while some threats have altered soil structure and stability. Disturbance regimes, including aeolian sand deposition and timing or intensity of fire in the matrix creosote bush vegetation, have or may negatively impact its landscape context. The historic prevalence of cattle grazing in combination with the introduction and spread of highly flammable exotic annuals has played a large role in altering historic fire regimes within the landscape dominated by creosote bush plant communities. Recent fires in the Mojave Desert indicate the likelihood of more fire as weeds increase in cover and native shrubs decrease.

Seven threats have been identified for the **Hidden Valley** population. They include OHV use, road development, grazing, and potential mineral exploration and development (Smith 2001). In 1994, Hidden Valley dunes were very disturbed by long term cattle grazing and some original vegetation has been replace by weedy annuals, such as Russian thistle, sand bursage, and Mediterranean grass (*Salsola australis, Ambrosia acanthicarpa,* and *Schimus arabicus*) (Sheldon 1994). The Hidden Valley grazing allotment has been grazed by 45-100 head of cattle from November to May since at least 1975 and possibly since the 1940s. A road just west of the population is an OHV racecourse. But the greatest concern for this population today is the threat of encroaching residential development and its associated sprawl from nearby Henderson growing south.

Smith (2001) lists grazing, mineral exploration and development, OHV use, and road development as significant threats for the **Jean Lake** population, while utility corridor development and maintenance also are threats. A current issue is whether the planned Ivanpah Airport located southwest of **Hidden Valley** and this population will impact the supply and movement of sands maintaining habitats for white-margined beardtongue.

The **Ivanpah Valley** and **Roach Lake** populations are significantly threatened by rural development and sprawl, OHV use and road development, utility corridor development and maintenance, and less so by mineral exploration and development (Smith 2001). However, the threat of greatest concern today is the direct loss of plants and habitat from developing the planned Ivanpah Airport and its unknown impact on aeolian sand deposition processes across the valley.

Road development is a significant threat in the **North of Ash Meadows** population where State Highway 95 intersects the population and ORV use is a noted threat for the Amargosa Valley (Smith 2001). In the **Specter Range Foothills**, mineral development and ORV use are listed threats. There are no current threats to the **Rock Valley** population in the Striped Hills. However, currently these three population groups are not accessible to the public because of NTS restricted access to the north and a locked fence along the highway in the south (Marrs-Smith, personal communication).

In California, the **Lavic Lake** populations are near Fort Irwin and the Marine Corp Testing Center where military activities (tank maneuvers, OHV use, camping) have disturbed the northern portion of the population (Rutherford 1988). Additional threats include a transmission line and three pipelines along the utility corridor, State Highway 40 and a railroad bisecting the population, presence of invasive exotics, and nearby mining development (Scogin 1989, Smith 2001). Rural and exurban development, grazing, ORV use, and roads development are threats to the **Arizona** site (Smith 2001).

Penstemon species are popular in horticulture and Smith (2001) found commercially available white-margined beardtongue seeds available. If the practice of collecting seed from this species in the wild dramatically increases, it may be a future issue. The poor collection record and absence of chemical studies for the species suggest its lack of use by the scientific community.

In summary, numerous current and proposed threats have been identified for populations of white-margined beardtongue and its habitats (table 37). By highest rank they include rural development and sprawl; mineral exploration and development; utility corridor construction and maintenance; invasive plant species competition; casual vehicle use and trail development; commercial development; livestock grazing management; highway and road construction and maintenance; legal off-highway events; Federal land disposal to private ownership; sand and gravel mining; and, military training and facilities development. Threats from highway/road and military activities have not been reported for populations in Clark County.

Table 37. Threat ranks for white-margined beardtongue populations grouped by MSHCP management category within Clark County and by states elsewhere.

White-margined beardtongue (*Penstemon albomarginatus*) Threats Across Population Groups		**Hidden Valley** (IMA)	**Ivanpah Valley, Jean Lake, Roach Lake** (MUMA)	**North of Ash Meadows, Rock Valley, Specter Range** (NV)	**Arizona, Fenner Valley, Lavic Lake** (AZCA)	**Overall Threat Rank**
1	Rural development and sprawl	Very High	Very High	-	Very High	Very High
2	Mineral exploration and development	High	High	High	Very High	Very High
3	Utility corridor construction and maintenance	-	Very High	High	High	High
4	Invasive exotic plant species competition	High	Very High	-	Medium	High
5	Increased fire frequency and intensity	High	High	Medium	High	High
6	Casual OHV use and trail development	High	High	Medium	High	High
7	Commercial development	-	Very High	-	-	High
8	Livestock grazing management	Medium	High	-	High	High
9	Highway and road construction and maintenance	-	-	High	High	High
10	Legal OHV use	Medium	High	-	-	Medium
11	Military activities (training and facilities)	-	-	Medium	High	Medium
12	BLM land disposal to private development	-	High	-	-	Medium
13	Sand and gravel mining	-	High	-	-	Medium

White-margined beardtongue (***Penstemon albomarginatus***) Threats Across Population Groups	**Hidden Valley** (IMA)	**Ivanpah Valley, Jean Lake, Roach Lake** (MUMA)	**North of Ash Meadows, Rock Valley, Specter Range** (NV)	**Arizona, Fenner Valley, Lavic Lake** (AZCA)	**Overall Threat Rank**
Threat Status for Populations and Overall Distribution	Very High	Very High	High	Very High	Very High

Conservation Assessment
The four populations of white-margined beardtongue occurring in Clark County are significant and high priority for the species long term survival for several reasons. Collectively, they define the core area for the species restricted global distribution. **Hidden Valley** is contiguous with Sloan Canyon NCA, which offers adjacent protective status. This population has been identified previously by BLM for habitat management (Sheldon 1994). It also has important restoration needs to address historic human-caused disturbances. **Ivanpah Valley** has the largest extent of the Clark County populations. Together **Ivanpah Valley** and **Roach Lake** have the best current viability status of the Clark County populations. The **Jean Lake** population has more documented individuals than the other three. Substantial threats need to be addressed for all of these populations, notably the looming issues of the planned Ivanpah Airport and rural development along the I15 corridor.

Two populations in Nye County (**North of Ash Meadows** and **Rock Valley**) also are significant and high priority for the species in its global context. The former is a high density population while the latter is larger in population size, and together they have the best overall current viability ranks among the global populations. North of State Highway 95, they are effectively protected from public use because of fencing and inaccessibility. One population in California (**Fenner Valley**) has not been verified in decades while no move to protect **Lavic Lake** from numerous threats has been made. **Arizona** may be indefensible from rural development and sprawl even with partial ACEC management.

White-margined beardtongue ecology and population biology is not well understood. Uncertainties in this assessment are many, including information on specific indicator values for key ecological attributes. Predicting suitable habitat needs refinement while surveys in identified potential habitat are incomplete. Known habitat conditions for the populations need updating as most are nearly ten years old or much more. Applied research on its seedbank, other aspects of reproductive biology, and pollination ecology are needed to fill information gaps, assist in assessing status, and identifying necessary ecological attributes for long term persistence. Also in need of attention are effective restoration techniques and mitigation measures to ensure successful no net unmitigated loss in Clark County. Table 38 is a summary of research and management needs ordered by priority. Nevertheless, practicing adaptive management is possible now and is necessary to decrease uncertainties regarding white-margined beardtongue ecology. A draft conceptual model, which can be refined as new information is obtained is in figure 22.

Table 38. Research and management needs for white-margined beardtongue with priority ranking.

Research and Management Need	Priority Rank
Species range distribution information	1
Smaller-scale soils and vegetation maps for predictive distribution mapping	1
Population genetics	1
Pollination ecology	1
Current viability of populations under documented climate conditions	1
Seed bank research	1
Population viability analyses	1
Geospatial-based threats analysis	1
Effectiveness and status monitoring	1
Effects of fire and invasive plant species interactions (including dune stabilization)	1
Effective restoration techniques	1
Role of exotics in resource competition	1
Impacts of global climate change	1
Species extents and abundances	2
Reproductive biology	2
Habitat patch connectivity requirements	2
Randomized surveys	3
Comprehensive conservation report	3

Nine conservation objectives address viability enhancement and threat abatement for white-margined beardtongue in the strategies section of this document. They include the multi-species and multi-site objectives 1-8 and the species specific objective 15.

Draft Conceptual Model for White-margined Beardtongue

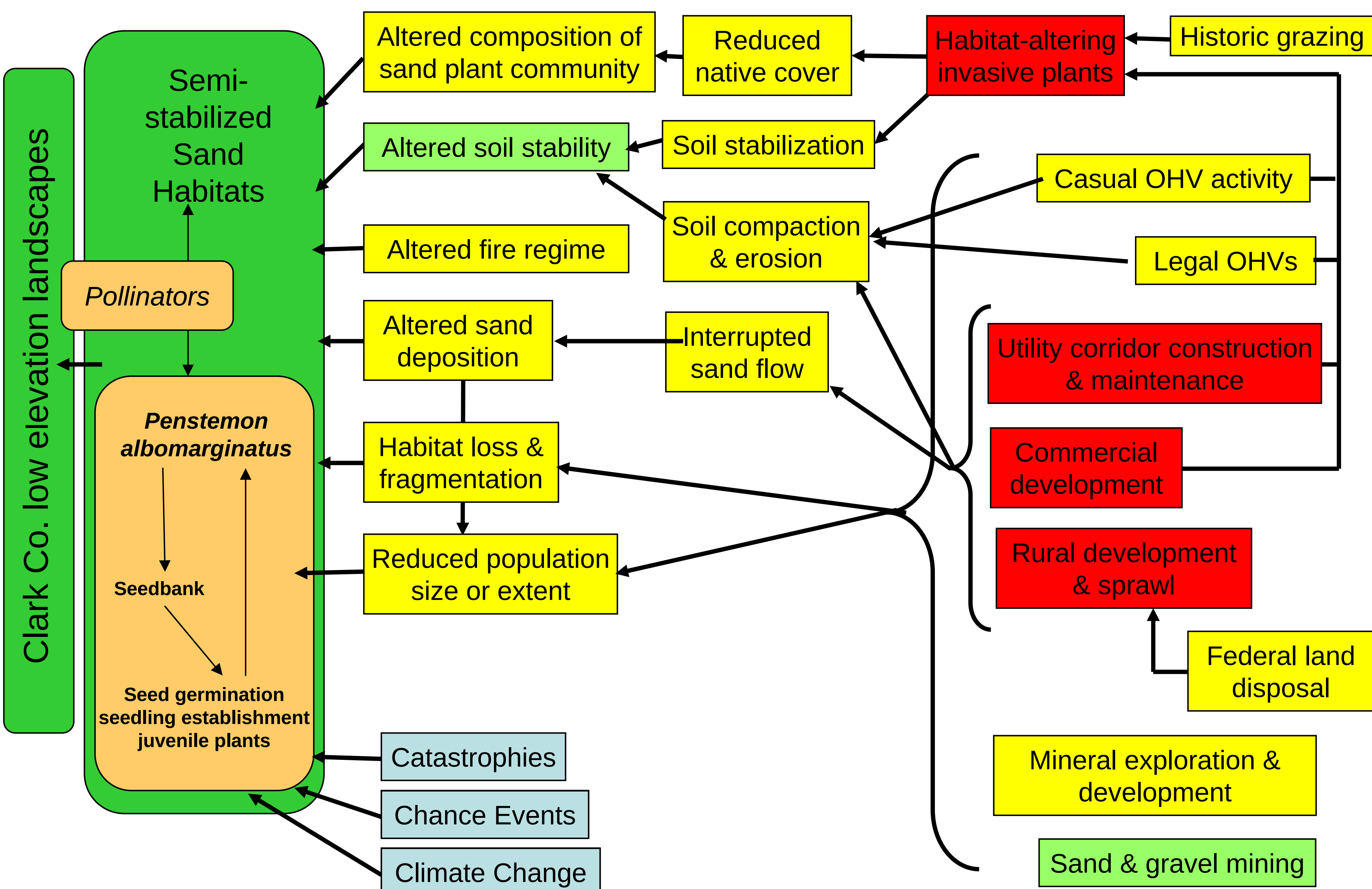

Figure 22. Conceptual model diagram for white-margined beardtongue.

Eriogonum bifurcatum **Reveal, Pahrump Valley wild buckwheat**

Photo courtesy of Gayle Marrs-Smith

Status, Trends, and Viability

Taxon Significance and Formal Status

Pahrump Valley wild buckwheat, also called forked wild buckwheat, is a second species in the genus *Eriogonum* addressed in this conservation strategy. Refer to this same section under *Eriogonum viscidulum* for generic significance in Nevada and Clark County.

Pahrump Valley wild buckwheat was first described by Reveal (1971), which makes it the most recently discovered of the suite of species considered here. Reveal collected it in Pahrump Valley one mile east of the state line so Nye County is the type locality for the species (Tiehm 1996).

Pahrump Valley wild buckwheat belongs among a complex of white-flowering annual species centered in the southwest deserts, many of which exhibit narrow distribution ranges. Pahrump Valley wild buckwheat indeed has a narrowly restricted range which straddles the immediate California–Nevada border. It has the most geographically restricted range of all the species included in this conservation strategy. The species occurs only in Stewart, Pahrump, and Mesquite valleys in Nye and Clark counties, Nevada, and in southern Pahrump Valley, Inyo County, California. Nye County has more known plants and habitat than Clark and Inyo counties—nevertheless, with such a narrow distribution all locations are significant for long term viability.

Pahrump Valley wild buckwheat is neither federally listed by USFWS under the ESA, nor state listed by Nevada under NRS 527.260. The BLM considers it a sensitive species (BLM 2003). The Nevada Native Plant Society believes it meets the federal definition of Threatened under the ESA and includes it on their list of threatened plant species. The global heritage status rank for Pahrump Valley wild buckwheat is imperiled as denoted by its G2 rank. In Nevada it is state ranked imperiled, S2, and in California, it is state ranked critically imperiled and threatened, S1.2 (NatureServe 2006).

Geographic Distribution

The known global distribution of Pahrump Valley wild buckwheat covers the smallest spatial extent of the nine plants addressed here (figure 23). It is endemic to the central portion of the Mojave Desert Ecoregion and spans just three adjacent valleys along the California-Nevada border. Its known occurrences fall into four population groups from northwest to southeast:

- one large population group located in Stewart Valley straddling the California-Nevada border in Nye and Inyo counties (**Stewart Valley**);
- two population groups located in Pahrump Valley, one large one straddling Nye and Inyo counties and one small one in Inyo County, California (**North Pahrump Valley** and **California Pahrump Valley**); and,
- one population group located in Mesquite Valley straddling the California-Nevada border in Clark and San Bernardino counties (**Mesquite Valley**).

This species has a highly restricted global distribution just 47 miles in length and seven miles at its widest. The distribution of Pahrump Valley wild buckwheat in Clark County is limited to one valley in the southwest portion, Mesquite Valley within which lies the community of Sandy Valley (figure 24). The Nevada populations in Clark County and immediately adjacent Nye County are crucial for the long term sustainability of Pahrump Valley wild buckwheat. Reveal (1985) reported that the species occurs in the Las Vegas Valley, but this appears to be erroneous as there is no conclusive documentation of the species as far east as Las Vegas Valley. It is listed in the floristic inventory of Nellis Air Force Base, Area II (Hazlett *et al.* 1997) which was a misidentification (Reveal, personal communication, 2004).

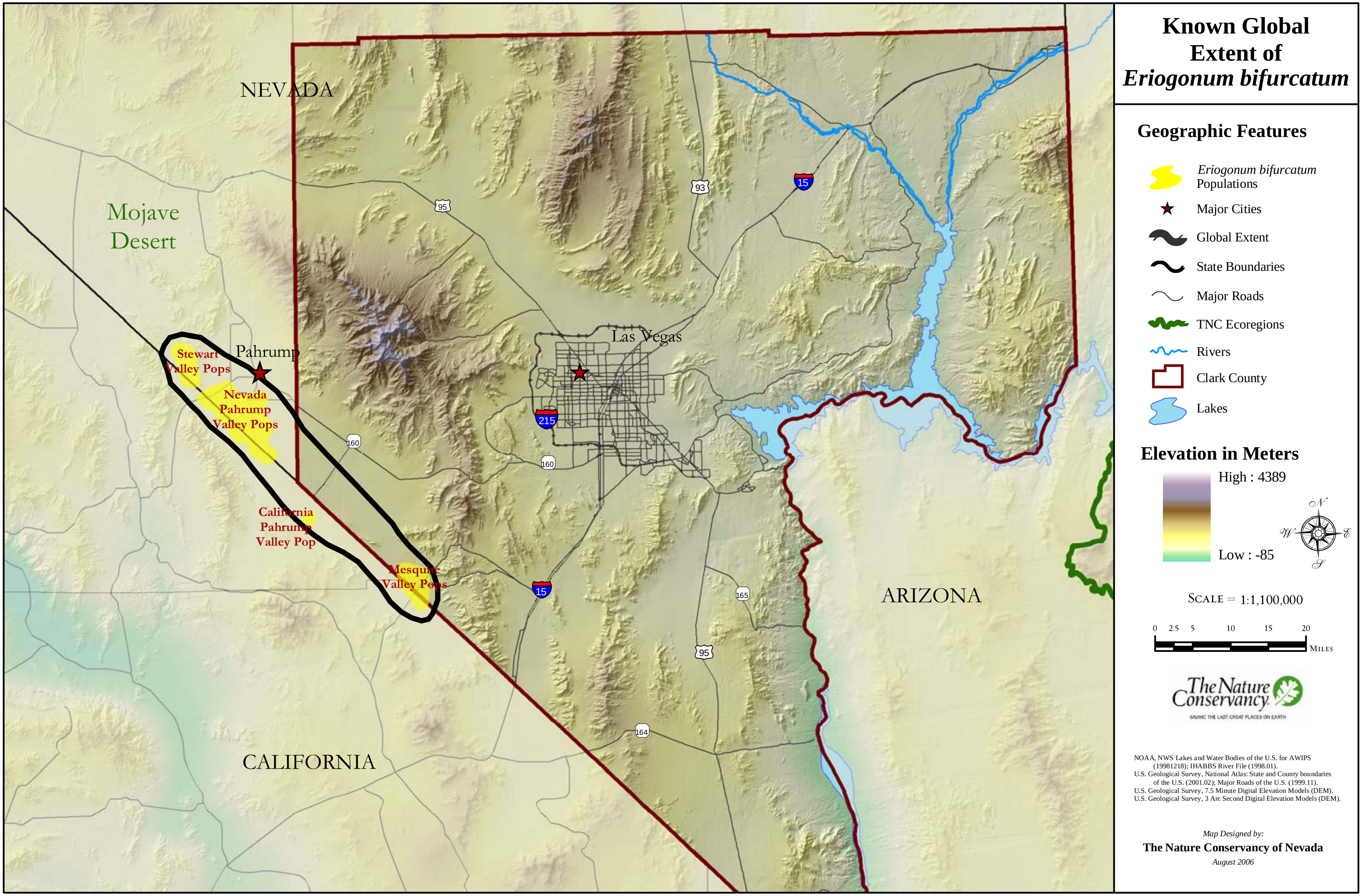

Figure 23. The known global extent of Eriogonum bifurcatum, Pahrump Valley wild buckwheat.

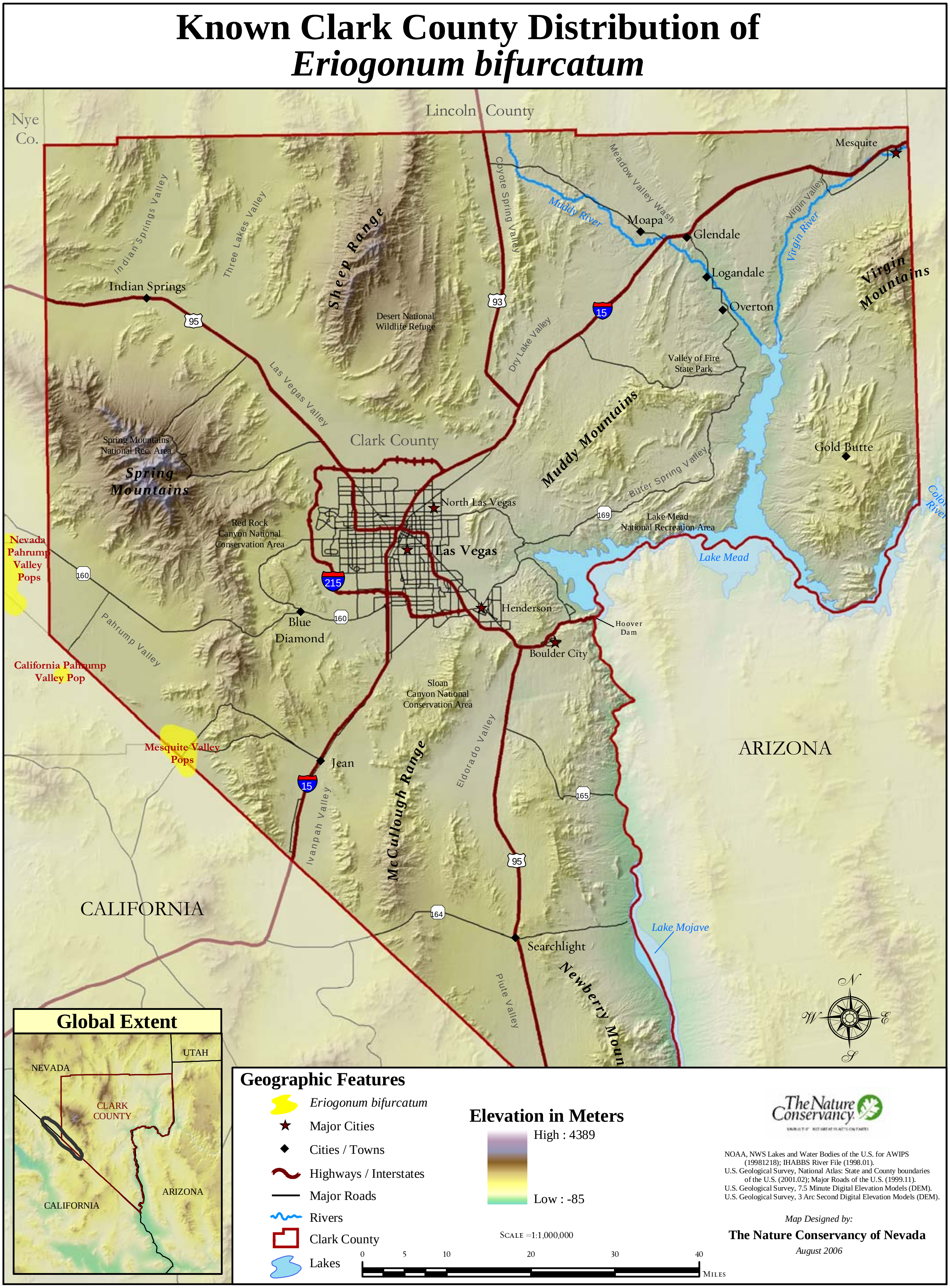

Figure 24. The known geographic distribution of Eriogonum bifurcatum, Pahrump Valley wild buckwheat, in Clark County.

Habitat Description
Pahrump Valley wild buckwheat occupies valley bottoms, playa margins, adjacent shore terraces, and stabilized sand dunes within a narrow elevation range. Sites typically are within creosote bush-white bursage and mixed salt desert scrub ecological systems. Niles *et al.* (1998) notes that habitat at the type locality in Pahrump Valley is on low rolling hills. Mesquite woodlands often occupy adjacent areas along ephemeral stream courses. Associated plant species include shadscale, fourwing saltbush, Torrey saltbush, desert holly, honey mesquite, inkweed, saltgrass, and spiny hopsage (*Atriplex confertifolia, A. canescens, A. lentiformis* ssp. *torreyi, A. hymenelytra, Prosopis glandulosa* var. *torreyana, Suaeda torreyana, Distichlis spicata,* and *Grayia spinosa*; Knight 1988, Niles *et al.* 1998, Morefield 2001). It occurs with Parry wild buckwheat (*Eriogonum brachypodum*) in Stewart Valley.

Known occurrence and data point locations average 778 m in elevation with a narrow range from 749 to 853 m (2457 to2798 feet) in elevation. It is most prevalent on flats with no slope or aspect. Where it occurs on gently sloping ground, it is most common on southwest to northwest exposures and least common on north to east exposures. It rarely occurs on slopes up to 14 degrees.

Substrates on valley landforms occupied by Pahrump Valley wild buckwheat are typically saline, heavy clay or silty hardpan soils derived primarily from Quaternary alluvial deposits and alluvial flat materials. The soil associations most commonly mapped at Pahrump Valley wild buckwheat occurrences in Nevada include Rumpah clay and Besherm-Tanazza association. Sites may be barren with no woody vegetation, but the plant is usually absent from compacted hardpan areas.

Life History Strategy
Pahrump Valley wild buckwheat is a winter annual that germinates following sufficient rains. Beatley (1967) determined that about 15 to 25 mm precipitation germinates winter annuals in the northern Mojave Desert. It grows quickly after germination and typically flowers in May and June. Its presence and abundance varies annually from virtually no plants during drought to abundant and dense populations during years of plentiful rain and warm growing temperatures. However, what precipitation and temperature thresholds must be reached before there is successful germination, seedling establishment, flowering, and seed set are unknown. Viable seed banks are vital for the long term persistence of annual species but how long its seed bank remains viable in order to reappear in years of favorable rainfall is unknown.

Surveys, Inventories, and Status Reports
Since its discovery in the early 1970s, this species has remained rare and restricted in distribution. Surveys were conducted in 1988 for a status report which covers its global distribution in California and Nevada (Knight 1988). At the time, Knight indicated that much habitat remained to be searched and suggested future work in western Stewart Valley, north western Pahrump Valley, the west side of south Pahrump Valley continuing down to northern Mesquite Valley, and further south near Black Butte in Clark and Inyo counties. A decade ensued before the opportunity and excellent growing conditions converged. Las Vegas BLM and Niles *et al.* (1998) made thorough surveys in 1998 which was a very favorable year for annuals with much above precipitation recorded at the Pahrump climate station. It is unclear whether all areas suggested by Knight (1988) were searched in 1998, however. Niles *et al.* (1998) further recommended surveys be made to the northwest where suitable habitats are available in Ash Meadows and the Amargosa Desert region.

The earliest status summary for Pahrump Valley wild buckwheat is provided in a one page synopsis by Mozingo and Williams (1980), which includes some useful basic information, although it has little relevance for current needs. The most recent summary abstract is a rare plant fact sheet and a generalized map of its Nevada distribution from NNHP (Morefield 2001). The only comprehensive conservation status report for the species is dated (Knight 1988).

Key Ecological Attributes

Table 39 lists seven preliminary key ecological attributes and their indicator rankings for Pahrump Valley wild buckwheat. Little quantitative ecological information is available for the species so ranking definitions, as well as attributes themselves, are expected to be improved as adaptive management provides information from monitoring and appropriate applied research studies.

Table 39. Key ecological attributes, indicators, and their ranking definitions for Pahrump Valley wild buckwheat populations. Italics represent the ultimate goal of land managers.

Category	Key Attribute	Indicator	Pahrump Valley Wild Buckwheat (*Eriogonum bifurcatum*) Indicator Rankings			
			Poor	Fair	Good	Very Good
Landscape Context	Ecological integrity of surrounding matrix systems and specific habitat	Density of vehicle tracks and animal (WHB/cattle) trails within habitat and matrix systems	High density or >50% scope of habitat impacted	Moderate density or >10<50% scope of habitat impacted (>1 mi / sq mi habitat)	Low density or <10% scope of habitat impacted (<1 mi / sq mi habitat)	*Virtually no vehicle tracks or animal trails*
Landscape Context	Hydrologic regime	Magnitude and duration of playa surface pooling	Insufficient pooling within historic range of variability for all ecological processes	Insufficient pooling within historic range of variability for most ecological processes	Sufficient pooling within historic range of variability for most ecological processes	*Sufficient pooling within historic range of variability for all ecological processes*
Condition	Characteristic native plant community	Native vs. exotic plant species composition	Many native species conspicuously absent, and exotics or habitat-altering invasives common	Some native species conspicuously absent, and several exotics or habitat-altering invasives present	Mostly native species composition, and with few exotics, although no habitat-altering invasives	*Native plant species composition with no habitat-altering exotic species present*
Condition	Recruitment	Frequency and extent of germination events	Virtually no germination in a good year	Little germination in >normal winter ppt years (70mm)	Good germination in >>normal winter ppt years (100mm), and sufficient germination in >normal winter ppt years (70mm)	*Relatively massive germination in >>normal winter ppt years (100mm), and very good germination in >normal winter ppt years (70mm)*
Size	Minimum dynamic area	Number and average size of habitat patches	Large number of habitat patches with small average size	Moderate number of habitat patches with moderate average size	Small number of habitat patches with large average size per patch	*Few habitat patches with very large average size*

Category	Key Attribute	Indicator	Pahrump Valley Wild Buckwheat (*Eriogonum bifurcatum*) Indicator Rankings			
			Poor	**Fair**	**Good**	**Very Good**
Size	Minimum dynamic area	Sufficient acreage for characteristic species and natural habitat disturbances within historic range of variability	Insufficient acreage for all sensitive species and severe disturbance likely to eliminate habitat	Insufficient acreage for most sensitive species and habitat susceptible to severe disturbance	Sufficient acreage for most sensitive species and habitat mostly resilient to severe disturbance	*Sufficient acreage for all sensitive species and severe disturbance*
Size	Population size & dynamics	Number of reproductive plants in non-drought year	few	>100	>1000	*>10,000*

Viability and Trend Status

Older and inexact information on population sizes were noted in Knight (1988). For example, the **California Pahrump Valley** population was "acres" in size in 1979. Today there is no additional viability information available for the California population from CNDDB. The type locality occurrence within the **Nevada Pahrump Valley** populations was described as "several hundred" in 1988, while the plant was locally common in the south end of Stewart Valley that same year (Knight 1988). Knight (1988) estimated the global size of Pahrump Valley wild buckwheat in 1988 at 10,000 plants total. She documented six populations, with two each in Stewart, Pahrump, and Mesquite valleys and each less than 2.5 acres (1 ha) in extent.

More detailed viability information (and the most current) is available from the much above normal precipitation year of 1998. Populations in Stewart, Pahrump, and Mesquite valleys were exhaustively surveyed by Las Vegas BLM in 1998 with range estimates of population numbers given. However no spatial extents were estimated although NNHP provides estimates of acreages for their interpretations of population occurrences from the BLM point data. The BLM also documented degree of disturbance at each data point recorded, thus indicating information on condition of habitats. **Stewart Valley** was in very good condition with no disturbance to habitat noted, but **Nevada Pahrump Valley** population had disturbance. The BLM data are discussed in Niles *et al.* (1998) who noted that the late winter rains of 1998 produced very large populations which were abundant in more friable, expanded, and uplifted clay materials around playas while typically being absent in more compacted, clayey, hardpan areas where roots find impenetrable conditions. Climate data for the Pahrump Valley station based on 45 to 49 years of monthly precipitation records shows that 1998 was a much above average precipitation year (8.49 inches compared to mean of 4.93 inches; WRCC 2004) suggesting that the following size estimates may be close to best case scenerios for the species.

The **Nevada Pahrump Valley** population group is the largest known with NNHP defining 32 occurrences from 367 BLM data points and other sources of information. NNHP has acreage information for about half of those occurrences, which cover a total estimated 1,104 acres. BLM abundance data estimated a range of 7,353-15,249 plants in 1998. About 46% of the BLM data points collected in Pahrump Valley were described as slight to moderately disturbed while 54% were not disturbed. The Stewart Valley population group includes 12 occurrences defined by NNHP, synthesizing 139 BLM data points, and covering a total estimated 412 acres. A range of 3,614-6,950 plants were estimated here and virtually all of them had no disturbance suggesting that Stewart Valley habitat was in good, if not excellent, condition in 1998. Stewart Valley continues to be in good condition (Marrs-Smith, personal communication, 2005). The Mesquite Valley population group is the smallest of the three Nevada-centered groups and is defined by 11 NNHP occurrences that integrate 83 BLM data points. Estimated acreage in Mesquite Valley is 113 acres, but this is based on information for only about half of the occurrences. Population estimates ranged from 1,583-3,478 with more than half (54%) categorized with no disturbance and 43% with slight to moderate disturbance. Only a few data points had heavy disturbance indicated in Mesquite Valley. In summary, based on the most recent 1998 surveys, all populations of Pahrump Valley wild buckwheat totaled from about 12,550 to 25,677 plants and covered at least 1,630 acres.

Information on viability of ecological processes necessary to maintain these populations and species connectivity needs between habitat patches is lacking in both the literature and in agency files. There is too little information over time to reveal trends in population numbers or areal extents of habitat for Pahrump Valley wild buckwheat, although the rangewide trend for Pahrump Valley wild buckwheat is stated as declining by FWS (2000). Morefield (2001) noted the trend for the species in Nevada is unknown. Viability estimates from literature and expert review are organized and summarized in table 40 by MSHCP management category within Clark County and by state elsewhere.

Table 40. Viability ranks for Pahrump Valley wild buckwheat populations grouped by MSHCP management category within Clark County and by states elsewhere.

Pahrump Valley Wild Buckwheat (*Eriogonum bifurcatum*)		Landscape Context	Condition	Size	Viability Rank
1	**Mesquite Valley** (UMA)	Fair	Good	Good	**Good**
2	**Nevada Pahrump Valley , Stewart Valley** (NV)	Fair	Good	Good	**Good**
3	**California Pahrump Valley** (CA)	Fair	-	Fair	**Fair**

Monitoring and Research

No monitoring activities of any kind, informal or by design are documented for this species. Monitoring annual fluctuations in population abundance and density based on quantitative data from permanent study plots at selected sites was recommended by Niles *et al.* (1998).

Management

Pahrump Valley wild buckwheat occurs on public and private lands at **Mesquite Valley,** which makes management difficult for BLM (table 41). Lands identified for disposal in **Mesquite Valley** need re-evaluation because of the presence of this species. Much of the Pahrump Valley (both Nevada and California sides of the valley) and **Stewart Valley** populations occur on public land managed for multiple uses. At the **Nevada Pahrump Valley** population group, the species sometimes occurs in mesquite woodland habitat and is addressed in the mesquite-acacia woodland habitat plan for BLM (Krueger 1999) and mesquite-acacia woodland CMS (Crampton *et al.* 2006). In other areas, mesquite woodlands occur adjacent or nearby plant populations where the species often defines the transition between matrix creosote bush (Mojave Desert scrub) and playa margins of basin bottomlands. No restoration actions have been documented for this species.

Table 41. Management of Pahrump Valley wild buckwheat in Clark County and beyond with percentages totaled for each population group provided above the number of data points.

Pahrump Valley wild buckwheat ***Eriogonum bifurcatum***	MUMA	UMA	Not Applicable	Population Total
Mesquite Valley	100.00% 27	100.00% 57	1.78% 10	14.55% 94
Pahrump Valley			71.17% 400	61.92% 400
Stewart Valley			26.87% 151	23.37% 151
California Pahrump Valley			0.18% 1	0.15% 1
Total % Total Count	100.00% 27	100.00% 57	100.00% 562	100.00% 646

Threats

Pahrump Valley wild buckwheat populations and habitats have several identified threats (table 42). In order of highest ranked threats, they include rural development and sprawl, commercial development, groundwater development, casual vehicle use and trail development, highway and road construction and maintenance, invasive plant species, agriculture practices, utility corridor construction and maintenance, Federal land disposal, wild horse and burro management, cutting mesquite woodlands, legal off-highway use, and illegal dumping. These threats have reduced size and extent of populations and habitats by both direct mortality of individuals and loss or fragmentation of habitats. They have altered composition of its plant communities by reducing native plants and spreading weeds. These threats also have altered surface water or groundwater flows.

Table 42. Threat ranks for Pahrump Valley wild buckwheat populations grouped by MSHCP management category within Clark County and by states elsewhere.

Pahrump Valley Wild Buckwheat (*Eriogonum bifurcatum*) **Threats Across Population Groups**		**Mesquite Valley** (UMA)	**Nevada Pahrump Valley , Stewart Valley** (NV)	**California Pahrump Valley** (CA)	**Overall Threat Rank**
1	Rural development and sprawl	Very High	High	High	High
2	Commercial development	Very High	High	-	High
3	Groundwater developments	High	High	-	High
4	Highway and road construction and maintenance	High	High	-	High
5	Casual OHV use and trail development	High	High	-	High
6	BLM land disposal to private development	High	Medium	-	Medium

Pahrump Valley Wild Buckwheat (*Eriogonum bifurcatum*) **Threats Across Population Groups**		**Mesquite Valley** (UMA)	**Nevada Pahrump Valley , Stewart Valley** (NV)	**California Pahrump Valley** (CA)	**Overall Threat Rank**
7	Invasive exotic plant species competition	-	High	-	Medium
8	Inappropriate agricultural practices (water intensive alfalfa production)	High	-	-	Medium
9	Utility corridor construction and maintenance	-	High	-	Medium
10	Wild horse and burro management	Medium	Medium	-	Medium
11	Mesquite woodlands cutting	Medium	Medium	-	Medium
12	Legal OHV use	Medium	-	-	Low
13	Illegal dumping	Medium	-	-	Low
Threat Status for Populations and Overall Distribution		Very High	Very High	Medium	Very High

Conservation Assessment
This species has the most limited global distribution of the low elevation plant species, therefore any contribution to conservation management that Clark County can make under the MSHCP will be of benefit to its long term survival. Enlarging Federal land management through acquisition of habitat at **Mesquite Valley** and ensuring conservation management for acquired lands is needed. Nye County carries most responsibility for conservation management of its core populations in **Stewart Valley** and **Pahrump Valley** and FWS has a role in coordinating this effort with habitat conservation planning in that county. Its annual habit with large fluctuating population numbers makes it difficult to understand long term population viability. The conservation status report is old and needs updating. Table 43 outlines a number of priority research and management needs for Pahrump Valley wild buckwheat with which Clark County can assist in filling.

Table 43. Research and management needs for Pahrump Valley wild buckwheat by priority ranking.

Research and Management Need	Priority Rank
Species extents and abundances	1
Reproductive biology	1
Pollination ecology	1
Population viability analyses	1
Geospatial-based threats analysis	1
Effectiveness and status monitoring	1
Effects of fire and invasive plant species interactions (including dune stabilization)	1
Effective restoration techniques	1
Role of exotics in resource competition	1
Species range distribution information	1
Seed bank research	1
Impacts of global climate change	1
Smaller-scale soils and vegetation maps for predictive distribution mapping	2
Comprehensive conservation report	2
Current viability of populations under documented climate conditions	2
Habitat patch connectivity requirements	2
Randomized surveys	2
Population genetics	3

Five conservation objectives address viability enhancement and threat abatement for Pahrump Valley wild buckwheat in the strategies section of this document. They include the multi-species and multi-site objectives 1, 4, 5, 8 and the species specific objective 16. A preliminary conceptual model for Pahrump Valley wild buckwheat follows (figure 25).

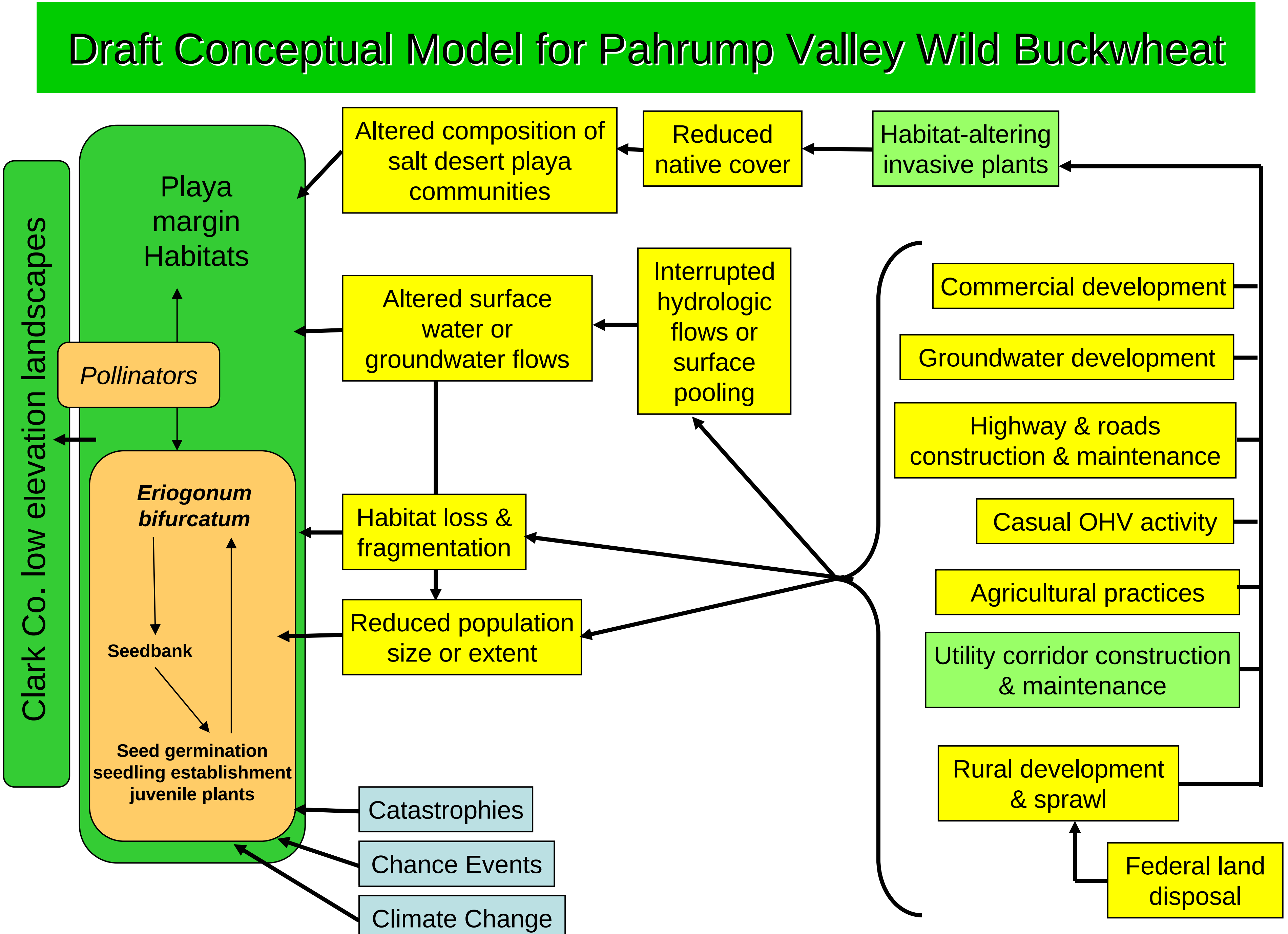

Figure 25. Conceptual model diagram for Pahrump Valley wild buckwheat.

***Phacelia parishii* A. Gray, Parish phacelia**

Photo courtesy of Jan Nachlinger

Status, Trends, and Viability

Taxon Significance and Formal Status

Phacelia is a highly diverse genus in the waterleaf family, Hydrophyllaceae. The genus is restricted to the western hemisphere (Cronquist 1984), with about 175 species known (Wilken *et al.* 1993). *Phacelia* has at least 57 species in Nevada (Kartesz 1987, Atwood *et al.* 2002), with 13 taxa considered rare and tracked by the Nevada Natural Heritage Program (Morefield 2001). There are 22 *Phacelia* species known from Clark County and five of them are tracked by NNHP.

The species epithet "parishii" commemorates the brothers Samuel Bonsall Parish (1838-1928) and William Fletcher Parish (1840-1918), who made the type collection of the species near Rabbit Springs, San Bernardino County, California. Asa Gray (1883) described and named the species. A closely related species, *Phacelia filiae*, was discovered at Nellis AFBGBR during surveys for Parish phacelia, and was formally described by Atwood *et al.* (2002). Two previously identified sites for Parish phacelia now are considered sites for the new species—identification of annual *Phacelia* in the region requires alert attention to avoid confusing the two overlapping species.

Parish phacelia is neither federally listed by USFWS under the ESA, nor state listed by Nevada under NRS 527.260. The BLM lists it as a sensitive species (BLM 2003). The global heritage status rank for Parish phacelia is imprecisely categorized as imperiled to vulnerable, which is denoted by its G2G3 rank. This same rank pertains to Nevada, S2S3, while in Arizona it is state ranked critically imperiled, S1, and in California, it is state ranked critically imperiled and very threatened, S1.1 (NatureServe 2006).

Geographic Distribution

Parish phacelia's known global distribution spans three states and two ecoregions in widely scattered populations (figure 26). Its center of distribution appears to be the northeastern Mojave Desert in Clark, Lincoln, and Nye counties. Three arms radiating north, southwest, and southeast from this center define its spatial distribution. All known occurrences have been grouped into 16 population groups from north to south, they include:

- six scattered population groups in the Great Basin Ecoregion with four in White Pine County (**Muncy, Millick Spring, Spring Creek Bastian**, and **Baking Powder Flat**), one in Lincoln County (**Lake Valley**), and one in Nye County (**White River Valley**), representing a notable northernmost extent for the species;
- five population groups at its center of distribution in the eastern Mojave Desert Ecoregion, with two in Clark County (**Indian Springs Valley** and **Three Lakes Valley**), two in Nye County (**North Pahrump Valley** and **Pahrump Valley**), and one in Inyo County, California (**Stewart Valley**);
- three small population groups in the western Mojave Desert Ecoregion in San Bernardino County, California (**Coyote Lake, Calico Mountains Foothills**, and **Lucerne Dry Lake**) defining its southwest distribution; and
- two populations in the eastern Mojave Desert Ecoregion straddling Mohave and Yavapai counties, Arizona (Arizona) and one recently discovered population in the western Apache Highlands Ecoregion, Arizona (Burro Creek) representing the species southeastern extent.

Although global occurrences total 16 population groups, only two occur in Clark County where it is limited to the northwestern portion of the County (figure 27). The two population groups in Clark County are **Indian Springs Valley** and **Three Lakes Valley**. Because Clark County and adjacent Nye and Lincoln counties appear to be the center of distribution for this species, and given the distantly patchy nature of the known populations, Clark County locations contribute to its long term survival.

In a comprehensive status report for Parish phacelia, Smith (1997) documents 21 sites for Parish phacelia and 14 suspected erroneous occurrences thought to be an undescribed taxon. Since then, Atwood *et al.* (2002) clarified additional sites for the newly described *Phacelia filiae* indicating that two previously identified sites for Parish phacelia in Smith (1997) are in error. These erroneous sites include historic locations in Las Vegas Valley (Clark County) and Desert Lake in Desert Valley (Lincoln County).

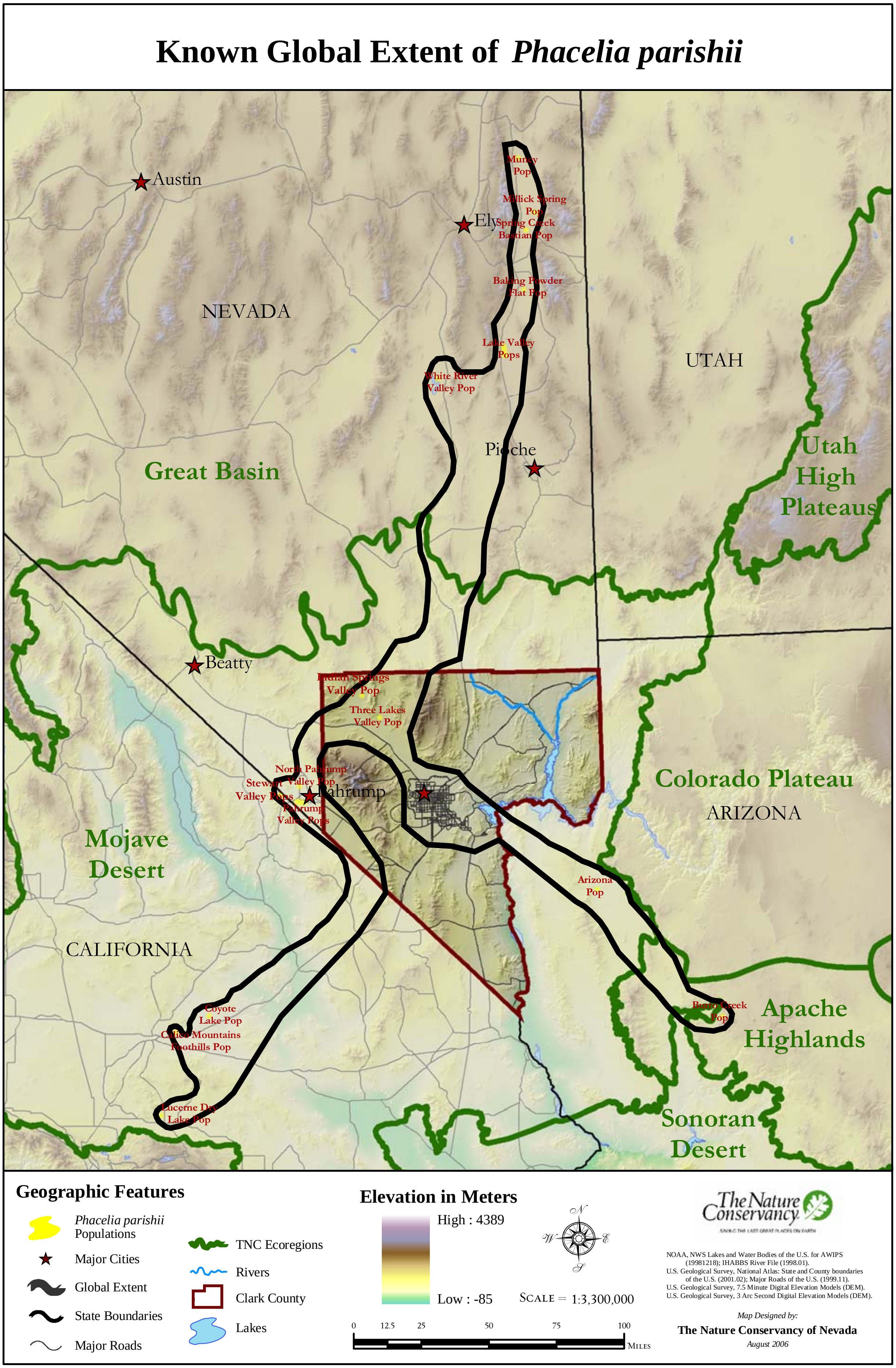

Figure 26. The known global extent of Phacelia parishii, Parish phacelia.

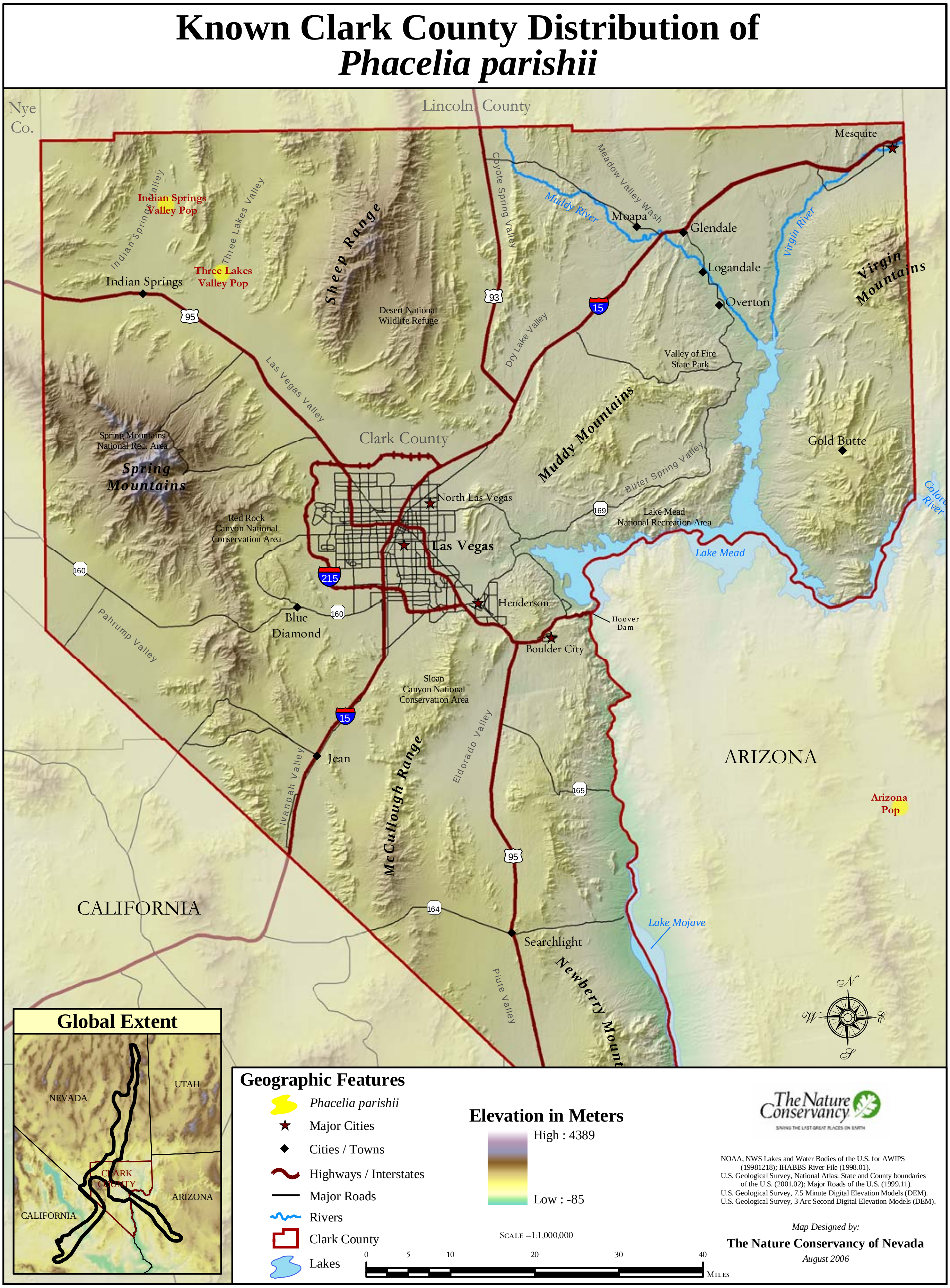

Figure 27. The known geographic distribution of Phacelia parishii, Parish phacelia, in Clark County.

Habitat Description

In the Mojave Desert, Parish phacelia occurs on alkaline flats, playas, lakebeds and margins, and valley floors. These habitats are typically sparsely vegetated, generally dry, and which fill as seasonal pools in years of high rainfall.

Various plant collection labels and reports describe Parish phacelia's habitat and associated plant species in Nevada as clay soil of dry lake bed (DNWR); white crusted soil and deep cracks with *Sarcobatus*, playa margin with sandy clay soil, and white calcareous exposed slopes, sandy soil with *Artemisia* (Sunnyside); disturbed soil (Pahrump); fine clay soils (Stewart Valley); alkaline flats and slopes or on clay soils (Yermo); on flats along south edge of lakebed in deep alkaline soils with *Phacelia fremontii* (Lucerne Valley); shallow dried alkaline pools, mostly barren except for annuals (Coyote Dry Lake); and wet, heavy clay soil with excessive concentration of soluble salts, with *Salicornia, Allenrolfea occidentalis,* and *Sarcobatus vermiculatus* (Sunnyside).

The vegetation types that have been noted for Parish phacelia include greasewood, fourwing saltbush, shadscale, Rocky Mountain juniper, and barren (interpreted for GAP). Smith (1997) list of commonly associated species in Nevada include shadscale, fourwing saltbush, big greasewood, red brome, squirreltail, Nevada bluegrass, yellow pepperweed, Fremont phacelia, salty popcornflower, and Nuttall povertyweed (*Atriplex confertifolia, Atriplex canescens, Sarcobatus vermiculatus, Bromus rubens, Elymus elymoides, Poa nevadensis, Lepidium flavum, Phacelia fremontii, Plagiobothrys salsus,* and *Monolepis nuttalliana*).

Parish phacelia occurrences average 1050 m in elevation with a wide range from 542 to 1804 m (1778 to 5917 feet) in elevation. Its Great Basin populations are higher in elevation than the Mojave Desert populations. Parish phacelia usually occurs on flats with no slope or aspect, and it has not been documented on slopes greater than three degrees. Where it occurs on very gentle slopes, southwest, south, and east exposures are more common while west and northwest aspects are least common.

Parish phacelia occurrences in Nevada most commonly map on Quaternary playas, alluvial flats, and alluvial deposits. Soil associations mapped at Parish phacelia populations are Besherm clay loam and Skyhaven very fine sandy loam. Smith (1997) collected three soil samples for analysis in Pahrump Valley (Nye Co.) and the erroneous Lake Valley (Lincoln Co.) site. All three had clay texture (57-60% clay) and medium basic to very strongly basic pH (8.1-9.2); however, electrical conductivity, sodium adsorption ratio, and soluble salts (calcium, magnesium, and sodium) varied greatly.

Life History Strategy

Parish phacelia is a winter annual which germinates in early spring as a response to increased moisture that dilutes concentrated salts in valley soils where the plant is found (Harrison 1980). It typically flowers in early June, but can flower as early as April especially further south, and it continues flowering into August where there is ample soil moisture. Most plants produce mature fruits by August. It produces many small seeds that probably are not dispersed more than a few feet beyond the parent plants. White (1998) notes that seeds may occasionally be ingested by shorebirds or picked up with mud on their feet and carried long distances. Parish phacelia avoids hot dry summers, cold dry winters, and entire years of inadequate rainfall by persisting in the soil seed bank.

Smith (1997) states that Mojave Desert populations in Clark and Nye counties had high mortality and perhaps one in 30 million plants set seed to replenish the seed bank in 1995. It may take several years for seed bank replenishment after high germination events.

Surveys, Inventories, and Status Reports

General plant surveys that included the species were conducted on the Nevada Test Site (Rhoads and Williams 1977 and 1978), in White Pine and Lincoln County on BLM lands (Harrison 1980), at the DNWR (Ackerman 1981), Ash Meadows National Wildlife Refuge, (Knight and Clemmer 1987), Fort Irwin National Training Center expansion area (Bagley 1989) where it was relocated after a 40 year absence, and Fort Irwin (Rutherford and Bransfield 1991).

In preparation for a comprehensive status report for the species throughout its distribution, surveys were made in 1995 with particular focus on its Nevada populations (Smith 1997). Earlier, a dated status report for Parish phacelia was written for California (Constance 1979), was summarized across its range in Mozingo and Williams (1980), and updated by White (1998) for California's western Mojave Desert. Results of surveys are summarized in the viability section below.

Key Ecological Attributes

Seven key ecological attributes and their indicator rankings are provided for Parish phacelia in table 44. Other than population numbers, scant quantitative ecological information is available. Key ecological attributes and indicator ranking definitions are expected to be improved over time population monitoring and appropriate applied research studies contribute information

Table 44. Key ecological attributes, indicators, and their ranking definitions for Parish phacelia populations. Italics represent the ultimate goal of land managers.

Category	Key Attribute	Indicator	Parish Phacelia (*Phacelia parishii*) Indicator Rankings			
			Poor	Fair	Good	Very Good
Landscape Context	Ecological integrity of surrounding matrix systems and specific habitat	Density of vehicle tracks and animal (WHB/cattle) trails within habitat and matrix systems	High density or >50% scope of habitat impacted	Moderate density or >10<50% scope of habitat impacted (>1 mi / sq mi habitat)	Low density or <10% scope of habitat impacted (<1 mi / sq mi habitat)	*Virtually no vehicle tracks or animal trails*
Landscape Context	Hydrologic regime	Magnitude and duration of playa surface pooling	Insufficient pooling within historic range of variability for all ecological processes	Insufficient pooling within historic range of variability for most ecological processes	Sufficient pooling within historic range of variability for most ecological processes	*Sufficient pooling within historic range of variability for all ecological processes*
Condition	Characteristic native plant community	Native vs. exotic plant species composition	Many native species conspicuously absent, and exotics or habitat-altering invasives common	Some native species conspicuously absent, and several exotics or habitat-altering invasives present	Mostly native species composition, and with few exotics, although no habitat-altering invasives	*Native plant species composition with no habitat-altering exotic species present*
Condition	Recruitment	Frequency and extent of germination events	Virtually no germination in a good year	Little germination in >normal winter ppt years (70mm)	Good germination in >>normal winter ppt years (100mm), and	*Relatively massive germination in >>normal winter ppt years*

Category	Key Attribute	Indicator	Parish Phacelia (*Phacelia parishii*) Indicator Rankings			
			Poor	Fair	Good	Very Good
					sufficient germination in >normal winter ppt years (70mm)	*(100mm), and very good germination in >normal winter ppt years (70mm)*
Size	Minimum dynamic area	Number and average size of habitat patches	Large number of habitat patches with small average size	Moderate number of habitat patches with moderate average size	Small number of habitat patches with large average size per patch	*Few habitat patches with very large average size*
Size	Minimum dynamic area	Sufficient acreage for characteristic species and natural habitat disturbances within historic range of variability	Insufficient acreage for all sensitive species and severe disturbance likely to eliminate habitat	Insufficient acreage for most sensitive species and habitat susceptible to severe disturbance	Sufficient acreage for most sensitive species and habitat mostly resilient to severe disturbance	*Sufficient acreage for all sensitive species and severe disturbance*
Size	Population size & dynamics	Number of reproductive plants in non-drought years	100s	>1,000	>10,000	*>100,000*

Viability and Trend Status
Smith (1997) estimated a 1995 Nevada-wide population of Parish phacelia with 14 sites on 4668 acres with greater than 37 million individuals; however, that included the two sites now identified as *P. filiae* (Atwood 2002). This is a near maximum snapshot estimate from a year of high annual productivity for the species and needs to be contrasted with drought years of little productivity when population estimates are essentially zero. The largest Nevada populations in 1995 included: **Indian Springs Valley** with an estimated 30 million on 1,388 acre; **Baking Powder Flat** with an estimated two million on 384 acres; **Lake Valley** with 1.7 million estimated on 873 acres; **Pahrump Valley** with 1.5 million estimated on 1,388 acres; and, **Three Lakes Valley** with an estimated one million on 186 acres.

In 1995, about 10,000 individuals on seven acres were estimated at **Burro Creek**, Arizona (Anderson, BLM survey 1995).

As many as 50,000 to 200 million plants were estimated in 1991 for the **Coyote Lake** population group based on density and area estimates (Rutherford and Bransfield 1991). Growth appears to be controlled by water level and timing (White 1998). The **Lucerne Dry Lake** population is assumed extirpated (CNDDB 2004), while status of **Calico Mountains Foothills** is unknown. Thousands were seen in **Stewart Valley** in 2004 (Charlet, personal communication, 2004).

The USFWS notes a stable rangewide trend. Its trend for Nevada is declining (Morefield 2001, Smith 1997), apparently based on acreage. Viability estimates from literature and expert review are organized and summarized in table 45 by MSHCP management category within Clark County and by state elsewhere.

Table 45. Viability ranks for Parish phacelia populations grouped by MSHCP management category within Clark County and by states elsewhere.

Parish Phacelia (*Phacelia parishii*)		Landscape Context	Condition	Size	Viability Rank
1	**Indian Springs Valley, Three Lakes Valley** (IMA/LIMA)	Good	Good	Very Good	**Good**
2	**North Pahrump Valley, Pahrump Valley, Desert Lake, Baking Powder Flat, Lake Valley, Millick Spring, Muncy, Spring Creek Bastian, White River Valley** (NV)	Fair	Good	Fair	**Fair**
3	**Arizona, Burro Creek, Calico Mountains Foothills, Coyote Lake, Lucerne Dry Lake, Stewart Valley** (AZCA)	Fair	Good	Fair	**Fair**

Monitoring and Research

Pritchett *et al.* (1999) set up monitoring at **Indian Springs Valley** and **Three Lakes Valley** populations on Nellis AFBGBR for the purpose of gathering demographic and ecologic information on Parish phacelia over time. These populations had over 30 million plants when initially surveyed in 1995, although most did not set seed (Smith 1997). Three monitoring sampling sites were set up at each location and initial data were collected in May 1998. Stakes were installed so that transects could be relocated in the future. The baseline data show that **Three Lakes Valley** population had a random distribution, whereas **Indian Springs Valley** population had an even or clumped distribution, but more years of data collection are needed to interpret any possible patterns. Climate data collection at these sites is recommended (Pritchett *et al.* 1999). The monitoring sites have not been revisited since the baseline of 1998 (Frank Smith, personal communication 2004).

No research studies have been conducted on Parish phacelia in Nevada. There are many unresolved questions regarding the species demography, reproductive biology, and pollination ecology in need of study to help refine indicators of key ecological attributes.

Management

Department of Defense manages the two IMA and LIMA population groups (**Indian Springs Valley** and **Three Lakes Valley**) in Clark County (table 46). Many populations in other counties of Nevada are managed by BLM (**Pahrump Valley, Desert Lake, Baking Powder Flat, Millick Spring, Muncy,** and **White River Valley**), although three are on private land (**Lake Valley, North Pahrump Valley,** and **Spring Creek Bastian**). Management in Arizona and California is by BLM (**Arizona, Burro Creek, Calico Mountains Foothills, Coyote Lake,** and **Stewart Valley**) except at **Lucerne Dry Lake**, which is on private land.

Table 46. Management of Parish phacelia in Clark County and beyond with percentages totaled for each population group provided above the number of data points.

Parish phacelia *Phacelia parishii*	IMA	LIMA	Not Applicable		Population Total
			Nevada	Arizona California	
Indian Springs Valley	100.00% 1				4.35% 1
Three Lakes Valley		100.00% 1			4.35% 1
Baking Powder Flat			4.76% 1		4.35% 1
Calico Mountains Foothills			4.76% 1		4.35% 1
Coyote Lake			4.76% 1		4.35% 1
Lake Valley			9.52% 2		8.70% 2
Lucerne Dry Lake			4.76% 1		4.35% 1
Millick Spring			4.76% 1		4.35% 1
Muncy			4.76% 1		4.35% 1
North Pahrump Valley			4.76% 1		4.35% 1
Spring Creek Bastian			4.76% 1		4.35% 1
White River Valley			4.76% 1		4.35% 1
Arizona				4.76% 1	4.35% 1
Burro Creek				4.76% 1	4.35% 1
Pahrump Valley				9.52% 2	8.70% 2
Stewart Valley				28.57% 6	26.09% 6
Total % Total Count	100.00% 1	100.00% 1	100.00% 21	100.00% 21	100.00% 23

Threats

Several threats have been identified for Parish phacelia populations and habitats, which are summarized in table 47. They include casual vehicle use and trail development, groundwater development, urban development and sprawl, military training and facilities development, utility corridor construction and maintenance, invasive plant species, commercial development, and livestock grazing management. These threats have reduced size and extent of populations and habitats by both direct mortality of individuals and loss or fragmentation of habitats. They have altered composition of its plant communities by reducing native plants and spreading weeds. These threats also have altered surface water or groundwater flows.

Table 47. Threat ranks for Parish phacelia populations grouped by MSHCP management category within Clark County and by states elsewhere.

Parish Phacelia (*Phacelia parishii*) **Threats Across Population Groups**		**Indian Springs Valley, Three Lakes Valley** (IMA/LIMA)	**North Pahrump Valley, Pahrump Valley, Desert Lake, Baking Powder Flat, Lake Valley, Millick Spring, Muncy, Spring Creek Bastian, White River Valley** (NV)	**Arizona, Burro Creek, Calico Mountains Foothills, Coyote Lake, Lucerne Dry Lake, Stewart Valley** (AZCA)	**Overall Threat Rank**
1	Casual OHV use and trail development	High	High	High	High
2	Groundwater developments	High	High	Medium	High
3	Rural development and sprawl	-	High	High	High
4	Military activities (training and facilities)	High	-	High	High
5	Commercial development	-	High	-	Medium
6	Invasive exotic plant species competition	-	High	-	Medium
7	Utility corridor construction and maintenance	-	-	High	Medium
8	Livestock grazing management	-	Medium	-	Low
Threat Status for Populations and Overall Distribution		High	High	High	Very High

Conservation Assessment

The burden of responsibility for conservation management of Parish phacelia lies north of Clark County in Nevada and in adjacent states, primarily with BLM. Yet the two population groups of Parish phacelia occurring in Clark County (**Indian Springs Valley** and **Three Lakes Valley**) lie at the core of its range distribution and are known to harbor the largest populations documented. Concern for these populations and their habitats is high because they are managed by DoD who is not a signing cooperator for the

MSHCP. Military activities pose a management problem for these populations. Conservation of population groups at Nellis Air Force Range ultimately is the responsibility of DoD, yet the FWS has an important role in coordinating conservation management with DoD through its INRMP revision. Assisting with information gaps and adaptive management for the species is a role for Clark County to undertake. A preliminary conceptual model is presented in figure 28.

Table 48. Research and management needs for Parish phacelia by priority ranking.

Research and Management Need	Priority Rank
Reproductive biology	1
Population viability analyses	1
Geospatial-based threats analysis	1
Effects of fire and invasive plant species interactions (including dune stabilization)	1
Species range distribution information	1
Seed bank research	1
Smaller-scale soils and vegetation maps for predictive distribution mapping	1
Habitat patch connectivity requirements	1
Impacts of global climate change	1
Species extents and abundances	2
Effectiveness and status monitoring	2
Effective restoration techniques	2
Role of exotics in resource competition	2
Current viability of populations under documented climate conditions	2
Randomized surveys	2
Population genetics	2
Pollination ecology	3
Comprehensive conservation report	3

Three conservation objectives address viability enhancement and threat abatement for Parish phacelia in the strategies section of this document. They include the multi-species and multi-site objectives 1, 2 and 9.

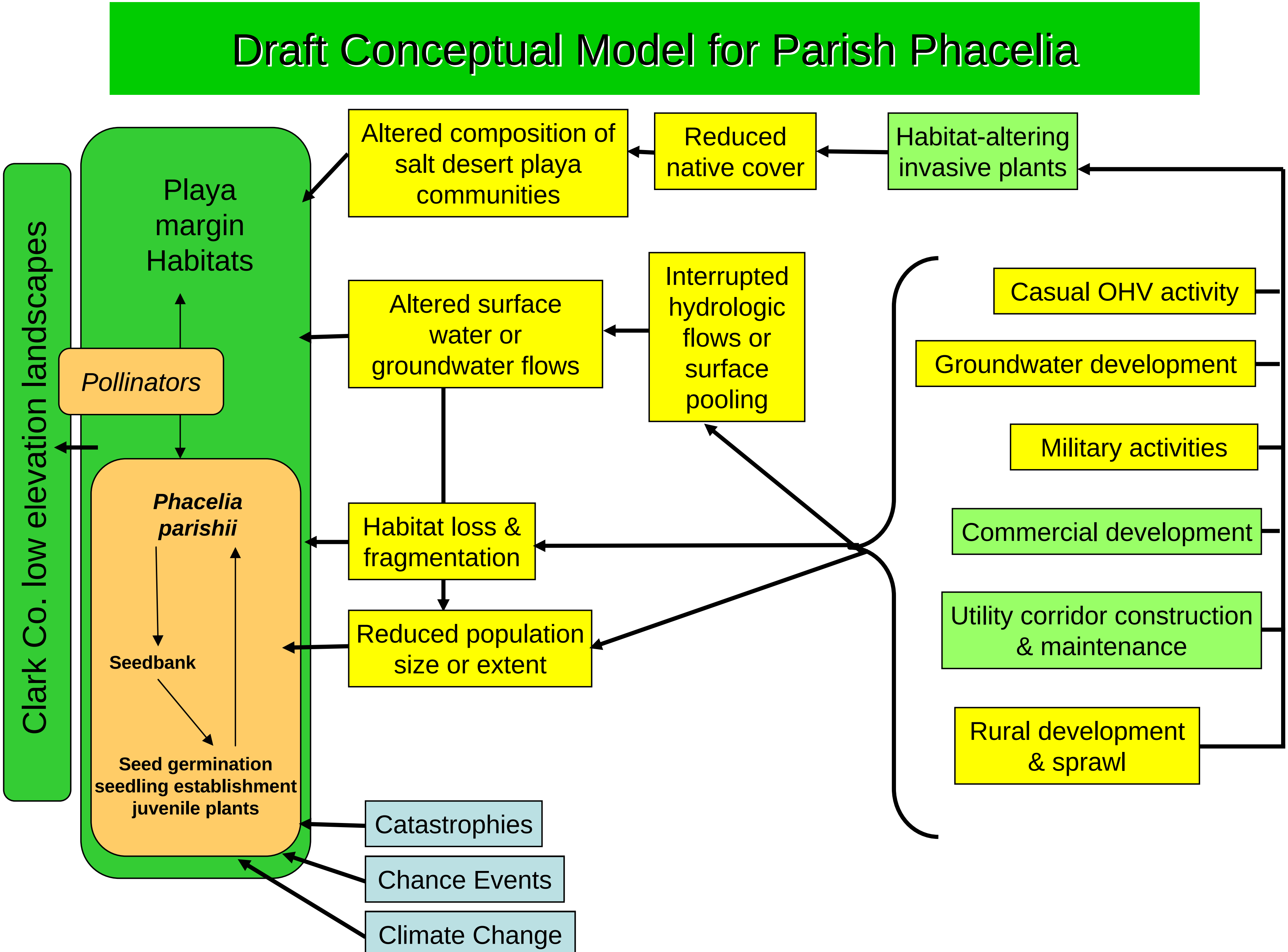

Figure 28. Conceptual model diagram for Parish phacelia.

***Calochortus striatus* Parish, alkali mariposa lily**

Photo courtesy of Gayle Marrs-Smith

Status, Trends, and Viability

Taxon Significance and Formal Status

Calochortus is a large genus in the lily family (Liliaceae) consisting of about 65 species worldwide, with 43 of these in California at its center of diversity (Fiedler and Ness 1993) and 10 species in Nevada. The global distribution if the genus is restricted to North and Central America. Alkali mariposa lily is the only species of the genus considered rare in Nevada (Morefield 2001).

Alkali mariposa lily was described and published by Parish (1902) based on his own type collection at Rabbit Springs in San Bernardino County, California (Greene and Sanders 1998). The species epithet comes from the Latin *striatus* (striped), a reference to the purple vertical stripes on the petals of the species. Alkali mariposa lily has been universally accepted as a species since Ownbey's monograph of the genus (Ownbey 1940).

Alkali mariposa lily is neither federally listed by USFWS under the ESA, nor state listed by Nevada under NRS 527.260. The BLM considers it a sensitive species (BLM 2003). The global heritage status rank for alkali mariposa lily is imperiled as denoted by its G2 rank. However, in Nevada it is state ranked critically imperiled, S1, and in California it is state ranked imperiled and threatened, S2.2 (NatureServe 2006).

Geographic Distribution

The known global distribution of alkali mariposa lily encompasses two states and four ecoregions with its center of distribution far west of Clark County in California (figure 29). Its known occurrences have been organized into 15 population groups with the largest occurring in the west Mojave Desert in Kern and Los Angeles counties, California. Three broad lobes radiating west, southeast, and northeast from Antelope Valley define its spatial distribution. From west to east, there are:

- two small populations in the Great Central Valley Ecoregion (**Allensworth** and **Buena Vista**) in Tulare and Kern counties;

- three population groups in the southern Sierra Nevada Ecoregion in Kern County—one large complex straddling the Great Central Valley Ecoregion (**Isabella Lake**), one small population (**Kelso Valley**), and one transitional into the Mojave Desert (**Red Rock Canyon**) representing the northern portion of its center of distribution;
- five population groups in the west Mojave Desert Ecoregion—one very large complex (**Antelope Valley**) at Edwards Air Force Base in Kern and Los Angeles counties representing the southern portion of its central distribution—three small satellite populations to the southeast in San Bernardino County (**Cushenbury Springs, Lucerne Valley**, and **Twentynine Palms**) with the former presumed extirpated, and another isolated satellite population north of these (**Paradise Range**);
- one small population south of Antelope Valley in the San Gabriel Mountains, Los Angeles County, on the periphery of the California South Coast Ecoregion (**Angeles NF**); and,
- four Nevada population groups in the eastern Mojave Desert Ecoregion representing the species northeastern most locations—one in Nye County (**Ash Meadows**), and three in Clark County with two in the Red Rock Canyon NCA (**Calico Hills** and **Lone Willow Spring**) and one presumably extirpated in Las Vegas Valley (**Las Vegas**), which is known from an historic collection record only.

The distribution of alkali mariposa lily in Clark County is limited to the County's western portion (figure 30). It occurs in the **Calico Hills** and at **Lone Willow Spring**, and it likely has been extirpated from Las Vegas Valley. In summary, Clark County populations of alkali mariposa lily are an eastern disjunct of its global distribution, isolated from core populations in the west Mojave Desert by about 160 air miles. As such they possibly represent important populations for genetic and ecotypic variation within this distinctive species.

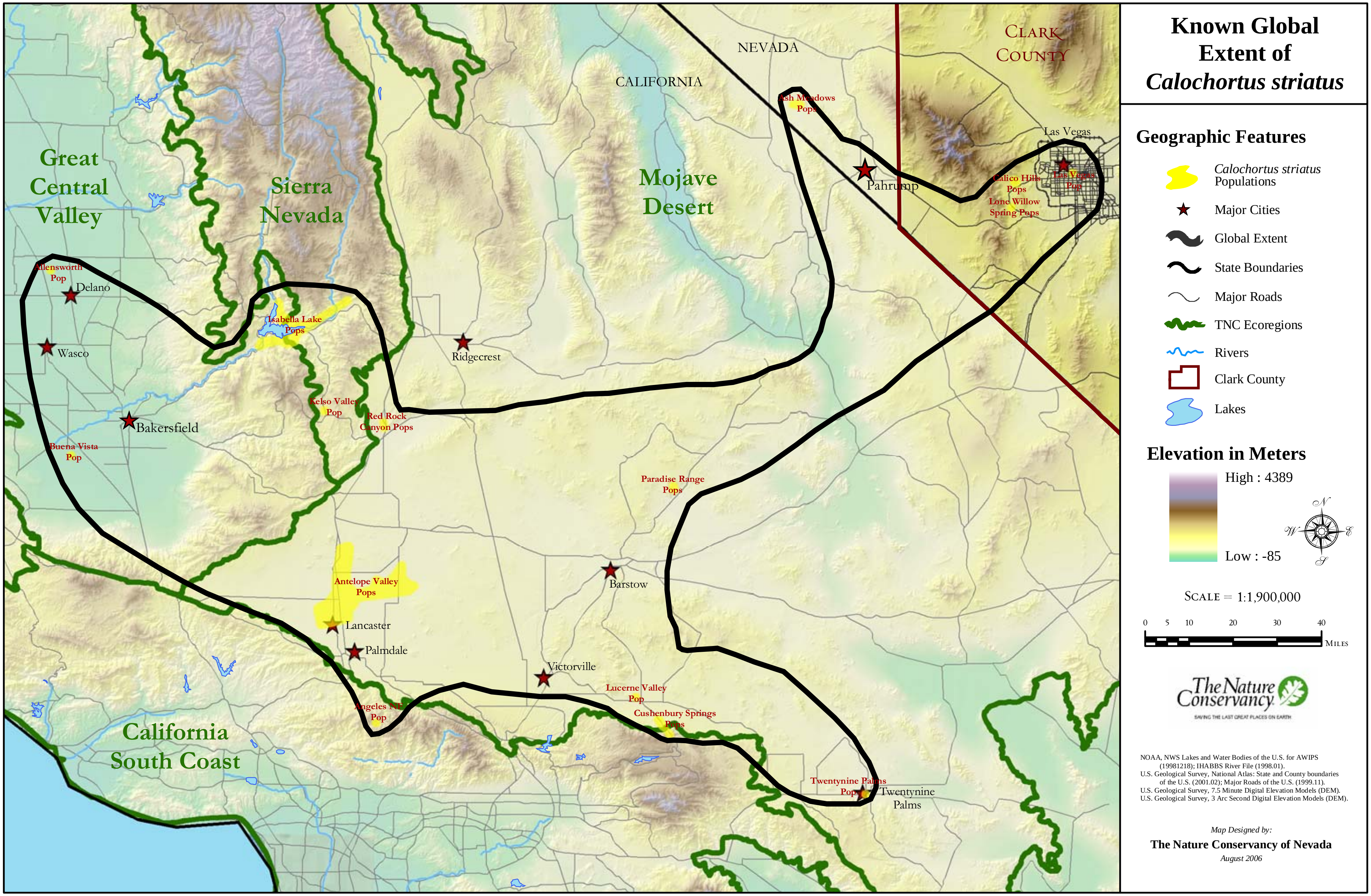

Figure 29. The known global extent of Calochortus striatus, alkali mariposa lily.

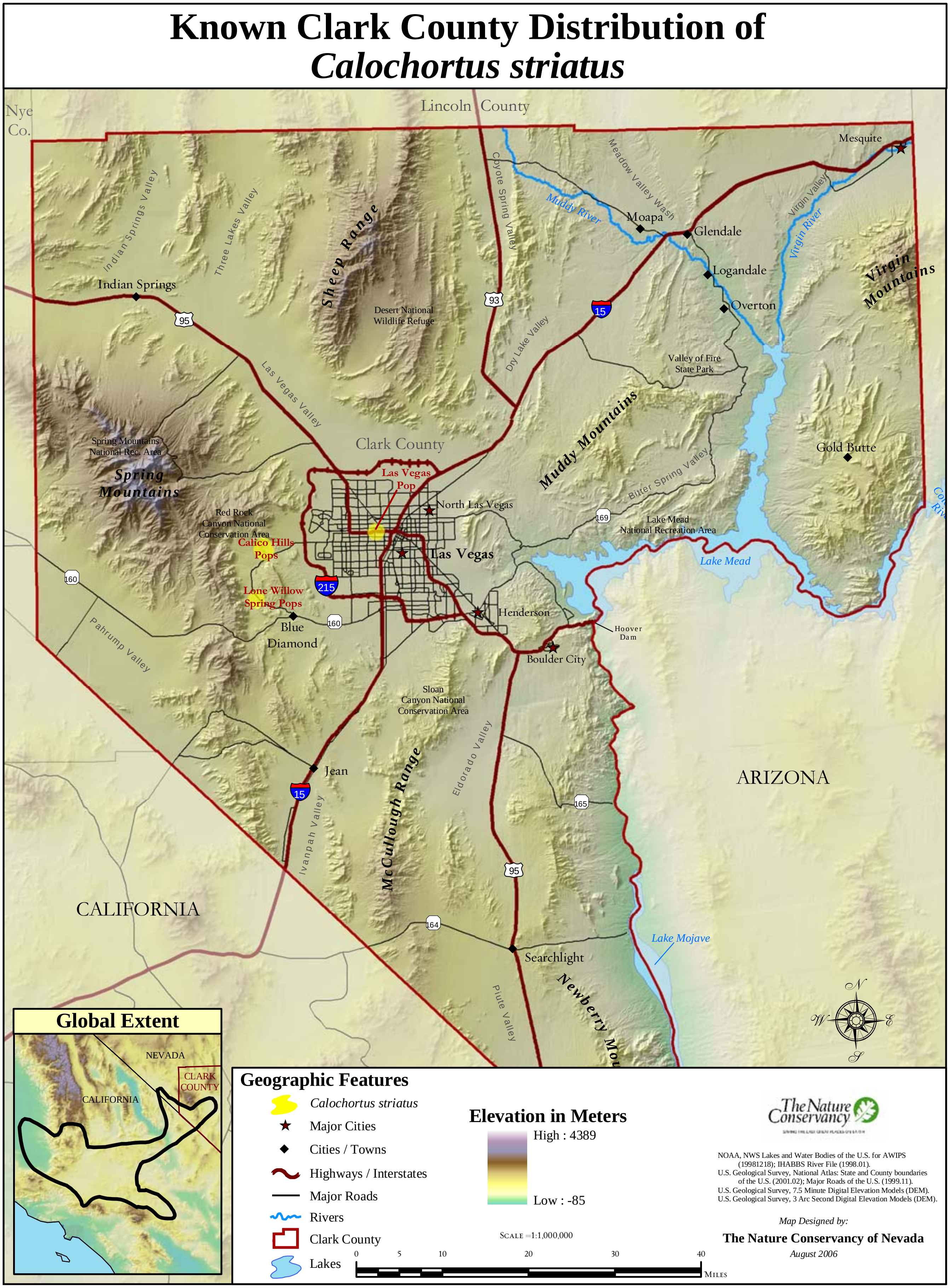

Figure 30. The known geographic distribution of Calochortus striatus, alkali mariposa lily, in Clark County.

Habitat Description
Alkali mariposa lily is restricted to seasonally moist alkaline soils in association with desert springs, floodplains, and topographic depressions. The moist alkaline soils lack surface salts and typically support small patch herbaceous meadow vegetation within large patch or matrix-forming Mojave scrub, creosote bush, or blackbrush ecological systems. The small mesic areas are vital features in the desert landscape, and receive heavy visitation from wildlife for water and cover. Commonly associated plant species include desert saltgrass, Mexican rush, beak spike sedge, alkali sacaton, rubber rabbitbrush, and honey mesquite (*Distichlis spicata* var. *stricta, Juncus mexicanus*, *Eleocharis rostellata*, *Sporobolus airoides*, *Chrysothamnus nauseosus* ssp. *hololeucus,* and *Prosopis glandulosa* var. *torreyana*).

Alkali mariposa lily occurrences average 857 m in elevation with a variable range from 73 to 1634 m (239 to 5360 feet) in elevation. Slopes are typically gentle averaging about four degrees, but they may be as great as 47 degrees. Alkali mariposa lily occurs on all exposures but is most common on aspects that provide cooler and moister conditions (east, northeast, north aspects or flat sites). It is least common on warmer west to southeast exposures.

The few occurrences of alkali mariposa lily in Clark County are mapped on Aztec sandstone, alluvial deposits, and the Chinle Formation. Soil associations mapped at alkali mariposa lily populations include Rock outcrop-St. Thomas complex and Cave loamy fine sand.

In 2003, Edwards Air Force Base in California developed a habitat model for three rare plant species, including alkali mariposa lily. The model uses habitat parameters of known locations and models potential habitat from a geospatial analysis (USFWS 2004). Habitat attributes included soil type, which was determined to be a limiting factor, and seasonally inundated drainage channels (Wood 2003).

Life History Strategy
Alkali mariposa lily is a bulbous herbaceous perennial with a few deciduous grass-like leaves that typically wither by the time it flowers in April to June. The conspicuously dark-veined flowers are pollinated by flies and bees (Tollefson 1992). Capsules contain numerous seed, but it is unknown whether alkali mariposa lily reproduction depends preferentially on seed or asexual division of the bulb (Greene and Sanders 1998). The life spans of alkali mariposa lily's corm (bulb) and seed bank are unknown.

Surveys, Inventories, and Status Reports
Alkali mariposa lily was included in the survey of endemic plants at Ash Meadows (Knight and Clemmer 1987), but no systematic surveys have been conducted in Nevada (Morefield 2001).

A brief status report for the species has been prepared for western Mojave Desert locations in California (Greene and Sanders 1998). No comprehensive conservation status report exists for t alkali mariposa lily in Nevada or for its global distribution.

Key Ecological Attributes
Table 49 provides eight key ecological attributes and their indicators for alkali mariposa lily. Most indicators have qualitative definition rankings because specific knowledge of the species ecology and population biology is lacking. We relied on expert knowledge and their comparisons among specific populations. This botanical expert knowledge of Clark and Nye county populations is found within the BLM Las Vegas District and the local academic community. Population numbers of plants is an indicator for which there is sufficient data to provide quantitative measurements. Indicators of ecological attributes for alkali mariposa lily need refining from information garnered from population monitoring and applied research studies.

Table 49. Key ecological attributes, indicators, and their ranking definitions for alkali mariposa lily populations. Italics represent the ultimate goal of land managers.

Category	Key Attribute	Indicator	Mariposa Lily (*Calochortus striatus*) Indicator Rankings			
			Poor	**Fair**	**Good**	**Very Good**
Landscape Context	Connectivity with intact adjoining systems	Degree of population isolation and fragmentation of matrix systems	Insufficient connectivity for all ecological processes AND high ecological integrity of all systems	Insufficient connectivity for all ecological processes AND high ecological integrity of most systems	Sufficient connectivity for all ecological processes AND high ecological integrity of most systems	*Sufficient connectivity for all ecological processes AND high ecological integrity of all systems*
Landscape Context	Ecological integrity of surrounding matrix systems and specific habitat	Density of vehicle tracks and animal (WHB and livestock) trails	High density or >50% scope of habitat impacted	Moderate density or >10<50% scope of habitat impacted	Low density or <10% scope of habitat impacted	*Virtually no vehicle tracks or animal trails*
Landscape Context	Hydrologic regime	Spring and seep base flows	Insufficient flow for adequate soil moisture throughout alkaline meadow	Insufficient flow for adequate soil moisture in most of alkaline meadow	Sufficient flow for adequate soil moisture in most of alkaline meadow	*Sufficient flow for adequate soil moisture throughout alkaline meadow*
Condition	Characteristic native plant community	Native vs. exotic plant species composition	Many native species conspicuously absent, and exotics or habitat-altering invasives common	Some native species conspicuously absent, and several exotics or habitat-altering invasives present	Mostly native species composition, and with few exotics, although no habitat-altering invasives	*Native plant species composition with no habitat-altering exotic species present*
Condition	Soil structure and stability	Degree of soil erosion or soil compaction	High erosion or compaction	Moderate erosion or compaction	Low erosion or compaction	*Virtually absent*
Size	Minimum dynamic area	Number and average size of habitat patches	Large number of habitat patches with small average size	Moderate number of habitat patches with moderate average size	Small number of habitat patches with large average size per patch	*Few habitat patches with very large average size*
Size	Minimum dynamic area	Sufficient acreage for characteristic species and natural habitat disturbances within historic range of variability	Insufficient acreage for all sensitive species and severe disturbance likely to eliminate habitat	Insufficient acreage for most sensitive species and habitat susceptible to severe disturbance	Sufficient acreage for most sensitive species and habitat mostly resilient to severe disturbance	*Sufficient acreage for all sensitive species and severe disturbance*

Category	Key Attribute	Indicator	Mariposa Lily (*Calochortus striatus*) Indicator Rankings			
			Poor	**Fair**	**Good**	**Very Good**
Size	Population size & dynamics	Number of reproductive plants in non-drought year	few	<100	100s	*1000s*

Viability and Trend Status
The rangewide trend for the species is presumed stable although a lack of detailed information is stated (USFWS 2000). The trend of alkali mariposa lily populations in Nevada is unknown (Morefield 2001).

Calico Hills is the largest population group in Clark County with a total abundance estimate of 344-906 in 1997 (BLM data). About half of those data points had heavy disturbance. **Lone Willow Spring** had fewer than 50 plants that same year. The **Las Vegas** population group is historic and presumed extirpated (Morefield 2001).

The alkali mariposa lily population in and near Edwards Air Force Base (**Lucerne Valley**) is by far the largest concentration of individuals of the species where thousands of individuals were observed in 1995 (CNDDB 2004). Paradise Valley had an estimated 1,500 plants in 1989 over 5-10 acres. **Cushenbury Springs** had fewer than one hundred plants in 1982, the year with the most plants recorded, but this location has been subject to habitat loss by development more recently (CNDDB 2004). **Isabella Lake** has had highly variable population numbers documented over years (Tollefson 1992).

Viability estimates from literature and expert review are organized and summarized in table 50 by MSHCP management category within Clark County and by state elsewhere.

Table 50. Viability ranks for alkali mariposa lily populations grouped by MSHCP management category within Clark County and by states elsewhere.

Mariposa Lily (*Calochortus striatus*)		Landscape Context	Condition	Size	Viability Rank
1	**Calico Hills, Lone Willow Spring** (LIMA)	Fair	Fair	Good	**Fair**
2	**Las Vegas** (UMA)	Poor	Poor	Poor	**Poor**
3	**Ash Meadows** (NV)	Good	Fair	Good	**Good**
4	**Allensworth, Angeles NF, Antelope Valley, Buena Vista, Cushenbury Springs, Isabella Lake, Kelso Valley, Lucerne Valley, Paradise Range, Red Rock Canyon** (CA)	Fair	Fair	Good	**Fair**

Monitoring and Research

No monitoring studies are documented for Nevada populations. Status monitoring of the Kern River, California populations (**Isabella Lake**) was conducted by Tollefson (1992), but there has been no monitoring data collection since the early 1990s.

Fiedler (1985) reported on the phenomenon of heavy metal accumulation and edaphic endemism in *Calochortus*, and later used these examples to discuss the concept of rarity in all vascular plants (Fiedler 1986, 1992). Fiedler also worked on the population dynamics (Fiedler 1987) and demographics (Fiedler 1998) in the genus.

Alkali mariposa lily depends on insect pollination for sexual reproduction, but the identity of the pollinators is unknown. Other Calochortus species are pollinated by a wide array of generalist pollinators, attracted to the large, open flowers and color patterns that guide the insect to the nectarines (Fiedler 1987).

Management

The two populations in Clark County are managed by BLM (table 51). There is no specific management in place for alkali mariposa lily although it occurs in Red Rock Canyon NCA. Its habitat benefits from recent spring restoration work at Red Springs (**Calico Hills**).

Table 51. Management of alkali mariposa lily in Clark County and beyond with percentages totaled for each population group provided above the number of data points.

Alkali mariposa lily ***Calochortus striatus***	LIMA	UMA	Not Applicable	Population Total
Calico Hills	90.63% 29	80.00% 4	0.00%	26.40% 33
Lone Willow Spring	9.38% 3	0.00%	0.00%	2.40% 3
Ash Meadows	0.00%	0.00%	4.55% 4	3.20% 4
Allensworth	0.00%	0.00%	1.14% 1	0.80% 1
Angeles NF	0.00%	0.00%	1.14% 1	0.80% 1
Antelope Valley	0.00%	0.00%	68.18% 60	48.00% 60
Buena Vista	0.00%	0.00%	1.14% 1	0.80% 1
Las Vegas	0.00%	20.00% 1	0.00%	0.80% 1
Cushenbury Springs	0.00%	0.00%	3.41% 3	2.40% 3
Isabella Lake	0.00%	0.00%	12.50% 11	8.80% 11
Kelso Valley	0.00%	0.00%	1.14%	0.80%
Lucerne Valley	0.00%	0.00%	1 1.14%	1 0.80%

Alkali mariposa lily ***Calochortus striatus***	LIMA	UMA	Not Applicable	Population Total
Paradise Range	0.00%	0.00%	1 2.27%	1 1.60%
Red Rock Canyon	0.00%	0.00%	2 2.27%	2 1.60%
Twentynine Palms	0.00%	0.00%	2 1.14%	2 0.80%
Total % Total Count	100.00% 32	100.00% 5	100.00% 88	100.00% 125

Threats

Numerous threats have been identified for populations and habitats of alkali mariposa lily. In order of highest ranked threats, they include urban development and sprawl (historic level led to loss in Las Vegas Valley), wild horse and burro management, invasive plant species, rural development and sprawl, casual vehicle use and trail development, groundwater development, cement mining, highway and road construction and maintenance, commercial development, military training and facilities development (in California), utility corridor construction and maintenance, and legal recreation use (table 52). These threats have reduced size and extent of populations and habitats by both direct mortality of individuals and loss or fragmentation of habitats. They have altered composition of its plant communities by reducing native plants and spreading weeds and they have altered surface water or groundwater flows.

Table 52. Threat ranks for alkali mariposa lily populations grouped by MSHCP management category within Clark County and by states elsewhere.

	Mariposa Lily (*Calochortus striatus*) **Threats Across Population Groups**	**Calico Hills, Lone Willow Spring** (LIMA)	**Las Vegas** (UMA)	**Ash Meadows** (NV)	**Allensworth, Angeles NF, Antelope Valley, Buena Vista, Cushenbury Springs, Isabella Lake, Kelso Valley, Lucerne Valley, Paradise Range, Red Rock Canyon** (CA)	**Overall Threat Rank**
1	Urban development and sprawl	-	Very High	-	High	High
2	Wild horse and burro management	High	-	High	-	High
3	Invasive exotic plant species competition	Medium	-	High	Medium	Medium

Mariposa Lily (*Calochortus striatus*) **Threats Across Population Groups**		**Calico Hills, Lone Willow Spring** (LIMA)	**Las Vegas** (UMA)	**Ash Meadows** (NV)	**Allensworth, Angeles NF, Antelope Valley, Buena Vista, Cushenbury Springs, Isabella Lake, Kelso Valley, Lucerne Valley, Paradise Range, Red Rock Canyon** (CA)	**Overall Threat Rank**
4	Rural development and sprawl	High	-	Medium	-	Medium
5	Casual OHV use and trail development	-	-	-	High	Medium
6	Surface water developments	Medium	-	-	Medium	Medium
7	Groundwater developments	Medium	-	Medium	-	Medium
8	Cement mining	-	-	-	Medium	Low
9	Highway and road construction and maintenance	-	-	-	Medium	Low
10	Commercial development	-	-	-	Medium	Low
11	Military activities (training and facilities)	-	-	-	Medium	Low
12	Utility corridor construction and maintenance	-	-	-	Medium	Low
13	Illegal dumping	-	-	-	Low	Low
14	Legal concentrated recreation use	Low	-	-	-	Low
Threat Status for Populations and Overall Distribution		High	High	High	High	High

Conservation Assessment
Clark County is at the eastern periphery of distribution for alkali mariposa lily. Habitats in the western Mojave Desert of California bear major responsibility for conservation management of its core populations. Nevertheless, its disjunct populations on Federal lands in Clark County hold genetic diversity which may contribute to the species viability in the eastern Mojave Desert. Management to improve viability and reduce threats in Red Rock Canyon NCA should be taken and adaptively applied to assist meeting MSHCP goals for the species. Conservation management for alkali mariposa lily at **Calico Hills** and **Lone Willow Spring** population groups is needed to meet MSHCP goals. Clark County can assist in improving research and management gaps for alkali mariposa lily (table 53).

Table 53. Research and management needs for alkali mariposa lily by priority ranking.

Research and Management Need	Priority Rank
Smaller-scale soils and vegetation maps for predictive distribution mapping	1
Population genetics	1
Pollination ecology	1
Current viability of populations under documented climate conditions	1
Geospatial-based threats analysis	1
Effectiveness and status monitoring	1
Effective restoration techniques	1
Impacts of global climate change	1
Species range distribution information	2
Species extents and abundances	2
Seed bank research	2
Population viability analyses	2
Comprehensive conservation report	2
Effects of fire and invasive plant species interactions (including dune stabilization)	2
Habitat patch connectivity requirements	2
Randomized surveys	3
Reproductive biology	3
Role of exotics in resource competition	3

Four conservation objectives address viability enhancement and threat abatement for alkali mariposa lily in the strategies section of this document. They include the multi-species and multi-site objectives 1, 3, 4 and 10. A preliminary conceptual model for alkali mariposa lily is given in figure 31 below.

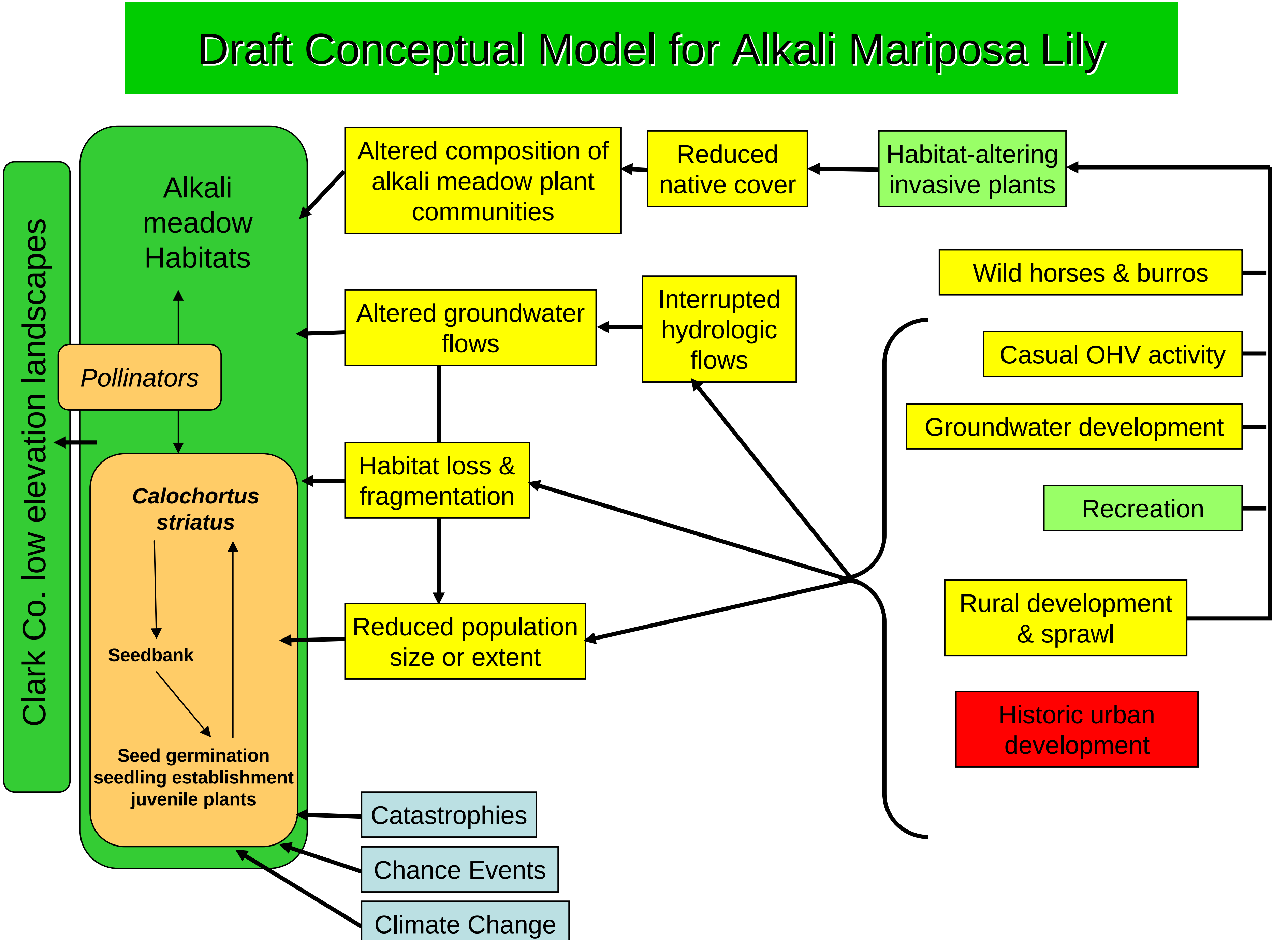

Figure 31. Conceptual model diagram for alkali mariposa lily.

CONSERVATION OBJECTIVES

EXISTING MANAGEMENT GOALS AND OBJECTIVES RELEVANT TO THE CMS

1. <u>Clark County</u>

The Clark County Multiple Species Habitat Conservation Plan states several general measurable biological goals for all nine of the permit-covered rare plant species (Clark County 2000). Table 54 is a summary of MSHCP goals for each low elevation rare plant including a few species-specific goals.

Table 54. MSHCP measurable biological goals for the nine low elevation plant taxa.

MSHCP Biological Goals	Sticky ringstem	Las Vegas bearpoppy	White bearpoppy	Threecorner milkvetch	Sticky wild buckwheat	White-margined beardtongue	Pahrump Valley wild buckwheat	Parish phacelia	Alkali mariposa lily
	Anulocaulis leiosolenus var. *leiosolenus*	*Arctomecon californica*	*Arctomecon merriamii*	*Astragalus geyeri* var. *triquetrus*	*Eriogonum viscidulum*	*Penstemon albomarginatus*	*Eriogonum bifurcatum*	*Phacelia parishii*	*Calochortus striatus*
No net unmitigated loss or fragmentation of habitat in IMAs, LIMAs, & MUMAs	X	X		X	X	X			
No net unmitigated loss or fragmentation of habitat in IMAs & LIMAs			X					X	X
No net unmitigated loss or fragmentation of habitat on public lands							X		
Maintain stable or increasing population numbers	X		X	X	X	X		X	X
Maintain stable or increasing population numbers on public lands							X		
Conserve populations on the NLVA, NAFB Area 3, & SNWA North Well Field	(benefits)	X							
Maintain or improve bearpoppy habitat in 4 BLM Management Areas*		X							
Implement modifications to grazing practices as indicated by exclosure study on Jean Lake and Hidden Valley						X[1]			
Develop inventory of extant populations in Pahrump and Sandy Valley							X		
Develop an activities plan for the NCA including management for this species									X
Develop, through adaptive management, appropriate detailed and quantifiable population or habitat goals for each Covered Species or, if possible, quantifiable goals for an appropriate surrogate indicator (ecosystem measure or key, umbrella, flagship species)	X	X	X	X	X	X	X	X	X

*The four management areas identified by BLM are Sunrise, Lovell Wash, Bitter Spring, and Gold Butte.

[1]This goal was partially met in late 2005 when the Jean Lake grazing allotment was purchased by Clark County and retired.

A number of other conservation management strategies are being developed as requirements to Clark County's MSHCP permit which have significance for the covered low elevation rare plants involved in this CMS. The Mesquite and Acacia Woodlands, Gold Butte-Pakoon, and Mormon Mesa conservation management strategies include ecological systems that define adjoining dynamic landscapes or directly harbor specific habitats and populations of these rare plants.

2. <u>BLM</u>

BLM Manual 6840 provides policy and guidance for conservation of candidates and other special status species, ensuring that actions authorized, funded, or carried out by BLM do not contribute to the need to list any candidate species. The goals of the agency's sensitive species policy are to:

1) maintain vulnerable species and habitat components in functional BLM ecosystems;
2) ensure sensitive species are considered in land management decisions;
3) prevent a need for species listing under the Endangered Species Act; and
4) prioritize needed conservation work with an emphasis on habitat.

The BLM Las Vegas Resource Management Plan (1998) more specifically provides management guidance for public lands in Clark and southern Nye counties. Resource management for special status species is most relevant for this CMS, but guidelines and directives for several other resource topics (soil, water, riparian, vegetation, etc.) are pertinent as well. Germane stated objectives for special status species are to:

1) manage special status species habitat at the potential natural community or desired plant community, according to the need of the species; and
2) manage habitats for non-listed special status species to support viable populations so that future listing would not be necessary.

Red Rock Canyon National Conservation Area is managed under a General Management Plan (BLM 2000). Management prescriptions include protection of natural habitats and features, including sensitive wildlife and plants, and riparian areas. The plan provides direction for monitoring populations of threatened, endangered, candidate, and other special status species.

Two additional BLM management plans directly relevant to this CMS address special status species and their habitats. The Las Vegas Bearpoppy Habitat Management Plan (1998) was developed with the overarching goal to manage its habitat for ecosystem, community, species, and genetic diversity, and to sustain viable populations of Las Vegas bearpoppy. Stated objectives are to:

1) maintain or improve 45,750 acres of habitat on four management areas and protect an additional population (at Apex); and
2) allow no net loss of bearpoppy habitat on public land from Federally-approved projects through mitigative actions.

The plan includes specific conservation actions and an implementation plan.

Additionally, the Sunrise Management Area Interim Management Plan (2000) has a stated objective to protect sensitive species (Las Vegas bearpoppy and sticky ringstem) while also providing for recreational opportunities. It includes specific protection, habitat rehabilitation, and law enforcement measures, along with other multiple use management actions that would positively influence sensitive species management in this popular area.

3. <u>NPS</u>

Park policy states that natural resources will be managed to preserve fundamental physical and biological processes, as well as individual species, features, and plant and animal communities. The Lake Mead National Recreation Area General Management Plan (NPS 1986) presents broad resource conservation goals and includes specific conservation actions for these park lands in eastern Clark County. Updated policy guidelines relevant to this CMS include project planning, inventory, vital signs monitoring, resource protection, environmental restoration, and research (NPS 1999). In addition, their GMP and Burro Management Plan (1995) provide specific conservation measures for additional resource protection benefiting rare plant habitat, and the Lake Management Plan (NPS 2003) offers management guidance for the rare plant species occurring along the lake's shoreline.

4. <u>NDF</u>

Nevada Division of Forestry administers a conditional Master Permit between NDF and Clark County (along with NDOT and cities within the County) for disturbance or destruction of the Las Vegas bearpoppy on non-Federal lands by MSHCP participants. Conditions of the permit include protection of the Las Vegas bearpoppy at North Las Vegas Air Terminal and Las Vegas Springs Preserve, protection of the species on Federal lands by the appropriate land management agencies, execution of a Memorandum of Agreement which would establish conservation easements on private lands for specific populations (however, this MoA has not been executed), NDF documentation of plant and habitat loss on public and private lands, and NDF monitoring of the effects of land use activities on populations. The Master Permit is valid for two year periods and unless specifically revoked or modified it is automatically extended. The FWS, NDF, and Clark County have been working since 2003 to modify and update conditions of the Master Permit, but to date have not yet finalized any modifications.

LOW ELEVATION RARE PLANT CMS CONSERVATION GOAL AND OBJECTIVES

The goal of this low elevation rare plant CMS is to provide a suite of priority conservation actions within an adaptive framework, which if successfully implemented would ensure long term viability of these nine species and their habitats. Success is broadly defined by preventing future listings (Federal and State) of these species. To meet the goal of ensuring long term viability for each of the nine low elevation rare plant species, we developed specific and measurable objectives supported by strategic actions and action steps designed to meet a given objective. Collectively, one or more conservation objectives, with its strategic actions, and action steps are referred to as conservation strategies. The low elevation rare plant CMS is a framework within which conservation strategies are identified for rare plants and discussed in current context—as such, the conservation strategies are open to incorporate information and lessons learned through adaptive management.

We used TNC CAP methodology to assess long term viability of the plant species (appendix 5) Briefly, we used key ecological attributes to identify and measure the composition, structure, and function of the plants and their habitats at various geographic scales. Key ecological attributes are critical components of a species life history, ecological processes, habitat, community and other species interactions, and environmental regimes and constraints. We considered indicators of those ecological characteristics that, if degraded (*e.g.*, soil stability) or missing (*e.g.*, pollinator), would seriously hinder that species ability to persist over time. Understanding (or accepting uncertainty about) the acceptable range of variation of key attributes helped to determine where and when thresholds are crossed that lead to a decline or loss of ecological function. A plant species is considered *conserved* when its entire suite of key ecological attributes are maintained or restored within their acceptable ranges of variation.

Our assessments of plant species viability defined indicators for four rankings that specify a hierarchical range from poor to very good viability. Table 55 summarizes current definitions of the four viability rankings for preliminarily selected key ecological attributes and their indicators for the nine low elevation rare plants. Again, assessing viability is an iterative process which captures the state of current knowledge at a given time, and often requires comfort with uncertainties. Where little information exists it is necessary to start with general ecological assumptions, and then as research clarifies basic assumptions, definitions are refined and become more objective and more easily measured. Most of the indicator definitions for these nine species are currently subjective because little detailed information exists to define them objectively. One of the goals is to make indicator ratings scientifically credible. Applied research and monitoring is needed to better define relative terms, such as “high”, “moderate”, “low”, “sufficient”, insufficient”, “some”, and “few”. This refinement process is the last Clark County MSHCP measurable goal stated in table 54 above.

Assessment of Target Viability and Desired Future Condition (indicated by italics)

Nine Low Elevation Rare Plants

Plant Species	Category	Key Attribute	Indicator	Poor	Fair	Good	Very Good
All nine species	Landscape Context	Ecological integrity of surrounding matrix systems and specific habitat	Density of vehicle tracks and animal (WHB/cattle) trails within habitat and matrix systems	High density or >50% scope of habitat impacted	Moderate density or >10<50% scope of habitat impacted (>1 mi / sq mi habitat)	Low density or <10% scope of habitat impacted (<1 mi / sq mi habitat)	*Virtually no vehicle tracks or animal trails in occupied habitat*
Anulocaulis leiosolenus, Arctomecon californica, Arctomecon merriamii	Landscape Context	Soil moisture and nutrient regime	Degree of surface disturbance relative to presence of surface crusts and gravels on gypsum soils	High surface disturbance with only remnant cryptobiotic crusts/gravel surfaces present	Moderate surface disturbance with <20% cover of cryptobiotic crusts/gravel surfaces present	Low surface disturbance with >20% of cryptobiotic crusts/gravel surfaces present	*Surface disturbance virtually absent with intact cryptobiotic crusts/gravel surfaces present*
Astragalus geyeri var. triquetrus, Penstemon albomarginatus	Landscape Context	Aeolian deposition process	Aeolian deposition between source and sink areas	Virtually lost ability to move and deposit sands	Insufficient aeolian sand deposition into most habitats	Sufficient aeolian sand deposition into most habitats	*Sufficient aeolian sand deposition into all habitats*
Astragalus geyeri var. triquetrus, Eriogonum viscidulum	Landscape Context	Fluvial deposition process	River or stream "sediment carrying capacity" and deposition	Virtually lost ability to carry and deposit sediment	Insufficient fluvial sand deposition in most habitats	Sufficient fluvial sand deposition in most habitats	*Sufficient fluvial sand deposition in all habitats*
Eriogonum bifurcatum, Phacelia parishii	Landscape Context	Hydrologic regime	Magnitude and duration of playa surface pooling	Insufficient pooling within historic range of variability for all ecological processes	Insufficient pooling within historic range of variability for most ecological processes	Sufficient pooling within historic range of variability for most ecological processes	*Sufficient pooling within historic range of variability for all ecological processes*
Calochortus striatus	Landscape Context	Hydrologic regime	Spring and seep base flows	Insufficient flow for adequate soil moisture throughout alkaline meadow	Insufficient flow for adequate soil moisture in most of alkaline meadow	Sufficient flow for adequate soil moisture in most of alkaline meadow	*Sufficient flow for adequate soil moisture throughout alkaline meadow*
Arctomecon californica, Arctomecon merriamii, Penstemon albomarginatus	Landscape Context	Pollination	Presence of characteristic pollinators	Exclusively generalist pollinator species	More generalist species than specialist pollinators	Specialist pollinators in healthy numbers although others may be present	*Dominated by specialist pollinators*
All nine species	Condition	Characteristic native plant community	Native vs. exotic plant species composition	Many native species conspicuously absent, and exotics or habitat-altering invasives common	Some native species conspicuously absent, and several exotics or habitat-altering invasives present	Mostly native species composition, and with few exotics, although no habitat-altering invasives	*Native plant species composition with no habitat-altering exotic species present*

Plant Species	Category	Key Attribute	Indicator	Poor	Fair	Good	Very Good
Arctomecon californica	Condition	Recruitment	Frequency and extent of germination events	Virtually no germination in a good year	Little germination in >normal winter ppt years (70mm)	Good germination in >>normal winter ppt years (100mm), and sufficient germination in >normal winter ppt years (70mm)	*Relatively massive germination in >>normal winter ppt years (100mm), and very good germination in >normal winter ppt years (70mm)*
Astragalus geyeri var. triquetrus, Eriogonum viscidulum, Eriogonum bifurcatum, Phacelia parishii (the annuals)	Condition	Recruitment	Frequency and extent of germination events	Virtually no germination in a good year	Little germination in >normal winter ppt years (70mm)	Good germination in >>normal winter ppt years (100mm), and sufficient germination in >normal winter ppt years (70mm)	*Relatively massive germination in >>normal winter ppt years (100mm), and very good germination in >normal winter ppt years (70mm)*
Seven species, excepting Eriogonum bifurcatum and Phacelia parishii	Condition	Soil structure and stability	Degree of soil erosion or soil compaction	High erosion or compaction	Moderate erosion or compaction	Low erosion or compaction	*Virtually absent*
All nine species	Size	Minimum dynamic area	Sufficient acreage for characteristic species and natural habitat disturbances within historic range of variability	Insufficient acreage for all sensitive species and severe disturbance likely to eliminate habitat	Insufficient acreage for most sensitive species and habitat susceptible to severe disturbance	Sufficient acreage for most sensitive species and habitat mostly resilient to severe disturbance	*Sufficient acreage for all sensitive species and severe disturbance*
All nine species	Size	Minimum dynamic area	Number and average size of habitat patches	Large number of habitat patches with small average size	Moderate number of habitat patches with moderate average size	Small number of habitat patches with large average size per patch	*Few habitat patches with very large average size*
Anulocaulis leiosolenus, Arctomecon merriamii, Astragalus geyeri var. triquetrus, and Calochortus striatus	Size	Population size & dynamics	Number of reproductive plants in non-drought periods	few	10s	100s	*>1000*
Eriogonum bifurcatum	Size	Population size & dynamics	Number of reproductive plants in non-drought year	few	>100	>1000	*>10,000*
Eriogonum viscidulum and Penstemon albomarginatus	Size	Population size & dynamics	Number of reproductive plants in non-drought	few	<1000	10,000s	*>50,000*
Arctomecon californica	Size	Population size & dynamics	Number of reproductive plants in non-drought years	few	<1000	10,000s	*>100,000*

Plant Species	Category	Key Attribute	Indicator	Poor	Fair	Good	Very Good
Phacelia parishii	Size	Population size & dynamics	Number of reproductive plants in non-drought years	100s	>1,000	>10,000	*>100,000*
				Ratings left of the double line indicate "not viable"		Ratings right of the double line indicate "viable"	

Indicator ranks which fall into good and very good categories imply that a key attribute is within the acceptable range of variation and, thus, is viable. Similarly, ranks of poor and fair suggest that the key attribute is outside of the acceptable range of variation, which is a non-viable status. Biologists of the primary federal agencies (BLM and NPS) responsible for management of the nine plant species and their habitats have stated that very good viability ranks of key attribute indicators should be the ultimate conservation goal (desired status) for all populations on their managed lands. Progress toward very good viability goals would be measured incrementally from current viability status to next improved categories.

Ultimately, the time, resources, and management/stakeholder compromises that may be necessary to achieve a very good viability status needs appropriate evaluation of the added benefit to the species and their habitats after achieving and maintaining good viability status. By determining if the return on investment is acceptable, and adapting conservation actions as necessary, the County and federal management agencies can evaluate if the greater goal for a given covered plant species population should be pursued. However, an alternative might be to achieve good viability status for populations on MUMAs where multiple uses are in place, but attempt to achieve a very good status on IMAs and LIMAs where greater protection of covered species is expected to occur. This alternative also complies with current BLM management plan goals of maintaining viable populations of special status species.

The viability of the nine low elevation rare plant species addressed in this CMS and their habitats have been affected by historic actions and they will continue to be influenced by additional ongoing and future actions during the Clark County MSHCP permit period. Accordingly, conservation strategies that address both restoration and threat (stressor) reducing goals are needed to ensure long term rare plant viability.

Each conservation objective is a specific statement detailing the outcome or desired conservation success of a particular set of strategic actions. The conservation objectives outlined below are stated in terms of reducing the status of a critical threat, enhancing or maintaining the status of a key ecological attribute, or both. Ultimately, conservation success for the nine low elevation rare plants would be achieved when adaptive management on Federal lands maintains all stated objectives in perpetuity, ensuring long term viability and preventing future Federal (and State) listings. Each objective is impact-oriented, measurable, practical, and credible. Most are time-limited and those where it is unstated are expected to continue at least through the length of the MSHCP—to 2030. Several objectives include variations of the phrase "does not significantly impact" which indicates that key ecological attributes (or their indicators) should remain or improve to viable (good or very good) indicator rankings, or threat ranks should be reduced to medium or lower, to achieve the given objective.

A total of nineteen objectives—or, CMS outcomes—were developed and are summarized in table 56 for the multi-species and multi-site objectives, and table 57 for single species objectives. Multi-species and multi-site objectives are ordered, in general, by the overall highest ranked threats across the greatest number of plant species population groups affected by the particular critical threat and lowered viability status. However, this ordering does not necessarily imply priority of strategic actions which are evaluated and presented in a subsequent section based on additional criteria. Detailed explanations of each conservation objective along with their associated strategic actions and action steps are provided in the next section on conservation strategies.

Table 56. Multi-species and multi-site conservation objectives and the nine low elevation rare plants and population groups addressed by each objective. Species population groups occurring on Nellis AFB and outside of Clark County are also addressed in appendix 7.

Conservation Objective	Notes on Species (and Population Groups) Addressed
1: Proactively protect and manage for long term viability of all populations of nine MSHCP covered rare plants on Federal lands (IMAs, LIMAs, MUMAs, and UMAs as appropriate) in Clark County.	**Sticky ringstem** (Bitter Spring Valley, East Black Mountains, Gold Butte, Gypsum Wash, Lava Butte, Overton Arm, West Black Mountains; n=7) **Las Vegas bearpoppy** (Bitter Spring Valley, Gale Hills, Gold Butte, Government Wash, Nellis Dunes, Las Vegas Valley [CTA only], Middle Point, Sunrise Valley, Valley of Fire, White Basin; n=10) **White bearpoppy** (Bird Spring Range, Black Hills, Calico Hills, Desert Range, Devil Canyon, Indian Springs, North Desert Range, Pahrump Valley, Pintwater Range, Spotted Range, Three Lakes Valley; n=11) **Threecorner milkvetch** (Bark Bay, California Wash, Ebony Cove, Lime Cove, Logandale, Mormon Mesa, Mud Lake, Mud Wash, Muddy River, Sandy Cove, The Meadows, Toquop Wash, Town Wash, Valley of Fire Wash, Virgin River, Weiser Wash; n=16) **Sticky wild buckwheat** (Bitter Ridge, Black Mountains, Lime Wash, Lower Virgin River, Lower Virgin Valley, Middle Muddy River, Overton Arm, Toquop Wash, Upper Muddy River, Upper Virgin Valley, Virgin River Confluence; n=11) **White-margined beardtongue** (Hidden Valley, Jean Lake, Ivanpah Valley, Roach Lake; n=4) **Pahrump Valley wild buckwheat** (Mesquite Valley; n=1) **Parish phacelia** (Indian Springs Valley, Three Lakes Valley; n=2) **Alkali mariposa lily** (Calico Hills, Lone Willow Spring; n=2)
2: Manage viable populations of sticky ringstem, LV bearpoppy, white bearpoppy, threecorner milkvetch, sticky wild buckwheat, white-margined beardtongue, Parish phacelia in IMAs, LIMAs and MUMAs by removing significant casual OHV impacts by 2020.	**Sticky ringstem** (Bitter Spring Valley, Gypsum Wash, Overton Arm; n=3) **Las Vegas bearpoppy** (Gold Butte, Government Wash, Sunrise Valley, Valley of Fire, Bitter Spring Valley, Gale Hills, Nellis Dunes, White Basin ;n=8) **White bearpoppy** (Calico Hills, Spotted Range, Bird Spring Range; n=3) **Threecorner milkvetch** (Bark Bay, Mormon Mesa, Mud Wash, Virgin River, California Wash, Mud Lake, Muddy River, Toquop Wash, Weiser Wash; n=9) **Sticky wild buckwheat** (Lower Virgin River, Lower Virgin Valley, Toquop Wash, Upper Virgin Valley; n=4) **White-margined beardtongue** (Hidden Valley, Jean Lake, Ivanpah Valley, Roach Lake; n=4)
3: Control weeds in low elevation rare plant habitats in IMAs, LIMAs and MUMAs by 2020.	**Sticky ringstem** (Bitter Spring Valley, Gypsum Wash, Overton Arm; n=3) **Las Vegas bearpoppy** (Gold Butte, Government Wash, Middle Point, Sunrise Valley, Valley of Fire, Bitter Spring Valley, Gale Hills; n=7) **White bearpoppy** (Calico Hills, Bird Spring Range; n=2) **Threecorner milkvetch** (Bark Bay, Ebony Cove, Lime Cove, Mormon Mesa, Sandy Cove, Valley of Fire Wash, Mud Wash, Virgin River, California Wash, Muddy River, Weiser Wash; n=11) **Sticky wild buckwheat** (Black Mountains, Lime Wash, Overton Arm, Virgin River Confluence, Lower Virgin River, Lower Virgin Valley, Toquop Wash, Upper Muddy River, Upper Virgin Valley; n=9) **White-margined beardtongue** (Hidden Valley, Jean Lake, Ivanpah Valley, Roach Lake; n=4)

Conservation Objective	Notes on Species (and Population Groups) Addressed
4: Ensure that long term viability of low elevation rare plants in IMAs, LIMAs and MUMAs is not significantly impacted by rural development and sprawl.	**Sticky ringstem** (Muddy River; n=1) **White bearpoppy** (Calico Hills; n=1) **Threecorner milkvetch** (Mormon Mesa, Virgin River, Muddy River, Toquop Wash, Town Wash, Weiser Wash; n=6) **Alkali mariposa lily** (Calico Hills; n=1) **Sticky wild buckwheat** (Lower Virgin River, Lower Virgin Valley, Middle Muddy River, Toquop Wash, Upper Muddy River, Upper Virgin Valley; n=6) **White-margined beardtongue** (Hidden Valley, Jean Lake, Ivanpah Valley, Roach Lake; n=4)
5: Ensure that disposal of Federal lands in Clark County will not significantly impact comprehensive conservation of low elevation rare plant populations.	**Sticky ringstem** (Muddy River; n=1) **Las Vegas bearpoppy** (Las Vegas Valley; n=1) **Threecorner milkvetch** (Muddy River, Toquop Wash, Town Wash, Weiser Wash; n=4) **Pahrump Valley wild buckwheat** (Mesquite Valley; n=1) **Sticky wild buckwheat** (Middle Muddy River, Toquop Wash, Upper Muddy River, Upper Virgin Valley; n=4) **White-margined beardtongue** (Jean Lake, Ivanpah Valley, Roach Lake; n=3)
6: Manage rare plants in sandy habitats in IMAs and MUMAs for long term viability by addressing altered fire regimes (increased fire frequency and intensity) over the next century.	**Threecorner milkvetch** (Mormon Mesa, Sandy Cove, Mud Wash, Virgin River, California Wash, Mud Lake, Muddy River, Toquop Wash, Town Wash, Weiser Wash ; n=10) **Sticky wild buckwheat** (Lime Wash, Overton Arm, Lower Virgin River, Lower Virgin Valley, Toquop Wash, Upper Muddy River, Upper Virgin Valley; n=7) **White-margined beardtongue** (Hidden Valley, Jean Lake, Ivanpah Valley, Roach Lake; n=4)
7: Manage viable populations of all covered rare plants in utility corridors in IMAs and MUMAs (BLM lands), and within potential rights of way corridors at LMNRA.	**Sticky ringstem** (Lava Butte, Gypsum Wash; n=2) **Las Vegas bearpoppy** (Sunrise Valley, Valley of Fire; n=2) **White bearpoppy** (Bird Spring Range; n=1) **Threecorner milkvetch** (Mormon Mesa, Mud Lake, Muddy River, Weiser Wash; n=4) **Sticky wild buckwheat** (Upper Muddy River, Upper Virgin Valley; n=2) **White-margined beardtongue** (Jean Lake, Ivanpah Valley, Roach Lake; n=3)
8: Manage viable populations of LV bearpoppy, white bearpoppy, Pahrump Valley wild buckwheat, and white-margined beardtongue along Federal highways and county roads in MUMAs and Nye Co.	**Las Vegas bearpoppy** (Nellis Dunes, Las Vegas Valley; n=2) **White-margined beardtongue**—See **appendix 7** **White bearpoppy—See appendix 7** **Pahrump Valley buckwheat—See appendix 7**
9: Manage populations of LV bearpoppy, white bearpoppy, and Parish phacelia at Nellis to ensure positive long term viability trend in IMAs, LIMAs and MUMAs within ten years.	**See appendix 7**
10: Manage viable populations of alkali mariposa lily and white bearpoppy populations in LIMAs and MUMAs by removing wild horse and burro use and addressing impacts of rural sprawl by 2020.	**White bearpoppy** (Bird Spring Range, Indian Springs, Pahrump Valley; n=3) **Alkali mariposa lily** (Calico Hills, Lone Willow Spring; n=2)

Conservation Objective	Notes on Species (and Population Groups) Addressed
11: Protect threecorner milkvetch and sticky wild buckwheat populations along Muddy and Virgin rivers in IMAs and MUMAs from significant agricultural impacts over the next fifty years.	**Threecorner milkvetch** (Virgin River, Muddy River; n=2) **Sticky wild buckwheat** (Lower Virgin River, Upper Virgin Valley; n=2)
12: Ensure conservation management for sticky wild buckwheat, threecorner milkvetch and LV bearpoppy populations at LMNRA (IMA) above high water line and manage populations below high water line during Lake Mead low water years.	**Las Vegas bearpoppy** (Valley of Fire; n=1) **Threecorner milkvetch** (Bark Bay, Ebony Cove, Lime Cove, Sandy Cove, The Meadows, Valley of Fire Wash, Virgin River; n=7) **Sticky wild buckwheat** (Black Mountains, Lime Wash, Overton Arm, Virgin River Confluence; n=4)
13: Ensure gypsum mining will not significantly impact habitat of LV bearpoppy and sticky ringstem in IMAs and MUMAs by 2008.	**Sticky ringstem** (Gold Butte, Lava Butte, Bitter Spring Valley, Gypsum Wash; n=4) **Las Vegas bearpoppy** (Gold Butte, Sunrise Valley, Bitter Spring Valley, Gale Hills; n=4)
17: Ensure construction of the Mesquite Airport does not significantly impact viability of threecorner milkvetch and sticky wild buckwheat on public lands.	**Threecorner milkvetch** (Mormon Mesa; n=1) **Sticky wild buckwheat** (Upper Virgin Valley; n=1)

Table 57. Single species conservation objectives and the four low elevation rare plants and population groups addressed by each objective.

Conservation Objective	Population Groups Addressed
14: Conserve LV bearpoppy's remaining genetic diversity in its western populations in Las Vegas Valley (MUMAs and UMAs) by 2015.	**Las Vegas bearpoppy** (Las Vegas Valley; n=1)
15: Ensure construction and maintenance of the Ivanpah Airport does not significantly impact viability of four white-margined beardtongue populations in MUMAs and county land in southern Clark County.	**White-margined beardtongue** (Ivanpah Valley, Roach Lake; n=2)
16: Ensure that disposal of Federal lands in Nye County will not significantly impact comprehensive conservation of Pahrump Valley wild buckwheat populations.	**See appendix 7**
18: Alleviate loss of LV bearpoppy and habitat from BLM recreation management actions at Nellis (Las Vegas) Dunes.	**Las Vegas bearpoppy** (Nellis Dunes; n=1)
19: Protect viable populations of sticky wild buckwheat in Gold Butte area (Lime Wash IMA populations) and Virgin River Dunes from trespass grazing and exotic plant impacts.	**Sticky wild buckwheat** (Lime Wash; n=1)

CONSERVATION STRATEGY

STRATEGIC ACTIONS AND ACTION STEPS

Conservation strategies were developed for the nine low elevation rare plants with cooperator participation and feedback in several meetings and communications. We used TNC's Conservation Action Planning framework (see methodology in appendix 5) which links strategic actions and action steps to a specific conservation objective to maximize efficiency, feasibility, and leverage of the objective's outcome. A strategic action is a broad or general course of action undertaken by a conservation team to accomplish one or more of the objectives. Strategic actions are followed by action steps which are the principal activities necessary for implementing strategic actions to achieve the objective. Explanations of conservation strategies follow next to document viability and threat rankings being addressed, rationale for actions, information sources if applicable, questions that arose during strategy discussions, and information gaps addressed. A summary table of these conservation strategies for the nine low elevation rare plant species with factors used to help prioritize strategic actions is presented later in the next section.

The following descriptions of the objectives, with their strategic actions and actions steps, are prefaced by a summary of baseline viability, threat status, and measures of success. **Baseline viability** is categorized by "very good", "good", "fair", or "poor" indicator rankings for each of the management category groups (IMAs, LIMAs, MUMAs, mixed, and in a few instances, UMAs), by species, that would be positively affected if the given objective is carried through. The ranks for each of these groups were calculated using CAP algorithims and are a summation of viability ranks of key ecological attribute indicators of each species. The ranking definitions for each key ecological attribute indicator are summarized in Table 55.

Threat ranks ("very high", "high", and "medium") are also provided for each of the management categories, by species, that would be affected by the objective. Threat ranks were calculated using CAP algorithims. Threats and their overall ranks, are summarized by species in the individual species accounts.

Measures of success include a list of the key ecological attributes that would be positively affected by the objective, if carried through, the indicators that could be used to measure improvement in the status of each key ecological attribute, and direct measures of threat reduction.

Objective 1: Proactively protect and manage for long term viability of all populations of nine MSHCP covered rare plants on Federal lands (IMAs, LIMAs, MUMAs, and as appropriate, UMAs) in Clark County.

(Note: Objective 1a in appendix 7 addresses the application of this objective and its strategic actions to rare plant population groups occurring outside Clark County, or in areas within Clark County but beyond the scope of the MSHCP, i.e., Nellis Air Force Range)

Baseline viability rank tally: 5 good, 15 fair, 1 poor
Threat rank tally: 10 high, 11 very high

Sticky ringstem
1. IMAs: Viability fair, threats high
2. Mixed mgt. categories: Viability fair, threats high
3. UMA (MUMA portion): Viability fair, threats high

Las Vegas bearpoppy
4. IMAs: Viability good, threats very high

5. Mixed mgt. categories: Viability fair, threats high
6. MUMAs: Viability fair, threats high
7. UMA (MUMA portion): Viability poor, threats very high

White bearpoppy

8. IMAs: Viability good, threats high
9. MUMAs: Viability good, threats very high
10. UMA (MUMA portion): Viability fair, threats high

Threecorner milkvetch

11. IMAs: Viability fair, threats very high
12. Mixed mgt. categories: Viability fair, threats very high
13. MUMAs: Viability fair, threats very high

Alkali mariposa lily

14. LIMAs: Viability fair, threats high

Pahrump Valley buckwheat

15. UMA: Viability good, threats very high

Sticky wild buckwheat

16. IMAs: Viability fair, threats high
17. Mixed mgt. categories: Viability fair, threats very high
18. MUMAs: Viability fair, threats very high

White-margined beardtongue

19. IMAs: Viability fair, threats very high
20. MUMAs: Viability fair, threats very high

Parish phacelia

21. IMA/LIMAs: Viability good, threats high

Measures of success

Key ecological attributes/indicators (see table 55 for indicator definitions):

- Minimum dynamic area/sufficient acreage for characteristic species and natural habitat disturbances within historic range of variability
- Soil structure, stability and movement/Degree of soil erosion and compaction
- Soil moisture and nutrient regime/Degree of surface crust disturbance
- Characteristic native plant community/Native versus exotic plant species composition
- Fire Regime/Fire frequency and area burned

Threat reduction:

- Numbers or percentages of designated core population group acreage under conservation management

This objective addresses 63 of 138 (45.7 %) total global population groups of the nine low elevation rare plants. Improved viability status and reduced threat status would result for 28 of the gypsophyte populations, 30 of the psammophyte populations, and five of the species populations associated with hydrologic factors. Proactive conservation management is the top priority objective because it avoids management problems and impacts to species and their habitats to the greatest extent possible. Conservation management is a more effective and efficient conservation strategy in comparison to restoration or limited management options after resource and use conflicts occur. Proactive conservation reduces the need for threat abatement, viability improvement, and habitat restoration management actions, which can be costly, time-consuming, and sometimes futile. For very rare species, a lack of proactive conservation management can lead to listing and recovery actions under the ESA—a series of actions which this CMS is designed to preclude.

Proactive management to maintain stable or increasing populations (long term viability) of all nine low elevation rare plants on Federal lands in Clark County is feasible. The BLM and NPS manage the majority of populations for these species in Clark County and their existing policies and guidelines for rare plants are consistent with the objective to achieve long term viability. However, current management and human uses in rare plant core populations are in need of change. Those populations that currently are subject to higher levels of threats or have significantly reduced viability resulting from altered key ecological attributes are addressed in the other conservation objectives below to measurably improve their status. The following eight strategic actions address proactive conservation management.

A. Designate specific rare plant populations (identified below) solely for conservation management within 10 years.

Without doubt the most powerful strategic action to accomplish proactive conservation management is establishment of designated special management areas designed to create a protected network. Designation could be done administratively within Federal agencies or by legislative action. Federal agencies vary in the kinds of special designations that are used for conservation management of their resources. For example, the BLM uses their unique administrative designation of Areas of Critical Environmental Concern (ACECs), whereas Research Natural Areas (RNAs) and Special Botanical Areas (SBAs) are sometimes used by agencies and departments such as DoD, NPS, and USFS. Notably, not one population of the nine permit-covered plants presently benefits from a fully protected conservation management status on Federal lands, although some receive partial protection in special designations designed for other purposes or allowing habitat-degrading human uses (*e.g.*, utility rights-of-way and vehicular recreation in Rainbow Gardens ACEC). Because special designations effectively manage lands for a specific purpose, they typically are identified in an agency's umbrella land management document (*e.g.* a BLM RMP or NPS GMP) so amendments to these plans are needed where core areas were not previously identified for special management. This action may require a National Environmental Policy Act (NEPA) analysis by the agency.

Congressional designations are another way of creating special management areas through the legislative process (*e.g.* National Conservation Areas or NCAs). In either method of designation, management plans are written for the established area which details special management requirements and restrictions; thus, protective conservation management for rare plants would be detailed in agency plans for the areas established (or revised) as rare plant ACECs, SBAs, RNAs, or other by this strategy. We included four action steps to accomplish establishment of a low elevation rare plant conservation network through special management designation:

1. Initiate required agency planning steps as soon as possible to ensure an efficient establishment process for special management designations.
2. Establish ACECs for rare plant conservation management on BLM lands (requires RMP amendment).
3. Investigate establishing SBAs or RNAs on NPS lands (*e.g.* Virgin River Dunes and Sandy Cove) where needed.
4. If administrative establishment process reaches an impasse, investigate legislative avenues of conservation designation to protect the identified core rare plant habitats.

About 48 percent (n=67) of all population groups for the nine rare plants occur in Clark County, and among those 60 percent (n=40) are recommended for special protective designation with inclusion of their core population areas at a minimum (specific boundaries will be identified during the establishment process). The groups were selected based on their current viability and threat rankings, and partial protective status for some (table 58). The forty populations currently fall into all three MSHCP management categories on Federal Lands—IMAs, LIMAs, and MUMAs in Clark County. These population groups are thought to have resiliency to recover from current threats and compromised viability status, and as such they are restorable. Eight population groups currently are within existing ACECs at least in part, which were designated for critical desert tortoise habitat or for purposes including rare plant protection among others. Extension of these designated areas to add rare plant habitat requirements or expansion of purpose to more specifically protect rare plant patterns and processes for sustainability would contribute efficiencies for a protected network. Fourteen recommended population groups presently overlap wilderness areas at least in part, and although management for wilderness sometimes poses problems for conservation management it often is complementary by limiting habitat degrading modes of access and excluding some human uses.

Table 58 also includes seven population groups on BLM lands in Nye County and seven other population groups primarily on DoD lands in Clark County for four species with few options for protective designation under the scope of the MSHCP. The four rare plants are white bearpoppy, white-margined beardtongue, Pahrump Valley wild buckwheat, and Parish phacelia. Proactive protection for these population groups will require the efforts of FWS and BLM, working with Nye County and Department of Defense, but they are included in table 58 (for a total of 54) to show a comprehensive list of all low elevation rare plant population groups recommended for special designations.

Table 58. Low elevation rare plant populations on Federal lands recommended for special protective designation status to create a rare plant conservation network. Plants are ordered by species within habitat categories. Bold font indicates that the population group occurs at least in part within an existing special designation (ACEC, NCA, or Wilderness Area—WA). *Italic* font indicates that the population group overlaps at least in part with one or more other population groups on this list.

Plant Taxon	Rare Plant Population Group Name	Primary Jurisdiction
Sticky Ringstem *Anulocaulis leiosolenus* var. *leiosolenus*	*Bitter Spring Valley*	NPS and BLM
	East Black Mountains	NPS
	Gold Butte	BLM
	Gypsum Wash	BLM
	Lava Butte	BLM
	Overton Arm	NPS
	West Black Mountains	NPS
Las Vegas Bearpoppy *Arctomecon californica*	*Bitter Spring Valley*	NPS and BLM
	CTA portion of Las Vegas	BLM
	Gale Hills	BLM
	Gold Butte	BLM
	Middle Point	NPS
	Sunrise Valley	BLM
	Valley of Fire	NPS
	White Basin	BLM
White Bearpoppy *Arctomecon merriamii*	***Calico Hills***	BLM
	Desert Range	DoD
	North Desert Range	DoD
	Pintwater Range	DoD
	Specter Range	BLM (Nye Co.)
	Spotted Range	DoD and FWS
	Stewart Valley	BLM (Nye Co.)
	Three Lakes Valley	DoD

Plant Taxon	Rare Plant Population Group Name	Primary Jurisdiction
Threecorner Milkvetch *Astragalus geyeri* var. *triquetrus*	*Bark Bay*	NPS
	California Wash	BLM
	Ebony Cove	NPS
	Lime Cove	BLM
	Logandale	BLM
	Mormon Mesa	BLM
	Mud Wash	BLM
	Sandy Cove	NPS
	Toquop Wash	BLM
	Valley of Fire Wash	NPS
	Weiser Wash	BLM
Sticky Wild Buckwheat *Eriogonum viscidulum*	***Bitter Ridge***	BLM
	Black Mountains	NPS
	Lime Wash	NPS
	Overton Arm	NPS
	Toquop Wash	BLM
	Upper Muddy River	BLM
	Virgin River Confluence	NPS
White-margined Beardtongue *Penstemon albomarginatus*	**Hidden Valley**	BLM
	Ivanpah Valley	BLM
	Jean Lake	BLM
	North of Ash Meadows	BLM (Nye Co.)
	Roach Lake	BLM
	Rock Valley	BLM (Nye Co.)
Pahrump Valley Wild Buckwheat *Eriogonum bifurcatum*	*(Nevada) Pahrump Valley*	BLM (Nye Co.)
	Stewart Valley	BLM (Nye Co.)
Parish Phacelia *Phacelia parishii*	Indian Springs Valley	DoD
	Pahrump Valley	BLM (Nye Co.)
	Three Lakes Valley	DoD
Alkali Mariposa Lily *Calochortus striatus*	***Calico Hills***	BLM
	Lone Willow Spring	BLM

The total number of population groups by species recommended for proactive protective designation varies among the nine taxa from two for Pahrump Valley wild buckwheat and alkali mariposa lily to 11 for threecorner milkvetch and they account for about 39% of all the known global populations for these taxa. Eighteen of the 54 are non-overlapping single species population groups with nine of them in Clark County. However, among the other groups (36 total with 30 in Clark County) overlapping population boundaries define 14 complexes for the low elevation rare plants—12 in Clark County with one of these on DoD and two in Nye County. Accordingly, establishment of new protective designations are effectively reduced from a total of 32 population groups (14 complexes and 18 non-overlapping species areas) with 21 in Clark County under the scope of the MSHCP (11 complexes and ten non-overlapping species areas). Figure 32 is a map showing recommended population groups for special conservation management designation centered on Clark County. Implementing this strategic action and ensuring conservation management within designated areas would go far in accomplishing long term viability for the nine low elevation rare plants. It is readily measured by tracking numbers or percentages of designated core population group acreage in conservation management.

Low Elevation Rare Plant Population Groups in Clark County Recommended For Special Protective Designation Status

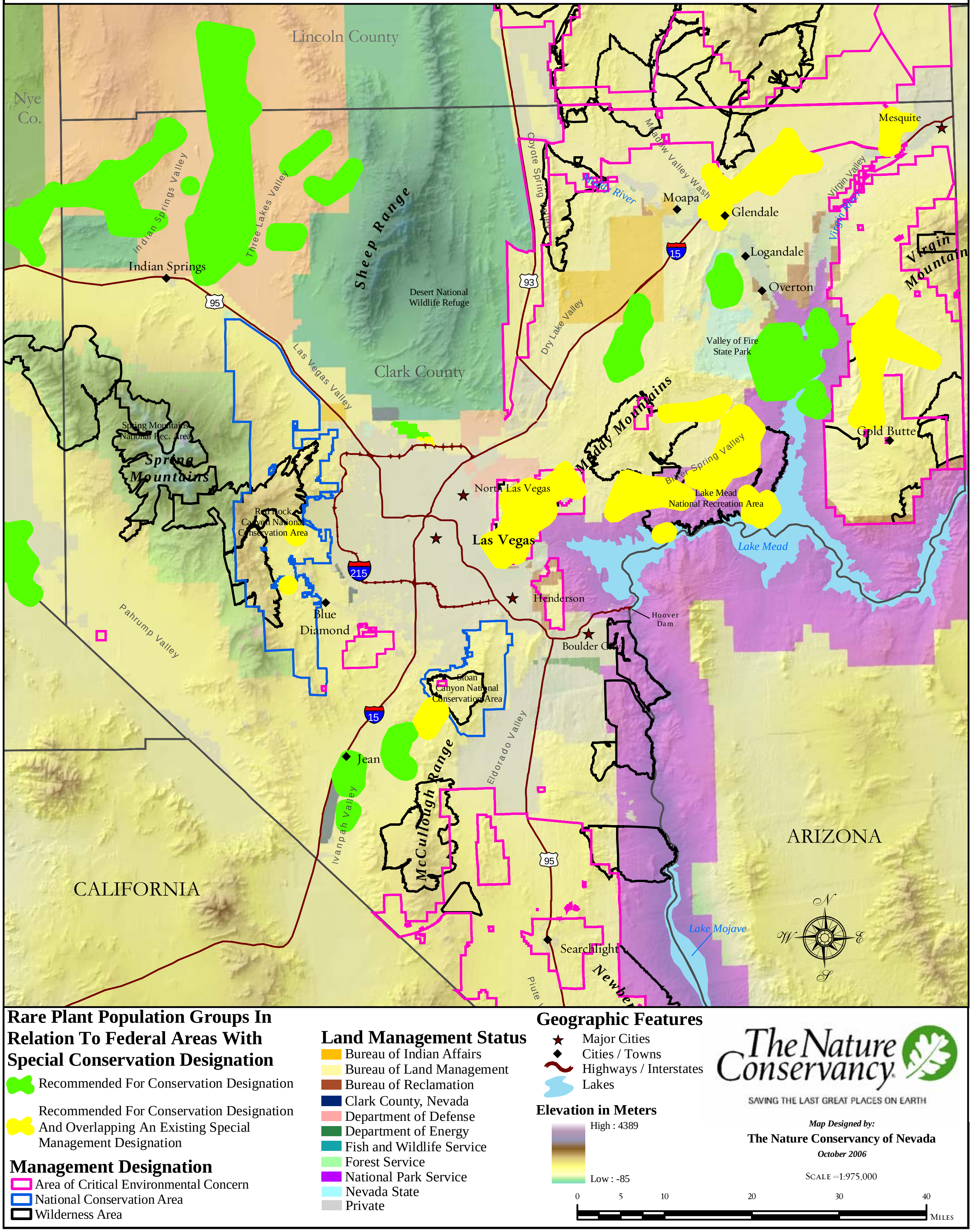

Figure 32. Low elevation rare plant population groups recommended for special protective designation status centered in Clark County.

Table 59 is a summary of the recommended low elevation rare plant conservation network by species and it can be used to measure incremental progress as well as fulfillment of the overall objective by 2016.

Table 59. Summary of each species global rare plant population groups recommended for special protective designation status to create a rare plant conservation network. Plants are ordered by species within habitat categories. For Las Vegas bearpoppy only the northernmost portion of the historic Las Vegas Valley population group is recommended for protection.

Plant Name	Number of Known Global Population Groups	Number (percent) of Known Clark County Population Groups	Number of Clark County Population Groups on Federal Lands	Number of Population Groups Recommended for Special Designation	Number (percent) of Population Groups Recommended for Conservation Network within Scope of MSHCP
Sticky ringstem, *Anulocaulis leiosolenus* var. *leiosolenus*	17	8 (47.1%)	7	7	7 (41.21%)
Las Vegas bearpoppy, *Arctomecon californica*	13	10 (76.9%)	10	8	8 (61.5%)
White bearpoppy, *Arctomecon merriamii*	33	12 (36.4%)	11	8*	1 (3.0%)
Threecorner milkvetch, *Astragalus geyeri* var. *triquetrus*	17	16 (94.1%)	14	11	11 (64.7%)
Sticky wild buckwheat, *Eriogonum viscidulum*	13	11 (84.6%)	10	7	7 (53.8%)
White-margined beardtongue, *Penstemon albomarginatus*	10	4 (40.0%)	4	6*	4 (40.0%)
Pahrump Valley wild buckwheat, *Eriogonum bifurcatum*	4	1 (25.0%)	0	2*	0
Parish phacelia, *Phacelia parishii*	16	2 (12.5%)	2	3*	0
Alkali mariposa lily, *Calochortus striatus*	15	3 (20.0%)	2	2	2 (13.3%)
Total	138	67 (48.6%)	60	54	40 (29.0%)

*Includes areas beyond scope of the MSHCP in Nye County or on DoD in Clark County (n = 7, 2, 2, and 3, respectively).

B. Coordinate MSHCP communications, funding priorities, implementation projects, monitoring protocols, and adaptive management programs among all existing and potential low elevation rare plant conservation partnerships and collaborators.
1. Ensure botanical expertise is included on the MSHCP adaptive management science team.
2. Develop procedures within DCP to regularly coordinate Environmental Planning with Comprehensive Planning and the County's Master Plans.

Successful implementation of the low elevation rare plant CMS hinges on coordination and communication of funding priorities for specific restoration or management projects, filling data gaps through research and monitoring, using comparable monitoring protocols among cooperating agencies, and putting adaptive management into practice. The cooperating agencies for the CMS have a large number of existing and potential partnerships and collaborators that can assist with various aspects of implementing the CMS (table 60). Their participation can add value to resources available to Clark County and CMS agency cooperators. DCP can coordinate among MSHCP signatories for MSHCP-covered species, so they may want to involve the planning departments of the other permittees (*e.g.* the Planning and Zoning Department of the City of North Las Vegas). This strategic action ensures that coordination and communication flows among all appropriate entities such that CMS implementation benefits from their involvement. It is measured by regular verbal, written, or in person contacts among various participants.

We included two specific action steps for effective coordination of the rare plant CMS. The first addresses a need for explicit botanical guidance and expertise for science and adaptive management topics relevant to the MSHCP. As DCP evolves to improve its service to the MSHCP, newly formed teams or committees assisting implementation of the low elevation rare plant CMS should include or have the means to tap botanical expertise, and conversely, science teams should be able to provide botanical guidance advice, for example on rare plant management issues and monitoring protocols. The second action step ensures that appropriate communications regarding the MSHCP among Clark County planning units, as well as planning units of other MSHCP participants, are maintained and integrated into county-wide planning documents so that impacts to plant populations and habitats are first avoided and secondarily mitigated appropriately for no net unmitigated loss.

Table 60. Preliminary list of existing and potential conservation partners for the low elevation rare plant conservation management strategy (not meant to be all inclusive).

Conservation Partnerships
Friends of Gold Butte
Friends of Red Rock Canyon
Friends of Sloan Canyon
Great Basin Institute
Joint Fire Science Program
Las Vegas Springs Preserve
National Fish and Wildlife Foundation
Nevada Department of Wildlife
Nevada Native Plant Society
Nevada Wilderness Coalition
Outside Las Vegas Foundation
Red Rock Canyon Interpretive Association
Rivers, Trails and Conservation Assistance Program
Southern Nevada Lands Partnership (= BLM, FWS, NPS, FS, PLI, OLVF)
UNLV Public Lands Institute
Virgin River Conservation Partnership

C. Develop a Clark County Rare Plant Scorecard website to highlight annual population status tracking, and investigate its potential as a web log to be a visible influence on removing all critical threats to rare plants and habitats.
1. Identify a webmaster to develop, promote, and maintain a website.
2. In addition to tracking population status on lands managed by MSHCP cooperators, include populations managed by Nellis at NAFB and NAFBGR.

The purpose of a rare plant scorecard website is for public outreach and information sharing on the goals and progress of the low elevation rare plant CMS. It would provide updates of plant species status and trend in a general "scorecard" fashion and would be updated regularly as new information is obtained. Unlike web sites maintained by NatureServe, Nevada Natural Heritage Program, and the resource management agencies, this web site is not meant to be a database of detailed status and trend information. Instead, this website would provide specific information on the status and effectiveness of rare plant conservation strategy implementation. Its potential as a web log could provide a means of public participation—a component element of any CMS, as well as a measure of the effectiveness and use of the scorecard website for public outreach; however, this is an exploratory recommendation because of maintenance, security, and other issues. Although the website would likely have little direct effect on meeting low elevation rare plant goals (identification of new populations by a responsive public is possible, although unlikely), it could indirectly positively influence public perceptions regarding rare plant conservation management and assist in maintaining stable rare plant populations. Development and maintenance of the website could be shared with other similar website endeavors to maximize efficiency and use of limited resources rather than being an independent website operation.

Two action steps are associated with this strategic action. The first action step is an example of where a conservation partner or the lead agency cooperator might seek efficiencies of staff and funding. The purpose of including rare plant populations managed by Nellis is to track and understand the status of all populations on Federal lands in the County.

D. Complete all management objectives in BLM's Las Vegas bearpoppy Habitat Management Plan by 2020.
1. Accomplish all conservation actions listed in the HMP.
2. Review the 1998 HMP and update management objectives, if needed.

The two stated objectives in BLM's Las Vegas Bearpoppy Habitat Management Plan are to 1) maintain or improve 45,750 acres of habitat on four management areas for fifty years while taking protective action at an additional population; and 2) allow no net loss of bearpoppy habitat on public land from Federally-approved projects through mitigative actions. The four management areas include Sunrise, Lovell Wash, Bitter Spring, and Gold Butte while the additional population is at Apex. Because these objectives were set nearly ten years ago, a review of them will inevitably highlight some needed changes to meet current objectives of the CMS (*e.g.*, additional populations on public lands are considered viable populations in need of targeted conservation action today). Nine planned actions are listed in the HMP including: reclamation and rehabilitation; potential habitat acquisition; law enforcement; GPS roads, trails, and rights-of-way; update and maintain GIS database; public information; establish monitoring plots and frequency of reading; road designations and signing; and, management plan for Sunrise area. To update and complete the conservation actions BLM needs 1) institutional leadership with assigned responsibility, authority, accountability, and sufficient time to review and implement conservation actions; 2) support from an internal team (or one dedicated lead person) to accomplish plan objectives; and, 3) sufficient operational funding.

E. Document (institutionalize) and continue to implement LMNRA's rare native plant program.
1. Identify NPS staff with primary responsibility to fully implement and document rare plant conservation on LMNRA.
2. Develop and implement a written plan with specific objectives and timeframes for inventory, monitoring, threat abatement, and effectiveness monitoring protocols.

Lake Mead NRA has had a rare native plant program for many years, and although many successful projects have been implemented by the program on behalf of rare plants, it has not been institutionalized with appropriate documentation to assure its standing and continuation over time. The program conducts rare plant inventorying, monitoring (including some on behalf of BLM), and threat abatement tasks, such as weed treatments in rare plant habitats and thus, is essential for appropriate management of rare plant resources within Lake Mead NRA. This program bears much of the responsibility of implementing specific projects for sticky ringstem, Las Vegas bearpoppy, threecorner milkvetch, and sticky wild buckwheat populations on Federal land to meet threat abatement and viability enhancement objectives in the rare plant CMS. Effectiveness monitoring protocols for the four plants at Lake Mead NRA need revision to improve power analyses and gain efficiency of measures. Although it receives informal backing by current administration and dedicated leadership, the program needs to be incorporated as a structured and formal Lake Mead NRA program to guarantee capacity (both leadership and staff) and resources (operational funding) in the event of future changes in priorities that could jeopardize its standing and benefits to rare plant adaptive management. Each aspect of the program (inventorying, monitoring, protection, and restoration) would benefit from written documentation to explain the scope, purpose, protocols, responsibilities, and any additional sections relevant to the institution for program transparency.

F. Continue botanical surveys on Federal lands to better understand distributions and abundance of low elevation rare plant populations.
1. Identify appropriate opportunities for annual surveys from priority survey gap areas based on projected development in the County.
2. Coordinate surveys on an annual basis by agency or contract biologists.

An increased understanding of low elevation rare plant distributions, abundance, status, and trend to make informed management decisions is addressed in this strategic action and steps. Many areas have been identified by experts or in the literature for their need to be surveyed for rare plant occurrences. Additionally, developing and testing models of apparently suitable habitats could identify more areas in need of surveying with less bias from traditional distribution assumptions. Nonetheless, suitable habitats for the nine low elevation rare plants for potential survey are described for each species in individual assessments when information was obtained. Addressing the need for predictive distribution mapping with appropriately-scaled soils and vegetation maps (and other spatial layers where available) would assist with survey gap analyses. Continued botanical surveys by respective agencies on Federal land will help fill these gaps in rare plant knowledge within Clark County (and beyond). For any given growing season, climate conditions may or may not be met for appropriateness of conducting botanical surveys for certain species. Regularly evaluating appropriate opportunities for annual surveys ensures that ongoing botanical surveys assist in filling distribution and abundance knowledge gaps in the most efficient and effective manner. Furthermore, repeat surveys of known populations on a regular basis are necessary to update status, assess trend, and (re)evaluate threats to plants and habitats. Agency staff may choose to contract biologists to ensure that this step is accomplished regularly and effectively.

G. Investigate a Low Elevation Rare Plant Conservation Fund to mitigate unavoidable impacts to plants and habitats on Federal lands.

On occasion, Clark County Department of Public Works projects, such as roads and utility rights of way development, occur on rare plant habitat on Federal lands where they must comply with the MSHCP no-net unmitigated loss policy. Many of these projects result in the permanent loss of plants and habitat or require periodic maintenance that eventually degrades rare plant habitat such that it no longer has ecological integrity. For previous Department Public Works projects affecting habitat on BLM land, compensation from Clark County was worked out through BLM. Setting up a mitigation fund to hold compensation monies for unavoidable impacts to rare plant habitat would benefit both Clark County and CMS agency cooperators by providing another mechanism to meet no-net unmitigated loss, however, this is not something that DCP can do. Currently BLM does not have the appropriate financial mechanisms or staff to hold and track funds provided as mitigation for the loss of rare plant habitat. Although paying compensation for unavoidable impacts is the least desirable option to achieve no-net unmitigated loss, in some cases it may be appropriate to designate and hold funds until a mitigation project is designed or adequate funds are pooled to benefit the impacted rare plant. NDF, FWS, or conservation partners could (co)lead or take an assistance role in administration of the mitigation fund.

H. Conduct applied research on the ecology of insect pollinators of all nine low elevation rare plants.

This strategic action addresses a huge uncertainty regarding pollination ecology of the nine low elevation rare plants. The two bearpoppy species are the only ones with knowledge of specific pollinators (some of which are rare and endemic themselves), yet even for these species there is little knowledge of pollinator ecology which could better inform management of habitat pattern and process issues related to minimum dynamic area. Minimum dynamic area for viable functioning plants may be very different than minimum dynamic area for pollinators.

I. Develop an interagency geospatial database to track cumulative plant and habitat loss and disturbance on Federal lands.
1. Coordinate Clark County's database for tracking direct take in UMAs with the interagency database for comprehensive tracking.

Tracking cumulative rare plant and habitat loss and disturbance on Federal lands in Clark County is necessary to meet the overarching goals of the MSHCP. Currently, each cooperating agency is responsible for tracking loss and disturbance within their management purview, yet it is often done haphazardly within and inconsistently across Federal jurisdictions. The purpose of an interagency geospatial tracking system is to make it orderly, consistent, and timely. A lead agency or entity (conservation partner) would need to be identified to take on the role of hosting an interagency database. Coordination with the County's database tracking of direct take on private lands and NDF's tracking of Nevada critically endangered plants would provide a comprehensive assessment of rare plant loss and disturbance across the entire County.

Objective 2: Manage viable populations of sticky ringstem, Las Vegas bearpoppy, white bearpoppy, threecorner milkvetch, sticky wild buckwheat, white-margined beardtongue, and Parish phacelia in IMAs, LIMAs and MUMAs by removing significant casual OHV impacts by 2020.

(Note: Objective 2a in appendix 7 addresses the application of this objective and its strategic actions to rare plant population groups occurring outside Clark County, or in areas within Clark County but beyond the scope of the MSHCP, i.e., Nellis Air Force Range)

Baseline viability rank tally: 10 fair, 3 good
Threats: 12 high, 1 very high (31 population groups)

Sticky ringstem
1. Mixed mgt. categories: Viability fair, threats high (Bitter Spring Valley, Gypsum Wash, Overton Arm)

Las Vegas bearpoppy
2. IMAs: Viability good, threats very high (Gold Butte, Government Wash, Sunrise Valley, Valley of Fire)
3. Mixed mgt categories: Viability fair, threats high (Bitter Spring Valley, Gale Hills)
4. MUMAs: Viability fair, threats high (Nellis Dunes, White Basin)

White bearpoppy

5. IMAs: Viability good, threats high (Calico Hills, Spotted Range)
6. MUMAs: Viability good, threats high (Bird Spring Range)

Threecorner milkvetch

7. IMAs: Viability fair, threats high (Bark Bay, Mormon Mesa)
8. Mixed mgt. categories: Viability fair, threats high (Mud Wash, Virgin River)
9. MUMAs: Viability fair, threats high (California Wash, Mud Lake, Muddy River, Toquop Wash, Weiser Wash)

Sticky wild buckwheat

10. Mixed mgt categories: Viability fair, threats high (Lower Virgin River, Lower Virgin Valley)
11. MUMAs: Viability fair, threats high (Toquop Wash, Upper Virgin Valley)

White-margined beardtongue

12. IMAs: Viability fair, threats high (Hidden Valley)
13. MUMAs: Viability fair, threats high (Ivanpah Valley, Jean Lake, Roach Lake)

Measures of success
Key ecological attributes/indicators (see table 55 for indicator definitions):

- Soil structure, stability, and movement/Density of vehicle tracks and degree of soil erosion or compaction
- Soil moisture and nutrient regime/Degree of surface crust disturbance
- Characteristic native plant community/Native versus exotic plant species composition
- Habitat destruction and loss/Sufficient acreage for characteristic species and natural habitat disturbances within historic range of variability

Threat reduction:

- Reduction in numbers or percentages of incursions

Casual off highway vehicle use impacts more low elevation rare plant species populations and their habitats than any other threat in Clark County, especially for the rare plants defined by gypsum, sand, and spring associated alkaline substrates. It is the highest priority critical threat which must be reduced across low elevation landscapes to ensure stable populations and long term viability for 36 population groups in Clark County (with high to very high threat rankings and including five Nellis population groups) and an additional 25 population groups on Federal land in adjacent Nevada counties. Casual OHV use will result in direct damage to rare plants and biological soil crusts leading to loss of individuals; decreased soil stability, infiltration, water retention, and resistance to wind and water erosion; increased opportunity for exotic plant invasions leading to altered plant community composition and structure; decreased resilience of plants to drought; loss of soil, soil moisture, and nutrients; and, increased dust accumulation on plants leading to decreased plant growth.

BLM is the main cooperator involved in tackling this objective because most casual vehicle use occurs on public lands whether they are adjacent to rural development (see objectives 4 and 10) or in more remote regions of the BLM Las Vegas District (*e.g.*, Gold Butte). NPS on Lake Mead NRA also has challenges related to casual and illegal OHV use.

A. Restore designated closed roads and trails in rare plant habitat in IMAs within five years of closure.
1. Seek commitment of Southern Nevada Restoration Team (SNRT) on an annual basis to accomplish road restoration priorities for low elevation rare plant habitat.
2. Implement public education program for habitat protection/road closure issues using multiple tools (brochures, signage, public service announcements, ads).
3. Install closure signs and vehicle barriers at access points to closed roads and trails.

4. Increase law enforcement and educational/informational patrols relative to increasing human population and increasing incursions to ensure that closed roads and trails stay closed.

BLM designated closed roads and trails in the 1998 Las Vegas District RMP and has made some progress on their closed road restoration goal back to the 1998 baseline. This strategic action addresses the need to ensure timely progress in and adjacent to rare plant habitat, especially in areas with the highest category of MSHCP management (*e.g.* Rainbow Gardens and Gold Butte). Initial restoration may necessarily focus on closure to protect rare plant habitat from further vehicle damage and initiate the natural restoration process. However, ultimate restoration should aim to ensure improving viability indicator rankings incrementally to good or very good which may involve active ecological restoration techniques.

Because the extent of road proliferation since the 1998 RMP has been high (which is being documented by a series of BLM road proliferation spatial layers) , the action steps highlight the need to increase staffing, leadership experience, institutional support, and operational funding of SNRT, or other potential restoration entities, to meet the stated objective timeframe by 2020. Law enforcement and public education focused specifically on rare plant habitats are important supporting action steps. A public education program for rare plant needs is listed as supporting strategic action steps for several subsequent strategic actions (see also 2D, 2E, 3D, 4B, and 6C); thus, efficiencies for this program's effectiveness are encouraged to bolster overall rare plant CMS goals. Measures relate directly back to indicators of key ecological attributes, along with additional measures, such as capacity relative to human population growth in the County, number of public service announcements, and warning indicators (*e.g.* tracking number of incursions).

B. Establish a transportation network on MUMAs by 2010 to identify open roads in rare plant habitats using 1998 RMP baseline.
1. Complete the BLM road inventory and mapping system depicting open and closed roads for monitoring continued road proliferation and as a means of producing public information products
2. Restore closed roads, add barriers and signage.

To effectively address casual OHV use on public lands, we identified the need for BLM to establish a transportation network so that many of the roads and trails created since 1998 on MUMAs can be designated closed and restored as they have on IMAs. Road proliferation on MUMAs has been very high across the Las Vegas District so this strategic action and accompanying action steps addresses 31 population groups throughout Clark County and parallels the strategy for IMAs.

C. Maintain law enforcement in closed areas to protect rare plant habitats on Federal lands.
1. Investigate increasing violation fees in rare plant habitats and ensure their use for rare plant habitat restoration.
2. Set up a toll-free phone line program for violations reporting by the public.

With limited staffing, the Federal land managing agencies and local governments have little control over their law enforcement priorities with respect to urgent (*e.g.* public safety) versus important (conservation) work, since matters of public safety will always come first. However finding the means to designate enforcement personnel to specific problem areas near or within rare plant habitats may help. We followed recommendations of the County's study of law enforcement needs (Jones and Stokes 2003) to investigate increasing violation fees, and we place an emphasis on investigating an increase as well as an earmark for use in rare plant restoration. This will likely require a policy change and needs to be assessed for feasibility by the cooperating Federal agencies since obstacles may reduce its priority. The toll-free phone program is suggested to encourage out of area public participants who may be visiting Federal lands in Clark County.

D. Implement a public education campaign about road closures and rare plant habitat protection.

This strategic action emphasizes the supporting role of public education in abating threats to low elevation rare plants and their habitats from casual OHV use. See conservation strategies 2A, 2E, 3D, 4B and 6C to link it with other threats for public education program efficiency.

E. Continue efforts on the ongoing Lake Mead NRA closed road restoration program.
1. Increase NPS law enforcement activities in rare plant habitats.
2. Increase the rate of SNRT road restoration activities at Lake Mead NRA to ensure that road restoration in rare plant habitats is accomplished within the specified time frame for this objective.
3. Install closure signs and vehicle barriers at access points to closed roads and trails.
4. Implement public education program for habitat protection/road closure issues at Lake Mead NRA.

Like BLM, Lake Mead NRA has a problem with casual OHV use although it is less pervasive on NPS land. This strategic action addresses 12 rare plant populations at Lake Mead NRA with decreased viability rankings and high OHV threat ranks. Supporting action steps are similar to those for BLM above. For efficiency of the public education program see conservation strategies 2A, 2D, 3D, 4B and 6C which links it with other areas in Clark County and other threats.

F. Maintain a law enforcement program concentrating on rare plant habitats at Desert National Wildlife Refuge (DNWR) Complex.
1. Intensify current law enforcement efforts on DNWR commensurate with current and future levels of impact.

This strategic action addresses four rare plant populations with decreased viability rankings and high casual use threat ranks. Casual use by OHV enthusiasts is an issue in rare plant habitat at DNWR with expected increases in unauthorized use as Las Vegas continues to grow towards it. The one supporting action step states the need to incrementally adjust law enforcement levels as OHV threats change.

Objective 3: Control weeds in low elevation rare plant habitats in IMAs, LIMAs and MUMAs by 2020.

(Note: Objective 3a in appendix 7 addresses the application of this objective and its strategic actions to rare plant population groups occurring outside Clark County, or in areas within Clark County but beyond the scope of the MSHCP, i.e., Nellis Air Force Range)

Baseline viability rank categories: 11 fair, 3 good
Threat rank categories: 4 medium, 9 high, 1 very high (38 population groups)
Sticky ringstem
1. Mixed categories: Viability fair, threats medium (Bitter Spring Valley, Gypsum Wash, Overton Arm)

Las Vegas bearpoppy
2. IMAs: Viability good, threats medium(Gold Butte, Government Wash, Middle Point, Sunrise Valley, Valley of Fire)
3. Mixed categories: Viability fair, threats medium (Bitter Spring Valley, Gale Hills)

White bearpoppy
4. IMAs: Viability good, threats high (Calico Hills)
5. MUMAs: Viability good, threats high (Bird Spring Range)

Threecorner milkvetch
6. IMAs: Viability fair, threats high (Bark Bay, Ebony Cove, Lime Cove, Mormon Mesa, Sandy Cove, Valley of Fire Wash)
7. Mixed mgt. categories: Viability fair, threats high (Mud Wash, Virgin River)
8. MUMAs: Viability fair, threats high (California Wash, Muddy River, Weiser Wash)

Alkali mariposa lily
9. LIMA: Viability fair, threats medium (Calico Hills, Lone Willow Spring)

Sticky wild buckwheat
10. IMAs: Viability fair, hreats high (Black Mountains, Lime Wash, Overton Arm, Virgin River Confluence)
11. Mixed mgt. categories: Viability fair, threats high (Lower Virgin River, Lower Virgin Valley)
12. MUMAs: Viability fair, threats high (Toquop Wash, Upper Muddy River, Upper Virgin Valley)

White-margined beardtongue
13. IMAs: Viability fair, threats high (Hidden Valley)
14. MUMAs: Viability fair, threats very high (Ivanpah Valley, Jean Lake, Roach Lake)

Measures of success

Key ecological attributes/indicators (see table 55 for indicator definitions):
- Characteristic native plant community/Native versus exotic plant species composition
- Soil structure, stability and movement/Degree of soil erosion and compaction
- Soil moisture and nutrient regime/Degree of surface crust disturbance
- Fire Regime/Fire frequency and area burned

Threat reduction:
- Number of population groups treated on an annual basis.

This objective addresses 38 population groups with fair or good viability and subject to medium, high or very high threats. Invasive species pose a region-wide problem requiring conservation actions at both local and landscape scales to achieve sufficient control in the targeted timeframe. Weeds that have become problems in low elevation rare plant habitats include Mediterranean grasses: red brome (*Bromus madritenis* ssp. *rubens*) and Mediterranean grass (*Schismus barbata*); species of annual mustards: Sahara mustard (*Brassica tournefortii*), tall whitetop (*Lepidium latifolium*), and African malcomia (*Malcomia africana*); other annual increasers: Russian thistle (*Salsola iberica*), Russian knapweed (*Centaurea repens*), and woolly plantain (*Plantago ovata*); and saltcedar (*Tamarix ramosissima*). They compete and replace native plants, leading to loss of individuals and eventual changes (ultimately type conversion) in composition and structure of specific habitats, and increased frequency, intensity, extent, and timing of fire from increased flammability or continuity of fuels. Sandy rare plant habitats and their matrix low elevation systems are most affected of the rare plant habitat groups. Mediterranean grasses and other annual forbs are prevalent weeds risking habitat type conversion for matrix systems surrounding threecorner milkvetch, sticky wild buckwheat, and white-margined beardtongue. Exotic plants have made recent inroads on gypsum habitats, which historically remained weed-free, but now are in need of early warning monitoring to identify incipient infestations.

A. Identify weed priorities on rare plant habitat within the weed program for Federal lands in Clark County.
1. Create a rare plant steering team or technical advisory group as soon as possible comprised of local agency staff to communicate and coordinate weed treatment priorities for rare plant habitats to SNRT and other affected parties with the weed program.
2. Communicate and coordinate weed treatment and other priorities with other professional botanists, scientists, resource specialists, and managers as needed.
3. Set specific project priorities and timeframes for inventorying, implementation projects, and monitoring programs in rare plant habitat.

There was a sense of urgency among cooperating agency botanists to prioritize rare plant populations for follow-up weed treatment and to coordinate with weed program entities (see below). This could be accomplished via a newly formed rare plant technical advisory group including key Federal botanists. The weed program would aid rare plant protection efforts by concentrating available time on highest rare plant habitat weed priorities (singled out from general habitat weed priority needs). The urgency is expressed by acting within a year because of perceived explosive infestation rates in some rare plant habitats. Top priority areas preliminarily identified include Lake Mead shorelines (Sandy Cove, Overton Beach), Virgin River Dunes, Muddy River and Ivanpah Valley. Communication and coordination would increase overall effectiveness of weed program by identifying specific rare plant weed-related projects for annual plans leading to shared weed treatment efforts. The third step acts on rare plant priorities by implementing and monitoring specific projects.

B. Support the Weed Sentry Program's mapping, early detection, and incipient infestation control program.
1. On an annual basis, ensure agencies prioritize and fully implement the program.
2. On an annual basis, coordinate among agencies and across state lines to identify incipient infestation areas.

Continuing facilitation and expansion of the Weed Sentry Program is an important strategic action to support their efforts in rare plant habitat early detection and incipient infestation control. Their role and activities complement Clark County's SNRT. Designated staffing and management support for operations will be necessary to implement this program and effectively coordinate across jurisdictional boundaries (*e.g.* across state lines at Lake Mead NRA).

C. Beginning in 2007, and annually thereafter, empower and facilitate the efforts of SNRT to facilitate coordination of weed treatments among the Weed Sentry Program, Exotic Plant Management Team (EPMT), and others.
1. Develop an integrated weed management program for rare plant habitats.
2. Identify a NEPA team to facilitate environmental approval of treatment projects.
3. Identify researchers to study impacts of chemical treatments on rare plants and habitats and to research alternative control methods.
4. Continue/increase inventorying, treatment, and monitoring programs to ensure that weed treatments are effectively controlling existing infestations and preventing new ones.
5. Develop quality control mechanisms for treatments, including habitat restoration, and effectiveness monitoring program.

This strategic action concentrates on implementing weed treatments to directly abate the threat of invasive exotic plant competition in rare plant habitats and their surrounding dynamic landscapes. An integrated weed management program for rare plant habitats would select, assimilate, implement, and measure effective weed control methods. The action steps identify tasks needed to accomplish aspects of weed abatement.

D. Implement a public education program to minimize the spread of weeds and decrease human-caused fire ignitions.

The need to implement a weed education program as soon as possible was identified to specifically address low elevation rare plant habitats on Federal land with identified weed issues in the County. Fewer sources of weed infestation and fire ignitions would simplify the work involved in weed control. Targeting appropriate audiences for behavioral changes by increasing their understanding of weed vectors, explaining impacts to rare plant habitats, and relating increased fire in the Mojave Desert to weed cover could help achieve this overall conservation strategy. It may be extremely difficult, if not impossible, to measure direct benefits of an education program for rare plants and weed issues, yet it would be a deficient strategy not to include a public education action with prospective value to globally restricted plant populations. This strategic action should be linked to other strategies involving public education (2A, 2D, 2E, 4B, and 6C) for efficiency.

E. Review effectiveness monitoring of projects and make adaptive management adjustments to programs as needed.

To determine whether the strategies are working as planned effectiveness monitoring, identifying appropriate indicators, adapting management, and documenting lessons learned are important ongoing actions. All conservation strategies in this rare plant CMS need solid, if not simple measures of effectiveness, but it was emphasized for this weed abatement conservation strategy as a separate action because of the looming magnitude and large scale of this threat.

F. Coordinate with all affected agencies (USGS, NPS, BoR, BLM) to develop a multi-pronged approach in finding a solution to access the Virgin River dunes and manage weeds in rare plant populations by 2008.
1. Identify potential alternative access which would not involve crossing private land currently denying access.
2. Acquire private land access from a willing seller or develop an easement access agreement.
3. Work with local weed program to negotiate reasonable access across private land in exchange for weed control or other service on private land.

Cooperating agency botanists highlighted the lack of access to Virgin River Dunes as a special case exacerbating the threat to rare plants by invasive exotics. Primary public access to the dunes was cut off with a locked gate by an uncooperative private landowner relatively recently. This has resulted in the inability of several agencies to manage rare plant populations or access the Virgin River on Federal land beyond the private property. Populations of threecorner milkvetch (Virgin River Dunes) and sticky wild buckwheat (Lower Virgin River) at the dunes have been invaded by Sahara mustard and the lack of access for management action has increased concern over a growing uncontrolled weed problem in sandy habitats for rare plants. There is no alternative route across Federal land because of large private land ownership in the area so private land acquisition or access easement is a potential option. This strategic action has a high priority timeline to accomplish it by the end of 2007. Success will be measured by the ability of Federal agencies to access the dunes and to subsequently decrease the threat of weeds (see strategic actions 3A-D).

Objective 4: Ensure that long term viability of low elevation rare plants in IMAs, LIMAs and MUMAs is not significantly impacted by rural development and sprawl.

(Note: Objective 4a in appendix 7 addresses the application of this objective and its strategic actions to rare plant population groups occurring outside Clark County).

Baseline viability rank tally: 9 fair, 2 good
Threat rank tally: 4 high, 7 very high (20 population groups)

Sticky ringstem
1. UMA (MUMA portion): Viability fair, high threats (Muddy River)

White bearpoppy
2. IMAs: Viability good, threats very high (Calico Hills)

Threecorner milkvetch
3. IMAs: Viability fair, threats high (Mormon Mesa)
4. Mixed mgt. categories: Viability fair, threats very high (Virgin River)
5. MUMAs: Viability fair, threats very high (Muddy River, Toquop Wash, Town Wash, Weiser Wash)

Alkali mariposa lily
6. LIMA: viability fair, threats high (Calico Hills)

Pahrump Valley buckwheat
7. UMA (MUMA portion): Viability good, threats very high (Mesquite Valley)

Sticky wild buckwheat
8. Mixed mgt. categories: Viability fair, threats high (Lower Virgin River, Lower Virgin Valley)
9. MUMAs: Viability fair, threats very high (Middle Muddy River, Toquop Wash, Upper Muddy River, Upper Virgin Valley)

White-margined beardtongue
10. IMAs: Viability fair, threats very high (Hidden Valley)
11. MUMAs: Viability fair, threats very high (Ivanpah Valley, Jean Lake, Roach Lake)

Measures of success
Key ecological attributes/indicators (see table 55 for indicator definitions):
- Minimum dynamic area/Sufficient acreage for characteristic species and natural habitat disturbances within historic range of variability
- Soil structure, stability and movement/Degree of soil erosion and compaction
- Soil moisture and nutrient regime/Degree of surface crust disturbance
- Characteristic native plant community/Native versus exotic plant species composition
- Fire Regime/Fire frequency and area burned

Threat reduction:
- Acreage developed or highly disturbed within individual population groups

Rural development and associated sprawl (see page 29 for explanation of this term) is a high or very high threat to 18 population groups in nine management categories. This threat causes habitat loss, fragmentation, and degradation of ecological integrity in similar ways to urban development, but perhaps at a smaller scale. Trampling soil and vegetation, introducing exotics, increasing fire ignitions, illegal dumping, and introducing air pollutants cause numerous stresses to rare plant habitats and surrounding matrix vegetation.

A. Increase law enforcement of illegal activities (dumping, casual trail development by recreation enthusiasts, wire burning, etc.) in rare plant habitats commensurate with the level and rate of impact to these habitats.

1. Increase BLM and NPS enforcement capacity on public land rare plant habitats in proximity to rural areas.
2. Investigate increasing violation fees in rare plant habitats and ensure their use for rare plant habitat restoration.
3. Maintain the toll-free phone line program for violations reporting by the public.

Increasing law enforcement capacity (staffing and operational funding) in parity with increasing rural development in Clark County is a means to ensure that law enforcement occurs in rare plant habitats adjacent to and near development. Early warning monitoring of specific adverse activity levels (dumping, etc.) can be measured to track increasing law enforcement needs. Refer to 2C for additional explanation.

B. Focus public education tools on rare plants and initiate a volunteer protection program.
1. Use brochures, public service announcements, signage, schools, and environmental educators for communications on the negative impacts of sprawl and importance of healthy habitats.
2. Develop neighborhood volunteer protection programs to adopt nearby rare plant populations for population monitoring, habitat restoration projects, compliance and violations reporting.

This strategic action is designed to address the hypothetical link between the negative impacts of sprawl associated with rural development and an informed, environmentally responsible public. DCP has engaged in a number of public education campaigns on behalf of the MSHCP via the PIE committee and by funding environmental educator hiring within Federal cooperating agencies. However, targeting the general public for a better understanding and appreciation of rare plants, their special habitats, and healthy landscapes could assist in reducing the threat of sprawl. Efficiencies of public education outreach actions can be met by linking this action to 2A, 2D, 2E, 3D, and 6C. Volunteer protection programs have benefits to Federal agencies (less costly assistance, increased capacity) as well as benefits to volunteers (sense of accomplishment, community spirit, connection with local landscape). A well run protection program aimed to connect neighbors with their rural surroundings could go far in assisting progress on decreasing the impacts of rural sprawl and CMS objectives related to sprawl (OHV, weeds, and fire threats).

C. Investigate opportunities to acquire land or conservation easements for Pahrump Valley wild buckwheat habitats in Clark and Nye counties, and for threecorner milkvetch and sticky wild buckwheat at Virgin River Dunes.
1. Make initial contacts with local landowners to determine willingness to negotiate.
2. If appropriate, secure SNPLMA funds for acquisitions.

Populations of Pahrump Valley wild buckwheat in Mesquite and Pahrump Valley occur on both private and public land. BLM management of rare plant habitat is complicated by rural sprawl impacts, but there may be opportunities to acquire land or easements in these valleys to better protect rare plant habitats. This strategic action is crucial for long term survival of Pahrump Valley wild buckwheat because there is currently too little habitat for the species in Federal land management and virtually none in protective management (IMAs or LIMAs). Similarly, populations of threecorner milkvetch and sticky wild buckwheat occur on private land adjacent to habitat on public land in the Virgin Valley. Although Clark County already has acquired land in the Virgin Valley, it has been for endangered species aquatic habitat, not for rare plant habitat. Portions of the Lower Virgin River and Upper Virgin Valley populations of sticky wild buckwheat and the Virgin River populations of threecorner milkvetch would benefit from acquisitions or easements to ensure their long term viability and lessen the threats of rural sprawl (and agriculture).

Objective 5: Ensure that disposal of Federal lands in Clark County does not significantly impact comprehensive conservation of low elevation rare plant populations.

Baseline viability rank tally: 1 poor, 4 fair, 1 good
Threat rank tally: 6 high (14 population groups)

Sticky ringstem
1. UMA (MUMA portion): Viability fair, threats high (Muddy River)

Las Vegas bearpoppy
2. UMA (MUMA portion): Viability poor, threats high (Las Vegas Valley)

Threecorner milkvetch
3. MUMAs: Viability fair, threats high (Muddy River, Toquop Wash, Town Wash, Weiser Wash)

Pahrump Valley wild buckwheat
4. UMA (MUMA portion): Viability good, threats high (Mesquite Valley)

Sticky wild buckwheat
5. MUMAs: Viability fair, threats high (Middle Muddy River, Toquop Wash, Upper Muddy River, Upper Virgin Valley)

White-margined beardtongue
6. MUMAs: Viability fair, threats high (Ivanpah Valley, Jean Lake, Roach Lake)

Measures of success
Key ecological attributes/indicators (see table 55 for indicator definitions):
- Minimum dynamic area/Sufficient acreage for characteristic species and natural habitat disturbances within historic range of variability
- Connectivity with intact adjoining systems/Degree of population isolation and fragmentation of matrix systems

Threat reduction:
- Acreage developed or highly disturbed within individual population groups
- Acres of Federal land with low elevation rare plant habitat disposed

The BLM Las Vegas District RMP (1998), Southern Nevada Public Lands Management Act of 1998, and the Clark County Conservation of Public Land and Natural Resources Act of 2002 all identify areas for disposal in the BLM's Las Vegas District. Disposed public lands become privately owned and risk development or land use incompatible with species conservation. The sale of land by BLM (public management to private ownership) does not result in direct impacts to permit-covered species; however, subsequent development of private land increases direct loss of plants and habitats, fragmentation of habitat, and other factors decreasing rare plant viability. Six of the nine rare plants have documented populations overlapping with disposal boundaries and are at risk for ensuing development. They include sticky ringstem, Las Vegas bearpoppy, threecorner milkvetch, sticky wild buckwheat, white-margined beardtongue, and Pahrump Valley wild buckwheat. The ongoing conservation process in the north Las Vegas Valley disposal on behalf of Las Vegas bearpoppy (and Las Vegas buckwheat) involving BLM, FWS, City of North Las Vegas, Nevada Division of Forestry, and others is an example of the complexity of issues and derived solutions when economic growth and biodiversity values overlap in proposed disposal areas. Where possible, avoiding direct conflicts by removing significant rare plant habitats from disposal boundaries is a timely and efficient conservation strategy.

A. Survey and inventory populations of sticky ringstem, Las Vegas bearpoppy, threecorner milkvetch, Pahrump Valley wild buckwheat, sticky wild buckwheat, white-margined

beardtongue within disposal boundaries appropriately to determine current status and significance.
1. Ensure surveys are scheduled well in advance of disposal actions for effective consideration.

This strategic action addresses information gaps for five of the six affected species. Current status updates for these rare plants are needed because information is either dated or non-existent, with the exception of Las Vegas bearpoppy in north Las Vegas Valley (although clarification on presence of white bearpoppy in the CTA is still needed). Disposal areas in Sandy Valley, Ivanpah Valley, and near rural communities of Glendale and Mesquite need timely surveys so as not to preclude conservation opportunities.

B. Reassess low elevation rare plant populations to determine if significance warrants retention in public lands system.
1. Review species status information.
2. Track all populations to better evaluate significance of these populations.

Disposal areas at Sandy Valley (in Mesquite Valley), in Ivanpah Valley, and near rural communities of Glendale and Mesquite overlap rare plant population groups deemed significant—or highly significant for Pahrump Valley wild buckwheat at Sandy Valley—in our global assessment using existing, sometimes dated, information. A re-evaluation with new data should be made in light of the significance of rare plant populations overlapping potential land sales. Again, these tasks should be completed well in advance of disposal actions so as not to preclude conservation opportunity.

C. Retain significant rare plant populations in public ownership, or find conservation buyer to manage for rare plant habitat if disposal goes forward.

Retention in BLM jurisdictions is the most straight forward strategic action for rare plant protection from private development. However, factors beyond rare plant considerations may weigh heavily in favor of disposal, so finding a conservation buyer or negotiating a conservation easement is a fallback action.

D. Investigate acquisition of habitat at Sandy Valley (Mesquite Valley population).
1. Secure funding for acquisition, if warranted, and facilitate timely acquisition of habitat.

Populations of Pahrump Valley wild buckwheat in Mesquite Valley partly occur on public land identified for disposal which may go forward despite the significance of rare plant habitat. Should that occur, it is important to search for opportunities to acquire private land (or find a conservation buyer) to better protect its habitat and aid long term viability in this valley. Again, this is a fallback option.

Objective 6: Manage rare plants in sandy habitats in IMAs and MUMAs for long term viability by addressing altered fire regimes (increased fire frequency and intensity) over the next century.

Baseline viability rank tally: 8 fair
Threat rank tally: 8 high (21 population groups)

Threecorner milkvetch
1. IMAs: Viability fair, threats high (Mormon Mesa, Sandy Cove)
2. Mixed mgt. categories: Viability fair, threats high (Mud Wash, Virgin River)
3. MUMAs: Viability fair, threats high (California Wash, Mud Lake, Muddy River, Toquop Wash, Town Wash, Weiser Wash)

Sticky wild buckwheat

4. IMAs: Viability fair, threats high (Lime Wash, Overton Arm)
5. Mixed mgt. categories: Viability fair, threats high (Lower Virgin River, Lower Virgin Valley)
6. MUMAs: Viability fair, threats high (Toquop Wash, Upper Muddy River, Upper Virgin Valley)

White-margined beardtongue

7. IMAs: Viability fair, threats high (Hidden Valley)
8. MUMAs: Viability fair, threats high (Ivanpah Valley, Jean Lake, Roach Lake)

Measures of success

Key ecological attributes/indicators (see table 55 for indicator definitions):

- Fire regime/fire frequency and area burned
- Characteristic native plant community/Native versus exotic plant species composition
- Fragmented populations with a degraded matrix/Degree of population isolation and fragmentation of matrix systems

Threat reduction:

- Number/acreage within population groups treated to restore fire regime to within historic range of variability

Habitat for the rare plant psammophytes (threecorner milkvetch, sticky wild buckwheat, and white-margined beardtongue) typically occurs within matrix creosote bush and bursage plant communities dominating low elevation landscapes in Clark County. The low elevation matrix vegetation has been altered by a combination of past human uses, including historic livestock grazing and initial introduction of exotic annual grasses (bromes and Mediterranean grass), such that the ability of the vegetation to carry fire has increased dramatically beyond the historic range of variation. Increased intensity, frequency, extent, and timing of fire results where it historically occurred at less frequent 150-500 year intervals. More frequent and intense fire increases concern that much Mojave Desert low elevation vegetation is nearing threshold points which would lead to irreplaceable loss of habitat from type conversion. Similar more recent unnatural vegetation conditions within the smaller patches of sandy habitats occur where herbaceous exotics (Sahara mustard and African malcolmia) have spread and helped to stabilize dunes and sand sheets. Altered conditions in habitats supporting the other six rare plant species is not thought to have reached similar levels of concern for altering fire regimes, although calcareous foothills harboring white bearpoppy may be the next habitat for concern. Increased fire threatens virtually all populations of the psammophytes and 21 population groups with reduced viability rankings in IMAs, mixed management categories and in MUMAs. It is expected that management actions needed to address this threat will take long timeframes to achieve success. However, accepted quantitative indicators of fire regime condition successfully measure incremental success.

A. Address research gaps on impacts of non-native grasses (*e.g.*, red brome and Mediterranean grass) and Sahara mustard on ecosystem processes in sandy habitats within next five years.

This action addresses the need to better understand relationships between introduced exotic grasses, introduced herbaceous plants, and historical fire disturbance regimes within the dynamic low elevation landscape of the Mojave Desert. Although some hypotheses on fire and introduced exotics in Mojave Desert vegetation are receiving attention, hypotheses more specific to rare plants and their habitats need investigation. For example, what cover of exotics within rare psammophyte habitat is more likely to change moderately departed conditions to highly departed following varying levels of fire? A review of existing fire research relevant to sandy habitats is a component piece of understanding research gaps. Research on varying fire responses of unstable versus semi-stabilized dunes and Aeolian versus fluvial sand sheet deposition in the Mojave Desert would help direct and improve management within specific rare plant habitats.

B. Address research gaps on effective control mechanisms for annual grasses and control mechanisms beyond currently used mechanical removal for Sahara mustard.
1. As appropriate, facilitate ongoing research that addresses control of annual introduced grasses and restoration issues (*e.g.* USGS cost effective restoration techniques using native rodents).
2. Investigate potential impacts of herbicide use (*e.g.* Imazapic, also known as Plateau®) on rare plants, pollinators, and their habitats.

The known effective herbicide, Plateau, for annual bromes (cheatgrass in particular) currently is banned everywhere on Federal land because of its impacts to salmon (and extrapolated potential impacts to other aquatics and sensitive habitats). With study there may be newly identified effective control mechanisms for exotics increasing in the Mojave Desert or release of Plateau for use in certain situations unlikely to cause known impacts. Appropriate restoration techniques, including the use of native perennial grass seed after disturbance, also needs more study. In addition, effective control methods for Sahara mustard and other introduced forbs is a high priority (see conservation strategy 3C). This strategy addresses decreased viability rankings because of introduced exotic plant competition in up to 20 population groups. Appropriately designed effectiveness monitoring plans could refine hypothetical relationships between weed treatments and increased rare plant population viability.

C. Coordinate with county-wide and local weed management efforts to specifically address fire/weed interactions (see objective 3).
1. Develop a public education program centered on the link between weeds and fire to control the spread of weeds and decrease human-caused fire ignitions.

There are existing state and transition models describing the relationship between increased fire and degraded states of plant communities from exotic species invasion. Ensuring that an integrated county-wide weed management program benefits from this applied research is important because of the potential magnitude of the issue for rare plant persistence. Interpretation of models for the lay audience would benefit the three psammophytes. This strategic action should be linked to 2A, 2D, 2E, 3C, and 4B for efficiency.

D. Maintain acceptable fire regime condition class (FRCC) determined by fire models in areas currently within the natural range of variation.
1. Using best available practices, control annual grass and Sahara mustard incursions into quality matrix desert systems surrounding rare plant habitat and suppress fire such that 1) large replacement fires are not introduced over the next 115 to 500 years for large patch systems and small patch systems surrounded by infrequent fire vegetation, respectively, and 2) small fires do not recur at the same location for about 150 years.

FRCC is a measure of ecological departure between pre-settlement (reference condition or historic range of variation) and current conditions based on vegetation structure, composition, and fire regimes. It incorporates all meaningful ecological disturbances for a potential vegetation type and is not limited to fire; thus, FRCC can be calculated even for those potential vegetation types with no fire disturbance regimes. The three condition classes group continuous values from 0% (completely similar to historic condition) to 100% (completely departed from historic condition) into the following three:

FRCC 1 = 0 – 33 % classified as "intact", unaltered, or within historic range;
FRCC 2 = 34 – 66 % classified as moderately departed; and,
FRCC 3 = 67 – 100 % classified as highly departed.

LANDFIRE biophysical setting descriptions or modeled pre-settlement vegetation dynamics and calculated historic range of variation are used to measure ecological departure within all potential vegetation type classes (i.e., seral stages). The vegetation classes most responsible for overall ecological departure are targeted for management to bring them back within the historic range of variation (the acceptable fire regime conditions). Until the historic range is achieved, fire suppression is needed in matrix infrequent-fire vegetation so that the abundance of introduced exotics does not permanently alter structure, composition, and disturbance regimes by crossing ecological thresholds. Timeframes for replacement and small fires in matrix vegetation come from descriptions of LANDFIRE biophysical settings which have been done for the Mojave Desert.

This strategic action targets maintaining areas important to rare plants that currently have good viability rankings for fire regime condition, whereas the next strategic action targets restoration of fire regime condition in areas with decreased viability rankings and at risk to type conversion.

E. Provide for fire regime condition classes FRCC 1 (within range of natural variability) or FRCC 2 (moderately departed) which avoid crossing thresholds to depleted state (type conversion).
1. Conduct smaller-scale fuels and fire hazard mapping in priority areas of rare plant sandy habitats than existing LANDFIRE data for the Mojave Desert.
2. Using LANDFIRE description of Inter-Mountain Basins Semi-Desert Grassland from the Mojave Desert, improve ratio of matrix patches surrounding rare plant habitat from FRCC 2 to FRCC 1 and FRCC 3 (highly departed) to FRCC 2 using best restoration practices.
3. Investigate use of animals (goats, sheep, and cattle) for strategically-timed and closely managed grazing to reduce exotic fuel loads along roads and other vectors into communities surrounding rare plant habitats; as appropriate, undertake control actions through use of grazing animals.
4. Seed matrix communities surrounding rare plant habitats with native perennial grass mixes where appropriate.

Because this strategic action applies to areas in need of restoration it concentrates on enhancing viability, whereas the previous strategic action concentrates on decreasing threats to achieve the objective. This strategy addresses the scale issue of existing LANDFIRE models, which would benefit specific rare plant habitats that typically occur as small patch plant communities within large patch or matrix plant communities. It relies on active restoration methods which need appropriate effectiveness monitoring, including the question of whether the reintroduction of native perennial grasses is more favorable than no grass cover.

Objective 7: Manage viable populations of all covered rare plants in utility corridors in IMAs and MUMAs (BLM lands), and within potential rights of way corridors at LMNRA.

(Note: Objective 7a in appendix 7 addresses the application of this objective and its strategic actions to rare plant population groups occurring outside Clark County).

Baseline viability rank tally: 6 fair, 2 good
Threat rank tally: 2 medium, 5 high, 1 very high (14 population groups)

Sticky ringstem
1. IMAs: Viability fair, threats medium (Lava Butte)
2. Mixed mgt. categories: Viability fair, threats medium (Gypsum Wash)

Las Vegas bearpoppy

3. IMAs: Viability good, threats high (Sunrise Valley, Valley of Fire)

White bearpoppy

4. MUMAs: Viability good, threats high (Bird Spring Range)

Threecorner milkvetch

5. IMAs: Viability fair, threats high (Mormon Mesa)
6. MUMAs: Viability fair, threats high (Mud Lake, Muddy River, Weiser Wash)

Sticky wild buckwheat

7. MUMA: Viability fair, threats high (Upper Muddy River, Upper Virgin Valley)

White-margined beardtongue

8. MUMAs: Viability fair, threats very high (Ivanpah Valley, Jean Lake, Roach Lake)

Measures of success

Key ecological attributes/indicators (see table 55 for indicator definitions):

- Connectivity with intact adjoining systems/Degree of population isolation and fragmentation of matrix systems
- Reduced population numbers or extent of populations/Number of reproductive plants in non-drought periods
- Characteristic native plant community/Native versus exotic plant species composition

Threat reduction:

- Acres of habitat in population groups restored or enhanced through mitigation projects relative to overall acreage disturbed

Designated utility corridors decrease 13 viability rankings and result in six high to very high threat rankings for rare plant population groups. This land use threatens several significant population groups of Las Vegas bearpoppy, white bearpoppy, threecorner milkvetch, sticky wild buckwheat, and white-margined beardtongue through fragmentation and destruction of habitat, direct loss of populations and individuals, and introduction of weeds. Progress to ensure threats are reduced is accomplished by learning more about effective habitat restoration techniques, incorporating them into mitigation projects, refining restoration standards, and ensuring that effective mitigation programs are carried through in a timely manner.

A. Assure mitigation and a restoration plan is developed for each individual project in corridors/rights of ways with rare plant habitat.
1. Coordinate with appropriate agencies to ensure mitigation and restoration projects are scheduled and initiated within a 1-2 year timeframe.
2. Refine restoration standards by 2008 to ensure mitigation success in restoration projects.

Mitigation and restoration plans typically are already component elements of utility corridor projects, so this strategic action is a restatement in support of these essential steps. Emphasis is needed to ensure that all project plans include appropriate measures of success criteria for mitigation. We need to test the hypothesis that existing restoration standards are inadequate for ensuring long term viability of rare plant populations, and develop new restoration standards as needed.

B. Implement an effectiveness monitoring program.
1. Require funding from project proponent, implement monitoring by 3rd party specialists, and ensure land manager/owner oversight of monitoring plan.
2. Develop appropriate protocol for monitoring, restoration activities, and reporting.
3. Ensure clear performance criteria to determine success of mitigation and restoration, and criteria for adaptive management.

4. Require remedial measures if mitigation or restoration is not successful during initial stated timeframes.

Effectiveness monitoring was an identified weak link for BLM's oversight of utility corridor projects. Assistance from Clark County's science advisor could improve current monitoring protocols (including criteria for success), restoration techniques, and reporting. Additional discussion of effectiveness monitoring programs is in the section on monitoring framework below.

C. Implement an adaptive management program.
1. Develop a GIS-based current status system of all populations along designated corridors and rights of ways in rare plant habitat.
2. Track cumulative impacts to covered rare plant populations in utility corridors and along existing utility lines independent of designated corridor locations.
3. Coordinate data exchange with effectiveness monitoring program.
4. Develop rapidly escalating mitigation requirements for repeated construction and maintenance impacts to habitat.
5. Secure additional mitigation funds to support weed treatments.
6. Secure additional mitigation funds when avoidance is not possible to study restoration questions related to rare plants and their habitats.
7. Ensure BLM and NPS oversight of appropriate project bond releases.

An adaptive management program is emphasized in this strategic action because of the knowledge gaps regarding repetitive disturbance and cumulative impacts in decreasing population viability. Most action steps are designed to improve measures of no net loss of habitat.

Objective 8: Manage viable populations of Las Vegas bearpoppy along Federal highways and county roads in MUMAs.

(Note: Objective 8a in appendix 7 addresses the application of this objective and its strategic actions to population groups of white bearpoppy, white-margined beardtongue, and Pahrump Valley buckwheat occurring outside Clark County).

Baseline viability rank tally: 1 fair, 1 poor
Threat rank tally: 1 high, 1 very high (2 population groups)
Las Vegas bearpoppy
1. MUMAs: Viability fair, threats high (Nellis Dunes)
2. UMA (MUMA portion): Viability poor, threats very high (Las Vegas Valley)

Measures of success
Key ecological attributes/indicators (see table 55 for indicator definitions):
- Connectivity with intact adjoining systems/degree of population isolation and fragmentation of matrix systems
- Adult population size/Number of reproductive plants in non-drought periods
- Soil structure, stability, and movement/Density of vehicle tracks; degree of soil erosion or compaction
- Loss of pollinator efficiency/Presence of characteristic pollinators

Threat reduction:
- Amount of acreage restored through mitigation associated with highway construction and maintenance in rare plant habitat

In Clark County, the threat of highway and road construction and maintenance is high for Las Vegas bearpoppy along the Interstate 15 corridor northeast of Las Vegas, along county roads east of the city, and potentially along new roads constructed to meet the demands of a growing Las Vegas. In addition, this threat is high for white bearpoppy and white-margined beardtongue along State Highway 95 and for Pahrump Valley wild buckwheat along State Highway 372 in adjacent Nye County (see appendix 7 for conservation strategy). Fair or poor current viability rankings for some populations may be the result of earlier loss or fragmentation of habitat from roads (*e.g.* along Interstate 15 near Apex).

A. Minimize necessary infrastructural impacts to rare plant populations along roadsides.
1. Coordinate with NDOT to minimize highway maintenance issues.
2. Coordinate with Clark Co. Department of Public Works to minimize road maintenance conflicts with rare plant management.
3. Implement project restoration plans and address related research gaps on propagation.
4. Investigate use of salvaged rare plant material for appropriate highway beautification projects (*e.g.*, Las Vegas bearpoppy seedbank and soil for interchanges on gypsum habitats).

In addition to the action steps listed above, testing effective restoration techniques and filling research gaps on plant propagation are needed. No suitable propagation techniques have been developed for the Las Vegas bearpoppy even though several attempts have been made. The use of salvaged rare plant materials (plants and soil) for appropriate highway beautification could elevate public awareness of the value of rare species and the degree of loss and fragmentation of habitat from unchecked growth. Although this type of mitigation has merit, there may be unintended threats which might reduce benefits (*e.g*. pollinator viability in proximity of highways). Appropriate soil salvaging techniques for semi-stabilized sands and playa margins need to be developed based on the results of monitoring studies in addition to plant propagation protocols.

Objective 9: Manage populations of Las Vegas bearpoppy, white bearpoppy, and Parish phacelia at Nellis to ensure positive long term viability trend in IMAs, LIMAs and MUMAs within ten years.

The rare plant CMS includes objectives and strategic actions that fall outside the scope of Clark County's authority. Objective 9 is limited to actions that would occur on lands controlled by Nellis Air Force Base and is incumbent on FWS leadership. See Objective 9a in appendix 7 for full discussion of this objective.

Objective 10: Manage viable populations of alkali mariposa lily and white bearpoppy populations in LIMAs and MUMAs by removing wild horse and burro use and addressing impacts of rural sprawl by 2020.

(Note: Objective 10a in appendix 7 addresses the application of this objective and its strategic actions to rare plant population groups occurring outside of the jurisdication of the Clark County MSHCP.)

Baseline viability rank tally: 1 fair, 1 good
Threat rank tally: 2 high (5 population groups)

White bearpoppy
1. MUMAs: Viability good, threats high (Bird Spring Range, Indian Springs, Pahrump Valley)

Alkali mariposa lily
2. LIMAs: Viability fair, threats high (Calico Hills, Lone Willow Spring)

Measures of success
Key ecological attributes/indicators (see table 55 for indicator definitions):

- Soil structure, stability and movement/Density of vehicle tracks and wild horse and burro trails
- Connectivity with intact adjoining systems/Degree of population isolation and fragmentation of matrix systems

Threat reduction:

- Number and acreage of population groups protected and/or restored through fencing and other efforts to control OHV incursions and recover habitat
- Number of wild horse and burro gathers over time relative to maintenance of herd management area levels

Wild horses and burros (WHB) negatively impact populations of alkali mariposa lily and white bearpoppy in Red Rock Canyon NCA and further east in Nye County where historic use decreased population viabilities. Rural (and urban) sprawl (see page 29 for explanation of this term) affects the same populations of alkali mariposa lily and white bearpoppy in Red Rock Canyon NCA, but also further south in the foothills of the Spring Mountains. In Red Rock Canyon NCA, the herd management area is Red Rocks, where the appropriate management level is not set, although it was scheduled for 2005. In the foothills of the Spring Mountains, the herd management area is Lucky Strike, where the appropriate management level is estimated (not officially set) for 50 horses and 27 burros. Animals are removed on an irregular basis in these herd management areas. Additionally, burros are a medium threat overall for several additional rare plant species population groups, but are an issue for population groups at Lake Mead NRA where their impacts are of great concern to NPS botanists.

A. Fence spring meadow habitats in LIMAs.
1. Designate a NEPA team for fencing projects.
2. Designate a team for implementation and monitoring.
3. Review effectiveness monitoring information and implement adaptive management as necessary.

Spring meadow habitats in the foothills of the Spring Mountains are very susceptible to damage by grazing wild horses and burros. Because the animals are drawn to sources of water, which tend to be small and isolated springs and springbrooks in Clark County, the most effective way of reducing their impacts is to fence spring habitats from their use. Fencing has been done at Red Spring, but has yet to be done at Calico or Lone Willow springs. Ensuring that BLM has the capacity to fence, monitor results, and adaptively manage is essential.

B. Conduct Wild Horse and Burro removals to ensure appropriate management levels are maintained.

Wild horse and burro removals are the effective way of maintaining appropriate management levels of animals once they increase beyond carrying capacity of the landscape. Removals need to be conducted fairly regularly on both BLM and NPS managed lands in Clark County to ensure that viability of rare plants and their habitats do not decline over time as a result of excessive grazing and trampling. Implicit in this strategic action is to continue monitoring wild horse and burro status over time, and to ensure that it is done in and surrounding rare plant habitats.

C. Allow natural restoration of meadows and gypsum/sand upland habitats by maintaining fences.

Fencing spring meadow habitats for alkali mariposa lily provides increased opportunity for natural restoration of meadows. But, wild horse and burro removal to maintain appropriate management levels is likely the only method of allowing natural restoration of gypsum habitats, which often have cryptobiotic crusts susceptible to trampling damage.

D. If necessary, actively restore meadow habitats using best practices.

Active restoration may be necessary to achieve a good viability status in some meadow habitats within the desired objective timeframe. Soil augmentation, temporary irrigation, and plantings may be among the suite of techniques used to secure stable populations of alkali mariposa lily.

Objective 11: Protect threecorner milkvetch and sticky wild buckwheat populations along Muddy and Virgin rivers in IMAs and MUMAs from significant agricultural impacts over the next fifty years.

Baseline viability rank tally: 4 fair
Threat rank tally: 4 high (4 population groups)

Threecorner milkvetch
1. Mixed mgt. categories: Viability fair, threats high (Virgin River)
2. MUMAs: Viability fair, threats high (Muddy River)

Sticky wild buckwheat
3. Mixed mgt. categories: Viability fair, threats high (Lower Virgin River)
4. MUMAs: Viability fair, threats high (Upper Virgin Valley))

Measures of success
Key ecological attributes/indicators (see table 55 for indicator definitions):
- Characteristic native plant community/native versus exotic plant species composition
- Fluvial deposition process/degree of "sediment carrying capacity" and deposition

Threat reduction:
- Number and acreage of population groups affected directly or indirectly by adjacent agricultural activity
- Acreage of agricultural lands acquired in or adjacent to habitat of population groups

Agricultural production has occurred in the Virgin and Muddy river valleys for much of this century and is thought to have contributed to loss of sandy floodplain habitat for threecorner milkvetch and sticky wild buckwheat. Clark County populations of threecorner milkvetch and sticky wild buckwheat are at their center of distributions and are significant for long term persistence of the two species. Enhancing long term viability of these populations by reducing significant agricultural impacts is needed to address their global viability and is expected to take several decades.

A. Acquire private lands and associated water rights (if feasible) from willing sellers that own habitat (Virgin River, Lower Virgin River, Upper Virgin Valley, and Muddy River).

Populations of threecorner milkvetch and sticky wild buckwheat in part occur on private land adjacent to core habitat and plants on public land both in the Virgin and Muddy river valleys. Global distributions of these two species are nearly restricted to Clark County and all populations likely contribute significantly to long term persistence of the two species. Clark County already has acquired endangered species aquatic habitat in the Virgin Valley, but not rare plant habitat. Private portions of the Lower Virgin River and Upper Virgin Valley populations of sticky wild buckwheat, and Virgin River and Muddy River populations of threecorner milkvetch would benefit from private land acquisitions to ensure long term viability and lessen the threats of agriculture (and rural sprawl—see page 29 for a discussion of this impact). Acquisition from willing sellers would assist in simplifying management of these vital core public land population groups.

B. Alternatively, acquire conservation easements from willing sellers that own habitat.

Acquisition of conservation easements on private lands in the Virgin and Muddy river valleys is an alternative strategic action with the potential to provide equivalent conservation management to BLM at a less costly price. Easements may be more attractive to local land owners than outright sale of property. Easements also may be an appropriate alternative if the private land is near core public land rare plant habitat but not immediately adjacent to it.

C. Assist private landowners with weed control issues that impact rare plants.
1. Coordinate with county-wide and local area weed programs.

Private lands in agricultural production often are source areas for weed infestation and expansion. Whether private land acquisition or conservation easements are accomplished for the benefit of threecorner milkvetch and sticky wild buckwheat, assisting private land owners with solutions to their weed control problems is essential to ensuring long term viability of the sand-inhabiting rare plants in the Virgin and Muddy river valleys. Coordination of weed issues on rare plant habitat across private and public lands is facilitated with the recent formation of a local weed management district.

Objective 12: Ensure conservation management for sticky wild buckwheat, threecorner milkvetch and Las Vegas bearpoppy populations at LMNRA (IMA) above high water line and manage populations below high water line during Lake Mead low water years.

Baseline viability rank tally: 3 fair, 1 good
Threat rank tally: 4 high (12 population groups)

Las Vegas Bearpoppy
1. IMAs: Viability good, threats high (Valley of Fire)

Threecorner milkvetch
2. IMAs: Viability fair, threats high (Bark Bay, Ebony Cove, Lime Cove, Sandy Cove, The Meadows, Valley of Fire Wash)
3. Mixed mgt. categories: Viability fair, threats high (Virgin River)

Sticky wild buckwheat
4. IMAs: Viability fair, threats high (Black Mountains, Lime Wash, Overton Arm, Virgin River confluence)

Measures of success
Key ecological attributes/indicators (see table 55 for indicator definitions):
- Adult population size/Number of reproductive plants in non-drought periods
- Characteristic native plant community/Native versus exotic plant species
- Soil structure, stability and movement/Degree of soil erosion or compaction
- Fluvial deposition process/Degree of river "sediment carrying capacity"
- Pollination/Presence of characteristic pollinators
- Connectivity with intact adjoining systems/Degree of population isolation and fragmentation of matrix systems

Threat reduction:

- Status of rare plant mitigation activities under Lower Colorado River MSCP

The filling of Lake Mead inundated the confluence of the Virgin and Muddy rivers and the Virgin River confluence with the Colorado River. Based on existing distributions of Las Vegas bearpoppy, threecorner milkvetch, and sticky wild buckwheat it is recognized that populations and habitats were lost although there is no pre-reservoir documentation of such loss. The Lower Colorado River MSCP, which includes regulation of Lake Mead by BoR, acknowledges a responsibility of loss of habitat by including mitigation fees to manage Lake Mead's shoreline.

A. Maintain viable populations above high water at LMNRA.
1. Negotiate timely receipt of mitigation fees from Lower Colorado River MSCP for acknowledged loss of populations along shoreline for use in managing remaining shoreline plants and habitat.

Populations of Las Vegas bearpoppy, threecorner milkvetch, and sticky wild buckwheat occur in gypsum and sandy habitats above high water at Lake Mead NRA. They have the potential to be viable population groups if they received appropriate conservation management, which could be accomplished with management provided by mitigation fees from the Lower Colorado River MSCP.

B. Manage lower elevation populations for expected longer terms because of greater probability of low reservoir levels.

Lower reservoir levels are expected to occur at Lake Mead NRA into the near future because of regional drought and/or longer term climate change. Populations of sticky wild buckwheat, in particular, recently have expanded into (or possibly have naturally reclaimed) previously inundated exposed shoreline where longer (than previously expected under full reservoir conditions) persistence is possible. Because global distribution of the species is nearly restricted to Clark County, these populations likely contribute to long term persistence of sticky wild buckwheat and should receive conservation management while exposed.

C. Use lower populations as donor sites for seed, and possibly for sand/soil as lake level increases and threatens inundation.
1. Collect seed bank from populations located below high water line.
2. Secure $10,000/year funding (to 2030) from the Lower Colorado River MSCP for sticky wild buckwheat and threecorner milkvetch seed banking and research studies.
3. Document loss of the lower populations as lake levels fluctuate from reservoir management.
4. Investigate and if feasible, implement policy changes with BoR regarding reservoir regulation beyond flood control, downstream water supply, and power generation to include management for rare plant population maintenance.

Lake Mead is currently managed for flood control, downstream water supply, and power generation, which would allow lake levels to rise under drought relief or global climate conditions that would increase precipitation and watershed runoff. As lower elevation populations of threecorner milkvetch and sticky wild buckwheat approach inundation levels, management to secure seed and possibly soil from these populations could offset their loss and is funded from mitigation dollars earmarked by the Lower Colorado River MSCP. Four action steps support this opportunity-driven strategic action. To eliminate potential cycles of long term inundation loss and drought expansion of rare plant habitats, investigating and implementing any feasible policy changes on reservoir regulation is included.

Objective 13: Ensure gypsum mining will not significantly impact habitat of Las Vegas bearpoppy and sticky ringstem in IMAs, LIMAS, and MUMAs by 2010.

Baseline viability rank tally: 3 fair, 1 good
Threat rank tally: 4 high (8 population groups)

Sticky ringstem
1. IMAs: Viability fair, threats high (Gold Butte, Lava Butte)
2. Mixed mgt. categories: Viability fair, threats high (Bitter Spring Valley, Gypsum Wash)

Las Vegas bearpoppy
3. IMAs: Viability good, threats high (Gold Butte, Sunrise Valley)
4. Mixed mgt. categories: Viability fair, threats high (Bitter Spring Valley, Gale Hills)

Measures of success
Key ecological attributes/indicators: (see table 55 for indicator definitions):
- Minimum dynamic area/Sufficient acreage for characteristic species and natural habitat disturbances within historic range of variability
- Adult population size/Number or reproductive plants in non-drought periods
- Pollination/Presence of characteristic pollinators
- Soil moisture and nutrient regime/Degree of surface crust disturbance
- Soil structure, stability and movement/Degree of soil erosion or compaction
- Characteristic native plant community/Native versus exotic plant species composition

Threat reduction:
- Number and acreage of active gypsum mines on rare plant habitat

Gypsum mining threatens Las Vegas bearpoppy and sticky ringstem in several populations east of the Las Vegas Valley (Gold Butte, Sunrise Valley, Bitter Spring Valley, Gypsum Wash, and Gale Hills, where good viability is threatened or decreased viability has resulted from past activities. Gypsum mining alters several rare plant key ecological attributes through destruction and alteration of habitat and the adjacent landscape.

A. Avoid new mining projects on Las Vegas bearpoppy and sticky ringstem habitat.

Gypsum habitats harboring Las Vegas bearpoppy, sticky ringstem, and other rare plant species (white bearpoppy in the CTA, Las Vegas buckwheat, and possibly others) should be avoided for new mining projects because essentially all of the remaining gypsophile habitats in Clark County are in need of protection to maintain or improve viability status of these rare plants in Clark County.

B. Withdraw rare plant habitat from mineral entry in new specially designated populations on public lands.
1. Facilitate BLM's ability to complete withdrawals within five years.

Four of seven sticky ringstem populations and six of eight Las Vegas bearpoppy populations recommended for special designation for rare plant conservation occur on BLM jurisdiction where withdrawing habitat from mineral entry can (or has, *e.g.* Rainbow Gardens in Sunrise Valley population group) assist long term habitat protection. NPS administers the other populations recommended for special designation where mining is not allowed.

C. **Apply best management practices to any unavoidable future mining operations.**
   1. Review past mitigation, monitoring, restoration, and lessons learned at mining operations impacting Las Vegas bearpoppy and sticky ringstem habitat for guidance.
   2. Ensure a mitigation and restoration plan is developed and scheduled to start within a one to two-year timeframe.

Operation of the Pabco Mine in Gypsum Wash has provided management and mitigation lessons to BLM over time. Application of best management practices learned should be applied where future unavoidable mining operations may occur in Las Vegas bearpoppy and sticky ringstem habitats. With completion of mineral entry withdrawal and the avoidance guideline for new mining projects in low elevation rare plant gypsum habitats, threat reduction can occur. However, for unavoidable mining activity, mitigation and restoration plans are needed to ensure appropriate measures for no net unmitigated loss.

Objective 14: Conserve Las Vegas bearpoppy's remaining genetic diversity in its western populations in Las Vegas Valley (MUMAs and UMAs) by 2015.

(Note: Objective 14a in appendix 7 addresses the application of this objective and its strategic actions to rare plant population groups occurring on Nellis Air Force Base)

Baseline viability rank tally: 1 poor
Threat rank tally: 1 very high

Las Vegas bearpoppy
1. UMA (MUMA portion): Viability poor, threats very high (Las Vegas Valley)

Measures of success
Key ecological attributes/indicators (see table 55 for indicator definitions):
- Minimum dynamic area/Sufficient acreage for characteristic species and natural habitat disturbances within historic range of variability)
- Adult population size/Number of reproductive plants
- Recruitment/Frequency and extent of germination effents
- Pollination/Presence of characteristic pollinators
- Connectivity with intact adjoining system/Degree of population isolation and fragmentation of matrix systems

Threat reduction:
- Habitat acreage in Las Vegas Valley managed under protective status

This objective addresses genetic research on Las Vegas bearpoppy which shows a component of genetic uniqueness in all populations, including individuals remaining in the highly fragmented Las Vegas Valley. Documentation of loss of individuals and habitats of Las Vegas bearpoppy is available for much of the Las Vegas Valley. However, portions of its historic distribution remain in the north part of the valley, and although it is unclear whether long term viability of these portions can be maintained given growth and development plans in the area, botanists encourage genetic protection of what remains.

A. **Protect four remaining viable populations of Las Vegas bearpoppy in the Las Vegas Valley.**
   1. Complete assessment of the Conservation Transfer Area in North Las Vegas and designate CTA in a protective management status in perpetuity.
   2. Monitor status of population at North Las Vegas Air Terminal.

The Conservation Transfer Area, North Las Vegas Air Terminal, Nellis Area II, and Nellis Area III are the four remaining portions of the Las Vegas Valley population group thought to have the potential for genetic viability benefits to the species. BLM and the city of North Las Vegas have worked together to ensure protection of the CTA, but final steps in protective management status are still needed. Clark County continues to protect remaining habitat at the North Las Vegas Air Terminal, but future management is not presently guaranteed. See objective 9a in appendix 7 for the strategies addressing the population at Nellis Area III since they occur on DoD lands which are beyond the scope of the MSHCP.

B. Manage remaining private lands populations where possible under State law.
1. Continue status monitoring for Las Vegas bearpoppy and continue tracking cumulative impacts on private lands in LV Valley.
2. Where opportunity exists collect seed for banking, and support research and related mitigation measures.
3. Develop NDF voluntary registry program on private lands.

NDF, through its state forester firewarden, has authority to issue or withhold permits for the "critically endangered" Las Vegas bearpoppy under NRS 527.270. NDF also tracks the Las Vegas bearpoppy on private lands in Clark County. In the past there have been a few examples of private land owners allowing NDF to collect seed for banking—NDF should continue to identify such opportunities to support mitigation measures. A volunteer registry program for private lands would provide for developing a willing landowner contact database for lands with identified habitat for Las Vegas bearpoppy. The relational database would be able to track the status of plants, seed bank, and habitat across undeveloped private lands. A volunteer land owner registry program benefits land owners by providing them with a sense of contribution to the community, as well as an opportunity to connect with their local natural heritage.

Objective 15: Ensure construction and maintenance of the Ivanpah Airport does not significantly impact viability of four white-margined beardtongue populations in MUMAs and county land in southern Clark County.

Baseline viability rank tally: 1 fair
Threat rank tally: 1 very high (2 population groups)

White-margined beardtongue
1. MUMAs: Viability fair, threats very high (Ivanpah Valley, Roach Lake)

Measures of success
Key ecological attributes/indicators (see table 55 for indicator definitions):
- Minimum dynamic area/Sufficient acreage for characteristic species and natural habitat disturbances within historic range of variability
- Connectivity with intact adjoining systems/Degree of population isolation and fragmentation of matrix systems
- Aeolian deposition process/Functionality of Aeolian deposition between source and sink areas
- Soil structure, stability and movement/Degree of soil erosion or sand stabilization
- Characteristic native plant community/Native versus exotic plant species composition
- Soil moisture and nutrient regime/Degree of surface crust disturbance
- Reduced population numbers or extent of population/Number of reproductive plants in non-drought periods

Threat reduction:
- Management status of affected populations

All four of the Clark County population groups of white-margined beardtongue are addressed in this objective, which focuses on the potential impacts of locating the planned Ivanpah Airport in Ivanpah Valley. Proposed commercial development in Ivanpah Valley would alter various key ecological attributes within the airport footprint as well as the greater proposed management area; and interrupt sand movement between upwind source areas and downwind plant habitats.

The four Clark County populations are at the center of the species tri-radiating geographic distribution and airport development would be situated within the **Ivanpah Valley** and **Roach Lake** population groups on playa materials thought to be crucial for maintaining the supply of sand to habitat at all four populations. Two indicators of key attributes for landscape context and size measure progress toward accomplishing this objective. First, a measure of sufficient aeolian deposition between source and sink areas indicates status of the driving ecological process maintaining white-margined beardtongue habitat. Second, sufficient acreage for characteristic species in its plant communities and for natural habitat disturbances within the historic range of variability indicates status of the minimum dynamic area necessary for population persistence. Additionally, tracking management status of the affected populations is a measure of the threat of commercial development. Four strategic actions are outlined to accomplish this threat driven objective.

A. Work with county planners to ensure final orientation of airport minimizes interruption of aeolian sand transport from source to habitat areas.

Clark County acquired almost 5,900 acres paralleling Interstate 15 in Ivanpah Valley for airport development and is preparing to acquire an adjacent 17,000 acres for airport management. The core airport acreage lies immediately southwest and west of the **Ivanpah Valley** and **Roach Lake** population groups. Prevailing wind patterns tend to move sand from the west side of the valley leeward to deposition areas on the east side of the valley and in western foothills of the McCullough Range and Lucy Gray Range. If the Ivanpah Airport is built at the planned location it would invariably alter sand transport across the valley. Minimizing the impact of airport development on wind-driven sand movements, by adjusting facility and runway orientations or by other means, may provide a sufficient supply of sand to maintain plant habitat over the long term.

B. Ensure conservation of two viable white-margined beardtongue populations in the 17,000 acre airport extended management area.

The additional identified acreage for airport management includes nearly all of the **Ivanpah Valley** population and much of the **Roach Lake** population. The 17,000 acres likely allows options for airport management to avoid loss of plants or loss and disturbance to the majority of its habitat. To ensure long term viability in MUMAs conservation management via special designation for these two population groups is a highly recommended strategy. Lands owned and managed by Clark County Department of Aviation in Ivanpah Valley would benefit from a stewardship and staff awareness program, perhaps one even stronger than what they already have at North Las Vegas Airport where small parcels of habitat for Las Vegas bearpoppy is fenced to avoid disturbance. Because of the large overlap between known white-margined beardtongue populations and the proposed 17,000 acre extended management area, any means of first avoiding (and secondarily minimizing) habitat fragmentation would help to maintain populations. The following three action steps support this strategy:

1. Establish a permanent specially designated conservation management area for two populations (Ivanpah Valley and Roach Lake).

2. Develop rare plant awareness program and stewardship guidelines for airport staff.
3. Avoid activities that impact rare plant habitat, such as OHV use, and locate (when unable to avoid) infrastructure to minimize habitat fragmentation.

C. Mitigate for no net loss on MUMAs and airport managed land when direct impacts are unavoidable.

If the Ivanpah Airport is developed as planned and direct impacts to plants and habitats are unavoidable, then mitigation action by Clark County Department of Aviation would be required to meet no net loss or fragmentation of habitat goals for this species. Two important information gaps addressed by monitoring and one important management action are identified for mitigation action which would add to the species knowledge base for indicators of key ecological attributes. Understanding the role of wind-driven sand transport in Ivanpah Valley for maintaining the four Clark County population groups is needed to refine quantitative indicator definitions for this ecological process. Similarly, understanding the plant's population dynamics and potential thresholds defining viability status is needed to distill quantitative indicators of minimum dynamic area. In addition, it is important to address a new source and spread of weeds in the valley resulting from the proposed commercial development of roads and infrastructure. Because the threat of weeds is very highly ranked for white-margined beardtongue in MUMAs, an effective weed management plan is needed to maintain or improve plant community composition throughout these population groups and within the intervening matrix vegetation. Three action steps are listed to accomplish these needs for white-margined beardtongue:

1. Conduct long term monitoring of aeolian sand transport system if deemed necessary to manage sand transport in the plant's habitat.
2. Conduct PVAs and long term population monitoring at all four populations in Clark Co.
3. Develop and implement a weed management plan for all four populations in Clark Co.

D. Identify NEPA team to evaluate commercial development impacts (*e.g.* roads) to adjacent BLM lands.

Development of the Ivanpah Airport would inevitably change the character of the landscape in Ivanpah Valley both on county land and on surrounding public land. Prior to BLM sale of the 17,000 acre extended management area to Clark County Department of Aviation an evaluation of environmental consequences of commercial development would be performed. An identified NEPA team would make the assessment of impacts to the surrounding area and offer alternatives to the proposed airport.

Objective 16: Ensure that disposal of Federal lands in Nye County will not significantly impact comprehensive conservation of Pahrump Valley wild buckwheat populations.

The rare plant CMS includes objectives and strategic actions that fall outside the scope of Clark County's authority. Objective 16 is limited to actions that should occur on lands in Nye County. See appendix 7 for full discussion of this objective.

Objective 17: Ensure construction of the Mesquite Airport does not significantly impact viability of threecorner milkvetch and sticky wild buckwheat on public lands.

Baseline viability rank tally: 2 fair
Threat rank tally: 2 high (2 population groups)

Threecorner milkvetch
1. IMA: Viability fair, threats high (Mormon Mesa)

Sticky wild buckwheat
2. MUMA: Viability fair, threats high (Upper Virgin Valley)

Measures of success
Key ecological attributes/indicators (see table 55 for indicator definitions)**:**
- Minimum dynamic area/Sufficient acreage for characteristic species and natural habitat disturbances within historic range of variability
- Connectivity with intact adjoining systems/Degree of population isolation and fragmentation of matrix systems
- Aeolian deposition process/Functionality of aeolian deposition between source and sink areas
- Soil structure, stability and movement/Degree of soil erosion or sand stabilization

Threat reduction:
- Management status of affected populations

This objective concentrates on the proposed commercial development adjacent to Mesquite where an airport facility is planned by the community. The development would directly and indirectly impact population groups of threecorner milkvetch and sticky wild buckwheat. Public land identified for disposal harbor sticky wild buckwheat while there is concern that development would affect ecological processes maintaining habitat for threecorner milkvetch on Mormon Mesa.

A. Monitor status of potential land disposal to avoid or minimize impacts to rare plant habitats.

Unlike County ownership progress in Ivanpah Valley, lands adjacent to Mesquite have yet to be acquired so avoidance or minimizing impacts may be possible by retaining disposal land in BLM jurisdiction and investigating alternative airport locations.

B. Work with airport developer to ensure orientation of airport minimizes interruption of aeolian sand transport from source to habitat areas.

Should airport development occur on the proposed disposal area west of Mesquite, actions to minimize interruption of ecological process for the rare plants are needed. Adjustments to facility and runway orientations or some other pre-development airstrip or facilities changes might provide a sufficient supply of sand to maintain rare plant habitat over the long term.

C. Assess mitigation fees to address impacts to rare plants and habitats.
1. Conduct long term monitoring of aeolian sand transport system.
2. Conduct PVAs and long term monitoring at impacted threecorner milkvetch and sticky wild buckwheat populations.
3. Acquire private habitat or conservation easement for protection.

If the Mesquite Airport is developed as desired by the community and direct impacts to plants and habitats are unavoidable, then mitigation action by the developer would be required to meet no net loss or fragmentation of habitat goals for threecorner milkvetch and sticky wild buckwheat. Two information gaps addressed by monitoring are identified for mitigation action which would add to the species knowledge base for indicators of key ecological attributes. Understanding the role of water- and wind-driven sand transport for maintaining habitat along the Virgin River and on Mormon Mesa is needed to refine quantitative indicator definitions for ecological processes. Also, understanding population dynamics and potential thresholds defining viability status for the two species is needed to refine quantitative indicators of size. An important management action that could be funded with mitigation fees is acquisition of land or easements on habitat elsewhere for these psammophytes.

Objective 18: Mitigate loss of Las Vegas bearpoppy and habitat from BLM recreation management actions at Nellis (Las Vegas) Dunes.

Baseline viability rank tally: 1 fair
Threat rank tally: 1 very high (1 population group)

Las Vegas bearpoppy

1. MUMA: Viability fair, threats very high (Nellis Dunes)

Measures of success
Key ecological attributes/indicators (see table 55 for indicator definitions):
- Soil structure, stability and movement/Density of vehicle tracks, degree of soil erosion or compaction
- Soil moisture and nutrient regime/Degree of surface crust disturbance

Threat reduction:
- Management status of affected populations
- Success of salvage operations

Loss of Las Vegas bearpoppy individuals and habitat from recreation management at Nellis Dunes, including open OHV use, occurred informally prior to 1998 and formally since the RMP was put in place. No mitigation for loss was identified in the RMP, so this objective is meant to rectify that oversight with a few strategic actions and action steps. The measures of success listed above should be carried out in the more remote areas of the dunes that sustain less OHV use and are thought to harbor remnant plants, seed, and topsoil.

A. Salvage Las Vegas bearpoppy seed bank (and seedlings, if appropriate) from Nellis Dunes in 2007 and/or subsequent years where remnant populations persist.
1. Collect surface soils around remnant plants at the Nellis Dunes and test for seed bank presence.
2. Archive seed and support its use to address research gaps as mitigation.
3. Collect seedlings, if appropriate, for research at NDF or Springs Preserve nurseries.
4. Facilitate seed banking and research activities beginning in 2007.

Nellis Dunes is a managed recreation area which has sustained loss and damage to rare plant habitat, and which would take extraordinary effort to reclaim. Rather than changing management here (and possibly leading to another area in good vegetative condition to be identified for recreation management needs) we recommend that Las Vegas bearpoppy research and feasible salvaging of seed, seedlings, and soil be done for mitigation.

B. Track loss of Las Vegas bearpoppy and habitat for documentation of cumulative take.
1. Document loss and status of population over time.
2. Document status of population in remote areas of dunes where little OHV use occurs.

Loss of individuals and habitat from recreational management has not been tracked regularly at these dunes. Remote areas of the dunes that sustain less OHV use are thought to harbor remnant plants, seed, and topsoil that should be surveyed. BLM may want to consider other management options for any identified remnant populations.

Objective 19: Protect viable populations of sticky wild buckwheat in Gold Butte area (Lime Wash IMA populations) and Virgin River Dunes from trespass grazing and exotic plant impacts.

Baseline viability rank tally: 1 fair
Threat rank tally: 1 high (1 population group)

Sticky wild buckwheat

1. IMA: Viability fair, threats high (Lime Wash)

Measures of success
Key ecological attributes/indicators (see table 55 for indicator definitions):
- Soil structure, stability and movement/Density of animal cattle trails
- Characteristic native plant community/Native versus exotic plant species composition

Threat reduction:
- Numbers of trespass cattle

This objective addresses a single-species concern. Populations of sticky wild buckwheat in Lake Mead NRA on the east side of the Overton Arm are subject to trespass grazing and related invasive plant problems. To ensure that long term viability of populations at Lime Wash and Lower Virgin River is stable and that populations are free from the threats of trespass cattle grazing, trampling, and invasive species competition, three strategic actions are recommended.

A. **Fence population from trespass cattle using available restoration funds and ensure maintenance of fence.**

Fencing will directly protect populations of sticky wild buckwheat from trespass cattle grazing and trampling, which has been occurring for a number of years in the remote areas east of Overton Arm. NPS has funding identified and available to complete the fencing action as soon as possible. Monitoring the fence is necessary because of remoteness and risk of vandalism.

B. **Coordinate with weed program to control exotics in sticky wild buckwheat populations.**

Historic cattle grazing and current trespass has exacerbated the spread of invasive plants, particularly Sahara mustard and African malcomia, in populations of sticky wild buckwheat east of Overton Arm. NPS coordination with appropriate entities setting weed priorities, and inventorying, mapping, and controlling weeds is recommended for action.

C. **Evaluate trespass grazing impacts and management options.**

Fencing is viewed as a short term solution to a complex problem which needs appropriate evaluation of management options to more directly address trespass grazing in the area. Management options identified from this action need to be evaluated for feasibility. Compliance monitoring by NPS is necessary.

PRIORITY CONSERVATION ACTIONS

Priorities for conservation strategies that help to achieve goals of the low elevation rare plant CMS are identified here because funding, capacity (staffing), and other implementation needs are not immediately available to address all actions simultaneously. Strategic actions are evaluated on several factors related to benefits (threat abatement, viability enhancement, contribution, duration, leverage), feasibility (lead individual/institution, ease of implementation, ability to motivate), and cost. Brief descriptions of each of these evaluation criteria follow.

Benefits

Contribution is the degree to which the proposed strategic action, if successfully implemented, will contribute to achievement of the objective(s) ranked from very high to low.
Threat Abatement is the number of threats that can reasonably be expected to have their current threat rank reduced by one or more ranks for one or more of the species within the next ten years if the particular strategic action is successfully implemented.
Viability Enhancement estimates the number of key ecological attributes for all species that might reasonably be expected to be improved by one or more ranks over ten years if the strategic action is successfully implemented.
Duration of Outcome is the degree, to which the proposed strategy, if successfully implemented, is likely to secure a long-lasting outcome ranked from very high to low.
Leverage estimates any constructive influence towards other high-impact strategies (default is Low) ranked from very high to low.

Feasibility

Lead Individual / Institution identifies the lead cooperator(s) for each strategic action and rank default is (HIGH). Estimate leadership rankings are from very high to low.
Ease of Implementation ranks ease of implementation for each strategic action from very high to low.
Ability to Motivate is to what degree are the key constituencies (*e.g.* landowners, public officials, interest groups) whose involvement is critical to implementing the strategic action well understood, and the strategic action is likely to appeal to their key motives, ranked from very high to low.

Total Cost

Estimate the total cost of implementing the strategy, including staff time – in unrestricted or discretionary dollars (i.e. dollars that might be applied to other purposes). Total cost is estimated for the length of the project, although not more than ten years since estimates become less precise with time. They are ranked:

Very High:	Greater than $1,000,000.
High:	$100,001 to $1,000,000.
Medium:	$10,001 to $100,000.
Low:	$10,000 or less.

The MSHCP lists a suite of 604 management actions by lead agency with 18 management actions directly referencing seven of the low elevation rare plant species (12 for Las Vegas bearpoppy including one with sticky ringstem; three for white-margined beardtongue, one for threecorner milkvetch and sticky wild buckwheat combined, and one each for white bearpoppy and alkali mariposa lily). Another 38 MSHCP management actions have indirect references to “special status species”, “covered species”, specific known rare plant habitat locations, or other relevant inferences to the nine plants. Any MSHCP management actions that support conservation strategies for this CMS are listed in the table by agency number as they are listed in the MSHCP (appendix 8).

Table 61 is a summary of priority evaluation criteria and existing agency management actions for the CMS conservation strategies. It identifies the agency, institution, or partner with leading or co-leading responsibility for carrying out a conservation action. It includes a best estimate of the cost of the action to assist with priority setting for budgeting timeframes (see implementation section). A timeline for action activity also is referenced by letters, where A denotes actions with short timeframes and recommended for initial attention in the first year of CMS implementation, B denotes actions recommended for initial attention through the first three years, and C denotes actions with ongoing timeframes requiring multiple years for prioritizing and allocating resources. The last column references agency management actions from the MSHCP.

Table 61. Low elevation rare plant conservation strategies with factors for ranking priorities and existing agency management actions.

(see next 22 pages)

Table 61. Low elevation rare plant conservation strategies with factors for ranking priorities and existing agency management actions.

Conservation Objectives, Strategic Actions, and Action Steps	**Notes on Threat and Viability Rankings Addressed by Objective**	Contri-bution	Duration of Outcome	Leverage toward other Strategies	Leader/ Institu-tion	Ease of Imple-mentation	Ability to Motivate	Cost	Time-line	MSHCP Manage-ment Actions
Objective 1: Proactively protect and manage for long term viability of all populations of nine MSHCP covered rare plants on Federal lands (IMAs, LIMAs, and MUMAs) in Clark County	The number of species populations on Federal lands in Clark County ranges from one for Pahrump Valley wild buckwheat to 16 for threecorner milkvetch. Overall, 35 viability rankings for population groups ordered by MSHCP management categories potentially would be enhanced. A total of 22 unique threats for all nine plants in Clark County potentially would be abated.									
A. Designate specific rare plant populations (identified below) solely for conservation management within 10 years		VH	VH	L	BLM/ NPS	M	M	VH	A	BLM 206 211 220 NDF 3
1. Initiate required agency planning steps as soon as possible to ensure an efficient establishment process for special management designations										
2. Establish ACECs for rare plant conservation management on BLM lands (requires RMP amendment)										
3. Investigate establishing SBAs or RNAs on NPS lands (*e.g.* Virgin River Dunes and Sandy Cove) where needed										
4. If administrative establishment process reaches an impasse, investigate legislative avenues of conservation designation to protect the identified core rare plant habitats										
B. Coordinate MSHCP communications, funding priorities, implementation projects, monitoring protocols, and adaptive management programs among all existing and potential low elevation rare plant conservation partnerships and collaborators		M	H	M	NDF/ DCP	H	H	M	C	BLM 33 35, 99 NDF 3 NPS 15, 21, 34
1. Ensure botanical expertise is included on the MSHCP adaptive management science team										
2. Develop procedures within DCP to regularly coordinate Environmental Planning										

Conservation Objectives, Strategic Actions, and Action Steps	Notes on Threat and Viability Rankings Addressed by Objective	Contri-bution	Duration of Outcome	Leverage toward other Strategies	Leader/ Institu-tion	Ease of Imple-mentation	Ability to Motivate	Cost	Time-line	MSHCP Manage-ment Actions
with Comprehensive Planning and the County's Master Plans										
C. Develop a Clark Co Rare Plant Scorecard website to highlight annual population status tracking, and investigate its potential as a web log to be a visible influence on removing all critical threats to rare plants and habitats		M	H	M	NDF	M	M	L	B	
1. Identify a webmaster to develop, promote, and maintain a web site.										
2. In addition to tracking population status on lands managed by MSHCP cooperators, include populations managed by Nellis at NAFB and NAFBGR (see appendix 7)										
D. Complete all management objectives in BLM's LV bearpoppy Habitat Management Plan by 2020		H	VH	L	BLM	VH	VH	H	C	<u>BLM</u> 99 107 220 304 <u>FWS</u> 30
1. Accomplish all conservation actions listed in the HMP										
2. Review the 1998 HMP and update management objectives, if needed										
E. Document (institutionalize) and continue to implement LMNRA's rare native plant program		H	VH	L	NPS	VH	VH	VH	B	<u>FWS</u> 30 <u>NPS</u> 1, 3, 4, 6, 15, 16, 21, 37, 51
1. Identify NPS staff with primary responsibility to fully implement and document rare plant conservation on LMNRA										
2. Develop and implement a written plan										

Conservation Objectives, Strategic Actions, and Action Steps	Notes on Threat and Viability Rankings Addressed by Objective	Contri-bution	Duration of Outcome	Leverage toward other Strategies	Leader/ Institu-tion	Ease of Imple-mentation	Ability to Motivate	Cost	Time-line	MSHCP Manage-ment Actions
with specific objectives and timeframes for inventory, monitoring, threat abatement, and effectiveness monitoring protocols										
F. Continue botanical surveys on Federal lands to better understand distributions and abundance of low elevation rare plant populations		H	M	L	BLM/ NPS/ FWS/ NDF	VH	VH	H	C	BLM 13, 25 FWS 5, 30 NDF 3 NPS 6
1. Identify appropriate opportunities for annual surveys from priority survey gap areas based on projected development in the County and neighboring areas										
2. Coordinate surveys on an annual basis by agency or contract biologists										
G. Investigate a Low Elevation Rare Plant Conservation Fund to mitigate unavoidable impacts to plants and habitats on Federal lands		M	M	H	NDF/ FWS	M	VH	M	B	BLM 107
H. Conduct applied research on the ecology of insect pollinators of all nine low elevation rare plants		M	--	M	FWS	H	H	H	C	FWS 10 NPS 4, 16
I. Develop an interagency geospatial database to track cumulative plant and habitat loss and disturbance on Federal lands		H	VH	H	BLM/ FWS/ NPS/ NDF/ DCP/ (NNHP)	M	VH	VH	C	
1. Coordinate Clark Co's database for tracking direct take in UMAs with the interagency database for comprehensive tracking										
Objective 2: Manage viable populations of sticky ringstem, LV bearpoppy, white bearpoppy, threecorner milkvetch, sticky wild buckwheat, white-margined beardtongue, alkali mariposa lily in IMAs, LIMAs and MUMAs by removing significant casual	Fair to Poor landscape context for sticky ringstem, Las Vegas bearpoppy, white bearpoppy, threecorner									

Conservation Objectives, Strategic Actions, and Action Steps	Notes on Threat and Viability Rankings Addressed by Objective	Contri-bution	Duration of Outcome	Leverage toward other Strategies	Leader/ Institu-tion	Ease of Imple-mentation	Ability to Motivate	Cost	Time-line	MSHCP Manage-ment Actions
OHV impacts by 2020	milkvetch, sticky wild buckwheat, white-margined beardtongue, alkali mariposa lily in IMA/LIMAs, Mixed, and/or MUMAs; High and Very High Casual OHV use and trail development threat for sticky ringstem, Las Vegas bearpoppy, white bearpoppy, threecorner milkvetch, sticky wild buckwheat, white-margined beardtongue, Parish phacelia in IMAs, Mixed, and/or MUMAs. Overall, 27 viability rankings potentially enhanced and 14 threat rankings potentially addressed.									
A. Restore designated closed roads and trails in rare plant habitat in IMAs within five years of closure		VH	H	L	BLM	H	VH	VH	C	BLM 97, 123, 303, 304
1. Seek commitment of Southern Nevada Restoration Team (SNRT) on an annual basis to accomplish road restoration priorities for low elevation rare plant habitat										
2. Implement public education program for habitat protection/road closure issues using multiple tools (brochures, signage, public service announcements, ads)										
3. Install closure signs and vehicle barriers at access points to closed roads and trails										
4. Increase law enforcement and educational/ informational patrols relative to increasing human population and increasing incursions to ensure that closed roads and trails stay closed										
B. Establish a transportation network on MUMAs by 2010 to identify open roads in rare plant habitats using 1998 RMP baseline		H	H	L	BLM	H	VH	VH	C	BLM 34 211
1. Complete the BLM road inventory and mapping system depicting open and closed roads for monitoring continued road proliferation and as a means of producing public information products										
2. Restore closed roads, add barriers and signage										
C. Maintain law enforcement in closed areas to protect rare plant habitats on Federal lands		VH	VH	M	DCP/ BLM/ FWS/ NPS	VH	VH	VH	B	BLM 98
1. Investigate increasing violation fees in rare plant habitats and ensure their use for										

Conservation Objectives, Strategic Actions, and Action Steps	Notes on Threat and Viability Rankings Addressed by Objective	Contri-bution	Duration of Outcome	Leverage toward other Strategies	Leader/ Institu-tion	Ease of Imple-mentation	Ability to Motivate	Cost	Time-line	MSHCP Manage-ment Actions
rare plant habitat restoration										
2. Maintain a toll-free phone line program for violations reporting by the public										
D. Implement a public education campaign about road closures and rare plant habitat protection		M	H	L	BLM/ FWS/ NPS	VH	M	M	B	BLM 5
E. Continue efforts on the ongoing LMNRA closed road restoration program		H	H	L	NPS	VH	VH	VH	C	
1. Increase NPS law enforcement activities in rare plant habitats										
2. Increase the rate of SNRT road restoration activities at LMNRA to ensure road restoration is accompolished within the specified time frame for objective										
3. Install closure signs and vehicle barriers at access points to closed roads and trails										
4. Implement public education program for habitat protection/road closure issues at LMNRA										
F. Maintain a law enforcement program concentrating on rare plant habitats at Desert National Wildlife Refuge (DNWR) Complex		H	H	L	FWS	VH	H	H	C	FWS 42
1. Intensify current law enforcement efforts on DNWR commensurate with current and future levels of impact										
Objective 3: Control weeds in low elevation rare plant habitats in IMAs, LIMAs and MUMAs by 2020	High to Very High Invasive exotics competition threat for white bearpoppy, threecorner milkvetch, sticky wild buckwheat, white-margined									
A. Identify weed priorities on rare plant habitat within the weed program for Federal lands in Clark County		H	VH	M	BLM/ NPS/ FWS	H	H	H	A	
1. Create a rare plant steering team, or technical advisory group as soon as possible										

Conservation Objectives, Strategic Actions, and Action Steps	Notes on Threat and Viability Rankings Addressed by Objective	Contri-bution	Duration of Outcome	Leverage toward other Strategies	Leader/ Institu-tion	Ease of Imple-mentation	Ability to Motivate	Cost	Time-line	MSHCP Manage-ment Actions
comprised of local agency staff to communicate and coordinate weed treatment priorities for rare plant habitats to SNRT and other affected parties with the weed program	beardtongue, in IMAs, Mixed, and/or MUMAs and Medium threat for sticky ringstem in IMAs and AZ portion of LMNRA; Fair condition for sticky ringstem, Las Vegas bearpoppy, threecorner milkvetch, sticky wild buckwheat, white-margined beardtongue, alkali mariposa lily in IMA/LIMAs, Mixed, and/or MUMAs. Overall, 19 viability rankings potentially enhanced and 10 threat rankings potentially addressed.									
2. Communicate and coordinate weed treatment and other priorities with other professional botanists, scientists, resource specialists, and managers as needed										
3. Set specific project priorities and timeframes for inventorying, implementation projects, and monitoring programs in rare plant habitat										
B. Support the Weed Sentry Program's mapping, early detection, and incipient infestation control program		H	VH	L	BLM/ NPS/ FWS/ NDF	H	VH	VH	C	
1. On an annual basis, ensure agencies prioritize and fully implement the program										
2. On an annual basis, coordinate among agencies and across state lines to identify incipient infestation areas										
C. Beginning in 2007, and annually thereafter, empower and facilitate the efforts of SNRT to facilitate coordination of weed treatments among Weed Sentry Program, Exotic Plant Management Team (EPMT), and others		VH	VH	L	BLM/ NPS/ FWS/ NDF	H	VH	VH	B	
1. Develop an integrated weed management program for rare plant habitats										
2. Identify a NEPA team to facilitate environmental approval of treatment projects										
3. Identify researchers to study impacts of chemical treatments to rare plants and habitats and to research alternative control methods										

Conservation Objectives, Strategic Actions, and Action Steps	Notes on Threat and Viability Rankings Addressed by Objective	Contri-bution	Duration of Outcome	Leverage toward other Strategies	Leader/ Institu-tion	Ease of Imple-mentation	Ability to Motivate	Cost	Time-line	MSHCP Manage-ment Actions
methods										
4. Continue/increase inventorying, treatment, and monitoring programs to ensure that weed treatments are effectively controlling existing infestations and preventing new ones										
5. Develop quality control mechanisms for treatments, including habitat restoration, and for effectiveness monitoring program										
D. Implement a public education program to minimize the spread of weeds and decrease human-caused fire ignitions		H	H	L	DCP	VH	M	M	A	BLM 5
E. Review effectiveness monitoring of projects and make adaptive management adjustments to programs as needed		H	VH	L	DCP/ BLM/ NPS/ FWS/ NDF	H	VH	H	C	
F. Coordinate with all affected agencies (USGS, NPS, BoR, BLM) to develop a multi-pronged approach in finding a solution to access the Virgin River dunes and manage weeds in rare plant populations by 2008		M	VH	L	NPS/ DCP	M	H	M - VH	A	
1. Identify potential alternative access which would not involve crossing private land currently denying access										
2. Acquire private land access from a willing seller or develop an easement access agreement										
3. Work with local weed program to negotiate reasonable access across private land in exchange for weed control or other service on private land										
Objective 4: Ensure that long term viability of low elevation rare plants in IMAs, LIMAs and MUMAs	Very High and High Rural development and									

Conservation Objectives, Strategic Actions, and Action Steps	Notes on Threat and Viability Rankings Addressed by Objective	Contri-bution	Duration of Outcome	Leverage toward other Strategies	Leader/ Institu-tion	Ease of Imple-mentation	Ability to Motivate	Cost	Time-line	MSHCP Manage-ment Actions
is not significantly impacted by rural development and sprawl	sprawl for sticky ringstem, white bearpoppy, threecorner milkvetch, sticky wild buckwheat, white-margined beardtongue, Pahrump Valley wild buckwheat (in UMA/MUMA), and alkali mariposa lily; Fair viability rankings. Overall, 20 viability rankings potentially enhanced and 9 threat rankings potentially addressed.									
A. Increase law enforcement of illegal activities (dumping, casual trail development by recreation enthusiasts, wire burning, etc.) in rare plant habitats		H	M	L	DCP/ BLM/ NPS	VH	H	H	B	
1. Increase BLM and NPS enforcement capacity on public land rare plant habitats in proximity to rural areas										
2. Investigate increasing violation fees in rare plant habitats and ensure their use for rare plant habitat restoration										
3. Maintain a toll-free phone line program for violations reporting by the public										
B. Focus public education tools on rare plants and initiate a volunteer protection program		M	H	M	DCP/ NDF	M	M	M	C	BLM 5
1. Use brochures, public service announcements, signage, schools, etc. for communications on the negative impacts of sprawl and importance of healthy habitats										
2. Develop neighborhood volunteer protection programs to adopt nearby rare plant populations for population monitoring, habitat restoration projects, compliance and violations reporting										
C. Investigate opportunities to acquire land or conservation easements for Pahrump Valley wild buckwheat habitats in Clark and Nye counties, and for threecorner milkvetch and sticky wild buckwheat at Virgin River Dunes		H	VH	L	BLM/ NPS	H	H	M - VH	A	BLM 164
1. Make initial contacts with local landowners to determine willingness to negotiate										

Conservation Objectives, Strategic Actions, and Action Steps	Notes on Threat and Viability Rankings Addressed by Objective	Contri-bution	Duration of Outcome	Leverage toward other Strategies	Leader/ Institu-tion	Ease of Imple-mentation	Ability to Motivate	Cost	Time-line	MSHCP Manage-ment Actions
2. If appropriate, secure SNPLMA funds for acquisitions										
Objective 5: Ensure that disposal of Federal lands in Clark County will not significantly impact comprehensive conservation of low elevation rare plant populations	High BLM land disposal to private development threat for sticky ringstem, Las Vegas bearpoppy, threecorner milkvetch, sticky wild buckwheat, white-margined beardtongue, Pahrump Valley wild buckwheat in MUMAs or adjacent MUMA/UMAs. Overall, 15 viability rankings potentially enhanced and 6 threat rankings potentially addressed.									
A. Survey and inventory populations of sticky ringstem, LV bearpoppy, threecorner milkvetch, PV wild buckwheat, sticky wild buckwheat, white-margined beardtongue within disposal boundaries appropriately to determine current status and significance		M	H	L	BLM	VH	H	H	B	BLM 111
1. Ensure surveys are scheduled well in advance of disposal actions for effective consideration										
B. Reassess low elevation rare plant populations to determine if significance warrants retention in public lands system		M	H	L	BLM	VH	H	L	B	BLM 111
1. Review species status information										
2. Track all populations to better evaluate significance of these populations										
C. Retain significant rare plant populations in public ownership, or find conservation buyer to manage for rare plant habitat if disposal goes forward		VH	VH	L	BLM	M	H	L	C	BLM 111
D. Investigate acquisition of habitat in Sandy (Mesquite Valley population)		H	VH	L	BLM	H	H	L - VH	C	BLM 164
1. Secure funding for acquisition, if warranted, and facilitate timely acquisition of habitat										
Objective 6: Manage rare plants in sandy habitats in IMAs and MUMAs for long term viability by addressing altered fire regimes (increased fire	High Increased fire threat in matrix communities									

Conservation Objectives, Strategic Actions, and Action Steps	Notes on Threat and Viability Rankings Addressed by Objective	Contri-bution	Duration of Outcome	Leverage toward other Strategies	Leader/ Institu-tion	Ease of Imple-mentation	Ability to Motivate	Cost	Time-line	MSHCP Manage-ment Actions
frequency and intensity) over the next century	surrounding threecorner milkvetch, sticky wild buckwheat, and white-margined beardtongue populations because of annual grass invasions; Fair viability rankings. Overall, 20 viability rankings potentially enhanced and 8 threat rankings potentially addressed.									
A. Address research gaps on impacts of Mediterranean grasses (red brome and Mediterranean grass) and Sahara mustard on ecosystem processes in sandy habitats		M	--	L	Inter-agency	H	H	H	C	
B. Address research gaps on effective control mechanisms for annual grasses and control mechanisms beyond currently used mechanical removal for Sahara mustard		M	--	L	Inter-agency	H	VH	H	C	
1. As appropriate, facilitate ongoing research that addresses control of annual introduced grasses and restoration issues (*e.g.* USGS cost effective restoration techniques using native rodents)										
2. Investigate potential impacts of herbicide use (*e.g.* Imazapic, also known as Plateau®) on rare plants, pollinators, and their habitats										
C. Coordinate with county-wide weed program to specifically address fire/weed interactions (see objective 3)		M	H	L	Inter-agency	H	M	M	C	
1. Develop a public education program centered on the link between weeds and fire to control the spread of weeds and decrease human-caused fire ignitions										
D. Maintain acceptable fire regime condition class (FRCC) determined by fire models in areas currently within the natural range of variation		VH	VH	M	BLM/ NPS/ FWS	L	H	VH	C	
1. Using best available practices, control annual grass and Sahara mustard incursions into quality matrix desert systems surrounding rare plant habitat and suppress fire such that 1) large replacement fires are										

Conservation Objectives, Strategic Actions, and Action Steps	Notes on Threat and Viability Rankings Addressed by Objective	Contri-bution	Duration of Outcome	Leverage toward other Strategies	Leader/ Institu-tion	Ease of Imple-mentation	Ability to Motivate	Cost	Time-line	MSHCP Manage-ment Actions
not introduced over the next 115 to 500 years for large patch systems and small patch systems surrounded by infrequent fire vegetation, respectively, and 2) small fires do not recur at the same location for about 150 years										
E. Provide for fire regime condition classes FRCC 1 (within range of natural variability) or FRCC 2 (moderately departed) which avoid crossing thresholds to depleted state (type conversion)		H	VH	L	BLM/ NPS/ FWS	L	H	VH	C	BLM 135
1. Conduct smaller-scale fuels and fire hazard mapping in priority areas of rare plant sandy habitats than existing LANDFIRE data for the Mojave Desert										
2. Using LANDFIRE description of Inter-Mountain Basins Semi-Desert Grassland from the Mojave Desert, improve ratio of matrix patches surrounding rare plant habitat from FRCC 2 to FRCC 1 and FRCC 3 (highly departed) to FRCC 2 using best restoration practices										
3. Investigate use of animals (goats, sheep, and cattle) for strategically-timed and closely managed grazing to reduce exotic fuel loads along roads and other vectors into communities surrounding rare plant habitats										
4. Seed matrix communities surrounding rare plant habitats with native perennial grass mixes as appropriate										
Objective 7: Manage viable populations of all covered rare plants in utility corridors in IMAs and MUMAs (BLM lands), and within potential rights of	High to Very High Utility corridor construction and									

Conservation Objectives, Strategic Actions, and Action Steps	Notes on Threat and Viability Rankings Addressed by Objective	Contri-bution	Duration of Outcome	Leverage toward other Strategies	Leader/ Institu-tion	Ease of Imple-mentation	Ability to Motivate	Cost	Time-line	MSHCP Manage-ment Actions
way corridors at LMNRA	maintenance threat for Las Vegas bearpoppy, white bearpoppy, threecorner milkvetch, sticky wild buckwheat, white-margined beardtongue in IMAs and MUMAs; Fair condition for sticky ringstem, Las Vegas bearpoppy, threecorner milkvetch, sticky wild buckwheat, white-margined beardtongue in IMAs, Mixed, and/or MUMAs. Overall, 13 viability rankings potentially enhanced and 6 threat rankings potentially addressed.									
A. Assure mitigation and a restoration plan is developed for each individual project in corridors/rights of ways with rare plant habitat		H	H	H	BLM/ NPS	VH	VH	M	A	BLM 107
1. Coordinate with appropriate agencies to ensure migigation and restoration are scheduled and accomplished within a 1-2 year timeframe										
2. Refine restoration standards by 2008 to ensure mitigation success in restoration projects										
B. Implement an effectiveness monitoring program		H	VH	L	BLM/ NPS	VH	VH	H	B	
1. Require funding from project proponent, implement monitoring by 3rd party specialists, and ensure land manager/owner oversight of monitoring plan										
2. Develop appropriate protocol for monitoring, restoration activities, and reporting										
3. Ensure clear performance criteria to determine success of mitigation and restoration, and criteria for adaptive management										
4. Require remedial measures if mitigation or restoration is not successful during initial stated timeframes										
C. Implement an adaptive management program		H	VH	H	BLM/ NPS	M	VH	VH	C	
1. Develop a GIS-based current status system of all populations along designated corridors and rights of ways in rare plant habitat										
2. Track cumulative impacts to covered rare										

Conservation Objectives, Strategic Actions, and Action Steps	Notes on Threat and Viability Rankings Addressed by Objective	Contri-bution	Duration of Outcome	Leverage toward other Strategies	Leader/ Institu-tion	Ease of Imple-mentation	Ability to Motivate	Cost	Time-line	MSHCP Manage-ment Actions
plant populations in utility corridors and along existing utility lines independent of designated corridor locations										
3. Coordinate data exchange with effectiveness monitoring program										
4. Develop rapidly escalating mitigation requirements for repeated construction and maintenance impacts to habitat										
5. Secure additional mitigation funds to support weed treatments										
6. Secure additional mitigation funds when avoidance is not possible to study restoration questions related to rare plants and their habitats										
7. Ensure BLM and NPS efforts in overseeing and ensuring appropriate project bond releases										
Objective 8: Manage viable populations of LV bearpoppy in MUMAs	High Highway and road construction and maintenance threat for Las Vegas bearpoppy in MUMAs, and white bearpoppy, Pahrump Valley wild buckwheat, and white-margined beardtongue in Nye Co.; Fair viability rankings. Overall, 8 viability rankings potentially enhanced and 6 threat rankings potentially addressed.									
A. Minimize necessary infrastructural impacts to rare plant populations along roadsides		H	VH	H	NDOT/ FWS / BLM/ NDF/ DCP	H	VH	M	C	NDOT 5 9 10 30 34
1. Coordinate with NDOT to minimize highway maintenance issues										
2. Coordinate with Clark Co. Department of Public Works to minimize road maintenance conflicts with rare plant management										
3. Implement project restoration plans and address related research gaps on propagation										
4. Investigate use of salvaged rare plant material for appropriate highway beautification projects (*e.g.*, LV bearpoppy seedbank and soil for interchanges on gypsum habitats)										

Conservation Objectives, Strategic Actions, and Action Steps	Notes on Threat and Viability Rankings Addressed by Objective	Contri-bution	Duration of Outcome	Leverage toward other Strategies	Leader/ Institu-tion	Ease of Imple-mentation	Ability to Motivate	Cost	Time-line	MSHCP Manage-ment Actions
Objective 9: Manage populations of LV bearpoppy, white bearpoppy, and Parish phacelia at Nellis to ensure positive long term viability trend in IMAs, LIMAs and MUMAs within ten years (See appendix 7 for coverage of this objective)	High or Very High Military activities threat for Las Vegas bearpoppy, white bearpoppy, and Parish phacelia in IMA/LIMAs, MUMAs and UMAs (DoD); High Groundwater development threat for white bearpoppy and Parish phacelia in IMA/LIMAs. Overall, 6 viability rankings potentially enhanced and 6 threat rankings potentially addressed.									
A. Assist implementation of a comprehensive rare plant habitat conservation program within the Nellis INRMP by 2008		VH	VH	H	FWS/ NDF	M	M	H	A	FWS 39
1. Secure Nellis' cooperation and commitment for implementing a rare plant tracking (inventorying and monitoring) program on DoD land										
2. Avoid military activities on LV bearpoppy habitats at Area II and investigate designating a conservation management area (at NAFB)										
3. Avoid military activities on white bearpoppy and Parish phacelia habitats in valley bottoms and foothills (at NAFBGR)										
4. Minimize military activities in areas directly adjacent to these rare plant habitats (at NAFBGR)										
5. Develop compatible ground-based military training activities in Indian Springs and Three Lakes valleys to abate soil compaction and erosion in rare plant habitat (at NAFBGR)										
6. Investigate special designations, such as RNAs for white bearpoppy populations in the Desert, Pintwater, and Spotted ranges, and Three Lakes Valley; and for Parish phacelia at Indian Springs and Three Lakes										

Conservation Objectives, Strategic Actions, and Action Steps	Notes on Threat and Viability Rankings Addressed by Objective	Contri-bution	Duration of Outcome	Leverage toward other Strategies	Leader/ Institu-tion	Ease of Imple-mentation	Ability to Motivate	Cost	Time-line	MSHCP Manage-ment Actions
valleys										
7. Manage ground-based activities so that indirect impacts (*e.g.* weed introductions) are avoided by effective environmental staff and military personnel communications										
8. Boardwalk, fence, or designate trails in LV bearpoppy habitat at Area III and develop a volunteer stewardship program by military families housed at Manch Manor) – need more info on current situation and alternatives (at NAFB)										
9. Develop alternatives to NAFB Area III for base housing expansion and proposed solar generation plant (at NAFB)										
10. Provide rare plant stewardship support (for weed management, base personnel education, habitat protection) by keeping environmental staff informed of latest available information										
B. Perform ongoing research for a better understanding of surface and groundwater connection at NAFBGR		M	--	L	(DOI)	H	M	L	C	
C. Coordinate conservation actions for MSHCP with Nellis' INRMP for consistency and effectiveness		H	VH	L	NDF	H	M	L	C	
Objective 10: Manage viable populations of alkali mariposa lily and white bearpoppy populations in LIMAs and MUMAs by removing wild horse and burro use and addressing impacts of rural sprawl by 2020	High WHB management threat for white bearpoppy and alkali mariposa lily at LIMAs and MUMAs and High Rural sprawl and development for									
A. Fence spring meadow habitats in LIMAs		VH	VH	L	BLM	VH	H	H	B	
1. Designate the NEPA team for fencing										

Conservation Objectives, Strategic Actions, and Action Steps	Notes on Threat and Viability Rankings Addressed by Objective	Contri-bution	Duration of Outcome	Leverage toward other Strategies	Leader/ Institu-tion	Ease of Imple-mentation	Ability to Motivate	Cost	Time-line	MSHCP Manage-ment Actions
projects	alkali mariposa lily; Fair condition for alkali mariposa lily viability; Medium WHB threat for LV bearpoppy, sticky ringstem, threecorner milkvetch and sticky wild buckwheat in IMAs at LMNRA.									
2. Designate a team for implementation and monitoring										
3. Review effectiveness monitoring information and implement adaptive management as necessary										
B. Conduct Wild Horse and Burro removals to ensure appropriate management levels are maintained		VH	M	L	BLM/ NPS	H	H	M	C	BLM 59
C. Allow natural restoration of meadows and gypsum/sand upland habitats		H	VH	L	BLM/ NPS	H	VH	L	C	
D. If necessary, actively restore meadow habitats using best practices		H	VH	L	BLM/ FWS	H	H	H	C	BLM 123
Objective 11: Protect threecorner milkvetch and sticky wild buckwheat populations along Muddy and Virgin rivers in IMAs and MUMAs from significant agricultural impacts over the next fifty years	High Agricultural practices threat for threecorner milkvetch and sticky wild buckwheat in MUMAs and Mixed; Fair viability rankings. Overall, 11 viability rankings potentially enhanced and 4 threat rankings potentially addressed.									
A. Acquire private lands and associated water rights (if feasible) from willing sellers that own habitat (Virgin River and Lower Virgin River, Muddy River and Middle Muddy River)		VH	VH	L	DCP	H	H	VH	C	BLM 164
B. Alternatively, acquire conservation easements from willing sellers that own habitat		VH	VH	L	DCP	H	H	VH	C	BLM 164
C. Assist private landowners with weed control issues that impact rare plants		H	VH	L	BLM/ NDF	VH	VH	M	C	
1. Coordinate with county and local area weed programs										
Objective 12: Ensure conservation management for sticky wild buckwheat, threecorner milkvetch and LV bearpoppy populations at LMNRA (IMA) above high water line and manage populations below high	High Lake Mead inundation and shoreline flux threat for Las Vegas									

Conservation Objectives, Strategic Actions, and Action Steps	Notes on Threat and Viability Rankings Addressed by Objective	Contri-bution	Duration of Outcome	Leverage toward other Strategies	Leader/ Institu-tion	Ease of Imple-mentation	Ability to Motivate	Cost	Time-line	MSHCP Manage-ment Actions
water line during Lake Mead low water years	bearpoppy, threecorner milkvetch, and sticky wild buckwheat in IMAs and Mixed; Fair viability rankings. Overall, 8 viability rankings potentially enhanced and 4 threat rankings potentially addressed.									
A. Maintain viable populations above high water at LMNRA		VH	VH	H	NPS	H	VH	H	C	
1. Negotiate timely receipt of mitigation fees from Lower Colorado River MSCP for acknowledged loss of populations to manage plants and habitat										
B. Manage lower elevation populations for expected longer terms because of greater probability of low reservoir levels		M	M	L	NPS	H	H	M	C	
C. Use lower populations as donor sites for seed, and possibly for sand/soil as lake level increases and threatens inundation		VH	H	H	NPS/ BoR/ DCP	M	M	H	C	
1. Collect seed bank from populations located below high water line										
2. Secure $10,000/year funding (to 2030) from the Lower Colorado River MSCP for sticky wild buckwheat and threecorner milkvetch seed banking and research studies										
3. Document loss of the lower populations as lake levels fluctuate from reservoir management										
4. Investigate and if feasible implement policy changes with BoR regarding reservoir regulation beyond flood control, downstream water supply, and power generation to include management for rare plant population maintenance										
Objective 13: Ensure gypsum mining will not significantly impact habitat of LV bearpoppy and sticky ringstem in IMAs and MUMAs by 2008	High Gypsum mining threat for Las Vegas bearpoppy and sticky ringstem in IMAs and Mixed populations;									
A. Avoid new mining projects on LV bearpoppy and sticky ringstem habitat		VH	VH	L	BLM	VH	VH	L	B	BLM 107

Conservation Objectives, Strategic Actions, and Action Steps	Notes on Threat and Viability Rankings Addressed by Objective	Contri-bution	Duration of Outcome	Leverage toward other Strategies	Leader/ Institu-tion	Ease of Imple-mentation	Ability to Motivate	Cost	Time-line	MSHCP Manage-ment Actions
B. Withdraw rare plant habitat from mineral entry in new specially designated populations on public lands	Fair viability rankings. Overall, 7 viability rankings potentially enhanced and 4 threat rankings potentially addressed.	VH	VH	L	BLM	H	H	VH	C	BLM 107
1. Facilitate BLM's ability to complete withdrawals within five years										
C. Apply best management practices to any unavoidable future mining operations		H	VH	H	BLM	VH	VH	M	C	BLM 107 123
1. Review past mitigation, monitoring, restoration, and lessons learned at mining operations impacting LV bearpoppy and sticky ringstem habitat for guidance										
2. Ensure a mitigation and restoration plan is developed and scheduled to start within a one to two-year timeframe										
Objective 14: Conserve LV bearpoppy's remaining genetic diversity in its western populations in Las Vegas Valley (MUMAs and UMAs) by 2015	High or Very High Urban development and sprawl, Military activities, and Federal land disposal threats for LV bearpoppy in UMA/MUMA (CC, DoD, BLM); Poor viability for LV bearpoppy in UMA/MUMA. Overall, 9 viability rankings potentially enhanced and 3 threat rankings potentially addressed.									
A. Protect four remaining viable populations of LV bearpoppy in the Las Vegas Valley		VH	VH	L	BLM/ FWS	M	H	H	C	BLM 32 107 164
1. Complete assessment of the Conservation Transfer Area in North Las Vegas and designate CTA in a protective management status in perpetuity										
2. Monitor status of population at North Las Vegas Air Terminal										
B. Manage remaining private lands populations where possible under State law		M	H	L	NDF	M	M	M	C	NDF 3
1. Continue status monitoring for LV bearpoppy and tracking cumulative impacts on private lands in LV Valley										
2. Where opportunity exists collect seed for banking, and support research and related										

Conservation Objectives, Strategic Actions, and Action Steps	Notes on Threat and Viability Rankings Addressed by Objective	Contri-bution	Duration of Outcome	Leverage toward other Strategies	Leader/ Institu-tion	Ease of Imple-mentation	Ability to Motivate	Cost	Time-line	MSHCP Manage-ment Actions
mitigation measures										
3. Develop NDF voluntary registry program on private lands										
Objective 15: Ensure construction and maintenance of the Ivanpah Airport does not significantly impact viability of four white-margined beardtongue populations in MUMAs and county land in southern Clark County	Very High Commercial development and Invasive exotics competition threats for white-margined beardtongue in MUMA. Overall, 4 viability rankings potentially enhanced and 2 threat rankings potentially addressed.									
A. Work with county to ensure final orientation of airport and infrastructure minimizes interruption of aeolian sand transport from source to habitat areas		H	VH	L	DCP	H	H	H	C	FWS 29
B. Secure protection of two white-margined beardtongue populations in the 17,000 acre airport extended management area		VH	VH	L	DCP	VH	H	H	C	BLM 300 FWS 29 NDF 3
1. Establish a permanent specially designated conservation management area for two populations (Ivanpah Valley and Roach Lake)										
2. Develop rare plant awareness program and stewardship guidelines for airport staff										
3. Avoid activities that impact rare plant habitat, such as OHV use, and locate (when unable to avoid) infrastructure to minimize habitat fragmentation										
C. Mitigate for no net loss on MUMAs and airport managed land when direct impacts are unavoidable		M	H	H	DCP	VH	H	VH	C	FWS 29
1. Conduct long term monitoring of aeolian sand transport system if deemed necessary to manage sand transport in the plant's habitat										
2. Conduct PVAs and long term population monitoring at all four populations in Clark										

Conservation Objectives, Strategic Actions, and Action Steps	Notes on Threat and Viability Rankings Addressed by Objective	Contri-bution	Duration of Outcome	Leverage toward other Strategies	Leader/ Institu-tion	Ease of Imple-mentation	Ability to Motivate	Cost	Time-line	MSHCP Manage-ment Actions
County										
3. Develop and implement a weed management plan for all four populations in Clark County										
D. Identify NEPA team to evaluate commercial development impacts (*e.g.* roads) to adjacent BLM lands		M	VH	L	BLM	VH	M	M	C	
Objective 16: Ensure that disposal of Federal lands in Nye County will not significantly impact comprehensive conservation of Pahrump Valley wild buckwheat populations (see appendix 7)	High BLM land disposal to private development threat for Pahrump Valley wild buckwheat on MUMAs adjacent to private; Very High Commercial development threat for Pahrump Valley wild buckwheat on UMAs adjacent to public.									
A. Coordinate with participants in Nye County HCP process on conservation actions to protect habitat		H	VH	L	FWS/ DCP/ BLM	H	H	L	C	
B. Retain Pahrump Valley wild buckwheat habitats in public land and manage for long term viability		VH	VH	L	BLM	VH	H	L	C	
1. Investigate special designations for Pahrump Valley wild buckwheat in Stewart and Pahrump valleys.										
Objective 17: Ensure construction of the Mesquite Airport does not significantly impact viability of threecorner milkvetch and sticky wild buckwheat on public lands	Very High and High Commercial development and BLM disposal to private development threats for threecorner milkvetch and sticky wild buckwheat in IMAs and MUMA/UMAs. Overall, 2 viability rankings potentially enhanced and 2 threat									
A. Monitor status of potential land disposal to avoid or minimize impacts to rare plant habitats		VH	VH	L	BLM	H	H	L	C	
B. Work with airport developer to ensure orientation of airport minimizes interruption of aeolian sand transport from source to habitat areas		H	VH	L	CCDA	H	M	H	C	
C. Assess mitigation fees to address impacts to rare plants and habitats		VH	VH	H	NDF/ CCDA	VH	H	M	C	

Conservation Objectives, Strategic Actions, and Action Steps	Notes on Threat and Viability Rankings Addressed by Objective	Contri-bution	Duration of Outcome	Leverage toward other Strategies	Leader/ Institu-tion	Ease of Imple-mentation	Ability to Motivate	Cost	Time-line	MSHCP Manage-ment Actions
1. Condcut long term monitoring of aeolian sand transport system	rankings potentially addressed.									
2. Conduct PVAs and long term monitoring at impacted threecorner milkvetch and sticky wild buckwheat populations										
3. Acquire private habitat or conservation easement for protection										
Objective 18: Mitigate loss of LV bearpoppy and habitat from BLM recreation management actions at Nellis Dunes	Very High Legal OHV use for Las Vegas bearpoppy in MUMA; Fair size rank for MUMAs. Overall, 3 viability rankings potentially enhanced and 1 threat ranking potentially addressed.									
A. Salvage LV bearpoppy seed bank (and seedlings, if appropriate) from Nellis Dunes in 2007 and/or subsequent years where remnant populations persist		H	M	L	BLM/ NDF	VH	M	H	A	
1. Collect surface soils around remnant plants at the Nellis Dunes and test for seed bank presence										
2. Archive seed and support its use to address research gaps as mitigation										
3. Collect seedlings, if appropriate, for research at NDF or Springs Preserve nurseries										
4. Facilitate seed banking and research activities beginning in 2007										
B. Track loss of LV bearpoppy and habitat for documentation of cumulative take		M	L	L	BLM	VH	VH	M	C	
1. Document loss and status of population over time										
2. Document status of population in remote areas of dunes where little OHV use occurs										
Objective 19: Protect viable populations of sticky wild buckwheat in Gold Butte area (Lime Wash IMA populations) and Virgin River Dunes from trespass	Fair condition for sticky wild buckwheat in IMAs from past									

Conservation Objectives, Strategic Actions, and Action Steps	Notes on Threat and Viability Rankings Addressed by Objective	Contri-bution	Duration of Outcome	Leverage toward other Strategies	Leader/ Institu-tion	Ease of Imple-mentation	Ability to Motivate	Cost	Time-line	MSHCP Manage-ment Actions
A. Fence population from trespass cattle using available restoration funds and ensure maintenance of fence	grazing and current trespass and weed competition. Overall, 3 viability rankings potentially enhanced.	VH	VH	L	NPS	VH	VH	H	B	BLM 125
B. Coordinate with weed program to control exotics in sticky wild buckwheat populations		H	VH	L	NPS	VH	H	H	C	
C. Evaluate trespass grazing impacts and management options		VH	VH	VH	NPS	L	VH	H	B	

PRIORITY CONSERVATION ACTIONS (continued)
Strategic actions are prioritized based on two main factors – consequences and species score. Each action was assigned a high, medium or low rank with regard to the possible *consequences of not implementing the action*. A high rank indicates that one or more population groups would be subject to permanent loss or extensive damage if threats to their viability are not abated. This category includes actions that would greatly reduce or eliminate threats. A medium rank was assigned to actions that, if carried through, would demonstratively improve the viability of one or more population groups. This category includes restoration and other mitigative actions. A lower rank includes actions that may, in conjunction with other activities, contribute to the overall conservation-based management of the rare plants, and those that together with other actions, may eventually improve viability of one or more population groups.

A species score was assigned to each conservation action based on the species that it addressed and the relative importance of Clark County to overall management of those species. Accordingly, three species—threecorner milkvetch, sticky wild buckwheat, and white-margined beardtongue are considered to be of highest priority because management of their population groups within Clark County are highly significant with respect to their global distributions, and in the case of the latter because Clark County populations are the largest and most viable. Sticky ringstem, Las Vegas bearpoppy, and Pahrump Valley buckwheat are each assigned a medium species priority. Their populations in Clark County are of management significance; however, less so than the higher priority group since there are additional management options for these species beyond Clark County—at least based on their currently accepted taxonomies. This represents a conservative decision for sticky ringstem because the genetic significance of it's disjunction in the County is yet to be determined. The lowest priority group includes white bearpoppy, alkali mariposa lily, and Parish phacelia. Population groups of these species in Clark County are on the periphery of their global distributions and their overall conservation management needs core area attention beyond Clark County. The numbers of species in each of these priority groups yielded a weighted total species score for each conservation action.

Nine possible rank categories and the number of strategic actions falling within each category are as follows:

Priority 1: Consequences high, species scores high (11 actions)
Priority 2: Consequences high, species scores medium (8 actions)
Priority 3: Consequences medium, species scores high (6 actions)
Priority 4: Consequences high, species scores low (9 actions)
Priority 5: Consequences medium, species scores medium (9 actions)
Priority 6: Consequences medium, species scores low (4 actions)
Priority 7: Consequences low, species scores high (5 actions)
Priority 8: Consequences low, species scores medium (1 action)
Priority 9: Consequences low, species scores low (7 actions)

Table 62 provides the priority ranking for various strategic actions. Of the 60 conservation actions ranked, about 42 percent fall within priorities 1, 2, and 3. To further refine conservation action priorities, table 62 includes feasibility rank, which has three components from table 61—capability of the lead institution, ease of implementation, and ability to motivate key constituencies. For example, of the 11 Priority 1 actions, five have a feasibility rank of very high, four are high, and two are medium. The strategic action priority and feasibility ranks considered together will be useful in determining Clark County funding priorities in any one biennium.

Table 62. Priority and feasibility ranks for each strategic action. Priorities are grouped in 9 possible categories, with 1 being the highest priority action and 9 being the lowest priority (see above). Feasibility ranks are VH=Very High, H=High, M=Medium, L=Low (see table 61). [Four strategic actions were not ranked during the course of this exercise because these actions in and of themselves do not abate threats or improve viability—that is, they are better treated as action steps supporting relevant strategic actions. The strategic action with which each of these actions steps is linked is indicated in this table.]

Conservation Objectives and Strategic Actions	Consequences of not Implementing Action	Species Score-Priority	Strategic Action Priority	Feasibility Rank
Objective 1: Proactively protect and manage for long term viability of all populations of nine MSHCP covered rare plants on Federal lands (IMAs, LIMAs, and MUMAs) in Clark County				
A. Designate specific rare plant populations solely for conservation management within 10 years	H	H	**1**	M
B. Coordinate MSHCP communications, funding priorities, implementation projects, monitoring protocols, and adaptive management programs among all existing and potential low elevation rare plant conservation partnerships and collaborators	H	H	**1**	H
C. Develop a Clark Co Rare Plant Scorecard website to highlight annual population status tracking, and investigate its potential as a web log to be a visible influence on removing all critical threats to rare plants and habitats	L	H	**7**	M
D. Complete all management objectives in BLM's LV bearpoppy Habitat Management Plan by 2020	M	M	**5**	VH
E. Document (institutionalize) and continue to implement LMNRA's rare native plant program	M	M	**5**	VH
F. Continue botanical surveys on Federal lands to better understand distributions and abundance of low elevation rare plant populations	H (Research/Mgt)	H	**1**	VH
G. Investigate a Low Elevation Rare Plant Conservation Fund to mitigate unavoidable impacts to plants and habitats on Federal lands	M	H	**3**	H
H. Conduct applied research on the ecology of insect pollinators of all nine low elevation rare plants	H (Research/Mgt)	H	**1**	H
I. Develop an interagency geospatial database to track cumulative plant and habitat loss and disturbance on Federal lands	H	H	**1**	H
Objective 2: Manage viable populations of sticky ringstem, LV bearpoppy, white bearpoppy, threecorner milkvetch, sticky wild buckwheat, white-margined beardtongue, alkali mariposa lily in IMAs, LIMAs and MUMAs by removing significant casual OHV impacts by 2020				
A. Restore designated closed roads and trails in rare plant habitat in IMAs within five years of closure	M	H	**3**	H
B. Establish a transportation network on MUMAs by 2010 to identify open roads in rare plant habitats	H	H	**1**	H

Conservation Objectives and Strategic Actions	Consequences of not Implementing Action	Species Score-Priority	Strategic Action Priority	Feasibility Rank
using 1998 RMP baseline				
C. Maintain law enforcement in closed areas to protect rare plant habitats on Federal lands	H	H	**1**	VH
D. Implement a public education campaign about road closures and rare plant habitat protection	L	H	**7**	H
E. Continue efforts on the ongoing LMNRA closed road restoration program	M	M	**5**	VH
F. Maintain a law enforcement program concentrating on rare plant habitats at Desert National Wildlife Refuge (DNWR) Complex	H	L	**4**	H
Objective 3: Control weeds in low elevation rare plant habitats in IMAs, LIMAs and MUMAs by 2020				
A. Identify weed priorities on rare plant habitat within the weed program for Federal lands in Clark County	H	H	**1**	VH
B. Maintain the Weed Sentry Program's mapping, early detection, and incipient infestation control program	H	H	**1**	VH
C. Beginning in 2007, and annually thereafter, empower and facilitate the efforts of SNRT to facilitate coordination of weed treatments among Weed Sentry Program, Exotic Plant Management Team (EPMT), and others	H	H	**1**	VH
D. Implement a public education program to minimize the spread of weeds and decrease human-caused fire ignitions	L	H	**7**	H
E. Review effectiveness monitoring of projects and make adaptive management adjustments to programs as needed	M	H	**3**	VH
F. Coordinate with all affected agencies (USGS, NPS, BoR, BLM) to develop a multi-pronged approach in finding a solution to access the Virgin River dunes and manage weeds in rare plant populations by 2008	H	M	**2**	M
Objective 4: Ensure that long term viability of low elevation rare plants in IMAs, LIMAs and MUMAs is not significantly impacted by rural development and sprawl				
A. Increase law enforcement of illegal activities (dumping, casual trail development by recreation enthusiasts, wire burning, etc.) in rare plant habitats	M	H	**3**	VH
B. Focus public education tools on rare plants and initiate a volunteer protection program	L	H	**7**	M
C. Investigate opportunities to acquire land or conservation easements for Pahrump Valley wild buckwheat habitats in Clark and Nye counties, and for threecorner milkvetch and sticky wild buckwheat at Virgin River Dunes	H	M	**2**	H
Objective 5: Ensure that disposal of Federal lands in Clark County will not significantly impact comprehensive				

Conservation Objectives and Strategic Actions	Consequences of not Implementing Action	Species Score-Priority	Strategic Action Priority	Feasibility Rank
conservation of low elevation rare plant populations				
A. Survey and inventory populations of sticky ringstem, LV bearpoppy, threecorner milkvetch, PV wild buckwheat, sticky wild buckwheat, white-margined beardtongue within disposal boundaries appropriately to determine current status and significance	(5C)			
B. Reassess low elevation rare plant populations to determine if significance warrants retention in public lands system	(5C)			
C. Retain significant rare plant populations in public ownership, or find conservation buyer to manage for rare plant habitat if disposal goes forward	H	H	**1**	M
D. Investigate acquisition of habitat in Sandy (Mesquite Valley population)	(5C)			
Objective 6: Manage rare plants in sandy habitats in IMAs and MUMAs for long term viability by addressing altered fire regimes (increased fire frequency and intensity) over the next century				
A. Address research gaps on impacts of Mediterranean grasses (red brome and Mediterranean grass) and Sahara mustard on ecosystem processes in sandy habitats	M (Research)	M	**5**	H
B. Address research gaps on effective control mechanisms for annual grasses and control mechanisms beyond currently used mechanical removal for Sahara mustard	M (Research)	M	**5**	H
C. Coordinate with county-wide weed program to specifically address fire/weed interactions (see objective 3)	L	M	**8**	H
D. Maintain acceptable fire regime condition class (FRCC) determined by fire models in areas currently within the natural range of variation	H	M	**2**	M
E. Provide for fire regime condition classes FRCC 1 (within range of natural variability) or FRCC 2 (moderately departed) which avoid crossing thresholds to depleted state (type conversion)	M	M	**5**	M
Objective 7: Manage viable populations of all covered rare plants in utility corridors in IMAs and MUMAs (BLM lands), and within potential rights of way corridors at LMNRA				
A. Assure mitigation and a restoration plan is developed for each individual project in corridors/rights of ways with rare plant habitat	L	H	**7**	VH
B. Implement an effectiveness monitoring program	M	H	**3**	VH
C. Implement an adaptive management program	M	H	**3**	H

Conservation Objectives and Strategic Actions	Consequences of not Implementing Action	Species Score-Priority	Strategic Action Priority	Feasibility Rank
Objective 8: Manage viable populations of LV bearpoppy in MUMAs				
A. Minimize necessary infrastructural impacts to rare plant populations along roadsides	L	L	**9**	VH
Objective 9: Manage populations of LV bearpoppy, white bearpoppy, and Parish phacelia at Nellis to ensure positive long term viability trend in IMAs, LIMAs and MUMAs within ten years (See appendix 7 for coverage of this objective)				
A. Assist implementation of a comprehensive rare plant habitat conservation program within the Nellis INRMP by 2008	(See app. 7)			
B. Perform ongoing research for a better understanding of surface and groundwater connection at NAFBGR	(See app. 7)			
C. Coordinate conservation actions for MSHCP with Nellis' INRMP for consistency and effectiveness	(See app. 7)			
Objective 10: Manage viable populations of alkali mariposa lily and white bearpoppy populations in LIMAs and MUMAs by removing wild horse and burro use and addressing impacts of rural sprawl by 2020				
A. Fence spring meadow habitats in LIMAs	H	L	**4**	VH
B. Conduct Wild Horse and Burro removals to ensure appropriate management levels are maintained	L	L	**9**	H
C. Allow natural restoration of meadows and gypsum/sand upland habitats	L	L	**9**	H
D. If necessary, actively restore meadow habitats using best practices	L	L	**9**	H
Objective 11: Protect threecorner milkvetch and sticky wild buckwheat populations along Muddy and Virgin rivers in IMAs and MUMAs from significant agricultural impacts over the next fifty years				
A. Acquire private lands and associated water rights (if feasible) from willing sellers that own habitat (Virgin River and Lower Virgin River, Muddy River and Middle Muddy River)	H	M	**2**	H
B. Alternatively, acquire conservation easements from willing sellers that own habitat	H	M	**2**	H
C. Assist private landowners with weed control issues that impact rare plants	M	M	**5**	VH
Objective 12: Ensure conservation management for sticky wild buckwheat, threecorner milkvetch and LV bearpoppy populations at LMNRA (IMA) above high water line and manage populations below high water line during Lake Mead low water years				

Conservation Objectives and Strategic Actions	Consequences of not Implementing Action	Species Score-Priority	Strategic Action Priority	Feasibility Rank
A. Maintain viable populations above high water at LMNRA	H	M	**2**	H
B. Manage lower elevation populations for expected longer terms because of greater probability of low reservoir levels	(12C)			
C. Use lower populations as donor sites for seed, and possibly for sand/soil as lake level increases and threatens inundation	M	M	**5**	M
Objective 13: Ensure gypsum mining will not significantly impact habitat of LV bearpoppy and sticky ringstem in IMAs and MUMAs by 2008				
A. Avoid new mining projects on LV bearpoppy and sticky ringstem habitat	H	L	**4**	VH
B. Withdraw rare plant habitat from mineral entry in new specially designated populations on public lands	H	L	**4**	H
C. Apply best management practices to any unavoidable future mining operations	M	L	**6**	VH
Objective 14: Conserve LV bearpoppy's remaining genetic diversity in its western populations in Las Vegas Valley (MUMAs and UMAs) by 2015				
A. Protect four remaining viable populations of LV bearpoppy in the Las Vegas Valley	H	L	**4**	M
B. Manage remaining private lands populations where possible under State law	L	L	**9**	M
Objective 15: Ensure construction and maintenance of the Ivanpah Airport does not significantly impact viability of four white-margined beardtongue populations in MUMAs and county land in southern Clark County				
A. Work with county to ensure final orientation of airport and infrastructure minimizes interruption of aeolian sand transport from source to habitat areas	H	L	**4**	H
B. Secure protection of two white-margined beardtongue populations in the 17,000 acre airport extended management area	H	L	**4**	H
C. Mitigate for no net loss on MUMAs and airport managed land when direct impacts are unavoidable	M	L	**6**	H
D. Identify NEPA team to evaluate commercial development impacts (*e.g.* roads) to adjacent BLM lands	M	L	**6**	H
Objective 16: Ensure that disposal of Federal lands in Nye County will not significantly impact comprehensive conservation of Pahrump Valley wild buckwheat populations				
A. Coordinate with participants in Nye County HCP process on conservation actions to protect habitat	(See app. 7)			
B. Retain Pahrump Valley wild buckwheat habitats in public land and manage for long term viability	(See app. 7)			

Conservation Objectives and Strategic Actions	Consequences of not Implementing Action	Species Score-Priority	Strategic Action Priority	Feasibility Rank
Objective 17: Ensure construction of the Mesquite Airport does not significantly impact viability of threecorner milkvetch and sticky wild buckwheat on public lands				
A. Monitor status of potential land disposal to avoid or minimize impacts to rare plant habitats	H	M	**2**	H
B. Work with airport developer to ensure orientation of airport minimizes interruption of aeolian sand transport from source to habitat areas	H	M	**2**	M
C. Assess mitigation fees to address impacts to rare plants and habitats	M	M	**5**	H
Objective 18: Mitigate loss of LV bearpoppy and habitat from BLM recreation management actions at Nellis Dunes				
A. Salvage LV bearpoppy seed bank (and seedlings if appropriate) from Nellis Dunes in 2007 and/or subsequent years where remnant populations persist	M	L	**6**	H
B. Track loss of LV bearpoppy and habitat for documentation of cumulative take	L	L	**9**	VH
Objective 19: Protect viable populations of sticky wild buckwheat in Gold Butte area (Lime Wash IMA populations) and Virgin River Dunes from trespass grazing and exotic plant impacts				
A. Fence population from trespass cattle using available restoration funds and ensure maintenance of fence	H	L	**4**	VH
B. Coordinate with weed program to control exotics in sticky wild buckwheat populations	H	L	**4**	H
C. Evaluate trespass grazing impacts and management options	L	L	**9**	M

MONITORING FRAMEWORK

This section of the low elevation rare plant CMS addresses a monitoring framework for these plants. Although monitoring is often seen as a last step (lower left box of figure 4) and possibly too challenging, it is a necessary component of conservation management and should be planned by design at early stages of project development. Monitoring, or measuring success, allows documentation of adapting and learning for better management, and importantly it enables project (and program) transparency and accountability. It is important to know if the conservation actions taken are having their intended impact as well as how the species and their habitats are doing. Thus, useful measures should be an integral part of conservation management designed to:

- gather information which will improve management (adaptive management)
- track progress toward meeting stated objectives and ensure more effective, efficient, and credible conservation action (effectiveness monitoring) and,
- document overall status of threats and species viabilities (status monitoring).

The nine low elevation rare plants have varying documented monitoring histories that range from no monitoring for sticky ringstem and Pahrump Valley wild buckwheat, to many years of population status monitoring at several permanent macroplots and sites along with some summary analyses for Las Vegas bearpoppy. In between these extremes are written monitoring plans and initial baseline data collection for white bearpoppy and Parish phacelia at two sites each, and several years of tracking presence (along with additional population information on occasion) at variable sites for two annuals—threecorner milkvetch and sticky wild buckwheat. All nine low elevation rare plants need evaluations or re-evaluation of their monitoring efforts to better link them with conservation actions taken on their behalf. To assist with this, we offer the following framework which discusses 1) strategy effectiveness measures; 2) status measures and early-warning detection; 3) considerations for designing useful monitoring plans for the low elevation rare plants; and, 4) adaptive management, which segues to the next section on CMS implementation.

Strategy Effectiveness Measures

When conservation action is taken on behalf of the MSHCP-covered low elevation rare plants, we hope to see a series of changes happen as a result of taking action. A number of possible indicators measure change at several points in the process—which is best explained using an example of a rare plant population for a stated objective and action. It is desirable to concentrate on indicators that are associated with threat and viability objectives. Figure 33 is an example using strategic action B in objective 2 for the gypsophile species and habitats:

> *Objective 2:*
> *Manage viable populations of sticky ringstem, Las Vegas bearpoppy, white bearpoppy, threecorner milkvetch, sticky wild buckwheat, white-margined beardtongue, and Parish phacelia in IMAs, LIMAs and MUMAs by removing significant casual OHV impacts by 2020.*
>
> *Strategic Action B:*
> *Establish a transportation network on MUMAs by 2010 to identify open roads in rare plant habitats using 1998 RMP baseline.*

Effectiveness monitoring, above the dashed line, includes tracking indicators of key ecological attributes (Las Vegas bearpoppy, white bearpoppy, and sticky ringstem population size) and direct threats to their habitats (casual OHV use and habitat fragmentation). Tracking implementation of the conservation action ensures progress toward meeting the objective.

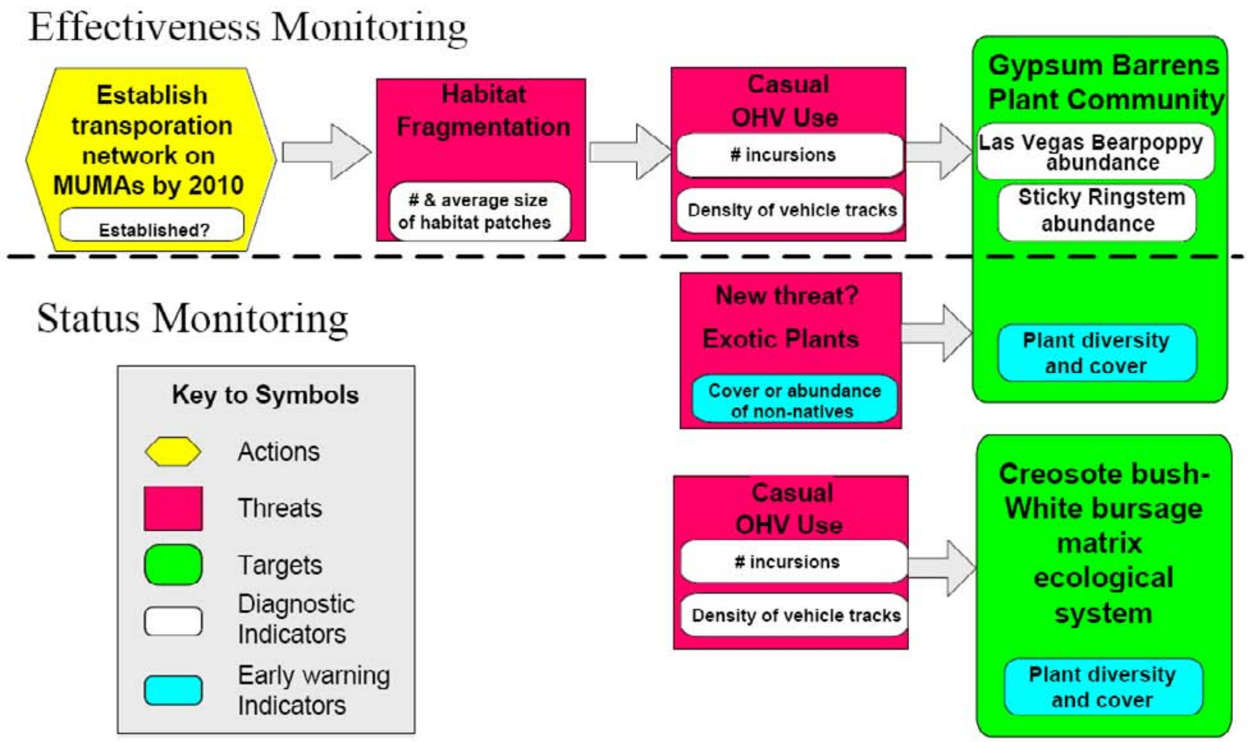

Figure 33. Block diagram of gypsophile rare plant species, habitats, relationship with threats, and possible indicators of effectiveness and status monitoring.

Block or conceptual text diagrams might show activities (the actual actions being taken), outputs (the immediate products of the project's actions), outcomes (the intermediate results – often measures of threat reduction) and the biodiversity impact – how the species and their habitats are actually improving. This classification is useful to distinguish other indicators associated with inputs (staff, money, capital investments). It is important to track more than just the species or habitats of concern when one is trying to figure out whether actions are achieving their intended results. Measures of the activities implemented and measures of threat abatement are critical to understanding whether strategic actions are working. Diagnostic indicators are used for monitoring and evaluation when there is at least some understanding of the causal relationship with effect. These indicators are used both where action is being taken to counter specific threats and whether those actions are having their desired outcome, but also where there is need to track new and potential threats.

For most conservation projects taking place at low elevations in Clark County there are additional aspects of the rare plant species and their habitats that are not linked to specific actions being taken. There is a need to track the *status* of these key attributes as well, but they are status indicators and not effectiveness indicators.

Status Measures

Periodic assessments provide confirmation of a good/very good viability rank or a low/moderate threat status, and as such they are status monitoring and evaluation. Alternatively, periodic assessments may reveal a declining fair/poor viability rank or an increasing high/very high threat rank which would trigger taking action. Once action is taken, there is a shift from status-only monitoring to determining effectiveness of management treatments. One might be tracking identical diagnostic indicators in both types of monitoring, but the reason for tracking the indicator has changed.

Some studies of intact systems are needed to serve as reference areas or to establish baseline conditions if future impacts are anticipated. They may be needed in some areas to learn basic life history information, better understand ecological processes, identify key ecological attributes, or to study the effect of threats (*e.g.* habitat fragmentation). However, investment of limited conservation resources in this type of status monitoring should be carefully evaluated and not done everywhere. There should be strong applied effectiveness monitoring addressed at many of the species population groups where conservation action is being taken.

Early warning detection is tracking primarily to confirm that no action is needed. For example, one might periodically check for presence of non-natives in areas of gypsophile habitat subject to disturbance (*e.g.* along roads and washes). Early warning indicators are tracked because there is a potential threat (expansion of an invasive population), but no action is yet being taken (weed control treatments). Cost-effective threat abatement solutions often are found by directly discovering and acting on new threats rather than waiting until the threat changes viability of the species and their habitats. A cursory site visit can be a cost-effective method of early warning detection, while at other times satellite imagery or other remotely-sensed documentation may be needed.

Designing Useful Monitoring Plans

Monitoring plans are driven by three different sources of information: 1) objectives and project plans; 2) viability summaries (*e.g.* tables from the CAP workbooks); and, 3) threat summaries (also, *e.g.* tables from the CAP workbooks). Considerations for designing useful monitoring plans for each of the low elevation rare plant species follow.

Management objectives and specific project or work plans drive adaptive management. Devise clear statements of desirable management outcomes for populations of each species on Federal lands (or other ownerships as appropriate). Complete census of rare plant populations is likely impossible because of the level of effort required. Instead identify sample populations across the geographic range of a given species in Clark County, and be sure to represent varying management units and typical habitats for the populations sampled. Results will be relevant for the sampled populations rather than for the species as a whole, so the initial selection of sample populations is extremely important. (Using sample populations to estimate total population size of a species poses problems because of heterogeneity of habitats, large variances in population response between years, and the large numbers of samples required). Monitoring objectives follow and specify how measures of management objectives are made. If monitoring and evaluation shows those management objectives are not being met, then changes are made adaptively.

Next identify effectiveness indicators and link them to appropriate monitoring methods and resources available. The monitoring worksheet in the CAP workbook is one way to organize and document monitoring projects. Effectiveness monitoring indicators could include *capacity, threat,* and *viability* indicators directly tied to strategic actions. Status monitoring for species viability uses indicators of key ecological attributes and they are not directly tied to specific objectives. Some status monitoring may be at populations with known threats, so direct measures of levels of threat are good indicators to use; but, some status monitoring may be at populations where early detection is desired to determine if a strategic action is warranted. By stating clear monitoring objectives, whether for effectiveness or status monitoring and evaluating results appropriately, monitoring informs next iterations of conceptual models, conservation strategies, and work or project plans.

Useful monitoring plans include eight habitual points: who, what, when, where, why, how much, for how long, and for whom. Table 63 is an example of these points adapted from the monitoring worksheet in the CAP workbook. Management objectives concentrate on *why* monitoring is done, whereas monitoring objectives might include *who, what*, *when, where*, *how much*, and so on.

Table 63. Example of low elevation rare plant (gypsophile) monitoring information for inclusion in a monitoring plan.

Category	Key Ecological Attribute	Indicator	Methods	Frequency and Timing	Location	Who Monitors	Annual Cost	Funding Source
Threat-based		Density of OHV roads and trails	Satellite imagery reviews	Monthly or as available (bimonthly?)	Populations adjacent to city boundaries (at a minimum)	BLM/NPS	Minimal (imagery from Clark County)	
Threat-based		Exotic plant presence (early warning indicator)	Spot surveys of randomly selected populations	Annually; early, middle and late growing season	Among Clark Co. sample populations with roads, utility corridors, mines (& other vectors)	Weed Sentry Program	$20,000	SNPLMA
Landscape Context	Precipitation	Winter (Dec-Jan-Feb) seasonal rainfall	Obtain records from Clark Co/ DRI/NOAA	Daily	Established climate stations nearest sample plots	BLM/NPS	Minimal	
Landscape Context	Soil moisture and nutrient regime	Cover of cryptobiotic crusts and gravel surfaces disturbed	Surveys of permanent sample plots	Annually	Clark Co. permanent sample populations	BLM/NPS/NDF	$5,000	
Condition	Recruitment	Frequency of germination events	Surveys of permanent sample plots	Annually; early growing season	Clark Co. permanent sample populations	BLM/NPS/NDF	$5,000	
Condition	Pollination	Presence of characteristic pollinators	Surveys of randomly selected transects at permanent sample plots	Annually; during main flowering period	Selected Clark Co. permanent sample plots	BLM/NPS	$4,000	
Size	Population size	Number of reproductive plants in non-drought periods	Surveys of permanent sample plots	Years with $\geq$ normal ppt; during main fruiting period	Clark Co. permanent sample populations	BLM/NPS/NDF	$5,000	

Monitoring plans also state what appropriate standard techniques are to be used for observation and documentation of plant response over time (*e.g.* annual versus perennial plants, seedlings versus mature plants).

Characteristics of good monitoring indicators are biologically (and socially) relevant, measurable, and cost-effective. They also are appropriately precise and might be pre-emptive such that early action is identified and acted on before a major management problem ensues. To find cost-effective monitoring solutions that meet information needs consider low-cost, qualitative options rather than no monitoring, or combining qualitative with quantitative monitoring. Less frequent monitoring visits may be more desirable than no monitoring at all. Monitoring costs might be reduced by engaging volunteers in monitoring projects or using conservation partner data whenever possible. Sometimes information needs can be met by measuring one indicator that suggests status of several attributes rather than tracking several attributes individually.

Select methods to collect monitoring data and consider the appropriate temporal and spatial scale of the species or threat. Select methods of data collection that are accurate and reliable, as well as feasible. Here again, consider cost-effective methods mentioned above. Some critical questions to ask include: Has at least one indicator and monitoring protocol been identified for each threat abatement and restoration objective? Have inconsequential, irrelevant or redundant indicators been excluded? Is the approach appropriate? Can the monitoring plan be feasibly implemented? (*e.g.* Is it too expensive?).

To assist with designing and implementing good monitoring plans be aware of common monitoring pitfalls. They include: 1) lack of a clearly stated purpose; 2) tracking either inefficient or ineffective indicators; 3) using a poor study design or inefficient and ineffective methods; 4) gathering data which are never summarized; 5) summarizing data, but not interpreting it relative to objectives; 6) summarizing and interpreting data appropriately, but not relaying results to managers; 7) using data at the local project level, but never sharing lessons learned with broader audiences.

In conclusion, there are materials available to help guide Clark County and CMS cooperators with the task of designing monitoring plans. Two relevant ones are:

- *Measuring Success: Designing, Managing, and Monitoring Conservation and Development Projects*, by Margoluis and Salafsky (1998), available from Island Press; and,
- *Conservation Measures Partnership website*: www.conservationmeasures.org

Adaptive Management

Adaptive management is the systematic collection and application of reliable information to improve natural resource management over time (Wilhere 2002). The adaptive management process is an iterative succession of steps and for any given conservation strategy it involves: 1) defining the project—including the species, habitats, and objectives of the management action; 2) conducting a current situation analysis (*e.g.* conceptual model); 3) developing a work plan; 4) developing a monitoring plan; 5) implementing the plans; and, 6) analyzing outputs and communicating results. These steps are shown in figure 34.

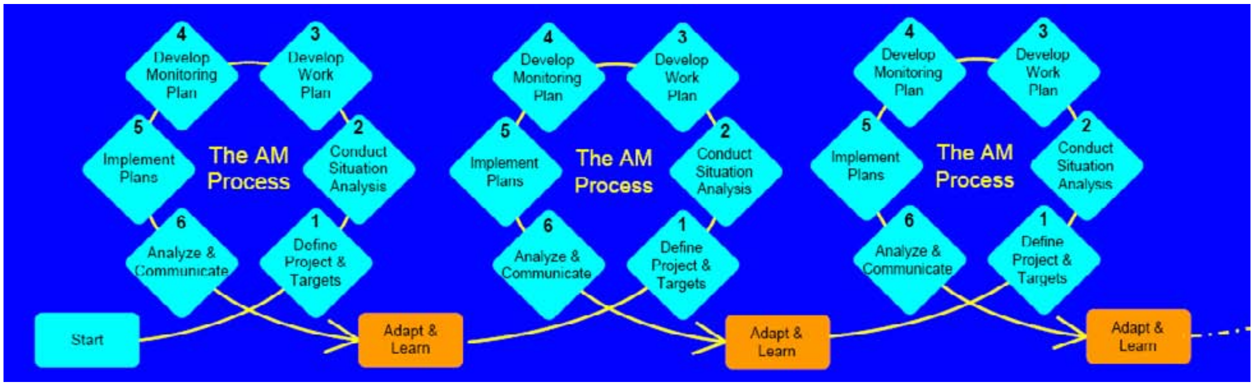

Figure 34. The iterative process of adaptive management over time.

Adapting and learning is needed to improve effectiveness of the conservation actions being taken, to enhance the knowledge base of DCP and project cooperator agencies, and to share in learning beyond this CMS project scope. Using measures information obtained in the steps above, identify what worked as predicted, what did not, and if possible why it did not. Producing predicted outcomes is often not possible, yet it is possible to make hypotheses. Are there minor changes or major corrections required after initial assumptions were tested? Make adjustments to the work plan (objectives, outcomes, strategies, and action tasks) and monitoring plan (indicators, methods) as necessary. Do these reviews systematically on a regular basis (*e.g.* biennially), and consider the value of external reviews (*e.g* other cooperators, adaptive management team, conservation partners). Uncertainty will always exist at some level for any given species and situation, so taking initial appropriate action—even in the face of uncertainty—and then keeping adaptive management in motion is very important.

Wilhere (2002) includes a block diagram and discusses the active adaptive management process specifically for habitat conservation plans and is relevant for this CMS.

IMPLEMENTATION FRAMEWORK FOR LOW ELEVATION RARE PLANT CMS

GUIDELINES FOR SETTING BUDGET PRIORITIES

The assignment of implementation priority rankings in table 62 is provided as guidance to the County and others involved in development of budgets, whether biennial or otherwise. Importantly, considerations of number and priority of species in Clark County that will benefit from implementation of an action, the consequences of taking no action, and the feasibility of taking action are critical initial assessments in the decision-making process and reflect the most appropriate suite of actions that could be taken under the most accommodating and optimal circumstances. However, these priorities should be assessed in appropriate budgeting timeframes (annually, biennially, or otherwise) because they are similar to a snapshot in time where funding and related circumstances change.

For example, if circumstances allowed sufficient funding during the next budget cycle, cooperating agencies, Clark County, or conservation partners could commit to accomplishing many of the actions in the Priority 1 group, and selecting from among the most feasible of the priorities in groups 2, 3, and 4. The Priority 1 group includes the following 11 actions (denoted by objective number and strategic action letter, *e.g.*, 1.A refers to Objective 1, strategic action A):

- 1.A. Designate specific rare plant populations for conservation management
- 1.B. Coordinate MSHCP communications, funding, projects, monitoring, and adaptive management
- 1.F. Continue botanical surveys on Federal lands
- 1.H. Conduct research on pollinators
- 1.I. Track cumulative loss of rare plant populations and habitats
- 2.B. Establish transportation network in MUMAs
- 2.C. Maintain law enforcement in areas closed to OHVs
- 3.A. Identify weed treatment priorities for rare plant habitats
- 3.B. Maintain weed mapping, early detection, and control program
- 3.C. Coordinate weed treatments with other entities
- 5.C. Retain significant populations of rare plants in public ownership

In evaluating the suite of Priority 1 actions, the agencies should consider the dynamic nature and limitations of resource management to determine the most suitable suite of expenditures in any one biennium. Some of the most significant considerations are as follows:

Urgency – If the action is not undertaken relatively soon, will populations or habitats be permanently lost, or will the costs of carrying out the action become prohibitive in the future? For example, is the threat of widespread weed invasion in particular habitats so extreme that if actions are not taken very soon the costs or feasibility of treating (and eventually controlling) them in future years become prohibitive? An assessment of urgency also should be considered in evaluating Priority 4 actions, *i.e.*, actions that may benefit only one or a few of the rare plant species but that have a high consequence if not carried out. If there is a risk of population or habitat loss if action is not taken soon, then Priority 4 actions should be undertaken as soon as possible rather than leaving for later. For example, conservation actions to abate the threat of population or habitat loss in Clark County for white-margined beardtongue from construction of the Ivanpah Airport may become more urgent as developments in the process advance.

Funding availability – How much funding is available within the biennial budget or other cycle? Can funding be sought elsewhere? If so, Clark County and cooperating agencies can work together to pursue alternative sources of funding to accomplish the action. For example, the action may be appropriate for funding other than the Conservation Initiatives category of SNPLMA, or through funding from federal appropriations or private foundations. Some actions need only be implemented once (*e.g.*, mineral withdrawals) while others will be an ongoing expenditure (*e.g.*, law enforcement, weed control). Careful consideration should be given to how to fund one-time actions as soon as possible since costs associated with those actions is likely to increase over time. Additionally, if effectiveness monitoring is required for a specific conservation action (*e.g.* restoration), identifying funding early for the monitoring component is best done when identifying funds for project implementation.

Socioeconomic factors – Are existing socioeconomic conditions suitable for implementation of the action? Are there impediments such as stakeholders opposed to the action that would make implementation at this time extremely difficult, cost prohibitive or overly time consuming? For example, are other entities concerned with the nature of the action such that extensive negotiations will be necessary prior to being able to implement the action?

Biophysical factors – Are there climatic or other biophysical factors that would make implementation of the action infeasible at this time? For example, if fire danger is extreme in any one year is there reason to believe that agency personnel simply will not be available during that year to implement the action?

Available expertise – Do the cooperators and partners have the necessary expertise to implement the action at this time? Are qualified managers available to oversee and carry out actions of field crews?

Agency capacity – Are agency staff available to work on these actions or are there other priorities in place that would preclude their involvement? For example, agencies have pre-project environmental compliance activities that must be carried out so staff need to be available to complete necessary environmental planning. Similar questions should be evaluated for agency leadership capacity and other members of any needed multidisciplinary teams—is their availability secured to give the required level of support needed for successful implementation?

Windows of opportunity – Are there circumstances that would facilitate low cost and ease of implementation of a lower priority action that may not be in place in later years? For example, cooperating agencies or involved partners currently may have incentives to participate that could be of benefit soon but not in later years. Two examples are alternative or discretionary funding sources and temporary work crews.

Coordinating/facilitating efforts of others – Are there actions that could be undertaken at little cost only if Clark County, the agencies, or others invests the time and staff to facilitate completion of the action by others. For example, the Colorado River MSCP is required to facilitate and make funds available to implement actions on the Lake Mead shoreline that could benefit habitat for the four rare plants there.

Based on a periodic opportunity/feasibility analysis using a suite of these factors, agencies may determine that some of the conservation actions identified under Priority 1 are simply not possible to undertake in the next biennium, and those actions from Priority 2, 3 or 4 groups should be addressed. For example, the Priority 2 group includes the following actions:

- 3.F. Address Virgin River Dunes access and weed issues
- 4.C. Investigate and if possible acquire habitat in Pahrump Valley and at Virgin River Dunes
- 6.D. Maintain fire regime condition class in sandy rare plant habitats (where FRCC is currently within historic range of variation)
- 11.A. Acquire habitat and/or water on the Virgin and Muddy rivers
- 11.B. Alternatively, acquire conservation easements on habitat along the Virgin and Muddy rivers

- 12.A. Maintain threecorner milkvetch and sticky buckwheat populations above Lake Mead high water line
- 17.A. Ensure land disposal associated with Mesquite airport avoids or minimizes impact on threecorner milkvetch and sticky buckwheat habitat
- 17.B. Work with Mesquite airport developer on a low impact configuration

In a review of Priority 2 actions it may be determined that opportunity and feasibility factors are more favorable in a given biennium for completing some of these actions rather than those included in Priority 1. The same exercise should be undertaken for activities in priorities 3 and 4. Because the full suite of conservation actions were developed to meet objectives to reduce threats and maintain or improve population group viabilities, the actions in priorities 5 through 9 also need to be examined to evaluate opportunities, feasibility, and appropriate timeframes for implementation funding.

ROLES AND RESPONSIBILITIES

Successful implementation of conservation actions is hinged on clear assignment of roles and responsibilities. DCP staff has many responsibilities that are shared with agency cooperators and partners, given sufficient expertise within their agencies and organizations. The cooperating Federal and State agencies each have responsibility within their agency and programmatic framework to assess strategy priorities, design and implement work and monitoring plans, evaluate and communicate results to achieve goals and objectives of the CMS. The following considerations apply:

Coordination – Clark County DCP, FWS, BLM, NPS, and NDF each have a role in assisting with coordination and communication among entities implementing the low elevation rare plant CMS. The rare plant steering team or technical advisory group comprised of local agency staff, which is recommended initially to address immediate weed priorities in rare plant habitat, could be enlisted to aid coordination of implementation priorities for a given year or biennium among agencies. This course is recommended to ensure that funding and implementing strategies is not redundant, inefficient for limited resources, or incomplete among the permittees, state agencies, and federal agencies. In every budget cycle, feasibility factors (funding opportunities, capacities, and socioeconomic conditions) will need to be evaluated because feasibility of a strategy changes over time. Although each entity involved in setting internal priorities, recommending funding, and determining projects does so within their agency process, communication and coordination among all involved in the low elevation rare plant CMS is an imperative synergy to effectively accomplish CMS and MSHCP goals.

Project oversight – There should be ongoing oversight of conservation projects to identify impediments to completion. Quarterly reports are an important aspect of project oversight, but these reports should not be overly complex or time consuming. They would provide the basis for those responsible for project implementation to identify problems and the need for assistance. There should be designated individuals, such as Clark County project managers, charged with assisting projects in overcoming any implementation obstacles. Objectives and actions 1B, 3C, 3F, 6C, 17B (and 9C and 16A in appendix 7) are coordination tasks that provide a framework for implementation oversight. There should be sufficient staff and leadership capacity within the DCP and primary agency cooperators to identify and address overarching and significant problems. These individuals, in order to be effective, should have sufficient management authority for making decisions in a timely manner.

Stakeholders – The processes associated with project implementation should be transparent to stakeholders; however, careful consideration needs to be given to avoid overly complicated, convoluted, or time-consumptive procedures that impede timely conservation action implementation. Involving key community figures and stakeholders who support specific conservation actions can sometimes be instrumental in resolving other stakeholder issues.

ALLOCATION OF RESOURCES

The question of how to allocate limited resources has many challenges in natural resources and conservation management. The first challenge in allocating resources is to determine use of resources and level of effort needed to take action versus those needed for monitoring priorities. For those low elevation rare plant population groups on Federal land where threats and conservation action to reduce threats have been identified, available funding resources should be divided among taking action, and doing research and monitoring. Low cost, easy to accomplish, short term (or one time only), politically and community supported actions with leadership and staff capacity should be identified for taking action as soon as possible. Costlier, difficult, and longer term (or ongoing) actions need to be sieved through evaluation factors discussed in the implementation section.

There are several issues to consider when balancing effectiveness measures of taking conservation action (whether using viability indicators or threat level indicators) versus status measures. They include: 1) the presence of known serious threats; 2) the level of current understanding of plant species, their key ecological attributes, and the likely impact of threats; 3) degree of certainty in effectiveness and risks of alternative management strategies; and, 4) available resources. There is no set formula for evaluation since new information becomes available and management situations change.

Where threats are known and if current monitoring only addresses status and trend, a re-evaluation of management and monitoring is warranted. Relatively little monitoring investment is needed when no action is required to reduce potential threat levels (status assessment only). Greater monitoring investment is needed when there are clear and feasible actions taken at any scale or to test multiple actions in an effort to determine best practices. Almost all projects should collect some combination of species and threat-based indicators to assess both status and measure effectiveness. It is relatively easy to shift a portion of a monitoring budget to threat reduction action, or to adopt a new lower cost monitoring approach, or to monitor a threat directly. It becomes harder when confidence levels of indicators and appropriate actions are low or unknown. Salzer and Salafsky (2003) include a decision tool for allocating monitoring resources between status assessment only versus status assessment and effectiveness measurement. They consider knowledge base regarding diagnostic indicators and whether clear and feasible actions to reduce threats are well understood.

While tangible on-the-ground conservation action is fundamental to the success of the DCP, applied research and monitoring are a necessary part of the overall process of adaptive management, without which, the DCP cannot determine the success of its efforts. The adaptive management program makes recommendations for research, monitoring and actions. Clark County's advisory committee makes final recommendations on what should be implemented. Another challenge for resource allocation is determining how much effort should be directed to random plot surveys across low elevations in the County to test initial distribution assumptions.

One coordination issue that should not be neglected is determining the extent to which existing research entities can be persuaded to address key applied research topics through the use of alternative funding sources. For example, the U.S. Geological Survey's Biological Research Division in Henderson has an active plant ecology program with existing staff expertise to address many of the research topics identified in table 4. Similarly, there is ecological expertise resident within the University of Nevada System and a number of foundations that support applied ecological research. All agencies should pursue partnerships and dialogues that advance collaboration in identifying funding resources to address the many research needs that have been identified.

REVIEW AND ASSESSMENT OF LOW ELEVATION RARE PLANT CMS

Assessing the conservation needs of other rare plants identified as covered, evaluation or watch species for the MSHCP needs a mechanism for review. An initial exercise based on species viability and threats criteria can assist in ranking species not yet considered a priority in the MSHCP. The Nevada Department of Wildlife's Nevada Wildlife Action Plan is a recent example of developing a ranking system for species (Wildlife Action Plan Team 2006). In this plan NDOW assigned scores for various viability, threats, and conservation criteria to wildlife species in Nevada and developed a matrix that ranks species based on greatest conservation need. Similarly, a technical review team composed of representatives from Clark County's DCP, adaptive management contractor, and appropriate expertise from agency cooperators would assess a rare plant species based on the following criteria:

Formal and Other Listing Status – Is the species federally listed by the USFWS under the ESA or state listed by Nevada under NRS 527.260? Is the species critically imperiled (1) or imperiled (2) because of rarity or other demonstrable factors by NatureServe?

Population Abundance and Trend – Are the species known populations at a few locations and mostly small in size? Are the known populations with documented declines at one or more locations?

Significance of Distribution in Clark County – Are the species known locations in Clark County significant or critical for long term viability with respect to its overall distribution? Consider the genetic contribution from Clark County if known, if habitats are significantly differently in Clark County, or whether Clark County locations are disjunct and isolated from other populations.

Habitat Condition and Trend – Are the species known habitats in Clark County declining, undergoing fragmentation or increasingly swifter degradation? Are indicators of habitat condition and maintenance (ecosystem processes) mostly poor or fair?

Threats – Are threats to the species or its habitats rapidly increasing in scope or severity across Clark County? Are direct indicators of threats considered mostly high or very high?

Affirmative answers to these questions indicate high risk to the species. Timeframe for these assessments are probably best served on an as needed basis when the DCP or agency cooperators are analyzing a given situation for a rare plant. The review team might then seek input or confirmation of concerns from broad based rare plant evaluation networks, such as the NNHP and Nevada Native Plant Society hosted annual rare plant workshop or Ecological Services of USFWS.

The low elevation rare plant CMS itself should be evaluated and revised as necessary after completion of three biennial budget cycles or six years. This will provide the opportunity for an overall assessment of MSHCP low elevation rare plant conservation in Clark County as it is a reasonable timeframe for progress on many priority conservation actions.

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APPENDIX 1

List of Acronyms Used in CMS

List of Acronyms Used in CMS

ACEC	Area of Critical Environmental Concern
AZNHP	Arizona Natural Heritage Program
BLM	Bureau of Land Management
BoR	Bureau of Reclamation
CMS	Conservation Management Strategy
CNDDB	California Natural Diversity Database
DCP	Desert Conservation Program
DNWR	Desert National Wildlife Range
DoD	Department of Defense
DWMA	Desert Wildlife Management Area
ESA	Endangered Species Act
FWS	U.S. Fish and Wildlife Service
GIS	Geographic Information System
GMP	General Management Plan
IMA	Intensively Managed Area
INRMP	Integrated Natural Resource Management Plan
LIMA	Less Intensively Managed Area
MoA	Memorandum of Agreement
MSCP	Multi-Species Conservation Plan
MSHCP	Multiple Species Habitat Conservation Plan
MUMA	Multiple Use Management Area
NAFB	Nellis Air Force Base
NAFBGR	Nellis Air Force Bombing and Gunnery Range
NCA	National Conservation Area
NDF	Nevada Division of Forestry

NEPA	National Environmental Policy Act
NLVAT	North Las Vegas Air Terminal
NNHP	Nevada Natural Heritage Program
NPS	National Park Service
NRA	National Recreation Area
NWR	National Wildlife Refuge
OHV	Off Highway Vehicle (also used for Off Road Vehicle)
R&PP	Recreation and Public Purposes Act
ReGAP	Regional Gap Analysis Project
RMP	Resource Management Plan
ROW	Right-of-Way
SNPLMA	Southern Nevada Public Lands Management Act
SNWA	Southern Nevada Water Authority
TNC	The Nature Conservancy
UMA	Unmanaged Area
UNLV	University of Nevada Las Vegas
WA	Wilderness Area
WHB	Wild Horse and Burro
WSA	Wilderness Study Area

APPENDIX 2

GIS Metadata and Notes

Geographic Information Systems (GIS) Metadata and Notes

This appendix provides an overview and some detailed documentation for the GIS work conducted over several years for this project. Included is information about data acquisition, data development, analyses and map production.

Many of the datasets used in this project are listed in Table 1. For vector data, if the layer is a shapefile, the suffix *.SHP is indicated. If there is no such suffix, the layer is an ArcInfo coverage. Some of the layers listed may have a name different from the original due to reprojection into another coordinate system.

The primary GIS software used were Environmental System Research Institute's ArcView 3.3, ArcInfo 9.0 and ArcGIS 8.2. Extensions – programs adding functionality to ESRI software - were used as well.

GIS data development and analyses prior to July 2005 were conducted by Brian McMenamy of The Nature Conservancy (Reno NV). Michael Polly of The Nature Conservancy (Reno NV) subsequently completed the GIS work from October 2005 forward.

Throughout the GIS work, acronyms were often used for the species:

Acronym	Species
ANLE	*Anulocaulis leiosolenus* var. *leiosolenus*
ARCA	*Arctomecon californica*
ARME	*Arctomecon merriamii*
ASGETR	*Astragalus geyeri* var. *triquetrus*
CAST	*Calochortus striatus*
ERBI	*Eriogonum bifurcatum*
ERVI	*Eriogonum viscidulum*
PEAL	*Penstemon albomarginatus*
PHPA	*Phacelia parishii*

Species Data Points

This report discuses nine rare, low-elevation plant species found in Clark County, NV. A total of 10,616 documented data points (records) of individuals/populations for these species were converted into a GIS data layer (FINAL_CC_RAREPLANTS_0606.SHP). Numerous fields were added to the dataset in order to capture information pertinent to each occurrence.

# data points	Species	Common Name
115	*Anulocaulis leiosolenus* var. *leiosolenus*	sticky ringstem
2,965	*Arctomecon californica*	Las Vegas bearpoppy
193	*Arctomecon merriamii*	white bearpoppy
738	*Astragalus geyeri* var. *triquetrus*	threecorner milkvetch
125	*Calochortus striatus*	alkali mariposa lily
646	*Eriogonum bifurcatum*	Pahrump Valley buckwheat
103	*Eriogonum viscidulum*	sticky buckwheat
5,708	*Penstemon albomarginatus*	white-margined beardtongue
23	*Phacelia parishii*	Parish phacelia

Table 1. GIS data used in the mapping and analyses of the nine low elevation rare plant species.

Data Description	***Dataset Name(s)***	***Data Type***	***Data Source***	***Notes***
Airports	AIRPORTUTM27 IVANPATH_CMA MORMON MESA AIRPORT UTM.SHP	Vector Vector Vector	BLM - Las Vegas BLM - Las Vegas BLM - Las Vegas	Proposed Placement of Jean Airport Proposed CMA / Airport Footprint (2006)
Areas of Critical Environmental Concern	ACEC ACEC.SHP NV_ACEC_12_04_1127.SHP	Vector Vector Vector	BLM - Las Vegas BLM - Las Vegas BLM - Las Vegas	
Aspect	30M_ASPECT 85M_ASPECT	Raster Grid Raster Grid		30m Aspect for NV 85m Aspect for CA and AZ
Counties	COUNTY100.SHP	Vector	BLM	
Elevation	30MDEM_4SLP 85MDEM_4SLP	Raster Grid Raster Grid		30m DEM for NV 85M DEM for CA and AZ
Federal Land Disposal	SNPLMA DISPSL_UTM27 CLARK_BLMDISP RMPDISPOSAL.SHP FUTUREBLMDISPOSALCONTIGUITYUTM.SHP	Vector Vector Vector Vector Vector	BLM - Las Vegas BLM - Las Vegas BLM - Las Vegas BLM - Las Vegas BLM - Las Vegas	SNPLMA Disposal BLM Disposal Properties BLM Resource Mngmt Plan 1998 (2006)
Geology	GEOL_27	Vector		(1999)
Grazing Allotments	ALLOTMENT_STATUS_27.SHP ALLOTMENT_OPEN_27.SHP ALLOTMENTS.SHP	Vector Vector Vector	BLM - Las Vegas BLM - Las Vegas BLM - Las Vegas	(2004) (1999)
Herd Management	HMA.SHP	Vector	BLM - Las Vegas	(September 2000)

Data Description	Dataset Name(s)	Data Type	Data Source	Notes
Land Management & Ownership	MSHCP_AREAS_NAD27.SHP STATUS0106_U11N27.SHP LANDMANAGEMENT_NAD27.SHP LANDOWNER_NAD27.SHP CAL_OWN_UTM03	Vector Vector Vector Vector Vector	Clark County NV BLM - Las Vegas BLM BLM CA Resources Agency	MSHCP Categories (1998) Land Ownership/Management (2006) BLM Land Mgmt Mojave Desert Only (1999) BLM Landowner (September 2003) CA Ownership (2003)
Mines	MINE_POLYS_27.SHP	Vector	BLM - Las Vegas	Current Open Pit Mine Parcels
MSHCP Management	MSHCP_AREAS_NAD27.SHP MNGR_MNGMNT_NAD27.SHP STATUS0106_U11N27.SHP	Vector Vector Vector	Clark County NV BLM - Las Vegas BLM - Las Vegas	MSHCP Categories (1998) MSHCP Management (1998) Land Ownership/Management (2006)
National Conservation Areas	NCA_1127.SHP NV_NCA_1127.SHP	Vector Vector	BLM - Las Vegas BLM	
PLSS (Township, Range, Section)	PLSS100K_27.SHP	Vector	Bureau of Mines / BLM	
Roads	FINAL_MERGED_ALL_ROADS.SHP	Vector	Various	1:100,000 and 1:24,000 and GPS dirt roads
Slope	30M_SLOPE 85M_SLOPE	Raster Grid Raster Grid		30m Slope for NV 85m Slope for CA and AZ
Soils	NV788_UTM NV608_UTM NV785_UTM NV755_UTM	Vector Vector Vector Vector	NRCS NRCS NRCS NRCS	NV788 (March 1998) NV608 (September 1999) NV785 (August 2002) NV755 (Preliminary)
US EPA Ecoregions	EPA_ECOREGIONS_UTM27.SHP	Vector	EPA	(2004)
Utility Lines & Corridors	CORRIDORS_IN_CC_27.SHP CORRIDORS_27.SHP GASLINE.SHP POWERLINES.SHP	Vector Vector Vector Vector	BLM - Las Vegas BLM - Las Vegas BLM - Las Vegas BLM - Las Vegas	Utility Corridors in Clark County Utility Corridors Gas Lines (Constructed, Proposed) (2006) Power Lines & Infrastructure (2006)

Data Description	Dataset Name(s)	Data Type	Data Source	Notes
Vegetation / Landcover	NVLANDCOVER_GAP.SHP LNDCOVERUTM27 MOJVEG.SHP CA_GAP_UTM11	Vector Raster Grid Vector Vector	NV GAP SWreGAP CA GAP	NV GAP (1995) SWreGAP (2004) Mojave Desert Vegetation CA GAP (1998)
Wilderness Areas / WSAs	NV_WSA_1204.SHP NV_WLD.SHP WILDERNESS WILDERNESS_IN_CLARKCO.SHP WILDERNESS_UTM11NAD27.SHP WILDERNESS	Vector Vector Vector Vector Vector Vector	BLM BLM BLM - Las Vegas BLM - Las Vegas BLM - Las Vegas BLM - Las Vegas	

Notes:

1. One or more data layers were used to map/analyze each listing in the Data Description column.
2. The file name for each data layer is listed in the Dataset Name(s) column.
3. For vector data, a *.SHP suffix indicates a shapefile; if no suffix, the dataset is an ArcInfo coverage.
4. Data Source indicates the agency/organization which developed the data AND/OR which provided the data to the Conservancy.
5. Some datasets listed may have been modified from the original provided by the Data Source in that the datasets were reprojected to another coordinate system or clipped to Clark County or perhaps edited in another minor way. The names of these datasets were often somewhat modified.
6. The Notes column provides supplemental information about the datasets. Years indicate date of the data or when the Conservancy acquired the data.
7. Most, but not all, of the data were developed, obtained or reprojected to UTM Zone 11 NAD27.

The following describes the process Brian McMenamy used to develop the shapefile for species occurrences:

- Initially started with the 2003 Nevada Natural Heritage Program data (occurrences) and selected the 9 plant species of interest.
- Made a new shapefile based on those results.
- Made the same selection on the Arizona species data and made another shapefile out of that.
- Used the 2004 CNDDB data and yet again selected the 9 species of interest and made a new shapefile based on those results.
- Because CNDDB data is polygon data, downloaded an avenue script from ESRI's website called PolyCentroidToPoint that created a point theme based on the centroids of each polygon. Created a new shapefile based on the point locations of each occurrence.
- For the Heritage based data, retained the Fields called **Sname, ComName, Precision, GRank, SRank, Firstobs, Lastobs, ChangeDate,** and **EOCode**.
- Used the GeoProcessing wizard in ArcView 3.3 to merge these new shapefiles together into a compiled dataset.
- Added 256 data points of ARCA data obtained from Libby Powell with NPS using the Merge feature in the GeoProcessing wizard. After working with the data I found 12 duplicates of one another therefore they were deleted from the compiled dataset.
- Of these new 244 data points, Libby identified 55 of those also having ANLE present at their location. Those 55 were then added to the compiled dataset using the GeoProcessing wizard.
- Next, David Charlet visited both the UNLV and the UNR Herbariums and found historical records of ANLE, ARME, and CAST that were not captured in the Heritage data.
- Brian McMenamy digitized these locations as accurately as possible using the historical location descriptions.
- Obtained Sensitive Species Plant data from the BLM Las Vegas District. Selected the 9 plant species of interest and made a new shapefile out of the results. However, initially missed 98 data points of ASGETR because they were only attributed as ASGE in the BLM dataset. After verifying that ASGE was truly supposed to be ASGETR, added those 98 additional data points to the compiled dataset.
- Bruce Lund provided a data form with an ANLE location near the town of Moapa that he was submitting to NNHP. He forwarded his information point on a 1:24,000 topo map that Brian McMenamy used to digitize the location.
- The last few locations Jan Nachlinger discovered while researching the distributions of each of the 9 rare plants. Brian McMenamy digitized these occurrences as accurately as possible with the written descriptions and vague maps in each document.
- After all of the additions the compiled dataset was named Final_cc_rareplants_0504_27.shp.
- This was the dataset that was used for all of the Spatial Analysis.

- Subsequent revisions were made to the dataset. The 'final' dataset created by Brian McMenamy was FINAL_CC_RAREPLANTS_0505.SHP.
- Table 2 lists source data used to generate the species dataset.

- Michael Polly further revised the plant occurrence data.
- 5 records of ARCA (ARCA_BLM2005.SHP) and 187 records of ASGETR (ASGETR_BLM2005.SHP) were identified and added to FINAL_CC_RAREPLANTS_0505.SHP which was renamed FINAL_CC_RAREPLANTS_0606.SHP.
- Analyses consistent with the other records were performed on the new data points in order to populate the attribute table with values.
- 2 PHPA data points were removed because they are attributed to a difference species in the latest literature.

Table 2. Sources used to create the final plant data points.

Spatial Data used for Species Identification	Data Acquired from (Year Acquired by TNC)
NV_PLANT2003.SHP 409 records	Humboldt-Toiyabe National Forest from Nevada Natural Heritage Program (2004)
AZ.SHP 37 records	AZ Heritage Program for Mojave Desert Ecoregional Planning (1999)
CNDDB_2004.SHP 126 records	Matt Merrifield in San Francisco Field Office from CNDDB (2004)
ARCA97-00.SHP 244 records	Libby Powel from National Park Service [Lake Mead National Recreation Area] (2004)
ANLE_55_ADDITIONS.SHP 55 records	Created from Data sent by David Charlet; originally from Access Database managed by Libby Powel NPS (2004)
Excel files located K:\GIS1\SITES_ClarkCoRarePlants\Data\UNLV_Collections 13 records (6 ANLE, 1 ARME, 6 CAST)	UNLV Herbarium (2004)
Excel files located K:\GIS1\SITES_ClarkCoRarePlants\Data\UNLV_Collections 3 records (1 ANLE, 2 CAST)	UNR Herbarium (2004)
SSPLANTS_PNTS2.SHP BLM_SPECIES_ADDITIONS.SHP is Subset of 9 plants except it is missing 98 ASGETR due to attributions being just ASGE All_BLM_PNT_OCCUR.SHP is subset of 9 plants with the 98 originally missed ASGETR records 9419 records	BLM Las Vegas District (May 2004)
Digitized from Written Record 2 ARCA records	Hazlett et. Al., 1997 (2004)
Digitized from Written Record 4 ARCA records	Mistretta, Pant, Ross, Porter and Morefield, 1996 (2004)
Digitized from Written Record 1 PHPA record	Smith, 1997 (2004)
Digitized from Written Record 11 ANLE records	Spellenberg & Wootten, 1999 (2004)
Digitized from Written Record 1 ASGETR record	Resource Concepts, 2004 (2004)
Digitized from hand drawn sketch on topo map 1 ANLE record	Lund Observation (2004)

Species Population Groups

The documented occurrences of each species were delineated into population groups. Brian McMenamy created 138 population groups, using the following approach:

- Started with a Digital Elevation Model. Set the brightness values to be based on a hillshadewhich a semi 3-D look at topography.
- Drew an e 1 to 1.5 mile radius around any given data point or cluster of data points with the exceptions being topographic barriers.
- Exception: If a plant is known to occur only grow in valleys then mountain ranges would not be included within the distribution group polygon. This would occasionally cause the radius to be less than the previously mentioned 1 to 1.5 miles.
- For Occurrences data pointthat were less precisely known, a larger radius closer to 2.5 to 3 miles was used. This pertained to the ANLE records that span from AZ to Mexico.
- For the California occurrences the original CNDDB data were polygons. Those polygons were used as a starting point so as not to make any group polygons smaller than the originals. The distribution group polygons were made larger than the CNDDB occurrence polygons to add more of a buffer to the actual locations of the rare plants.
- Each Distribution Group polygon was then named based on either a local geographic feature it was located near i.e. valley name, etc. or based on the name given to a known area containing the rare plant as it was described in a published document.

Subsequently, Michael Polly regenerated the boundaries for population groups. In this second iteration of drawing boundaries for the population groups, the groups themselves were delineated as in the first iteration (i.e., the same documented data points exist in each of the population groups for the first and second iterations), but a more standardized approach to drawing the boundaries was used.

- For each of the 9 species, an approximately 1-mile circular buffer was drawn around each documented data point.
- Within population groups, these buffer polygons were merged. For some population groups (especially those consisting of one or a few occurrences of the plant), the merged buffer became the population group boundary.
- For other population groups, the merged buffer polygons formed a single boundary which was then ‘smoothed’. This smoothed polygon became the boundary representing the population group.
- For the remaining population groups, two or more separate clusters of buffered data points were united into a single, smoothed boundary.
- One population group was eliminated from the final data set because it was later determined to be a different species of *Phacelia*.

There are 138 population groups:

# Groups	Species	Common Name
17	*Anulocaulis leiosolenus* var. *leiosolenus*	sticky ringstem
13	*Arctomecon californica*	Las Vegas bearpoppy
33	*Arctomecon merriamii*	white bearpoppy
17	*Astragalus geyeri* var. *triquetrus*	threecorner milkvetch
15	*Calochortus striatus*	alkali mariposa lily
4	*Eriogonum bifurcatum*	Pahrump Valley buckwheat
13	*Eriogonum viscidulum*	sticky buckwheat
10	*Penstemon albomarginatus*	white-margined beardtongue
16	*Phacelia parishii*	Parish phacelia

Species Global Extent Boundaries
For each of the nine plant species, a boundary outlining the documented global data points was drawn. This global extent boundary was developed by drawing a single boundary around the population groups.

Roads
The following describes the process Brian McMenamy used to create a single roads dataset from all available Clark County road data:

- Obtained both 1:24,000 and 1:100,000 scale roads of Clark County from the BLM Las Vegas District who also provided a preliminary GPS coverage of roads that is still being compiled. File names were ROADS24K, ROADS100K, and ROADS_GPS.
- The first step was to reproject from State Plane to UTM Zone 11 NAD27 creating new coverages named ROADS24K_27, ROADS100K_27, ROADS_GPS_27.
- Clipped all these datasets to Clark County creating shapefiles called ROADS24K_27_CC.SHP, ROADS100K_27_CC.SHP, and ROADS_GPS_27_CC.SHP.
- Started with the 1:24,000 scale roads because it had the best combination of being the most complete and accurate.
- Selected arcs from the 1:100,000 scale roads that did not overlap the 1:24,000 scale roads and made a new shapefile of the selected arcs called: 100K_NOT_OVERLAPPING_24K.SHP.
- Selected arcs from the GPS overage that did not overlap either the 1:24,000 or the 1:100,000 scale roads and made a new shapefile of the selected arcs called GPS_NOT_OVERLAPING_24KOR100K.SHP.
- Used ArcGIS 8.2 to edit the 100K_NOT_OVERLAPPING_24K.SHP file to snap the 1:100,000 arcs to the ends of the 1:24,000 arcs and to delete overlapping arcs that ended up getting selected during the selection process.
- Also used the same exercise to delete overlapping arcs and snap the ends of the GPS roads to either the 1:24,000 or the 1:100,000 roads that they intersected.
- Used the Geoprocessing tools to Merge the ROADS24K_27_CC.SHP, 100K_NOT_OVERLAPPING_24K.SHP, and the GPS_NOT_OVERLAPING_24KOR100K.SHP into one shapefile called MERGED_ALL_ROADS.SHP.
- Obtained a road layer from Gayle Marrs-Smith who works for the BLM Las Vegas District that was of GPS dirt roads from the Rainbow Gardens ACEC called FRENCHMAN_RDS.SHP.
- Selected arcs FRENCHMAN_RDS.SHP that did not overlap with MERGED_ALL_ROADS.SHP and made a new shapefile of the selected arcs called RAINBOWGARDENS_ADDITIONS.SHP.
- Used ArcGIS 8.2 to edit the RAINBOWGARDENS_ADDITIONS.SHP to both delete any overlapping arcs and to snap the remaining arcs to the ends of MERGED_ALL_ROADS.SHP.
- Used the Geoprocessing tools again to Merge the RAINBOWGARDENS_ADDITIONS.SHP with the MERGED_ALL_ROADS.SHP to create the final roads layer used for the analysis called FINAL_MERGED_ALL_ROADS.SHP.

Analysis: Species Data Points
In order to obtain information about each documented individual/population of the nine plant species, a variety of datasets were analyzed. The final data layer for the documented data points, FINAL_CC_RAREPLANTS_0606.SHP, contains fields which represent values of various datasets

analyzed. Table 3 provides information for many of the datasets used and the names of the fields generated in FINAL_CC_RAREPLANTS_0606.SHP.

The following description provides the method by which most of the analyses were conducted for the species data points:

- Used the Geoprocessing wizard in ArcView 3.3 to spatially join the attributes from all of the listed shapefiles and coverages to the final rare plant shapefile.
- Edited the table and added a new field describing the relevant data. Used the map calculator to copy the records from the newly joined fields to the new field that was just created. The join was then removed.

To generate values of grid data associated with species records, the following methodology was used:

- The Avenue script GetZValueFromGrid was downloaded from ESRI's web site to extract the cell value in the grid datasets and attribute them to the final rare plant shapefile. That created a new field called zValue.
- The table for the rare plant shapefile was edited by adding new fields describing the relevant data: elevation, slope, aspect, etc.
- Used the map calculator to copy the records from the zValue field to the new field that was just created.
- Then, would need to delete the field called zValue in order to run the script on the next grid dataset and repeat the above process.

Table 3. Spatial data used in analysis of the nine low elevation plant species.

Spatial Data Used	Spatial Data Description	Dataset Type	Field Name(s) in Final Rare Plant Point Dataset
CAL_OWN_UTM03	CA Ownership (2003)	Coverage	Lndowner_abb; Landowner
CA_GAP_UTM11	CA Gap (1998)	Coverage	GAP_Veg_NV; CA_GAP_Code
GEOL_27	Geology (1999)	Coverage	Geol_Code; Formation
LNDCOVERUTM27	SW Regap Landcover (2004)	Grid	REGAP_Veg; REGAP_ID
85M_SLOPE	85m Slope for CA and AZ	Grid	Slope_Degree
85M_ASPECT	85m Aspect for CA and AZ	Grid	Aspect
85MDEM_4SLP	85m DEM for CA and AZ	Grid	Elevation
30M_SLOPE	30m Slope for NV	Grid	Slope_Degree
30M_ASPECT	30m Aspect for NV	Grid	Aspect
30MDEM_4SLP	30m DEM for NV	Grid	Elevation
LANDOWNER_NAD27.SHP	BLM Landowner (Sep. 2003)	Shapefile	Lndowner_abb; Landowner
EPA_ECOREGIONS_UTM27.SHP	EPA Ecoregions (2004)	Shapefile	EPA_Level4
NVLANDCOVER_GAP.SHP	GAP Shapefile (1995)	Shapefile	GAP_Veg_NV; NV_GAP_Code
ALLOTMENTS.SHP	Allotments (1999)	Shapefile	Allotment_Status; Allotment_Name
ALLOTMENT_STATUS27.SHP	Allotment Status (2004)	Shapefile	Allotment_Name; Allotment_Status
ALLOTMENT_OPEN_27.SHP	Allotments	Shapefile	Allotment_Name; Allotment_Status
MOJVEG.SHP	Mojave Desert Vegetation	Shapefile	Mojave_Des
HMA.SHP	Herd Management Areas (Sep. 2000)	Shapefile	Herd_Mngmnt
LANDMANAGEMENT_NAD27.SHP	BLM Landmanagement Mojave Desert Only	Shapefile	Land_Mngmnt
MSHCP_AREAS_NAD27.SHP	MSHCP Categories (1998)	Shapefile	CO_Mngmnt; COMngmt2
MNGR_MNGMNT_NAD27.SHP	MSHCP Management (1998)	Shapefile	MSHCP_Mngmnt
COUNTIES1127.SHP; COUNTY100.SHP	Counties	Shapefile	County
COUNTIES1127.SHP; COUNTY100.SHP	States	Shapefile	State
NV788_UTM	Soils: NV788 (Mar. 1998)	Coverage	Soil_name; Soil_symbol
NV785_UTM	Soils: NV608 (Sep. 1999)	Coverage	Soil_name; Soil_symbol
NV608_UTM	Soils: NV785 (Aug. 2002)	Coverage	Soil_name; Soil_symbol
NV755_UTM	Soils: NV755 (Preliminary)	Coverage	Soil_name; Soil_symbol
FINAL_MERGED_ALL_ROADS.SHP	Roads	Shapefile	ZM_Road; Z0M_Road

Analysis: Populations recommended for conservation management

Provided in this report are a list of population groups recommended for conservation management. An analysis was performed to determine which of these population groups, in whole or in part (even a minor part), fell within an area currently designated with conservation status. The population groups were compared against Areas of Critical Environmental Concern, National Conservation Areas, Wilderness Areas and the BLM – City of North Las Vegas Conservation Agreement. The following population groups recommended for conservation management intersect with an area currently designated with conservation status in Clark, Lincoln and Nye Counties, Nevada. Note that population groups may appear more than once if they intersect with multiple conservation areas.

Area of Critical Environmental Concern

Gold Butte, Part A ACEC
- ANLE Gold Butte
- ARCA Gold Butte
- ASGETR Mud Wash
- ERVI Bitter Ridge

Gold Butte, Part B ACEC
- ANLE Gold Butte
- ARCA Gold Butte

Mormon Mesa ACEC
- ASGETR Mormon Mesa
- ASGETR Toquop Wash
- ASGETR Weiser Wash
- ERVI Toquop Wash
- ERVI Upper Muddy River

Rainbow Gardens ACEC
- ANLE Gypsum Wash
- ANLE Lava Butte
- ARCA Sunrise Valley

Virgin River ACEC
- ASGETR Toquop Wash
- ERVI Toquop Wash

National Conservation Area

Red Rock Canyon NCA
- ARME Calico Hills
- CAST Lone Willow Spring
- CAST Calico Hills

Sloan Canyon NCA
- PEAL Hidden Valley

Wilderness Areas

Jimbilnan WA
- ANLE Bitter Spring Valley
- ARCA Bitter Spring Valley
- ARCA Middle Point
- ASGETR Ebony Cove
- ERVI Black Mountains

LaMadre Mountain WA
- ARME Calico Hills
- CAST Calico Hills

Lime Canyon WA
- ANLE Gold Butte
- ARCA Gold Butte

Muddy Mountains WA
- ARCA Gale Hills
- ARCA White Basin

North McCullough WA
- PEAL Hidden Valley

Pinto Valley WA
- ANLE East Black Mountains
- ANLE West Black Mountains
- ARCA Bitter Spring Valley
- ARCA Gale Hills
- ARCA Middle Point
- ASGETR Ebony Cove
- ASGETR Sandy Cove

BLM - City of North Las Vegas Conservation Agreement
- ARCA Las Vegas Valley - *BLM-NLV Cons. Agreement portion*

APPENDIX 3

Analysis of the Management Situation for Nine Low Elevation Rare Plants

Analysis of the Management Situation for Nine Low Elevation Rare Plants

Sixty-seven of the 138 species population groups are wholly or mostly within Clark County. We used their current levels of conservation protection, as defined by their combinations of MSHCP management categories to organize our assessment of the conservation management situation. We revised MSHCP management categories for 7% of all data points (n=735) to rectify discrepancies between the MSHCP (RECON 2000) and BLM's updated 2004 land ownership information, or to address management updates from the Clark County Act of 2002. To rectify discrepancies, we accepted BLM's ownership layer because it had been updated and had greater digitized detail than the older and less detailed layers from the MSHCP. The majority (60%) of the category changes were from multiple use lands to private lands, while 28% effectively retained high protection status because of National Conservation Area designation in 2002. Table AX provides the original management category, the revised category, and rationale for change for the affected population groups.

Most of the 138 rare plant population groups primarily fall into the highest current level of conservation protection on public lands (n=32). Twenty-six population groups are wholly on IMAs (n=21), LIMAs (n=3), or a combination of the two management categories (n=2). Another six population groups fall on a mix of 82-97% of these protective categories, so they are clearly primarily in protective management, but with the remainder of their populations falling on 5-18% MUMA (n=3) or 3-14% UMA (n=3), multiple-use public lands or private lands, respectively. Eight of the nine rare plants are among these population groups—Pahrump Valley wild buckwheat is the only species which currently has no populations in a MSHCP protective management category. These population groups occur across the County with concentrations of them in the northwest on the Desert National Wildlife Range and Nellis Air Force Ranges, in the east on Lake Mead NRA or Mormon Mesa ACEC, and scattered in west, central and south county areas falling within Red Rock Canyon NCA, Rainbow Gardens ACEC, or Sloan Canyon NCA. Primary management responsibility for these population groups includes NPS (n=14), BLM (n=10), DoD (n=7), and FWS (n=1), while only five have shared management.

The next largest category of management for the rare plant population groups is primarily multiple-use public land management (n=20) with 12 wholly on MUMAs and seven with little to noteworthy amounts of private land (1-43% UMA). One population group in this category swings the other direction for secondary management with 5% on IMA. Five rare plant species are among these population groups and they are scattered on the west side of Clark County in the foothills of the Spring Mountains and Ivanpah Valley, and on the east side of the County at Nellis Dunes, California Wash, White Basin, and along the Muddy and Virgin rivers. All 20 of these population groups are managed by BLM, while six are shared management with BLM and private owners, DoD, BIA, or BR.

There are ten population groups which fall into mixed management by having between 25-65% in protective management (IMA), but also 25-63% multiple use management (MUMA) or between 3-50% private lands (UMA). Four of the nine rare plants are among these ten population groups which occur on the east side of the County in Gale Hills, Bitter Spring Valley, along the Virgin River, and between the Virgin Mountains and Gold Butte. Seven of these population groups are primarily managed by BLM, two by NPS, and 1 with private management. Six of them have shared management.

Lastly in Clark County, six population groups primarily fall on lands with no protective management, either occurring wholly on private lands (n=4) or with 6-32% secondary multiple use management. These population groups occur in Las Vegas Valley, Mesquite Valley, and at

Glendale. Six rare plant species are involved, although only historic information in Las Vegas Valley applies for two of these species. BLM has shared management for two population groups, while DoD shares management for one.

Twenty-five population groups occur either wholly or partly in three other counties in Nevada—Lincoln (n=7), Nye (n=14), and White Pine (n=4)—with an additional two overlapping Clark County and two overlapping into California or Arizona. The majority of these are primarily managed by BLM (n=17), with the others primarily managed by FWS (n=4), DoD (n=2), or private owners (n=2).

Finally, forty-seven population groups occur outside of Nevada, in adjacent California (n=31) and Arizona (n=12), or beyond in New Mexico, Texas, and Chihuahua, Mexico (n=4) with an additional three overlapping Nevada. NPS (Lake Mead NRA, Grand Canyon NP, and Death Valley NP) primarily manages 16 of these population groups, California and Arizona BLM primarily manages 11, and private landowners in California manage nine of them. Three are primarily managed by the state of California, one each by DoD and FS, while six have unknown management responsibility (these are the easternmost population groups of sticky ringstem).

Table A summarizes MSHCP management categories across the 67 population groups of nine low elevation rare plants in Clark County. Table B documents changes made to MSHCP management categories for species locations based on the updated BLM land status layer.

Table A. MSHCP management categories for locations of population groups of nine low elevation rare plant species in Clark County.

Species Population	IMA	LIMA	MUMA	UMA	DESCRIPTION 1	DESCRIPTION 2
ANLE East Black Mountains Populations	100				100% IMA	Highest level of conservation management potential
ANLE Gold Butte Populations	100				100% IMA	Highest level of conservation management potential
ANLE Lava Butte Populations	100				100% IMA	Highest level of conservation management potential
ANLE West Black Mountains Populations	100				100% IMA	Highest level of conservation management potential
ARCA Gold Butte Populations	100				100% IMA	Highest level of conservation management potential
ARCA Government Wash Populations	100				100% IMA	Highest level of conservation management potential
ARCA Middle Point Populations	100				100% IMA	Highest level of conservation management potential
ARCA Sunrise Valley Populations	97		0.1	3	82-95% IMA, LIMA, or combo, but 3-18% MUMA or UMA issues	Mostly high level of conservation management with some concerns
ARCA Valley of Fire Populations	91		9		82-95% IMA, LIMA, or combo, but 3-18% MUMA or UMA issues	Mostly high level of conservation management with some concerns
ARME Black Hills Populations	100				100% IMA	Highest level of conservation management potential
ARME Calico Hills Populations		100			100% LIMA	Highest level of conservation management potential
ARME Desert Range Populations	100				100% IMA	Highest level of conservation management potential
ARME North Desert Range Populations	100				100% IMA	Highest level of conservation management potential
ARME Pintwater Range Populations	79	7		14	82-95% IMA, LIMA, or combo, but 3-18% MUMA or UMA issues	Mostly high level of conservation management with some concerns
ARME Spotted Range Populations	94	6			100% IMA and LIMA combo	Highest level of conservation management potential
ARME Three Lakes Valley Populations	88	13			100% IMA and LIMA combo	Highest level of conservation management potential
ASGETR Bark Bay Populations	100				100% IMA	Highest level of conservation management potential
ASGETR Ebony Cove Population	100				100% IMA	Highest level of conservation management potential
ASGETR Lime Cove Population	100				100% IMA	Highest level of conservation management potential
ASGETR Mormon Mesa Populations	95		5		82-95% IMA, LIMA, or combo, but 3-18% MUMA or UMA issues	Mostly high level of conservation management with some concerns
ASGETR Sandy Cove Populations	100				100% IMA	Highest level of conservation management potential
ASGETR The Meadows Population	100				100% IMA	Highest level of conservation management potential
ASGETR Valley Of Fire Wash Populations	100				100% IMA	Highest level of conservation management potential
CAST Calico Hills Populations		88		12	82-95% IMA, LIMA, or combo, but 3-18% MUMA or UMA issues	Mostly high level of conservation management with some concerns
CAST Lone Willow Spring Populations		100			100% LIMA	Highest level of conservation management potential

ERVI Black Mountains Populations	100				100% IMA	Highest level of conservation management potential
ERVI Lime Wash Populations	100				100% IMA	Highest level of conservation management potential
ERVI Overton Arm Populations	100				100% IMA	Highest level of conservation management potential
ERVI Virgin River Confluence Populations	100				100% IMA	Highest level of conservation management potential
PEAL Hidden Valley Populations	72	10	18		82-95% IMA, LIMA, or combo, but 3-18% MUMA or UMA issues	Mostly high level of conservation management with some concerns
PHPA Indian Springs Valley Population	100				100% IMA	Highest level of conservation management potential
PHPA Three Lakes Valley Population		100			100% LIMA	Highest level of conservation management potential
ANLE Bitter Spring Valley Populations	55		45		25-67% IMA, but 25-63% MUMA or 3-50% UMA	Mixed levels of conservation and multiple use/private management issues
ANLE Gypsum Wash Populations	67			33	25-67% IMA, but 25-63% MUMA or 3-50% UMA	Mixed levels of conservation and multiple use/private management issues
ANLE Overton Arm Populations	38		63		25-67% IMA, but 25-63% MUMA or 3-50% UMA	Mixed levels of conservation and multiple use/private management issues
ARCA Bitter Spring Valley Populations	40		60		25-67% IMA, but 25-63% MUMA or 3-50% UMA	Mixed levels of conservation and multiple use/private management issues
ARCA Gale Hills Populations	45		52	3	25-67% IMA, but 25-63% MUMA or 3-50% UMA	Mixed levels of conservation and multiple use/private management issues
ASGETR Mud Wash Populations	60		40		25-67% IMA, but 25-63% MUMA or 3-50% UMA	Mixed levels of conservation and multiple use/private management issues
ASGETR Virgin River Populations	63			38	25-67% IMA, but 25-63% MUMA or 3-50% UMA	Mixed levels of conservation and multiple use/private management issues
ERVI Bitter Ridge Populations	50		50		25-67% IMA, but 25-63% MUMA or 3-50% UMA	Mixed levels of conservation and multiple use/private management issues
ERVI Lower Virgin River Populations	25		25	50	25-67% IMA, but 25-63% MUMA or 3-50% UMA	Mixed levels of conservation and multiple use/private management issues
ERVI Lower Virgin Valley Populations	67		33		25-67% IMA, but 25-63% MUMA or 3-50% UMA	Mixed levels of conservation and multiple use/private management issues
ARCA Las Vegas Dunes Populations			57	43	Combo of 57-80% MUMA with 20-43% UMA	Predominantly multipe use, but also private management issues
ARCA White Basin Populations			78	22	Combo of 57-80% MUMA with 20-43% UMA	Predominantly multipe use, but also private management issues
ARME Bird Spring Range Population			100		95-100% MUMA, with up to 5% IMA or UMA combo	Predominantly multipe use management issues
ARME Devil Canyon Population			100		95-100% MUMA, with up to 5% IMA or UMA combo	Predominantly multipe use management issues
ARME Indian Springs Population			100		95-100% MUMA, with up to 5% IMA or UMA combo	Predominantly multipe use management issues
ARME Pahrump Valley Population			100		95-100% MUMA, with up to 5% IMA or UMA combo	Predominantly multipe use management issues

ASGETR California Wash Populations			78	22	Combo of 57-80% MUMA with 20-43% UMA	Predominantly multipe use, but also private management issues
ASGETR Mud Lake Populations			98	2	95-100% MUMA, with up to 5% IMA or UMA combo	Predominantly multipe use management issues
ASGETR Muddy River Populations			99	1	95-100% MUMA, with up to 5% IMA or UMA combo	Predominantly multipe use management issues
ASGETR Toquop Wash Populations			100		95-100% MUMA, with up to 5% IMA or UMA combo	Predominantly multipe use management issues
ASGETR Town Wash Population			100		95-100% MUMA, with up to 5% IMA or UMA combo	Predominantly multipe use management issues
ASGETR Weiser Wash Populations			100		95-100% MUMA, with up to 5% IMA or UMA combo	Predominantly multipe use management issues
ERVI Middle Muddy River Populations			100		95-100% MUMA, with up to 5% IMA or UMA combo	Predominantly multipe use management issues
ERVI Toquop Wash Populations			100		95-100% MUMA, with up to 5% IMA or UMA combo	Predominantly multipe use management issues
ERVI Upper Muddy River Populations	5		95		95-100% MUMA, with up to 5% IMA or UMA combo	Predominantly multipe use management issues
ERVI Upper Virgin Valley Populations			75	25	Combo of 57-80% MUMA with 20-43% UMA	Predominantly multipe use, but also private management issues
PEAL Ivanpah Valley Populations			80	20	Combo of 57-80% MUMA with 20-43% UMA	Predominantly multipe use, but also private management issues
PEAL Jean Lake Populations			100		95-100% MUMA, with up to 5% IMA or UMA combo	Predominantly multipe use management issues
PEAL Roach Lake Populations			100		95-100% MUMA, with up to 5% IMA or UMA combo	Predominantly multipe use management issues
ERBI Mesquite Valley Populations			32	68	> 68% UMA with 6-32% MUMA	Predominantly private management, may have some multiple use
ARCA Las Vegas Valley Populations			6	94	> 68% UMA with 6-32% MUMA	Predominantly private management, may have some multiple use
ANLE Muddy River Populations				100	100% UMA	Predominantly private management, may have some multiple use
ARME Las Vegas Valley Populations				100	100% UMA	Predominantly private management, may have some multiple use
CAST Las Vegas Population				100	100% UMA	Predominantly private management, may have some multiple use

Table B. Documented changes to MSHCP management categories based on updated BLM land status for the CMS analysis.

Species _ID	Landowner	MSHCP_ MNGM	CO_ MNGMT_ CATEGORY	LAND_ MANAG	MSHCP_ Category_ Update	MSHCP_Change_Reason
61	Water		N/A		IMA	On NPS...Shoreline was crudely digitized in MSHCP Layer Vs. the 2004 BLM Landownership Layer.
140	Water		N/A		IMA	On NPS...Shoreline was crudely digitized in MSHCP Layer Vs. the 2004 BLM Landownership Layer.
304	Water		N/A		IMA	On NPS...Shoreline was crudely digitized in MSHCP Layer Vs. the 2004 BLM Landownership Layer.
305	NPS		N/A		IMA	On NPS...Shoreline was crudely digitized in MSHCP Layer Vs. the 2004 BLM Landownership Layer.
306	NPS		N/A		IMA	On NPS...Shoreline was crudely digitized in MSHCP Layer Vs. the 2004 BLM Landownership Layer.
307	NPS		N/A		IMA	On NPS...Shoreline was crudely digitized in MSHCP Layer Vs. the 2004 BLM Landownership Layer.
309	Water		N/A		IMA	On NPS...Shoreline was crudely digitized in MSHCP Layer Vs. the 2004 BLM Landownership Layer.
310	Water		N/A		IMA	On NPS...Shoreline was crudely digitized in MSHCP Layer Vs. the 2004 BLM Landownership Layer.
312	NPS		N/A		IMA	On NPS...Shoreline was crudely digitized in MSHCP Layer Vs. the 2004 BLM Landownership Layer.
316	NPS		N/A		IMA	On NPS...Shoreline was crudely digitized in MSHCP Layer Vs. the 2004 BLM Landownership Layer.
397	Water		N/A		IMA	On NPS...Shoreline was crudely digitized in MSHCP Layer Vs. the 2004 BLM Landownership Layer.
433	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
437	Private	Private	UMA	ACEC	UMA	No Longer falls in ACEC in 2004 Updated BLM Landownership Layer
620	Private	Overton WMA	IMA	State WildlifeArea	UMA	2004 Updated BLM Landownership Layer has changed this area to Private Ownership
627	BLM	critical	IMA	ACEC	MUMA	ACEC Selected for Prehistoric Habitation and Rock Art Not for Biological Preservation
629	Water		N/A		IMA	On NPS...Shoreline was crudely digitized in MSHCP Layer Vs. the 2004 BLM Landownership Layer.
642	Private	Private	UMA	LMNRA	UMA	No Longer falls in LMNRA in 2004 Updated BLM Landownership Layer
678	BLM	Private	UMA	NCA	LIMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer but is still in NCA
708	BLM	Private	UMA		MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
723	Private		N/A		UMA	On Private…state boundary was crudely digitized in MSHCP Layer Vs. the 2004 BLM Landownership Layer.
748	BLM	critical	IMA	ACEC/SRA	MUMA	ACEC Selected for Prehistoric Habitation and Rock Art Not for Biological Preservation
749	Water		N/A		IMA	On NPS...Shoreline was crudely digitized in MSHCP Layer Vs. the 2004 BLM Landownership Layer.
755	Private	Private	UMA	ACEC	UMA	No Longer falls in ACEC in 2004 Updated BLM Landownership Layer
756	Water		N/A		IMA	On NPS...Shoreline was crudely digitized in MSHCP Layer Vs. the 2004 BLM Landownership Layer.
773	Private	Private	UMA	ACEC	UMA	No Longer falls in ACEC in 2004 Updated BLM Landownership Layer
917	BLM	Private	UMA	ACEC	IMA	Definitely falls in ACEC in 2004 Updated BLM Landownership Layer
918	BLM	Private	UMA	ACEC	IMA	Definitely falls in ACEC in 2004 Updated BLM Landownership Layer
919	BLM	Private	UMA	ACEC	IMA	Definitely falls in ACEC in 2004 Updated BLM Landownership Layer
920	BLM	Private	UMA	ACEC	IMA	Definitely falls in ACEC in 2004 Updated BLM Landownership Layer
921	BLM	Private	UMA	ACEC	IMA	Definitely falls in ACEC in 2004 Updated BLM Landownership Layer
922	Private	Private	UMA	ACEC	UMA	No Longer falls in ACEC in 2004 Updated BLM Landownership Layer
933	BLM	Private	UMA	ACEC	IMA	Definitely falls in ACEC in 2004 Updated BLM Landownership Layer
934	Private	Private	UMA	ACEC	UMA	No Longer falls in ACEC in 2004 Updated BLM Landownership Layer
935	Private	Private	UMA	ACEC	UMA	No Longer falls in ACEC in 2004 Updated BLM Landownership Layer
936	Private	Private	UMA	ACEC	UMA	No Longer falls in ACEC in 2004 Updated BLM Landownership Layer
937	Private	Private	UMA	ACEC	UMA	No Longer falls in ACEC in 2004 Updated BLM Landownership Layer
1111	Private	Private	UMA	ACEC	UMA	No Longer falls in ACEC in 2004 Updated BLM Landownership Layer
1112	Private	Private	UMA	ACEC	UMA	No Longer falls in ACEC in 2004 Updated BLM Landownership Layer

Species _ID	Landowner	MSHCP_ MNGM	CO_ MNGMT_ CATEGORY	LAND_ MANAG	MSHCP_ Category_ Update	MSHCP_Change_Reason
1115	Private	Private	UMA	ACEC	UMA	No Longer falls in ACEC in 2004 Updated BLM Landownership Layer
1116	Private	Private	UMA	ACEC	UMA	No Longer falls in ACEC in 2004 Updated BLM Landownership Layer
1117	Private	Private	UMA	ACEC	UMA	No Longer falls in ACEC in 2004 Updated BLM Landownership Layer
1118	BLM	Private	UMA	ACEC	IMA	Definitely falls in ACEC in 2004 Updated BLM Landownership Layer
1160	Private	Private	UMA	ACEC	UMA	No Longer falls in ACEC in 2004 Updated BLM Landownership Layer
1161	Private	Private	UMA	ACEC	UMA	No Longer falls in ACEC in 2004 Updated BLM Landownership Layer
1162	Private	Private	UMA	ACEC	UMA	No Longer falls in ACEC in 2004 Updated BLM Landownership Layer
2572	Private	undesignated	IMA	ACEC	UMA	No Longer falls in ACEC in 2004 Updated BLM Landownership Layer
2573	Private	undesignated	IMA	ACEC	UMA	No Longer falls in ACEC in 2004 Updated BLM Landownership Layer
2574	Private	undesignated	IMA	ACEC	UMA	No Longer falls in ACEC in 2004 Updated BLM Landownership Layer
2575	Private	undesignated	IMA	ACEC	UMA	No Longer falls in ACEC in 2004 Updated BLM Landownership Layer
2610	BLM	Private	UMA	WSA	MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
2615	BLM	Private	UMA		MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
2624	BLM	Private	UMA		MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
2633	BLM	Private	UMA		MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
2634	BLM	Private	UMA		MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
2686	DoD	Private	UMA		UMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
2761	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
2766	Private	undesignated	IMA	ACEC	UMA	No Longer falls in ACEC in 2004 Updated BLM Landownership Layer
2863	BLM	Private	UMA		MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
2864	BLM	Private	UMA		MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
2865	BLM	Private	UMA		MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
2866	BLM	Private	UMA		MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
2867	BLM	Private	UMA		MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
2871	BLM	Private	UMA		MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
3025	BLM	Private	UMA		MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
3026	BLM	Private	UMA		MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
3027	BLM	Private	UMA		MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
3028	BLM	Private	UMA		MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
3044	BLM	Private	UMA		MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
3059	BLM	Private	UMA		MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
3394	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
3873	BLM	critical	IMA	ACEC	MUMA	ACEC Selected for Prehistoric Habitation and Rock Art Not for Biological Preservation
3876	BLM	Private	UMA	NCA	LIMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer but is still in NCA
3877	BLM	Private	UMA	NCA	LIMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer but is still in NCA
3882	Private	NCA	LIMA	NCA	UMA	Points fell within Inholding in the NCA Using the 2004 Updated BLM Landownership Layer
3883	Private	NCA	LIMA	NCA	UMA	Points fell within Inholding in the NCA Using the 2004 Updated BLM Landownership Layer
3884	Private	NCA	LIMA	NCA	UMA	Points fell within Inholding in the NCA Using the 2004 Updated BLM Landownership Layer
3885	Private	NCA	LIMA	NCA	UMA	Points fell within Inholding in the NCA Using the 2004 Updated BLM Landownership Layer
4367	BLM	Private	UMA		MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
4368	BLM	Private	UMA		MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer

Species _ID	Landowner	MSHCP_ MNGM	CO_ MNGMT_ CATEGORY	LAND_ MANAG	MSHCP_ Category_ Update	MSHCP_Change_Reason
4369	BLM	Private	UMA		MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
4370	BLM	Private	UMA		MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
4371	BLM	Private	UMA		MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
4372	BLM	Private	UMA		MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
4373	BLM	Private	UMA		MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
4374	BLM		N/A		MUMA	On BLM…state boundary was crudely digitized in MSHCP Layer Vs. the 2004 BLM Landownership Layer. Points fell on BLM on the BLM Landown layer.
4375	BLM		N/A		MUMA	On BLM…state boundary was crudely digitized in MSHCP Layer Vs. the 2004 BLM Landownership Layer. Points fell on BLM on the BLM Landown layer.
4376	BLM		N/A		MUMA	On BLM…state boundary was crudely digitized in MSHCP Layer Vs. the 2004 BLM Landownership Layer. Points fell on BLM on the BLM Landown layer.
4377	BLM	Private	UMA		MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
4378	BLM	Private	UMA		MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
4379	BLM	Private	UMA		MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
4380	BLM	Private	UMA		MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
4381	BLM	Private	UMA		MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
4382	BLM	Private	UMA		MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
4383	BLM	Private	UMA		MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
4384	BLM	Private	UMA		MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
4385	Private		N/A		UMA	On Private…state boundary was crudely digitized in MSHCP Layer Vs. the 2004 BLM Landownership Layer.
4403	BLM	Private	UMA		MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
4442	BLM	Private	UMA		MUMA	No Longer falls in Private in 2004 Updated BLM Landownership Layer
4588	BLM	critical	IMA	ACEC/SRA	MUMA	ACEC Selected for Prehistoric Habitation and Rock Art Not for Biological Preservation
6239	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6240	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6241	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6242	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6243	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6246	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6257	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6258	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6259	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6260	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6267	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6268	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6269	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6270	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6271	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6272	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6273	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6276	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6327	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer

Species _ID	Landowner	MSHCP_ MNGM	CO_ MNGMT_ CATEGORY	LAND_ MANAG	MSHCP_ Category_ Update	MSHCP_Change_Reason
6328	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6329	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6330	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6331	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6332	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6333	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6334	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6335	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6336	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6337	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6338	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6339	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6340	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6341	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6342	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6343	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6344	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6345	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6346	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6347	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6529	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6530	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6531	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6532	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6533	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6534	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6535	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6536	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6537	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6538	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6539	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6540	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6541	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6542	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6543	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6544	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6545	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6546	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6547	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6548	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6549	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer

Species_ID	Landowner	MSHCP_MNGM	CO_MNGMT_CATEGORY	LAND_MANAG	MSHCP_Category_Update	MSHCP_Change_Reason
6550	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6551	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6552	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6553	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6554	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6555	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6556	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6557	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6558	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6559	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6560	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6561	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6562	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6563	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6564	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6565	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6566	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6567	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6568	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6569	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6570	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6627	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6628	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6629	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6664	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6665	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6666	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6667	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6668	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6669	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6670	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6671	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6672	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6673	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6674	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6675	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6676	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6677	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6678	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6679	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6680	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer

Species _ID	Landowner	MSHCP_ MNGM	CO_ MNGMT_ CATEGORY	LAND_ MANAG	MSHCP_ Category_ Update	MSHCP_Change_Reason
6681	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6682	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6683	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6684	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6685	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6686	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6687	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6688	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6689	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6690	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6691	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6692	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6693	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6694	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6695	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6696	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6697	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6698	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6699	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6700	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6701	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6702	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6703	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6704	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6705	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6706	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6707	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6708	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6709	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6710	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6711	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6712	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6713	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6714	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6715	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6716	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6717	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6718	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6719	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6720	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6721	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer

Species _ID	Landowner	MSHCP_ MNGM	CO_ MNGMT_ CATEGORY	LAND_ MANAG	MSHCP_ Category_ Update	MSHCP_Change_Reason
6722	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6723	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6724	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6725	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6726	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6727	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6728	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6729	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6730	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6731	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6732	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6733	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6734	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6735	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6736	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6737	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6738	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6739	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6740	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6741	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6742	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6743	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6744	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6745	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6746	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6747	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6748	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6749	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6750	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6751	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6752	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6753	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6754	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6755	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6756	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6757	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6758	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6759	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6760	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6761	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6762	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer

Species _ID	Landowner	MSHCP_ MNGM	CO_ MNGMT_ CATEGORY	LAND_ MANAG	MSHCP_ Category_ Update	MSHCP_Change_Reason
6763	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6764	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6765	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6766	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6767	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6768	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6769	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6770	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6771	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6772	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6773	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6774	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6775	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6776	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6777	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6778	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6779	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6780	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6781	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6782	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6783	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6784	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6785	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6786	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6787	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6788	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6789	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6790	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6791	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6792	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6793	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6794	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6795	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6796	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6797	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6798	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6799	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6800	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6801	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6802	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6803	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer

Species _ID	Landowner	MSHCP_ MNGM	CO_ MNGMT_ CATEGORY	LAND_ MANAG	MSHCP_ Category_ Update	MSHCP_Change_Reason
6804	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6805	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6806	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6807	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6808	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6809	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6810	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6811	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6812	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6813	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6814	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6815	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6816	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6817	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6818	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6819	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6820	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6821	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6822	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6823	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6824	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6825	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6826	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6827	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6828	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6829	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6830	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6831	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6832	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6833	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6834	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6835	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6836	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6837	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6838	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6839	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6840	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6841	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6842	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6843	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6844	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer

Species _ID	Landowner	MSHCP_ MNGM	CO_ MNGMT_ CATEGORY	LAND_ MANAG	MSHCP_ Category_ Update	MSHCP_Change_Reason
6845	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6846	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6847	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6848	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6849	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6850	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6851	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6852	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6853	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6854	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6855	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6856	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6857	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6858	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6859	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6860	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6861	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6862	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6863	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6864	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6865	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6866	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6867	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6868	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6869	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6870	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6871	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6872	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6873	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6874	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6875	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6876	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6877	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6878	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6879	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6880	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6881	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6882	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6883	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6884	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6885	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer

Species _ID	Landowner	MSHCP_ MNGM	CO_ MNGMT_ CATEGORY	LAND_ MANAG	MSHCP_ Category_ Update	MSHCP_Change_Reason
6886	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6887	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6888	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6889	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6890	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6891	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6892	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6893	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6894	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6895	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6896	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6897	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6898	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6899	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6900	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6901	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6902	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6903	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6904	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6905	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6906	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6907	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6908	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6909	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6910	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6911	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6912	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6913	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6914	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6915	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6916	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6917	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6918	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6919	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6920	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6921	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6922	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6923	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6924	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6925	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6926	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer

Species _ID	Landowner	MSHCP_ MNGM	CO_ MNGMT_ CATEGORY	LAND_ MANAG	MSHCP_ Category_ Update	MSHCP_Change_Reason
6927	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6928	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6929	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6930	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6931	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6932	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6933	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6934	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6935	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6936	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6937	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6938	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6939	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6940	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6941	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6942	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6943	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6944	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6945	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6946	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6947	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6948	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6949	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6950	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6951	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6952	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6953	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6954	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6955	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6956	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6957	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6958	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6959	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6960	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6961	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6962	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6963	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6964	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6965	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6966	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6967	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer

Species _ID	Landowner	MSHCP_ MNGM	CO_ MNGMT_ CATEGORY	LAND_ MANAG	MSHCP_ Category_ Update	MSHCP_Change_Reason
6968	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6969	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6970	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6971	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6977	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6978	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6986	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6987	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6988	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6989	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6990	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6991	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6992	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6993	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6994	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6995	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6996	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6997	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6998	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
6999	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
7000	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
7001	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
7002	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
7003	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
7004	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
7005	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
7006	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
7007	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
7008	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
7009	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
7010	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
7011	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
7012	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
7013	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
7014	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
7015	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
7016	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
7017	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
7018	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
7019	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
7020	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer

Species_ID	Landowner	MSHCP_MNGM	CO_MNGMT_CATEGORY	LAND_MANAG	MSHCP_Category_Update	MSHCP_Change_Reason
7021	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
7022	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
7039	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
7040	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
7041	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
7042	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
7043	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
7044	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
7045	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
7046	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
7047	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
7048	Private	undesignated	MUMA		UMA	On Private Land….Parcel Boundary Changes between the MSHCP Layer and the 2004 Updated BLM Landownership Layer
9159	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9167	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9168	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9170	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9171	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9172	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9173	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9174	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9175	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9176	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9177	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9178	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9179	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9180	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9916	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9917	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9918	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9919	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9923	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9924	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9925	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9926	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9927	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9928	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9929	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9930	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9932	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9933	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9934	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002

Species _ID	Landowner	MSHCP_ MNGM	CO_ MNGMT_ CATEGORY	LAND_ MANAG	MSHCP_ Category_ Update	MSHCP_Change_Reason
9935	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9936	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9937	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9938	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9939	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9940	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9941	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9942	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9943	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9944	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9945	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9946	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9949	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9950	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9951	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9952	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9953	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9954	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9955	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9956	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9957	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9958	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9959	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9960	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9961	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9965	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9966	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9967	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9968	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9969	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9970	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9971	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9972	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9973	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9974	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9975	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9976	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9977	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9978	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9980	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9981	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002

Species _ID	Landowner	MSHCP_ MNGM	CO_ MNGMT_ CATEGORY	LAND_ MANAG	MSHCP_ Category_ Update	MSHCP_Change_Reason
9982	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9983	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9984	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9985	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9986	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9987	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9988	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9989	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9990	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9991	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9994	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9995	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9996	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9997	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9998	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
9999	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10000	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10001	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10002	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10003	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10004	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10005	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10006	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10007	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10008	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10009	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10010	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10011	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10012	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10013	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10014	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10015	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10016	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10017	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10018	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10019	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10020	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10021	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10022	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10023	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10024	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002

Species _ID	Landowner	MSHCP_ MNGM	CO_ MNGMT_ CATEGORY	LAND_ MANAG	MSHCP_ Category_ Update	MSHCP_Change_Reason
10025	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10026	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10027	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10028	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10029	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10030	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10031	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10032	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10033	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10034	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10035	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10036	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10037	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10038	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10039	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10040	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10041	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10042	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10043	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10044	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10045	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10046	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10047	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10048	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10049	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10050	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10051	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10052	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10053	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10054	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10055	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10056	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10057	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10058	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10059	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10060	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10061	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10062	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10063	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10064	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10065	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002

Species _ID	Landowner	MSHCP_ MNGM	CO_ MNGMT_ CATEGORY	LAND_ MANAG	MSHCP_ Category_ Update	MSHCP_Change_Reason
10066	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10067	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10068	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10069	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10070	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10071	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10072	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10073	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10074	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10075	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10076	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10077	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10078	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10079	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10080	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10081	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10082	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10083	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10084	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10085	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10086	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10087	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10088	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10089	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10090	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10091	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10092	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10093	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10094	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10095	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10096	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10097	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10098	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10099	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10100	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10101	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10102	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10103	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10104	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10105	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10106	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002

Species _ID	Landowner	MSHCP_ MNGM	CO_ MNGMT_ CATEGORY	LAND_ MANAG	MSHCP_ Category_ Update	MSHCP_Change_Reason
10107	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10108	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10109	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10110	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10111	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10112	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10113	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10114	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10115	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10116	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10117	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10118	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10119	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10120	BLM	WSA	IMA	WSA	LIMA	WSA was changed into an NCA in the Clark County Act of 2002
10336	BLM	Native American	UMA	Native Am. Lands	MUMA	No Longer falls in Native Am. Lands in 2004 Updated BLM Landownership Layer
10339	BLM	Native American	UMA	Native Am. Lands	MUMA	No Longer falls in Native Am. Lands in 2004 Updated BLM Landownership Layer
10341	BLM	Native American	UMA	Native Am. Lands	MUMA	No Longer falls in Native Am. Lands in 2004 Updated BLM Landownership Layer
10348	BLM	Native American	UMA	Native Am. Lands	MUMA	No Longer falls in Native Am. Lands in 2004 Updated BLM Landownership Layer
10401	BLM	Private	UMA	ACEC	IMA	Definitely falls in ACEC in 2004 Updated BLM Landownership Layer

APPENDIX 4

Species Data Point Enumeration by Geological, Soil, and Southwest ReGAP Land Cover Type

Table A. Species data point enumerations by geological type. Geologic data from Longwell *et al.* (1965).

Geological Type	Sticky ringstem *Anulocaulis leiosolenus*	Las Vegas bearpoppy *Arctomecon californica*	White bearpoppy *Arctomecon merriamii*	Threecorner milkvetch *Astragalus geyeri var. triquetrus*	Alkali mariposa lily *Calochortus striatus*	Pahrump Valley wild buckwheat *Eriogonum bifurcatum*	Sticky wild buckwheat *Eriogonum viscidulum*	White-margined beardtongue *Penstemon albomarginatus*	Parish phacelia *Phacelia parishii*	Total
Alluvial Deposits	1.94% 2	16.65% 489	38.36% 61	40.49% 297	34.15% 14	83.66% 517	15.94% 16	95.49% 5420	33.33% 4	65.86% 6820
Andesite and Basalt Flows	0.00%	0.00%	0.00%	0.41% 3	0.00%	0.00%	0.00%	1..30% 74	0.00%	0.74% 77
Aztec Sandstone	1.94% 2	0.61% 18	12.58% 20	24.76% 181	39.02% 16	0.00%	2.90% 2	0.00%	0.00%	2.31% 239
Basalt Flows	0.00%	0.20% 6	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.06% 6
Breccia	0.00%	0.00%	0.00%	0.00%	0.00%	0.32% 2	0.00%	0.00%	0.00%	0.02% 2
Cherty Limestone	13.59% 14	13.11% 385	0.00%	0.00%	0.00%	0.00%	1.45% 1	0.00%	0.00%	3.87% 400
Cherty Limestone, and Sparce Dolomite, Shale and Sandstone	0.97% 1	0.37% 11	0.00%	0.00%	0.00%	0.00%	1.45% 1	0.00%	0.00%	0.13% 13
Chinle Formation and Associated Rocks	1.94% 2	7.08% 208	0.00%	0.55% 4	26.83% 11	0.00%	0.00%	0.00%	0.00%	2.17% 225
Continental Sedimentary Rocks	31.07% 32	10.45% 307	0.63% 1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	3.29% 340
Dolomite	0.00%	0.00%	6.29% 10	0.00%	0.00%	0.00%	0.00%	1.20% 68	0.00%	0.75% 78
Dolomite and Limestone	0.00%	0.31% 9	0.63% 1	0.00%	0.00%	0.00%	0.00%	0.42% 24	0.00%	0.33% 34
Dolomite, Limestone and Minor amounts of Sandstone and Quartzite	0.97% 1	0.07% 2	11.95% 19	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.21% 22
Horse Spring Formation	0.97% 1	10.32% 303	4.40% 7	1.09% 8	0.00%	0.00%	0.00%	0.00%	0.00%	3.08% 319
Limestone and Dolomite	0.00%	0.00%	1.26% 2	0.00%	0.00%	0.00%	1.45% 1	0.04% 2	0.00%	0.05% 5
Limestone and Dolomite, Locally thick sequences of Shale and Siltstone	0.00%	0.03% 1	6.29% 10	0.14% 1	0.00%	0.16% 1	0.00%	0.04% 2	0.00%	0.14% 15
Limestone and Minor amounts of Dolomite and Shale	0.00%	0.00%	0.63% 1	0.00%	0.00%	0.00%	0.00%	0.30% 17	0.00%	0.17% 18
Limestone and Sparce Dolomite	0.00%	1.57% 46	0.00%	0.00%	0.00%	0.00%	0.00%	1.06% 60	0.00%	1.02% 106
Limestone and Sparce Dolomite, Siltstone and Sandstone	0.00%	0.10% 3	0.63% 1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.04% 4
Limestone, Dolomite, Shale, and Quartzite	0.00%	0.00%	12.58% 20	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.19% 20
Moenkopi Formation	32.04% 33	27.17% 798	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	8.03% 831

Geological Type	Sticky ringstem *Anulocaulis leiosolenus*	Las Vegas bearpoppy *Arctomecon californica*	White bearpoppy *Arctomecon merriamii*	Threecorner milkvetch *Astragalus geyeri var. triquetrus*	Alkali mariposa lily *Calochortus striatus*	Pahrump Valley wild buckwheat *Eriogonum bifurcatum*	Sticky wild buckwheat *Eriogonum viscidulum*	White-margined beardtongue *Penstemon albomarginatus*	Parish phacelia *Phacelia parishii*	Total
Moenkopi Formation, Thaynes and Related Rocks	6.80% 7	1.29% 38	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.43% 45
Playa	0.00%	0.00%	0.00%	1.37% 10	0.00%	14.40% 89	0.00%	0.00%	0.00%	0.96% 99
Playa,Marsh,Alluvial Flat Deposits, Locally Eroded	0.00%	0.00%	0.00%	0.27% 2	0.00%	1.46% 9	0.00%	0.00%	66.67% 8	0.18% 19
Quartzite and Minor amounts of Conglomerate	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.16% 9	0.00%	0.09% 9
Quartzite and Minor amounts of Conglomerate,Phyllitic Siltstone, Limestone and Dolomite	0.00%	0.00%	1.26% 2	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02% 2
Quartzite, Phillitic Siltstone, Conglomerate, Limestone and Dolomite	0.00%	0.00%	0.63% 1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01% 1
Shale, Siltstone, Sandstone, Chert-pebble Conglomerate and Limestone	0.00%	0.00%	1.89% 3	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.03% 3
Siltstone	0.00%	0.41% 12	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.12% 12
Siltstone, Sandstone, Limestone and Dolomite	0.00%	0.03% 1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01% 1
Tufaceous Sedimentary Rocks	7.77% 8	10.21% 300	0.00%	30.92% 228	0.00%	0.00%	76.81% 55	0.00%	0.00%	5.67% 591
Total Percent & Number	100.00% 103	100.00% 2937	100.00% 159	100.00% 734	100.00% 41	100.00% 618	100.00% 76	100.00% 5676	100.00% 12	100.00% 10356

Table B. Species data point enumerations by soil map unit. Soils data provided by Douglas Merkler (NRCS, personal communication) and Lato (2006)

Soil Map Unit	Sticky Ringstem	Las Vegas Bearpoppy	White Bearpoppy	Threecorner Milkvetch	Alkali Mariposa Lily	Pahrump Valley Wild Buckwheat	Sticky Wild Buckwheat	White-Margined Beardtongue	Parish Phacelia	Total
	Anulocaulis Leiosolenus	*Arctomecon Californica*	*Arctomecon Merriamii*	*Astragalus Geyeri Var. Triquetrus*	*Calochortus Striatus*	*Eriogonum Bifurcatum*	*Eriogonum Viscidulum*	*Penstemon Albomarginatus*	*Phacelia Parishii*	
Alluvial Land	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.63% 2	0.00%	0.00% A	0.02% 2
Arada Fine Sand, 2 To 8 Percent Slopes	0.00%	0.00%	0.00%	9.66% 71	0.00%	0.00%	1.32% 1	0.00%	0.00%	0.68% 72
Arada Fine Sand, Gravelly Substratum, 0 To 4 Percent Slopes	0.00%	0.00%	0.00%	8.03% 59	0.00%	0.00%	0.00%	0.00%	0.00%	0.56% 59
Arada Fine Sand, Hardpan Variant, 2 To 8 Percent Slopes	0.00%	0.00%	0.00%	1.36% 10	0.00%	0.00%	1.32% 1	0.00%	0.00%	0.10% 11
Arizo Gravelly Fine Sand, 2 To 4 Percent Slopes	0.00%	0.00%	0.00%	1.63% 12	0.00%	0.00%	2.63% 2	0.00%	0.00%	0.13% 14
Arizo-Bluepoint-Dune Land Complex, 0 To 4 Percent Slopes	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.04% 2	0.00%	0.02% 2
Aztec Very Gravelly Sandy Loam, 2 To 8 Percent Slopes	0.00%	0.03% 1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01% 1
Badland	0.87% 1	0.91% 27	0.00%	5.85% 43	0.00%	0.00%	40.79% 31	0.00%	0.00%	0.96% 102
Bard Gravelly Fine Sand, 4 To 15 Percent Slopes	0.00%	0.00%	0.00%	19.46% 143	0.00%	0.00%	0.00%	0.00%	0.00%	1.35% 143
Bard Gravelly Fine Sandy Loam, 2 To 8 Percent Slopes	0.00%	0.00%	0.00%	1.50% 11	0.00%	0.00%	0.00%	0.00%	0.00%	0.10% 11
Baseline-Callville-Badland	9.57% 11	5.40% 160	0.00%	0.27% 2	0.00%	0.00%	1.32% 1	0.00%	0.00%	1.64% 174
Baseline-Guardian Associat	5.22% 6	18.80% 557	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	5.32% 563
Baseline-Gypwash Associati	0.87% 1	1.22% 36	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.35% 37
Besherm Clay Loam	0.00%	0.00%	0.00%	0.00%	0.00%	5.88% 38	0.00%	0.00%	13.04% 3	0.39% 41
Besherm-Tanazza Association	0.00%	0.00%	0.00%	0.00%	0.00%	23.53% 152	0.00%	0.00%	0.00%	1.44% 152
Birdspring-Birdspring, War	0.00%	0.00%	0.52% 1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01% 1
Bludiamond-Diamonhil Assoc	0.00%	0.00%	0.00%	0.00%	2.40% 3	0.00%	0.00%	0.00%	0.00%	0.03% 3
Bluepoint Association	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	18.99% 1084	0.00%	10.24% 1084
Bluepoint Loamy Fine Sand, Warm, 4 To 30 Percent Slopes	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.04% 2	0.00%	0.02% 2
Bluepoint-	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	31.59%	0.00%	17.04%

Soil Map Unit	Sticky Ringstem	Las Vegas Bearpoppy	White Bearpoppy	Threecorner Milkvetch	Alkali Mariposa Lily	Pahrump Valley Wild Buckwheat	Sticky Wild Buckwheat	White-Margined Beardtongue	Parish Phacelia	Total
	Anulocaulis Leiosolenus	*Arctomecon Californica*	*Arctomecon Merriamii*	*Astragalus Geyeri Var. Triquetrus*	*Calochortus Striatus*	*Eriogonum Bifurcatum*	*Eriogonum Viscidulum*	*Penstemon Albomarginatus*	*Phacelia Parishii*	
Grapevine Associ								1803		1803
Bobnbob-Cobatus Complex, 0 To 2 Percent Slopes	0.00%	0.00%	0.00%	0.00%	0.80% 1	0.00%	0.00%	0.00%	0.00%	0.01% 1
Bracken Very Gravelly Fine Sandy Loam, 2 To 8 Percent S Lopes	0.00%	0.03% 1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01% 1
Callville-Badland-Guardian	1.74% 2	0.30% 9	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.10% 11
Callville-Gypwash-Badland	0.00%	0.34% 10	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.09% 10
Carrizo-Carrizo-Riverbend	0.00%	0.14% 4	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.04% 4
Casaga Very Gravelly Sandy Clay Loam, 0 To 8 Percent Sl Opes	0.00%	0.07% 2	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02% 2
Casaga-Nowoy Complex, 2 To 4 Percent Slopes	0.00%	0.00%	0.52% 1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01% 1
Cave Loamy Fine Sand, 2 To 8 Percent Slopes	0.00%	0.00%	4.15% 8	0.00%	7.20% 9	0.00%	0.00%	0.00%	0.00%	0.16% 17
Cheme-Huevi Association	0.00%	0.14% 4	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.04% 4
Cololag-Badland Associatio	0.00%	0.30% 9	0.00%	0.00%	0.00%	0.00%	1.32% 1	0.00%	0.00%	0.09% 10
Colorock-Tonopah Association, Moderately Sloping	0.00%	0.00%	0.00%	0.14% 1	0.00%	0.00%	0.00%	0.00%	0.00%	0.01% 1
Commski-Tanazza Association	0.00%	0.00%	0.00%	0.00%	0.00%	2.17% 14	0.00%	0.00%	0.00%	0.13% 14
Commski-Weiser-Threelakes	0.00%	0.00%	0.00%	0.00%	0.00%	0.15% 1	0.00%	0.00%	0.00%	0.01% 1
Dalian Very Gravelly Fine Sandy Loam, 2 To 4 Percent Sl Opes	0.00%	0.00%	0.52% 1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01% 1
Drygyp Association	0.00%	0.10% 3	0.00%	0.27% 2	0.00%	0.00%	0.00%	0.00%	0.00%	0.05% 5
Drygyp Fine Sandy Loam, 2	0.00%	0.03% 1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01% 1
Drygyp-Bluegyp Association	5.22% 6	0.74% 22	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.26% 28
Drygyp-Guardian-Baseline A	16.52% 19	2.23% 66	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.80% 85
Dumps	0.87% 1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01% 1
Glencarb Silt Loam	0.00%	0.07% 2	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02% 2

Soil Map Unit	Sticky Ringstem *Anulocaulis Leiosolenus*	Las Vegas Bearpoppy *Arctomecon Californica*	White Bearpoppy *Arctomecon Merriamii*	Threecorner Milkvetch *Astragalus Geyeri Var. Triquetrus*	Alkali Mariposa Lily *Calochortus Striatus*	Pahrump Valley Wild Buckwheat *Eriogonum Bifurcatum*	Sticky Wild Buckwheat *Eriogonum Viscidulum*	White-Margined Beardtongue *Penstemon Albomarginatus*	Parish Phacelia *Phacelia Parishii*	Total
Goodsprings Gravelly Fine Sandy Loam, 2 To 4 Percent Sl Opes	0.00%	0.03% 1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01% 1
Govwash-Guardian-Badland A	0.00%	0.30% 9	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.09% 9
Grapevine Loamy Fine Sand, 2 To 4 Percent Slopes	0.00%	0.03% 1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01% 1
Guardian-Badland Associati	0.00%	0.10% 3	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.03% 3
Guardian-Baseline Associat	33.91% 39	20.56% 609	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	6.12% 648
Guardian-Baseline-Guardian	0.00%	2.90% 86	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.81% 86
Guardian-Sunrock-Badland A	0.00%	0.07% 2	0.00%	0.14% 1	0.00%	0.00%	0.00%	0.00%	0.00%	0.03% 3
Gypwash Very Gravelly Fine	0.00%	0.27% 8	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.08% 8
Gypwash-Callville-Carrizo	0.00%	0.17% 5	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.05% 5
Haymont Very Fine Sandy Loam, 0 To 2 Percent Slopes	0.00%	0.00%	0.00%	0.00%	0.00%	0.15% 1	0.00%	0.00%	0.00%	0.01% 1
Haymont-Bluepoint Associat	0.00%	0.00%	0.00%	0.00%	0.00%	6.81% 44	0.00%	0.00%	0.00%	0.42% 44
Heleweiser Association	0.00%	0.10% 3	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.03% 3
Heleweiser-Carrizo Associa	0.87% 1	0.07% 2	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.03% 3
Heleweiser-Carrizo-Teebar	0.87% 1	3.38% 100	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.95% 101
Huevi Association	0.00%	0.10% 3	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.03% 3
Huevi-Badland Association	0.87%	0.44% 13	0.00%	0.27% 1	0.00%	0.00%	2.63% 2	0.00%	0.00%	0.17% 16
Huevi-Cheme Association	1.74% 2	0.07% 2	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.04% 4
Huevi-Hiller Association	1.74% 2	0.57% 17	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.18% 19
Hypoint-Vegastorm Associat	0.00%	0.00%	0.00%	0.00%	0.00%	6.50% 42	0.00%	0.00%	0.00%	0.40% 42
Iceberg-St.Thomas-Rock Out	0.87% 1	1.11% 33	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.32% 34
Irongold-Wechech Associati	0.00%	0.03% 1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01% 1
Kanackey Very	0.00%	0.00%	0.52%	0.00%	0.00%	0.15%	0.00%	0.00%	0.00%	0.02%

Soil Map Unit	Sticky Ringstem	Las Vegas Bearpoppy	White Bearpoppy	Threecorner Milkvetch	Alkali Mariposa Lily	Pahrump Valley Wild Buckwheat	Sticky Wild Buckwheat	White-Margined Beardtongue	Parish Phacelia	Total
	Anulocaulis Leiosolenus	*Arctomecon Californica*	*Arctomecon Merriamii*	*Astragalus Geyeri Var. Triquetrus*	*Calochortus Striatus*	*Eriogonum Bifurcatum*	*Eriogonum Viscidulum*	*Penstemon Albomarginatus*	*Phacelia Parishii*	
Gravelly Loam, 15 To 50 Percent Slopes			1			1				2
Las Vegas Gravelly Fine Sandy Loam, 0 To 2 Percent Slop Es	0.00%	0.17% 5	2.59% 5	0.00%	0.80% 1	0.00%	0.00%	0.00%	0.00%	0.10% 11
Las Vegas Gravelly Fine Sandy Loam, 2 To 4 Percent Slop Es	0.00%	0.10% 3	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.03% 3
Las Vegas-Destazo Complex, 0 To 2 Percent Slopes	0.00%	1.32% 39	4.66% 9	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.45% 48
Las Vegas-Mccarran-Grapevine Complex, 0 To 4 Percent Sl Opes	0.00%	0.17% 5	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.05% 5
Las Vegas-Skyhaven Complex, 0 To 4 Percent Slopes	0.00%	0.10% 3	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.03% 3
Lastchance-Ferrogold-Comms	0.00%	0.00%	0.52% 1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01% 1
Mccarran Fine Sandy Loam, 0 To 4 Percent Slopes	0.00%	0.27% 8	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.08% 8
Mesabase Extremely Gravell	0.00%	0.17% 5	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.05% 5
Mesabase-Azsand Associatio	0.00%	0.20% 6	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.06% 6
Mormon Mesa Fine Sandy Loam, 0 To 8 Percent Slopes	0.00%	0.00%	0.00%	1.77% 13	0.00%	0.00%	0.00%	0.00%	0.00%	0.12% 13
Mormon Mesa Loamy Fine Sand, 0 To 4 Percent Slopes	0.00%	0.00%	0.00%	3.27% 24	0.00%	0.00%	0.00%	0.00%	0.00%	0.23% 24
Nickel-Arizo Association	0.00%	0.78% 23	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.22% 23
Nopah Loam	0.00%	0.00%	0.00%	0.00%	0.00%	0.77% 5	0.00%	0.00%	0.00%	0.05% 5
Nowoy-Tanazza-Yurm Association	0.00%	0.00%	1.04% 2	0.00%	2.40% 3	0.00%	0.00%	0.00%	0.00%	0.05% 5
Playas	0.00%	0.00%	0.00%	0.00%	0.00%	2.01% 13	0.00%	0.00%	0.00%	0.12% 13
Potosi-Zeheme-Rock Outcrop	0.00%	0.00%	1.04% 2	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02% 2
Prisonear Fine Sand, 2 To	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	39.70% 2266	0.00%	21.41% 2266
Purob-Irongold Association	0.00%	0.00%	0.00%	0.00%	3.20% 4	0.00%	0.00%	0.00%	0.00%	0.04% 4
Ramshead-St. Thomas-Rock O	0.00%	0.17% 5	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.05% 5

Soil Map Unit	Sticky Ringstem *Anulocaulis Leiosolenus*	Las Vegas Bearpoppy *Arctomecon Californica*	White Bearpoppy *Arctomecon Merriamii*	Threecorner Milkvetch *Astragalus Geyeri Var. Triquetrus*	Alkali Mariposa Lily *Calochortus Striatus*	Pahrump Valley Wild Buckwheat *Eriogonum Bifurcatum*	Sticky Wild Buckwheat *Eriogonum Viscidulum*	White-Margined Beardtongue *Penstemon Albomarginatus*	Parish Phacelia *Phacelia Parishii*	Total
Riverwash	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.32% 1	0.00%	0.00%	0.01% 1
Rock Outcrop, Sandstone	0.00%	0.00%	0.00%	0.00%	2.40% 3	0.00%	0.00%	0.00%	0.00%	0.03% 3
Rock Outcrop-Moapa-Bluepoi	0.00%	0.10% 3	0.00%	0.00%	0.00%	0.00%	1.32% 1	0.00%	0.00%	0.04% 4
Rock Outcrop-St. Thomas Association	0.00%	0.00%	4.66% 9	0.00%	0.00%	0.00%	0.00%	0.02% 1	0.00%	0.09% 10
Rock Outcrop-St. Thomas Complex, 15 To 30 Percent Slope S	0.00%	0.00%	0.00%	0.00%	1.60% 2	0.00%	0.00%	0.00%	0.00%	0.02% 2
Rockland-St. Thomas Association, Very Steep	0.00%	3.48% 103	0.00%	3.81% 28	0.00%	0.00%	0.00%	0.00%	0.00%	1.24% 131
Rositas-Riverbend Associat	0.00%	0.00%	0.00%	0.54% 4	0.00%	0.00%	2.63% 2	0.00%	0.00%	0.06% 6
Rumpah Clay	0.00%	0.00%	0.00%	0.00%	0.00%	37.93% 245	0.00%	0.00%	0.00%	2.32% 245
Sandpan-Rositas Associatio	0.00%	0.00%	0.00%	0.27% 2	0.00%	0.00%	1.32% 1	0.00%	0.00%	0.03% 3
Sanwell-Commski Association	0.00%	0.00%	1.55% 3	0.00%	0.00%	0.31% 2	0.00%	0.00%	0.00%	0.05% 5
Skyhaven Very Fine Sandy Loam, 0 To 4 Percent Slopes	0.00%	0.03% 1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01% 1
Spring Clay Loam	0.00%	0.03% 1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01% 1
St. Thomas-Iceberg-Rock Ou	0.00%	2.16% 64	0.00%	0.00%	0.00%	0.00%	2.63% 2	0.00%	0.00%	0.62% 66
St. Thomas-Rock Outcrop Co	0.00%	0.20% 6	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.06% 6
St. Thomas-Rock Outcrop-Commski Association	0.00%	0.00%	2.59% 5	0.00%	0.00%	0.15% 1	0.00%	0.04% 2	0.00%	0.08% 8
St. Thomas-Upperline-White	0.00%	1.59% 47	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.44% 47
Sunrock-Callville-Badland	0.00%	1.15% 34	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.32% 34
Sunrock-Haleburu-Rock Outc	0.00%	0.03% 1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01% 1
Sunrock-Rock Outcrop Assoc	0.00%	0.07% 2	0.00%	0.27% 2	0.00%	0.00%	1.32% 1	0.00%	0.00%	0.05% 5
Tanazza-Wechech-Wodavar Association	0.00%	0.00%	0.00%	0.00%	0.00%	4.33% 28	0.00%	0.00%	0.00%	0.26% 28
Teebar-Sandpan Association	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.32% 1	0.00%	0.00%	0.01% 1

Soil Map Unit	Sticky Ringstem *Anulocaulis Leiosolenus*	Las Vegas Bearpoppy *Arctomecon Californica*	White Bearpoppy *Arctomecon Merriamii*	Threecorner Milkvetch *Astragalus Geyeri Var. Triquetrus*	Alkali Mariposa Lily *Calochortus Striatus*	Pahrump Valley Wild Buckwheat *Eriogonum Bifurcatum*	Sticky Wild Buckwheat *Eriogonum Viscidulum*	White-Margined Beardtongue *Penstemon Albomarginatus*	Parish Phacelia *Phacelia Parishii*	Total
Tonopah Very Gravelly Sandy Loam, 4 To 15 Percent Slopes	0.00%	0.00%	0.00%	0.14% 1	0.00%	0.00%	1.32% 1	0.00%	0.00%	0.02% 2
Toquop Fine Sand, 2 To 8 Percent Slopes	0.00%	0.00%	0.00%	7.76% 57	0.00%	0.00%	14.47% 11	0.00%	0.00%	0.64% 68
Upperline-St. Thomas Assoc	0.00%	0.78% 23	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.22% 23
Upperline-St. Thomas-Upper	0.00%	0.95% 28	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.26% 28
Upperline-Weiser-Whitebasi	0.00%	0.07% 2	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02% 2
Wechech-Ifteen	0.00%	0.17% 5	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.05% 5
Wechech-Weiser Association	0.00%	1.15% 34	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.32% 34
Weiser Extremely Gravelly Fine Sandy Loam, 2 To 8 Perce Nt Slopes	0.00%	0.03% 1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01% 1
Weiser-Canoto Association	0.00%	0.00%	1.55% 3	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.03% 3
Weiser-Goodsprings Complex, 2 To 4 Percent Slopes	0.00%	0.03% 1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01% 1
Whitebasin-Upperline Assoc	0.00%	3.24% 96	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.91% 96
Yermo-Commski Association	0.00%	0.00%	0.52% 1	0.00%	0.00%	0.77% 5	0.00%	0.00%	0.00%	0.06% 6
Yermo-Woda-Nowoy Association	0.00%	0.00%	0.52% 1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01% 1
Zeheme-Rock Outcrop Associ	0.00%	0.17% 5	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.05% 5
(Blank)	0.00%	0.00%	0.00%	0.00% 3	0.00%	0.00%	0.00% 7	0.00%	0.00%	0.00% 10
No Soil Data Available	11.30% 2	6.01% 153	65.80% 93	1.09% 6	67.20%	8.20% 25	14.47% 4	0.56%	86.96% 9	4.97% 292
Aztec-Bracken Complex, 4 To 30 Percent Slopes	2.61% 3	0.54% 16	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.18% 19
Las Vegas-Mccarran-Grapevine Complex, 0 To 4 Perce	0.00%	4.15% 123	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.16% 123
Bracken Very Gravelly Fine Sandy Loam, 4 To 30 Per	0.00%	0.78% 23	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.22% 23
Aztec Very Gravelly Sandy Loam, 2 To 8 Percent Slo	0.00%	0.17% 5	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.05% 5

Soil Map Unit	Sticky Ringstem	Las Vegas Bearpoppy	White Bearpoppy	Threecorner Milkvetch	Alkali Mariposa Lily	Pahrump Valley Wild Buckwheat	Sticky Wild Buckwheat	White-Margined Beardtongue	Parish Phacelia	Total
	Anulocaulis Leiosolenus	*Arctomecon Californica*	*Arctomecon Merriamii*	*Astragalus Geyeri Var. Triquetrus*	*Calochortus Striatus*	*Eriogonum Bifurcatum*	*Eriogonum Viscidulum*	*Penstemon Albomarginatus*	*Phacelia Parishii*	
Callville Association	0.00%	0.07% 2	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02% 2
Rock Outcrop-Redneedle-Hel	1.74% 2	1.28% 38	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.38% 40
Las Vegas Gravelly Fine Sandy Loam, 0 To 2 Percent	0.00%	0.74% 22	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.21% 22
Skyhaven Very Fine Sandy Loam, 0 To 4 Percent Slop	0.00%	4.36% 129	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.22% 129
Las Vegas Gravelly Fine Sandy Loam, 2 To 4 Percent	0.00%	0.41% 12	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.11% 12
Weiser-Wechech Association	0.00%	0.03% 1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01% 1
Irongold-Weiser Associatio	0.00%	0.44% 13	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.12% 13
Bard-Nickel-Limewash Assoc	1.74% 2	0.27% 8	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.09% 10
Cheme-Carrizo-Huevi Associ	0.00%	0.14% 4	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.04% 4
Bluepoint-Arizo Associatio	0.00%	0.03% 1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01% 1
Crosgrain-Irongold-Nickel	0.00%	0.51% 15	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.14% 15
Weiser Extremely Gravelly Fine Sandy Loam, 2 To 8	0.00%	0.03% 1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01% 1
Arizo Very Gravelly Sandy Loam, Moist, 0 To 2 Perc	0.00%	0.00%	0.52% 1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01% 1
Rock Outcrop-St. Thomas Complex, 15 To 30 Percent	0.00%	0.00%	6.22% 12	0.00%	12.00% 15	0.00%	0.00%	0.00%	0.00%	0.26% 27
Bard Gravelly Fine Sandy Loam, 2 To 8 Percent Slop	0.87% 1	0.00%	0.00%	12.11% 89	0.00%	0.00%	0.00%	0.00%	0.00%	0.85% 90
Arada Fine Sand, Gravelly Substratum, 0 To 4 Perce	0.00%	0.00%	0.00%	3.40% 25	0.00%	0.00%	0.00%	0.00%	0.00%	0.24% 25
Bitter Spring-Arizo Association, Moderately Slopin	0.00%	0.00%	0.00%	0.68% 5	0.00%	0.00%	1.32% 1	0.00%	0.00%	0.06% 6
Flattop Gravelly Clay Loam, 2 To 8 Percent Slopes	0.00%	0.00%	0.00%	0.68% 5	0.00%	0.00%	0.00%	0.00%	0.00%	0.05% 5
Arizo Fine Sand, 0 To 2 Percent Slopes	0.00%	0.00%	0.00%	0.27% 2	0.00%	0.00%	0.00%	0.00%	0.00%	0.02% 2
Haymont Very	0.00%	0.00%	0.00%	0.00%	0.00%	0.15%	0.00%	0.00%	0.00%	0.01%

Soil Map Unit	Sticky Ringstem	Las Vegas Bearpoppy	White Bearpoppy	Threecorner Milkvetch	Alkali Mariposa Lily	Pahrump Valley Wild Buckwheat	Sticky Wild Buckwheat	White-Margined Beardtongue	Parish Phacelia	Total
	Anulocaulis Leiosolenus	*Arctomecon Californica*	*Arctomecon Merriamii*	*Astragalus Geyeri Var. Triquetrus*	*Calochortus Striatus*	*Eriogonum Bifurcatum*	*Eriogonum Viscidulum*	*Penstemon Albomarginatus*	*Phacelia Parishii*	
Fine Sandy Loam, 0 To 2 Percent Slope						1				1
Toquop Fine Sand, 0 To 2 Percent Slopes	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.32% 1	0.00%	0.00%	0.01% 1
Tonopah Very Gravelly Sandy Loam, 4 To 15 Percent	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.32% 1	0.00%	0.00%	0.01% 1
Tipnat-Bluepoint-Hypoint A	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.04% 2	0.00%	0.02% 2
Tonopah-Arizo Association	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02% 1	0.00%	0.01% 1
Birdspring Association	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.82% 47	0.00%	0.44% 47
Arizo Association	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.63% 93	0.00%	0.88% 93
Haleburu-Hiddensun Associa	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.18% 10	0.00%	0.09% 10
Nipton-Hiddensun-Haleburu	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.67% 38	0.00%	0.36% 38
Railroad Association	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	3.40% 194	0.00%	1.83% 194
Commski-Arizo Association	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.77% 44	0.00%	0.42% 44
Arizo-Bluepoint-Dune Land Complex, 0 To 4 Percent	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.51% 86	0.00%	0.81% 86
Zalda-Greyeagle-Upspring Association	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02% 1	0.00%	0.01% 1
Tonopah Gravelly Sandy Loam, 0 To 4 Percent Slopes	0.00%	0.00%	0.00%	0.27% 2	0.00%	0.00%	0.00%	0.00%	0.00%	0.02% 2
Bard Very Stony Loam, 2 To 4 Percent Slopes	0.00%	0.00%	0.00%	0.14% 1	0.00%	0.00%	0.00%	0.00%	0.00%	0.01% 1
Riverbend-Cheme-Carrizo As	0.00%	0.00%	0.00%	0.14%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%
Water	0.00%	0.00%	0.00%	0.14% 1	0.00%	0.00%	0.00%	0.00%	0.00%	0.01% 1
Rockland-Moapa Association, Hilly	0.00%	0.00%	0.00%	14.69% 108	0.00%	0.00%	0.00%	0.00%	0.00%	1.02% 108
Total Percent & Number	100.00% 103	100.00% 2937	100.00% 159	100.00% 734	100.00% 41	100.00% 618	100.00% 76	100.00% 5676	100.00% 12	100.00% 10356

Table C. Species data point enumerations by Southwest ReGAP land type unit.

Landtype	Sticky ringstem	Las Vegas bearpoppy	White bearpoppy	Threecorner milkvetch	Alkali mariposa lily	Pahrump Valley wild buckwheat	Sticky wild buckwheat	White-margined beardtongue	Parish phacelia	Total
	Anulocaulis leiosolenus	*Arctomecon californica*	*Arctomecon merriamii*	*Astragalus geyeri var. triquetrus*	*Calochortus striatus*	*Eriogonum bifurcatum*	*Eriogonum viscidulum*	*Penstemon albomarginatus*	*Phacelia parishii*	
Apacherian-Chihuahuan Piedmont Semi-Desert Grassland and Steppe	2 0.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2 0.02%
Chihuahuan Stabilized Coppice Dune and Sand Flat Scrub	1 0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1 0.01%
Colorado Plateau Blackbrush-Mormon-tea Shrubland	2 0.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2 0.02%
Colorado Plateau Mixed Bedrock Canyon and Tableland	0.00%	2 0.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2 0.02%
Colorado Plateau Pinyon-Juniper Woodland	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1 0.01%	1 0.01%
Developed, Medium - High Intensity	0.00%	25 0.24%	5 0.05%	3 0.03%	0.00%	0.00%	0.00%	0.00%	0.00%	33 0.32%
Developed, Open Space - Low Intensity	0.00%	17 0.16%	3 0.03%	0.00%	1 0.01%	1 0.01%	0.00%	0.00%	0.00%	22 0.21%
Great Basin Pinyon-Juniper Woodland	0.00%	0.00%	1 0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1 0.01%
Inter-Mountain Basins Big Sagebrush Shrubland	0.00%	0.00%	1 0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1 0.01%
Inter-Mountain Basins Greasewood Flat	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	4 0.04%	4 0.04%
Inter-Mountain Basins Mixed Salt Desert Scrub	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2 0.02%	2 0.02%
Inter-Mountain Basins Playa	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1 0.01%	1 0.01%
Inter-Mountain Basins Semi-Desert Shrub Steppe	0.00%	0.00%	13 0.13%	0.00%	1 0.01%	0.00%	0.00%	22 0.21%	0.00%	36 0.35%
Invasive Southwest Riparian Woodland and Shrubland	1 0.01%	3 0.03%	0.00%	2 0.02%	0.00%	0.00%	3 0.03%	0.00%	0.00%	9 0.09%
Mojave Mid-	1	4	43		18			79		145

Landtype	Sticky ringstem *Anulocaulis leiosolenus*	Las Vegas bearpoppy *Arctomecon californica*	White bearpoppy *Arctomecon merriamii*	Threecorner milkvetch *Astragalus geyeri var. triquetrus*	Alkali mariposa lily *Calochortus striatus*	Pahrump Valley wild buckwheat *Eriogonum bifurcatum*	Sticky wild buckwheat *Eriogonum viscidulum*	White-margined beardtongue *Penstemon albomarginatus*	Parish phacelia *Phacelia parishii*	Total
Elevation Mixed Desert Scrub	0.01%	0.04%	0.41%	0.00%	0.17%	0.00%	0.00%	0.76%	0.00%	1.40%
North American Arid West Emergent Marsh	0.00%	0.00%	1 0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1 0.01%
North American Warm Desert Badland	5 0.05%	49 0.47%	0.00%	4 0.04%	0.00%	0.00%	1 0.01%	0.00%	0.00%	59 0.57%
North American Warm Desert Bedrock Cliff and Outcrop	2 0.02%	104 1.00%	29 0.28%	11 0.11%	2 0.02%	0.00%	9 0.09%	21 0.20%	0.00%	178 1.71%
North American Warm Desert Pavement	16 0.15%	331 3.19%	0.00%	0.00%	1 0.01%	0.00%	0.00%	0.00%	0.00%	348 3.35%
North American Warm Desert Playa	0.00%	24 0.23%	1 0.01%	0.00%	3 0.03%	21 0.20%	0.00%	0.00%	2 0.02%	51 0.49%
North American Warm Desert Volcanic Rockland	0.00%	11 0.11%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	11 0.11%
North American Warm Desert Wash	3 0.03%	48 0.46%	0.00%	48 0.46%	0.00%	0.00%	2 0.02%	0.00%	0.00%	101 0.97%
Open Water	1 0.01%	17 0.16%	0.00%	4 0.04%	0.00%	0.00%	18 0.17%	0.00%	0.00%	40 0.39%
Sonora-Mojave Creosotebush-White Bursage Desert Scrub	77 0.74%	2301 22.16%	58 0.56%	666 6.41%	15 0.14%	370 3.56%	70 0.67%	5356 51.59%	4 0.04%	8917 85.89%
Sonora-Mojave Mixed Salt Desert Scrub	0.00%	26 0.25%	4 0.04%	0.00%	0.00%	158 1.52%	0.00%	220 2.12%	0.00%	408 3.93%
Sonoran Mid-Elevation Desert Scrub	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	6 0.06%	0.00%	6 0.06%
Total Percent & Number	111 1.07%	2962 28.53%	159 1.53%	738 7.11%	41 0.39%	550 5.30%	103 0.99%	5704 54.94%	14 0.13%	10382 100.00%

APPENDIX 5

TNC Conservation Action Planning (CAP) Enhanced-5S Methodology with Glossary of Terminology

TNC Conservation Action Planning (CAP) Enhanced-5S Methodology with Glossary of Terminology

The framework used for the low elevation rare plant CMS is a tested, science-based method developed and used by TNC on numerous conservation projects and often with outside conservation partners. This section is an overview of TNC's Conservation Action Planning process to help conservation projects develop strategies, take action, and measure their success and then to adapt and learn over time (Baumgartner *et. al* 2005). Refer to the attached glossary for definitions of underlined terms.

Define the Project:

Two initial steps of CAP define the conservation project by identifying the people involved, defining the project scope, and the focal conservation targets. Explanations of these steps are skipped because the Clark County MSHCP and now defunct Rare Plant Working Group defined these initial steps for the low elevation rare plant CMS and they are documented in earlier report sections. Because the focal conservation targets for this project are nine rare plant species, we substituted the term conservation target with species to make this explanation clearer for this Clark County project application.

Develop Conservation Strategies and Measures:

3. Assess Viability of Conservation Targets (5S = Systems/Species)

This step looks at each species (conservation target) carefully to determine how to measure its "health" over time, and then identifies how the species is doing today and what a "healthy state" might be. It is key to knowing which species and populations are most in need of immediate attention, and for measuring success over time. Specific questions that this step answers include: *How do we define 'health' (viability) for each species?," "What is the current status of each species?,"* and, *"What is the desired status for each?"*

• **Select key ecological attributes and associated indicators** – Each species has certain characteristics or key ecological attributes (KEAs) that can be used to help define and assess its ecological viability or integrity. These attributes are critical aspects of the species' biology or ecology that, if missing or altered, would lead to its loss over time. Key ecological attributes are linked to the size, condition, and landscape context of the species. Each key ecological attribute can either be measured directly, or has an associated indicator that can be measured to represent its status.

• **Determine acceptable variation for each attribute** – Most attributes vary naturally over time, but we can define an acceptable range of variation. This is the range of variation for each attribute (or technically its indicators) that would allow the species to persist over time – a range in which we can categorize the attribute as good or very good status. If the attribute drops below or rises above this acceptable range, it is a degraded attribute. A project challenge is to specify–with the best current knowledge–the assumption of what constitutes an acceptable range of variation.

• **Determine current and desired status of each attribute** – The next task is to assess current status and set the desired status of attributes. The current status reflects where the key ecological attribute is today; the desired status represents where we want to be in the future. It is important to consider the appropriate spatial extent and time frame for achieving the desired status; some changes may require long time periods (50-100 years). Four qualitative terms are used to discuss viability rankings—very good, good, fair, and poor. Very good indicates the ecologically desirable status, which requires very little intervention for long term maintenance. Good means that the indicator is within an acceptable range of variation, but some intervention is required for maintenance. These first two ratings mean that the species is viable, in contrast to the next two, which indicate that the species is not viable over the long term. Fair signifies that the indicator is outside of an acceptable range of variation, requiring human intervention for maintenance. And, poor means that intervention, such as restoration, is increasingly difficult, and could lead to extirpation of populations of the species.

• **Document sources of information** – Often little is known about the things we are trying to conserve. Consequently, for many, if not most of the species, some informed guesses about their status and what constitutes viability need to be made. Recording information sources, rationale, and key questions that come up help document discussions and decisions. Capturing these questions also help to identify possible research needs and partnerships in the future.

4. Identify Critical Threats (5S = Stresses & Sources)

This step helps identify various factors that immediately affect the project species and then rank them so that we can concentrate conservation actions where they are most needed. Specific questions that this step answers include: *"What threats are affecting the species?"*, and *"Which threats are more of a problem?"*.

• **Identify and rate the stresses affecting each species** – Stresses are disturbances that are likely to destroy, degrade, or impair species and that result directly or indirectly from human sources. Most stresses acting on the rare plants can be identified by looking at which key ecological attributes are currently degraded or have a high potential to become degraded within the typical planning horizon (e.g., the next 10 years). Each stress is then rated, in terms of its likely scope and severity of impact on the species within the project planning horizon.

• **Combine stress and source ratings to determine critical threats** – Combining the ratings of stresses and sources of stress produces an overall ranking of the sources of stress affecting the plant species (the CAP Excel Workbook automatically does these calculations). The sources of stress that are highest ranked (typically "very high" and "high" rated threats) define the critical threats.

5. Develop Conservation Strategies (5S = Strategies)

This step first describes the current understanding of the project situation – both the biological issues and the human context in which the project occurs. Developing ecological models of the species and their systems helps. It then asks us to specifically and measurably describe what success looks like and to develop the specific actions that the involved entities will undertake to achieve it. In particular, try to find the actions that will provide the most impact for the resources available. Specific questions that this step answers include: *"What factors and/or stakeholders positively & negatively affect the species?," "What do we need to accomplish?,"* and *"What is the most effective way to achieve these results?"*

• **Assess the situation** – To achieve conservation we ultimately have to abate critical threats and restore degraded targets. To do this effectively, we must understand the system or situation that drives these problems and also identify promising conditions that may lead to solutions. This means understanding the biological, political, economic, and socio-cultural context within which the plants exist – in particular, the indirect threats and opportunities behind each critical threat or degraded key attribute. Each indirect threat or opportunity can be linked to one or more stakeholders, those people who may have a hand in creating or abating threats, or may stand to gain or lose if conditions change. Relevant stakeholders, their actions, and their motivations must be causally linked to critical threats or degraded attributes. This assessment can be done by asking probing questions and capturing the results in text descriptions and/or box-and-arrow diagrams. Either way, the goal is to make explicit assumptions as to what specific factors and which players are behind each critical threat and degraded attribute to provide insights and prompt discovery of effective points of entry or courses of action.

• **Set objectives that describe "success"** – Objectives are specific and measurable statements of what we hope to achieve. They represent the assumption of what is needed to accomplish and as such, become the measuring stick against which project progress is gauged. Objectives can be set for and linked to abatement of threats, restoration of degraded key ecological attributes, and/or the outcomes of specific conservation actions. Well stated objectives meet the criteria of being impact oriented, measurable, time limited, specific, practical, and credible.

• **Identify strategic actions that will be undertaken** – Strategic actions are sets of interventions that the project team will undertake to achieve stated objectives. A challenge is to identify high leverage actions that will provide the most impact for the resources available. There is no set formula for developing good actions other than using the situation analysis (e.g., ecological model), asking probing questions to surface potential actions, evaluating the options, and then selecting those actions for implementation that are most promising and cost effective.

6. Establish Measures (5S = Success)

This step involves deciding how the project team will measure results. It is needed to help the team see whether strategies are working as planned, and thus, whether adjustments are needed. It also is needed to track those species and threats that are not being acted on at the moment, but may need to be in the future. Specific questions that this step answers include: *"What do we need to measure to see if we are making progress towards the objectives and whether the actions are making a difference?,"* and *"Are there other conservation targets or threats that we need to pay attention to?"*

• **Select a limited set of indicators to measure** – An indicator is a measure of a key ecological attribute, critical threat, objective, or other factor. At this point, it's likely that indicators have been identified for at least some key attributes. The objectives will provide good direction for selection of additional meaningful indicators tied to threats and actions being taken. A challenge is to select the *fewest* number of indicators required to measure both the effectiveness of the strategies being implemented toward the objectives as well as the status of important species/systems and threats not currently being addressed but in need of tracking (e.g., a low-ranked threat that might become a major problem in the future).

• **Develop methods to track each indicator –** A method is a specific technique used to collect data to measure one or more indicators. A challenge is to select the most cost effective method that will give information reliable enough to meet management needs.

Implement Conservation Strategies and Measures

7. Develop Work Plans

This step takes the strategic actions and monitoring indicators and develops specific plans for doing this work as the project goes forward. Specific questions include: *"What do we specifically need to do?," "Who will be responsible for each task?,"* and *"What resources do we need?"*

• **Identify action steps and monitoring tasks –** Each strategic action can be broken down into a series of tasks or action steps that the project team and conservation partners will undertake. Likewise, monitoring indicators requires a series of monitoring tasks. It is important to identify which individual(s) will be responsible for these steps or tasks, when they will do them, where they will do them and what resources they will need.

• **Assess project resources and address critical needs –** Elements of the project's capacity include project leadership and staff availability, funding, community support, an enabling legal framework, and other resources. As the work plan is developed, it's important to consider how current capacity for the project matches up with the resources required to achieve this plan. If there are greater needs than current capacity, investing in new resources may be needed or plans may need scaling back.

8. Implement

The challenge here is to implement plans to the best of abilities. Implementation is the most important step in the entire process; however, given the diversity of project needs and situations, the only requirement is:

• **Put individual plans into action –** See that each team member and partner does the work that each has planned for themselves.

Close the Cycle

9. Analyze, Reflect, & Adapt

This step asks to systematically take the time to evaluate actions implemented, to update and refine the knowledge of each plant species, and to review results available from the monitoring data. This reflection provides insight on how actions are working, what may need to change, and what to emphasize next. Specific questions that this step answers include: *"What are the monitoring data telling us about the project?," "What should we be doing differently?," and "How can we continually refine our thinking and capture information?"*

• **Analyze actions and data from monitoring efforts –** An annual review of the actions accomplished and results observed by the core project team and select advisors will provide continuity and facilitate learning. A challenge is to regularly use the data to enrich understanding of the project and inform future work. Depending on what type of data is available and what project needs are, analysis can range from formal statistical studies to simple qualitative assessments.

• **Use results to adapt action and monitoring plans –** A challenge is to use what has been learned from analyses to modify the project.

• **Update project documents –** It is important to formally record updates to project documents on a regular (at least annual) basis to capture new knowledge and changes in plans. Not only will this aid the original team, but it will protect against a loss of institutional knowledge in the case of staff transitions. If the project uses the CAP Excel Workbook this spreadsheet is designed to be flexible and easy (with familiarity) to update with new information.

10. Learn & Share

This step asks to document what has been learned and to share it with others. Conservation is a knowledge business. We will advance further and faster if those who come later can build on the foundation that has been set and not have to constantly go over the same ground. Specific questions that this step answers include: *"How will we capture what we have learned?,"* and *"How can we make sure other people benefit from what we have learned?"*

• **Document findings** – By capturing what has been learned in the CAP Excel Workbook or other written format, team members will be able to remember from year to year what has been done, who the information sources were, what worked and what did not work, and what is planned to do in the future. This ensures that once current team members have moved on, new project staff will have a record of what was done and learned.

• **Share results with key audiences** – Many other practitioners can benefit from this project's experience. Share with them what has been found. Communicate results in an appropriate way for each audience.

Glossary

Acceptable Range of Variation – Key ecological attributes of focal targets naturally vary over time. The acceptable range defines the limits of this variation which constitute the minimum conditions for persistence of the target (note that persistence may still require human management interventions). This concept of an acceptable range of variation establishes the minimum criteria for identifying a conservation target as "conserved" or not. If the attribute drops below or rises above this acceptable range, it is a degraded attribute.

Adaptive Management – A process originally developed to manage natural resources in large scale ecosystems by deliberate experimentation and systematic monitoring of the results. More broadly, it is the incorporation of a formal learning process into conservation action. Specifically, it is the integration of design, management, and monitoring to systematically test assumptions in order to learn and adapt.

Action Steps – Specific tasks required to advance and make progress toward a strategic action.

CAP – Shorthand for Conservation Action Planning.

CAP Excel Workbook – An Excel-based software program developed by The Nature Conservancy to facilitate the CAP process, automate the roll-up of summary results, and serve as a consistent repository for CAP information. Can be downloaded at www.conserveonline.org/2003/07/s/ConPrjMgmt_v4.

Condition – An integrated measure of the composition, structure, and biotic interactions that characterize the occurrence. This includes factors such as reproduction, age structure, biological composition (presence of native versus exotic species; presence of characteristic patch types for ecological systems), structure (canopy, understory, and groundcover in a forested community; spatial distribution and juxtaposition of patch types or seral stages in an ecological system), and biotic interactions (levels of competition, predation, and disease).

Conservation Action Planning (CAP) – The Nature Conservancy's process for helping conservation practitioners develop strategies, take action, measure success, and adapt and learn over time

Conservation Approach – A key part of the Nature Conservancy's *Conservation by Design Framework*. It is an integrated conservation process comprised of four fundamental components: 1) Setting priorities through ecoregional planning and global habitat assessments; 2) Developing strategies at multiple scales to address these priorities; 3) Taking direct conservation action; and 4) Measuring conservation success. The CAP process outlined in this document covers components 2-4.

Conservation Project – A set of actions undertaken by any group of managers, researchers, or local stakeholders in pursuit of a specified conservation vision and objectives. Can range in scale from managing a small site over a few weeks to an entire region over many years.

Contribution – One of the criteria used to rate the impact of a source of stress. The degree to which a source of stress, acting alone, is likely to be responsible for the full expression of a stress within the project area within 10 years. See also reversibility.

Core Project Team – A specific group of practitioners who are responsible for designing, implementing, and monitoring a project. This group can include managers, stakeholders, researchers, and other key implementers.

Critical Threats – Sources of stress that are most problematic. Most often, "very high" and "high" rated threats based on the Conservancy's rating criteria of the scope, severity, contribution, and reversibility of their impact on the focal targets

Current Status – An assessment of the current "health" of a target as expressed through the most recent measurement or rating of an indicator for a key ecological attribute. Compare to desired status.

Degraded Attribute – A key ecological attribute that is outside its acceptable range of variation.

Desired Status – A measurement or rating of an indicator for a key ecological attribute that describes the level of viability/integrity that the project intends to achieve. Compare to current status.

Direct Threats − Used as a synonym for sources of stress. Agents or factors that directly degrade targets. A project's highest ranked direct threats are its critical threats. For example, "logging" or "fishing."

Ecoregional Targets – Ecoregions are relatively large geographic areas of land and water delineated by climate, vegetation, geology and other ecological and environmental patterns. Ecoregional targets are the species, ecological communities, and ecological systems within a given ecoregion used to set conservation priorities. See also focal conservation targets.

Effectiveness Measures – Information used to answer the question: Are the conservation actions we are taking having their intended impact? Compare to status measures.

Efroymson Coaches Network – Individuals throughout the Conservancy who are trained in the application of the CAP practice, responsible for helping projects and practitioners go through the

CAP Process in a structured peer-review format, and committed to sharing their experience across the organization. The name “Efroymson” refers to the family that has provided critical support to the Conservancy in our efforts to teach and apply the methodology since 1998.

Focal Conservation Targets – A limited suite of species, communities, and ecological systems that are chosen to represent and encompass the full array of biodiversity found in a project area. They are the basis for setting goals, carrying out conservation actions, and measuring conservation effectiveness. In theory – and hopefully in practice – conservation of the focal targets will ensure the conservation of all native biodiversity within functional landscapes. Often referred to as Focal Targets.

Goal – Synonymous with vision. A general summary of the desired state or ultimate condition of the project area that a project is working to achieve. A good goal statement meets the criteria of being visionary, relatively general, brief, and measurable.

Indicators – Measurable entities related to a specific information need (for example, the status of a key ecological attribute, change in a threat, or progress towards an objective). A good indicator meets the criteria of being: measurable, precise, consistent, and sensitive.

Indirect Threats – Factors identified in an analysis of the project situation that are drivers of direct threats. Often an entry point for conservation actions. For example, “logging policies” or “demand for fish.”

Integrity – The status or “health” of an ecological community or system. Integrity indicates the ability of a community or system target to withstand or recover from most natural or anthropogenic disturbances and thus to persist for many generations or over long time periods. See also viability for species.

Irreversibility – A synonym for reversibility (used in CAP Excel Workbook ratings). One of the criteria used to rate the impact of a source of stress. The degree to which the effects of a source of stress can be restored. Typically includes an assessment of both the technical difficulty and the economic and/or social cost of restoration. See also contribution.

KEA – Short for Key Ecological Attribute.

Key Ecological Attributes (also Key Attributes, or KEAs) – Aspects of a target’s biology or ecology that, if missing or altered, would lead to the loss of that target over time. As such, KEAs define the target’s viability or integrity. More technically, the most critical components of biological composition, structure, interactions and processes, environmental regimes, and landscape configuration that sustain a target’s viability or ecological integrity over space and time. “Attribute” used as shorthand in this document.

Landscape context – An integrated measure of two factors: the dominant environmental regimes and processes that establish and maintain the target occurrence, and connectivity. Dominant environmental regimes and processes include herbivory, hydrologic and water chemistry regimes (surface and groundwater), geomorphic processes, climatic regimes (temperature and precipitation), fire regimes, and many kinds of natural disturbance. Connectivity includes such factors as species targets having access to habitats and resources needed for life cycle completion, fragmentation of ecological communities and systems, and the ability of any target to respond to environmental change through dispersal, migration, or recolonization.

Methods – Specific techniques used to collect data to measure an indicator. Methods vary in their accuracy and reliability, cost-effectiveness, feasibility, and appropriateness.

Monitoring Tasks – Specific activities required to measure each indicator.

Nested Targets – Species, ecological communities, or ecological system targets whose conservation needs are subsumed by one or more focal conservation targets. Often includes targets identified as ecoregional targets.

Objectives – Specific statements detailing the desired accomplishments or outcomes of a particular set of activities within a project. A typical project will have multiple objectives. Objectives are typically set for abatement of critical threats and for restoration of degraded key ecological attributes. They can also be set, however, for the outcomes of specific conservation actions, or the acquisition of project resources. If the project is well conceptualized and designed, realization of all the project's objectives should lead to the fulfillment of the project's vision. A good objective meets the criteria of being: impact oriented, measurable, time limited, specific, practical, and credible.

Opportunities – Factors identified in an analysis of the project situation that potentially have a positive effect on targets, either directly or indirectly. Often an entry point for conservation actions. For example, "demand for sustainably harvested timber."

Project Area – The place where the biodiversity of interest to the project is located. It can include one or more "conservation areas" or "areas of biodiversity significance" as identified through ecoregional assessments. Note that in some cases, project actions may take place outside of the defined project area.

Project Capacity – A project team's ability to accomplish its work. Elements include project leadership and staff availability, funding, community support, an enabling legal framework, and other resources.

Project Team – Shorthand for core project team. A specific group of practitioners who are responsible for designing, implementing, and monitoring a project. This group can include managers, stakeholders, researchers, and other key implementers.

Reversibility – One of the criteria used to rate the impact of a source of stress. The degree to which the effects of a source of stress can be restored. Typically includes an assessment of both the technical difficulty and the economic and/or social cost of restoration. Sometimes referred to as "irreversibility." See also contribution.

Scope (in the context of a threat assessment) – One of the measurements used to rate the impact of a stress. Most commonly defined spatially as the proportion of the overall area of a project site or target occurrence likely to be affected by a threat within 10 years. See also severity.

Severity – One of the criteria used to rate the impact of a stress. The level of damage to the conservation target that can reasonably be expected within 10 years under current circumstances (i.e., given the continuation of the existing situation). See also scope.

Size – A measure of the area or abundance of the conservation target's occurrence. For ecological systems and communities, size is simply a measure of the occurrence's patch size or geographic coverage. For animal and plant species, size takes into account the area of occupancy and number of individuals. Another aspect of size is minimum dynamic area, or the area needed to ensure survival or re-establishment of a target after natural disturbance.

Sources of Stress – Proximate agents or factors that directly degrade targets. Synonymous with direct threats.

Stakeholders – Individuals, groups, or institutions who have a vested interest in the natural resources of the project area and/or who potentially will be affected by project activities and have something to gain or lose if conditions change or stay the same.

Status Measures – Information used to answer the questions: "How is the biodiversity we care about doing?" and/or "How are threats to biodiversity changing?" for key ecological attributes and/or threats that are not currently the subject of conservation actions. Compare to effectiveness measures.

Strategic Actions – Interventions undertaken by project staff and/or partners designed to reach the project's objectives. A good action meets the criteria of being: linked (to threat abatement or target restoration), focused, strategic, feasible, and appropriate.

Strategies – Broad courses of action that include one or more objectives, the strategic actions required to accomplish each objective, and the specific action steps required to complete each strategic action.

Stresses – Disturbances that are likely to destroy, degrade, or impair targets that result directly or indirectly from human sources. Generally equivalent to degraded key ecological attributes.

Targets – Elements of biodiversity which can include species, ecological communities, and ecological systems. Strictly speaking, refers to all biodiversity elements at a project site, but sometimes is used as shorthand for focal conservation targets.

Threats – Agents or factors that directly or indirectly degrade targets. See also direct threat, indirect threat, and critical threat.

Viability – The status or "health" of a population of a specific plant or animal species. More generally, viability indicates the ability of a conservation target to withstand or recover from most natural or anthropogenic disturbances and thus to persist for many generations or over long time periods. See also integrity for ecological communities and ecological systems.

Vision – A general summary of the desired state or ultimate condition of the project area or scope that a project is working to achieve. A good vision statement meets the criteria of being visionary, relatively general, brief, and measurable. Synonymous with project goal.

APPENDIX 6

Species Population Groups Categorized by MSHCP Management Status and Spatial Representation of Threats with Their Overall Ranks Across MSHCP Management Categories for Nine Low Elevation Rare Plant Species

Focal Target Description and Nested Conservation Targets: ANLELE Global Population Groups

Targets

Focal Target Description and
Nested Conservation Targets

ANLELE Global Population Groups

Conservation Targets	**1** Anulocaulis leiosolenus IMA (4)	**2** Anulocaulis leiosolenus Mixed (3)	**3** Anulocaulis leiosolenus UMA (1)	**4** Anulocaulis leiosolenus ANMTM (9)
Focal Target Description	Clark County (NPS BLM)	Clark County (NPS BLM PVT)	Clark County (PVT)	AZ, NM, TX, MX (NPS PVT?)
Nested Target # 1	ANLE East Black Mountains Populations	ANLE Bitter Spring Valley Populations	ANLE Muddy River Populations	ANLE Big Gypsum Ledges Population
Nested Target # 2	ANLE Gold Butte Populations	ANLE Gypsum Wash Populations		ANLE Havasupai Canyon Populations
Nested Target # 3	ANLE Lava Butte Populations	ANLE Overton Arm Populations		ANLE Little Colorado River Populations
Nested Target # 4	ANLE West Black Mountains Populations			ANLE Upper Colorado River Population
Nested Target # 5				ANLE Yavapai County Populations
Nested Target # 6				ANLE Rio Grande NW Populations
Nested Target # 7				ANLE Culberson County Population
Nested Target # 8				ANLE Hudspeth County Populations
Nested Target # 9				ANLE Chihuahua Populations

Focal Target Description and Nested Conservation Targets: ARCA Global Population Groups

ARCA Global Population Groups

Conservation Targets	**1** Arctomecon californica IMA (5)	**2** Arctomecon californica Mixed (2)	**3** Arctomecon californica MUMA (2)	**4** Arctomecon californica UMA (1)
Focal Target Description	Clark County (BLM NPS PVT BR DoD NVState)	Clark County (BLM NPS PVT)	Clark County (BLM PVT DoD)	Clark County (PVT DoD BLM)
Nested Target # 1	ARCA Gold Butte Populations	ARCA Bitter Spring Valley Populations	ARCA Las Vegas Dunes Populations	ARCA Las Vegas Valley Populations
Nested Target # 2	ARCA Government Wash Populations	ARCA Gale Hills Populations	ARCA White Basin Populations	
Nested Target # 3	ARCA Middle Point Populations			
Nested Target # 4	ARCA Sunrise Valley Populations			
Nested Target # 5	ARCA Valley of Fire Populations			

Focal Target Description and Nested Conservation Targets: ARCA Global Population Groups

ARCA Global Population Groups

Conservation Targets	**5** Arctomecon californica AZ (3)
Focal Target Description	AZ (NPS, AZ State)
Nested Target # 1	ARCA Arizona Populations
Nested Target # 2	ARCA Grand Canyon Populations
Nested Target # 3	ARCA Meadview NW Populations
Nested Target # 4	
Nested Target # 5	

Focal Target Description and Nested Conservation Targets: ARME Global Population Groups

Targets

Focal Target Description and
Nested Conservation Targets

ARME Global Population Groups

Conservation Targets	1 Arctomecon merriamii IMA (7)	2 Arctomecon merriamii MUMA (4)	3 Arctomecon merriamii UMA (1)	4 Arctomecon merriamii Other NV (8)
Focal Target Description	Clark County (FWS BLM DoD DOE)	Clark County (BLM)	Clark County (PVT)	Lincoln, Nye (DoD BLM, BLM PVT)
Nested Target # 1	ARME Black Hills Populations	ARME Bird Spring Range Population	ARME Las Vegas Valley Populations	ARME Desert Hills Population
Nested Target # 2	ARME Calico Hills Populations	ARME Devil Canyon Population		ARME East Desert Range Population
Nested Target # 3	ARME Desert Range Populations	ARME Indian Springs Population		ARME South Delamar Mountains Populations
Nested Target # 4	ARME North Desert Range Populations	ARME Pahrump Valley Population		ARME Ash Meadows Populations
Nested Target # 5	ARME Pintwater Range Populations			ARME Devils Hole Populations
Nested Target # 6	ARME Spotted Range Populations			ARME Specter Range Populations
Nested Target # 7	ARME Three Lakes Valley Populations			ARME Stewart Valley Populations
Nested Target # 8				ARME West of Last Chance Range Populations
Nested Target # 9				
Nested Target # 10				
Nested Target # 11				
Nested Target # 12				
Nested Target # 13				

Focal Target Description and Nested Conservation Targets: ARME Global Population Groups

Targets

Focal Target Description and
Nested Conservation Targets

ARME Global Population Groups

Conservation Targets	**5**	**6**	**7**	**8**
	Arctomecon merriamii CA (13)			
Focal Target Description	CA (NPS BLM CAState PVT)			
Nested Target # 1	ARME Amargosa Range Populations			
Nested Target # 2	ARME Argus Range Population			
Nested Target # 3	ARME Black Mountains Population			
Nested Target # 4	ARME Clark Mountain Range Populations			
Nested Target # 5	ARME Cottonwood Mountains Population			
Nested Target # 6	ARME Dry Mountain Population			
Nested Target # 7	ARME Funeral Mountains Populations			
Nested Target # 8	ARME Grapevine Mountains Populations			
Nested Target # 9	ARME North Death Valley Population			
Nested Target # 10	ARME Racetrack Valley Populations			
Nested Target # 11	ARME Resting Spring Population			
Nested Target # 12	ARME Silurian Hills Populations			
Nested Target # 13	ARME Teakettle Junction Population			

Focal Target Description and Nested Conservation Targets: ASGETR Global Population Groups

Targets

Focal Target Description and
Nested Conservation Targets

ASGETR Global Population Groups

Conservation Targets	1 Astragalus geyeri triquetrus IMA (7)	2 Astragalus geyeri triquetrus Mixed (2)	3 Astragalus geyeri triquetrus MUMA (7)	4 Astragalus geyeri triquetrus NV (1)
Focal Target Description	Clark County (NPS BLM)	Clark County (BLM PVT)	Clark County (BLM BIA BR PVT)	Lincoln County and AZ (BLM)
Nested Target # 1	ASGETR Bark Bay Populations	ASGETR Mud Wash Populations	ASGETR California Wash Populations	ASGETR Sand Hollow Wash Populations
Nested Target # 2	ASGETR Ebony Cove Population	ASGETR Virgin River Populations	ASGETR Mud Lake Populations	
Nested Target # 3	ASGETR Lime Cove Population		ASGETR Muddy River Populations	
Nested Target # 4	ASGETR Mormon Mesa Populations		ASGETR Toquop Wash Populations	
Nested Target # 5	ASGETR Sandy Cove Populations		ASGETR Town Wash Population	
Nested Target # 6	ASGETR The Meadows Population		ASGETR Weiser Wash Populations	
Nested Target # 7	ASGETR Valley Of Fire Wash Populations		ASGETR Logandale Populations	

Focal Target Description and Nested Conservation Targets: CAST Global Population Groups

Targets

Focal Target Description and
Nested Conservation Targets

CAST Global Population Groups

Conservation Targets	**1**	**2**	**3**	**4**
	Calochortus striatus LIMA (2)	Calochortus striatus UMA (1)	Calochortus striatus NV (1)	Calochortus striatus CA (11)
Focal Target Description	Clark County (BLM PVT)	Clark County (PVT)	Nye County (PVT)	CA (CAState USFS DoD PVT BLM TNC)
Nested Target # 1	CAST Calico Hills Populations	CAST Las Vegas Population	CAST Ash Meadows Populations	CAST Allensworth Population
Nested Target # 2	CAST Lone Willow Spring Populations			CAST Angeles NF Population
Nested Target # 3				CAST Antelope Valley Populations
Nested Target # 4				CAST Buena Vista Population
Nested Target # 5				CAST Cushenbury Springs Populations
Nested Target # 6				CAST Isabella Lake Populations
Nested Target # 7				CAST Kelso Valley Populations
Nested Target # 8				CAST Lucerne Valley Population
Nested Target # 9				CAST Paradise Range Populations
Nested Target # 10				CAST Red Rock Canyon Populations
Nested Target # 11				CAST Twentynine Palms Population

Focal Target Description and Nested Conservation Targets: ERBI Global Population Groups

Targets

Focal Target Description and
Nested Conservation Targets

ERBI Global Population Groups

Conservation Targets	1	2	3	4
	Eriogonum bifurcatum UMA (1)	Eriogonum bifurcatum NV (2)	Eriogonum bifurcatum CA (1)	
Focal Target Description	Clark County (PVT BLM)	Nye County (BLM PVT)	CA (PVT)	
Nested Target # 1	ERBI Mesquite Valley Populations	ERBI Nevada Pahrump Valley Populations	ERBI California Pahrump Valley Population	
Nested Target # 2		ERBI Stewart Valley Populations		

Focal Target Description and Nested Conservation Targets: ERVI Global Population Groups

Targets

Focal Target Description and
Nested Conservation Targets

ERVI Global Population Groups

Conservation Targets	1 Eriogonum viscidulum IMA (4)	2 Eriogonum viscidulum Mixed (3)	3 Eriogonum viscidulum MUMA (4)	4 Eriogonum viscidulum NV AZ (2)
Focal Target Description	Clark County (NPS)	Clark County (BLM PVT NPS)	Clark County (BLM PVT)	Lincoln County, Arizona (BLM)
Nested Target # 1	ERVI Black Mountains Populations	ERVI Bitter Ridge Populations	ERVI Middle Muddy River Populations	ERVI Eastern Lincoln County Populations
Nested Target # 2	ERVI Lime Wash Populations	ERVI Lower Virgin River Populations	ERVI Toquop Wash Populations	ERVI Arizona Populations
Nested Target # 3	ERVI Overton Arm Populations	ERVI Lower Virgin Valley Populations	ERVI Upper Muddy River Populations	
Nested Target # 4	ERVI Virgin River Confluence Populations		ERVI Upper Virgin Valley Populations	

Focal Target Description and Nested Conservation Targets: PEAL Global Population Groups

Targets

Focal Target Description and
Nested Conservation Targets

PEAL Global Population Groups

Conservation Targets	1 Penstemon albomarginatus IMA (1)	2 Penstemon albomarginatus MUMA (3)	3 Penstemon albomarginatus NV (3)	4 Penstemon albomarginatus AZCA (3)
Focal Target Description	Clark County (BLM)	Clark County (BLM PVT)	Nye County (BLM)	AZ and CA (BLM PVT AZState, PVT BLM)
Nested Target # 1	PEAL Hidden Valley Populations	PEAL Ivanpah Valley Populations	PEAL North of Ash Meadows Populations	PEAL Arizona Populations
Nested Target # 2		PEAL Jean Lake Populations	PEAL Rock Valley Population	PEAL Fenner Valley Population
Nested Target # 3		PEAL Roach Lake Populations	PEAL Specter Range Foothill Populations	PEAL Lavic Lake Populations

Focal Target Description and Nested Conservation Targets: PHPA Global Population Groups

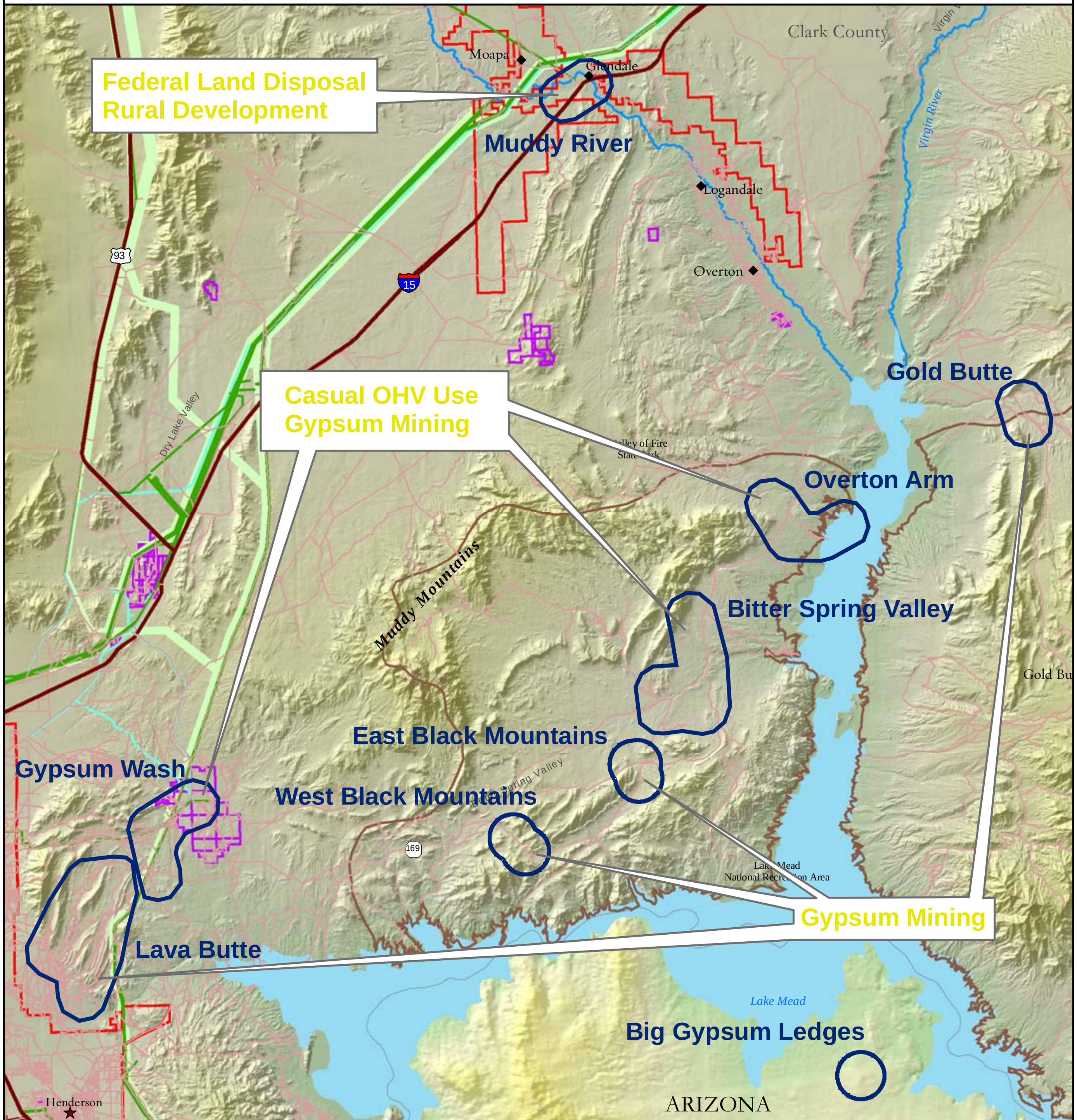
Targets

Focal Target Description and
Nested Conservation Targets

PHPA Global Population Groups

Conservation Targets	1	2	3	4
	Phacelia parishii IMA/LIMA (2)	Phacelia parishii NV (9)	Phacelia parishii AZCA (6)	
Focal Target Description	Clark County (DoD)	Nye, Lincoln, White Pine County (BLM PVT, FWS, BLM PVT)	AZ and CA (BLM, BLM PVT)	
Nested Target # 1	PHPA Indian Springs Valley Population	PHPA North Pahrump Valley Population	PHPA Arizona Population	
Nested Target # 2	PHPA Three Lakes Valley Population	PHPA Pahrump Valley Populations	PHPA Burro Creek Population	
Nested Target # 3		PHPA Desert Lake Populations	PHPA Calico Mountains Foothills Population	
Nested Target # 4		PHPA Baking Powder Flat Population	PHPA Coyote Lake Population	
Nested Target # 5		PHPA Lake Valley Populations	PHPA Lucerne Dry Lake Population	
Nested Target # 6		PHPA Millick Spring Population	PHPA Stewart Valley Populations	
Nested Target # 7		PHPA Muncy Population		
Nested Target # 8		PHPA Spring Creek Bastian Population		
Nested Target # 9		PHPA White River Valley Population		

Very High & High Threats to *Anulocaulis leiosolenus* var. *leiosolenus* Population Groups Within Clark County



Very High (red) and High (yellow) threats are indicated for population groups.

Map Features

- *Anulocaulis leiosolenus* var. *leiosolenus*
- Major Cities
- Cities / Towns
- Highways / Interstates
- Roads
- Major Rivers
- Power Lines
- Gas Lines
- Open Pit Mine Parcels
- HMA
- Federal Land Disposal
- Utility Corridors
- Airport
- Lakes

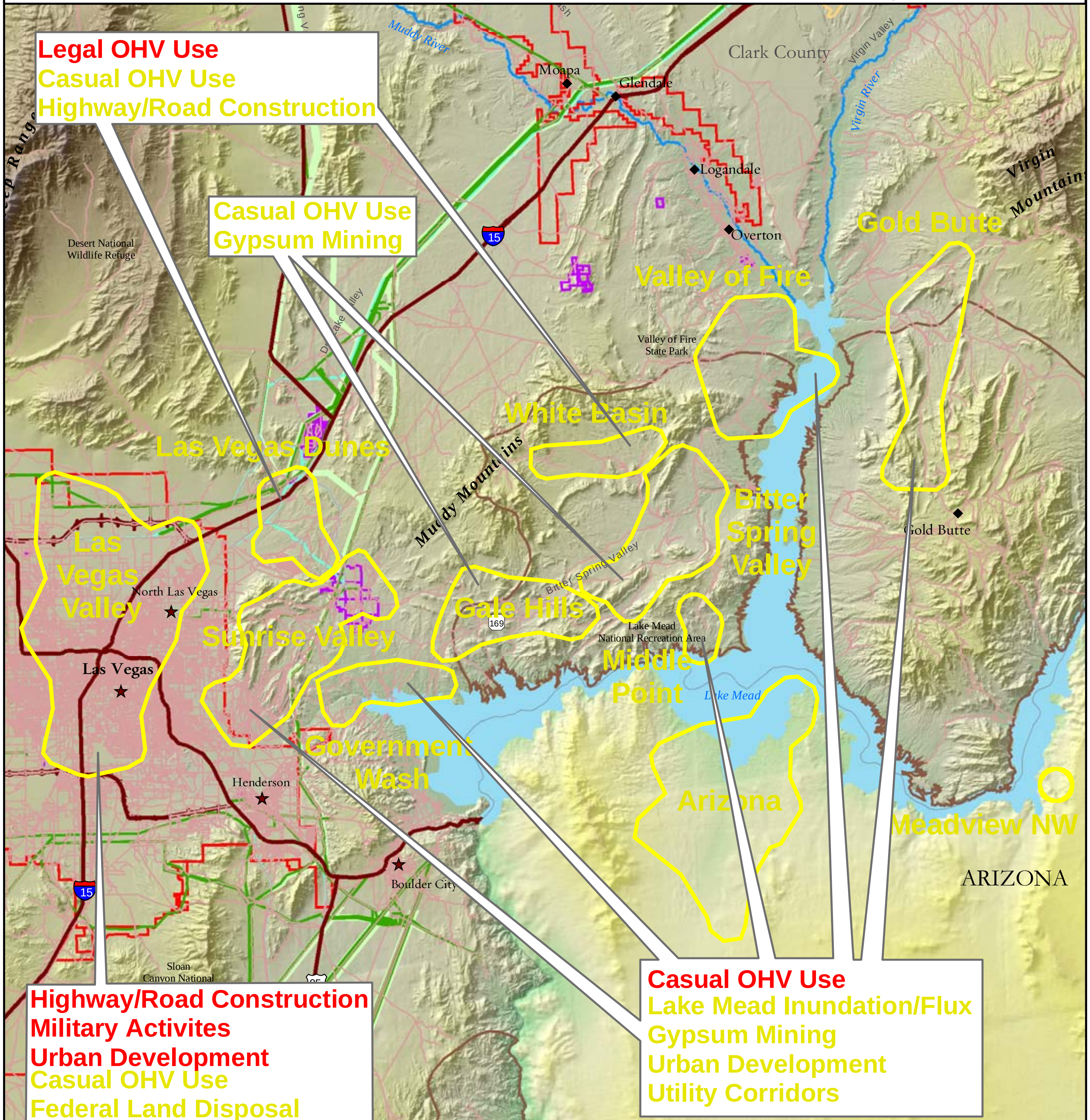
Elevation (meters)
High : 4389
Low : -85

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

Map Designed by:
The Nature Conservancy of Nevada
November 2006

SCALE =1:400,000
0 5 10
MILES

Very High & High Threats to *Arctomecon californica* Population Groups Within Clark County



Very High (red) and High (yellow) threats are indicated for population groups.

Map Features

- *Arctomecon californica*
- Major Cities
- Cities / Towns
- Highways / Interstates
- Roads
- Major Rivers
- Power Lines
- Gas Lines
- Open Pit Mine Parcels
- HMA
- Federal Land Disposal
- Utility Corridors
- Airport
- Lakes

Elevation (meters)
High : 4389
Low : -85

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

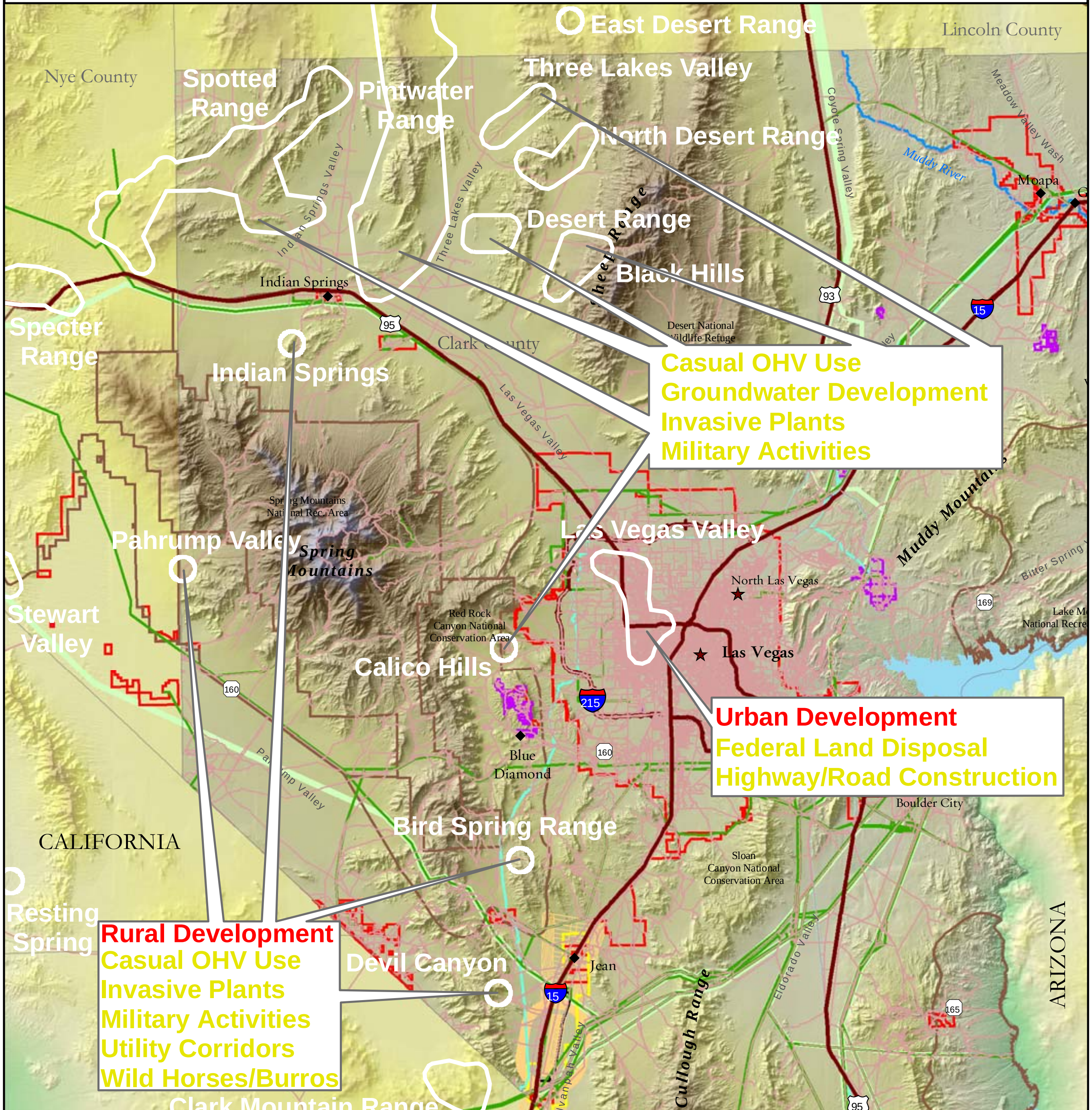
Map Designed by:
The Nature Conservancy of Nevada
November 2006

SCALE =1:600,000

0 5 10 15 MILES

N W E S

Very High & High Threats to *Arctomecon merriamii* Population Groups Within Clark County



Very High (red) and High (yellow) threats are indicated for population groups.

Map Features

- *Arctomecon merriamii*
- Major Cities
- Cities / Towns
- Highways / Interstates
- Roads
- Major Rivers
- Power Lines
- Gas Lines
- Open Pit Mine Parcels
- HMA
- Federal Land Disposal
- Ivanpah CMA
- Airport Footprint
- Utility Corridors
- Airport
- Lakes

Elevation (meters)
High : 4389
Low : -85

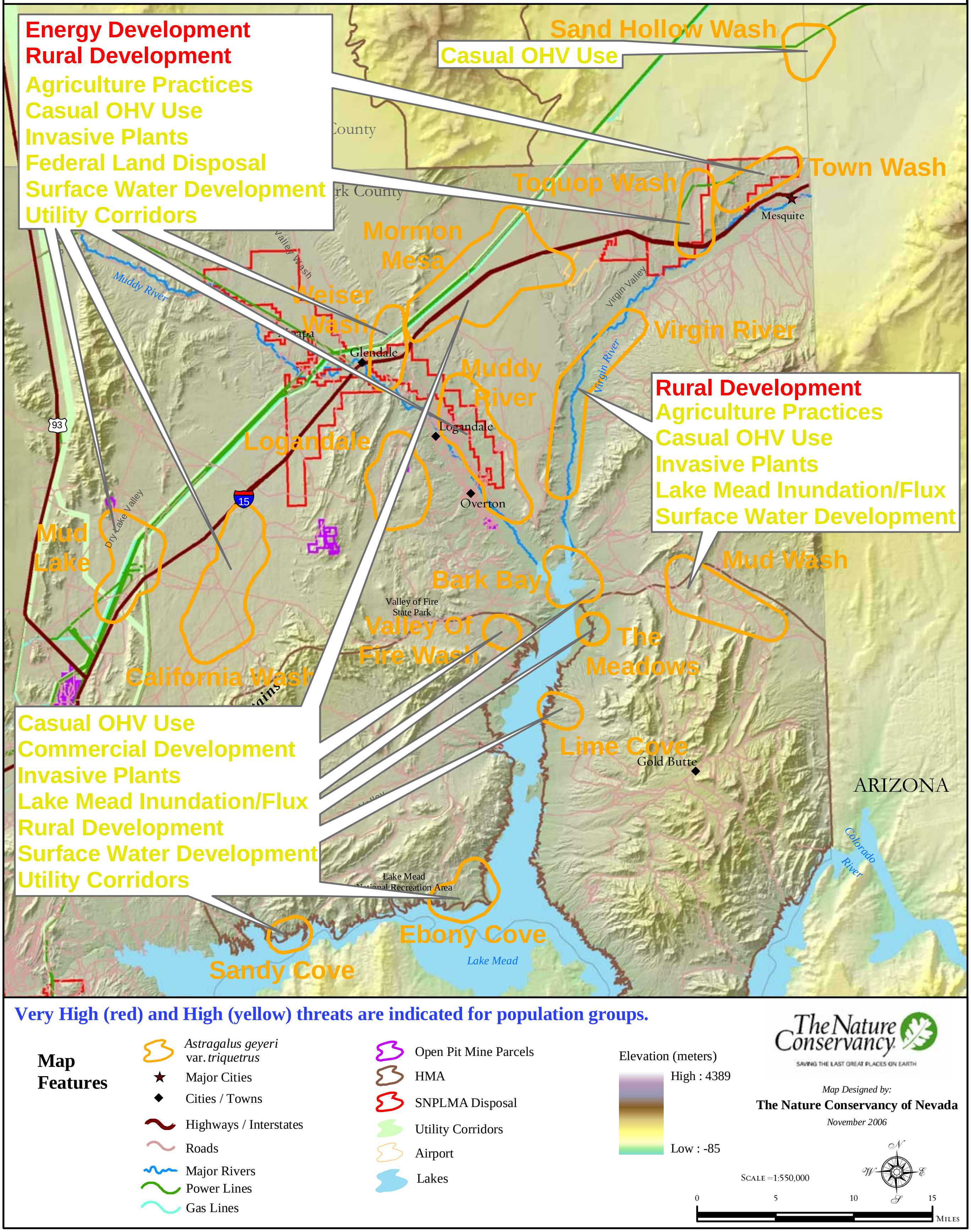
The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

Map Designed by:
The Nature Conservancy of Nevada
November 2006

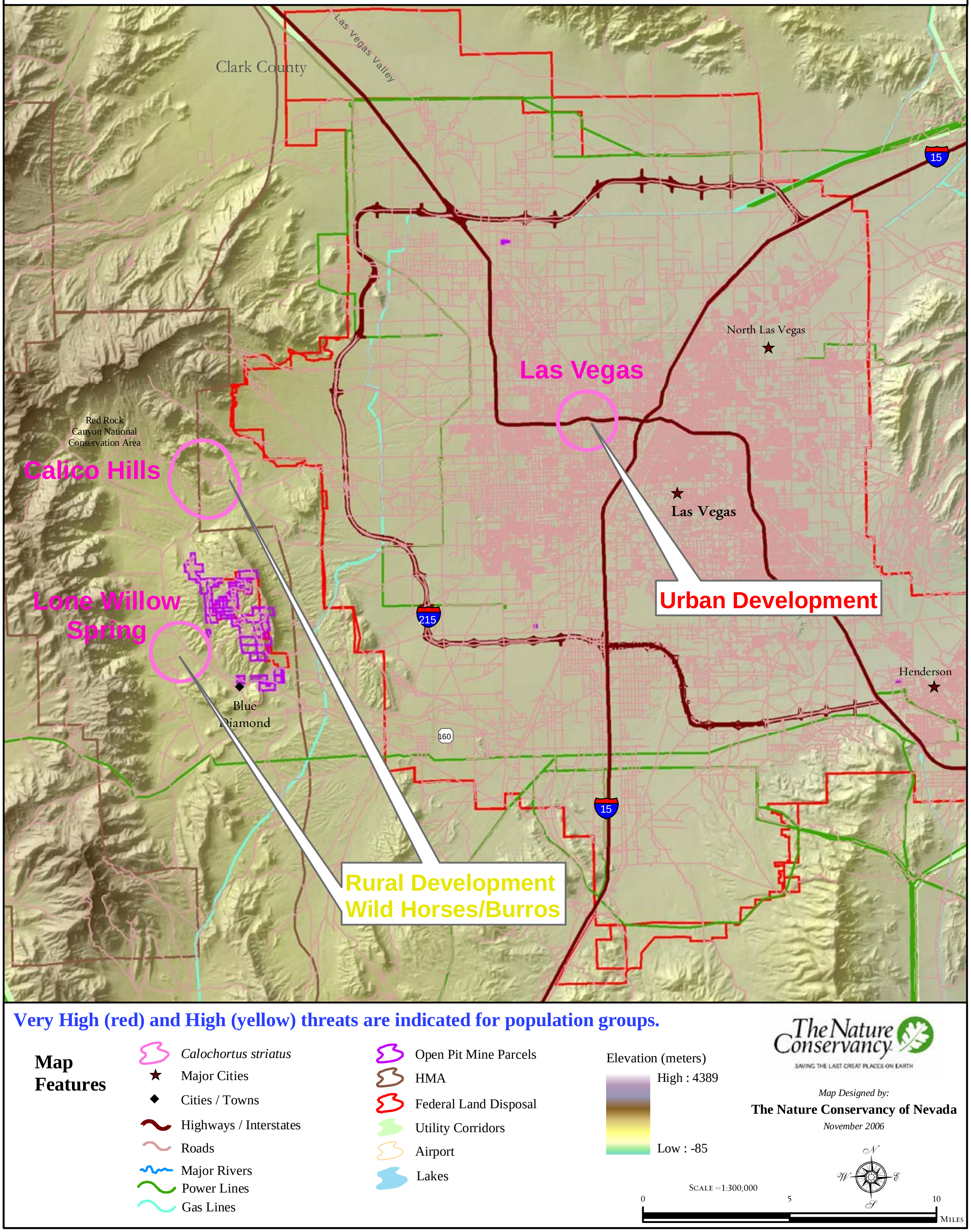
SCALE = 1:800,000

0 5 10 15 20 MILES

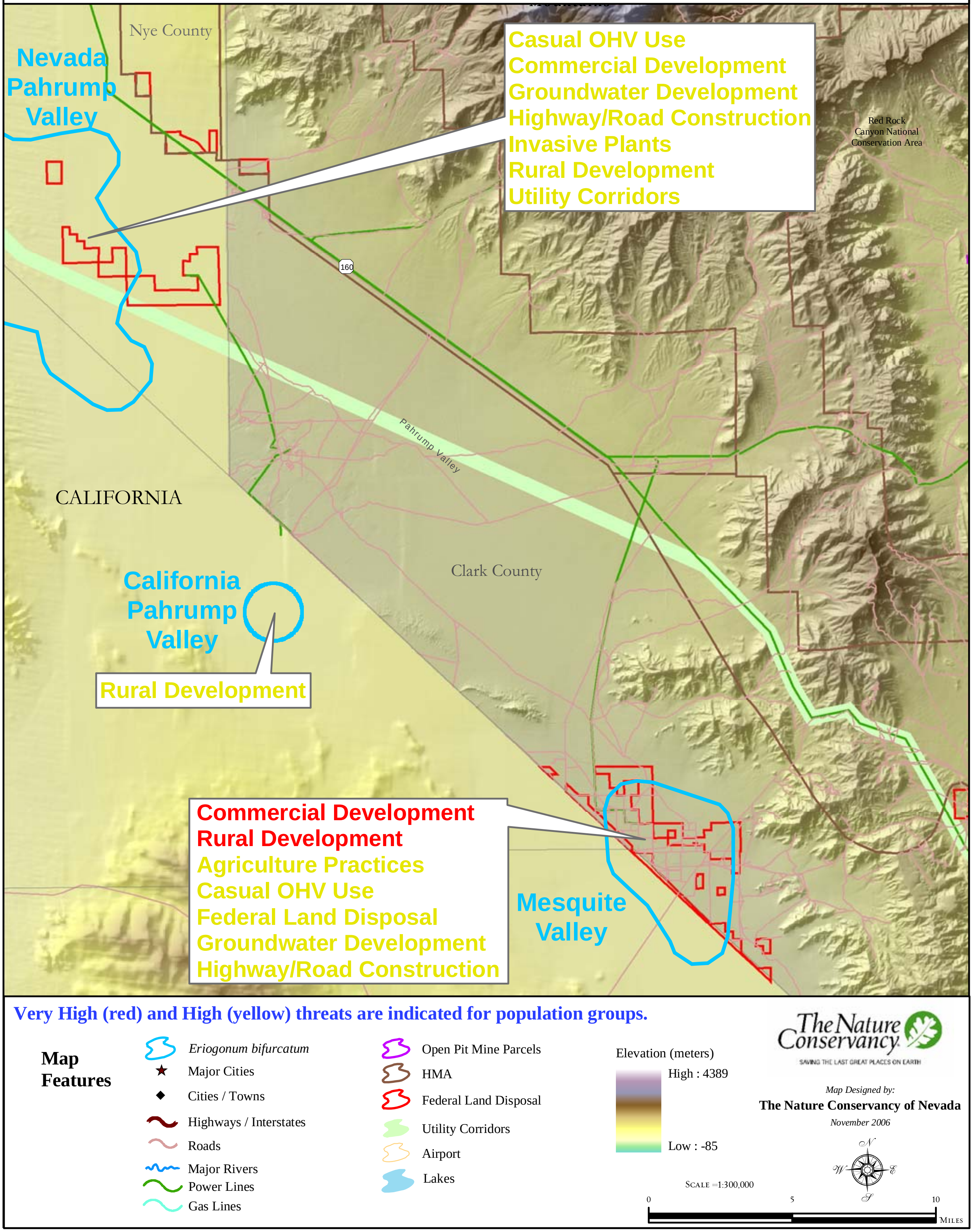
Very High & High Threats to *Astragalus geyeri* var. *triquetrus* Population Groups Within Clark County



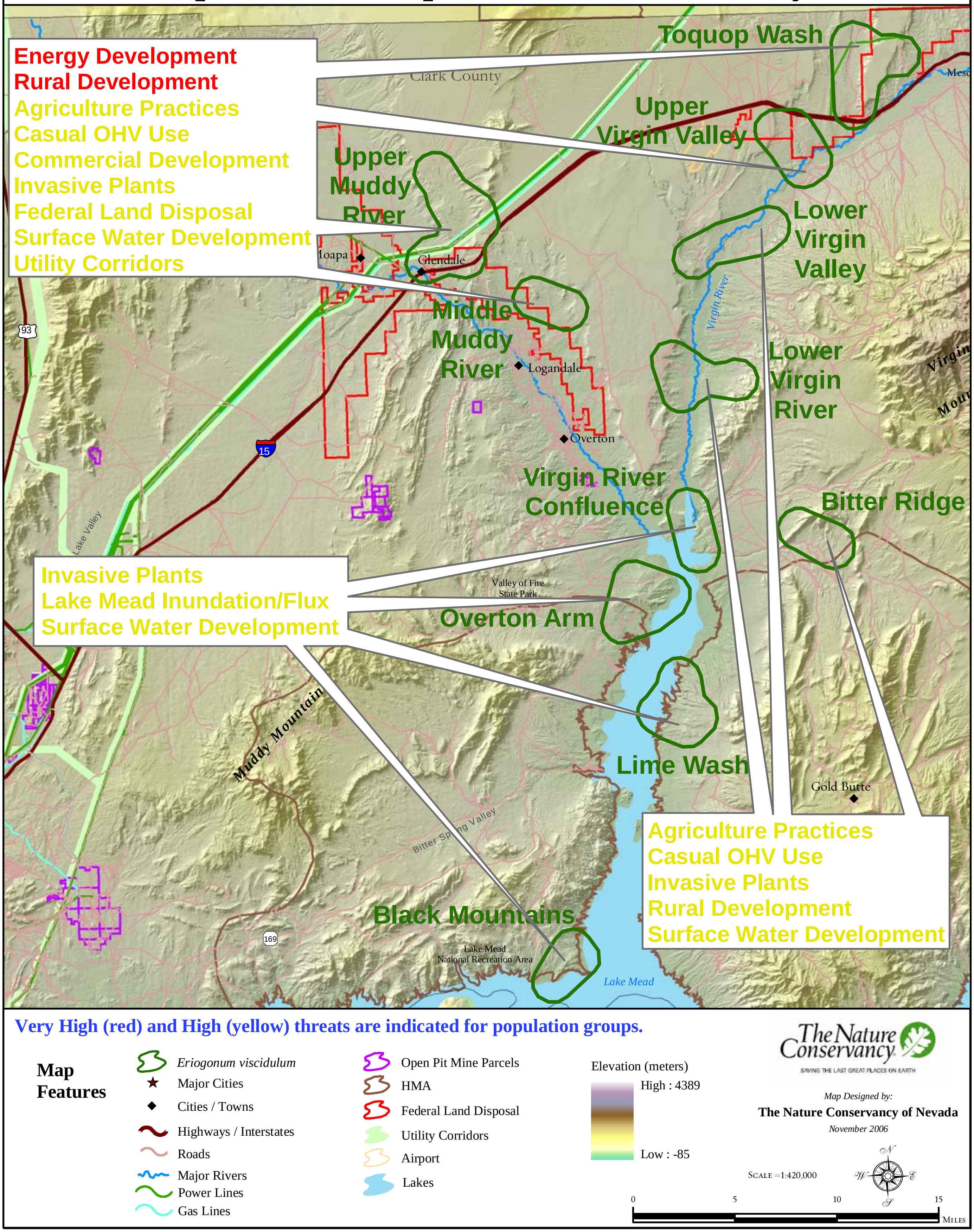
Very High & High Threats to *Calochortus striatus* Population Groups Within Clark County



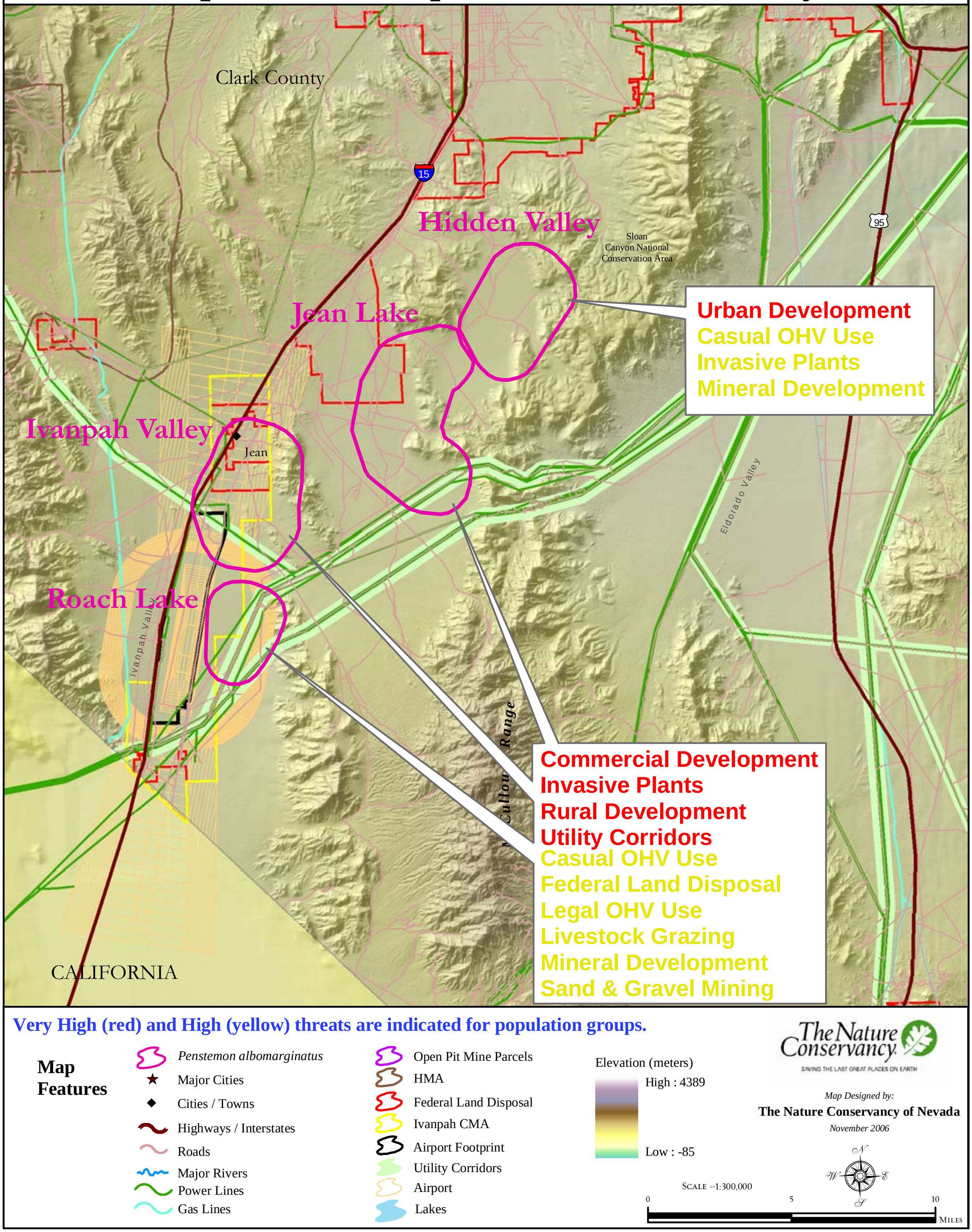
Very High & High Threats to *Eriogonum bifurcatum* Population Groups Within Clark County



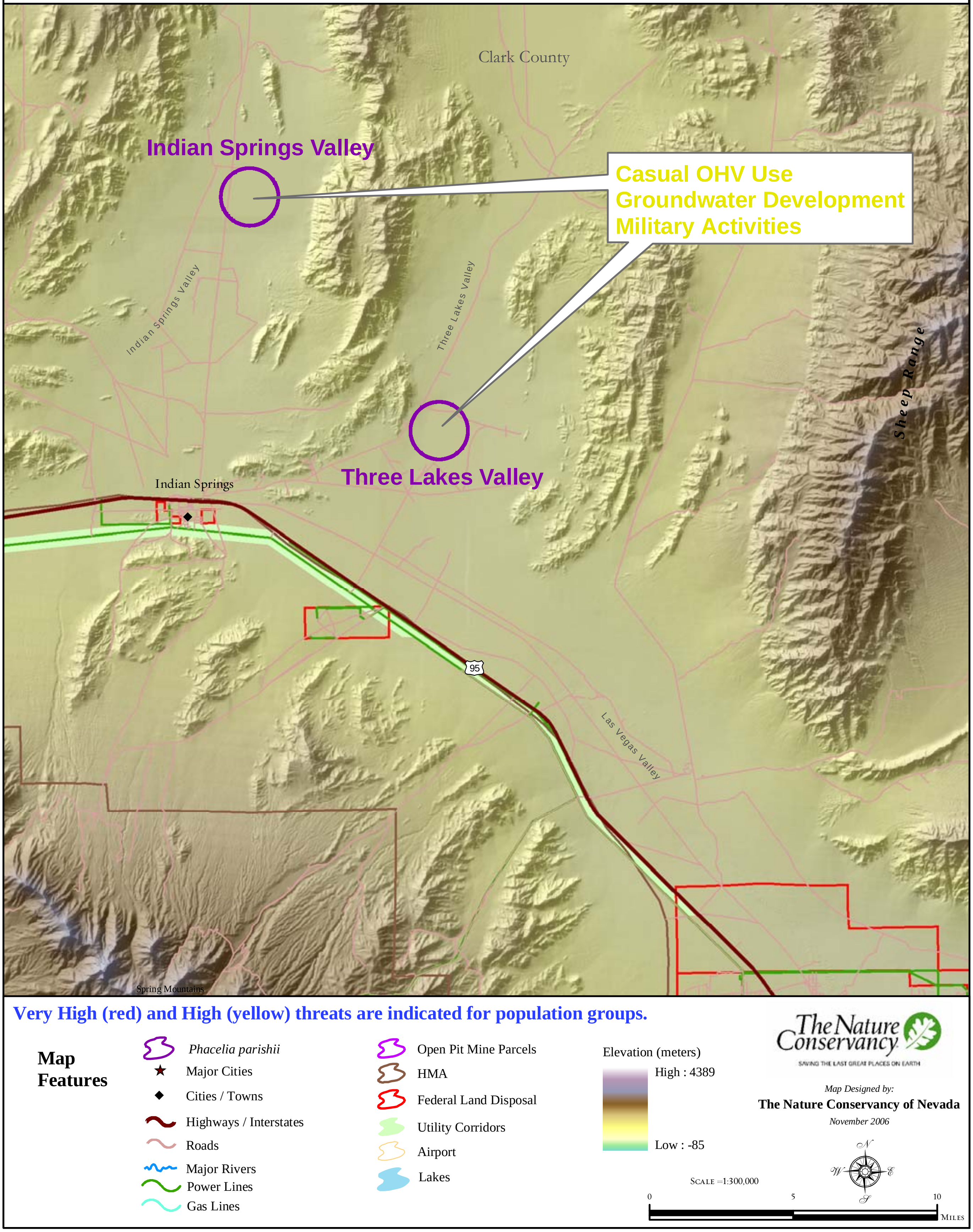
Very High & High Threats to *Eriogonum viscidulum* Population Groups Within Clark County



Very High & High Threats to *Penstemon albomarginatus* Population Groups Within Clark County



Very High & High Threats to *Phacelia parishii* Population Groups Within Clark County



APPENDIX 7

Conservation Strategies for Low Elevation Rare Plants beyond the Scope of the MSHCP

Conservation Strategies for Low Elevation Rare Plants beyond the Scope of the MSHCP

Conservation objectives and strategies for rare plant population groups occurring on Nellis Air Force Base and Range, and in Nye and Lincoln counties

Objectives and their strategies that do not fall under the jurisdiction of the Clark County Desert Conservation Program and its MSHCP are included in this appendix. It will be necessary for other management entities (e.g., the U.S. Fish and Wildlife Service, Bureau of Land Management, Department of Defense, Nevada Division of Forestry, Nye County) to take responsibility for successful strategy implementation.

Strategies for Objectives 9 and 16 are provided in full here since they fall completely outside of the Clark County DCP's responsibility. Strategies for other objectives that address rare plants within Nevada but outside Clark County are summarized. The reader should refer back to the main text for complete discussions of the strategic actions and action steps necessary to address the objectives.

Objective 1a: Proactively protect and manage for long term viability of all populations of nine MSHCP covered rare plants on Federal lands

Baseline viability rank tally: 5 good, 3 fair
Threat rank tally: 2 medium, 4 high, 2 very high

White bearpoppy
22. IMAs (Nellis): Viability good, threats high
23. Other Nevada: Viability good, threats very high
Threecorner milkvetch
24. Other Nevada: Viability fair, threats medium
Alkali mariposa lily
25. Other Nevada: Viability good, threats high
Pahrump Valley buckwheat
26. Other Nevada: Viability good, threats very high
Sticky wild buckwheat
27. Other Nevada: Viability fair, threats medium
White-margined beardtongue
28. Other Nevada: Viability good, threats high
Parish phacelia
29. IMA/LIMAs: Viability fair, threats high

Measures of success:
Key ecological attributes/indicators (see table 55 for indicator definitions):
- Minimum dynamic area/sufficient acreage for characteristic species and natural habitat disturbances within historic range of variability
- Soil structure, stability and movement/Degree of soil erosion and compaction
- Soil moisture and nutrient regime/Degree of surface crust disturbance
- Characteristic native plant community/Native versus exotic plant species composition
- Fire Regime/Fire frequency and area burned

Threat reduction:
Numbers or percentages of designated core population groups under conservation management

The strategic actions included under Objective 1 are applicable to rare plant population groups outside of the jurisdiction of the MSHCP. In particular, this objective identifies seven population groups on BLM lands in Nye County and seven other population groups primarily on DoD lands in Clark County for four species with few options for protective designation under the scope of the MSHCP. The four rare plants are white bearpoppy, white-margined beardtongue, Pahrump Valley wild buckwheat, and Parish phacelia. Coordination with the Nye County HCP currently under development, and with Department of Defense for management of populations on Nellis AFR will be necessary to protect these additional fourteen population groups.

Table A. Low elevation rare plant populations on Federal lands in Nevada (but outside of Clark County) recommended for special protective designation status to create a rare plant conservation network. Plants are ordered by species within habitat categories. **Bold** font indicates that the population group occurs at least in part within an existing special designation (ACEC, NCA, or WA). *Italic* font indicates that the population group overlaps at least in part with one or more other population groups on this list.

Plant Taxon	Rare Plant Population Group Name	Primary Jurisdiction
White bearpoppy *Arctomecon merriami*	Desert Range	DoD
	North Desert Range	DoD
	Pintwater Range	DoD
	Specter Range	BLM (Nye Co.)
	Spotted Range	DoD and FWS
	Stewart Valley	BLM (Nye Co.)
	Three Lakes Valley	DoD
White-margined Beardtongue *Penstemon albomarginatus*	North of Ash Meadows	BLM (Nye Co.)
	Rock Valley	BLM (Nye Co.)
Pahrump Valley Wild Buckwheat *Eriogonum bifurcatum*	*(Nevada) Pahrump Valley*	BLM (Nye Co.)
	Stewart Valley	BLM (Nye Co.)
Parish Phacelia *Phacelia parishii*	Indian Springs Valley	DoD
	Pahrump Valley	BLM (Nye Co.)
	Three Lakes Valley	DoD

Strategic action A within this objective includes an action step intended to track population status on DoD lands:

J. Develop a Clark County Rare Plant Scorecard website to highlight annual population status tracking, and investigate its potential as a web log to be a visible influence on removing all critical threats to rare plants and habitats.
1. Identify a webmaster to develop, promote, and maintain a website.
2. In addition to tracking population status on lands managed by MSHCP cooperators, include populations managed by Nellis at NAFB and NAFBGR.

As described in the main document, the purpose of a rare plant scorecard website is for public outreach and information sharing on the goals and progress of the low elevation rare plant CMS.
Two action steps are associated with this strategic action. The second action step involves tracking rare plant populations managed by Nellis to more comprehensively understand the global status of rare plant species that occur on Nellis.

Objective 2a: Manage viable populations of white bearpoppy, threecorner milkvetch, sticky wild buckwheat, white-margined beardtongue, and Parish phacelia on DoD, Nye and Lincoln County lands by removing significant casual OHV impacts by 2020.

Baseline viability rank tally: 5 good, 3 fair
Threat rank tally: 8 high (32 population groups)

White bearpoppy
1. IMAs (Nellis): Viability good, threats high (Black Hills, Desert Range, Pintwater Range, Spotted Range, Three Lakes Valley)
2. Other Nevada: Viability good, threats high (Desert Hills, East Desert Range, South Delamar Mountains, Ash Meadows, Devils Hole, Specter Range, Stewart Valley, West of Last Chance Range)

Threecorner milkvetch
3. Other Nevada: Viability fair, threats high (Sand Hollow Wash)

Pahrump Valley buckwheat
4. Other Nevada: Viability good, threats high (Nevada Pahrump Valley, Stewart Valley)

Sticky wild buckwheat
5. Other Nevada: Viability good, threats high (Eastern Lincoln County)

White-margined beardtongue
6. Other Nevada: Viability good, threats high (north of Ash Meadows, Rock Valley, Specter Range)

Parish phacelia
7. IMA/LIMA (Nellis): Viability fair, threats high (Indian Springs Valley, Three Lakes Valley)
8. Other Nevada: Viability fair, threats high (North Pahrump Valley, Pahrump Valley, Desert Lake, Baking Powder Flat, Lake Valley, Millick Spring, Muncy, Spring Creek Bastian, White River Valley

Measures of success
Key ecological attributes/indicators (see table 55 for indicator definitions):
- Soil structure, stability, and movement/Density of vehicle tracks and degree of soil erosion or compaction
- Soil moisture and nutrient regime/Degree of surface crust disturbance
- Characteristic native plant community/Native versus exotic plant species composition
- Habitat destruction and loss/Sufficient acreage for characteristic species and natural habitat disturbances within historic range of variability

Threat reduction:
Reduction in numbers or percentages of incursions

Casual OHV impacts pose a threat to rare plant population groups not addressed under the Clark County MSHCP. Objective 2 and its accompanying strategic actions should be applied to population groups present on DoD lands in Clark County, as well as in Nye and Lincoln counties. See Objective 2 in main text for a description of those strategic actions and action steps that address OHV impacts.

Objective 3a: Control weeds in low elevation rare plant habitats on DoD, Nye and Lincoln County lands by 2020.

Baseline viability rank tally: 5 good, 1 fair
Threat rank tally: 4 high, 2 very high (28 population groups)

White bearpoppy

1. IMAs (Nellis): Viability good, threats high (Black Hills, Desert Range, Pintwater Range, Spotted Range, Three Lakes Valley)
2. MUMAs (Nellis): Viability good, threats high (Bird Spring Range, Devil Canyon, Pahrump Valley)
3. Other Nevada: Viability good, threats very high (Desert Hills, East Desert Range, South Delamar Mountains, Ash Meadows, Devils Hole, Specter Range, Stewart Valley, West of Last Chance Range

Alkali mariposa lily

4. Other Nevada: Viability good, threats high (Ash Meadows)

Pahrump Valley buckwheat

5. Other Nevada: Viability good, threats very high (Nevada Pahrump Valley, Stewart Valley)

Parish phacelia

6. Other Nevada: Viability fair, threats high (North Pahrump Valley, Pahrump Valley, Desert Lake, Baking Powder Flat, Lake Valley, Millick Spring, Muncy, Spring Creek Bastian, White River Valley)

Measures of success

Key ecological attributes/indicators (see table 55 for indicator definitions):

- Characteristic native plant community/Native versus exotic plant species composition
- Soil structure, stability and movement/Degree of soil erosion and compaction
- Soil moisture and nutrient regime/Degree of surface crust disturbance
- Fire Regime/Fire frequency and area burned

Threat reduction:

Number of population groups treated on an annual basis.

Weed invasions pose a threat to rare plant population groups not addressed under the Clark County MSHCP. This objective and its accompanying strategic actions should be applied to population groups present on DoD lands in Clark County, as well as in Nye and Lincoln counties, where viability of rare plant populations is threatened by weed invasion. See Objective 3 in main text for a description of strategic actions and action steps that address weed invasions.

Objective 4a: Ensure that long term viability of low elevation rare plants is not significantly impacted by rural development and sprawl.

Baseline viability rank tally: 2 good, 1 fair
Threat rank tally: 3 high (5 population groups)

White bearpoppy

1. Other Nevada: Viability good, threats high (Stewart Valley)

Pahrump Valley wild buckwheat

2. Other Nevada: Viability good, threats high (Nevada Pahrump Valley, Stewart Valley)

Parish phacelia

3. Other Nevada: Viability fair, threats high (North Pahrump Valley, Pahrump Valley)

Measures of success

Key ecological attributes/indicators (see table 55 for indicator definitions):

- Minimum dynamic area/Sufficient acreage for characteristic species and natural habitat

disturbances within historic range of variability
- Soil structure, stability and movement/Degree of soil erosion and compaction
- Soil moisture and nutrient regime/Degree of surface crust disturbance
- Characteristic native plant community/Native versus exotic plant species composition
- Fire Regime/Fire frequency and area burned

Threat reduction:
Acreage developed or highly disturbed within individual population groups

Rural sprawl and development is a significant threat to population groups of white bearpoppy, Pahrump Valley wild Buckwheat, and Parish phacelia in Nye County, around the existing town of Pahrump where substantial new residential and commercial development is occurring. See Objective 4 in main text for a description of strategic actions and action steps that address rural development and sprawl. Strategic action 4C specifically addresses rural development in Nye County.

D. Investigate opportunities to acquire land or conservation easements for Pahrump Valley wild buckwheat habitats in Clark and Nye counties, and for threecorner milkvetch and sticky wild buckwheat at Virgin River Dunes.
1. Make initial contacts with local landowners to determine willingness to negotiate.
2. If appropriate, secure SNPLMA funds for acquisitions.

Populations of Pahrump Valley wild buckwheat in Mesquite and Pahrump Valley occur on both private and public land. BLM management of rare plant habitat is complicated by rural sprawl impacts, but there may be opportunities to acquire land or easements in these valleys to better protect rare plant habitats. This strategic action is crucial for long term survival of Pahrump Valley wild buckwheat because there is currently too little habitat for the species in Federal land management and virtually none in protective management.

Objective 7a: Manage viable populations of all covered rare plants in utility corridors on BLM lands.

Baseline viability rank tally: 2 good
Threat rank tally: 2 high (4 population groups)

Pahrump Valley buckwheat
1. Other Nevada: Viability good, threats high (Nevada Pahrump Valley, Stewart Valley)

White-margined beardtongue
2. Other Nevada: Viability good, threats high (North of Ash Meadows, Rock Valley, Specter Range)

Measures of success
Key ecological attributes/indicators (see table 55 for indicator definitions):
- Connectivity with intact adjoining systems/Degree of population isolation and fragmentation of matrix systems
- Reduced population numbers or extent of populations/Number of reproductive plants in non-drought periods
- Characteristic native plant community/Native versus exotic plant species composition

Threat reduction:
Acres of habitat in population groups restored or enhanced through mitigation projects relative to

overall acreage disturbed

Utility corridor development in Nye County poses a threat to population groups of white-margined beardtongue and Pahrump Valley wild buckwheat, while it may be a threat to white bearpoppy and Parish phacelia in Stewart Valley and the Specter Range where powerlines outside of designated corridors receive maintenance work on occasion. See Objective 7 in main text for a description of strategic actions and action steps that address the threat of utility corridor development.

Objective 8a: Manage viable populations of Las Vegas bearpoppy along Federal highways and county roads.

Baseline viability rank tally: 3 good
Threat rank tally: 3 high (6 population groups)

White bearpoppy
1. Other Nevada: Viability good, threats high (Specter Range)

Pahrump Valley buckwheat
2. Other Nevada: Viability good, threats high (Nevada Pahrump Valley, Stewart Valley)

White-margined beardtongue
3. Other Nevada: Viability good, threats high (North of Ash Meadows, Rock Valley, Specter Range)

Measures of success
Key ecological attributes/indicators (see table 55 for indicator definitions):

- Connectivity with intact adjoining systems/degree of population isolation and fragmentation of matrix systems
- Adult population size/Number of reproductive plants in non-drought periods
- Soil structure, stability, and movement/Density of vehicle tracks; degree of soil erosion or compaction
- Loss of pollinator efficiency/Presence of characteristic pollinators

Threat reduction:
Amount of acreage restored through mitigation associated with highway construction and maintenance in rare plant habitat

In Nye County, the threat of highway and road construction and maintenance is high for white bearpoppy and white-margined beardtongue along State Highway 95 and for Pahrump Valley wild buckwheat along State Highway 372. See Objective 8 in main text for a description of strategic actions and action steps that address this threat.

Objective 9a: Manage populations of Las Vegas bearpoppy, white bearpoppy, and Parish phacelia at Nellis to ensure positive long term viability trend in IMAs, LIMAs and UMAs within ten years.

Baseline viability rank tally: 2 good, 1 poor
Threat rank tally: 2 high, 1 very high (8 population groups)

California bearpoppy
1. UMA (Nellis): Viability poor, threats very high (Las Vegas Valley)

White bearpoppy
2. IMAs (Nellis): Viability good, threats high (Desert Range, North Desert Range, Pintwater

Range, Spotted Range, Three Lakes Valley)

Parish phacelia

3. IMA/LIMAs: Viability good, threats high (Indian Springs Valley, Three Lakes Valley)

Measures of success:

Key ecological attributes/indicators (see table 55 in main document for indicator rankings):

- Minimum dynamic area/sufficient acreage for characteristic species and natural habitat disturbances within historic range of variability
- Soil structure, stability and movement/Degree of soil erosion and compaction
- Soil moisture and nutrient regime/Degree of surface crust disturbance
- Characteristic native plant community/Native versus exotic plant species composition
- Fire Regime/Fire frequency and area burned

Threat reduction:

Numbers or percentages of population groups under conservation management by DoD.

DoD is not a signatory participant of the MSHCP, yet lands managed by Nellis Air Force Base (Nellis AFB) and Nellis Air Force Base and Gunnery Bombing Range (Nellis AFBGBR) are categorized and included in acreage figures for protected lands (IMAs and LIMAs) in the County. Nellis AFBGBR harbors two important populations of Parish phacelia (Indian Springs Valley [IMA] and Three Lakes Valley [LIMA]), while it harbors five important populations of white bearpoppy (Spotted Range, Pintwater Range, Three Lakes Valley, North Desert Range, and Desert Range [all IMAs and/or LIMAs]). Nellis AFB has a significant population of the Las Vegas Valley population group of Las Vegas bearpoppy (UMA) because of its unique genetic material in a rapidly declining population.

A. Assist implementation of a comprehensive rare plant habitat conservation program within the Nellis INRMP by 2008.

1. Secure Nellis' cooperation and commitment for implementing a rare plant tracking (inventorying and monitoring) program on DoD land.
2. Avoid military activities on Las Vegas bearpoppy habitats at Area II and investigate designating a conservation management area (at NAFB).
3. Avoid military activities on white bearpoppy and Parish phacelia habitats in valley bottoms and foothills (at NAFBGR).
4. Minimize military activities in areas directly adjacent to these rare plant habitats (at NAFBGR).
5. Develop compatible ground-based military training activities in Indian Springs and Three Lakes valleys to abate soil compaction and erosion in rare plant habitat (at NAFBGR).
6. Investigate special designations, such as RNAs for white bearpoppy populations in the Desert, Pintwater, and Spotted ranges, and Three Lakes Valley; and for Parish phacelia at Indian Springs and Three Lakes valleys.
7. Manage ground-based activities so that indirect impacts (e.g. weed introductions) are avoided by effective environmental staff and military personnel communications.
8. Boardwalk, fence, or designate trails in Las Vegas bearpoppy habitat at Area III and develop a volunteer stewardship program by military families housed at Manch Manor (at NAFB).
9. Develop alternatives to NAFB Area III for base housing expansion and proposed solar generation plant (at NAFB).

10. Provide rare plant stewardship support (for weed management, base personnel education, habitat protection) by keeping environmental staff informed of latest available information.

Nellis is currently updating its Integrated Natural Resources Management Plan (INRMP) which provides an opportunity for FWS and NDF to work with them to develop a strong rare plant conservation program in the INRMP. This would benefit long term viability of all three species at the noted population groups. Ten action steps are detailed for FWS and NDF to accomplish this strategic action which also could lessen the impacts of several threats, including OHV use, weeds, military activities, and urban sprawl in addition to improving population viabilities.

B. Perform ongoing research for a better understanding of surface and groundwater connection at NAFBGR.

The impacts of regional groundwater withdrawal and its connection with surface water in valley bottoms harboring rare plants (e.g. Three Lakes Valley) are not well understood. Research is ongoing, but more may be needed to answer relevant questions about ecological variables that drive rare plant distributions and abundances.

C. Coordinate conservation actions for MSHCP with Nellis' INRMP for consistency and effectiveness.

Because FWS has a role in both the MSHCP and Nellis' INRMP, they are in the unique position of ensuring coordination among the two programs. Both conservation programs would benefit from efficiencies gained by FWS coordination.

Objective 10a: Manage viable populations of alkali mariposa lily and white bearpoppy populations in LIMAs and MUMAs by removing wild horse and burro use and addressing impacts of rural sprawl by 2020.

Baseline viability rank tally: 2 good
Threat rank tally: 2 high (3 population groups)

White bearpoppy
1. Other Nevada: Viability good, threats high (Indian Springs, Stewart Valley)

Alkali mariposa lily
2. Other Nevada: Viability good, threats high (Ash Meadows)

Measures of success
Key ecological attributes/indicators (see table 55 for indicator definitions):
- Soil structure, stability and movement/Density of vehicle tracks and wild horse and burro trails
- Connectivity with intact adjoining systems/Degree of population isolation and fragmentation of matrix systems

Threat reduction:
- Number and acreage of population groups protected and/or restored through fencing and other efforts to control OHV incursions and recover habitat

Number of wild horse and burro gathers over time relative to maintenance of herd management area levels

Wild horses and burros pose a high threat to populations of alkali mariposa lily and white bearpoppy in Nye County. See Objective 10 in main text for a description of strategic actions and action steps that address this threat.

Objective 14a: Conserve Las Vegas bearpoppy's remaining genetic diversity in its western populations in Las Vegas Valley (including Area II of Nellis Air Force Base) by 2015.

Baseline viability rank tally: 1 poor
Threat rank tally: 1 very high (1 population group)

Las Vegas bearpoppy

1. UMA (Nellis): Viability poor, threats very high (Las Vegas Valley)

Measures of success: See objective 9a above

Conservation measures to address the genetic diversity at Nellis AFB Area II are important because a large percentage of the historic range of Las Vegas bearpoppy in its Las Vegas Valley population group has been lost to urban development, and because this population has been found to have unique genetic material which may be a factor in long term viability. See objective 9a for a full discussion of the strategic actions recommended on DoD lands.

Objective 16: Ensure that disposal of Federal lands in Nye County will not significantly impact comprehensive conservation of Pahrump Valley wild buckwheat populations.

Baseline viability rank tally: 1 good,
Threat rank tally: 1 medium (2 population groups)

Pahrump Valley buckwheat

1. Other Nevada: Viability good, threats medium (Nevada Pahrump Valley, Stewart Valley)

Measures of success:
Key ecological attributes/indicators (see table 55 in main document for indicator rankings):

- Minimum dynamic area/Sufficient acreage for characteristic species and natural habitat disturbances within historic range of variability
- Connectivity with intact adjoining systems/Degree of population isolation and fragmentation of matrix systems

Threat reduction:

- Acres of Federal land with low elevation rare plant habitat disposed
- Acreage developed or highly disturbed within individual population groups

Pahrump Valley wild buckwheat is extremely limited in its global distribution and three of four population groups occur in Nye County. Pahrump and Stewart valleys harbor large populations of Pahrump Valley wild buckwheat in Nye County and they are the populations with the greatest potential of offering long term viability to the species. Portions of these population groups occur on Las Vegas District BLM land slated for disposal.

This objective addresses a BLM sensitive species goal to ensure they are considered in land management decisions. Measures of success include tracking the threat of disposal via ownership and management status of the affected population groups. Viability indicators of key ecological attributes include: 1) number of reproductive plants in non-drought periods (adult population size); 2) sufficient acreage for characteristic species and natural habitat disturbances within historic range of variability (minimum dynamic size); and, 3) degree of population isolation and fragmentation of matrix systems (connectivity with intact adjoining systems). This objective compliments Objective 4 and Objective 5 which address other aspects of land ownership and management of Pahrump Valley wild buckwheat habitat.

A. Coordinate with participants in Nye County HCP process on conservation actions to protect habitat.

FWS is working with Nye County's ongoing HCP process which is likely to provide opportunities to ensure protection of Pahrump Valley wild buckwheat in Pahrump and Stewart valleys. An evaluation of the costs and benefits of disposal versus rare plant protection by BLM is needed early in the process so as to avoid late hour costly solutions to management decisions.

B. Retain Pahrump Valley wild buckwheat habitats in public land and manage for long term viability.
1. Investigate special designations for Pahrump Valley wild buckwheat in Stewart and Pahrump valleys.

Retention of rare plant habitat in BLM jurisdiction is a recommended strategic action to protect Pahrump Valley wild buckwheat from private development. Although there may be factors beyond rare plant considerations that may weigh heavily in favor of disposal, these core populations are significant for long term viability of the species. If removing rare plant habitat from disposal is successful, designating special areas for conservation management is an important step to ensure adequate protection and management.

APPENDIX 8

Conservation Actions As Stated in the Clark County MSHCP

Actions directly reference low elevation rare plant species:

Conservation Action Number	Conservation Action	Species
BLM(32)	Develop and implement a monitoring program for the Las Vegas bearpoppy in cooperation with the Lake Mead National Recreation Area. The presence or absence of known pollinators will be documented as a part of the monitoring study	Las Vegas bearpoppy
BLM(33)	Develop and implement a monitoring program for BLM Special Status Plants such as the alkali mariposa lily, Blue Diamond cholla and covered and evaluation moss species in the Red Rock Canyon NCA.	BLM Special Status Plants such as the alkali mariposa lily, and covered species in the Red Rock Canyon NCA.
BLM(34)	Monitor road and trail proliferation in desert tortoise ACECs, Las Vegas bearpoppy management areas, and WSAs.	Las Vegas bearpoppy management areas
BLM(99)	Enter into conservation agreements with the U.S. Fish and Wildlife Service and the State of Nevada, that if implemented, could reduce the necessity of future listings of the species in question. Conservation agreements may include, but not be limited to, the following: Las Vegas bearpoppy, white-margined penstemon, and phainopepla.	include, but not be limited to, Las Vegas bearpoppy, white-margined penstemon
BLM(107)	Allow no net loss of Las Vegas bearpoppy habitat on Public Land from Federally approved projects through mitigative actions including avoidance and rehabilitation.	Las Vegas bearpoppy habitat
BLM(123)	Within desert tortoise critical habitat/ACECs, Las Vegas bearpoppy habitat, and other important habitats for covered and evaluation species, require reclamation of activities which result in loss or degradation of habitat, with habitat to be reclaimed so that pre-disturbance condition can be reached within a reasonable time frame. Reclamation may include salvage and transplant of cactus and yucca, recontouring the area, scarification of compacted soil, soil amendments, seeding, and transplant of seedling shrubs. If necessary subsequent seeding or transplanting efforts may be required, should monitoring indicate that the original effort was not successful.	Las Vegas bearpoppy habitat, and other important habitats for covered species
BLM(220)	Designate important bearpoppy habitat in Lovell Wash (Muddy Mountains) and the Bitter Springs as ACECs for the protection of Las Vegas bearpoppy and sticky ringstem. These areas should be limited to designated roads and trails, closed to OHV competitive events and all forms of mineral entry. (Land Use Amendment Required).	Las Vegas bearpoppy and sticky ringstem
BLM(300)	Fifty acres in Jean Lake Valley and thirty acres in Hidden Valley are being fenced to conserve white-margined penstemon habitat.	white-margined penstemon habitat.
BLM(303)	Implement a program to rehab surface disturbances including the first hundred feet or so of “closed” roads and trails within proposed desert tortoise ACECs, Las Vegas bear poppy habitat, and other areas important for special status species.	Las Vegas bear poppy habitat and other areas important for special status species.

Conservation Action Number	Conservation Action	Species
BLM(304)	Maintain and/or improve 45,750 acres of Las Vegas bearpoppy habitat in four bearpoppy management areas: Sunrise, Lovell Wash, Bitter Spring, and Gold Butte. Protect Las Vegas bearpoppy habitat within the Apex land sale area in cooperation with Clark County.	Las Vegas bearpoppy habitat
NPS(6)	Coordinate inventory of three-cornered milkvetch and sticky buckwheat with other survey efforts on Federal lands.	three-cornered milkvetch and sticky buckwheat
NPS(15)	Monitor Las Vegas bearpoppy populations.	Las Vegas bearpoppy
NPS(16)	Manage Mojave poppy bee and other gypsiferous soil species consistent with Las Vegas bearpoppy populations. The relationship between pollinators and species should be monitored; the populations may be mutually dependent and both necessary for successful conservation management.	Mojave poppy bee and other gypsiferous soil species consistent with Las Vegas bearpoppy populations
NPS(21)	Implement the memorandum between USFWS and managing agencies for Las Vegas bearpoppy.	Las Vegas bearpoppy.
USFWS(29)	Develop a conservation agreement for white-margined beardtongue with agencies as appropriate (Ecological Services).	white-margined beardtongue
USFWS(30)	Implement the memorandum of agreement between USFWS and managing agencies for Las Vegas bearpoppy (Ecological Services).	Las Vegas bearpoppy
USFWS(39)	If proposed actions will result in surface disturbance near a population of white bearpoppy, remove soil with seed source and relocate to a potential habitat site and monitor over time (DNWR).	white bearpoppy

BLM special status species are Las Vegas bearpoppy, threecorner milkvetch, and sticky wild buckwheat. Others are sensitive species.

Actions indirectly reference low elevation rare plant species:

Conservation Action Number	Conservation Action	Species
BLM(5)	Develop brochures, pamphlets, and interpretive signs for covered species and the habitats of which they depend as determined to be appropriate by BLM in coordination with the HCP I & M Committee.	covered species
BLM(13)	Continue to conduct inventories as determined by the BLM and I & M Committee on special status plant species to determine their distribution, abundance, and potential threats and take appropriate actions to protect the habitat of these plant and animal species.	special status plant species
BLM(35)	Monitor water table levels at the Pahrump, Moapa, Stewart Valley, and Stump Springs mesquite woodlands.	(Erbi phpa habitat)
BLM(59)	Manage wild horses and burros as necessary to maintain thriving ecological balance and consistent with the protection of special status species in important habitat areas.	special status species
BLM(89)	Where feasible, proposals for saleable materials in essential habitats for special status species will be avoided.	special status species
BLM(97)	Restrict mountain bikes and other mechanized non-motorized vehicles to designated trails within the RRCNCA and only allow new trails consistent with the conservation of BLM sensitive species, including the Spring Mountain milkvetch.	sensitive species (arme cast)
BLM(98)	Provide adequate law enforcement presence to ensure that management actions and restrictions are implemented for the conservation of covered and/or evaluation species.	covered species
BLM(111)	Prior to the disposal of identified public lands, an analysis will be conducted to determine their resource values, including the occurrence of Special Status Species and sensitive habitats such as riparian and aquatic habitats. Land disposal will be consistent with conservation of special status species unless there is an overriding public benefit.	Special Status Species and sensitive habitats
BLM(114)	Manage public lands adjacent to the Ash Meadows ACEC and Moapa National Wildlife Refuge to compliment spring and aquatic habitat for special status species, including projects that may affect ground water levels or spring flows.	(cast)
BLM(125)	As grazing systems are developed for each allotment, ensure the system is consistent with the conservation of BLM special status species. Where conflicts occur, encourage Clark County to obtain grazing privileges on a willing seller basis.	special status species
BLM(135)	Implement reseeding with native plant species and other soil stabilization and habitat restoration actions following wildfires within areas important for the conservation of covered species and where the feasibility of success is reasonably certain.	covered species
BLM(163)	BLM will review their special status species list annually and update it as appropriate to include the MSHCP “covered” species , and where appropriate,“evaluation” species.	special status species
BLM(164)	The following are land acquisition priorities on a willing seller basis:	special status species

Conservation Action Number	Conservation Action	Species
BLM(164)	1) Private lands required to meet management objectives within designated ACECs, WSAs, T&E habitat and areas containing special status species.	special status species
BLM(164)	3) Lands not specifically identified for acquisition could be acquired on a caseby-case basis for the following reasons: a) protection of T&E and special status species; b) to provide resource protection; c) to facilitate implementation of the Resource Management Plan; d) to provide a more manageable land ownership pattern; or e) to maintain or enhance public uses and values.	special status species
BLM(206)	Designate the following areas as ACECs for the conservation of Federally listed and special status species of wildlife and plants:	special status species
BLM(206)	Mormon Mesa 151,360 acres	special status species
BLM(206)	Gold Butte (Parts A, B, & C) 344,437 acres	special status species
BLM(206)	Rainbow Garden 37,620 acres	special status species
BLM(206)	Virgin River 6,411 acres	special status species
BLM(211)	Designate 1,107,800 acres as limited to designated roads and trails for all motorized and mechanized vehicles within desert tortoise ACECs, Rainbow Garden ACEC, and areas adjacent to Red Rock Canyon NCA and Spring Mountain NRA.	(anle and arca habitat)
NDF(3)	Cooperate, to the maximum extent practicable, with Clark County, and enter into agreements, as appropriate, with Clark County and other Participants in the MSHCP for the administration and management of any areas established for the conservation, protection, restoration, and propagation of species of native flora which are threatened with extinction (NRS 527.300).	species of native flora which are threatened with extinction (arca, asgetr, ervi)
NDOT(5)	Compile an inventory of Covered Species and valuable habitat lands that occur on NDOT rights-of-way. This inventory will be accumulated on a project-byproject basis during NDOT's environmental review process.	Covered Species
NDOT(9)	Survey maintenance and construction activities conducted in undisturbed habitat by NDOT's Environmental Services Division prior to disturbance. For the purpose of the MSHCP, undisturbed habitat will include those areas that NDOT had not historically graded, excavated, and so on, in the previous two years (24-month period) in association with rights-of-way maintenance and construction activities, and/or those areas which NDOT biologists or NDOT approved biological consultants deem to have potential habitat values for Covered Species.	Covered Species (arca)

Conservation Action Number	Conservation Action	Species
NDOT(10)	Avoid any Covered Species discovered in disturbed or undisturbed habitat in proposed maintenance or construction areas, if possible. If unable to avoid, best efforts will be made to relocate/salvage species. Relocation/salvage will only be attempted if the species is highly likely to survive the action and it is reasonably cost effective. This will be determined by NDOT's Environmental Services Division.	Covered Species
NDOT(30)	Coordinate with BLM to perform plant salvages prior to work in undisturbed habitat and/or when Covered plant species cannot be avoided, especially cactus and yucca species.	Covered Species (arca and peal)
NDOT(34)	During project development and design, avoid areas known to support Covered Species to the maximum extent practicable.	Covered Species
NPS(1)	Develop brochures, pamphlets, interpretive signs, and exhibits for Covered Species and the habitats on which they depend as determined to be appropriate by NPS in coordination with the MSHCP I & M Committee.	Covered Species
NPS(3)	Cooperate in the identification, development, and implementation of research projects located on Federal lands. Emphasis shall be placed on research that addresses management concerns and the conservation of Covered and Evaluation Species.	Covered Species
NPS(4)	Investigate the basic ecology of obligate pollinators of target plant species to insure complementarity of conservation recommendations and the location of protected areas, insuring the inclusion of the pollinator's full habitat and food source requirements.	target plant species
NPS(34)	Assure long-term implementation of existing management policies and actions benefiting Covered Species through amendment of the GMP.	Covered Species
NPS(37)	Include MSHCP Covered Species as sensitive species in evaluations of road construction or maintenance activities on Federal lands.	Covered Species
NPS(51)	Assure full and continuing implementation of existing management policies and actions, and monitoring of sensitive habitats and species.	sensitive habitats and species
USFWS(5)	Conduct preactivity surveys for biological resources before implementing projects which may impact resources; and avoid sensitive species to the extent possible (DNWR).	sensitive species
USFWS(6)	Monitor and protect water sources and water flows (springs, seeps, and streams) to assure adequate water is provided for sensitive species (DNWR).	sensitive species
USFWS(10)	Investigate the basic ecology of obligate pollinators of target plant species to insure complementarity of conservation recommendations and the location of protected areas, insuring the inclusion of the pollinator's full habitat and food source requirements (DNWR).	target plant species
USFWS(42)	Assure full and continuing implementation of existing management policies and actions, and monitoring of sensitive habitats and species (DNWR).	sensitive habitats and species