APPENDIX J-1
PLANT SPECIES TRANSLOCATION, PROPAGATION AND MANAGEMENT PLAN

I. INTRODUCTION

This Plant Species Translocation, Propagation and Management Plan describes the management methods for four special-status plant species potentially affected by development on RMV. This section also addresses two additional plant species that may require mitigation pursuant to CEQA with translocation as a potential component of the mitigation. The program set forth in this section provides the methodologies for implementing translocation as necessary to compensate for significant impacts (as identified in the GPA/ZC EIR) for each development planning area.

The four species addressed in this Plan include thread-leaved brodiaea (*Brodiaea filifolia*), many-stemmed dudleya (*Dudleya multicaulis*), southern tarplant (*Centromadia parryi* ssp. *australus*), and Coulter's saltbush (*Atriplex coulteri*). The additional plants addressed in this Plan consist of **(1)** an intergrade between the common Weed's mariposa lily (*Calochortus weedii* var. *weedii*) and the intermediate mariposa lily (*Calochortus weedii* var. *intermedius*), which is a CNPS List 1B taxon; and **(2)** the mud nama, a CNPS List 2 taxon. Mitigation for impacts to these species will include avoidance of existing populations and, where appropriate, translocation of populations to be impacted.

II. THREAD-LEAVED BRODIAEA

A. Background

Thread-leaved brodiaea (*Brodiaea filifolia*) is Federally listed as threatened, State listed as endangered, and is designated by the California Native Plant Society (CNPS) as a List 1B species (Plants rare, threatened, or endangered in California and elsewhere). The thread-leaved brodiaea is a member of the lily family (Liliaceae). It is a perennial geophyte that has a corm with a dark brown, fibrous tunic. The flowering stalk is 8-16 inches high and the narrow leaves are generally shorter than the flowering stem. The flowers are dark blue to violet and have six perianth segments. There are three stamens and three staminodia (sterile stamens), which are narrow and thread-like in each flower.

Thread-leaved brodiaea grows in clay soils that are typically poorly drained. The species preferred habitat is native perennial grassland or grassland/sage scrub ecotones, but it will tolerate a component of weedy annual grasses, such as ryegrass (*Lolium* sp.) and to a lesser extent wild oats (*Avena* sp.), and, within the RMV Open Space, is often associated with somewhat dense areas of low-growing fascicled tarplant (*Deinandra fasciculata*), and even a small component of black mustard (*Brassica nigra*). Thread-leaved brodiaea is usually absent in areas that are dominated by other annual grasses, such as bromes (*Bromus* sp.). Besides grasslands, the species is also associated with vernal pools; however, on RMV all occurrences are in grasslands. In general, the brodiaea occurs in areas of gentle topography, including broad ridge tops and low gradient slopes.

B. Restoration Program

The proposed restoration program for thread-leaved brodiaea within the RMV Open Space would include some or all of the following key components. The methods ultimately employed will depend on the extent of impact, conditions associated with the impacted populations, habitat conditions associated with individuals determined suitable for translocation and site conditions associated with receptor sites.

- Pre-Translocation Monitoring
- Seed collection
- Selection of Receptor Sites
- Site preparation
- Direct seeding at translocation sites
- Translocation of existing populations by means of corm salvage and relocation
- Maintenance and Monitoring

Pre-Translocation Monitoring

Once it has been determined which brodiaea populations will require translocation, each population will be monitored annually, for three seasons prior to relocation, to delineate the location of flowering individuals associated with the population to be relocated.[1] This information will be important for locating and marking the extent of each population because the number of individuals that flower in any given year can vary based on rainfall and other

[1] It most instances, two years of pre-translocation monitoring would be sufficient; however, by extending the monitoring period to three years, low rainfall years, or otherwise years with suboptimal conditions would be addressed.

environmental factors. Monitoring for multiple seasons will ensure that the maximum number of individuals will be subject to translocation efforts.

For the first growing season of pre-translocation monitoring, the existing population(s) will be divided into distinct clumps to be translocated. The size of each clump will be approximately two-feet by two-feet, and will be determined based on the size that is feasible for translocating without damaging brodiaea corms. The limits of each clump will be clearly demarcated (pin-flags, stakes, etc.) to identify them at each stage of the translocation process. Each clump will be given a unique identification number.

Seed Collection

In preparation for future direct seeding of translocation sites, biologists will collect seed from brodiaea populations to be translocated. To ensure that an adequate amount of seed is collected, seed can be collected from populations to be relocated for as many seasons as determined necessary by the Restoration Specialist/Plant Ecologist, prior to translocation. Seed will be collected from individuals once they have set seed. Seed will be stored in a climate-controlled facility under appropriate storage conditions, with candidate institutions to include California State University, Fullerton (CSUF) or Rancho Santa Ana Botanic Garden.

Selection of Receptor Sites

Due the small amount of thread-leaved brodiaea expected to be translocated, receptor sites for the translocation of thread-leaved brodiaea will likely include existing populations to be enhanced, but may also include native grassland sites that do not currently support the species if enhancement opportunities are limited in the occupied areas. Additional opportunities would be associated with areas subject to coastal sage scrub (CSS)/valley grassland (VGL) creation or restoration, as described in the upland restoration plan. Such areas would also receive high priority, as candidate brodiaea relocation sites based on site-specific conditions. Physical and biological criteria will be used in evaluating suitability, and ultimately in the selection of receptor sites.

Physical criteria will largely be based on the presence of suitable soils. Using the Soil Conservation Service (CSC) soil survey for Orange County, soil types will be identified for areas supporting existing brodiaea populations. Priority for receptor sites will be given to those areas that have the same (or similar) soil type as existing populations. Another primary physical selection criterion will be soil texture, to be determined through the collection of soil samples at existing populations as well as receptor sites for comparison. Receptor sites will exhibit clay

soils, or will contain a clay lense within a larger matrix of cobbly loams, clay loams, or sandy clay loams. Soil moisture also appears to be important for brodiaea as areas supporting brodiaea typically exhibit soil moisture at depths of six to eight inches during July and August whereas adjacent unoccupied areas typically do not exhibit similar soil moisture (Bomkamp and Young, 2001). Other physical characteristics of the site may include slope angle and position, and slope aspect.

Biological selection criteria will include the vegetation community, the presence of dispersal vectors (i.e., pollinators), any soil mycorrhizal associations, an evaluation of the overall similarity of the proposed site to the existing sites, and an evaluation of the presence of potential competitors (i.e., non-native invasives) and herbivores.

Site Preparation

Exotic Control

Once selected, receptor sites will be prepared by eradication of non-native, invasive vegetation as needed. Non-native species targeted for removal will include artichoke thistle (*Cynara cardunculus*), mustard (*Brassica* sp.), and non-native grasses such as Italian ryegrass (*Lolium multiflorum*), bromes (*Bromus* sp.), and oats (*Avena* sp.). For areas of existing VGL or VGL/CSS ecotone that contain a minor component of non-native invasives, the sites will be weeded to remove the non-natives prior to translocation of brodiaea. Receptor sites will be weeded early in the growing season, to remove plants after they have germinated and established, but before they flower and set seed. For non-native vegetation occurring around established native shrubs and bunchgrasses, the invasives will be removed by hand. Herbicides may be used for spraying larger areas of non-native grasses and herbs.

Creation of Native Habitats

For sites that are dominated by non-native invasives, the existing vegetation will be removed completely, and a habitat of native vegetation will be created in its place. As noted above, where physical conditions are suitable, brodiaea will be relocated to needlegrass-dominated areas of CSS/VGL restoration or creation sites associated with the upland restoration program. Restored or created habitats that will serve as brodiaea receptor sites will consist of VGL or an ecotone of CSS/VGL, with the goal of attaining a 10 to 15 percent maximum cover of shrub species. Table 1 provides a conceptual plant palette for brodiaea translocation areas, and is a brodiaea-specific subset of the CSS/VGL plant palettes described in the upland restoration plan.

Habitat creation or restoration will occur at least one full growing season prior to translocation of brodiaea populations to allow for establishment of the planted natives and maintenance of non-native invasives. The first step in the creation of native VGL habitat to where brodiaea will be relocated will be to remove the existing non-native vegetation and as much of the soil seed bank as possible. As needed, and where directed by the Restoration Specialist/Plant Ecologist, a bulldozer may be used to scrape the topsoil and remove the existing vegetation. Hydroseeding or hand broadcasting will be used to distribute the native seed mix, followed by the planting of container stock. Since the non-native seed bank is still expected to be a problem at some receptor sites, a five-year maintenance program will be conducted prior to and following brodiaea translocation to prevent the establishment of non-natives within the translocation site.

TABLE 1
PLANT PALETTE FOR HABITAT CREATION
AT THREAD-LEAVED BRODIAEA RECEPTOR SITES

Species	Common Name	Type
Nasella pulchra	purple needlegrass	container stock & seed
Ericameria palmeri var. *pachylepis*	grassland goldenbush	container stock
Lupinus microcarpus	white-whorled lupine	container stock
Corethrogyne filaginifolia	sand aster	container stock
Sisyrinchium bellum	blue-eyed grass	Seed
Bloomeria crocea	golden stars	Seed
Dodacatheon clevelandii	shooting star	Seed
Cryptantha intermedia	forget-me-not	Seed
Deinandra fasciculate	fascicled tarweed	Seed
Daucus pusillus	wild carrot	seed

Translocation of Existing Populations

As stated above, translocation of brodiaea populations will occur in late summer after seed has set and been collected and the plants have become dormant. Clumps of individuals will first be flagged at existing sites in order to identify distinct soil sections for translocation. Once clumps of brodiaea are removed, they will be transported to the receptor sites on the same day for installation.

Flagging of Plants to be Translocated

As previously mentioned, clumps to be translocated will be demarcated during the pre-translocation monitoring period to identify them later for translocation. As each clump is flagged, the clump will be given a unique identification number for reference. A translocation map will be prepared for each receptor site that identifies where each translocated clump will be placed. Where areas of created or restored VGL will sever as the receptor sites, specific brodiaea translocation sites should be identified prior to beginning the VGL creation/restoration to ensure that access routes are provided that limit disturbance to created/restored areas and to ensure that the appropriate plants have been installed in the vicinity of the brodiaea receptor areas.

Removal of Brodiaea Clumps

Translocation of existing brodiaea populations will occur in late summer after individuals have set seed and entered the period of dormancy. Removal of previously flagged clumps will be conducted using a front-end loader with a closed-bucket. As the loader removes clumps of brodiaea, each clump will be placed onto two-foot by two-foot plywood boards and hand carried to a flatbed truck for transport to a receptor site. Since the goal is to install clumps on the same day as they are removed, time allowed for removal and transport will be limited.

To minimize the damage to the corms of other flagged brodiaea, the loader will be positioned carefully throughout the site. Access to clumps will be planned in advance to minimize disturbance. To remove the brodiaea clumps, the loader bucket will penetrate the ground to approximately eight inches. The bucket should then be angled horizontally and driven forward for about three feet, undercutting the clump and forcing it into the bucket. It is expected that removing a clump will break the clump into a number of small clods. Once a clump is securely in the bucket, it will be lifted clear of the ground and the intact clods will be transferred to the plywood boards for hand loading onto the flatbed truck. As clumps are loaded onto the truck, a numbered pin-flag will be placed with the clump for identification that will allow the clump to be installed at the predetermined location within the receptor site.

Installation of Brodiaea Clumps

Prior to translocation efforts, specific receptor areas will be identified within receptor sites. A minimum number of access paths will also be identified to reduce the impacts to existing native habitat. To minimize disturbance to the existing habitat, a bobcat with rubber tires will be used to access the site and rip the soil in areas where brodiaea clumps are to be installed. Larger dirt

clods will be broken up and smoothed to leave the soil in a condition suitable for digging planting holes.

Brodiaea clumps will be transferred by hand into the site and set into the planting holes. The larger, intact clods will be placed together in the center of the hole and the smaller clods will be packed around the larger ones to fill in the hole. As it can be determined, the clods will be placed right side up in the holes. Loose soil and debris, including loose corms, will be poured in between and around the clods. Finally, finely crumbled soil will be poured down cracks between clods to minimize underground crevices, and additional soil will be placed one to two inches over the top of the surface. Pin-flags will be placed to mark the perimeter of the installed clump.

After all clumps have been installed at a receptor site, a water truck will be used to provide deep watering to the brodiaea clumps. The main purpose of the watering will be to consolidate the finely crumbled soil in the crevices between clods, and so to improve the integrity of the clumps. The intent will be to minimize the clumps drying out and to exclude herbivores from eating the corms. After the deep watering, additional fine soil will be added to each clump to replace the soil that is washed down into the crevices. A second, lighter watering will be conducted to consolidate the added soil. Mulch will be placed over the clumps to a depth of three inches. The use of mulch is intended to retain soil moisture, reduce soil overheating from the sun, and to inhibit the germination of weedy species. Orange plastic fencing or stakes with flagging will be placed around each of the installed clumps for future identification and monitoring purposes. Finally, another thin layer of mulch will be placed over entire area to provide additional coverage to the clumps, as well as to cover spaced in between clumps.

Direct Seeding at Translocation Sites

As noted, translocation of existing brodiaea populations will occur in late summer after individuals have set seed, seed has been collected, and the plants have entered their period of dormancy. Following brodiaea translocation, translocation sites will be seeded directly with seed previously collected from the existing populations. Seed will be hand dispersed through the sites in late September or early October to be in place for the start of the rainy season (October 15). Seed will be hand broadcast to ensure a uniform distribution.

Long-Term Maintenance and Monitoring

Brodiaea translocation sites will be monitored for a period of five years to determine the success of the translocation efforts. The five-year program will include active weeding of the sites to

minimize the establishment of non-native invasives. Monitoring will be conducted for the entire five-year period by a qualified Restoration Specialist/Plant Ecologist.

Maintenance

Weed eradication will be conducted as necessary to minimize competition that could prevent the successful establishment of the translocated brodiaea. The crucial period for weed control is the first two years of project establishment. As weeds become evident, they should be immediately removed by hand or controlled with an appropriate herbicide as determined by a licensed Pest Control Advisor (PCA). Weed control shall occur monthly following the first rainfall for the first growing season, and not less than quarterly for the remainder of the maintenance period. All maintenance personnel will be trained to distinguish weedy species from native vegetation.

Monitoring

Translocated brodiaea clumps will be monitored annually for a five-year monitoring period. The number of flowering brodiaea individuals can vary significantly from year to year based primarily on rainfall. Because population sizes can vary from year to year, the relative sizes of extant and translocated populations are expected to vary widely from year to year. Because of this, development of performance standards can be difficult. As such, the performance standards are intended to evaluate general trends relative to performance and include flexibility, recognizing the inherent variability of this species. Under average conditions, populations should be increase to carrying capacity over time; however, in any given year, brodiaea may not even emerge if conditions are not appropriate. Therefore, if during any of the five-year period, the standard set forth for flowering individuals for year five is achieved, the program will be considered as having achieved the five-year performance standard. The performance standards set forth below are based on expected average conditions; however, there is a high likelihood that numbers will vary substantially from year to year.

First-Year Monitoring

Brodiaea can flower between late March and late June, with peak flowering varying according to seasonal rainfall patterns. Monitoring of translocated populations will begin in mid-March and will be conducted every two weeks until peak flowering occurs. When peak flowering occurs, as determined by the Restoration Specialist/Plant Ecologist, quantitative measurements (i.e. flowering individuals) will be obtained.

Success Standard: translocated populations combined to achieve 20 percent of number of individuals impacted, using the population data collected during a three-year monitoring program conducted prior to translocation.

Second-Year Monitoring

Success Standard: translocated populations combined to achieve 35 percent of number of individuals impacted using the population data collected during a three-year monitoring program conducted prior to translocation.

Third-Year Monitoring

Success Standard: translocated populations combined to achieve 50 percent of number of individuals impacted using the population data collected during a three-year monitoring program conducted prior to translocation.

Fourth-Year Monitoring

Success Standard: translocated populations combined to achieve 60 percent of number of individuals impacted using the population data collected during a three-year monitoring program conducted prior to translocation.

Fifth-Year Monitoring

Success Standard: translocated populations combined to achieve 75 percent of number of individuals impacted using the population data collected during a three-year monitoring program conducted prior to translocation.

The Adaptive Management Program provides for ongoing long-term monitoring and management of target species in the RMV Open Space. Replacement of the 75 percent of impacted brodiaea individuals by the end of the five- year monitoring and maintenance program, in the context of the long-term management goals, ensures that no functional loss for brodiaea occurs within the RMV Open Space.

III. MANY-STEMMED DUDLEYA

A. Background

The many-stemmed dudleya (*Dudleya multicaulis*) is a small geophyte in the stonecrop family (Crassulaceae) and is designated by CNPS as a List 1B species. Many-stemmed dudleya originates from a corm, and usually grows in shallow weathered cobbly loam or clay soils in clay soils, rocky places, or thinly vegetated openings in chaparral, coastal sage scrub, and foothill and valley needlegrass grassland.

B. Restoration Program

The proposed restoration program for many-stemmed dudleya within the RMV Open Space would include some or all of the following key components. The methods ultimately employed will depend on the extent of impact, conditions associated with the impacted populations, habitat conditions associated with individuals determined suitable for translocation and site conditions associated with receptor sites.

- Pre-translocation monitoring
- Seed collection
- Selection of receptor sites
- Greenhouse propagation
- Site preparation
- Translocation of natural populations
- Introduction of cultivated plants
- Direct seeding at translocation site
- Maintenance and Monitoring

Pre-Translocation Monitoring

Once it has been determined which dudleya populations will require translocation, each population will be monitored annually, for up to three years prior to translocation, to identify the number of flowering individuals associated with the population to be relocated.[2] This information will be important for locating and marking the extent of each population because the number of individuals that flower in any given year can vary based on rainfall and other

[2] It most instances, two years of pre-translocation monitoring would be sufficient; however, by extending the monitoring period to three years, low rainfall years, or otherwise years with suboptimal conditions would be addressed.

environmental factors. Monitoring for multiple seasons will ensure that the maximum number of individuals will be subject to translocation efforts.

For the first growing season of pre-translocation monitoring, the existing population(s) will be divided into distinct sections to be translocated. The size of each section will be approximately two-feet by two-feet, and will be determined based on the size that is feasible for translocating without damaging dudleya corms. The limits of each section will be clearly demarcated (pin-flags, stakes, etc.) to identify them at each stage of the translocation process. Each section will be given a unique identification number.

Seed Collection

Biologists will collect dried dudleya fruits from populations to be translocated, in order to obtain seeds to be used in the cultivation of seedlings under greenhouse conditions, and to a much lesser extent, for direct seeding of translocation sites. The highest priority will be given to cultivated seedlings grown under greenhouse conditions. Geurrant (1996) showed that cultivated plants, when grown to even slightly larger than seedling size, have a greater survivorship than field-germinated seeds, and are much more likely to create a larger final population size.

To ensure that an adequate amount of seed is collected, dried fruits will be collected for as many seasons as determined necessary by the Restoration Specialist/Plant Ecologist, prior to translocating candidate populations. The fruits will be stored in a climate-controlled facility under appropriate storage conditions, with candidate institutions to include California State University, Fullerton (CSUF) or Rancho Santa Ana Botanic Garden.

Selection of Receptor Sites

Receptor sites for the translocation of many-stemmed dudleya may include existing populations to be enhanced, but may also include sites that do not currently support the species if enhancement opportunities are limited. Since the habitat requirements of many-stemmed dudleya and mariposa lily intergrade (*Calochortus weedii* var. *intermedius* x *weedii* var. *weedii*) are very similar, and the two species are known to co-exist, receptor sites may be used for the translocation of both many-stemmed dudleya and the mariposa lily. Therefore, existing habitats of CSS/VGL supporting one species, but not the other, may be suitable for translocation of the species that does not currently exist.

Physical and biological criteria will be used in evaluating suitability, and ultimately in the selection of receptor sites to be used for new introductions of many-stemmed dudleya. Physical

criteria will largely be based on the presence of suitable soils. Receptor sites will have rocky clay or cobbly loam soils on slopes and ridgelines. Other physical characteristics of the site may include slope angle and position, and slope aspect.

Biological selection criteria will mainly include the vegetation community, targeting open areas of CSS or VGL. Preferably, receptor sites will support an ecotonal habitat of VGL/CSS, with a maximum shrub cover of 15 to 35 percent. If there is a lack of available native habitats for translocation, areas of created restored/created CSS/VGL, including specific areas dominated by CSS, VGL or VGL/CSS ecotone with suitable soils. Finally, areas supporting non-native grassland may be used for habitat creation if the soils are suitable to support many-stemmed dudleya and other sites noted above are not suitable.

Greenhouse Propagation

As stated above, priority will be given to cultivated seedlings grown under greenhouse conditions, with the direct seeding of translocation sites being a secondary use of seed collected from natural populations. Many-stemmed dudleya will be cultivated in a greenhouse setting for transplanting later to the receptor sites. The facility used for seed storage will also be used for greenhouse cultivation. Cultivation should begin at least two seasons prior to translocation of natural populations to ensure enough time for cultivated individuals to be large enough for transplanting. Individuals will be cultivated from seed collected from natural populations to be translocated.

Seed germination efforts will begin early in the growing season. Soil will be salvaged from the sites of natural populations to be translocated. The salvaged soil will be placed in standard greenhouse flats and mixed with washed builder's sand in an approximate ratio of three parts soil to one part sand. The sand will be used to loosen the soil and prevent from becoming too hard upon moistening, due to the high clay content.

The dried dudleya fruits will be broken open and seeds sprinkled on the moist soil surface, but the seeds will not be covered by the soil. The seeds will be watered immediately with a fine mist and this procedure will be repeated three times daily to keep them continuously moist. The greenhouse flats will be covered with shade cloth to reduce evaporative water loss from the soil and to minimize mechanical disturbance from watering.

Each flat will be weeded throughout the growing season. Supplemental water will be given as needed during the dry periods. Supplemental watering will be discontinued by late April or early

May to allow the cultivated plants to enter the natural dormancy cycle for the species, which begins at the onset of summer drought.

Site Preparation

Exotic Control

Once selected, all receptor sites will be prepared by eradication of non-native, invasive vegetation. Non-native species targeted for removal and control will include artichoke thistle, mustard, smooth cat's-ear (*Hypocharis glabra*), Crete hedynopsis (*Hedynopsis cretica*), and non-native grasses such as ryegrass (*Lolium* sp.), bromes (*Bromus* sp.), and wild oats (*Avena* sp.). For areas of existing native CSS/VGL ecotone that contain a minor component of non-native invasives, the sites will be weeded to remove the non-natives prior to translocation of many-stemmed dudleya. Receptor sites will be weeded early in the growing season, to remove plants after they have germinated and established, but before they flower and set seed. For non-native vegetation occurring around established native shrubs and bunchgrasses, the invasives will be removed by hand. Herbicides may be used for spraying larger areas of non-native grasses and herbs.

Creation of Native Habitats

For candidate VGL and/or CSS areas within the CSS/VGL restoration sites that are dominated by non-native grasses and forbs, the existing vegetation will be removed completely, and a habitat of native vegetation will be created in its place. Created habitats to receive the many-stemmed dudleya will consist of VGL, CSS, or VGL/CSS ecotone, with the goal of attaining a 15 to 35 percent cover of shrub species. Table 2 provides a site-specific conceptual plant palette for creation of the dudleya relocation sites where the sites are to be located in CSS/VGL creation areas.

Habitat creation will occur at least one full growing season prior to translocation of dudleya populations to allow for establishment of the planted natives and maintenance of non-native invasives. The first step in the creation of native habitat will be to remove the existing non-native vegetation, note above, and as much of the soil seed bank as possible. As needed, and where directed by the Restoration Specialist/Plant Ecologist, a bulldozer can be used to scrape the topsoil and remove the existing vegetation. Hand seeding will be used to distribute the native seed mix, followed by the planting of container stock.

TABLE 2
PLANT PALETTE FOR HABITAT CREATION
AT MANY-STEMMED DUDLEYA RECEPTOR SITES

Species	Common Name	Type
Salvia apiana	white sage	container stock
Galium angustifolium	narrow-leaved bedstraw	container stock
Bothriochloa barbinodis	silver beardgrass	container stock & seed
Nasella pulchra	purple needlegrass	container stock & seed
Agrostis exarata	spike redtop	Seed
Harpagonella palmeri	Palmer's grappling-hook	Seed
Osmadenia tenella	southern rosinweed	Seed
Dudleya edulis	ladies'-fingers	Seed
Chorizanthe staticoides	Turkish rugging	Seed

Since it will be important to maintain a habitat with adequate open areas between shrubs, the establishment of shrubs will be limited to container stock since shrub species in the seed mix would encourage a broad distribution of shrub species. Container stock of shrubs will be placed in the more-fertile areas of sites, leaving the rocky, less fertile areas for the translocation of dudleya, since it is in these areas that dudleya will be most successful due to lack of competition.

Since the non-native seed bank may continue to persist at reduce levels and may still pose a problem at some receptor sites, a five-year maintenance program will be implemented following dudleya translocation to provide appropriate control of non-natives within the translocation site, necessary to achieve performance standards.

Translocation of Natural Populations

Translocation of dudleya populations will occur in late summer after seed has been collected and the plants have become dormant. Clumps of individuals will first be flagged at existing sites in order to identify distinct soil sections for translocation. Once sections of dudleya are removed, they will be transported to the receptor sites on the same day for installation.

Flagging of Plants to be Translocated

As previously mentioned, dudleya sections to be translocated will be demarcated during the pre-translocation monitoring period to identify them later for translocation. As each section is flagged, the section will be given a unique identification number for reference. A translocation map will be prepared for each receptor site to plan for where each translocated soil section will be placed.

Removal of Dudleya Sections

Removal of previously flagged sections will be conducted using a front-end loader with a closed-bucket. As the loader removes sections of dudleya, each section will be placed onto two-foot by two-foot plywood boards and hand carried to a flatbed truck for transport to a receptor site. Since the goal is to install soil sections on the same day they are removed, time allowed for removal and transport will be limited.

To minimize the damage to the corms of other flagged dudleya, the loader will be positioned carefully throughout the site. Access to sections will be planned in advance to minimize disturbance. To remove the dudleya sections, the loader bucket will penetrate the ground to approximately eight inches. The bucket should then be angled horizontally and driven forward for about three feet, undercutting the soil section and forcing it into the bucket. It is expected that removing a soil section will break the section into a number of smaller fragments. Once a section is securely in the bucket, it will be lifted clear of the ground and the intact fragments will be transferred to the plywood boards for hand loading onto the flatbed truck. As soil sections are loaded onto the truck, a numbered pin-flag will be placed with the section for identification that will allow the soil section to be installed at the predetermined location within the receptor site.

Installation of Dudleya Sections

Prior to translocation efforts, specific receptor areas will be identified within (1) areas supporting dudleya that exhibit high potential for enhancement and expansion of existing populations (2) areas of native habitat, unoccupied by dudleya, selected due to the presence of appropriate physical and biotic conditions, or (3) within areas of created/restored VGL, CSS or VGL/CSS ecotonal areas, or (4) areas of non-native grassland or degraded CSS that would be restored as part of the dudleya relocation program. A minimum number of access paths will also be identified to reduce the impacts to existing native habitat. To minimize disturbance to the existing habitat, a bobcat with rubber tires will be used to access the site and rip the soil in areas

where dudleya sections are to be installed. Larger dirt clods will be broken up and smoothed to leave the soil in a condition suitable for digging planting holes.

Dudleya sections will be transferred by hand into the site and set into the planting holes. The larger, intact clods will be placed together in the center of the hole and the smaller clods will be packed around the larger ones to fill in the hole. As it can be determined, the clods will be placed right side up in the holes. Loose soil will be poured in between and around the clods. Finally, finely crumbled soil will be poured down cracks between clods to minimize underground crevices, and additional soil will be placed one to two inches over the top of the surface. Pin-flags will be placed to mark the perimeter of the installed clump.

After all soil sections have been installed at a receptor site, a water truck will be used to provide deep watering to the dudleya sections. The main purpose of the watering will be to consolidate the finely crumbled soil in the crevices between clods, and so to improve the integrity of the soil sections. The intent will be to minimize the soil sections drying out and to exclude herbivores from eating the corms. After the deep watering, additional fine soil will be added to each section to replace the soil that is washed down into the crevices. A second, lighter watering will be conducted to consolidate the added soil. Mulch will be placed over the sections to a depth of three inches. The use of mulch is intended to retain soil moisture, reduce soil overheating from the sun, and to inhibit the germination of weedy species. Orange plastic fencing or stakes with flagging will be placed around each of the installed soil sections for future identification and monitoring purposes. Finally, another thin layer of mulch will be placed over entire area to provide additional coverage to the soil sections, as well as to cover spaced in between sections.

Introduction of Cultivated Plants

Cultivated plants will be translocated to receptor sites while they are in their dormancy period and early in subsequent growing seasons, immediately prior to or after a rainfall event. To introduce the dudleya, soil blocks with plants will be sliced out of the flats. Immediately prior to planting a soil section, a hole slightly larger than the section of plants will be excavated. The section will then be lowered into the hole and the gap between the section and hole edge will be filled with soil and lightly compacted. Each section will be placed into the hole, either flush with or slightly below the existing soil surface. If the sections are placed above the soil surface, the soil may eventually erode, which causes the dudleya roots and caudex to become exposed above ground, which may eventually lead to plant death.

Direct Seeding at Translocation Site

Following the translocation of the salvaged dudleya populations (i.e., corms) and/or transplanting of cultivated individuals, translocation sites will be seeded directly with seed previously collected from the natural populations. Seed will be hand dispersed within areas where translocation will occur. Dried fruits collected from natural populations will be broken open and the seeds placed into a coffee can. Soil collected from the site of a natural population will be added to the coffee can and mixed with the seeds. This mixture will be spread throughout areas where individuals have been transplanted.

Long-Term Maintenance and Monitoring

Dudleya translocation sites will be monitored for a period of five years to determine the success of the translocation efforts. During the five-year program, active weeding of the sites to limit the establishment of non-native invasives will be performed. Monitoring will be conducted for the five-year period by a qualified Restoration Specialist/Plant Ecologist.

Maintenance

Weed eradication will be conducted as necessary to minimize competition that could prevent the successful establishment of the translocated dudleya. The crucial period for weed control is the first two years of project establishment. As weeds become evident, they should be immediately removed by hand or controlled with an appropriate herbicide as determined by a licensed Pest Control Advisor (PCA). Weed control shall in general occur monthly following the first rainfall for the first growing season, and then as needed for the remainder of the maintenance period. Quarterly visits are recommended following the first by the Restoration Specialist/Plant Ecologist to qualitatively evaluate the sites. All maintenance personnel will be trained to distinguish weedy species from native vegetation.

Monitoring

Translocated dudleya sections will be monitored annually for the five-year monitoring period. As with most geophytes, the number of flowering dudleya individuals can vary significantly from year to year based primarily on rainfall. Because population sizes can vary from year to year, the relative sizes of extant and translocated populations are expected to vary widely from year to year. Because of this, development of performance standards can be difficult. As such, the performance standards are intended to evaluate general trends relative to performance and

include flexibility, recognizing the inherent variability of this species. Under average conditions, populations should increase to carrying capacity over time; however, in any given year, dudleya may not even emerge or may emerge in very low numbers if conditions are not appropriate. Therefore, if during any of the five-year period, the standard set forth for flowering individuals for year five is achieved, the program will be considered as having achieved the five-year performance standard. The performance standards set forth below are based on expected average conditions; however, there is a high likelihood that numbers will vary substantially from year to year.

First-Year Monitoring

Many-stemmed dudleya typically flowers between mid April and early July and with peak flowering varying according to seasonal rainfall patterns. Monitoring of translocated populations will begin in on or about April 1, and will be conducted every two weeks until peak flowering occurs. When peak flowering occurs, as determined by the Restoration Specialist/Plant Ecologist, quantitative measurements (i.e. counts of flowering individuals) will be obtained.

Success Standard: translocated populations combined to achieve 20 percent of number of individuals impacted using the population data collected during a three-year monitoring program conducted prior to translocation.

Second-Year Monitoring

Success Standard: translocated populations combined to achieve 35 percent of number of individuals impacted using the population data collected during a three-year monitoring program conducted prior to translocation.

Third-Year Monitoring

Success Standard: translocated populations combined to achieve 50 percent of number of individuals impacted using the population data collected during a three-year monitoring program conducted prior to translocation.

Fourth-Year Monitoring

Success Standard: translocated populations combined to achieve 60 percent of number of individuals impacted using the population data collected during a three-year monitoring program conducted prior to translocation.

Fifth-Year Monitoring

Success Standard: translocated populations combined to achieve 75 percent of number of individuals impacted using the population data collected during a three-year monitoring program conducted prior to translocation.

The Adaptive Management Program provides for ongoing long-term monitoring and management of the target species within the RMV Open Space. Replacement of 75 percent of impacted many-stemmed dudleya individuals by the end of the five- year monitoring and maintenance program, in the context of the long-term management goals, ensures that no functional loss for many-stemmed dudleya occurs within the RMV Open Space.

V. SOUTHERN TARPLANT

A. Background

Southern tarplant (*Centromadia parryi* ssp. *australis*) is designated by CNPS as a List 1B species. The tarplant is an annual herbaceous member of the sunflower family (Asteraceae) that blooms from June to November. It is a densely glandular, erect plant with spine tipped leaves and yellow flowering heads. Habitat of the southern tarplant includes marshes (estuary margins), valley and foothill grasslands (vernally mesic), vernal pools, and seasonally moist (saline) grasslands. The tarplant also establishes well in highly disturbed areas.

B. Restoration Program

The proposed restoration program for southern tarplant within the RMV Open Space would consist of the following key components:

- Seed collection
- Selection of introduction sites
- Site preparation
- Direct seeding at introduction site
- Maintenance and Monitoring

Seed Collection

Biologists will collect seed from populations to be impacted, and the collected seed will be used in the direct seeding of introduction sites. Seed will be collected for as many seasons as possible prior to impacts to ensure that an adequate amount of seed. Existing populations will be monitored to determine when collection should begin. Seed collection is expected to occur in early to mid fall (mid September to early November). Tarplant individuals will be shaken over storage boxes to collect seeds. All materials falling from plants will be collected, including seeds, chaff, and other vegetative material. The boxes will be stored in a climate-controlled facility under appropriate storage conditions, with candidate institutions to include California State University, Fullerton (CSUF) or Rancho Santa Ana Botanic Garden.

Selection of Introduction Sites

Receptor sites for the translocation of southern tarplant will consist of mesic areas with alkaline soils adjacent to existing alkali marsh habitats, alkali meadows, and riparian habitats within the RMV Open Space, including riparian/wetland mitigation sites.

Site Preparation

Site preparation for the mitigation areas will consist of site grading to locate the reintroduction area closer to the groundwater table as well as to provide suitable microtopography. Grading is would also serve to remove the "weedy" seed bank where present at the reintroduction site(s).

Direct Seeding of Introduction Sites

Of the tarplant seed collected, fifty percent of the seed will be spread throughout the introduction site during the first year of introduction. The remaining seed will be kept in storage, to be used to for additional seeding of introduction sites, in the event that establishment is low, due to factors such as low rainfall, and further treatment is necessary in some areas. The method of seed dispersal will be to spread the collected materials (seed, chaff, etc.) evenly throughout the sites by hand broadcasting. The materials will be spread prior to October 1 of the year that seed is collected.

Long-Term Maintenance and Monitoring

Maintenance

Because southern tarplant does not emerge until late spring and does not flower until July or August, the potential for removing this species accidentally during weeding is high. Therefore, no weeding will be performed in areas where southern tarplant is introduced. In addition, no herbicides will be used within the southern tarplant reintroduction areas.

Monitoring

Translocated southern tarplant will be monitored annually for the five-year monitoring period. As with most annuals, the number of germinating individuals can vary significantly from year to year based on rainfall and for this species, disturbance. Because population sizes can vary from year to year, the relative sizes of extant and translocated populations are expected to vary widely from year to year. Because of this, development of performance standards can be difficult. As such, the performance standards are intended to evaluate general trends relative to performance and include flexibility, recognizing the inherent variability of this species. Under average conditions, populations should increase to carrying capacity over time; however, in any given year, southern tarplant may emerge in very low numbers if conditions are not appropriate. Therefore, if during any of the five-year period, the standard set forth for flowering individuals for year five is achieved, the program will be considered as having achieved the five-year performance standard. The performance standards set forth below are based on expected average conditions; however, there is a high likelihood that numbers will vary substantially from year to year.

First-Year Monitoring

Southern tarplant typically flowers as early June and sometimes into October and with peak flowering varying according to seasonal rainfall patterns. Monitoring of translocated populations will begin in on or about July 1, and will be conducted every two weeks until peak flowering occurs. When peak flowering occurs, as determined by the Restoration Specialist/Plant Ecologist, quantitative measurements (i.e. counts of flowering individuals) will be obtained.

Success Standard: translocated populations combined to achieve 30 percent of number of individuals impacted using the population data based on pre-impact surveys.

Second-Year Monitoring

Success Standard: translocated populations combined to achieve 45 percent of number of individuals impacted using the population data based on pre-impact surveys.

Third-Year Monitoring

Success Standard: translocated populations combined to achieve 60 percent of number of individuals impacted using the population data based on pre-impact surveys.

Fourth-Year Monitoring

Success Standard: translocated populations combined to achieve 75 percent of number of individuals impacted using the population data based on pre-impact surveys.

Fifth-Year Monitoring

Success Standard: translocated populations combined to achieve 90 percent of number of individuals impacted using the population based on pre-impact surveys.

The Adaptive Management Program provides for ongoing long-term monitoring and management of the Planning and Identified Species within the RMV Open Space. Replacement of the 90 percent of impacted southern tarplant individuals by the end of the five- year monitoring and maintenance program, in the context of the long-term management goals, ensures that no functional loss for southern tarplant occurs within the RMV Open Space.

VI. COULTER'S SALTBUSH

A. Background

Coulter's saltbush (*Atriplex coulteri*) is designated by CNPS as a List 1B species. This species occurs on coastal bluffs and on alkaline and saline flats. The leaves are subsessile, elliptic to lanceolate, somewhat greenish, sparsely fine scaly and dentate. The plants are monoecious (male and female flowers on the same plant) with the inconspicuous female flowers subtended by bracts and the male flowers in panicles. The seeds are found within a fruiting bract, which is sharply dentate, 2-3 mm long, and with small tubercles (sometimes smooth) covering the surface of the bract.

B. Restoration Program

The proposed restoration program for Coulter's saltbush within the RMV Open Space would consist of the following key components:

- Seed collection
- Selection of receptor sites
- Greenhouse propagation
- Site preparation
- Translocation of natural populations
- Introduction of cultivated plants
- Direct seeding at translocation site
- Maintenance and Monitoring

Seed Collection

Biologists will collect seed from populations to be impacted, and the collected seed will be used in the direct seeding of introduction sites. Seed will be collected for as many seasons as possible prior to impacts to ensure that an adequate amount of seed. Existing populations will be monitored to determine when collection should begin. Fruits will be removed from saltbush plants and placed in dry paper bags for storage. The bags of seed will be stored in a climate-controlled facility under appropriate storage conditions, with candidate institutions to include California State University, Fullerton (CSUF) or Rancho Santa Ana Botanic Garden.

Selection of Introduction Sites

Receptor sites for the translocation of Coulter's saltbush will generally be within areas used for southern tarplant (*Centromadia parryi* ssp. *australus*) as these species often co-occur and therefore exhibit similar habitat requirements. However, Coulter's saltbush typically occupies specific micro-sites, such as clay barrens or alkali flats with limited cover by species such a shining peppergrass (*Lepidium nitidum*), alkali peppergrass (*Lepidium latipes*), and alkali plantain (*Plantago elongata*). As such, translocation sites will consist of mesic alkaline barrens or clay barrens adjacent to existing alkali marsh, alkali meadow or riparian habitats within the Habitat Preserve, including riparian/wetland mitigation sites with suitable micro-sites.

Greenhouse Propagation

Priority will be given to cultivated seedlings grown under greenhouse conditions, with the direct seeding of translocation sites being a secondary use of seed collected from natural populations. Coulter's saltbush will be cultivated in a greenhouse setting for transplanting later to the receptor sites. The facility used for seed storage will also be used for greenhouse cultivation. Cultivation should begin at least two seasons prior to translocation of natural populations to ensure enough time for cultivated individuals to be large enough for transplanting. Individuals will be cultivated from seed collected from natural populations to be translocated.

Seed germination efforts will begin early in the growing season. Soil will be salvaged from the sites of natural populations to be translocated. The salvaged soil will be placed in standard greenhouse flats for use in cultivating seedlings. Saltbush individuals will be cultivated in the flats until they are ready for introduction at the translocation sites.

Site Preparation

Site preparation for the mitigation areas will consist of site grading to locate the reintroduction area closer to the groundwater table. Grading is expected to remove the "weedy" seed bank currently established on the reintroduction site.

Translocation of Natural Populations

Removal of Existing Individuals

Coulter's saltbush populations will be translocated in early to mid fall, prior to the first rainfall of the next growing season. Individuals will first be flagged at existing sites in order to identify plants for translocation. Once individuals are removed, they will be transported to the receptor sites on the same day for installation.

Biologists will remove soil sections containing saltbush individuals using hand tools, generally excavating areas around the small plants to a depth of about six to eight inches to ensure that the entire root system is collected with the individual plants. Each soil section will be placed onto two-foot by two-foot plywood boards and placed on a flatbed truck for transport to a receptor site. Since the goal is to install soil sections on the same day as they are removed, time allowed for removal and transport will be limited.

Installation of Saltbush Sections

Planting holes will be excavated at receptor sites by using a bobcat with rubber tires. Saltbush sections will be transferred by hand into the site and set into the planting holes. Loose soil will be poured in between and around the installed soil section. Pin-flags will be placed to mark the installed sections.

After all soil sections have been installed at a receptor site, a water truck will be used to provide deep watering to the installed saltbush individuals. After the deep watering, additional soil will be added to each section to replace the soil that is washed down into the space around the installed section. A second, lighter watering will be conducted to consolidate the added soil. Orange plastic fencing or stakes with flagging will be placed around each of the installed soil sections for future identification and monitoring purposes.

Introduction of Cultivated Plants

Cultivated plants will be translocated to receptor sites in mid fall, prior to the first rainfall of the new growing season. To remove the cultivated plants, soil blocks with plants will be sliced out of the flats. Immediately prior to planting a soil section, a hole slightly larger than the section of plants will be excavated. The section will then be placed into the hole and the gap between the section and hole edge will be filled with soil and lightly compacted. Each section will be placed into the hole, either flush with or slightly below the existing soil surface. If the sections are placed above the soil surface, the soil may eventually erode, which may causes the roots to become exposed above ground, which may eventually lead to plant death.

Direct Seeding at Translocation Site

Following the translocation of the natural saltbush individuals and planting of cultivated individuals, translocation sites will be seeded directly with seed previously collected from the natural populations. Seed will be hand dispersed within the translocation areas.

Long-Term Maintenance and Monitoring

Coulter's saltbush translocation sites will be monitored for a period of five years to determine the success of the translocation efforts. The five-years program will include active weeding of the sites to minimize the establishment of non-native invasives. Monitoring will be conducted for the entire five-year period by a qualified biologist.

Maintenance

Weed eradication will be conducted as necessary to minimize competition that could prevent the successful establishment of the translocated Coulter's saltbush. The crucial period for weed control is the first two years of project establishment. As weeds become evident, they should be immediately removed by hand. Weed control shall occur monthly following the first rainfall for the first growing season, and then as needed for the remainder of the maintenance period (quarterly qualitative monitoring visits are recommended to evaluate the success of the sites). All maintenance personnel will be trained to distinguish weedy species from native vegetation.

Monitoring

Translocated Coulter's saltbush sections will be monitored annually during the five-year monitoring period. Success will be based on 75 percent survivorship of translocated individuals. Where mortality occurs with translocated individuals, these individuals will be replaced by greenhouse-cultivated plants and/or germinated seed.

Population sizes of the Coulter's saltbush can vary significantly from year to year based primarily on rainfall. Because population sizes can vary from year to year, the relative sizes of translocated populations are expected to vary widely from year to year. Because of this, development of performance standards can be difficult and as such the performance standards are intended to provide general trends relative to performance and are not intended to be used a "hard and fast' standards. Rather, the overall trends should be increasing over time; however, in any given year, the plant may not even emerge if conditions are not appropriate. If during any of the five-year period, the standard set forth for year five is achieved, the program will be considered as having achieved the five-year performance standard.

First-Year Monitoring

Coulters saltbush typically re-emerges from underground rootstock as early as mid February, extending into May with peak flowering varying according to seasonal rainfall patterns; however, flowering is not necessary to conducted surveys for this species. Monitoring of translocated populations will begin on March 1 and will be conducted every two weeks until survey conditions are optimal. When survey conditions are optimal, as determined by the Restoration Specialist/Plant Ecologist, quantitative measurements will be obtained.

Success Standard: translocated populations combined to achieve 20 percent of number of individuals impacted using the population data based on pre-impact surveys.

Second-Year Monitoring

Success Standard: translocated populations combined to achieve 35 percent of number of individuals impacted using the population data based on pre-impact surveys.

Third-Year Monitoring

Success Standard: translocated populations combined to achieve 50 percent of number of individuals impacted using the population data based on pre-impact surveys.

Fourth-Year Monitoring

Success Standard: translocated populations combined to achieve 60 percent of number of individuals impacted using the population data based on pre-impact surveys.

Fifth-Year Monitoring

Success Standard: translocated populations combined to achieve 75 percent of number of individuals impacted using the population data based on pre-impact surveys.

The Adaptive Management Program provides for ongoing long-term monitoring and management of the Planning and Identified Species within the RMV Open Space. Replacement of the 75 percent of impacted Coulter's saltbush individuals by the end of the five- year monitoring and maintenance program, in the context of the long-term management goals, ensures that no functional loss for Coulter's occurs within the RMV Open Space.

VII. MUD NAMA

A. Background

Mud nama is an annual species designated by CNPS as a List 2 species (rare in California but more common elsewhere) that occurs in vernally wet areas including vernal pools, the drying margins of lakes and ponds, and other intermittently wet areas. This species occurs within muddy embankments of marshes and swamps, and within lake margins and riverbanks between 5 and 500 m (16-1,640 ft) (CNPS 2001; Rieser 1994). Mud nama is a prostrate to ascending annual with short soft silky hairs, short glandular hairs, and some stiff hairs that are swollen at the base. The leaves

vary from 5-30 mm and are typically oblanceolate or spoon shaped with wavy margins and rolled edges. The flowers are white to cream and the corolla is funnel shaped and 4-6 mm long. The annual/ perennial herb blooms from January to July (CNPS 2001).

B. Restoration Program

All occurrences of this species within the RMV lands are associated with the margins of seasonal ponds including one vernal pool, two stockponds, and one sediment basin. In all cases, the plants germinate following dry-down of the ponds following their filling during winter and spring rains. The annual habitat of this species along with its diminutive stature and adaptability make it an easy species to relocate. The methods employed will follow methods used for relocation of vernal pool species that exhibit similar characteristics and life history. The relocation program will consist of the elements listed below.

- Pre-Translocation Monitoring
- Collection of Inoculum (topsoil and dried plants to obtain seed)
- Selection of Receptor Sites
- Intoduction of Inoculum to Receptor Sites
- Maintenance and Monitoring

Pre-Translocation Monitoring

Pre-translocation monitoring will be conducted for two years prior to impacts at sites proposed for impacts. Because the species is an annual and will germinate in different locations every season, flagging of plants is not appropriate. Rather, the limits of occupied areas within ponds to be impacted will be marked by staking or other appropriate means as determined by the Restoration Specialist/Plant Ecologist.

Inoculum Collection

Two methods for inoculum collection will be employed, according to site-specific conditions at the time of collection (described below). Prior to collection, the collection sites must be monitored for flowing period and seed set which can vary widely based on rainfall patterns which dictate filling and drying of occupied ponds. Collections sites (i.e., seasonal ponds) will be monitored during the rainy season beginning in March, and every two weeks until the plants flower and set seed. Because some portions (e.g., margins) of ponds will dry-down in advance of other areas, the flowering and seed set may be somewhat staggered and may actually require two or three collection efforts timed according to the drying of the plants (the timing will be

determined by the Restoration Specialist/Plant Ecologist at the time of the collection based on site specific conditions as dictated by the particular rainy season).

Inoculum (Soil and Dried Plants) Collection

The most effective method to collect the dried plants, including their seed, and the soil seed bank is collect the upper one to two centimeters of topsoil, including the dried plant remains using square-end shovels. Areas supporting dried remains of the mud nama are carefully picked-up/scraped using square-end shovels so as to gather all of the above-ground plant material plus the top one or two centimeters of pond surface. The materials are placed directly into cardboard boxes for transport to receptor sites or for storage if collection occurs before inoculation of the receptor sites.

This method should only be employed where the percentage of non-native pond species is less than ten percent. Portions of the seasonal ponds in the RMV Open Space support substantial numbers (sometimes exhibiting 100 percent cover) of swamp timothy (*Crypsis vaginiflora*) and/or hyssop loosestrife (*Lythrum hyssopifolium*), both non-native invasive pond species. Where the swamp timothy or hyssop loosestrife occur, collection should be accomplished to as to transfer as little as possible of either species to receptor sites. Where swamp timothy and/or hyssop loosestrife occur in moderate or high density, then hand collection of the mud nama would be the preferred method.

Hand Collection

Where collection of mud nama using square-end shovels would result in collection of swamp timothy or hyssop loosestrife, hand collection will be employed. In some instances, portions of a pond may be subject to the square-end shovel method while other areas are subject to hand collection. Hand collection will be accomplished by carefully removing each plant by pulling it up from the base. In order to increase the effectiveness of this method collections should be performed just after the plant has dried out and before the capsules have broken apart, dispersing the seed. Plants should be place in paper sacks as they are collected for transport to receptor sites or for storage if collection occurs before inoculation of the receptor sites. All inoculum collected using either method will be stored in a climate-controlled facility under appropriate storage conditions, with candidate institutions to include California State University, Fullerton (CSUF) or Rancho Santa Ana Botanic Garden.

Selection of Introduction Sites

A number of suitable receptor sites occur within the RMV Open Space, including the vernal pools on Chiquita Ridge (one of which has a small population of mud nama that could be substantially expanded), the vernal pools in the vicinity of Radio Tower Road (none of which support mud nama), and/or the three Tijeras Creek vernal pools (none of which support mud nama).

Intoduction of Inoculum to Receptor Sites

Inoculum will be introduced to the receptor sites by hand. Boxes containing inoculum (i.e., salvaged soil dried plants) will be carefully distributed around the outer one-third of the receptor pools (which corresponds to its typical distribution). Once distributed, the inoculum should be carefully raked (using the flat side of the rake rather than the toothed side) to ensure a depth of no more than one centimeter at any location in the receptor site.

For pools that support listed fairy shrimp, salvaged soil will not be placed in the pond as this could potentially bury or damage cysts. Pools occupied by listed fairy shrimp will receive the hand-collected inoculum that will be evenly spread around the outer one-third of each receptor pond.

Maintenance and Monitoring

Maintenance

Maintenance is not proposed for the vernal pool receptor sites for a number of reasons. First, many of the potential receptor pools support federally listed fairy shrimp, including the San Diego fairy shrimp and/or the Riverside fairy shrimp. Maintenance would require regular access of the pools, causing trampling and potential damage to cysts. Furthermore, the action of weeding could require soil disturbance, which also could damage cysts and is therefore not recommended. All of the seasonal ponds within the RMV Open Space that support mud nama also support high densities of swamp timothy and/or hyssop loosestrife and appears to persist in the presence of these invasives.

Monitoring

A qualified biologist will monitor mud nama introduction sites for a period of five years to determine the success of the introduction efforts. As with most annuals, the number of

germinating individuals can vary significantly from year to year based on rainfall for this species, as well as with ponding depth and duration. Because population sizes can vary from year to year, development of performance standards can be difficult. As such, the performance standards are intended to evaluate general trends relative to performance and include flexibility, recognizing the inherent variability of this species. Under average conditions, populations should increase to carrying capacity over time; however, in any given year, mud nama may not emerge or may only emerge in very low numbers if conditions are not appropriate. Therefore, if during any of the five-year period, the standard set forth for flowering individuals for year five is achieved, the program will be considered as having achieved the five-year performance standard. The performance standards set forth below are based on expected average conditions; however, there is a high likelihood that numbers will vary substantially from year to year.

First-Year Monitoring

Mud nama typically flowers as early April and sometimes into July and with peak flowering varying according to seasonal rainfall patterns. Monitoring of translocated populations will begin in on or about April 1, and will be conducted every two weeks until peak flowering occurs. When peak flowering occurs, as determined by the Restoration Specialist/Plant Ecologist, quantitative measurements (i.e. counts of flowering individuals) will be obtained.

Success Standard: translocated populations combined to achieve 30 percent of number of individuals impacted using the population data based on pre-impact surveys.

Second-Year Monitoring

Success Standard: translocated populations combined to achieve 45 percent of number of individuals impacted using the population data based on pre-impact surveys.

Third-Year Monitoring

Success Standard: translocated populations combined to achieve 60 percent of number of individuals impacted using the population data based on pre-impact surveys.

Fourth-Year Monitoring

Success Standard: translocated populations combined to achieve 75 percent of number of individuals impacted using the population data based on pre-impact surveys.

Fifth-Year Monitoring

Success Standard: translocated populations combined to achieve 90 percent of number of individuals impacted using the population data based on pre-impact surveys.

The Adaptive Management Program provides for ongoing long-term monitoring and management of the Planning and Identified Species within the RMV Open Space. Replacement of the 90 percent of impacted mud nama individuals by the end of the five- year monitoring and maintenance program, in the context of the long-term management goals, ensures that no functional loss for mud nama occurs within the RMV Open Space.

VIII. MARIPOSA LILY

A. Background

As noted in the Introduction to this section, one additional plant addressed in this program consists of an intergrade between the common Weed's mariposa lily (*Calochortus weedii* var. *weedii*) and the intermediate mariposa lily (*Calochortus weedii* var. *intermedius*), which is a CNPS List 1B taxon. Both mariposa lily varieties are perennial geophytes in the lily family (Liliaceae) that occur in coastal sage scrub, chaparral, and grassland/scrub ecotones. Both varieties typically produce from three to four campanulate flowers. The petals of Weed's mariposa lily are typically bright yellow and the petals or the intermediate mariposa lily are broadly cuneate-obovate and light yellow, tinged with purple and usually fringed with yellow hairs.

It is difficult to determine the number of individuals of the intermediate mariposa lily occurring on RMV lands because of the questionable taxonomic status of the individuals documented on RMV. During surveys conducted over the last eight years many of the individuals identified consist of the intergrade noted above and more fully described below.

The more common *C .w. weedii* occurs on Camp Pendleton and in the Cleveland National Forest to the south and east of RMV while *C .w. intermedius* occurs, as noted above, in the foothill and coastal areas associated with the Central and Coastal NCCP/HCP subregions to the north and west of RMV, as well as in the Foothill-Trabuco which is north of RMV. Populations of *C. weedii* on RMV lands exhibit characteristics of both *C .w. weedii* and *C .w. intermedius*, with a discernible south-to-north gradient, based on field observations and directed field sampling in 2003. *C. weedii* populations associated with the southeast portion of RMV (e.g., Gabino

Canyon) exhibit a strong *C. w.weedii* influence, with more than 50 percent of the individuals exhibiting characteristics consistent with *C. w. weedii* and another 42 percent that are intergrades between *C. w. weedii* and *C .w. intermedius.* Only about 7 percent of the individuals evaluated in this portion of the subregion exhibited characteristics consistent with *C .w. intermedius.*

Individuals exhibiting characteristics consistent with *C .w. intermedius* become more common along the gradient from south-to-north. For example in the Trampas Canyon area, plants with characteristics consistent with *C .w. intermedius* account for approximately 30 percent of the individuals, with intergrades comprising another 50 percent and plants consistent with *C. w. weedii* accounting for about 20 percent. Further north, in upper Gobernadora, plants exhibiting characteristics of *C. w. weedii* account for only 2 percent of the population, with intergrades comprising 75 percent and plants with a strong *C .w. intermedius* influence accounting for about 23 percent of the population. *Table 3* summarizes the results surveys conducted in 2003 to evaluate relative proportions of *C. w. intermedius, C. w. weedii,* and intergrades at ten locations along a generally south-to-north gradient on RMV.

Work by other botanists in the subregion support this characterization of *C. weedii* in the planning area. Qualitative observations by Mr. Fred Roberts and Mr. David Bramlet during surveys conducted in 2003 and in previous years support the conclusion the *C. w. weedii* exhibits an influence on RMV lands, with the influence strongest in the southeast portion (e.g., Gabino Canyon) (Roberts, pers. comm.. 2003). Freshly collected specimens from Gabino Canyon were evaluated by Mr. Steve Boyd at Rancho Santa Ana Botanical Gardens and were determined to be *C. w. weedii*, with other populations on RMV exhibiting intergrades between *C. w. weedii* and *C .w. intermedius* (Boyd, pers. comm.. 2003).

Given the unclear taxonomy of the *C. weedii* populations on RMV, it is not appropriate to consider the population on RMV as *C .w. intermedius.*

TABLE 3
GEOGRAPHIC DISTRIBUTION *CALOCHORTUS WEEDII* VARIETIES AND INTERGRADES ON RANCHO MISSION VIEJO

Population Location	Species in Percent (%)		
	C. w. weedii	Intergrade	*C. w. intermedius*
Gabino	51	42	7
Upper Gabino	40	51	9
Cristianitos (north of TRW)	30	45	25
Cristianitos Meadows	27	30	43
Trampas	20	50	30
Color Spot Nursery	6	84	10
Verdugo	4	71	25
Chiquadora Ridge	4	75	21
Upper Gobernadora	2	75	23
Tijeras	0	3	97

B. Provisional Restoration Program

Populations of the "clean" intermediate mariposa lily occur outside of RMV and would not be affected by proposed development. Impacts would occur only to the intergrade populations. Based upon further evaluation, it may be necessary to perform some level of mitigation pursuant to CEQA for the intergrade population(s). The provisional program is set forth below.

The proposed restoration program for the *C .w. weedii* x *C .w. intermedius* intergrade, to the extent that mitigation is required under CEQA would consist of the following key components:

- Pre-translocation monitoring
- Seed collection
- Selection of receptor sites
- Greenhouse propagation

- Site preparation
- Salvage and introduction of bulbs
- Direct seeding at translocation site
- Long-term maintenance and monitoring

Pre-Translocation Monitoring

Once it has been determined which *C .w. weedii* x *C .w. intermedius* intergrade, populations will require translocation, each population will be monitored annually, for as many seasons as possible prior to development, to identify the maximum number of flowering individuals. This information will provide part of the baseline for establishing success criteria for the future monitoring of translocated populations.

For the first growing season of pre-translocation monitoring, biologists will re-survey the areas supporting the *C .w. weedii* x *C .w. intermedius* intergrade and will demarcate the areas with pin flags or stakes and flagging. In addition, each plant (or group of plants as determined appropriate by the biologist) will be marked with pin flags to optimize future salvage. For two growing seasons leading up to translocation, biologists will repeat surveys of the known populations and will use pin flags to mark all flowering individuals not marked during previous pre-translocation surveys. A different color pin flag will be used for each season that surveys are conducted in order to easily identify in the field individuals that flowered in the most recent growing season versus those that flowered in previous season.

Seed Collection

Biologists will collect seed from populations to be translocated, to be used in the cultivation of seedlings under greenhouse conditions, and to a much lesser extent, for direct seeding of translocation sites. The highest priority will be given to cultivated seedlings grown under greenhouse conditions. Geurrant (1996) showed that cultivated plants, when grown to even slightly larger than seedling size, have a greater survivorship than field-germinated seeds, and are much more likely to create a larger final population size.

Seed will be collected in mid to late summer (July or August) once the capsules have begun to open, and as determined by a qualified biologist. To ensure that an adequate amount of seed is collected for direct seeding of receptor sites, seed will be collected for as many seasons as determined appropriate by the Restoration Specialist/Plant Ecologist prior to translocating the natural populations. Seed will be stored in a climate-controlled facility under appropriate storage

conditions, with candidate institutions to include California State University, Fullerton (CSUF) or Rancho Santa Ana Botanic Garden.

Selection of Receptor Sites

Receptor sites for the translocation of intermediate mariposa lily may include existing populations to be enhanced, but may also include sites that do not currently support the species if enhancement opportunities are limited. Areas that support non-intergraded populations (i.e., "clean" populations) of the intermediate mariposa lily will not be used to ensure the range of intergrade populations is not artificially expanded as a result of the translocation program. Since the habitat requirements of the *C .w. weedii* x *C .w. intermedius* intergrade, and many-stemmed dudleya (*Dudleya multicaulis*) are very similar, and the two species are known to co-exist, receptor sites may be used for the translocation of both the intergrade mariposa lily and many-stemmed dudleya. Therefore, existing habitats of CSS/VGL supporting one species, but not the other, may be suitable for translocation of the species that does not currently exist.

Physical and biological criteria will be used in evaluating suitability, and ultimately in the selection of receptor sites to be used for new introductions of the *C .w. weedii* x *C .w. intermedius* intergrade. Physical criteria will largely be based on the presence of suitable soils. Receptor sites will have rocky clay or cobbly loam soils on slopes and ridgelines. Other physical characteristics of the site may include slope angle and position, and slope aspect.

Biological selection criteria will mainly include the vegetation community, targeting open areas of CSS/VGL. Preferably, receptor sites will support an ecotonal habitat of CSS/VGL, with a maximum shrub cover of 15 to 35 percent. If there is a lack of available native habitats for translocation, areas supporting non-native invasives may be used for habitat creation if the soils are suitable to support the *C .w. weedii* x *C .w. intermedius* intergrade.

Greenhouse Propagation

As stated above, priority will be given to cultivated seedlings grown under greenhouse conditions, with the direct seeding of translocation sites being a secondary use of seed collected from natural populations. *C .w. weedii* x *C .w. intermedius* intergrade, will be cultivated in a greenhouse setting for transplanting later to the receptor sites. Plants will be germinated and raised to a sufficient size necessary for transfer of the bulbs to the restoration site. The facility used for seed storage will also be used for greenhouse cultivation. Cultivation should begin at least two seasons prior to translocation of natural populations to ensure enough time for

cultivated individuals to be large enough for transplanting. Individuals will be cultivated from seed collected from natural populations to be translocated.

Seed germination efforts will begin early in the growing season. Soil will be salvaged from the sites of natural populations to be translocated. The salvaged soil will be placed in standard greenhouse flats and mixed with washed builder's sand in an approximate ratio of three parts soil to one part sand. The sand will be used to loosen the soil and prevent from becoming too hard upon moistening, due to the high clay content.

Seed will be sprinkled on a moist soil surface, but the seeds will not be covered by the soil. The seeds will be watered immediately with a fine mist and this procedure will be repeated three times daily to keep them continuously moist. The greenhouse flats will be covered with shade cloth to reduce evaporative water loss from the soil and to minimize mechanical disturbance from watering.

Each flat will be weeded throughout the growing season. Supplemental water will be given as needed during the dry periods. Supplemental watering will be discontinued by late spring/early summer to allow the cultivated plants to enter the natural dormancy cycle for the species, which begins at the onset of summer drought.

Site Preparation

Exotic Control

Once selected, all receptor sites will be prepared by eradication of non-native, invasive vegetation. Non-native species targeted for removal and control will include artichoke thistle, mustard, non-native grasses such as ryegrass, bromes, and wild oats. For areas of existing native coastal sage scrub/grassland ecotone that contain a minor component of non-native invasives, the sites will be weeded to remove the non-natives prior to translocation of the lily. Receptor sites will be weeded early in the growing season, to remove plants after they have germinated and established, but before they flower and set seed. For non-native vegetation occurring around established native shrubs and bunchgrasses, the invasives will be removed by hand. Herbicides may be used for spraying larger areas of non-native grasses and herbs.

Creation of Native Habitats

For candidate VGL and/or CSS creation/restoration sites that are dominated by non-native grasses and forbs, the existing vegetation will be removed completely, and a habitat of native

vegetation will be created in its place. Created habitats will consist of VGL, CSS, or VGL/CSS ecotone, with the goal of attaining a 15 to 35 percent cover of shrub species. Table 4 provides a site-specific conceptual plant palette for creation of the intergrade mariposa lily relocation sites where the sites are to be located in VGL or CSS creation areas.

TABLE 4
PLANT PALETTE FOR HABITAT CREATION AT MARIPOSA LILY RECEPTOR SITES

Species	Common Name	Type
Salvia apiana	white sage	container stock
Galium angustifolium	narrow-leaved bedstraw	container stock
Bothriochloa barbinodis	silver beardgrass	container stock & seed
Nasella pulchra	purple needlegrass	container stock & seed
Agrostis exarata	spike redtop	seed
Harpagonella palmeri	Palmer's grappling-hook	seed
Osmadenia tenella	southern rosinweed	seed
Dudleya edulis	ladies'-fingers	seed
Chorizanthe staticoides	Turkish rugging	seed

Habitat creation will occur at least one full growing season prior to the introduction of salvaged/cultivated bulbs to allow for establishment of the planted natives and maintenance of non-native invasive plants. The first step in the creation of native habitat will be to remove the existing non-native vegetation and as much of the soil seed bank as possible. A bulldozer will be used to scrape the topsoil and remove the existing vegetation where determined appropriate by the Restoration Specialist/Plant Ecologist. Hand broadcast seed will be used to distribute the native seed mix, followed by the planting of container stock.

Since it will be important to maintain a sage scrub/grassland ecotone with adequate open areas between shrubs, the establishment of shrubs will be limited to container stock since shrub species in the seed mix would encourage a broad distribution of shrub species. Container stock of shrubs will be placed in the more-fertile areas of sites, leaving the rocky, less fertile areas for the translocation of *C .w. weedii* x *C .w. intermedius* intergrade, since it is in these areas that the mariposa lily will be most successful.

Since the non-native seed bank may continue to persist at reduce levels and may still pose a problem at some receptor sites, a five-year maintenance program will be implemented following mariposa lily translocation to provide appropriate control of non-natives within the translocation site, necessary to achieve performance standards.

Salvage of *C .w. weedii* x *C .w. intermedius* Intergrade Bulbs

Translocation of the *C .w. weedii* x *C .w. intermedius* intergrade populations will occur upon determination that individuals have become dormant. It is expected that salvage will occur in late summer/early fall.

All flowering individuals identified in the growing season immediately prior to translocation will be salvaged by hand (using only hand tools). Once all visible plants have been removed by hand, marked plants that flowered during previous growing seasons will be salvaged. A front-end loader with a closed bucket will be used to excavate a small section of soil at each location of pin flags.

As the loader removes soil sections, each section will be placed onto two-foot by two-foot plywood boards and hand carried to a staging area. Using hand tools, biologists will carefully break apart the soil sections to salvage additional bulbs. All salvaged bulbs will be placed in paper sacks and stored within a cool dry place until time for relocation to the receptor sites.

Introduction of Salvaged/Cultivated Bulbs to Receptor Sites

In late fall, prior to first rainfall of the new growing season, salvaged/cultivated bulbs will be planted at the receptor sites. Dense populations of the mariposa lily typically exhibit densities of one to five plant per square meter; however, lower densities of 1 to 2 plants per 10 sq m is also common in high quality habitat. Planting of the bulbs should generally average two individuals per square meter; however, in areas where the substrate appears particularly good (few or no non-natives and the presence of associate species), densities can be increased to three per square meter.

For planting bulbs, a hole slightly larger than the bulb itself will be excavated. The bulb will then be placed into the hole and the gap between the section and hole edge will be filled with soil and lightly compacted. Each bulb will be planted either flush with or slightly below the existing soil surface. If the bulbs are placed above the soil surface, the soil may eventually erode, which causes the roots and caudex to become exposed above ground, which may eventually lead to plant death.

Direct Seeding at Translocation Site

Following introduction of the salvaged/cultivated bulbs, translocation sites will be seeded directly with seed previously collected from the natural populations. Seed will be hand dispersed within translocation areas.

Long-Term Maintenance and Monitoring

The *C .w. weedii* x *C .w. intermedius* intergrade introduction sites will be monitored for a period of five years to determine the success of the introduction efforts. The five-year program will include active weeding of the sites to minimize the establishment of non-native invasives. Monitoring will be conducted for the five-year period by a qualified Restoration Specialist/Plant Ecologist.

Maintenance

Weed eradication will be conducted as necessary to minimize competition that could prevent the successful establishment of the translocated intergrade mariposa lily. The crucial period for weed control is the first two years of project establishment. As weeds become evident, they should be immediately removed by hand or controlled with an appropriate herbicide as determined by a licensed Pest Control Advisor (PCA). Weed control shall occur monthly following the first rainfall for the first growing season, and not less than quarterly for the remainder of the maintenance period. All maintenance personnel will be trained to distinguish weedy species from native vegetation.

Monitoring

Intermediate mariposa lily translocation sites will be monitored annually for the five-year monitoring period. During the pre-translocation monitoring period, flowering individuals will be flagged during each growing season.

For each flowering period (for five years) following the introduction of salvaged/cultivated bulbs, flowering individuals will be counted within the limits of the translocation site. Population sizes of mariposa lily vary significantly from year to year based primarily on rainfall. Because of this, development of performance standards can be difficult. As such, the performance standards are intended to evaluate general trends relative to performance and include flexibility, recognizing the inherent variability of this species. Under average conditions, populations should increase to

carrying capacity over time; however, in any given year, *C .w. weedii* x *C .w. intermedius* intergrade may not even emerge or may emerge in very low numbers if conditions are not appropriate. Therefore, if during any of the five-year period, the standard set forth for flowering individuals for year five is achieved, the program will be considered as having achieved the five-year performance standard. The performance standards set forth below are based on expected average conditions; however, there is a high likelihood that numbers will vary substantially from year to year.

First-Year Monitoring

The *C .w. weedii* x *C .w. intermedius* intergrade typically flowers between late May and July and with peak flowering varying according to seasonal rainfall patterns. Monitoring of translocated populations will begin in May and will be conducted every two weeks until peak flowering occurs. When peak flowering occurs, as determined by the Restoration Specialist/Plant Ecologist, quantitative measurements will be obtained.

Success Standard: translocated populations combined to achieve 20 percent of number of individuals impacted using the data collected during pre-impact surveys.

Second-Year Monitoring

Success Standard: translocated populations combined to achieve 35 percent of number of individuals impacted using the data collected during pre-impact surveys.

Third-Year Monitoring

Success Standard: translocated populations combined to achieve 50 percent of number of individuals impacted using the data collected during pre-impact surveys.

Fourth -Year Monitoring
Success Standard: translocated populations combined to achieve 60 percent of number of individuals impacted using the data collected during pre-impact surveys.

Fifth-Year Monitoring

Success Standard: translocated populations combined to achieve 75 percent of number of individuals impacted using the data collected during pre-impact surveys.

Replacement of the 75 percent of impacted *C.w. weedii* x *C.w. intermedius* intergrade individuals by the end of the five- year monitoring and maintenance program, ensures that no functional loss for *C.w. weedii* x *C.w. intermedius* intergrade occurs within the RMV Open Space.