

Appendix E: Plant Species Present at Cabeza Prieta National Wildlife Refuge

The following list includes 391 species verified to occur on the refuge. The plants are listed alphabetically by family, genus, species, subspecies or variety. Common names appear first. Non-native plants are indicated with an asterisk [*]. This information was compiled by Richard Felger¹.

FERNS AND FERN ALLIES

MARSILEACEAE -- Pepperwort family

Hairy water-clover *Marsilea vestita*

PTERIDACEAE -- Brake Family

Scaly star fern *Astroblepis cochisensis cochisensis*

Parry's lip fern *Cheilanthes parryi*

Indian fern or California cloak fern *Notholaena Californica californica*

Star cloak fern *Notholaena standelyi*

SELAGINELLACEAE -- Spikemoss family

Arizona spike-moss *Selaginella arizonica*

Desert spike-moss *Selaginella eremophila*

SEED PLANTS

ACANTHACEAE -- Acanthus Family

Lemilla *Carlowrightia arizonica*

Desert hummingbird-bush *Justicia californica*

AGAVACEAE -- Century Plant Family

Desert agave *Agave deserti simplex*

AIZOACEAE -- Aizoon Family

Slender-leaf iceplant *Mesembryanthemum fimbriatus*

AMARANTHACEAE -- Amaranth Family

Fringed pigweed *Amaranthus fimbriatus*

Careless weed, or pigweed, *Amaranthus palmeri*

Honeysweet *Tidestromia lanuginosa*

ANACARDIACEAE -- Sumac Family

Desert sumac *Rhus kearneyi kearneyi*

APIACEAE (UMBELLIFEREAE) -- Carrot Family

Hairy bowlesia *Bowlesia incana*

Wild carrot *Daucus pusillus*

Eryngium nasturtiiifolium

Scale seed *Spermolepis echinata*

ARISTOLOCHIACEAE -- Birthwort Family

Indian-Root *Aristolochia watsonii*

ASCLEPIADACEAE -- Milkweed Family

White-stem milkweed *Asclepias albicans*

Giant sand-milkweed *Asclepias erosa*

Angle pod *Matelea parvifolia*

Climbing milkweed *Sarcostemma cynanchoides hartwegii*

ASTERACEAE (COMPOSITAE) -- Daisy Family

Brownfoot *Acourtia wrightii*

¹ Felger, Richard S. 1998, *Checklist of the Plants of Cabeza Prieta National Wildlife Refuge, Arizona*. Drylands Institute: Tucson.

Adenophyllum porophylloides
Canyon ragweed *Ambrosia ambrosioides*
Slim-leaf ragweed *Ambrosia confertiflora*
Triangle-leaf bursage *Ambrosia delotidea*
White bursage *Ambrosia dumosa*
Holly-leaved burshage *Ambrosia ilicifolia*
Baccharis brachyphylla
Seep willow *Baccharis salicifolia*
Desert broom *Baccharis sarothroides*
Many-flowered desert-marigold *Baileya multiradiata*
Woolly desert-marigold *Baileya pleniradiata*
Sweet-bush *Bebbia juncea* var. *aspera*
Brickellia atractyloides var. *atractyloides*
Brickell-bush *Brickellia coulterii* var. *coulterii*
White tackstem *Calycoseris wrightii*
*** Yellow star-thistle** *Centaurea melitensis*
Pebble pincushion *Chaenactis carphoclinia*
Desert pincushion *Chaenactis stevioides* var. *steviioides*
***Horseweed** *Conyza canadensis* var. *glabrata*
**Conyza coulteri*
Brittlebush *Encelia farinosa* var. *farinosa*
Brown-center brittlebush *Encelia Farinosa* var. *phenicodonta*
Rayless encelia *Encelia frutescens* var. *frutescens*
Desert fleabane *Erigeron lobatus*
Woolly daisy *Eriophyllum lanosum*
Arizona fluffweed *Filago arizonica*
California fluffweed *Filago californica*
Arizona blanket-flower *Gaillardia arizonica*
Desert sunflower *Geraea canescens*
Gutierrezia arizonica, Xanthocephalum arizonicum
Broom snakeweed *Gutierrezia sarothrae*
Gumhead *Gymnosperma glutinosum*
Dune sunflower *Helianthus niveus*
Slender burro-bush *Hymenoclea monogyra*
White burro-bush *Hymenoclea salsola* var. *pentalepis*
Hymenothrix wislizenii
Bitterweed *Hymenoxys odorata*
Alkali goldenbush *Isocoma acradenia* var. *acradenia*
***Prickly lettuce, or compass plant,** *Lactuca seriola*
Goldenweed *Machaeranthera coulteri* var. *arida*
Spiny goldenweed *Machaeranthera pinnatifida* var. *gooddingii*
Desert dandelion *Malacothrix fendleri*
Smooth desert dandelion *Malacothrix glabrata*
***Pineapple weed, or false chamomile,** *Matricaria matricarioides*
Mojave Desert star *Monoptilon bellioides*
Spanish needles *Palafoxia arida* var. *arida*
Desert chinchweed *Pectis papposa* var. *papposa*
Desert rock daisy *Perityle emoryi*
Desert fir, or pygmy cedar *Peucephyllum schottii*
Arrow-leaf *Pleuocoronis pluriseta*
Odora *Porophyllum gracile*
Prenanthesella exigua
Desert velvet *Psathyrotes ramosissima*

- Paper daisy *Psilostroche cooperi*
 California chicory *Rafinesquia californica*
 Desert chicory *Rafinesquia neomexicana*
 Lemmon groundsel *Senecio lemmonii*
 Mojave groundsel *Senecio mohavensis*
 *Spiny sow-thistle *Sonchus asper asper*
 Desert straw *Stephanomeria pauchiflora* var. *pauchiflora*
 Schott's wire-lettuce *Stephanomeria schottii*
 Desert nest-straw *Stylocline micropoides*
 Coyote manzanilla *Thymophylla concinna*
Thymophylla pentachaeta
 Yellow head *Trichoptilium incisum*
Trixis californica var. *californica*
 Silver puffs *Uropappus lindleyi*
 Parish goldeneye *Viguiera parishii*
- BIGNONIACEAE -- Bigonia Family**
 Desert willow *Chilopsis linearis arcuata*
- BORAGINACEAE -- Borage Family**
 Devil's lettuce, or fiddleneck, *Amsinckia intermedia* var. *echinata*
 Checker fiddleneck *Amsinckia tessellata*
 Desert cryptantha *Cryptantha angustifolia*
 Bearded cryptantha *Cryptantha barbiger*
 Dune cryptantha *Cryptantha ganderi*
 Winged cryptantha *Cryptantha holoptera*
 White-haired cryptantha *Cryptantha maritima* var. *maritima*
 White-haired cryptantha *Cryptantha maritima* var. *pilosa*
 Dwarf cryptantha *Cryptantha micrantha micrantha*
 Wing-nut *Cryptantha pterocarya* var. *cycloptera*
 Alkali heliotrope *Heliotropium curassavicum*
 Stickseed *Lappula redowskii*
 Mixed-nut comb-bur *Pectocarya heterocarpa*
 Broad-wing comb-bur *Pectocarya platycarpa*
Tiquilia canescens
 Palmer crinklemat *Tiquilia palmeri*
- BRASSICACEAE (CRUCIFERAE) -- Mustard Family**
 *Sahara mustard *Brassica tournefortii*
Caulanthus lasiophyllus var. *lasiophyllus*
 Tansy mustard *Descurainia pinnata*
 Dune spectacle-pod *Dimorphocarpa pinnatifida*
 Spectacle-pod *Dithyrea californica*
 Wedge-leaf draba *Draba cuneifolia* var. *integrifolia*
 Sand peppergrass *Lepidium lasiocarpum*
 Delicate bladderpod *Lesquerella tenella*
Lyrocarpa coulteri var. *coulteri*
 London rocket *Sisymbrium irio*
 Long-beaked twist-flower *Streptanthella longirostris*
 Lacepod *Thysanocarpus curvipes*
- FURSERACEAE -- Frankincense Family**
 Elephant tree *Bursera microphylla*
- CACTACEAE -- Cactus Family**
 Saguaro *Carnegiea gigantea*
 Many-headed barrel cactus *Echinocactus polycephalus* var. *polycephalus*
 Hedgehog cactus *Echiocereus engelmannii* var. *chrysocentrus*

- Golden hedgehog cactus *Echinocereus nicholii*
 Mountain barrel cactus *Ferocactus cylindraceus*
 Barrel cactus *Ferocactus emoryi*
 Barrel cactus *Ferocactus wislizeni*
 Senita *Lophocereus schottii* var. *schottii*
 Fishhook cactus *Mammillaria grahamii*
 Corkseed fishhook cactus *Mammillaria tetrancistra*
 Buckhorn cholla *Opuntia acanthocarpa*
 Beavertail cactus *Opuntia basilaris* var. *basilaris*
 Teddybear cholla *Opuntia bigelovii*
 Pancake prickly-pear *Opuntia cholorotica*
 Silver cholla *Opuntia echinocarpa*
 Desert prickly-pear *Opuntia engelmannii* var. *engelmannii*
 Yellow-spine desert prickly-pear *Opuntia engelmannii* var. *engelmannii*
 Jumping cholla *Opuntia fulgida* var. *fulgida*
 Desert club cholla *Opuntia kunzei*
 Desert Christmas-cholla *Opuntia leptocaulis*
 Diamond cholla *Opuntia ramosissima*
 Cane cholla *Opuntia spinosior*
 Desert night-blooming cereus *Peniocereus greggii* var. *transmountanis*
 Organpipe *Stenocereus thurberi*
- CAMPANULACEAE -- Bellflower Family**
 Threadstem *Nemacladus glanduliferus* var. *orientalis*
- CAPPARACEAE -- Caper Family**
 Jackass clover *Wislizenia refracta refracta*
- CARYOPHYLLACEAE --- Pink Family**
 Sand mat, or frost mat *Achyronychia cooperi*
Drymaria viscosa
 Sleepy catchfly *Silene antirrhina*
- CHENOPODIACEAE -- Goosefoot Family**
 Four-wing saltbush *Atriplex canescens*
 Wheel-scale orach *Atriplex elegans elegans*
 Wheel-scale orach *Atriplex elegans fasciculata*
 Narrow-leaf saltbush *Atriplex linearis*
 Pacific orach *Atriplex pacifica*
 Desert saltbush *Atriplex polycarpa*
 *Net-leaf goosefoot *Chenopodium murale*
 Poverty weed *Momolepis nuttalliana*
 *Russian thistle, or tumbleweed, *Salsola tragus*
 Desert seepweed *Suaeda moquinii*
- CONVOLVULACEAE -- Morning Glory Family**
 Morning glory *Ipomoea hederacea*
- CRASSULACEAE -- Stonecrop Family**
Crassula connata
 Arizona liveforever *Dudleya arizonica*
- CROSSOSOMATACEAE -- Crossosoma Family**
 Ragged rock-flower *Crossosoma bigelovii*
- CUCURBITACEAE -- Gourd Family**
 Desert starvine *Brandegea bigelovii*
 Coyote gourd *Cucurbita digitata*
- CUSCUTACEAE -- Dodder Family**
 Dodder *Cuscuta umbellata*
- CYPERACEAE -- Sedge Family**

Yellow nutgrass *Cyperus esculentus* var. *esculentus*
 Dwarf sedge *Cyperus squarrosus*
EPHEDRACEAE -- Ephedra Family
 Mormon tea *Ephedra aspera*
EUPHORBIACEAE -- Spurge Family
 Copperleaf *Acalypha californica*
 Sonora croton *Croton sonorae*
 Dune croton *Croton wigginsii*
 Sonoran silverbush *Ditaxis brandegeei* var. *intonsa*
 Narrowleaf silverbush *Ditaxis lanecolata*
Ditaxis serrata var. *serrata*
 Golondrina *Euphorbia abramsiana*
 Rattlesnake weed *Euphorbia albomarginata*
Euphorbia florida
Euphorbia eriantha
 Hyssop spurge *Euphorbia hyssopifolia*
 Golondrina *Euphorbia micromera*
 Louse spurge *Euphorbia pediculifera* var. *pediculifera*
 Golondrina *Euphorbia petrina*
 Desert spurge *Euphorbia polycarpa*
 Fringed spurge *Euphorbia setiloba*
Euphorbia spathulata
Euphorbia trachysperma
 Limberbush *Jatropha cuneata*
 Arizona jumping bean *Sebastiania bilocularis*
Stillingia linearifolia
FABACEAE (LEGUMINOSAE) -- Legume Family
 White-thorn *Acacia constricta*
 Catclaw *Acacia greggii*
 Sand locoweed *Astragalus insularis* var. *harwoodii*
 Small-flowered milk-vetch *Astragalus nuttallianus* var. *imperfectus*
 Hog potato *Caesalpinia glauca*
 Fairy duster *Calliandra eriophylla*
 Blue palo verde *Cercidium microphyllum*
 Silky Dalea *Dalea mollis*
 Desert rock-pea *Lotus rigidus*
Lotus Salsuginosus var. *brevivillus*
 Hairy lotus *Lotus strigosus*
 Arizona lupine *Lupinus arizonicus*
 Elegant lupine *Lupinus concinnus*
 Mohave lupine *Lupinus sparsiflorus*
Marina parryi
 Ironwood *Olneya tesota*
 Desert bean *Phaseolus filiformis*
 Western honey mesquite *Prosopis glandulosa* var. *torreyana*
 Velvet mesquite *Prosopis velutina*
 Emory indigo-bush *Psoralethamnus emoryi* var. *emoryi*
 Smoke tree *Psoralethamnus spinosus*
 Hojasen *Senna covesii*
FOUQUIERIACEAE -- Ocotillo Family
 Ocotillo *Fouquieria splendens splendens*

- GERANIACEAE -- Geranium Family
 *Filaree, or storksbill, *Erodium cicutarium*
 False filaree, or desert storksbill, *Erodium texanum*
- HYDROPHYLLACEAE -- Waterleaf Family
Eucrypta chrysanthemifolia var. *bipinnatifida*
 Peluda *Eucrypta micrantha*
 Purple matseed *Nama demissum*
 Bristly nama *Nama hispidum*
 Desert heliotrope *Phacelia ambigua*
 Fern-leaf phacelia *Phacelia distans*
Phacelia neglecta
Pholistoma auritum var. *arizonicum*
- KRAMERICACEAE -- Ratany Family
 Range ratany *Krameria erecta*
 White ratany *Krameria grayi*
- LAMIACEAE (LABIATAE) -- Mint Family
 False pennyroyal *Hedeoma nanum* var. *macrocalyx*
 Desert lavender *Hyptis emoryi*
 Bladder sage *Salazaria mexicana*
 Desert chia *Salvia columbariae*
Teucrium cubesne depressum
Teucrium glandulosum
- LILIACEAE -- Lily Family
 Wild onion *Allium macropetalum*
 Ajo-lily, or desert-lily, *Hesperocallis undulata*
 Blue sand-lily *Triteleopsis palmeri*
- LOASACEAE -- Stick-leaf Family
 Velcro plant *Eucnide rupestris*
 Triangle-seed blazing-star *Mentzelia affinis*
 White-stem blazing-star *Mentzelia involucrate* var. *megacantha*
 Blazing -star *Mentzelia multiflora*
Mentzelia oreophila
 Sandpaper plant *Petalonyx thurberi*
- MALPIGHIACEAE -- Malpighia Family
 Fermina *Janusia gracilis*
- MALVACEAE -- Mallow Family
Abutilon incanum
Abutilon malacum
Abutilon palmeri
Eremalche exilis
 Bladder mallow *Herissantia crispa*
 Desert rose-mallow *Hibiscus coulteri*
 Rock hibiscus *Hibiscus denudatus* var. *denudatus*
 Pink velvet-mallow *Horsfordia alata*
 Orange velvet-mallow *Horsfordia newberryi*
Malvella leprosa
Mavella sagittifolia
 Desert globe mallow *Sphaeralcea ambigua ambigua*
 Annual globe mallow *Sphaeralcea coulteri* var. *coulteri*
 Mal de ojo *Sphaeralcea emory*
 Orcutt globe mallow *Sphaeralcea orcuttii*
- MARTYNIACEAE -- Devil's Claw Family
 Devil's claw *Proboscidea altheaefolia*

MOLLUGINACEAE -- Carpetweed Family

* *Glinus lotoides*

NOLINACEAE -- Beargrass Family

Desert tree-beargrass *Nolina bigelovii*

NYCTAGINACEAE -- Four-O'clock Family

Sand verbena *Abronia villosa* var. *villosa*

Angel's trumpets *Acleisanthes longiflora*

Trailing windmills *Allionia incarnata*

*Scarlet spiderling *Boerhavia diffusa*

Spiderling *Boerhavia erecta* var. *erecta*

Spiderling *Boerhavia erecta* var. *intermedia*

Spiderling *Boerhavia spicata*

Spiderling *Boerhavia wrightii*

Desert four-o'clock *Mirabilis bigelovii* var. *bigelovii*

OLEACEAE -- Olive Family

Twinberry *Menodora scabra*

ONAGRACEAE -- Evening Primrose Family

Camissonia arenaria

Woody bottle-washer *Camissonia boothii condensata*

Camissonia californica

Willow-herb evening primrose *Camissonia chamaenerioides*

Camissonia claviformis peeblesii

Camissonia claviformis rebescens

Lizard-tail or velvet-leaf gaura *Gaura parviflora*

Oenothera deltoidea deltoidea

Dune primrose, or white desert primrose, *Oenothera deltoidea deltoidea*

Yellow desert primrose *Oenothera primiveris primiveris*

OROBANCHACEAE -- Broomrape Family

Desert broomrape *Orobanche cooperi*

PAPAVERACEAE -- Poppy Family

Prickly poppy *Argemone gracilentia*

Little gold poppy *Eschscholzia minutiflora*

PLANTAGINACEAE -- Plantain Family

Woolly plantain, or Indian wheat, *Plantago ovata*

Pastora *Plantago patagonica*

POACEAE (GRAMINEAE) -- Grass Family

Six-week three-awn *Aristida adscensionis*

California three-awn *Aristida californica* var. *californica*

Parish three-awn *Aristida parishii*

Purple three-awn *Aristida ternipes* var. *nealleyi*

Poverty three-awn *Aristida ternipes* var. *gentiles*

Spidergrass *Aristida ternipes* var. *ternipes*

Cane bluestem *Bothriochloa barbinodis*

Six-week needle grama *Bouteloua aristidoides*

Six-week grama *Bouteloua barbata*

Red grama *Bouteloua trifida*

Piojillo de Arizona *Brachiaria arizonica*

California brome *Bromus carinatus*

*Foxtail, or red brome, *Bromus rubens*

*Field sandbur *Cenchrus incertus*

*Feather fingergrass *Chloris virgata*

*Bermuda grass *Cynodon dactylon* var. *dactylon*

Cottontop *Digitaria californica*

- *Junglegrass, junglerice or leopard grass, *Echinochola colonum* var. *colonom*
- *Barnyard grass *Echinochloa crusgalli* var. *crusgalli*
- Spike pappusgrass *Enneapogon desvauxii*
- *Stinking lovegrass *Eragrostis cilianensis*
- *Lehmann lovegrass *Eragrostis lehmanniana*
- Bearded cupgrass *Eriochloa aristata* var. *aristata*
- Fluff-grass *Erioneuron pulchellum*
- Tanglehead *Heteropogon contortus*
- *Wild barley *Hordeum murinum glaucum*
- Rep sprangletop *Leptochloa mucronata*
- Sticky sprangletop *Leptochloa viscida*
- Littleseed muhly *Muhlenbergia microsperma*
- Bush muhly *Muhlenbergia porteri*
- Panicum alatum* var. *alatum*
- Mexican panicgrass *Panicum hirticaule* var. *hirticaule*
- *Buffelgrass *Pennisetum ciliare*
- *Fountain grass *Pennisetum setaceum*
- *Little-seed canary grass *Phalaris minor*
- Big galleta *Pleuraphis rigida*
- Bigelow bluegrass *Poa bigelovii*
- *Schismus arabicus
- *Mediterranean grass *Schismus barbatus*
- White-haired bristlegrass *Setaria leucopila*
- *Johnson grass *Sorghum halepense*
- Alkali sacaton *Sporobolus airoides*
- Sand dropseed *Sporobolus cryptandrus*
- Slim tridens *Triens muticus* var. *muticus*
- Sixweeks fescue, or eight-flowered fescue, *Vulpia octoflora*
- POLEMONIACEAE -- Phlox Family**
- Eriastrum diffusum*
- Broad-leaf gilia *Gilia latifolia*
- Star gilia *Gilia stellata*
- Langloisia setosissima setosissima*
- Linanthus bigelovii*
- POLYGONACEAE -- Buckwheat Family**
- Brittle spine flower, or short-horn spine-flower, *Chorizanthe brevicornu brevicornu*
- Wrinkled spine-flower *Chorizanthe corrugata*
- Rigid spine-flower *Chorizanthe rigida*
- Skeleton weed *Eriogonum deflexum*
- Flat-top buckwheat *Eriogonum faciculatum* var. *polifolium*
- Desert trumpet, or bladder stem, *Eriogonum inflatum*
- Eriogonum thomasii*
- Eriogonum thurberi*
- Little trumpet *Eriogonum trichopes* var. *trichopes*
- Eriogonum wrightii* var. *pringlei*
- Woolly heads *Nemacaulis denudata* var. *gracilis*
- *Silversheath *Polygonum argyocoleon*
- PORTULACACEAE -- Portulaca Family**
- Portulaca halimoides*
- RANUNCULACEAE -- Ranunculus Family**
- Texas virgin bower *Clematis drummondii*
- Barestem larkspur *Delphinium scaposum*

RESEDACEAE -- Mignonette Family
 Desert cambess *Oligomeris linifolia*

RHAMNACEAE -- Buckthorn Family
 Crucillo *Condalia globosa* var. *pubescens*
 Graythorn *Ziziphus obtusifolia* var. *canescens*

RUBIACEAE -- Madder Family
 Starry bedstraw *Galium stellatum* var. *eremicum*

RUTACEAE -- Rue of Citrus Family
 Turpentine broom *Thamnosma Montana*

SCROPHULARIACEAE -- Snapdragon Family
 Desert snapdragon *Antirrhinum cyathiferum*
 Snapdragon vine *Maurandya antirrhiniflora*
 Mojave beard tongue *Penstemon pseudo spectabilis* var. *pseudospectabilis*
 Purslane speedwell, or necklace-weed, *Veronica peregrina xalapensis*

SIMAROUBACEAE -- Quassia Family
 Crucifixion thorn *Castela emoryi*

SOLANACEAE -- Nightshade Family
 False nightshade *Chamaesaracha coronopus*
 Poisonous nightshade *Datura discolor*
 Desert wolfberry *Lycium andersonii* var. *andersonii*
 Fremont wolfberry *Lycium fremontii* var. *fremontii*
Lycium macrodon var. *macrodon*
 Parish wolfberry *Lycium parishii* var. *parishii*
 Desert tobacco *Nicotiana clevelandii*
 Coyote tobacco, or desert tobacco, *Nicotiana obtusifolia*
 Desert ground cherry *Physalis crassifolia*
Physalis lobata

STERCULIACEAE – Cacao Family
Ayenia filiformis

TAMARICACEAE – Tamarisk Family
 *Salt-cedar, or tamarisk, *Tamarix ramosissima*

TYPHACEAE – Cattail Family
 Southern cattail *Typha domingensis*

ULMACEAE – Elm Family
 Desert hackberry *Celtis pallida pallida*

URTICACEAE – Nettle Family
 Desert pellitory *Parietaria floridana*

VERBENACEAE – Verbena Family
 Oreganillo *Aloysia wrightii*
Tetradlea coulteri
Verbena bracteata
Verbena gooddingii
Verbena officinalis halei

VISCACEAE – Mistletoe Family
 Desert mistletoe *Phoradendron californicum*

ZYGOPHYLLACEAE – Caltrop Family
Fagonia californica laevis
Fagonia californica longipes
Fagonia pachyacantha
 California caltrop *Kallstroemia californica*
 Orange caltrop *Kallstroemia grandiflora*
 Creosote bush *Larrea divaricata tridentate*
 *Puncture vine, or goathead, *Tribulus terrestris*

Appendix F: Minimum Requirements Analyses for Refuge Management Actions in Cabeza Prieta National Wildlife Refuge Designated Wilderness

All management actions proposed to occur within designated wilderness on the refuge are subject to minimum requirements analysis (MRA). This is a two-step analysis of each action's appropriateness. The first step evaluates the proposed action's necessity to continued administration of the area as wilderness. The second step investigates and compares the impacts to wilderness resources that would result from various alternative methods of implementing the proposed management action. The first step verifies that a proposed action meets the stipulation of Section 4 (c) of the Wilderness Act that permitted uses are necessary to administer the area as wilderness. The second step verifies that the proposed action is the minimum required to meet the need for management intervention in wilderness.

The overall environmental analysis presented in the EIS and the selection of Alternative 4 as the proposed alternative indicates that Alternative 4 is the required minimum action necessary to achieve the wilderness goals of refuge management. This is analogous to the first step of the MRA, as described above. Each step of the MRA is detailed for the generic actions described below to provide the reader an understanding the rationale that was used to determine appropriate actions in wilderness.

An MRA for each of the generic management actions proposed under Alternative 4 (the proposed alternative) follows. When actual management activity in wilderness is scheduled to occur, a site specific MRA for that action, considering site conditions, season, recent weather and other variables specific to that action will be prepared to supplement the generic MRA for the class management activity. The basic format for the MRAs follows the procedure of the Minimum Requirement Decision Guide, published by the Arthur Carhart National Wilderness Training Center in April 2002. The decision process is presented in narrative form summarized from the worksheets presented in Minimum Requirement Decision Guide.

In every alternative described below that will require refuge staff or volunteers to camp in wilderness while accomplishing a management action, the persons will be advised to observe leave-no-trace camping practices.

Action 1: Radio collar Sonoran pronghorns

The refuge is the center of U.S. range of the Sonoran pronghorn, an endangered species. The species' recovery plan calls for use of a population monitoring protocol that includes maintaining operable radio collars on 10 per cent of the U.S. population. Radio collared individuals are essential to accurately determining the population levels of this rare, wide-ranging animal. Refuge and AGFD staffs conduct collaring operations from helicopters, using net guns to capture animals and then landing the helicopter nearby to fit the animal with a radio collar and take biological measurements of the collared animal. This action thus involves landing of aircraft in designated wilderness.

Minimum Requirements Questions

Step 1. Is the action necessary to administer the Wilderness?

1. Is this an emergency? **No.** "Emergency" in this context means an immediate threat to human health or safety.
2. Is this problem/issue subject to valid existing rights, such as access to valid mining claim, state lands, etc.? **No**
3. Can the problem/issue be addressed by administrative actions outside a wilderness area? **No** Discussion: some occupied Sonoran pronghorn range lies within non-wilderness lands of the refuge or administered by the Bureau of Land Management and Department of Defense. While it would be feasible to conduct all radio collar operations in these areas, such selection of animals occurring only in non-wilderness would result in a non-representative sample of the population being collared, because only the small subset of the population occurring in that limited range would be sampled. This skewing of the sample could result in drawing inaccurate conclusions regarding the status of the overall population, and is thus inappropriate.
4. Is there a special provision in legislation that allows this project activity? **No**

Step 1, Continued: does resolving the issue/problem protect wilderness character and values identified in the Wilderness Act.

1. If the issue/problem is not resolved, or action not taken, will the natural processes of the wilderness be adversely affected? **Yes. Why/how?** Between the fall of 2002 and the winter of 2005, no active collars remained on any Sonoran pronghorns in the U.S. population. During that period the Service experienced extreme difficulty in determining the population's size and movements. The failure to maintain such population data adversely affects the recovery efforts for this animal and could contribute to its extirpation or extinction. Loss of this animal, in addition to being contrary to the Endangered Species Act, would reduce wilderness naturalness, as the Sonoran pronghorn is a component of the Sonoran Desert in its natural state.
2. If the issue/problem goes unresolved, or action is not taken, will the values of solitude or primitive and unconfined type of recreation be threatened? **Yes. Why/How?** – Some visitors to the refuge are interested in viewing the Sonoran pronghorn. To the extent that poor understanding of the size and structure of the population resulting from a failure to collar animals contributes to their decline, it would adversely affect these recreationists.
3. If the issue/problem goes unresolved or action is not taken will evidence of human manipulation, permanent improvements, or human habitation be substantially noticeable? **No**
4. Does addressing the issue/problem or taking action protect the wilderness as a whole, as opposed to a single resource? **No.** This effort is focused on the recovery of single species, the Sonoran pronghorn.

5. Does addressing this issue/problem or taking action contribute to protection of enduring wilderness for future generations? **Yes Why/How?** This issue is directly related to conservation of a critically endangered wilderness species.
6. Is this an issue for reasons other than convenience or cost of administration? **Yes Why/How?** Obtaining accurate information on the size and movements of the U.S. subpopulation of Sonoran pronghorn is critical to the sub-species' recovery. For reasons stated above, it necessary to collar animals in wilderness to obtain these data.

Step 1 conclusion: As administering the activity in non-wilderness areas only is not feasible, and the activity will protect some wilderness values (four of six questions above answered "yes") it is appropriate to administer the activity in wilderness.

Step 2, Determining the Minimum Tool

Identify and describe the range of alternatives, including those that utilize traditional tools and non-motorized and mechanized as well as other methods.

Alternative 1

The refuge and AGFD staff will capture and collar Sonoran pronghorn using net guns fired from helicopters and then land the helicopters to provide access to the captured animals for radio collaring.

Does this alternative involve:

Use of temporary road?	No
Use of motor vehicles?	No
Use of motorized equipment?	No (other than landing helicopters)
Landing of airplanes?	No
Landing of helicopters?	Yes
Use of mechanical transport?	No (other than landing helicopters)
Creating a structure or installation?	No
Other impacts to wilderness character?	Yes (some animals will be collared)

Describe the biophysical effects/benefits of this alternative: implementing this alternative would result in maintaining functioning radio collars on 10 percent of the U.S. sup-population of Sonoran pronghorn. This is a requirement of the species' recovery plan and will allow accurate tracking of the sub-population's size and movement. In the past some mortality to animals has occurred during or subsequent to capture and collar operations. Protocols now in place should greatly reduce the incidence of mortality.

Describe the societal/political effects/benefits: Some stakeholders oppose collaring animals in wilderness as inconsistent with the natural and untrammled character of wilderness. Visitors observing a capture operation would likely feel that their wilderness experience was compromised.

Describe health and safety and concerns/benefits: While there is some possibility of a helicopter crash or other accident, the safety plan in place for capture and collar operations should address health and safety concerns.

Describe economic and timing considerations/benefits: Maintaining radio collars on ten percent of the population of Sonoran pronghorn will improve the efficiency of species recovery efforts.

Describe heritage resource considerations/benefits: None

Selected alternative is Alternative 1. The use of helicopters and their landing in wilderness is the only method to accomplish radio collaring of Sonoran pronghorn, a necessary recovery activity. Alternatives methods such as attracting the animals into an enclosure for collaring through use of food bait, or darting the animals to immobilize them have proven unworkable.

Action 2: Sonoran pronghorn population monitoring

The refuge is the center of U.S. range of the Sonoran pronghorn, an endangered species. The species' recovery plan calls for estimating the population level. The refuge and AGFD staff cooperatively monitors the species using aircraft. A full population survey of the refuge is conducted every year in December. AGFD conducts less detailed flights weekly to ascertain, using both radio telemetry and visual observations, how the population is moving and identify any large changes in population numbers.

Minimum Requirements Questions

Step 1. Is the action necessary to administer the Wilderness?

1. Is this an emergency? **No**
2. Is this problem/issue subject to valid existing rights, such as access to valid mining claim, state lands, etc.? **No**
3. Can the problem/issue be addressed by administrative actions outside a wilderness area?
Yes Why/How? AGFD aircraft are used in the airspace over the wilderness, but do no land in wilderness.
1. Is there a special provision in legislation that allows this project activity? **No**

As the activity can be undertaken entirely outside of wilderness, using aircraft in the airspace over the wilderness. No further analysis is necessary.

Action 3: Accessing Wilderness to conduct necropsy of Sonoran pronghorn

When dead Sonoran pronghorn are identified, either by direct observation during weekly telemetry flights, or by receipt of a “mortality” signal from a radio collar in the case of a collared individual, a refuge and/or AGFD biologist is deployed to locate the carcass and conduct a field necropsy and general investigation to determine the cause of death. The biologist also collects tissue samples and takes measurements to ascertain the animal’s condition at the time of death. This information is important to understanding mortality factors for this endangered species.

Minimum Requirements Questions

Step 1. Is the action necessary to administer the Wilderness?

- 1 Is this an emergency? **No.**
- 2 Is this problem/issue subject to valid existing rights, such as access to valid mining claim, state lands, etc.? **No**
- 3 Can the problem/issue be addressed by administrative actions outside a wilderness area? **No** Discussion: when a Sonoran pronghorn dies in wilderness, the field necropsy and other field investigations must occur in wilderness.
- 4 Is there a special provision in legislation that allows this project activity? **No**

Step 1, Continued: does resolving the issue/problem protect wilderness character and values identified in the Wilderness Act.

1. If the issue/problem is not resolved, or action not taken, will the natural processes of the wilderness be adversely affected? **Yes. Why/how?** Timely necropsies of Sonoran pronghorn mortalities yield valuable data regarding stresses on the U.S. sub-population of Sonoran pronghorn. Understanding the factors affecting mortality in this endangered species should allow development of increasingly effective means of managing the species in wilderness.
2. If the issue/problem goes unresolved, or action is not taken, will the values of solitude or primitive and unconfined type of recreation be threatened? **Yes Why/How?** Wildlife observation is a type of unconfined recreation and is a priority public use of National Wildlife Refuges. The loss of a large mammal from the refuge/ecosystem would be an important loss to the public.
3. If the issue/problem goes unresolved or action is not taken will evidence of human manipulation, permanent improvements, or human habitation be substantially noticeable? **No**
4. Does addressing the issue/problem or taking action protect the wilderness as a whole, as opposed to a single resource? **No.** The action would benefit management of the Sonoran pronghorn, a single species.
5. Does addressing this issue/problem or taking action contribute to protection of enduring wilderness for future generations? **Yes Why/How?** This issue is directly related to conservation of a critically endangered wilderness species. If this wilderness species were to become extinct, the wilderness resource would be altered for future generations.
6. Is this an issue for reasons other than convenience or cost of administration? **Yes Why/How?** The animals must be recovered from the place of mortality. Collecting data from only those individuals that die in non-wilderness would be more convenient and less costly for the refuge, but would not implement the species’ recovery plan.

Step 1 conclusion: Administering the activity in non-wilderness areas only is not feasible as the location of the activity is dependent on the location of Sonoran pronghorn mortalities. The activity will protect some wilderness values (four of six questions above answered “yes”). It is, thus appropriate to administer the activity in wilderness.

Step 2, Determining the Minimum Tool

Identify and describe the range of alternatives, including those that utilize traditional tools and non-motorized and mechanized as well as other methods.

Alternative 1

Refuge and/or AGFD will access identified Sonoran mortalities by driving a refuge or AGFD vehicle to the nearest non-wilderness point and then walking to the site of mortality, conducting the necropsy and walking back to the vehicle.

Does this alternative involve:

Use of temporary road?	No
Use of motor vehicles?	No
Use of motorized equipment?	No
Landing of airplanes?	No
Landing of helicopters?	No
Use of mechanical transport?	No
Creating a structure or installation?	No
Other impacts to wilderness character?	No

Describe the biophysical effects/benefits of this alternative: implementing this alternative could result in refuge and/or AGFD staff hiking up to approximately 23 kilometers (14.3 miles) from their vehicles to reach the site of mortality. This would delay the necropsy investigations by up to 3 hours over the maximum hiking time of Alternative 2 below. Any delay in reaching the mortality site increases the likelihood that the scavenging and other decomposition will reduce the potential for effective necropsy.

Describe the social recreational benefits: Visitors are not disturbed by the motor vehicles used within wilderness in other alternatives.

Describe the societal/political effects/benefits: None

Describe health and safety concerns/benefits: the long hikes potentially required by this alternative could be hazardous to health and safety of staff conducting the investigations, particularly during the heat of summer, when much Sonoran pronghorn mortality occurs.

Describe economic and timing considerations/benefits: None

Describe heritage resource considerations/benefits: None

Alternative 2

Refuge and/or AGFD will access identified Sonoran mortalities by driving a refuge or AGFD vehicle to the nearest point on a refuge Administrative Trail or non-wilderness access road and then walking to the site of mortality, conducting the necropsy and walking back to the vehicle. The maximum one-way distance from a vehicle to a potential mortality location would be approximately 8 kilometers (5.6 miles) Staff would only use administrative trails when the site of mortality is greater than 5 kilometers (3.1 miles) from the non-wilderness access road.

Does this alternative involve:

Use of temporary road?	Yes
Use of motor vehicles?	Yes
Use of motorized equipment?	No
Landing of airplanes?	No
Landing of helicopters?	No
Use of mechanical transport?	No
Creating a structure or installation?	No
Other impacts to wilderness character?	No

Describe the biophysical effects/benefits of this alternative: implementing this alternative could result in refuge and/or AGFD staff hiking up to approximately 8 kilometers (5.6 miles) to reach sites of necropsy. This savings in distance hiked, and therefore time, could result in collecting superior information about Sonoran pronghorn mortality

Describe the social recreational effects/benefits: This alternative would slightly increase the number of vehicle trips on Administrative Trails in wilderness. This would negatively impact the wilderness recreational experience of any visitors who encounter a vehicle in wilderness. The likelihood of this impact occurring, however, is low, as the greatest mortality to Sonoran pronghorn occurs during the heat of summer when visitation is very low.

Describe the societal/political effects/benefits: None

Describe health and safety concerns/benefits: the reduced length of hiking required by this alternative would place less stress on the health and safety of staff conducting the investigations, particularly during the heat of summer, when much Sonoran pronghorn mortality occurs.

Describe economic and timing considerations/benefits: None

Describe heritage resource considerations/benefits: None

Alternative 3

Refuge and/or AGFD will access identified Sonoran mortalities by driving a refuge or AGFD vehicle with horse trailer to the nearest non-wilderness point, riding to the site of mortality, conducting the necropsy and riding back to the vehicle.

Does this alternative involve:

Use of temporary road?	No
Use of motor vehicles?	No
Use of motorized equipment?	No
Landing of airplanes?	No
Landing of helicopters?	No
Use of mechanical transport?	No
Creating a structure or installation?	No
Other impacts to wilderness character?	No

Describe the biophysical effects/benefits of this alternative: implementing this alternative should result in time savings in accessing Sonoran pronghorn mortalities in wilderness. This should result in collection of more accurate data on the causes of death and animal condition at death. This benefit would be negated, however, if difficulty in traversing refuge roads while towing a trailer (see below) results in unreliable access for necropsies.

Describe health and safety concerns/benefits: implementing this alternative would greatly reduce the amount of hiking required of refuge/AGFD staff conducting necropsy investigations. This would benefit the staff's health and safety, particularly during hot summer weather when much Sonoran pronghorn mortality occurs.

Describe the social recreational benefits: This alternative would result in no additional use of vehicles in wilderness, a recreational benefit, as compared with Alternative 1, above.

Describe the societal/political effects/benefits: None

Describe economic and timing considerations/benefits: implementing this alternative would require that the refuge or AGFD keep horses and trailers in the area ready to deploy for necropsy investigations, which are unpredictable events. The stock would necessarily be fed pelletized fodder at all times to prevent introducing exotic species to the refuge by manure. Pulling a horse trailer on the refuge non-wilderness access roads could present difficulties, as these roads are maintained to a low level. The possibility of a horse trailer becoming stuck would be high, considering that the Comprehensive Conservation Plan bans travel trailers due to high likelihood of problems.

Describe heritage resource considerations/benefits: None

Sheet 4: Selection of Minimum Tool Alternative

The Selected Alternative is number 2. This alternative, while requiring some operation of vehicles on refuge administrative trails, provides a greater level of staff safety and assurance that the important necropsies will occur in a timely manner than the other alternatives. The amount of driving on refuge administrative trails required for necropsy investigations should be low, given the small size of the U.S. subpopulation of Sonoran pronghorn, and the fact that not all mortalities are detected.

What are the maintenance requirements? No additional maintenance of refuge administrative trails or non-wilderness access roads would be required due to implementation of this alternative.

What standards and designs will apply? None

Develop and describe any mitigation measures that apply. The staff will only drive on administrative trails when the site of mortality is more than 5 kilometers (3.1 miles) from the nearest non-wilderness access road. Refuge vehicles will be washed and visually inspected frequently to limit the introduction of exotic plant species. Refuge vehicles operating on administrative trails will proceed at low speeds to limit dust and noise generation.

What will be provided for monitoring and feedback to strengthen future efforts and preventative actions to be taken to help in future efforts? The refuge will keep a detailed log of necropsy investigations. If review of the log shows that delays resulted in poor condition specimens and inconclusive necropsies, the refuge may consider other means of accessing the mortalities more quickly.

Action 4: Accessing Wilderness to maintain and supply water to developed waters in Sonoran pronghorn habitat.

There are 15 developed waters located in Sonoran pronghorn habitat within the refuge wilderness. Maintaining these developed waters and supplying supplemental water is a component of the Sonoran pronghorn recovery plan. While maintenance of the waters is typically completed using hand tools (primitive tool) hauling supplemental water typically uses as 567-liter (1,500-gallon) heavy truck operating on refuge administrative trails.

Minimum Requirements Questions

Step 1. Is the action necessary to administer the Wilderness?

1. Is this an emergency? **No.**
2. Is this problem/issue subject to valid existing rights, such as access to valid mining claim, state lands, etc.? **No**
3. Can the problem/issue be addressed by administrative actions outside a wilderness area? **No** 15 developed waters for Sonoran pronghorn are located within refuge wilderness. The recovery team judged these locations necessary for species recovery.
4. Is there a special provision in legislation that allows this project activity? **No.**

Step 1, Continued: does resolving the issue/problem protect wilderness character and values identified in the Wilderness Act.

1. If the issue/problem is not resolved, or action not taken, will the natural processes of the wilderness be adversely affected? **Yes. Why/how?** If developed waters for Sonoran pronghorn are not maintained and supplied with water, the U.S. sub-population would risk becoming extirpated. These waters replace other off-refuge perennial water sources such as the Gila and Salt Rivers that the sub-population previously accessed in its natural state but that are now isolated from the sub-population by agricultural development, canals, roadways or other human urban development. Given the critically small size of the remaining U.S. Sonoran pronghorn population, waters have been located where there is the greatest likelihood of their being encountered by pronghorn.
2. If the issue/problem goes unresolved, or action is not taken, will the values of solitude or primitive and unconfined type of recreation be threatened? **Yes, Why/how?** If the Sonoran pronghorn is extirpated, visitors who value the opportunity to see these rare animals would be adversely affected.
3. If the issue/problem goes unresolved or action is not taken will evidence of human manipulation, permanent improvements, or human habitation be substantially noticeable? **No**
4. Does addressing the issue/problem or taking action protect the wilderness as a whole, as opposed to a single resource? **No** The proposed action is focused on a single species, the Sonoran pronghorn.
5. Does addressing this issue/problem or taking action contribute to protection of enduring wilderness for future generations? **Yes Why/How?** This issue is directly related to conservation of a critically endangered wilderness species.
6. Is this an issue for reasons other than convenience or cost of administration? **Yes Why/How?** Implementing the Sonoran pronghorn recovery is a refuge purpose.

Step 1 conclusion: As administering the activity in non-wilderness areas only is not feasible, and the activity will protect some wilderness values (four of six questions above answered "yes") it is appropriate to administer the activity in wilderness.

Step 2, Determining the Minimum Tool

Identify and describe the range of alternatives, including those that utilize traditional tools and non-motorized and mechanized as well as other methods.

Alternative 1

The Refuge will continue to maintain the waters as necessary, accessing the waters on foot and using hand tools such as shovels. The refuge will haul water to the developed waters, as necessary to prevent their going dry, using a 3,578-liter (1,500-gallon) heavy truck operating on refuge administrative trails

Does this alternative involve:

Use of temporary road?	Yes
Use of motor vehicles?	Yes
Use of motorized equipment?	No
Landing of airplanes?	No
Landing of helicopters?	No
Use of mechanical transport?	No
Creating a structure or installation?	No
Other impacts to wilderness character?	No

Describe the biophysical effects/benefits of this alternative: implementing this alternative is consistent with recovery of the Sonoran pronghorn, an endangered species. The operation of the water truck on refuge administrative trails should not have any noticeable effect. The refuge only hauls water when the administrative trails are free of mud, and uses measures such as high volume tires, six-wheel drive vehicles and low speed to avoid tire spinning, wash boarding of other damage to the administrative trails. Even during a drought year, the total use of administrative trails by the refuge water truck is a small fraction of the use of these trails by border law enforcement vehicles.

Describe the social/recreation effects/benefits: the operation of trucks in wilderness degrades the solitude, naturalness and quiet sought by wilderness visitors.

Describe the societal/political effects/benefits: the operation of heavy trucks in a federal wilderness area, regardless of the validity of doing so to maintain wilderness wildlife populations, degrades the untrammelled, natural and undeveloped character of the wilderness. This degradation causes a strongly negative reaction from members of society that highly value wilderness values.

Describe health and safety concerns/benefits: None.

Describe economic and timing considerations/benefits: the potential impact to recreationists is mitigated by the fact that water hauling occurs entirely during the hottest period of the summer, when visitation to the refuge is extremely low.

Describe heritage resource considerations/benefits: None

Alternative 2

The refuge will continue to maintain the developed waters in Sonoran pronghorn habitat in wilderness using hand tools. The refuge will haul water to the developed waters, as needed to keep them from going dry, using a pack string of horses, mules, or burros.

Does this alternative involve:

Use of temporary road?	No
Use of motor vehicles?	No
Use of motorized equipment?	No
Landing of airplanes?	No
Landing of helicopters?	No
Use of mechanical transport?	No
Creating a structure or installation?	No
Other impacts to wilderness character?	No

Describe the biophysical effects/benefits of this alternative: implementing this alternative would keep the developed waters from going dry, but would require very high numbers of pack animals on the refuge. One horse, mule or burro can carry approximately 95 liters (25 gallons) of water, and two additional pack animals are needed to carry drinking water for every ten pack animals. Replacing each trip by the 5,678-liter (1,500-gallon) water truck would thus require approximately 72 pack animal trips. During an average year, the refuge hauls water to Sonoran pronghorn waters in wilderness approximately 6 to 7 times, or 432 to 504 animal trips. This level of pack stock use on the refuge is unprecedented, and would result in changes in vegetation along the haul route from grazing, as well as disturbance of native wildlife from the presence of so many pack stock animals.

Describe the social recreational benefits: refuge visitors observing pack strings would consider their visit affected, either positively or negatively. The importance of this potential impact is mitigated in that water hauling occurs during the hottest period of the summer, when refuge visitation is very low.

Describe the societal/political effects/benefits: None

Describe health and safety concerns/benefits: water hauling typically occurs during the hottest months of the year. Travel by pack and saddle stock during these conditions would subject both the human packers and saddle/pack animals to extreme heat stress.

Describe economic and timing considerations/benefits: there are currently no commercial stock leasing companies in the refuge region. Implementing this alternative would require the refuge's maintaining a large herd of pack stock. Additional staff would be needed to husband the stock, and refuge land would have to be acquired or converted from native wildlife habitat to support the herd.

Describe heritage resource considerations/benefits: use of mule pack strings on the refuge would be a return of a traditional use dating back to Eighteenth Century.

Alternative 3

The Refuge will continue to maintain the waters as necessary, accessing the waters on foot and using hand tools such as shovels. The refuge will haul water to the developed waters, as necessary to prevent their going dry, using aerial drops of water from helicopters

Does this alternative involve:

Use of temporary road?	No
Use of motor vehicles?	No
Use of motorized equipment?	No
Landing of airplanes?	No
Landing of helicopters?	No (no landing proposed)
Use of mechanical transport?	No (not on the wilderness ground surface)
Creating a structure or installation?	No
Other impacts to wilderness character?	No

Describe the biophysical effects/benefits of this alternative: this alternative would keep the developed waters in Sonoran pronghorn habitat from going dry. This benefit would be offset, however by impacts to wildlife from the noise and rotor wash of frequent low altitude helicopter operation over the refuge.

Describe the social/recreational effects/benefits: low altitude use of helicopters is very jarring to wilderness visitors. The noise and rotor wash of heavy helicopter operating at low altitude would degrade the solitude, naturalness and quiet sought by wilderness recreationists over a larger area and to a greater intensity than the noise of a refuge water truck.

Describe the societal/political effects/benefits: the use of heavy helicopters over a federal wilderness area, while not directly regulated by the Wilderness Act, is contrary to overall wilderness values, and causes a strongly negative reaction from members of society that highly value wilderness values.

Describe economic and timing considerations/benefits: helicopter operational costs vary directly with the size of the aircraft, but generally exceed \$1,000 per hour. Hauling water by helicopter would exhaust the existing refuge operational budget during drought years. The importance disturbance of recreationists is mitigated in that water hauling occurs during the hottest period of the summer, when refuge visitation is very low.

Describe heritage resource consideration/benefits: None.

Sheet 4: Selection of Minimum Tool Alternative

The Selected Alternative is number 1. This alternative, while requiring some operation of vehicles on refuge administrative trails, would cause lower disturbance to habitat than the use of large numbers of water hauling trips by pack stock (Alternative 3) or disturbance of wildlife and wilderness solitude than hauling by helicopter (Alternative 2).

What are the maintenance requirements? No additional of maintenance of refuge administrative trails or non-wilderness access roads would be required due to implementation of this alternative.

What standards and designs will apply? None

Develop and describe any mitigation measures that apply: water hauling trips will only be made when, in the best professional opinion of refuge biologists, there is a danger that the developed water will go dry within one week. Refuge vehicles operating on administrative trails will proceed at low speeds to limit dust and noise generation.

What will be provided for monitoring and feedback to strengthen future efforts and preventative actions to be taken to help in future efforts? The refuge will keep a log of all vehicle miles driven in wilderness for water hauling, as well as the water level in developed at the time of delivery. This information may be helpful in avoiding unnecessary water hauling in the future.

Action 5: Installing photovoltaic water level sensors in developed waters in refuge wilderness.

The refuge proposes to identify potential sources of commercially available photovoltaic powered water level sensors with remote transmission capability. If such sensors were available, one would be installed in every developed water on the refuge wilderness (both waters in Sonoran pronghorn and desert bighorn sheep habitat).

Minimum Requirements Questions

Step 1. Is the action necessary to administer the Wilderness?

1. Is this an emergency? **No**.
2. Is this problem/issue subject to valid existing rights, such as access to valid mining claim, state lands, etc.? **No**
3. Can the problem/issue be addressed by administrative actions outside a wilderness area? **No** The waters slated for remote monitoring occur in wilderness
4. Is there a special provision in legislation that allows this project activity? **No**

Step 1, Continued: does resolving the issue/problem protect wilderness character and values identified in the Wilderness Act.

1. If the issue/problem is not resolved, or action not taken, will the natural processes of the wilderness be adversely affected? **Yes. Why/how?** The proposed water level sensors would allow more accurate determination of the need to haul water, without entering the wilderness to examine the waters. This should allow reduced intrusions from unnecessary water hauling.
2. If the issue/problem goes unresolved, or action is not taken, will the values of solitude or primitive and unconfined type of recreation be threatened? **Yes, Why/How?** The reduction in truck use in wilderness yielded from real-time, accurate water level readings would benefit backcountry visitors by decreasing the likelihood they would encounter a refuge management vehicle in wilderness. The importance of this change is limited, however, by the fact that most water hauling occurs during the summer, when visitation to the refuge is very low.
3. If the issue/problem goes unresolved or action is not taken will evidence of human manipulation, permanent improvements, or human habitation be substantially noticeable? **Yes, Why/How?** The sensors should reduce water hauling, thus decreasing the evidence of human manipulation of wilderness.
4. Does addressing the issue/problem or taking action protect the wilderness as a whole, as opposed to a single resource? **No**
5. Does addressing this issue/problem or taking action contribute to protection of enduring wilderness for future generations? **Yes Why/How?** This issue is directly related to conservation of a critically endangered wilderness species and the conservation of a wilderness dependent wildlife species (desert bighorn sheep).
6. Is this an issue for reasons other than convenience or cost of administration? **Yes Why/How?** While avoiding unnecessary water hauling certainly would be a convenience measure, it would also reduce vehicle use in wilderness.

Step 1 conclusion: As administering the activity in non-wilderness areas only is not feasible, and the activity will protect some wilderness values (five of six questions above answered "yes") it is appropriate to administer the activity in wilderness.

Step 2, Determining the Minimum Tool

Identify and describe the range of alternatives, including those that utilize traditional tools and non-motorized and mechanized as well as other methods.

Alternative 1

If suitable water level monitors can be acquired, refuge staff will hike from the nearest non-wilderness access point to install them in developed waters and then hike back to their vehicles in non-wilderness.

Does this alternative involve:

- | | |
|--|------------|
| Use of temporary road? | No |
| Use of motor vehicles? | No |
| Use of motorized equipment? | No |
| Landing of airplanes? | No |
| Landing of helicopters? | No |
| Use of mechanical transport? | No |
| Creating a structure or installation? | No |
| Other impacts to wilderness character? | No. |

Describe the biophysical effects/benefits of this alternative: implementing this alternative would result in increased hiking by refuge staff within wilderness. This could result in some physiological stress to refuge staff members.

Describe the social/recreation effects/benefits: None.

Describe the societal/political effects/benefits: None

Describe health and safety concerns/benefits: None.

Describe economic and timing considerations/benefits: Hiking to developed waters would divert staff from other refuge administration activities.

Describe heritage resource considerations/benefits: None

Alternative 2

If suitable water level monitors can be acquired, refuge staff will install them during water hauling trips to the developed waters.

Does this alternative involve:

Use of temporary road?	Yes
Use of motor vehicles?	Yes
Use of motorized equipment?	No
Landing of airplanes?	No
Landing of helicopters?	No
Use of mechanical transport?	No
Creating a structure or installation?	No
Other impacts to wilderness character?	No.

Describe the biophysical effects/benefits of this alternative: implementing this alternative would reduce hiking by refuge staff, as compared to Alternative 1 above, resulting in less stress to staff. As the water level monitors would be installed during scheduled water hauling trips, this alternative would not involve any increase in vehicle use in wilderness.

Describe the social/recreation effects/benefits: None.

Describe the societal/political effects/benefits: None

Describe health and safety concerns/benefits: None.

Describe economic and timing considerations/benefits: This action would result in the water level monitors being installed when supplemental water was judged to be needed at each developed water. Combining trips for water hauling and water level sensors would increase efficiency as compared to scheduling separate hiking trips for water level sensor installation.

Describe heritage resource considerations/benefits: None

Sheet 4: Selection of Minimum Tool Alternative

The Selected Alternative is number 2. This alternative accomplishes the objective of installing water level sensors in developed waters located in wilderness most efficiently without additional use of motorized or mechanized transport in wilderness.

What are the maintenance requirements? No additional of maintenance of refuge administrative trails or non-wilderness access roads would be required due to implementation of this alternative.

What standards and designs will apply? None

Develop and describe any mitigation measures that apply: none.

What will be provided for monitoring and feedback to strengthen future efforts and preventative actions to be taken to help in future efforts? The refuge will verify that sensor readout is accurate by estimating water level on required water hauling trips to the developed waters.

Action 6: Developing or Redeveloping Sonoran pronghorn developed waters in refuge wilderness.

The refuge will construct additional Sonoran pronghorn developed waters as determined necessary by the recovery team. It is anticipated that some of the waters will be sited in refuge wilderness. Additionally, the refuge proposes to enlarge the storage tanks at four emergency waters constructed in 2003 and improve their water collection system. The proposed improvements may result in sufficient water collection and retention efficiency that the waters will require any hauling of supplemental water only during periods of prolonged drought.

Minimum Requirements Questions

Step 1. Is the action necessary to administer the Wilderness?

1. Is this an emergency? **No.**
2. Is this problem/issue subject to valid existing rights, such as access to valid mining claim, state lands, etc.? **No**
3. Can the problem/issue be addressed by administrative actions outside a wilderness area? **No** The four waters slated for redevelopment are located in refuge wilderness. Any new waters proposed for development in wilderness would only be so located if necessary to serve existing populations of pronghorn.
4. Is there a special provision in legislation that allows this project activity? **No.**

Step 1, Continued: does resolving the issue/problem protect wilderness character and values identified in the Wilderness Act.

1. If the issue/problem is not resolved, or action not taken, will the natural processes of the wilderness be adversely affected? **Yes. Why/how?** Developed waters for Sonoran pronghorn would replace other off-refuge perennial water sources such as the Gila and Salt Rivers that the sub-population previously accessed in its natural state but that are now isolated from the sub-population by agricultural development, canals, roadways or other human urban development. The proposed redevelopment of four existing emergency waters will allow them to be filled by natural runoff and reduce the need for water hauling.
2. If the issue/problem goes unresolved, or action is not taken, will the values of solitude or primitive and unconfined type of recreation be threatened? **Yes, How/Why?** The proposed improved waters will require much less water hauling than the existing waters, thus decreasing the likelihood that a visitor will encounter a refuge management vehicle operating in wilderness. The improved waters also are much more natural looking than previous types of developed waters. Only a small drinking trough and water collection inlets in arroyos would be visible from the soil surface. Refuge visitors will therefore see less evidence of structures in wilderness.
3. If the issue/problem goes unresolved or action is not taken will evidence of human manipulation, permanent improvements, or human habitation be substantially noticeable? **No**
4. Does addressing the issue/problem or taking action protect the wilderness as a whole, as opposed to a single resource? **No.**
5. Does addressing this issue/problem or taking action contribute to protection of enduring wilderness for future generations? **Yes Why/How?** This issue is directly related to conservation of a critically endangered wilderness species.
6. Is this an issue for reasons other than convenience or cost of administration? **Yes Why/How?** Recovery of Sonoran pronghorn is mandated by the Endangered Species Act.

Step 1 conclusion: As administering the activity in non-wilderness areas only is not feasible, and the activity will protect some wilderness values (four of six questions above answered "yes") it is appropriate to administer the activity in wilderness.

Step 2, Determining the Minimum Tool

Identify and describe the range of alternatives, including those that utilize traditional tools and non-motorized and mechanized as well as other methods.

Alternative 1

The Refuge will construct new waters as needed, and reconstruct four existing developed waters in Sonoran pronghorn habitat within the refuge wilderness. The refuge will use volunteer labor from various non-profit organizations and all excavation will be done by hand using hand shovels and pickaxes (primitive tool). Work crews will hike to the project sites from non-wilderness access points. The water reservoir systems will be airlifted to the sites by helicopters. Nineteen to twenty-three flights will be required for each water. Complete excavation, installation and covering will require two weeks per developed water, and the ten-person crews will camp near the site during this period.

Does this alternative involve:

Use of temporary road?	No
Use of motor vehicles?	No
Use of motorized equipment?	No
Landing of airplanes?	No
Landing of helicopters?	Yes
Use of mechanical transport?	No
Creating a structure or installation?	Yes
Other impacts to wilderness character?	Yes Temporary disturbance of solitude due to large work crew camping for two weeks per project.

Describe the biophysical effects/benefits of this alternative: implementing this alternative is consistent with recovery of the Sonoran pronghorn, an endangered species. Noise and rotor wash associated multiple, low altitude helicopter trips over the refuge wilderness would adversely affect wildlife and soils. The presence of ten-person work crews on each project site for two weeks per project would create a problem with heavy loads of human sanitary waste in a typically very low organic load environment.

Describe social/recreation effects/benefits: the presence of work crews at the work site for two weeks per project could disrupt another visitor's opportunities to enjoy wilderness solitude and an unconfined type of primitive recreation.

Describe health and safety concerns/benefits: None.

Describe economic and timing considerations/benefits: The work should be conducted during the cooler time of the year, when stress on both Sonoran pronghorn and work crews will be lowest, but prior to beginning of the Sonoran pronghorn fawning season (prior to March 15).

Describe heritage resource considerations/benefits: None

Alternative 2

The Refuge will construct new waters as needed, and reconstruct four existing developed waters in Sonoran pronghorn habitat within the refuge wilderness. The refuge will use volunteer labor from various non-profit organizations. Excavation will use a backhoe driven to the site via non-wilderness roads and administrative trails in wilderness. Work crews will hike to the project sites from non-wilderness access points. The water reservoir systems will be airlifted to the sites by helicopters. Eighteen to twenty-two round helicopter trips will be required to and from the site of each new or redeveloped water, depending on the number of reservoir components needed. Complete excavation, installation and covering will require two days per developed water, and the ten-person crews will camp near the site during this period.

Does this alternative involve:

Use of temporary road?	Yes
Use of motor vehicles?	Yes
Use of motorized equipment?	Yes
Landing of airplanes?	No
Landing of helicopters?	Yes
Use of mechanical transport?	No
Creating a structure or installation?	Yes
Other impacts to wilderness character?	No

Describe the biophysical effects/benefits of this alternative: this alternative would contribute to the recovery of Sonoran pronghorn, an endangered species. Rotor wash and noise from the high intensity of low-altitude helicopter use required by this alternative would adversely affect wildlife and has the potential to disturb soils. The presence of ten-person work crews on each project site for two days per project would cause fewer problems associated with waste than would the longer duration of stay necessary under the first alternative. Driving the backhoe (one round trip to and from each new or redeveloped water site) should not appreciably effect the administrative trails, given the backhoe's high-floatation, off-road tires, low speed of driving and the high background volume of vehicle use on administrative trails by border law enforcement personnel.

Describe social/recreation effects/benefits: the high intensity of helicopter use at low altitude would result in disturbance of wilderness solitude and naturalness. The presence of mechanized equipment (a backhoe) and the work crews at the work site could disrupt a visitor's opportunities to enjoy wilderness solitude and an unconfined type of primitive recreation. While this would be an intense invasion of the visitor's experience due to the presence of mechanized equipment, and low altitude over flights, the overall shorter time frame (two versus 14 days) would reduce the likelihood of a visitor impacts.

Describe health and safety concerns/benefits: None.

Describe economic and timing considerations/benefits: The work should be conducted during the cooler time of the year, when stress on both Sonoran pronghorn and work crews will be lowest, but prior to beginning of the Sonoran pronghorn fawning season (prior to March 15).

Describe heritage resource considerations/benefits: None

Alternative 3

The Refuge will construct new waters as needed, and reconstruct four existing developed waters in Sonoran pronghorn habitat within the refuge wilderness. The refuge will use volunteer labor from various non-profit organizations. Excavation will use a backhoe driven to the site via non-wilderness roads and administrative trails in wilderness. Work crews will hike to the project sites from non-wilderness access points. The water reservoir systems will be hauled to the sites using a truck and trailer combination. Two round trips to and from each site will be required. Complete excavation, installation and covering will require two days per developed water, and the ten-person crews will camp near the site during this period.

Does this alternative involve:

Use of temporary road?	Yes
Use of motor vehicles?	Yes
Use of motorized equipment?	Yes
Landing of airplanes?	No
Landing of helicopters?	No
Use of mechanical transport?	No
Creating a structure or installation?	Yes
Other impacts to wilderness character?	No

Describe the biophysical effects/benefits of this alternative: this alternative would contribute to the recovery of Sonoran pronghorn, an endangered species. The presence of ten-person work crews on each project site for two days per project would cause much less problem associated with waste than would the longer duration of stay necessary under the first alternative. Driving the backhoe (one round trip to and from each new or redeveloped water site) and reservoir component truck (two round trips to and from each new or redeveloped water site) should not appreciably effect the administrative trails, given the backhoe's high-floatation, off-road tires, low speed of driving by the backhoe and delivery truck and the high background volume of vehicle use on administrative trails by border law enforcement personnel.

Describe social/recreation effects/benefits: in presence of mechanized equipment (a backhoe) and the work crews at the work site could disrupt another visitor's opportunities to enjoy wilderness solitude and an unconfined type of primitive recreation. While this would be a more intense invasion of the visitor's experience due to the presence of mechanized equipment, the overall much shorter time frame (two versus 14 days) would minimize the likelihood of a visitor's being affected.

Describe health and safety concerns/benefits: None.

Describe economic and timing considerations/benefits: The work should be conducted during the cooler time of the year, when stress on both Sonoran pronghorn and work crews will be lowest, but prior to beginning of the Sonoran pronghorn fawning season (prior to March 15)..

Describe heritage resource considerations/benefits: None

Alternative 4

The Refuge will construct new waters as needed and reconstruct four existing developed waters in Sonoran pronghorn habitat within the refuge wilderness. The refuge will use volunteer labor from various non-profit organizations. Excavation will use hand tools. Work crews will hike to the project sites from non-wilderness access points. The water reservoir systems will be hauled to the sites using a truck and trailer combination. Two round trips to and from each site will be required. Complete excavation, installation and covering will require two weeks per developed water, and the ten-person crews will camp near the site during this period.

Does this alternative involve:

Use of temporary road?	Yes
Use of motor vehicles?	Yes
Use of motorized equipment?	Yes
Landing of airplanes?	No
Landing of helicopters?	No
Use of mechanical transport?	No
Creating a structure or installation?	Yes
Other impacts to wilderness character?	No

Describe the biophysical effects/benefits of this alternative: this alternative would contribute to the recovery of Sonoran pronghorn, an endangered species. The presence of ten-person work crews on each project site for two weeks per project would create a problem with heavy loads of human sanitary waste in a typically very low organic load environment.

Describe social/recreation effects/benefits: the use of a truck to haul reservoir components into the refuge could adversely affect the wilderness experience of visitors who see or hear the truck operating in wilderness. The use of primitive tools (picks and shovels) to excavate for the reservoirs could be used as a teaching example about the appropriateness of primitive tools in wilderness.

Describe health and safety concerns/benefits: None.

Describe economic and timing considerations/benefits: The work should be conducted during the cooler time of the year, when stress on both Sonoran pronghorn and work crews will be lowest, but prior to beginning of the Sonoran pronghorn fawning season (prior to March 15).

Describe heritage resource considerations/benefits: None

Sheet 4: Selection of Minimum Tool Alternative

The Selected Alternative is number 4. This alternative, while requiring some operation of vehicles on refuge administrative trails, has the least overall impact to wilderness of the four proposed alternatives.

What are the maintenance requirements? No additional of maintenance of refuge administrative trails or non-wilderness access roads would be required due to implementation of this alternative.

What standards and designs will apply? All aboveground visible components of the improved waters will be painted to match the background soil color.

Develop and describe any mitigation measures that apply: when construction is complete, all grades will be returned as close as is possible to pre-construction contour. During soil disturbance, the refuge will implement erosion controls and other best management practices to minimize erosion and dust generation. Work crews will use portable sanitary facilities to allow efficient collection and removal of sanitary wastes.

What will be provided for monitoring and feedback to strengthen future efforts and preventative actions to be taken to help in future efforts? The refuge will take pre- and post construction photographs of each site and will periodically monitor project sites for erosion or settling.

Action 7: Annually collect water samples from all developed waters for wildlife (in both Sonoran pronghorn and desert bighorn sheep habitat) for analysis and identification of potential pathogens. The water samples should be collected at the same time of the year in order to facilitate effective comparisons of water quality and pathogen presence between years.

Minimum Requirements Questions

Step 1. Is the action necessary to administer the Wilderness?

1. Is this an emergency? **No.**
2. Is this problem/issue subject to valid existing rights, such as access to valid mining claim, state lands, etc.? **No**
3. Can the problem/issue be addressed by administrative actions outside a wilderness area? **No** Several of the waters slated for sample collection occur in wilderness
4. Is there a special provision in legislation that allows this project activity? **No**

Step 1, Continued: does resolving the issue/problem protect wilderness character and values identified in the Wilderness Act.

1. If the issue/problem is not resolved, or action not taken, will the natural processes of the wilderness be adversely affected? **Yes. Why/how?** The proposed water sampling would allow identification of any unnatural levels or varieties of pathogens present in the developed waters. Removal of such pathogen sources would enhance the naturalness of the refuge wilderness.
2. If the issue/problem goes unresolved, or action is not taken, will the values of solitude or primitive and unconfined type of recreation be threatened? **No**
3. If the issue/problem goes unresolved or action is not taken will evidence of human manipulation, permanent improvements, or human habitation be substantially noticeable? **No**
4. Does addressing the issue/problem or taking action protect the wilderness as a whole, as opposed to a single resource? **Yes Why/How?** The proposed action would allow assurance that wildlife waters are not introducing pathogens into the wilderness environment
5. Does addressing this issue/problem or taking action contribute to protection of enduring wilderness for future generations? **Yes Why/How?** This issue is directly related to conservation of a critically endangered wilderness species and the conservation of a wilderness dependent wildlife species (desert bighorn sheep).
6. Is this an issue for reasons other than convenience or cost of administration? **Yes Why/How?** This action is proposed to protect the health of refuge wildlife populations.

Step 1 conclusion: As administering the activity in non-wilderness areas only is not feasible, and the activity will protect some wilderness values (four of six questions above answered “yes”) it is appropriate to administer the activity in wilderness.

Step 2, Determining the Minimum Tool

Identify and describe the range of alternatives, including those that utilize traditional tools and non-motorized and mechanized as well as other methods.

Alternative 1

Once each year refuge staff will hike from the nearest non-wilderness access point to each wildlife water and collect a water sample. The sample will be sealed and stored in a cooler during transport to a laboratory for analysis. This sampling would occur during the cool season when visiting the developed waters is less likely to affect stressed wildlife populations and hiking in the refuge is less strenuous.

Does this alternative involve:

- | | |
|--|------------|
| Use of temporary road? | No |
| Use of motor vehicles? | No |
| Use of motorized equipment? | No |
| Landing of airplanes? | No |
| Landing of helicopters? | No |
| Use of mechanical transport? | No |
| Creating a structure or installation? | No |
| Other impacts to wilderness character? | No. |

Describe the biophysical effects/benefits of this alternative: implementing this alternative would allow collection of water samples with minimal biophysical effects. Should pathogens be identified, benefits to refuge wildlife populations would result, as waters with high pathogen loading could be modified to avoid sources of contamination.

Describe the social recreational benefits: None, other than possible improvement of refuge wildlife population health, which indirectly benefits individuals and groups concerned about wildlife health.

Describe the societal/political effects/benefits: None

Describe health and safety and concerns/benefits: No human health and safety effects.

Describe economic and timing considerations/benefits: None

Describe heritage resource considerations/benefits: None

Alternative 2

Once each year refuge staff will collect a water sample from each developed water during visits for water hauling. If no trips are made to some of the developed waters during a particular year, the refuge will schedule trips to those waters for sampling. The sample will be sealed and stored in a cooler during transport to a laboratory for analysis. This sampling would occur opportunistically during the water-hauling season, typically the hottest time of the year.

Does this alternative involve:

Use of temporary road?	Yes
Use of motor vehicles?	Yes
Use of motorized equipment?	No
Landing of airplanes?	No
Landing of helicopters?	No
Use of mechanical transport?	No
Creating a structure or installation?	No
Other impacts to wilderness character?	No

Describe the biophysical effects/benefits of this alternative: implementing this alternative would allow collection of water samples with minimal biophysical effects. Should pathogens be identified, benefits to refuge wildlife populations would result.

Describe the social recreational benefits: None, other than possible improvement of refuge wildlife population health, which indirectly benefits individuals and groups concerned about wildlife health.

Describe the societal/political effects/benefits: None

Describe health and safety and concerns/benefits: None

Describe economic timing considerations/benefits: while combining water sampling with water hauling, the refuge would enjoy an increase in operational efficiency. This efficiency would be offset by collecting samples at non-standard times, thus reducing the comparability of samples collected over several years.

Describe heritage resource considerations/benefits: None

Sheet 4: Selection of Minimum Tool Alternative

The Selected Alternative is number 2. This alternative accomplishes the objective of collecting samples from developed waters located in wilderness with no additional use of motorized or mechanized transport in wilderness.

What are the maintenance requirements? No additional of maintenance of refuge administrative trails or non-wilderness access roads would be required due to implementation of this alternative.

What standards and designs will apply? None

Develop and describe any mitigation measures that apply: none.

What will be provided for monitoring and feedback to strengthen future efforts and preventative actions to be taken to help in future efforts? The refuge will track water analysis results over time to identify any trends.

Action 8: Develop up to three forage enhancements within Sonoran pronghorn habitat.

The Sonoran pronghorn recovery plan calls for the establishment and evaluation of forage enhancement plots on the Barry M. Goldwater Range, north of the refuge. Given the apparent early success of these plots, and the critical status of the U.S. sub-population of Sonoran pronghorn, the Sonoran pronghorn recovery team proposed development of four plots on the refuge. One forage enhancement has been developed south of Charlie Bell Road, in refuge non-wilderness.

Forage enhancements are areas of approximately 10 hectares (25 acres), selected on sites having greater than average vegetative cover in areas of documented frequent pronghorn presence. The area is prepared by first thinning creosote bush to create openings. Selected creosote bush is killed by burning with a hand-held weed burner. This improves the area for pronghorn by reducing cover, and thus the potential for predator ambush. Approximately 2.4 hectares (6 acres) within the enhancement is then rigged for sprinkler irrigation. The site is irrigated during low rainfall years to mimic natural rainfall of a slightly wetter than average year. No supplemental seeds are planted, as the ground should have adequate seed resources and off-site seed sources may be contaminated with exotic species.

Wilderness issues related to forage enhancements include loss of naturalness and untrammeled character due to irrigation, development of a well or water pipeline, and vegetation manipulation.

Minimum Requirements Questions

Step 1. Is the action necessary to administer the Wilderness?

1. Is this an emergency? **No.**
2. Is this problem/issue subject to valid existing rights, such as access to valid mining claim, state lands, etc.? **No**
3. Can the problem/issue be addressed by administrative actions outside a wilderness area? **Not entirely** The forage enhancements must be located in suitable habitat within the species' range. Most suitable sites on the refuge are located in wilderness. The exact sites for forage enhancements have not yet been located. Forage enhancements have been proposed both in refuge wilderness and refuge non-wilderness.
4. Is there a special provision in legislation that allows this project activity? **No**

Step 1, Continued: does resolving the issue/problem protect wilderness character and values identified in the Wilderness Act.

1. If the issue/problem is not resolved, or action not taken, will the natural processes of the wilderness be adversely affected? **Yes. Why/how?** The issue is related to recovery of the Sonoran pronghorn. If the issue is not resolved, extirpation of the U.S. sub-population, a natural component of the wilderness fauna, could result
2. If the issue/problem goes unresolved, or action is not taken, will the values of solitude or primitive and unconfined type of recreation be threatened? **No**
3. If the issue/problem goes unresolved or action is not taken will evidence of human manipulation, permanent improvements, or human habitation be substantially noticeable? **No**
4. Does addressing the issue/problem or taking action protect the wilderness as a whole, as opposed to a single resource? **No** – the proposed action is aimed at single species recovery.
5. Does addressing this issue/problem or taking action contribute to protection of enduring wilderness for future generations? **Yes Why/How?** This issue is directly related to conservation of a critically endangered wilderness species.

6. Is this an issue for reasons other than convenience or cost of administration? **Yes**
Why/How? This action is proposed to implement the Sonoran pronghorn recovery plan.

Step 1 conclusion: As administering the activity entirely in non-wilderness areas only is not feasible, and the activity will protect some wilderness values (three of six questions above answered “yes”) it is appropriate to administer the activity in wilderness.

Step 2, Determining the Minimum Tool

Identify and describe the range of alternatives, including those that utilize traditional tools and non-motorized and mechanized as well as other methods.

Alternative 1

Refuge staff, in consultation with the Sonoran pronghorn recovery team, will survey the refuge Sonoran pronghorn habitat to identify the three sites most favorable for additional forage enhancements. It is considered likely that at least one site will be located within wilderness. During preparation of the site well drilling rig will be required on site, a windmill will be erected to pump water from the well, irrigation lines will be installed and weed burner will be used to clear creosote bush.

Does this alternative involve:

Use of temporary road?	Yes
Use of motor vehicles?	Yes
Use of motorized equipment?	Yes
Landing of airplanes?	No
Landing of helicopters?	No
Use of mechanical transport?	No
Creating a structure or installation?	Yes
Other impacts to wilderness character?	Yes Vegetation manipulation, irrigation in desert

Describe the biophysical effects/benefits of this alternative: implementing this alternative would create additional sources of forage for the endangered Sonoran pronghorn. It would also artificially alter the plant composition and abundance of wilderness, which may alter the density and distribution of insects and predators in the wilderness.

Describe the social recreational benefits: implementing this alternative would result in adding visible structures such as water wells and windmills in wilderness. The presence of such alteration would adversely affect the recreational experience of refuge visitors.

Describe the societal/political effects/benefits: implementing this alternative should yield the societal benefit of aiding recovery of an endangered species. Implementing this alternative would have the negative societal effect of altering areas within the Wilderness Preservation System.

Describe health and safety and concerns/benefits: None

Describe economic and timing considerations/benefits: None

Describe heritage resource considerations/benefits: Implementing this alternative would change the natural appearance of a traditionally wild landscape

Alternative 2

Refuge staff, in consultation with the Sonoran pronghorn recovery team, will survey the refuge Sonoran pronghorn habitat to identify the three sites most favorable for additional forage enhancements. It is considered likely that at least one site will be located within wilderness. Water will be brought to the site via a pipeline from an existing well, pipes for the line will be brought into the wilderness using a truck, irrigation lines will be installed and weed burner will be used to clear creosote bush.

Does this alternative involve:

Use of temporary road?	Yes
Use of motor vehicles?	Yes
Use of motorized equipment?	Yes
Landing of airplanes?	No
Landing of helicopters?	No
Use of mechanical transport?	No
Creating a structure or installation?	Yes
Other impacts to wilderness character?	Yes Vegetation manipulation, irrigation in desert

Describe the biophysical effects/benefits of this alternative: implementing this alternative would create additional sources of forage for the endangered Sonoran pronghorn. It would also artificially alter the plant composition and abundance of wilderness. The presence of a 10-centimeter (4-inch) pipe on the ground surface could alter drainage patterns and would restrict movement of some small animals.

Describe the social and recreational benefits: implementing this alternative would result in adding installations such as irrigation lines and water pipelines in wilderness. The presence of such alteration would adversely affect the recreational experience of refuge visitors.

Describe the societal/political effects/benefits: implementing this alternative should yield the societal benefit of aiding recovery of an endangered species. Implementing this alternative would have the negative societal effect of altering areas within the Wilderness Preservation System.

Describe health and safety and concerns/benefits: None

Describe economic and timing considerations/benefits: None

Describe heritage resource considerations/benefits: Implementing this alternative would change the natural appearance of a traditionally wild landscape

Alternative 3

Refuge staff, in consultation with the Sonoran pronghorn recovery team, will survey only non-wilderness refuge Sonoran pronghorn habitat to identify the three sites most favorable for additional forage enhancements. Development of the forage enhancements will proceed as described for Alternative 1 above.

Does this alternative involve:

Use of temporary road?	No
Use of motor vehicles?	No
Use of motorized equipment?	No
Landing of airplanes?	No
Landing of helicopters?	No
Use of mechanical transport?	No
Creating a structure or installation?	No
Other impacts to wilderness character?	No

Describe the biophysical effects/benefits of this alternative: implementing this alternative would restrict the location of forage enhancements to a small fraction of the refuge Sonoran pronghorn habitat. Such restriction would limit the effectiveness of the forage enhancements and could contribute to extirpation of the U.S. sub-population of Sonoran pronghorn.

Describe the social recreational benefits: none.

Describe the societal/political effects/benefits: none other than those related to Sonoran pronghorn recovery.

Describe health and safety and concerns/benefits: None

Describe economic and timing considerations/benefits: None

Describe heritage resource considerations/benefits: None.

Sheet 4: Selection of Minimum Tool Alternative

The Selected Alternative is a combination of number s 1 and 2. Essentially, where distance and terrain permit, water will be piped to the forage enhancements from wells located in non-wilderness. When this is not feasible, new water well will be drilled and windmills erected in wilderness.

What are the maintenance requirements? The forage enhancements will require regular inspection and maintenance of water lines, irrigation components, and windmills.

What standards and designs will apply? Any windmill will be designed to resemble the type of irrigation windmill traditionally used by ranches in the region. Irrigation lines will be painted to blend visually with the soil.

Develop and describe any mitigation measures that apply: none.

What will be provided for monitoring and feedback to strengthen future efforts and preventative actions to be taken to help in future efforts? Upon recovery and delisting of the Sonoran pronghorn, all structures and facilities of the forage enhancements will be dismantled and removed.

Action 9: Coyote management

The Sonoran pronghorn recovery plan calls reduction of predation pressure through the selective removal of coyotes from specific areas at times of the year when pronghorn are most susceptible to predation. The refuge proposes to exceed the minimum of coyote control by adding a component of coyote study, including radio collaring coyotes to study their movements relative to Sonoran pronghorn movements and their use of developed waters.

Minimum Requirements Questions

Step 1. Is the action necessary to administer the Wilderness?

1. Is this an emergency? **No.**
2. Is this problem/issue subject to valid existing rights, such as access to valid mining claim, state lands, etc.? **No**
3. Can the problem/issue be addressed by administrative actions outside a wilderness area? **Not entirely.** Restricting coyote management activities to the non-wilderness portion of the refuge would limit the activities' effectiveness, as only a fraction of the refuge Sonoran pronghorn habitat occurs in non-wilderness.
4. Is there a special provision in legislation that allows this project activity? **No**

Step 1, Continued: does resolving the issue/problem protect wilderness character and values identified in the Wilderness Act.

1. If the issue/problem is not resolved, or action not taken, will the natural processes of the wilderness be adversely affected? **No**
2. If the issue/problem goes unresolved, or action is not taken, will the values of solitude or primitive and unconfined type of recreation be threatened? **No**
3. If the issue/problem goes unresolved or action is not taken will evidence of human manipulation, permanent improvements, or human habitation be substantially noticeable? **No**
4. Does addressing the issue/problem or taking action protect the wilderness as a whole, as opposed to a single resource? **No** – the proposed action is aimed at single species recovery.
5. Does addressing this issue/problem or taking action contribute to protection of enduring wilderness for future generations? **Yes Why/How?** This issue is directly related to conservation of a critically endangered wilderness species.
6. Is this an issue for reasons other than convenience or cost of administration? **Yes Why/How?** This action is proposed to implement the Sonoran pronghorn recovery plan.

Step 1 conclusion: As administering the activity in non-wilderness areas only is not feasible, and the activity will protect some wilderness values (two of six questions above answered "yes") it is appropriate to administer the activity in wilderness.

Step 2, Determining the Minimum Tool

Identify and describe the range of alternatives, including those that utilize traditional tools and non-motorized and mechanized as well as other methods.

Alternative 1

Refuge staff or contract trappers will set padded leg-hold traps to capture coyotes for radio collaring. The trapper will walk to and from the trap line from a non-wilderness access point. The traps will be placed and baited to avoid capture of non-target species (primarily birds of prey). Any non-target species will be released from the traps. Trap lines will be checked daily to minimize injury/stress to captured animals.

Coyote removal (when warranted by Sonoran pronghorn population size [fewer than 100 Sonoran pronghorn in U.S. subpopulation] and weather conditions [annual rainfall less than 50 percent of the average]) will be accomplished by calling in coyotes with a commercially produced predator call and shooting. The shooter will walk to and from the site from a non-wilderness access point.

Does this alternative involve:

Use of temporary road?	No
Use of motor vehicles?	No
Use of motorized equipment?	No
Landing of airplanes?	No
Landing of helicopters?	No
Use of mechanical transport?	No
Creating a structure or installation?	No
Other impacts to wilderness character?	Yes Placing radio collars on native wildlife, reducing natural predation.

Describe the biophysical effects/benefits of this alternative: other than changing the predator density, this alternative would have little effect on wilderness biophysical conditions. Trapping to radio collar coyotes would likely result in a female-biased sample, as female coyotes are more easily trapped than males (John Morgart, USFWS, pers. comm., 2004). This would artificially depress the refuge coyote population.

Describe the social recreational benefits: implementing this alternative could result in conflicts between coyote trappers/control personnel and recreational visitors. The likelihood of such conflict however is low due to very low levels of backcountry visitation at the refuge.

Describe the societal/political effects/benefits: predator control, as proposed, is a highly controversial practice. Groups and individuals opposed to lethal control would be adversely affected by this alternative.

Describe health and safety and concerns/benefits: None

Describe economic and timing considerations/benefits: None

Describe heritage resource considerations/benefits: None

Alternative 2

Refuge or AGFD staff will capture coyotes for radio collaring using net guns fired from helicopters. The helicopter will then land nearby and staff will exit the helicopter to collar and release the captured animals.

Coyote removal (when warranted by Sonoran pronghorn population size and weather conditions [fewer than 100 Sonoran pronghorn in U.S. subpopulation] and weather conditions [annual rainfall less than 50 percent of the average]) will be accomplished by calling in coyotes with a commercially produced predator call and shooting. The shooter will walk to and from the site from a non-wilderness access point.

Does this alternative involve:

Use of temporary road?	No
Use of motor vehicles?	No
Use of motorized equipment?	No
Landing of airplanes?	No
Landing of helicopters?	Yes
Use of mechanical transport?	No
Creating a structure or installation?	No
Other impacts to wilderness character?	Yes Placing radio collars on native wildlife, reducing natural predation.

Describe the biophysical effects/benefits of this alternative: implementing this alternative would result in the landing of helicopters in wilderness. The noise and rotor wash from the helicopters would adversely affect refuge wildlife and soils. This alternative would also result in artificial depression of the refuge coyote population.

Describe the social recreational benefits: observing or hearing low altitude operation and land of helicopters in the refuge wilderness would greatly compromise the wilderness recreational visitor. Similarly the possibility of conflicts between recreational visitors and coyote removal personnel exists. The likelihood of such conflict however is low due to very low levels of backcountry visitation at the refuge.

Describe the societal/political effects/benefits: predator control, as proposed, is a highly controversial practice. Groups and individuals opposed to lethal control would be adversely affected by this alternative.

Describe health and safety and concerns/benefits: None

Describe economic and timing considerations/benefits: None

Describe heritage resource considerations/benefits: None

Sheet 4: Selection of Minimum Tool Alternative

The Selected Alternative is number 2. Occasional use and landing of helicopters in wilderness, while more intrusive than the placement of traps, is preferred due to its greater effectiveness in obtaining a representative sample of the refuge coyote population.

What are the maintenance requirements? No additional maintenance would be required.

What standards and designs will apply? None

Develop and describe any mitigation measures that apply: none.

What will be provided for monitoring and feedback to strengthen future efforts and preventative actions to be taken to help in future efforts? None.

Action 10: Population Surveys and Monitoring

The Cabeza Prieta CCP calls for conducting surveys for the presence of several species of conservation interest, including the endangered lesser long-nosed bat and recently delisted cactus ferruginous pygmy-owl, among others. The CCP also calls monitoring population status of several other species of conservation or recreational interest, including LeConte's thrasher, Gila monster, mule deer and many others.

Minimum Requirements Questions

Step 1. Is the action necessary to administer the Wilderness?

1. Is this an emergency? **No**
2. Is this problem/issue subject to valid existing rights, such as access to valid mining claim, state lands, etc.? **No**
3. Can the problem/issue be addressed by administrative actions outside a wilderness area? **No** In order for population surveys and monitoring to be valid, they should cover as much of the potential habitat as is possible.
4. Is there a special provision in legislation that allows this project activity? **No**.

Step 1, Continued: does resolving the issue/problem protect wilderness character and values identified in the Wilderness Act.

1. If the issue/problem is not resolved, or action not taken, will the natural processes of the wilderness be adversely affected? **No**
2. If the issue/problem goes unresolved, or action is not taken, will the values of solitude or primitive and unconfined type of recreation be threatened? **No**
3. If the issue/problem goes unresolved or action is not taken will evidence of human manipulation, permanent improvements, or human habitation be substantially noticeable? **No**
4. Does addressing the issue/problem or taking action protect the wilderness as a whole, as opposed to a single resource? Yes **Why/How?** The data collection proposed will provide valuable information about the wilderness' wildlife species composition.
5. Does addressing this issue/problem or taking action contribute to protection of enduring wilderness for future generations? **Yes Why/How?** These species composition data will help the refuge to design long-term species conservation measures and detect any species declines.
6. Is this an issue for reasons other than convenience or cost of administration? **Yes Why/How?** The issue is collection of appropriate data.

Step 1 conclusion: As administering the activity in non-wilderness areas only is not feasible, and the activity will protect some wilderness values (three of six questions above answered "yes") it is appropriate to administer the activity in wilderness.

Step 2, Determining the Minimum Tool

Identify and describe the range of alternatives, including those that utilize traditional tools and non-motorized and mechanized as well as other methods. Survey plots or transects will be identified in the field using global position system equipment so that no permanent physical markings in wilderness will be necessary.

Alternative 1

Refuge staff, contracted researchers or volunteers will access wilderness survey/monitoring sites on foot from the nearest non-wilderness access point. Some survey/monitoring efforts may require several days in the field.

Does this alternative involve:

Use of temporary road?	No
Use of motor vehicles?	No
Use of motorized equipment?	No
Landing of airplanes?	No
Landing of helicopters?	No
Use of mechanical transport?	No
Creating a structure or installation?	No
Other impacts to wilderness character?	No

Describe the biophysical effects/benefits of this alternative: no direct biophysical effects; this alternative serves to gather data.

Describe the social recreational benefits: no direct effects; future visitors would be able to obtain more complete information regarding the refuge's fauna from the results of this alternative.

Describe the societal/political effects/benefits: None.

Describe health and safety and concerns/benefits: None

Describe economic and timing considerations/benefits: None

Describe heritage resource considerations/benefits: None

Sheet 4: Selection of Minimum Tool Alternative

Alternative 1 is the only alternative examined, as it is fully compliant with the Wilderness Act of 1964 and satisfies the refuge's data needs.

What are the maintenance requirements? No facilities will be maintained in wilderness.

What standards and designs will apply? Only survey/monitoring protocols will apply. These affect the execution of fieldwork, not wilderness features.

Develop and describe any mitigation measures that apply: none.

What will be provided for monitoring and feedback to strengthen future efforts and preventative actions to be taken to help in future efforts? The refuge will maintain survey/monitoring records.

Action 11: Radio collaring desert bighorn sheep

Conservation of desert bighorn sheep was central to the establishment of the refuge. The CCP calls for maintaining operable radio collars on 10 percent of the refuge population. In order to accurately estimate the population of the species, which inhabits inaccessible terrain, radio collaring is essential. Refuge and AGFD staffs conduct collaring operations from helicopters, using net guns to capture animals and then landing the helicopter nearby to fit the animal with a radio collar and take biological measurements of the collared animal. This action thus involves landing of aircraft in designated wilderness.

Minimum Requirements Questions

Step 1. Is the action necessary to administer the Wilderness?

1. Is this an emergency? **No**
2. Is this problem/issue subject to valid existing rights, such as access to valid mining claim, state lands, etc.? **No**
3. Can the problem/issue be addressed by administrative actions outside a wilderness area? **No** Discussion: some occupied desert bighorn sheep habitat lies within non-wilderness lands of the refuge. While it would be feasible to conduct all radio collar operations in these areas, such selection of animals occurring in non-wilderness would result in a non-representative sample of the population being collared. This skewing of the sample could result in drawing inaccurate conclusions regarding the status of the overall population, and is thus inappropriate.
4. Is there a special provision in legislation that allows this project activity? **No**

Step 1, Continued: does resolving the issue/problem protect wilderness character and values identified in the Wilderness Act.

1. If the issue/problem is not resolved, or action not taken, will the natural processes of the wilderness be adversely affected? **No**.
2. If the issue/problem goes unresolved, or action is not taken, will the values of solitude or primitive and unconfined type of recreation be threatened? **Yes, Why/How?** – Some individuals visit the refuge primarily to observe and/or photograph large mammals such as desert bighorn sheep. Additionally, desert bighorn sheep hunting on the refuge benefits from knowledge of the status and movements of the refuge desert bighorn sheep population.
3. If the issue/problem goes unresolved or action is not taken will evidence of human manipulation, permanent improvements, or human habitation be substantially noticeable? **No**
4. Does addressing the issue/problem or taking action protect the wilderness as a whole, as opposed to a single resource? **No**
5. Does addressing this issue/problem or taking action contribute to protection of enduring wilderness for future generations? **Yes Why/How?** This issue is directly related to conservation of a high-profile wilderness dependent species.
6. Is this an issue for reasons other than convenience or cost of administration? **Yes Why/How?** The use of helicopters and their landing in wilderness is not a function of cost or convenience, but rather the only effective method to accomplish radio collaring of desert bighorn sheep, a necessary refuge management activity.

Step 1 conclusion: As administering the activity in non-wilderness areas only is not feasible, and the activity will protect some wilderness values (three of six questions above answered “yes”) it is appropriate to administer the activity in wilderness.

Step 2, Determining the Minimum Tool

Identify and describe the range of alternatives, including those that utilize traditional tools and non-motorized and mechanized as well as other methods.

Alternative 1

The refuge and AGFD staff will capture and collar desert bighorn sheep using net guns fired from helicopters and then land the helicopters to provide access to the captured animals for radio collaring.

Does this alternative involve:

Use of temporary road?	No
Use of motor vehicles?	No
Use of motorized equipment?	No
Landing of airplanes?	No
Landing of helicopters?	Yes
Use of mechanical transport?	No
Creating a structure or installation?	No
Other impacts to wilderness character?	Yes (some animals will be collared)

Describe the biophysical effects/benefits of this alternative: implementing this alternative would result in maintaining functioning radio collars on 10 percent of the refuge desert bighorn sheep population

Describe the societal/political effects/benefits: conservation of desert bighorn sheep is a high priority of the State of Arizona. The refuge is an important player in this conservation effort and accurate population data supports the effort.

Describe health and safety and concerns/benefits: None

Describe economic and timing considerations/benefits: None.

Describe heritage resource considerations/benefits: None

Selected alternative is Alternative 1. No other alternatives are viable for radio collaring desert bighorn sheep, given the steep terrain of desert bighorn sheep habitat, and the high likelihood of injury in darting sheep.

Action 12: Desert bighorn sheep population monitoring

Monitoring the size and movement of the refuge desert sheep population is an important component of species conservation and regulation of the desert bighorn sheep hunt. AGFD and refuge staffs conduct a refuge-wide population survey every three years. Using a group-siting model from aircraft.

Minimum Requirements Questions

Step 1. Is the action necessary to administer the Wilderness?

1. Is this an emergency? **No**
2. Is this problem/issue subject to valid existing rights, such as access to valid mining claim, state lands, etc.? **No**
3. Can the problem/issue be addressed by administrative actions outside a wilderness area?
Yes AGFD aircraft are used in the airspace over the wilderness, but do not land in wilderness.
4. Is there a special provision in legislation that allows this project activity? **No**

As the activity can be undertaken entirely outside of wilderness, using aircraft in the airspace over the wilderness. No further analysis is necessary.

Action 13: Accessing wilderness to maintain and supply water to developed waters in desert bighorn sheep habitat.

There are 14 developed waters located in desert bighorn sheep habitat within the refuge wilderness. Two of these, Bassarisc Tank and Charlie Bell Well, are also used by Sonoran pronghorn. Their maintenance and water supply is addressed above under Action 4. The refuge maintains and/or hauls water, at least occasionally, to 11 of the developed waters: Buck Peak, Halfway, Cabeza Prieta, Buckhorn, Tule, Tuseral, Senita, North Pinta, Granite, Heart and Eagle Tanks. These waters have been maintained and supplied with supplemental water, as needed, for many years. The University of Arizona is currently reviewing the results of a five year study of desert bighorn sheep response to denying access to three of the waters (see EIS, Section 2.5.1.2.1). Until the results of this study (or other studies, if this one is not determined to be definitive) are available, the refuge will continue to manage developed waters as essential to desert bighorn sheep population viability. If studies show that desert bighorn sheep are not dependent on developed waters, the refuge will consider altering current maintenance and water hauling practices.

Maintenance of the waters is typically completed using hand tools (primitive tool). Hauling supplemental water typically uses as 5,678-liter (1,500-gallon) heavy truck operating on refuge administrative trails.

Minimum Requirements Questions

Step 1. Is the action necessary to administer the Wilderness?

1. Is this an emergency? **No.**
2. Is this problem/issue subject to valid existing rights, such as access to valid mining claim, state lands, etc.? **No**
3. Can the problem/issue be addressed by administrative actions outside a wilderness area? **No.** Eleven developed waters are maintained and supplied in refuge wilderness. The wilderness waters are a component of species conservation.
4. Is there a special provision in legislation that allows this project activity? **No.**

Step 1, Continued: does resolving the issue/problem protect wilderness character and values identified in the Wilderness Act.

1. If the issue/problem is not resolved, or action not taken, will the natural processes of the wilderness be adversely affected? **Yes. Why/how?** If developed waters for desert bighorn sheep are not maintained and supplied with water, the refuge populations would risk becoming severely depleted or extirpated. These waters compensate for anthropogenic decimating factors not operating on the desert bighorn sheep populations prior to modern times.
2. If the issue/problem goes unresolved, or action is not taken, will the values of solitude or primitive and unconfined type of recreation be threatened? **No**
3. If the issue/problem goes unresolved or action is not taken will evidence of human manipulation, permanent improvements, or human habitation be substantially noticeable? **No**
4. Does addressing the issue/problem or taking action protect the wilderness as a whole, as opposed to a single resource? **Yes Why/How?** The desert bighorn sheep, considered a wilderness dependent species by several researchers (Leopold, 1933; Hendee et al., 2002), is a key indicator of naturalness of the wilderness. Species conservation is thus consistent with wilderness values.
5. Does addressing this issue/problem or taking action contribute to protection of enduring wilderness for future generations? **Yes Why/How?** This issue is directly related to conservation of a wilderness dependent species.

6. Is this an issue for reasons other than convenience or cost of administration? **Yes**
Why/How? Conservation of desert bighorn sheep is a refuge purpose

Step 1 conclusion: As administering the activity in non-wilderness areas only is not feasible, and the activity will protect some wilderness values (four of six questions above answered “yes”) it is appropriate to administer the activity in wilderness.

Step 2, Determining the Minimum Tool

Identify and describe the range of alternatives, including those that utilize traditional tools and non-motorized and mechanized as well as other methods.

Alternative 1

The Refuge will continue to maintain the waters as necessary, accessing the waters on foot and using hand tools such as shovels. The refuge will haul water to the developed waters, as necessary to prevent their going dry, using a 3,578-liter (1,500-gallon) heavy truck operating on refuge administrative trails

Does this alternative involve:

- | | |
|--|---|
| Use of temporary road? | Yes |
| Use of motor vehicles? | Yes |
| Use of motorized equipment? | No |
| Landing of airplanes? | No |
| Landing of helicopters? | No |
| Use of mechanical transport? | No |
| Creating a structure or installation? | No |
| Other impacts to wilderness character? | Yes Why/How? Maintaining developed waters adversely affects untrammeled character. |

Describe the biophysical effects/benefits of this alternative: implementing this alternative is consistent with conservation of desert bighorn sheep. The physical effects of fewer than 20 truck trips on administrative trails per year should be negligible, given the routine use of these trails by border law enforcement personnel.

Describe the social/recreation effects/benefits: the operation of trucks in wilderness has a very negative effect on recreationists who see or hear them. This potential impact is mitigated by the fact that water hauling occurs entirely during the hottest period of the summer, when visitation to the refuge is extremely low.

Describe the societal/political effects/benefits: the operation of heavy trucks in a federal wilderness area, regardless of the validity of doing so to maintain wilderness wildlife populations, is contrary to overall wilderness values, and causes a strongly negative reaction from members of society that highly value wilderness values.

Describe health and safety concerns/benefits: None.

Describe economic and timing considerations/benefits: None

Describe heritage resource considerations/benefits: None

Alternative 2

The refuge will continue to maintain the developed waters in desert bighorn sheep habitat in wilderness as described for Alternative 1. The refuge will haul water to the developed waters, as needed to keep them from going dry, using a pack string of horses, mules, or burros.

Does this alternative involve:

Use of temporary road?	No
Use of motor vehicles?	No
Use of motorized equipment?	No
Landing of airplanes?	No
Landing of helicopters?	No
Use of mechanical transport?	No
Creating a structure or installation?	No
Other impacts to wilderness character?	No

Describe the biophysical effects/benefits of this alternative: implementing this alternative would keep the developed waters from going dry, but would require very high numbers of pack animals on the refuge. One horse, mule or burro can carry approximately 95 liters (25 gallons) of water, and two additional animals are needed to carry drinking water for every ten pack animals. Replacing each trip by the 5,678-liter (1,500-gallon) water truck would thus require approximately 72 pack animal trips. This level of stock use on the refuge is unprecedented, and would result in changes in vegetation along the haul route from grazing, as well as disturbance of native wildlife from the presence of so much saddle/pack stock.

Describe the social and recreational benefits: refuge visitors observing pack strings would consider their visit affected, either positively or negatively. The importance of this potential impact is mitigated in that water hauling occurs during the hottest period of the summer, when refuge visitation is very low.

Describe the societal/political effects/benefits: None

Describe health and safety concerns/benefits: water hauling typically occurs during the hottest months of the year. Travel by pack and saddle stock during these conditions would subject both the human packers and saddle/pack animals to extreme heat stress.

Describe economic and timing considerations/benefits: there are currently no commercial stock leasing companies in the refuge region. Implementing this alternative would require that the refuge maintain a large herd of pack stock. Additional staff would be needed to husband the stock, and refuge land would have to be acquired or converted from native wildlife habitat to support the herd.

Describe heritage resource considerations/benefits: use of mule pack strings on the refuge would be a return of a traditional use dating back to Eighteenth Century.

Alternative 3

The Refuge will continue to maintain the waters as necessary, accessing the waters on foot and using hand tools such as shovels. The refuge will haul water to the developed waters, as necessary to prevent their going dry, using aerial drops of water from helicopters

Does this alternative involve:

Use of temporary road?	No
Use of motor vehicles?	No
Use of motorized equipment?	No
Landing of airplanes?	No
Landing of helicopters?	No (no landing proposed)
Use of mechanical transport?	No (not on the wilderness ground surface)
Creating a structure or installation?	No
Other impacts to wilderness character?	No

Describe the biophysical effects/benefits of this alternative: this alternative would keep the developed waters in desert bighorn sheep habitat from going dry. This benefit would be offset, however by impacts to wildlife from the noise and rotor wash of frequent low altitude helicopter operation over the refuge. While border patrol helicopters regularly operate over the refuge wilderness, the aircraft required to haul water would be considerably larger and would operate at very low altitudes.

Describe the social/recreational effects/benefits: low altitude use of helicopters is very jarring to wilderness visitors. The importance of this potential impact is mitigated in that water hauling occurs during the hottest period of the summer, when refuge visitation is very low.

Describe the societal/political effects/benefits: the use of heavy helicopters over a federal wilderness area, while not directly regulated by the Wilderness Act, is contrary to overall wilderness values, and causes a strongly negative reaction from members of society that highly value wilderness values.

Describe economic and timing considerations/benefits: helicopter operational costs vary directly with the size of the aircraft, but generally exceed \$1,000 per hour. Hauling water by helicopter would exhaust the existing refuge operational budget during drought years.

Describe heritage resource consideration/benefits: None.

Sheet 4: Selection of Minimum Tool Alternative

The Selected Alternative is number 1. This alternative, while requiring some operation of vehicles on refuge administrative trails, would cause lower disturbance to habitat than the use of large numbers of water hauling trips by pack stock (Alternative 2) or disturbance of wildlife and wilderness solitude than hauling by helicopter (Alternative 3).

What are the maintenance requirements? No additional of maintenance of refuge administrative trails or non-wilderness access roads would be required due to implementation of this alternative.

What standards and designs will apply? None

Develop and describe any mitigation measures that apply: water hauling trips will only be made when, in the best professional opinion of refuge biologists, there is a danger that the developed water will go dry within one week. Refuge vehicles operating on administrative trails will proceed at low speeds to limit dust and noise generation.

What will be provided for monitoring and feedback to strengthen future efforts and preventative actions to be taken to help in future efforts? The refuge will keep a log of all vehicle miles driven in wilderness for water hauling. This record will be available for public review.

Action 14: Redeveloping desert bighorn sheep developed waters in refuge wilderness.

The refuge has plans to redevelop ten of the developed waters in wilderness desert bighorn sheep habitat. The proposed improvements include placing water storage tanks with multiple point rainwater collectors under cement covers shaped and tinted to resemble the surrounding natural bedrock. The water tanks would supply water to small drinking troughs near the location of the existing developed water. Such improved desert bighorn sheep waters have been constructed in desert regions of Southern California, and have provided reliable water sources requiring very little supplemental water hauling maintenance. They also have very little visual impact, as most of the components are hidden by a natural-appearing cement cover (John Herbert, AGFD, peers. comm., 2002).

Minimum Requirements Questions

Step 1. Is the action necessary to administer the Wilderness?

1. Is this an emergency? **No.**
2. Is this problem/issue subject to valid existing rights, such as access to valid mining claim, state lands, etc.? **No**
3. Can the problem/issue be addressed by administrative actions outside a wilderness area? **No** The developed waters proposed for improvement are located within refuge wilderness, and the proposed improvements are aimed at making their continued operation less intrusive on wilderness character
4. Is there a special provision in legislation that allows this project activity? **No.**

Step 1, Continued: does resolving the issue/problem protect wilderness character and values identified in the Wilderness Act.

1. If the issue/problem is not resolved, or action not taken, will the natural processes of the wilderness be adversely affected? **No**
2. If the issue/problem goes unresolved, or action is not taken, will the values of solitude or primitive and unconfined type of recreation be threatened? **No**
3. If the issue/problem goes unresolved or action is not taken will evidence of human manipulation, permanent improvements, or human habitation be substantially noticeable? **Yes Why/How?** Several of the existing developed waters in desert bighorn sheep habitat are highly visually intrusive, artificial appearing structures. The proposed action would replace these structures with natural appearing ones that are not substantially noticeable.
4. Does addressing the issue/problem or taking action protect the wilderness as a whole, as opposed to a single resource? **Yes Why/How?** – the proposed upgrades to desert bighorn sheep waters would reduce the unnatural appearance of these features and also significantly reduce the need to haul water in wilderness, thus reducing vehicle use.
5. Does addressing this issue/problem or taking action contribute to protection of enduring wilderness for future generations? **Yes Why/How?** The proposed upgrades to developed waters should be long lasting.
6. Is this an issue for reasons other than convenience or cost of administration? **Yes Why/How?** While the proposed upgrades would increase the efficiency of wilderness administrations, they would also reduce visual intrusion and reduce vehicle operation in wilderness.

Step 1 conclusion: As administering the activity in non-wilderness areas only is not feasible, and the activity will protect some wilderness values (four of six questions above answered “yes”) it is appropriate to administer the activity in wilderness.

Step 2, Determining the Minimum Tool

Identify and describe the range of alternatives, including those that utilize traditional tools and non-motorized and mechanized as well as other methods.

Alternative 1

The Refuge will redevelop ten existing developed waters in desert bighorn sheep habitat within the refuge wilderness. The refuge will use volunteer labor from various non-profit organizations and all excavation will be done by hand using hand shovels and pickaxes (primitive tool). Work crews will hike to the project sites from non-wilderness access points. A batch cement mixer with concrete and water, the water reservoir systems and necessary concrete reinforcement material will be airlifted to the sites by helicopters. This would require 19 to 22 round trips to and from the work site for each redevelopment project. Complete excavation, installation and covering will require two weeks per developed water, and the ten-person crews will camp near the site during this period.

Does this alternative involve:

Use of temporary road?	No
Use of motor vehicles?	No
Use of motorized equipment?	Yes
Landing of airplanes?	No
Landing of helicopters?	Yes
Use of mechanical transport?	No
Creating a structure or installation?	Yes
Other impacts to wilderness character?	Yes Temporary disturbance of solitude due to large work crew camping for two weeks per project.

Describe the biophysical effects/benefits of this alternative: implementing this alternative would result in the presence of ten-person work crews on each project site for two weeks per project would create a problem with heavy loads of human sanitary waste in a typically very low organic load environment. Use of helicopters for multiple low level flights to deliver materials would adversely impact wildlife and wilderness solitude.

Describe social/recreation effects/benefits: implementing this alternative would result in many low-altitude helicopter flights over the refuge wilderness and the presence of work crews at the wilderness work site for two weeks per project. The increased noise and activity associated with these activities could disrupt another visitor's opportunities to enjoy wilderness solitude and an unconfined type of primitive recreation.

Describe health and safety concerns/benefits: None.

Describe economic and timing considerations/benefits: None.

Describe heritage resource considerations/benefits: None

Alternative 2

The Refuge will redevelop ten existing developed waters in desert bighorn sheep habitat within the refuge wilderness. The refuge will use volunteer labor from various non-profit organizations. Work crews will hike to the project sites from non-wilderness access points. Excavation will be done by a backhoe driven to the site on non-wilderness access roads and refuge administrative trails. A batch cement mixer with concrete and water, the water reservoir systems and necessary concrete reinforcement materials will be delivered to the site by truck via non-wilderness access roads and refuge administrative trails. Complete excavation, installation and covering will require three round trips to and from the work site per developed water, and the ten-person crews will camp near the site during this period.

Does this alternative involve:

Use of temporary road?	Yes
Use of motor vehicles?	Yes
Use of motorized equipment?	Yes
Landing of airplanes?	No
Landing of helicopters?	No
Use of mechanical transport?	No
Creating a structure or installation?	Yes
Other impacts to wilderness character?	Yes temporary disturbance of wilderness solitude by operation of construction equipment and the presence of a work crew in the wilderness.

Describe the biophysical effects/benefits of this alternative: this alternative would result in temporary disturbance of wildlife and soil surfaces. The presence of ten-person work crews on each project site for three days per project would cause much fewer problems associated with waste than would the longer duration of stay necessary under the first alternative.

Describe social/recreation effects/benefits: in presence of mechanized equipment (a backhoe and cement batch mixer) and the work crews at the work site could disrupt another visitor's opportunities to enjoy wilderness solitude and an unconfined type of primitive recreation. While this would be a more intense invasion of the visitor's experience due to the presence of additional mechanized equipment, the overall much shorter time frame (two versus 14 days) would minimize the likelihood of a visitor being affected.

Describe health and safety concerns/benefits: None.

Describe economic and timing considerations/benefits: None.

Describe heritage resource considerations/benefits: None

Sheet 4: Selection of Minimum Tool Alternative

The Selected Alternative is number 2. This alternative, while requiring some operation of vehicles on refuge administrative trails and motorized equipment in refuge wilderness, would cause a much shorter duration of disturbance.

What are the maintenance requirements? No additional of maintenance of refuge administrative trails or non-wilderness access roads would be required due to implementation of this alternative.

What standards and designs will apply? The vault covering the reservoir system would be shaped and colored to resemble natural rock in the area of the developed water.

Develop and describe any mitigation measures that apply: when construction is complete, all grades will be returned as close as is possible to pre-construction contour. During soil disturbance, the refuge will implement erosion controls and other best management practices to minimize erosion and dust generation.

What will be provided for monitoring and feedback to strengthen future efforts and preventative actions to be taken to help in future efforts? The refuge will take pre- and post construction photographs of each site and will periodically monitor project sites for erosion or settling.

Action 15: Mountain lion management

The refuge will initiate study of mountain lion predation on desert bighorn sheep, mountain lion movement in relation to desert bighorn sheep and use of developed waters in desert bighorn sheep habitat. Should the results of this study indicate excessive predation on desert bighorn sheep by mountain lion, predator population control measures will be implemented.

Minimum Requirements Questions

Step 1. Is the action necessary to administer the Wilderness?

1. Is this an emergency? **No**
2. Is this problem/issue subject to valid existing rights, such as access to valid mining claim, state lands, etc.? **No**
3. Can the problem/issue be addressed by administrative actions outside a wilderness area? **No** – only a small fraction of the refuge desert bighorn sheep habitat occurs outside of wilderness. Conducting predation studies on this portion of the species' range would produce biased results.
4. Is there a special provision in legislation that allows this project activity? **No**

Step 1, Continued: does resolving the issue/problem protect wilderness character and values identified in the Wilderness Act.

1. If the issue/problem is not resolved, or action not taken, will the natural processes of the wilderness be adversely affected? **No**
2. If the issue/problem goes unresolved, or action is not taken, will the values of solitude or primitive and unconfined type of recreation be threatened? **No**
3. If the issue/problem goes unresolved or action is not taken will evidence of human manipulation, permanent improvements, or human habitation be substantially noticeable? **No**
4. Does addressing the issue/problem or taking action protect the wilderness as a whole, as opposed to a single resource? **No** – the proposed action is aimed as single species conservation.
5. Does addressing this issue/problem or taking action contribute to protection of enduring wilderness for future generations? **Yes Why/How?** This issue is directly related to conservation of desert bighorn sheep, a wilderness dependent wildlife species.
6. Is this an issue for reasons other than convenience or cost of administration? **Yes Why/How?** This action is proposed to further one of the refuge purposes, conservation of desert bighorn sheep.

Step 1 conclusion: As administering the activity in non-wilderness areas only is not feasible, and the activity will protect some wilderness values (two of six questions above answered "yes") it is appropriate to administer the activity in wilderness.

Step 2, Determining the Minimum Tool

Identify and describe the range of alternatives, including those that utilize traditional tools and non-motorized and mechanized as well as other methods.

Alternative 1

Refuge staff or contracted trappers will set padded leg-hold traps to capture mountain lions for radio collaring. The trapper will walk to and from the trap line from a non-wilderness access point. The traps will be placed and baited to avoid capture of non-target species (primarily birds of prey). Any non-target species will be released from the traps. Trap lines will be checked daily to minimize injury/stress to captured animals.

Mountain lion removal (only if warranted by demonstrated deleterious predation on desert bighorn sheep) will be accomplished by calling in mountain lions with a commercially produced predator call and shooting. The shooter will walk to and from the site from a non-wilderness access point.

Does this alternative involve:

Use of temporary road?	No
Use of motor vehicles?	No
Use of motorized equipment?	No
Landing of airplanes?	No
Landing of helicopters?	No
Use of mechanical transport?	No
Creating a structure or installation?	No
Other impacts to wilderness character?	Yes Placing radio collars on native wildlife, possibly reducing natural predation.

Describe the biophysical effects/benefits of this alternative: other than potentially changing the predator density, this alternative would have little effect on wilderness biophysical conditions. Trapping to radio collar mountain lions may prove ineffective, as there are few trappers with experience trapping this species in Arizona (John Morgart, USFWS, pers. comm., 2004). This alternative could also result in reduction of natural predation, should predator control be implemented.

Describe the social recreational benefits: implementing this alternative could result in conflicts between mountain lion trappers/control personnel and recreational visitors. The likelihood of such conflict however is low due to very low levels of backcountry visitation at the refuge.

Describe the societal/political effects/benefits: predator control, a potential outcome of this action, is a controversial practice. Groups and individuals opposed to lethal control would be adversely affected should predator control be implemented under this alternative.

Describe health and safety and concerns/benefits: None

Describe economic and timing considerations/benefits: None

Describe heritage resource considerations/benefits: None

Alternative 2

Refuge or AGFD staff will capture mountain lions for radio collaring using net guns fired from helicopters. The helicopter will then land nearby and staff will exit the helicopter to collar and release the captured animals.

Mountain lion removal (only if warranted by demonstrated deleterious predation on desert bighorn sheep) will be accomplished by calling in mountain lions with a commercially produced predator call and shooting. The shooter will walk to and from the site from a non-wilderness access point.

Does this alternative involve:

Use of temporary road?	No
Use of motor vehicles?	No
Use of motorized equipment?	No
Landing of airplanes?	No
Landing of helicopters?	Yes
Use of mechanical transport?	No
Creating a structure or installation?	No
Other impacts to wilderness character?	Yes Placing radio collars on native wildlife, possibly reducing natural predation.

Describe the biophysical effects/benefits of this alternative: implementing this alternative would result in the landing of helicopters in wilderness. The noise and rotor wash from the helicopters would adversely affect refuge wildlife and soils. This alternative could also result in artificial depression of the refuge mountain lion population, should predator control be implemented.

Describe the social recreational benefits: observing or hearing low altitude operation and land of helicopters in the refuge wilderness would greatly compromise the wilderness recreational visitor. Similarly the possibility of conflicts between recreational visitors and mountain lion removal personnel exists. The likelihood of such conflict however is low due to very low levels of backcountry visitation at the refuge.

Describe the societal/political effects/benefits: predator control, as proposed, is a controversial practice. Groups and individuals opposed to lethal control would be adversely affected should predator control be implemented under this alternative.

Describe health and safety and concerns/benefits: None

Describe economic and timing considerations/benefits: None

Describe heritage resource considerations/benefits: None

Sheet 4: Selection of Minimum Tool Alternative

The Selected Alternative is number 2. Occasional use and landing of helicopters in wilderness, while more intrusive than the placement of traps, is preferred due to its greater effectiveness in obtaining a sample of the refuge mountain lion population.

What are the maintenance requirements? No additional maintenance would be required.

What standards and designs will apply? None

Develop and describe any mitigation measures that apply: none.

What will be provided for monitoring and feedback to strengthen future efforts and preventative actions to be taken to help in future efforts? None.

Action 16: Meteorological, vegetation, and wilderness impact monitoring

In 1999 the refuge initiated a program of annually surveying 25 pairs of plots in wilderness, one of each pair adjacent to a non-wilderness access road or administrative trail, the other in similar habitat more distant from any road or trail, for a variety of impacts. In 2002 the refuge established vegetation transects in various plant communities. Annual monitoring of these stations, plots and transects will provide a record of long-term changes in wilderness conditions on the refuge, both background changes caused by outside factors such as climate and local effects caused by on-site uses.

Minimum Requirements Questions

Step 1. Is the action necessary to administer the Wilderness?

1. Is this an emergency? **No**
2. Is this problem/issue subject to valid existing rights, such as access to valid mining claim, state lands, etc.? **No**
3. Can the problem/issue be addressed by administrative actions outside a wilderness area? **No** – monitoring within wilderness is necessary to detect changes in wilderness conditions.
4. Is there a special provision in legislation that allows this project activity? **No**.

Step 1, Continued: does resolving the issue/problem protect wilderness character and values identified in the Wilderness Act.

1. If the issue/problem is not resolved, or action not taken, will the natural processes of the wilderness be adversely affected? **No**
2. If the issue/problem goes unresolved, or action is not taken, will the values of solitude or primitive and unconfined type of recreation be threatened? **No**
3. If the issue/problem goes unresolved or action is not taken will evidence of human manipulation, permanent improvements, or human habitation be substantially noticeable? **No**
4. Does addressing the issue/problem or taking action protect the wilderness as a whole, as opposed to a single resource? **Yes Why/How?** Monitoring will provide valuable information about the physical and biological condition of the refuge wilderness.
5. Does addressing this issue/problem or taking action contribute to protection of enduring wilderness for future generations? **Yes Why/How?** This long-term monitoring is designed specifically to identify, and facilitate response to, long-term trends of wilderness impact.
6. Is this an issue for reasons other than convenience or cost of administration? **Yes Why/How?** The issue is collection of appropriate data.

Step 1 conclusion: As administering the activity in non-wilderness areas only is not feasible, and the activity will protect some wilderness values (three of six questions above answered “yes”) it is appropriate to administer the activity in wilderness.

Step 2, Determining the Minimum Tool

Identify and describe the range of alternatives, including those that utilize traditional tools and non-motorized and mechanized as well as other methods.

Alternative 1

Refuge staff access study plots and vegetation transects on foot from the nearest non-wilderness access point.

Does this alternative involve:

Use of temporary road?	No
Use of motor vehicles?	No
Use of motorized equipment?	No
Landing of airplanes?	No
Landing of helicopters?	No
Use of mechanical transport?	No
Creating a structure or installation?	No
Other impacts to wilderness character?	No

Describe the biophysical effects/benefits of this alternative: no direct biophysical effects; this alternative serves to gather data.

Describe the social recreational benefits: None

Describe the societal/political effects/benefits: None.

Describe health and safety and concerns/benefits: None

Describe economic and timing considerations/benefits: None

Describe heritage resource considerations/benefits: None

Sheet 4: Selection of Minimum Tool Alternative

Alternative 1 is the only alternative examined, as it is fully compliant with the Wilderness Act of 1964 and satisfies the refuge's data needs.

What are the maintenance requirements? No facilities will be maintained in wilderness.

What standards and designs will apply? Only survey/monitoring protocols will apply. These affect the execution of fieldwork, not wilderness features.

Develop and describe any mitigation measures that apply: none.

What will be provided for monitoring and feedback to strengthen future efforts and preventative actions to be taken to help in future efforts? The refuge will maintain survey/monitoring records.

Action 17: Exotic/invasive species control

Several plant species not native to the refuge have the potential to become established at infestation levels. Control of such infestations is necessary to prevent degradation of habitat and ecological communities on the refuge.

Minimum Requirements Questions

Step 1. Is the action necessary to administer the Wilderness?

1. Is this an emergency? **No**
2. Is this problem/issue subject to valid existing rights, such as access to valid mining claim, state lands, etc.? **No**
3. Can the problem/issue be addressed by administrative actions outside a wilderness area? **No** – the exotic/invasive species must be controlled where they occur.
4. Is there a special provision in legislation that allows this project activity? **No**.

Step 1, Continued: does resolving the issue/problem protect wilderness character and values identified in the Wilderness Act.

1. If the issue/problem is not resolved, or action not taken, will the natural processes of the wilderness be adversely affected? **Possibly** – the extent of infestations does not currently constitute an unnatural condition in the refuge wilderness, but the infestations could expand to create unnatural plant composition over large areas in the absence of control actions.
2. If the issue/problem goes unresolved, or action is not taken, will the values of solitude or primitive and unconfined type of recreation be threatened? **No**
3. If the issue/problem goes unresolved or action is not taken will evidence of human manipulation, permanent improvements, or human habitation be substantially noticeable? **No**
4. Does addressing the issue/problem or taking action protect the wilderness as a whole, as opposed to a single resource? **Yes. Why/How?** Controlling invasive species will protect natural processes in wilderness.
5. Does addressing this issue/problem or taking action contribute to protection of enduring wilderness for future generations? **Yes Why/How?** Conversion of natural habitats by invading exotic species degrades the natural character of wilderness areas over time. Control of exotic/invasive species should help to preserve the natural character of the wilderness for future generations.
6. Is this an issue for reasons other than convenience or cost of administration? **Yes Why/How?** The issue is ecological community protection.

Step 1 conclusion: As administering the activity in non-wilderness areas only is not feasible, and the activity will protect some wilderness values (three of six questions above answered “yes”) it is appropriate to administer the activity in wilderness.

Step 2, Determining the Minimum Tool

Identify and describe the range of alternatives, including those that utilize traditional tools and non-motorized and mechanized as well as other methods.

Alternative 1

Refuge staff will be trained to recognize all exotic plants that have the potential of becoming infested on the refuge. During regular refuge management activities the staff will note the locations of all such species observed. Newly identified small clumps of fountain grass will be removed by hand pulling to contain its spread. Any access to wilderness specifically focused on invasive species control or survey will be on foot from a non-wilderness access point.

Does this alternative involve:

Use of temporary road?	No
Use of motor vehicles?	No
Use of motorized equipment?	No
Landing of airplanes?	No
Landing of helicopters?	No
Use of mechanical transport?	No
Creating a structure or installation?	No
Other impacts to wilderness character?	No

Describe the biophysical effects/benefits of this alternative: some reduction of the spread of fountain grass, but primarily collection of data.

Describe the social recreational benefits: None

Describe the societal/political effects/benefits: None.

Describe health and safety and concerns/benefits: None

Describe economic and timing considerations/benefits: None

Describe heritage resource considerations/benefits: None

Sheet 4: Selection of Minimum Tool Alternative

Alternative 1 is the only alternative examined, as it is fully compliant with the Wilderness Act of 1964 and satisfies the refuge's data needs.

What are the maintenance requirements? No facilities will be maintained in wilderness.

What standards and designs will apply? Only survey/monitoring protocols will apply. These affect the execution of fieldwork, not wilderness features.

Develop and describe any mitigation measures that apply: none.

What will be provided for monitoring and feedback to strengthen future efforts and preventative actions to be taken to help in future efforts? The refuge will maintain survey/monitoring records.

Note: if the refuge determines that infestations of exotic/invasive are sufficiently extensive as to require aggressive control treatments, a control plan will be developed, and subjected to minimum requirements analysis.

Action 18: Abandoned Vehicle Removal

Many motor vehicles are abandoned every year in the refuge wilderness by undocumented aliens or smugglers. The refuge removes the vehicles as quickly as possible after they are found.

Minimum Requirements Questions

Step 1. Is the action necessary to administer the Wilderness?

1. Is this an emergency? **No**
2. Is this problem/issue subject to valid existing rights, such as access to valid mining claim, state lands, etc.? **No**
3. Can the problem/issue be addressed by administrative actions outside a wilderness area? **No** – the vehicles in question are in wilderness.
4. Is there a special provision in legislation that allows this project activity? **No**.

Step 1, Continued: does resolving the issue/problem protect wilderness character and values identified in the Wilderness Act.

1. If the issue/problem is not resolved, or action not taken, will the natural processes of the wilderness be adversely affected? **No**.
2. If the issue/problem goes unresolved, or action is not taken, will the values of solitude or primitive and unconfined type of recreation be threatened? **Yes, Why/how?** The abandoned vehicles are very visually jarring in the wilderness. Encountering an abandoned vehicle in wilderness would adversely affect a visitor's experience of wilderness.
3. If the issue/problem goes unresolved or action is not taken will evidence of human manipulation, permanent improvements, or human habitation be substantially noticeable? **Yes Why/How?** Vehicles will remain in the refuge wilderness.
4. Does addressing the issue/problem or taking action protect the wilderness as a whole, as opposed to a single resource? **Yes Why/How?** The presence of abandoned vehicles adversely affects several elements of wilderness character.
5. Does addressing this issue/problem or taking action contribute to protection of enduring wilderness for future generations? **Yes. Why/How?** Vehicles not removed would remain in the wilderness for many years.
6. Is this an issue for reasons other than convenience or cost of administration? **Yes. Why/How?** The issue addresses a direct impact to wilderness.

Step 1 conclusion: As administering the activity in non-wilderness areas only is not feasible, and the activity will protect some wilderness values (five of six questions above answered "yes") it is appropriate to administer the activity in wilderness.

Step 2, Determining the Minimum Tool

Identify and describe the range of alternatives, including those that utilize traditional tools and non-motorized and mechanized as well as other methods.

Alternative 1

Refuge staff will tow the vehicle to the nearest non-wilderness road, typically El Camino del Diablo, using a refuge vehicle. Whenever feasible, the vehicle will be towed along its entry track, thus avoiding new impacts to wilderness. Once removed to a road outside of wilderness, a commercial towing company will haul the vehicle off of the refuge. The refuge will also examine the feasibility entering a memorandum of agreement with adjacent military commands to make heavy-lift military helicopters available for removing abandoned vehicles from refuge wilderness.

Does this alternative involve:

Use of temporary road?	Yes (in some cases the vehicle will be towed along administrative trails, as unauthorized vehicles often use them)
Use of motor vehicles?	Yes
Use of motorized equipment?	No
Landing of airplanes?	No
Landing of helicopters?	Potentially (only if an agreement with the Military is reached)
Use of mechanical transport?	No
Creating a structure or installation?	No
Other impacts to wilderness character?	No

Describe the biophysical effects/benefits of this alternative: some new rutting could occur during vehicle removal.

Describe the social recreational benefits: while witnessing actual removal operations would disturb a visitor's wilderness experience, the overall result of removing abandoned vehicles would be enhancement of the recreational value of the wilderness.

Describe the societal/political effects/benefits: None.

Describe health and safety and concerns/benefits: None

Describe economic and timing considerations/benefits: None

Describe heritage resource considerations/benefits: None

Alternative 2

Refuge staff will tow the vehicle to the nearest non-wilderness road, typically El Camino del Diablo, using draft horses or oxen. The draft animals will be hauled to nearest non-wilderness access point in a stock trailer and then led to location of the abandoned vehicle by the shortest route. The vehicle would be towed out of the wilderness along its entry track, if feasible, to avoid new impacts to wilderness. Once removed to a road outside of wilderness, a commercial towing company will haul the vehicle off of the refuge.

Does this alternative involve:

Use of temporary road?	No
Use of motor vehicles?	No
Use of motorized equipment?	No
Landing of airplanes?	No
Landing of helicopters?	No
Use of mechanical transport?	No
Creating a structure or installation?	No
Other impacts to wilderness character?	No

Describe the biophysical effects/benefits of this alternative: some new rutting could occur during vehicle removal.

Describe the social recreational benefits: the overall result of removing abandoned vehicles would be enhancement of the recreational value of the wilderness.

Describe the societal/political effects/benefits: None.

Describe health and safety and concerns/benefits: trailering stock along non-wilderness access roads could lead to some problems with the tow vehicles and trailers becoming stuck due to the poor condition of those roads.

Describe economic and timing considerations/benefits: None

Describe heritage resource considerations/benefits: this alternative would use traditional methods consistent with the pre-industrial period.

Sheet 4: Selection of Minimum Tool Alternative

The Selected Alternative is number 1. The overall efficiency and reliability of this alternative recommends it.

What are the maintenance requirements? No facilities will be maintained in wilderness.

What standards and designs will apply? None.

Develop and describe any mitigation measures that apply: the tow vehicle will be operated at low speed. If the abandoned vehicle has functional steering, it will be steered while in tow to limit any travel beyond the area already disturbed.

What will be provided for monitoring and feedback to strengthen future efforts and preventative actions to be taken to help in future efforts? The refuge will maintain records of vehicles removed.

Note: if the refuge enters a memorandum of agreement with the military to use heavy-lift helicopters to remove abandoned vehicles, a separate analysis will be completed.

Action 19: Military debris removal

The primary military debris issue on the refuge is the presence of up to 1,600 old aerial gunnery tow darts scattered throughout the wilderness. These are wood and aluminum structures approximately 4 meters (13 feet) long with a cement weight. They were formerly towed behind aircraft and used as targets for air-to-air gunnery. Tow darts are an unnatural element in the refuge that can be highly visible when reflecting sunlight, and tow cable can entangle wildlife.

Step 1. Is the action necessary to administer the Wilderness?

1. Is this an emergency? **No**
2. Is this problem/issue subject to valid existing rights, such as access to valid mining claim, state lands, etc.? **No**
3. Can the problem/issue be addressed by administrative actions outside a wilderness area? **No** – the debris in question is in wilderness.
4. Is there a special provision in legislation that allows this project activity? **No**.

Step 1, Continued: does resolving the issue/problem protect wilderness character and values identified in the Wilderness Act.

1. If the issue/problem is not resolved, or action not taken, will the natural processes of the wilderness be adversely affected? **No**.
2. If the issue/problem goes unresolved, or action is not taken, will the values of solitude or primitive and unconfined type of recreation be threatened? **Yes, Why/how?** The old tow darts are very visually jarring in the wilderness. Encountering one in wilderness would adversely affect a visitor's experience.
3. If the issue/problem goes unresolved or action is not taken will evidence of human manipulation, permanent improvements, or human habitation be substantially noticeable? **Yes Why/How?** Modern artifacts will remain in the refuge wilderness.
4. Does addressing the issue/problem or taking action protect the wilderness as a whole, as opposed to a single resource? **Yes Why/How?** The presence of military debris adversely affects several elements of wilderness character.
5. Does addressing this issue/problem or taking action contribute to protection of enduring wilderness for future generations? **Yes. Why/How?** Debris not removed would remain in the wilderness for many years.
6. Is this an issue for reasons other than convenience or cost of administration? **Yes. Why/How?** The issue addresses a direct impact to wilderness.

Step 1 conclusion: As administering the activity in non-wilderness areas only is not feasible, and the activity will protect some wilderness values (five of six questions above answered "yes") it is appropriate to administer the activity in wilderness.

Step 2, Determining the Minimum Tool

Identify and describe the range of alternatives, including those that utilize traditional tools and non-motorized and mechanized as well as other methods.

Alternative 1

Refuge staff and volunteers will walk to the tow dart or tow cable, cut it into manageable pieces with hand tools and carry the pieces out of the wilderness. The cement weights from the nose of each dart would be left in an inconspicuous location, as they are too heavy to carry for any great distance (greater than 75 kilograms [165 pounds]).

Does this alternative involve:

Use of temporary road?	No
Use of motor vehicles?	No
Use of motorized equipment?	No
Landing of airplanes?	No
Landing of helicopters?	No
Use of mechanical transport?	No
Creating a structure or installation?	No
Other impacts to wilderness character?	No

Describe the biophysical effects/benefits of this alternative: implementing this alternative would remove tow cable, which may cause injury to wildlife.

Describe the social recreational benefits: implementing this alternative would remove evidence of modern military use of the wilderness.

Describe the societal/political effects/benefits: None.

Describe health and safety and concerns/benefits: removal would occur during cool times of the year to limit stress on personnel.

Describe economic and timing considerations/benefits: None

Describe heritage resource considerations/benefits: None

Alternative 2

Refuge staff and volunteers will use a truck to haul tow darts out of the wilderness. The route to each tow dart will be planned to require the minimum distance driven on administrative trails or wilderness soil.

Does this alternative involve:

Use of temporary road?	Yes
Use of motor vehicles?	Yes
Use of motorized equipment?	No
Landing of airplanes?	No
Landing of helicopters?	No
Use of mechanical transport?	No
Creating a structure or installation?	No
Other impacts to wilderness character?	No

Describe the biophysical effects/benefits of this alternative: implementing this alternative would result in soil disturbance and vehicle tracks in previously pristine areas.

Describe the social recreational benefits: implementing this alternative would remove tow darts and tow cable, which presently cause adverse effects to wilderness recreation visitors.

Describe the societal/political effects/benefits: the proposed use of vehicles in wilderness beyond the limits of administrative trails would adversely affect groups and individuals who value wilderness.

Describe health and safety and concerns/benefits: None.

Describe economic and timing considerations/benefits: None

Describe heritage resource considerations/benefits: none.

Alternative 3

Refuge staff and volunteers will access the tow dart or tow cable, using a horse-drawn wagon. Tow darts and cable will be loaded onto the wagon and hauled out of wilderness for disposal.

Does this alternative involve:

Use of temporary road?	No
Use of motor vehicles?	No
Use of motorized equipment?	No
Landing of airplanes?	No
Landing of helicopters?	No
Use of mechanical transport?	Yes
Creating a structure or installation?	No
Other impacts to wilderness character?	No

Describe the biophysical effects/benefits of this alternative: implementing this alternative would create some wheel ruts in previously pristine areas of the refuge. This alternative would also remove tow cable, which may cause injury to some wildlife.

Describe the social recreational benefits: implementing this alternative would remove evidence of modern military use of the wilderness.

Describe the societal/political effects/benefits: None.

Describe health and safety and concerns/benefits: removal would occur during cool times of the year to limit stress on personnel.

Describe economic and timing considerations/benefits: implementing this alternative would require obtaining draft horses and a suitable wagon.

Describe heritage resource considerations/benefits: None

Sheet 4: Selection of Minimum Tool Alternative

The Selected Alternative is number 1. While this alternative would leave cement dart weights in the wilderness, these are inert and could be moved short distances to sites where they would be inconspicuous.

What are the maintenance requirements? None

What standards and designs will apply? None.

Develop and describe any mitigation measures that apply: None

What will be provided for monitoring and feedback to strengthen future efforts and preventative actions to be taken to help in future efforts? None

Action 20: Cultural resource site reconnaissance and stabilization

The CCP calls for periodic reconnaissance of known cultural resources sites to identify any damage or signs of vandalism. Sites that have become exposed and unstable will be stabilized.

Step 1. Is the action necessary to administer the Wilderness?

1. Is this an emergency? **No**
2. Is this problem/issue subject to valid existing rights, such as access to valid mining claim, state lands, etc.? **No**
3. Can the problem/issue be addressed by administrative actions outside a wilderness area? **No** – the some of the cultural resources sites are in wilderness.
4. Is there a special provision in legislation that allows this project activity? **No**.

Step 1, Continued: does resolving the issue/problem protect wilderness character and values identified in the Wilderness Act.

1. If the issue/problem is not resolved, or action not taken, will the natural processes of the wilderness be adversely affected? **No**.
2. If the issue/problem goes unresolved, or action is not taken, will the values of solitude or primitive and unconfined type of recreation be threatened? **No**.
3. If the issue/problem goes unresolved or action is not taken will evidence of human manipulation, permanent improvements, or human habitation be substantially noticeable? **No**.
4. Does addressing the issue/problem or taking action protect the wilderness as a whole, as opposed to a single resource? **No**.
5. Does addressing this issue/problem or taking action contribute to protection of enduring wilderness for future generations? **Yes. Why/How?** Protection and stabilization of cultural resources will conserve the historical value of the wilderness.
6. Is this an issue for reasons other than convenience or cost of administration? **Yes. Why/How?** Federal law and Service policy mandate protecting cultural resources.

Step 1 conclusion: As administering the activity in non-wilderness areas only is not feasible, and the activity will protect some wilderness values (two of six questions above answered “yes”) it is appropriate to administer the activity in wilderness.

Step 2, Determining the Minimum Tool

Identify and describe the range of alternatives, including those that utilize traditional tools and non-motorized and mechanized as well as other methods.

Alternative 1

Refuge staff will reconnoiter each known cultural resource on the refuge once a year to document any signs of deterioration/vandalism. Sites showing excessive erosion will be stabilized using simple practices. All access to sites in wilderness will be on foot and simple hand tools will be used for any needed stabilization.

Does this alternative involve:

Use of temporary road?	No
Use of motor vehicles?	No
Use of motorized equipment?	No
Landing of airplanes?	No
Landing of helicopters?	No
Use of mechanical transport?	No
Creating a structure or installation?	No
Other impacts to wilderness character?	No

Describe the biophysical effects/benefits of this alternative: None

Describe the social recreational benefits: None

Describe the societal/political effects/benefits: None.

Describe health and safety and concerns/benefits: None

Describe economic and timing considerations/benefits: None

Describe heritage resource considerations/benefits: implementing this alternative would conserve and protect cultural resources.

Sheet 4: Selection of Minimum Tool Alternative

Alternative 1 is the only alternative examined, as it is fully compliant with the Wilderness Act of 1964 and satisfies the refuge's objectives for reconnaissance and stabilization of cultural resources sites.

What are the maintenance requirements? No facilities will be maintained in wilderness.

What standards and designs will apply? Only reconnaissance and stabilization protocols will apply. These affect the execution of fieldwork, not wilderness features.

Develop and describe any mitigation measures that apply: none.

What will be provided for monitoring and feedback to strengthen future efforts and preventative actions to be taken to help in future efforts? The refuge will maintain reconnaissance records.

REFERENCES CITED

Hendee, J. C., and C. P. Dawson. 2002. *Wilderness management: stewardship and protection of resources and values*. Third edition. Fulcrum Publishing, Golden, Colorado.

Leopold, A. 1933. *Game management*. University of Wisconsin Press, Madison, Wisconsin.

