FINAL RESTORATION PLAN AND ENVIRONMENTAL ASSESSMENT

FOR RESTORING INJURIES TO WILDLIFE AND FISHERIES HABITATS FROM THE TEXMO DIESEL SPILL AND FIRE THROUGH THE NATURAL RESOURCE DAMAGE ASSESSMENT AND RESTORATION PROGRAM AT THE BILL WILLIAMS RIVER NATIONAL WILDLIFE REFUGE, MOHAVE AND LA PAZ COUNTY, ARIZONA

Trustee for Natural Resources: Department of the Interior U.S. Fish and Wildlife Service

Legal Authority: Oil Pollution Act of 1990 (33 U.S.C. 2701, *et seq*., 15 C.F.R. Part 990), Federal Water Pollution Control Act (Clean Water Act) (as amended), National Environmental Policy Act, 42 U.S.C. §§4321-4347

Responsible Federal Agency: U.S. Fish and Wildlife Service

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CHAPTER 1: INTRODUCTION

This Restoration Plan and Environmental Assessment (RP/EA) is proposed by the Department of the Interior (DOI), represented by the U. S. Fish and Wildlife Service (USFWS), to restore natural resources, ecological services, and trust species from injuries sustained from the Texmo Oil Company Jobbers tanker truck accident, which occurred on July 28, 2006. The accident resulted in a diesel spill into the Bill Williams River (BWR) where it joins Lake Havasu and involved a fire on the Bill Williams River National Wildlife Refuge (BWRNWR). Trust species injured as a result of the spill included both endangered species and migratory birds which use the BWRNWR (Figure 1).

The BWRNWR is located in Arizona, approximately 20 miles north of Parker and 20 miles south of Lake Havasu City. The Bill Williams River forms the boundary between La Paz and Mohave counties. From the confluence with the Lower Colorado River (LCR) at Lake Havasu, the refuge continues east along the Bill Williams River approximately ten miles. The BWRNWR was established to provide "a refuge and breeding ground for migratory birds and other wildlife" and is suitable "for incidental fish and wildlife oriented recreational developments, the protection of natural resources, and the conservation of endangered species or threatened species" (USFWS 1994 pp.13-14).

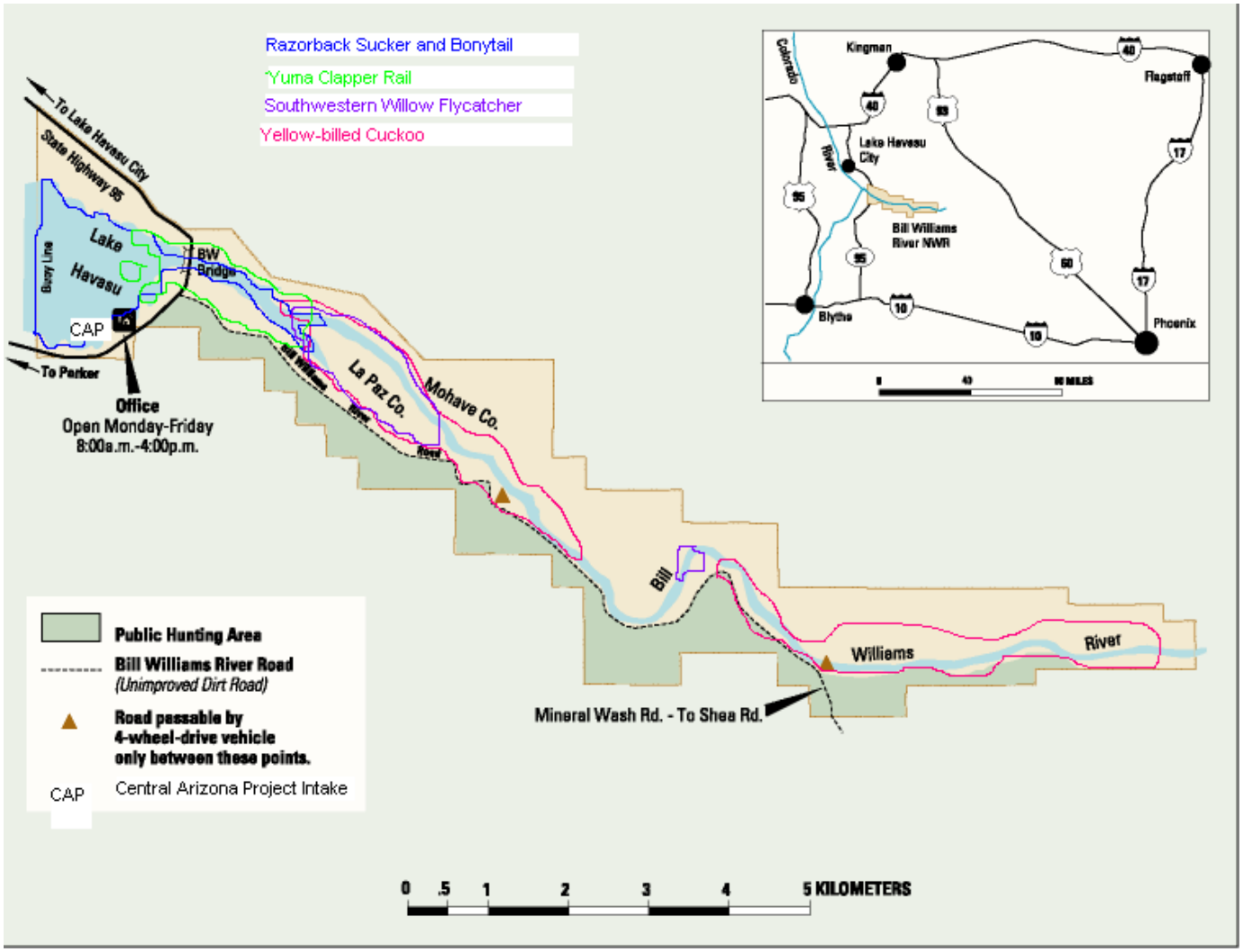

Figure 1. Location of Bill Williams River National Wildlife Refuge showing distributions of resident or breeding federally-listed endangered, threatened, and candidate species

1.1 PURPOSE AND NEED

The 7,600 – 7,800 gallon diesel spill and subsequent fire on July 28, 2006, resulted in loss or damage to 348 acres in five habitat types on the BWRNWR and caused injury to trust species and natural resources (Figure 2). The Texmo spill and fire injured some of the rarest habitats left on the LCR, particularly the Mixed Riparian Woodlands, which include nearly the entire historical complement and the most intact community of riparian-dependent species left on the LCR. During the spill and fire, local and Federal fire crews responded to the spill, used water to control and extinguish the fire, and controlled excess fuel with boom. Arizona Department of Transportation completed the bridge repair in 2010. No remediation was necessary elsewhere.

The purpose of this RP/EA is to identify restoration project alternatives, evaluate the environmental impact of the alternatives, and select a restoration project to compensate the public for injuries to natural resources at the BWRNWR. The alternative selected will lead to recovery, restoration, or acquisition of natural resources and ecological services as compensation to the public for the injury of trust resources and services caused by the diesel spill and fire. Any selected alternative must be feasible, safe, cost-effective, address injured natural resources, consider actual and anticipated conditions, have a reasonable likelihood of success, and be consistent with applicable laws and policies. Implementation of the preferred alternative would occur over a period of time, dependent upon the type of projects involved.

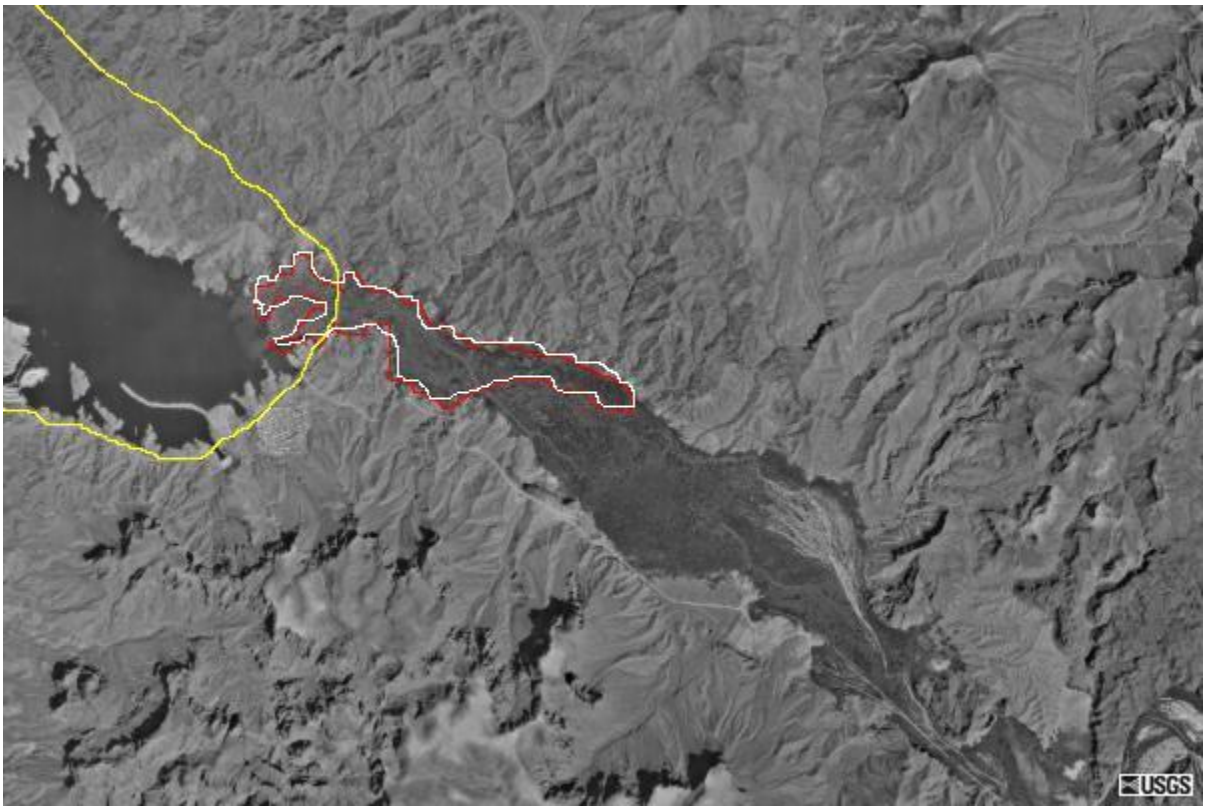

Figure 2. Aerial view of the Bill Williams River and the boundary (indicated in white) of the affected area resulting from the Texmo diesel spill and fire on Bill Williams River National Wildlife Refuge, near Parker, Arizona. The Texmo spill was on the AZ 95 (indicated in yellow) bridge where it crosses the Bill Williams River.

1.2 AUTHORITY

The RP/EA was prepared by the USFWS pursuant to its authority and responsibilities as natural resource trustee under the Oil Pollution Act (OPA) (33 U.S.C. 2701, *et seq*.); the Federal Water Pollution Control Act, 33 U.S.C. § 1251, *et seq.* (also known as the Clean Water Act or CWA); other applicable Federal and state laws, including Subpart G of the National Oil and Hazardous Substances Contingency Plan (NCP), 40 C.F.R. §§ 300.600 through 300.615; and the Consent Decree (United States versus Texmo Oil Jobbers, Inc. 2007, No. CIV 07-1401-PHX-DKD). The OPA, through its Natural Resource Damage Assessment and Restoration (NRDAR) provisions, provides for the designation of a Federal, state (on behalf of the public), or Indian tribe to act as trustees for natural resources (15 C.F.R. 990.11). The damages recovered from parties responsible for the natural resource injuries must be used to restore, rehabilitate, replace, and/or acquire the equivalent of those trust natural resources injured (collectively "restoration"). The USFWS trust resources injured by the spill and resulting fire include, but are not limited to, migratory birds, federally-listed threatened and endangered species and their habitats, and lands and other natural resources owned and managed by the USFWS.

The USFWS's Southwest Regional Director has been designated the Federal Authorized Official (AO) for this site. The Federal AO is the DOI official delegated the authority to act on behalf of the Secretary to conduct a natural resource damage assessment, restoration planning and implementation. The AO represents the interests of the DOI, including all affected bureaus. The USFWS recognizes the State of Arizona as a co-trustee for natural resources and environmental services injured and lost; however, while the State of Arizona did not participate in the assessment of injuries or settlement, we provided them a copy of the draft plan so could comment.

The National Environmental Policy Act (NEPA; 42 U.S.C. §§4321-4347) requires that we provide a reasonable range of alternatives prior to the selection of a preferred alternative as well as a public comment period. The final RP/EA will also provide the information needed to determine whether an EA is adequate to support a Finding of No Significant Impact (FONSI) decision or whether an Environmental Impact Statement (EIS) needs to be prepared.

1.3 SETTLEMENT OF NATURAL RESOURCE CLAIM

The USFWS estimated injuries to trust natural resources using the Habitat Equivalency Analysis method, which uses a process for valuing natural resources as outlined in the NRDAR regulations implementing the OPA (15 C.F.R. Part 990). This included habitat losses to endangered, threatened and candidate species, migratory birds and natural ecological services. On September 12, 2007, Texmo Oil Jobbers, Inc. entered into a negotiated settlement and consent decree with the United States (represented by USFWS) to compensate the public; the U.S. Fish and Wildlife Service received $1.2 million in the settlement. The consent decree specified that the damages must be used by the U.S. Fish and Wildlife Service for primary and/or compensatory restoration, rehabilitation, or replacement of injured natural resources and/or acquisition of equivalent natural resources, including but not limited to any administrative costs and expenses necessary or incidental to restoration planning and restoration, and to reimburse DOI's costs for injury assessment.

1.4 EMERGENCY RESTORATION

Emergency restoration actions pursuant to OPA regulations (15 CFR § 990.26) were conducted in December 2006, to prevent further soil erosion and the invasion of non-native plants into the riparian woodlands and desert washes impacted by the fire. Approximately 80 acres of the burned area were seeded with native grasses and forbs. The emergency restoration action was taken because soil erosion and invasion of non-native species would have occurred during the restoration planning process and would have resulted in increased natural resource injury and damages. The anticipated natural recovery period, without additional action, for the riparian woodlands

is approximately 40 years and recovery for desert wash habitat is 75 years. The emergency restoration prevented further harm but did not fully compensate for the injuries.

CHAPTER 2: NATURAL RESOURCES AND SERVICES AFFECTED BY THE TEXMO SPILL AND FIRE

This section of the document describes the natural resources affected by the Texmo spill and fire.

2.1 TRUST RESOURCES AFFECTED BY THE SPILL AND FIRE

2.1.1 HABITATS AND ASSOCIATED WILDLIFE

The diesel spill occurred on the bridge over the delta at the confluence of the Bill Williams River and Lake Havasu (Lower Colorado River) in west central Arizona; 7,600 to 7,800 gallons of fuel were released. The spilled fuel caught fire and flowed off the bridge and onto the BWRNWR, igniting the cattail marsh, and spreading to burn woody riparian, desert wash, and upland desert habitats. The BWRNWR habitats are used for breeding, migration, and wintering by over 350 species of birds including migratory and endangered or threatened species (USFWS 2009a). In addition, two species of endangered fish frequent the waters of the marsh (USFWS 2009b; USFWS 2009c). Approximately 348 total acres of five habitat types were affected by the fire. Estimates for specific habitat acreages and species impacts are based on before-and-after aerial photos, satellite imagery, topographic maps, direct, on-the-ground surveys by refuge personnel, and the BWRNWR's long-term biological database. The acreages of the five habitats impacted were approximately:

Open Water Aquatic:	15 acres
Delta Marsh:	235 acres
Mixed Riparian Woodlands:	60 acres
Desert Wash:	20 acres
Upland Desert:	18 acres

The Open Water Aquatic habitat consists of the Bill Williams arm of Lake Havasu. The Delta Marsh is an extensive cattail marsh where the Bill Williams River meets Lake Havasu. The Mixed Riparian Woodlands include both active floodplain as well as terraces and are characterized by various combinations of Freemont cottonwood (*Populus fremontii*), Goodding's willow (*Salix gooddingii*), salt cedar (*Tamarisk* spp.), honey mesquite (*Prosopis glandulosa*), and a variety of shrubs whose exact community composition depends on specific conditions of surface water, groundwater, flood regime, and topography. The riparian habitats of the Bill Williams River are unique because they are the only flood-regenerated, naturally functioning habitats and communities remaining on the LCR (Shafroth 1999). The Desert Wash and Desert Upland habitats have communities with compositions controlled by precipitation, slope, and soils, and are generally very stable over time. They are dominated by long-lived plant species such as cacti, palo verde (*Cercidium floridum*), creosote (*Larrea tridentata*), and bursage (*Ambrosia* spp.), although the response of annuals changes dramatically from year to year based on winter precipitation.

Consequently, these communities have exceptional species diversity across all taxonomic groups. Many species of birds, bats, and insects that were once common in the LCR floodplain are now found only along the Bill Williams River. Small mammals, reptiles and desert-adapted birds predominate here, although there are some insect and vertebrate species that move between habitats seasonally.

2.1.2 THREATENED AND ENDANGERED SPECIES

The endangered and species listed under the Endangered Species Act (ESA) found on the BWRNWR and likely impacted by the Texmo spill and fire included two birds and two fish: the endangered southwestern willow flycatcher (*Empidonax traillii extimus*), Yuma clapper rail (*Rallus longirostris yumanensis*), razorback sucker (*Xyrauchen texanus)*, and bonytail (*Gila elegans*). One candidate species, the yellow-billed cuckoo (*Coccyzus americanus*), is also present (USFWS 2009a).

Both the bonytail and razorback sucker inhabit the waters of the Bill Williams River arm of Lake Havasu, based on surveys done since 1998 (USFWS 2009b; USFWS 2009c). Yuma clapper rails have been found in the Bill Williams River delta marsh since 1971, based on surveys done during the breeding season (USFWS 2009a). Yellow-billed cuckoos were recorded within the impacted area immediately before the fire (Johnson et al. 2007) and southwestern willow flycatchers have bred since 1995 directly across the river channel from the impacted area (McLoud et. al. 2005; Koronkiewicz, et. al 2006; McLoud et. al 2007; USFWS 2009a).

One endangered fish, the desert pupfish (*Cyprinodon macularius*), occurs on the refuge, but is restricted to a refugia pond near the headquarters, and, consequently, was not in the affected area. In addition, Office Cove is a larger pond located adjacent to the refuge headquarters. It is used as a grow-out pond for razorback suckers and bonytail. It was also unaffected by the spill and fire.

2.1.3 MIGRATORY BIRDS

Long-term migratory bird monitoring surveys have occurred on the refuge since 1998, in several habitats that include those affected by the spill and fire. Additional data are available from Audubon Christmas Bird Counts and many research projects carried out on the refuge since the 1970s. Based on long-term monitoring transects and other surveys of the specific habitats affected, 44 avian species have been recorded in the Upland Desert habitat; 47 in the Desert Wash, and 138 in the Mixed Riparian Woodlands, while 112 species have been recorded using the Open Water or Marsh habitats (USFWS 2009a). Avian species use the refuge habitats for breeding, wintering, and migration depending on the natural history of the individual species. Species of concern that were formerly listed under the ESA, bald eagles (*Haliaeetus leucocephalus*), Peregrine Falcon (*Falco peregrinus*), and California brown pelicans (*Pelecanus occidentalis*), also use the affected habitats (USFWS 2009a). Depending on the species, some birds will be able to continue to use the affected habitats or use the early successional stages that come in after the fire; other species will be affected for years until the habitat returns to its previous quality and function.

2.2 WATER RESOURCES

Fuel released into the Open Water Aquatic habitat had a temporary effect in this habitat type. Acute effects to the lake likely persisted for only a few days to weeks since the residual components in diesel fuel remaining after the fire were volatile and evaporated. Due to the combustion of the discharged diesel fuel, we believe the direct oil contamination of the water resources was minimal.

2.3 ECOSYSTEM SERVICES

The area affected by the Texmo spill and fire provided many environmental services. The vegetation in both the riparian zone and the marsh provides filtration of water and sediment during flood events. Beaver along the Bill Williams River act as ecosystem engineers and their dam and pond complexes act to buffer minor floods, retain soil moisture, increase groundwater infiltration, riparian vegetation, and overall biodiversity.

Lake Havasu is the source of water for both the Central Arizona Project (CAP) for central Arizona and for the Metropolitan Water District (MWD), which supplies water to southern California. The inlet for the CAP is adjacent to the refuge headquarters, approximately ½ mile downstream from the Bill Williams River Delta Marsh. Since Lake Havasu is the drinking water source for southern California and central Arizona, it provides an important environmental service such as clean and reliable water for large metropolitan areas.

The loss or change in the vegetative community resulted in a decline in food web productivity, biomass, and diversity of invertebrates. Therefore, all levels and species of the community, including birds, pollinators, and many other wildlife species, were affected. The effects to fish were more acute and short-term since their habitat returned to baseline the quickest.

The loss of vegetative structure and cover affected both resident and migratory birds, particularly animals which are dependent on native plant species for food, cover, and suitable nesting sites. Examples of other important ecosystem services include water filtration and contaminant buffering by riparian vegetation.

In addition, bats, dragonflies and other predators provide pest control (i.e., mosquitoes). These services were disrupted by the spill and fire.

2.4 RECREATIONAL/EDUCATIONAL RESOURCES

The BWRNWR provides the public recreational and aesthetic opportunities and services such as hunting, fishing, wildlife viewing, photography, education, and interpretation. The area impacted was particularly popular for canoeing, kayaking, boating, fishing, bird watching, and photography.

CHAPTER 3: RESTORATION ALTERNATIVES

The OPA regulations require the trustees to develop a reasonable number of possible alternatives for restoration. The regulations (15 CFR § 990.54) identify the following six factors to be used when evaluating and selecting projects to restore or replace injured natural resources:

1. Cost to carry out the alternative;

2. Extent to which each alternative is expected to meet the Trustees' goals and objectives in returning the injured natural resources and services to baseline and/or compensating for interim losses;

3. Likelihood of success of each alternative;

4. Extent to which each alternative will prevent future injury as a result of the incident, and avoid collateral injury as a result of implementing the alternative;

5. Extent to which each alternative benefits more than one natural resource and/or service; and

6. Effect of each alternative on public health and safety.

Also, no primary or compensatory restoration projects are proposed for the Open Water Aquatic and Delta Marsh habitats. Since these habitat types recovered quickly from the release and fire, the resulting injuries were assumed to be minimal. We calculated injury to the Upland Desert habitats (USDOI 2007), but the likelihood of success of a primary restoration project in the Upland Desert is low.

3.1 ALTERNATIVES CONSIDERED BUT NOT CARRIED FORWARD

Foliar Herbicide Treatment by Helicopter –We considered applying herbicides by helicopter to the Mixed Riparian Woodlands as an alternative for primary restoration. However, site conditions were unacceptable for this application method. For example, helicopter applications require dense canopies to intercept the herbicide before it contacts the ground and low concentrations of non-target plants. By the time the salt cedar would have a sufficient canopy to allow aerial application, the concentration of native seedlings and trees in the canopy would be too high to prevent an unacceptable amount of native tree mortality. In addition, it would also be more difficult to control overspray because helicopter applications are more vulnerable to wind speed and direction. Therefore, this alternative was not carried forward for further analysis.

Restoration of the Upland Desert – We considered primary restoration of the Upland Desert burned in the fire. The probability of successfully planting or sowing seeds for cacti, trees, and shrubs (e.g., bursage, foothills palo verde, and creosote bush) that grow on the rocky cliff faces is low. Complete natural recovery of the Upland Desert would take hundreds of years. Since restoration is not practical for the Upland Desert habitat, natural recovery in these areas is the only suitable option. Therefore, this alternative was not carried forward for further analysis.

3.2 ALTERNATIVES CARRIED FORWARD FOR DETAILED ANALYSIS

Since the settlement funds were specifically recovered for the injury to the five habitat types by the diesel spill and fire, these monies must be used to restore resources similar to those that were affected. Consequently, actions will be carried out along the Bill Williams River or the Lower Colorado River for the restoration or protection of habitats that are comparable to those injured. Priority will be given to alternatives that restore or acquire habitats of similar ecological and hydrological function. Trustees must consider a "reasonable number" of restoration

projects with evaluations based on the factors identified in OPA. Additionally, we considered factors such as 1) proximity to the affected site in locations where comparable biodiversity and ecological services can be secured or restored, 2) ecological benefits that can be measured for recovery of natural resources toward the pre-incident baseline, 3) long-term management and maintenance of the restoration site, including monitoring, 4) leveraging funds through partnerships, 5) regional landscape planning and local needs, and 6) an implementation timeframe. Therefore, we propose a reasonable range of alternatives that meet the criteria specified by OPA and NEPA. These alternatives include:

- Alternative A: No Action/Natural Recovery
- Alternative B: Primary Restoration of Mixed Riparian Woodlands and Desert Washes On-site
- Alternative C: Acquisition of Comparable Habitats in the Bill Williams River Corridor and/or Lower Colorado River valley near the BWR corridor
- Alternative D: Compensatory Restoration of Mixed Riparian Woodland and Desert Wash Habitats On-Refuge but Off-site
- Alternative E: Restoration of Comparable Habitats along the BWR Corridor or the LCR Corridor between Needles, California and Parker Dam, Arizona
- Alternative F: Inventory Research
- Alternative G: Preferred Alternative; Combination of All of the Alternatives B-F

A discussion of these alternatives follows. Chapter 4 discusses the environment affected by these alternatives.

3.2.1 ALTERNATIVE A: NO ACTION/NATURAL RECOVERY

Under this alternative, no restoration actions (including on-site restoration or replacement) nor monitoring would be performed. This alternative would involve no further action to restore the loss to the natural resources or services at the impacted site. No compensatory restoration would be performed off-site. Therefore, there are no costs associated with this option.

3.2.2 ALTERNATIVE B: PRIMARY RESTORATION OF MIXED RIPARIAN WOODLANDS AND DESERT WASHES ON-SITE

Under this alternative, we would perform primary restoration of the burned area of the Mixed Riparian Woodland and Desert Washes to the maximum extent physically possible. Access to the site would be limited to transport with a small boat, precluding use of any heavy equipment; therefore, habitat restoration would be limited to personnel with hand tools. In addition, installing infrastructure such as a well and drip systems to irrigate newly planted trees would be cost prohibitive. Consequently, restoration actives would be restricted to limited areas of the burn which are presently close to the river edge and have adequate depth to groundwater. In the Desert Wash and Upland habitat, due to the intrinsic nature of the native vegetation and where it grows (i.e., cacti growing on cracked rock faces), restoration by natural succession over long time periods would be more appropriate. We considered on-site, primary restoration seriously, but access limitations prevent us from being able to install a well or irrigation system. Therefore, primary restoration opportunities in the Mixed Riparian Woodlands at the BWRNWR would be limited to small patches of habitat within the wetted floodplain.

Salt cedar is present in the Mixed Riparian Woodlands that burned. Before the fire, salt cedar growth was limited by the dense native riparian vegetation. Since the fire opened up the riparian canopy, it has outcompeted native

tree growth and will grow to dominate the riparian gallery unless it is actively controlled. We know salt cedar can erupt rapidly after fire and dramatically take over a site (Busch and Smith 1995; Taylor 2000). When salt cedar takes over a site, re-colonization by native vegetation is very difficult and usually impossible without human intervention or high-impact flooding. In a salt cedar-dominated community, there will be significant differences in the post-fire species' community composition as opposed to the pre-fire species' community composition. This change in species composition may be long term, if not permanent, in its effect (Anderson et. al 2004, Shafroth 1999; Busch 1995; Busch and Smith 1995; Taylor 2000).

Therefore, we would control salt cedar on the burned portion of the site by hand-application of appropriate herbicides (BASF 2006, Taylor and McDaniel 2004) by cut-stump methods to encourage growth of native tree species (See Appendix A for more information on imazepyr herbicides). Using the cut-stump method, the herbicide is brushed onto a freshly cut tree stump, which protects non-target vegetation from overspray. If spot applications are necessary to control salt cedar, herbicides would be applied according to the procedures as described in the Recommended Protection Measures for Pesticide Applications in Region 2 of the U.S. Fish and Wildlife Service (RPMPA) (USFWS 2007). The RPMPA defines spot application as pesticide applications by hand-operated equipment or a spray gun that discharges pesticide in liquid streams from a spray tank. If salt cedar control is less than 80%, a second cut-stump application would be necessary the subsequent year, to establish more extended control of salt cedar and reduce competition for the native plant species. Research has shown that salt cedar eradication followed by restoration of native species in riparian communities improves fire control, channel movement and morphology, hydrology, as well as the wildlife community (Taylor and McDaniel 2004; Taylor 2000).

Fremont cottonwood, Goodding's willow, mesquite species (*Prosopis* spp.), blue palo verde, catclaw (*Acacia greggii*), desert smoketree (*Dalea spinosa*), and ironwood (*Olneya tesota*) would be planted as poles or potted plants, as appropriate for each species, to re-establish native vegetation in the Riparian Woodland. Since we cannot irrigate these plants, we would install plants at suitable depths to groundwater to maximize survival.

Desert Wash habitat that burned would be re-planted by hand with potted individuals of a species mix including Blue and Foothills Palo Verde, catclaw, desert lavender, wolfberry and other species that are consistent with other comparable areas on the BWRNWR. Water-harvesting micro-landscaping methods would be used to enhance their survivorship.

Costs for this alternative include salt cedar control and interstitial re-planting in the Mixed Riparian Woodlands and Desert Washes. It would take one crew[1] to perform cut-stump applications of herbicide on 60 acres of Mixed Riparian Woodlands, with follow-up spot treatments, as needed. The following year, the crew would plant cottonwood and willow poles at a rate of 50-60/acre in the riparian zone. The cost estimates for labor, herbicide, material, and support in the Mixed Riparian Woodlands would be approximately $51,172. To plant twenty acres of desert wash with container-grown palo verde, catclaw and other local, native woody species would cost approximately $12,392 Overall, the 2011 cost estimate for this alternative would be approximately $63,564 not including refuge staff supervision, overhead, or administration.

[1] Costs are based on an estimate obtained from the American Conservation Experience (Flagstaff, Arizona) for six trained laborers.

3.2.3 ALTERNATIVE C: ACQUISITION OF COMPARABLE HABITATS IN THE BILL WILLIAMS RIVER CORRIDOR AND/OR LOWER COLORADO RIVER VALLEY NEAR THE BILL WILLIAMS RIVER CORRIDOR

This alternative includes acquisition of land and/or conservation easements proximal to the Bill Williams River NWR or with comparable habitats along the BWR corridor or near the Havasu National Wildlife Refuge (Havasu NWR). Protection of such areas from residential or agricultural development would result in a net resource benefit through conservation of habitat that would otherwise be lost. There are private lands for sale near the BWRNWR refuge boundaries with habitats comparable to those that were injured. Preference for acquisition would be given to lands with ecological conditions and functions comparable to those injured. We would perform restoration or rehabilitation to lands with lower ecological function to maximize the habitat's potential.

Habitat(s) would be purchased in fee title or preserved via conservation easement(s) in areas adjacent to or in the vicinity of the BWRNWR or Havasu NWR and have comparable ecological conditions to habitats which were damaged or be restorable to those ecological conditions.

Land acquired would be protected by agreement and deeded to individual state, tribal, Federal, local governments, land trusts, or conservation non-governmental organizations after following specific procedures and standards set for each governmental entity. Payment in lieu of taxes would be made on land deeded to government parties for lands acquired in the State of Arizona. Since the primary purpose of the preservation of this land is to protect fish and wildlife habitats. It may be necessary to restrict public access to portions of the acquired properties to protect these resource values.

Costs associated with this alternative would depend on the availability of willing sellers at the time. Comparable properties nearby have appraised for $2,000/acre in 2010. Additional acquisition expenses would need to include FWS administrative costs and overhead.

3.2.4 ALTERNATIVE D: COMPENSATORY RESTORATION OF MIXED RIPARIAN WOODLAND AND DESERT WASH HABITATS ON-REFUGE BUT OFF-SITE

Restoration and enhancement of riparian habitats in burned areas (off-site) but on-refuge would include the expansion of the native bosque terrace plantings on the abandoned Kohen Ranch agricultural fields by approximately 20 acres. This area has a well and irrigation infrastructure. We would rehabilitate and expand the irrigation system and improve access for smaller heavy equipment. We would use a variety of methods to restore the habitat. These methods include applying herbicide to control Bermuda grass (*Cynodon* spp.) or other invasive species, using prescribed burns to eliminate the existing standing biomass, and mowing to reduce overgrowth. Both burning and mowing increase the success of herbicide applications because they improve contact and herbicide coverage. The herbicide imazapyr would be applied by hand and by a sprayer attached to an all-terrain or utility vehicle. A second spot application would probably be required in a subsequent year, as needed, to establish more extended control for Bermuda grass and reduce competition for the native species. Then, we would plant container-grown native shrubs and trees, including species such as mesquite, palo verde, ironwood and wolfberry (*Lycium fremontii*) and irrigate them from an existing well system until they become established.

The Kohen Ranch area is former agricultural land owned by the BWRNWR has both access and potential water sources available for irrigation. The soils and terrain of the abandoned agricultural sites are in the historic floodplain; therefore, these areas could provide many of the same ecological services and values as the injured site did before the fire. For example, restoration of the old fields to Mixed Riparian Woodlands habitat and some Desert Wash species would be possible. The community of riparian obligate species already present on the ranches would be enhanced, thereby making for more rapid compensation for the losses suffered during the Texmo spill and fire.

We compiled the 2011 costs associated with this alternative. These amounts are for comparison purposes only and are expected to change closer to implementation. The approximate costs include 1) contracting to have the existing Bermuda grass controlled either by a) controlled burn ($45,000) or b) mowing ($6,175) to remove existing vegetative overburden and then applying herbicides twice to maintain control over the invasive vegetation ($23,122); 2) installing an irrigation system ($9,300), 3) growing plants from seed ($5,525) 4) planting and maintaining the irrigation until plants are well established ($7,982), as well as 5) monitoring plant survivorship and associated terrestrial vertebrate communities. In 2011 dollars, the estimated costs were between $88,538 and $49,929 depending primarily on whether fire or mowing was selected to initially remove the Bermuda grass overburden. Additional acquisition expenses would need to include FWS administrative costs and overhead.

3.2.5 ALTERNATIVE E: RESTORATION OF COMPARABLE HABITATS ALONG THE BILL WILLIAMS RIVER CORRIDOR OR BETWEEN NEEDLES, CALIFORNIA AND PARKER DAM, ARIZONA

There are other suitable areas for restoration of Mixed Riparian Woodlands and Desert Washes on other Federal, state, or privately-owned lands between the Havasu NWR and the BWR corridor as well as on Havasu NWR, and on the BWR corridor. If counties or cities are interested, we could also partner with them. For example, the Havasu NWR is located nearby on the LCR, and restoration could be performed on its lands. There are also BLM and state-owned lands within the Bill Williams River corridor upstream of the BWRNWR where we could perform restoration. Restoration activities on other refuges or other government-owned lands could enhance biodiversity and ecosystem services of wildlife habitat and contribute to the protection of habitat solely for wildlife values as compensation to the public for the injuries sustained by the spill and fire on the BWRNWR. The USFWS, as the Trustee, would work closely with partners to perform projects that would restore or protect natural resources. Restoration would likely include converting former agricultural fields to mesquite bosques or cottonwood-willow forests, perhaps including salt cedar control. Priority would be give to locations with similar habitat qualities or potential as those injured.

Specific cost estimates are not possible for many potential locations along the BWR corridor as the individual partnerships and sites have not been identified for analysis. However, as an example, Havasu NWR has land where salt cedar (*Tamarisk* sp) could be removed, controlled, and replanted with native woody riparian species like cottonwood and willow. In order to determine site suitability, a LIDAR (LIght Detection And Ranging) flight would be required to establish depth to groundwater and to identify the best areas for restoration. This flight would cost an estimated $50,000. Since Havasu NWR has limited personnel and equipment, salt cedar removal and planting would be contracted out. Cost estimates for similar work performed at Havasu NWR and Bosque Del Apache NWR, New Mexico, in 2010 were between $1,200 and $3,200 per acre depending on the total acreage, site characteristics such as stand density, and the plant materials used for revegetation. Most salt cedar at Havasu NWR is very dense, so costs would be near the high end of these estimates. Depending also on the site selection, one or two irrigation gates would need to be installed for a cost of approximately $100,000. Additional costs would include soil treatment and/or site preparation. Planting costs would include both the cost of the plants as well as labor or equipment. Cottonwood and willow poles could be augured in for $42 each and should be planted at a rate of 500/acre[2] for an estimated cost of $21,000 per acre. In addition, species of trees and shrubs, such as palo verde, mesquite, or *Baccarris* could be planted to establish a heterogeneous stand composition. Other tree and shrub species would cost $820 per acre, while seeding is $675 per acre. Overall, the 2011 cost estimate for this alternative would be $150,000 to $250,000 for LIDAR and infrastructure and $25,000 per acre for salt cedar

[2] To minimize the need to suppress salt cedar and other weeds later, we would plant a very dense stand of native trees.

removal and native species planting. Additional acquisition expenses would need to include FWS administrative costs and overhead.

3.2.6 ALTERNATIVE F: INVENTORY RESEARCH

The BWRNWR's long-term monitoring database has been a powerful tool for strategic habitat planning and natural resource damage assessment. Integrating new monitoring information on invertebrates into this database would improve future conservation planning, management, and any new damage assessments. Additionally, scientists rarely get the opportunity to monitor areas that have been disturbed or left to recover on their own (Russell et. al 2001; Rich 2004). Further, wildlife monitoring should be an integral part of any restoration project including baseline and comparative data (Block et. al 2001). Increasing our understanding of the native ecological processes and functions that make the Bill Williams River a unique remnant of former habitats along the Lower Colorado River would benefit injured habitats by making future management actions more successful.

We would use funds from the Texmo NRDAR settlement to perform inventories for poorly understood ecological functions and animal guilds in areas where restoration is performed and at comparison sites in undisturbed habitats of the refuges. We already know that water management is the largest controlling factor (i.e., volume, timing, duration of releases from Alamo Dam) towards keeping the former ecological processes intact. We do not know what ecological components of the native and non-native species' processes are and how they work together. For example, invertebrate identification/censusing, abundance, and richness monitoring has not been systematically conducted at BWRNWR, yet invertebrates and their ecological functions, such as pollination and as members of the food web, were impacted by the spill and fire. Data were not available for invertebrates, and therefore the injury to invertebrates could not be quantified during the NRD assessment phase. If this data were available in the future, we could quantify the effects of the injury.

This alternative proposes to conduct inventory research related to the species or ecological habitats injured; this research would be performed in conjunction with primary or compensatory restoration. To better understand how the species, processes, or sites that were injured recover, inventories would also be conducted on non-disturbed sites for comparison. Baseline inventories for all sites and all alternatives will be performed prior to and after restoration. This alternative takes a step further from the baseline monitoring that helps us understand if we have been successful with our restoration implementation and fills large data gaps with respect to information for species and ecological functions where no information currently exists at BWRNWR. This alternative does not provide a detailed discussion of baseline monitoring nor success criteria. For example, if off-site, off-refuge projects are undertaken, site evaluation and post-implementation monitoring is required. More information on performance-based monitoring can be found in the draft monitoring plan for the BWRNWR Texmo Restoration. Inventory research on restoration sites for sensitive species and the supporting communities could enhance long-term management and recovery of all species and habitats.

The goal would be to use existing transects on the refuge that are monitored quarterly and add an additional ecological component, such as invertebrates, to the list of species to monitor. Therefore, in year one, the refuge would choose which species or guilds and which habitats to include in its existing monitoring program. It would take one to three years to fully inventory all of these species to establish a sufficient list. The goals for year's three to ten would be to continue monitoring, analyze data and plot species abundance/richness over time, and assess whether any monitoring items need to be added or deleted. This alternative would be successful after 10 years if a long-term monitoring program had been established for the injured habitats on the refuge and compared with non-injured reference areas to understand how the disturbance affected the different habitat types. The data generated would contribute to understanding larger, more complex ecological processes in the LCR and southwest such as climate change as well as providing information regarding desert riparian restoration that can aid in better safeguarding these habitats in the future or recovering them when damaged. Support for inventory research of the species and ecological processes associated with the five habitats injured would provide a long-term benefit for future recovery and security of these habitats. Decision-making is made on the best available science, but the

science must first be available to make good decisions. More information based on good science performed at the BWRNWR could improve management at all of the LCR National Wildlife Refuges.

The estimated 2011 costs for this alternative were based on hiring one refuge biologist[3] to monitor and analyze data for a cost of $177,110 for three years.

3.2.7 ALTERNATIVE G: PREFERRED ALTERNATIVE; COMBINATION OF ALTERNATIVES B-F

Our initial goal is to restore, enhance, or acquire approximately 10 to 64 acres of habitats in the BWRNWR or Lower Colorado River area between Havasu NWR and the BWR corridor. Available settlement funds, restoration opportunities, and restoration costs will influence this goal over time.

This alternative allows any combination of alternatives B-F to be performed and would provide a variety of compensatory restoration or acquisition actions, rather than just one. Selecting a mix of restoration projects from Alternatives B-G allows for more flexibility for cost-effectiveness and feasibility due to possible future changes related to the ecology of the area, access to the restoration sites, and/or ability to find willing participants and sellers. This is the preferred alternative.

To guide implementation of a range of projects our natural resource-based geographical priorities are as follows: 1) first priority is to acquire land in the Mixed Riparian Woodlands on the BWR, 2) the second priority is to restore or acquire land in the Desert Wash of the BWR, and 3) the third priority is to restore or acquire lands of equal ecological value off-site and/or off-refuge. This would include Mixed Riparian Woodlands and Desert Washes in other tributaries to the Lower Colorado River or associated tributaries.

We expect that geographical priorities would be influenced primarily by the following key factors: 1) proximity (to the BWR and mature, functioning riparian woodlands); 2) quality of restoration opportunities (areas with greater ecological opportunities are preferred); and 3) cost-effectiveness (areas with lower cost per services or values are preferred).

Projects would also be evaluated for their likelihood of success given the proposed methods. Factors that would be considered include whether the proposed technique is appropriate to the project, whether it has been used before, and whether it has been successful. Projects incorporating wholly experimental methods, research, or unproven technologies would be given lower priority.

Note that ecological benefits from each alternative would be measured in recovery of natural resource services toward the level of pre-incident baseline.

[3] The costs were based on a term, GS-9 full-time employee.

CHAPTER 4: ENVIRONMENT AFFECTED BY RESTORATION ALTERNATIVES

4.1 PHYSICAL CHARACTERISTICS OF THE SITES WHERE RESTORATION IS PROPOSED

The Bill Williams River forms the boundary between La Paz and Mohave counties in western Arizona. One of only two tributaries of the LCR, it enters Lake Havasu at an elevation of approximately 450 feet. Flows in the river generally maintain the historical temporal patterns to which native riparian species are adapted, in spite of the presence of Alamo Dam approximately 40 miles upstream (Shafroth 1999). The Bill Williams River is one of only eleven Sustainable Rivers projects (a joint venture between the Army Corps of Engineers and The Nature Conservancy) in the United States (BWRCSC 2009). With rainfall in the area averaging 3.5 inches per year and summer temperatures averaging 111.46 ºF since 2000 (USFWS 2009a), the LCR is among the hottest and driest areas in North America. Unlike many desert rivers, however, the Bill Williams River drains a relatively low salinity watershed (BWRCSC 2009). The BWR corridor maintains a successful native riparian community because it receives adequate flows that deliver nutrients and organic matter and encourages retention of soil moisture. Periodically, it receives large floods which flush salts from the floodplain, control invasive species, and encourage native plant succession. Because the flow regime of the BWR mimics the flood regime before the Alamo Dam, the BWR corridor is the only remaining riparian area on the LCR where native vegetation, particularly woody vegetation, naturally recruits and regenerates. Other LCR refuges have no choice but to use water with a higher salinity and do not receive the benefits of a semi-natural flow regime.

The dominant riparian vegetation at Havasu NWR is salt cedar. HNWR does not have the semi-natural flow regime that BWRNWR has, so native vegetation cannot establish itself naturally. . However, the HNWR has infrastructure to deliver water for flood irrigation to fields and native plantings.

There may be other small areas on state, county, municipal, or Federal lands along or near the shoreline of Lake Havasu that would be suitable for native plant restoration. This type of restoration action could improve the areas for wildlife and function as travel corridors during migration, which would benefit the trust resources injured by the loss of habitat on the BWRNWR.

If restoration under this plan occurs on other properties on the LCR outside the BWR corridor, and differences in site physical characteristics are significant, we would have to conduct a separate effects analysis to determine species suitability, restoration success criteria, and other environmental effects.

4.2 LAND USE

The BWRNWR is presently comprised of 6,105 acres of open water, marsh and other wetlands, riparian flood plain and terrace woodlands, desert wash habitats, upland desert, and the administrative buildings. The refuge is used by the public for a variety of recreation purposes including hunting, fishing, boating, hiking, photography, wildlife viewing, and research, as well for educational purposes. No grazing, mineral extraction, agriculture, camping, or other development-related uses on the refuge are allowed. Approximately 500 acres of the floodplain were farmed until 1983 and four historic irrigation wells (in various conditions of usability) are present.

The Bureau of Land Management (BLM) manages the uplands which border the BWRNWR; the uplands include arid desert and mountainous terrain. Recreation is the only current use of the BLM lands, although there was some mining in the late 1800s and early 1900s which resulted in tailings piles near the BWR floodplain.

Immediately upstream of the BWRNWR is Planet Ranch, a private parcel of approximately 8,600 acres, which forms the eastern boundary of the refuge. Planet Ranch was farmed until major flooding in the mid-1990s removed significant infrastructure. Presently, the area is under a purchase agreement with Freeport-McMoRan Copper & Gold, Inc (FMI). At this time, FMI plans to convey the riparian reaches of the ranch to Arizona Game and Fish Department to be managed for the LCR MSCP. Arizona Game and Fish Department would restore riparian

habitats to meet the requirements for habitat restoration and protection of several species of concern for the LCR MSCP for the next 50 years. Tentatively, the uplands are to be conveyed to BLM with a conservation easement. There is another private parcel adjacent to the BWRNWR and Planet Ranch to the northeast.

Private lands are for sale near the BWRNWR boundary as well as near the Havasu NWR with habitats comparable to some of those injured. Some of these lands are currently used for agriculture; however, several landowners are interested in developing their properties for residential use or to sell water rights. Water purchased from these landowners could be transferred away from the Bill Williams River and used for residential, commercial, or industrial uses. This would result in less water in-stream and would negatively affect the BWRNWR riparian habitat, which is dependent on a reliable supply of water.

Lake Havasu is a very popular recreation destination and also functions as the primary water withdrawal location for the Central Arizona Project and the Metropolitan Water District of Southern California. The Central Arizona Project water intake pumps are adjacent to the refuge office and are less than one mile downstream of the Bill Williams River delta.

4.3 BIOLOGICAL RESOURCES

4.3.1 HABITATS AND VEGETATION

The project sites are generally in the transition zone between the Sonoran and Mohave deserts. Most riparian areas on the LCR are dominated by salt cedar, although small isolated patches or remnant individual native trees and shrubs (cottonwoods and willows) can be found throughout.

4.3.1.1 MIXED RIPARIAN WOODLAND

The Mixed Riparian Woodlands present on the BWRNWR are the only flood-regenerated riparian woodlands in the LCR valley and, other than the presence of salt cedar as an understory, are likely quite similar to those once occupying over 240 square miles of the historic LCR floodplain (USBR 1998). The Mixed Riparian Woodlands of the BWRNWR consist of nearly 2,000 acres of floodplain forest and are also the largest contiguous stand on the LCR. Major flood events on the BWRNWR are controlled by both natural precipitation and the Corps of Engineers' regulation of Alamo Dam. Native riparian woody species require floods to remove existing vegetation and enhance soil moisture in order to provide non-competitive seeding opportunities and adequate groundwater to sustain stands (Webb et al. 2007; Anderson et al. 2004). Based on historical records, major flood events with amplitudes in excess of 50,000 cfs occurred on average on every 15 years on the Bill Williams River (USGS 2011; Fields 2009). However, since Alamo Dam was built in 1968, those flood events have been reduced to no more than 7,000 cubic feet per second. The most recent flood event of that magnitude occurred in 2005-2006.

The exotic invasive salt cedar tree, also known as tamarisk, is present at the BWRNWR and presents significant management challenges. This fire-tolerant species co-occurs with native woody species throughout the LCR and other western rivers.

4.3.1.2 DESERT WASH

The Desert Wash habitats on the LCR are ephemeral side-drainages that feed the higher-order streams, which in this case is either the BWR or LCR. Species such as ironwood, palo verde, mesquite, acacia,

bursage, brittlebush, and creosote occupy Desert Wash habitats. Most species of trees and shrubs in the desert washes are long-lived and grow very slowly.

4.3.1.3 DESERT UPLANDS

Slow growth rates are also common for many of the most critical species in the Desert Uplands habitat, particularly cacti, trees and woody shrubs. The saguaro cacti (*Carnegiea gigantea*), foothills palo verde, creosote bush, brittle bush (*Encelia farinosa*), and cholla (*Opuntia* sp.) occupy the Desert Uplands. Under optimal conditions in the Saguaro National Monument near Tucson, Arizona, with an average rainfall of 12.7 inches, saguaro cacti require at least 55 years to grow 8 – 9 feet tall and begin to bloom, and 50 – 100 years to grow arms. In the lower Colorado River valley, which only receives 4 inches of average rainfall per year, maturation and periods between successful reproduction would be even longer (Dimmitt 2000). Saguaro cacti live to be at least 250 years old. The foothills palo verde does not reach maturity until it is 100 years old and may live to be 400 years (Dimmitt 2000, Webb et al. 2007). Trees and cacti require several consecutive years of warmer and wetter conditions than average to become established because they are vulnerable to drought and temperature extremes when small (Dimmitt 2000).

4.3.2 MIGRATORY BIRDS

The BWRNWR has documented over 350 species of migratory birds using different refuge habitats for breeding, wintering, and migration. The BWRNWR itself has been designated an Important Bird Area (IBA) by the American Bird Conservancy (American Bird Conservancy 2010) and an IBA at the state, continental and global levels by the Audubon Society (Audubon 2010). Species of concern found at BWRNWR that were formerly listed under the Endangered Species Act (ESA) include bald eagles and California brown pelicans. These birds use the open water and marsh of the Bill Williams River delta and LCR in the fall, winter and spring months, while the cliffs that border the refuge often support nesting peregrine falcons based on the refuge databases (USFWS 2009a). Although the BWRNWR has more riparian-obligate birds using its woodlands than other sites along the LCR, species that occur in the Desert Washes and Desert Uplands on the BWRNWR are similar in diversity and richness to other areas along the LCR where uplands and washes join the mainstem of the river.

The Havasu NWR is a significant refuge for migratory and wintering waterfowl because it manages farm fields to attract waterfowl and geese. Its extensive marshes provide suitable loafing, foraging, and nesting habitat to shorebirds.

4.3.3 FEDERALLY THREATENED AND ENDANGERED SPECIES

Threatened, endangered, or candidate species found in the LCR include fishes such as the endangered razorback sucker and endangered bonytail. Both species of fish are commonly found the Bill Williams arm of Lake Havasu.

The endangered Yuma clapper rail, the endangered southwestern willow flycatcher, and the candidate yellow-billed cuckoo breed on or are year-around residents of the LCR. Yuma clapper rails nest in the marshes of the Bill Williams River delta and Topock Marsh on the Havasu NWR and are occasionally found during fall and winter in the lotic marshes along the BWR (USFWS 2009a). Both southwestern willow flycatchers and yellow-billed cuckoos nest in the Mixed Riparian Woodlands on the BWRNWR. Yellow-billed cuckoos have been detected on Havasu NWR during migration, but do not nest there (Johnson et. al 2007). Yellow-billed cuckoos are habitat specialists and associate with large, mature, “gallery” native-dominated riparian woodlands that occur in patch sizes of at least 10-40 hectares. Because of their habitat requirements, over 75% of all yellow-billed cuckoos detected on the LCR

are on the BWR. Although cuckoos avoid areas dominated by salt cedar, particularly for breeding, flycatchers do not if the soil hydrology is otherwise suitable. Southwestern willow flycatchers nest successfully on both refuges.

4.3.4 OTHER WILDLIFE SPECIES

The BWRNWR has over 1,200 species of wildlife and plants, including all but three of the entire known historical complement of species that was present 100 years ago (USFWS 2009a). Havasu NWR has documented 595 species of wildlife and plants. Game species of significance to Arizona Game and Fish Department (AZGFD 2010) that occur on the BWR and LCR include the Gamble's quail (*Callipepla gambelii*), white-winged dove (*Zenaida asiatica*), desert cottontail (*Sylvilagus audubonii*) and bighorn sheep (*Ovis canadensis*).

4.4 CULTURAL RESOURCES

The indigenous people of the Bill Williams River area (Mohave, Chemehuevi, Yavapai, Havasupai, and Hualapai peoples) were largely hunter-gatherers, with limited floodplain agriculture (Garces 1965). There is little evidence left of indigenous cultures on the landscape[4], but scattered petroglyphs, geoglyphs, or possible sleeping circles can be found in the uplands throughout the Bill Williams and Colorado River basins. Native riparian woodland trees, however, are significant to several southwestern tribes. For example, the Chemehuevi use willows to make their traditional basketry. Harvesting riparian trees and shrubs for traditional uses is currently allowed on the BWRNWR.

Approximately 20 miles south of the BWRNWR, the Colorado River Indian Tribes (CRIT) reservation is the home of individuals from the Mohave, Chemehuevi, Hopi and Navajo tribes. The Chemehuevi tribal reservation is approximately 20 miles north of the BWRNWR, on the California side of Lake Havasu and the Fort Mohave Indian Tribe's reservation is adjacent to the HNWR, near Fort Mohave, Arizona approximately 100 miles north of the BWR. Other Tribes with cultural affiliation and claims to the lower Colorado River from Needles, California to Parker, Arizona include the Cocopah, Yavapai-Prescott Tribe, Yavapai Apache Nation, Hualapai, and Hopi. These tribes will be notified and this document be made available to them for consultation and comment.

The Spanish explored the area in the early 1500s and established some mining claims (Bolton 1952). The American fur-trappers explored the river in the early 1800s (Favour 1962) and additional mines were established on the LCR by the late 1800s. Historic mines in the surrounding mountains were largely copper-based and none have been worked significantly for several decades. None are within the BWRNWR boundaries.

Although two former homesteads are located within the boundaries of the BWRNWR, the only remainder of these original settlements is a small graveyard in the uplands of the former Esquerra Ranch. Older features were eliminated in the 1960s when the irrigation system was improved by the landowners. Historic settlements that were associated with the river boat landings near the mouth of the BWR are underwater in Lake Havasu. The dynamic nature of the floodplain before Alamo Dam was built removed the rest of the structures or artifacts from earlier eras that were located in the floodplain. The proposed actions would not take place near the graveyard or other persistent historic sites.

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[4] The historic Bill Williams River frequently had flows over 50,000 cfs and occasionally as high as 150,000 cfs or more (USGS 2010). Even though the river corridor was a major east-west thoroughfare for native peoples, the extremely dynamic nature of Bill Williams River caused frequent, dramatic floodplain disturbance, removing any historic and pre-historic cultural resources in the riparian zone.

4.5 LOCAL SOCIOECONOMIC CONDITIONS

Parker, Arizona, Lake Havasu City, Arizona, Golden Shores (aka Topock), Arizona and Needles, California are the four closest towns to the areas affected by the proposed restoration alternatives.

According to statistics from 2005-2009 by the U.S. Census (Census 2009), Parker has a population of 2,768, with a median household income of $40,868. Demographically the town's population has a median age of 29.7 and is 49.4% White, 42.1% Latino, 21.2% Native American, 2.8% Asian, and 1.9% Black.

Lake Havasu City has a population of 55,165, with a median household income of $53,821. The town's median age is 47 and demographics are 93.8% White, 12.2% Latino, .8% Native American, .4% Black and.4% Asian.

Golden Shores has a population of 3,118, with a median household income of $33,586. The town's median age is 52.5 and demographics are 95.2% White, 7% Latino, 1% Native American, 0.5% Black and 0.6% Asian.

Needles has a population of 5,307, with a median household income of $30,114. The town's median age is 42.4 and demographics are 82.2% White, 16.8% Latino, 8.2% Native American, 1.3% Black and 0.2% Asian.

The economies of these towns are largely based on tourism/recreation by boaters in the summer months and by "snowbirds", fishermen, and off-road enthusiasts in the winter. Winter visitors include those with second homes in the area and many more with motor homes and RVs. Lake Havasu City is also major retirement community. State Highway 95, which passes through the BWRNWR, is the major northwest travel route for the western part of Arizona. Other important roads in this area include I-40 and Historic Route 66. Activities based on natural resources of the LCR for both locals and visitors include hunting, fishing, boating, bird watching, and the general scenic appeal of the desert riparian areas against the contrasting desert uplands.

Agricultural activities in La Paz and Mohave Counties primarily include alfalfa farming at the Colorado River Indian Tribes reservation near Parker and the Fort Mohave Reservation near Needles. There is some light industry in Lake Havasu City. Other minor activities in the area include grazing and mineral exploration/prospecting.

None of our proposed alternatives are biased toward a particular culture, race, or people with respect to planning and implementation. Therefore, the restoration, acquisition, replacement, or enhancement would provide environmental justice to all inhabitants near the restoration sites.

CHAPTER 5: ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ALTERNATIVES

No restoration alternative will affect the Delta Marsh and Upland Desert habitats. Also, environmental compliance with the ESA and NHPA will be performed prior to implementation of any of these alternatives. If we identify protective measures as a result of the environmental compliance, the protective measures would be performed during project implementation.

5.1 ALTERNATIVE A: NO ACTION/NATURAL RECOVERY

Under this alternative, no action would be undertaken to restore the Mixed Riparian Woodlands and Desert Wash injured by the spill and fire. Recovery would rely on the natural processes of succession and would be strongly influenced by weather patterns. Since salt cedars are fire-resistant, they largely survived the fire as rootstock and are re-growing in the Mixed Riparian Woodlands. No more than 10% of the native tree species, including Fremont

cottonwoods, Goodding's willows and mesquite, survived the fire. This means under the No Action alternative, the area would convert from a habitat that was approximately 50% native species/50% salt cedar to one that is approximately 10% native tree species/90% salt cedar. With no affirmative action, natural recovery from this condition to the pre-fire baseline would not occur in the foreseeable future. Habitat conversion would negatively affect some species that are dependent on the native riparian trees either directly (e.g., yellow-billed cuckoo) or indirectly in response to changes in the taxa richness, productivity, or specific ecosystem services such as pollination.

In addition to adverse impacts related to the colonization by invasive species, there would be no improvements to compensate the public for the interim loss of services. Furthermore, no environmental benefits would be realized from the damages received in the settlement and the Trustees would not be fulfilling their obligations. While implementation of this alternative would have no project impacts, failure to restore injured resources is not acceptable to the Trustees because it does not meet the requirements of the law.

5.1.1 BIOLOGICAL RESOURCES

5.1.1.1 HABITATS AND VEGETATION

Under the No Action alternative, recovery of the burned areas would take place without any salt cedar control or native species' plantings. The Mixed Riparian Woodland habitat would change from a pre-fire condition of approximately 50% native species (cottonwood, willow, and mesquite)/50% salt cedar to approximately 10% native tree species/90% salt cedar riparian woodlands. At least one major, high-flow flood[5] in early March would be required to remove at least 50% of the existing salt cedar, and several major, overbank (5,000 - 7,000 cfs) flood events would be necessary before cottonwood and willow succession could take place. It would take approximately 40 years under these conditions for the Mixed Riparian Woodlands to return to the 50%/50% pre-fire condition. Until recovery occurs, species that are dependent on native vegetation being greater than 10% of the community would be negatively affected.

In the Desert Wash areas of the fire, the No Action alternative would eventually result in recovery of the vegetation to pre-fire conditions based on natural rates of recovery from re-seeding of surviving plants upslope from the area, and survivorship based on natural precipitation. Re-colonization of the Desert Wash habitat entirely from seed takes at least two to three years of consecutive, locally-high rainfall for the seed to germinate and become established. Based on rainfall records since 1893, such rainfall years come on average of every 15 - 20 years (NOAA 2007; Western Regional Climate Center 2006). Accordingly, significant natural re-vegetation of the Desert Wash habitat could be expected over approximately 30 - 60 years. Considerable time would also be needed to reach maturity. Natural recovery to 100% of baseline resources and services would take at least 75 years due to the slow growth rate of the woody vegetation (Bainbridge 2007, Abella 2010).

Upland Desert areas would likewise recover slowly under the no action alternative. For the dominant vegetation (saguaros, creosote, etc), environmental factors such as above average rainfall and/or temperatures that do not fall below freezing are necessary for several consecutive years before a new crop of Upland Desert Vegetation is successfully established. New cohorts of saguaro cacti, for example, appear every 15-20 years based on BWRNWR data (USFWS 2009a).

[5] Major, high-flow floods do occur even though Alamo Dam is 40 miles upstream. We consider flows in excess of 5,000 cfs to be major, high-flow floods.

Once established, vegetation in Desert Uplands such as saguaros and cholla, grow very slowly. Natural recovery of mature habitat function in the Desert Uplands is estimated to be at least 50 years for shrubs and 100 years for cacti and trees. Some estimate that desert vegetation may take centuries to recover from damage (Bainbridge 2007; Webb 2007; Webb et al. 2007; Abella 2010).

5.1.1.2 FEDERALLY THREATENED AND ENDANGERED SPECIES

Under the No Action/Natural Recovery alternative, negative impacts to some protected species may continue since no direct action would be taken to restore injured natural resources. Therefore, no negative impacts are expected to the razorback sucker, bonytail, Yuma clapper rail, and southwestern willow flycatcher. Research has shown that southwestern flycatchers use either salt cedar or cottonwood/willow as long as there is standing water or saturated soils and canopy structure is sufficient (McLoud et al., 2005; Koronkiewicz et al. 2006; McLeod et al. 2007). However, there is no standing water or saturated soils in the burned Mixed Riparian Woodlands and southwestern willow flycatchers did not use this area much before the spill and fire.

Yellow-billed cuckoos would be negatively affected by this alternative because the conversion of woodlands from 50/50 native/salt cedar to a 10/90 native/salt cedar would result in a net loss of approximately 60 acres of suitable habitat for this species. This species was using the affected area the year of the fire (Johnson et. al 2007).

5.1.1.3 MIGRATORY BIRDS

Conversion of 50/50 native/salt cedar riparian woodlands to 10/90 native/salt cedar riparian woodlands would have mixed effects on migratory birds. No species-specific predictions can be made other than 1) upper canopy-dependent species would decline and 2) species dependent on native trees would become less common.

Twenty-seven migratory bird species using the Desert Wash habitats would be negatively impacted by the loss of productivity in these habitats until they naturally recover.

Other Federal trust migratory species such as waterfowl and shorebirds would be unaffected as they are dependent on water conditions, not terrestrial vegetation type.

5.1.1.4 OTHER WILDLIFE SPECIES

Several butterfly species that are dependent upon native tree species (e.g., Western Viceroy, Greater Purple Hairstreak, Mourning Cloak) would be negatively affected. Bighorn Sheep would be unaffected by the conversion of a native-dominated riparian woodland to a salt cedar-dominated woodland as this species does not use woody riparian habitat of either type on the refuge. Gambel's Quail and Desert Cottontails could be moderately affected as both species avoid dense, salt cedar dominated habitat but are occasionally found in the open glades of cottonwood-willow woodlands where herbaceous and grassy vegetation is more common. Both species are most abundant in the edges of the riparian terraces dominated by mesquite, native shrubs and herbaceous plants, and in the edges of the uplands. White-winged doves would be positively affected since they are more common in salt cedar-dominated riparian areas. Mourning Doves are more common in native-dominated riparian woodlands (BWRNWR 2007) so

they would be negatively affected. Both dove species also use the Desert Washes and would be negatively affected until this habitat type returns to its baseline condition.

Examples of species that would be unaffected by the conversion to a salt cedar-dominated forest as long as at least 25% native trees remain would be Bell's Vireo, Bendier's Thrasher, Costa's Hummingbird, Crissal Thrasher, Gila Woodpecker, Lucy's Warbler, Sonoran Yellow Warbler, Virginia's Warbler, Western Red Bat, and Western Yellow Bat.

5.1.2 WATER RESOURCES

The Open Water Aquatic and Delta Marsh affected areas recovered within 3-6 months after the fuel spill and fire. Therefore, natural filtration provided by submerged vegetation and emergent marsh vegetation was restored by 2007. No adverse or beneficial impact would result from this alternative.

5.1.3 ECOSYSTEM SERVICES

There would be a long-term loss of riparian and terrestrial species diversity and productivity since no primary or compensatory projects would occur.

5.1.4 RECREATIONAL RESOURCES

Under this alternative, there would be no new recreational opportunities. Aesthetics of the burned area would remain degraded in their current condition until complete natural recovery occurs. Opportunities for hunting would not be affected.

5.1.5 CULTURAL RESOURCES

Native riparian woodland trees are significant to several southwestern tribes. The Chemehuevi use willows harvested along riparian areas to craft their traditional basketry. The No Action Alternative would negatively affect cultural resources important to Tribes such as willows and other native woody species since they would be less abundant, although we expect these effects would be minimal because of the abundance of cottonwood/willow elsewhere. There would be no negative effects to cultural and archeological sites since no on-the-ground activities would occur. This alternative would not preserve any archeological and historic resources.

5.1.6 ENVIRONMENTAL JUSTICE

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (59 Federal Register 7629(1994)), directs Federal agencies to incorporate environmental justice in their decision making process. Federal agencies are directed to identify and address as appropriate, any disproportionately high and adverse environmental effects of their programs, policies and activities on minority or low-income populations. This alternative would not disproportionally impact any low-income or minority group since no action would take place; all refuge user groups would be equally impacted by the loss of biodiversity in the area.

5.1.7 SOCIOECONOMIC IMPACTS

If the No Action alternative were implemented, one indirect, minimal economic impact on the local economy would be fewer lands that could provide recreational activities in the area. Since natural resources would not be restored, rehabilitated, replaced or the equivalent acquired under this alternative, another indirect economic impact would be continued development of land that is or could provide important ecological services to the BWR or LCR. This alternative would do nothing to compensate the public for the short-term disruption of fishing and boating the area experienced.

5.1.8 CUMULATIVE IMPACTS

The cumulative impacts from the 'No Action' alternative would be negative because the public would not be compensated fully for the loss of natural resources due to the spill and fire.

5.2 ALTERNATIVE B: PRIMARY RESTORATION OF MIXED RIPARIAN WOODLANDS AND DESERT WASHES ON-SITE

This alternative would provide primary restoration in the Mixed Riparian Woodlands and Desert Washes and would include the use of approved herbicides to control salt cedar as well as pole or pot plantings to replace native trees and shrubs. The goal of this alternative would be to return the affected burn areas to their 2006, pre-fire conditions. We would use the herbicides "Habitat" and/or "Arsenal" to selectively kill salt cedar to reduce competition for space, water and light for the native species and decrease the increase in soil surface salinity that accompanies salt cedar encroachment.

"Habitat" and "Arsenal" are approved for aquatic and near-stream conditions when used in accordance with label instructions. The active ingredient in "Habitat" and "Arsenal" is imazapyr. "Habitat" is registered for use in aquatic situations and can be applied aerially, ground-broadcast, via low-volume backpack spot treatment, or cut-stump to control salt cedar. "Arsenal" is for use in rangeland and non-crop sites and can be applied aerially, ground-broadcast, via low-volume backpack spot treatment, or cut-stump to control salt cedar. A detailed discussion imazapyr can be found in Appendix A.

This alternative would create short-term negative environmental impacts since it requires vegetation removal and herbicide applications, but the overall, long-term environmental impacts would be positive.

5.2.1 BIOLOGICAL RESOURCES

Temporary disruption of the Mixed Riparian Woodland habitat would occur during herbicide application and pole planting; disturbance in the Desert Washes would occur when potted plants are transplanted. We would perform these activities in late fall and winter so they would not disrupt breeding and nesting and would maximize plant survivorship.

5.2.1.1 HABITATS AND VEGETATION

The overall consequences of this action would be to increase native riparian plant density at the injured site rather than exotic plant communities.

When imazapyr is used in accurate, low-volume applications on monoculture stands of dense-canopy salt cedar desirable understory vegetation, including forage grasses and native brush and trees have the opportunity to grow and succeed without competition. Revegetation efforts may need to accompany herbicide use if salts have built up and/or are toxic due to salt cedar allopathic residues.

If Habitat or Arsenal is applied properly, you can achieve 90% to 98% salt cedar control. Follow-up applications to control the remaining 2 to 10% of plants should be selective, low volume spot treatments, or cut-stump, applied to give the least impact to the ecosystem. Spraying is not involved in the cut-stump method so no drift would occur.

Because on-site restoration would be limited to small boat use and any heavy equipment or development of irrigation wells would be precluded, restoration actions would be limited to personnel with hand tools. Thus, disturbance to soil would be minimized.

Using "Habitat", habitats would recover to near pre-injury conditions 20 years faster than if it were not used, and would result in little disturbance of the soil or existing native vegetation.

5.2.1.2 FEDERALLY THREATENED AND ENDANGERED SPECIES

No long-term adverse effects are anticipated for the Yuma clapper rail, southwestern willow flycatcher, razorback sucker, and bonytail as a result of Alternative B. The candidate yellow-billed cuckoo is dependent on mature riparian trees like cottonwood/willows. There would be short-term negative impacts to the yellow-billed cuckoo before the native trees mature, but in the long-term, impacts would be positive. Short-term negative impacts would occur as a result of the disturbance during salt cedar removal and herbicide application, but since this would occur during the fall (outside of the breeding season), negative impacts would be minimized.

5.2.1.3 MIGRATORY BIRDS

Approximately 108 migratory birds use the riparian corridor of the BWRNWR and could be impacted by Alternative B. The use of herbicide to control the salt cedar would allow for native tree re-colonization and would return the area to its original terrestrial riparian vegetation, vertebrate, and invertebrate communities. These activities would occur in late fall and winter and would not disrupt breeding activities, with the possible exception of Costa's and Anna's hummingbirds or large species of owls which breed in December and January on the LCR. Depending upon individual species' habitat preferences, we would check trees for bird activity. If we suspect birds are nesting in a tree we need to treat, we would delay treatment until later in the year or not at all. We would minimize our disruption of nesting birds as much as possible. With these mitigation measures, we expect negative impacts to be minimal.

Other Federal trust migratory species such as waterfowl and shorebirds would be unaffected as they are dependent on water conditions, not terrestrial woody vegetation type. Overall, impacts to the migratory birds from Alternative B would be negative, but minimal, in the short-term, but significantly positive in the long-term as native vegetation is restored.

5.2.1.4 OTHER WILDLIFE SPECIES

Other wildlife would be affected the same as listed species or migratory birds. These effects include short-term habitat disturbance in the late fall and winter with significant positive benefits, including a more rapid return of ecosystem services.

5.2.2 WATER RESOURCES

No disturbance to sediments or open water would result from this alternative.

5.2.3 ECOSYSTEM SERVICES

There would be a short-term loss of riparian and terrestrial species diversity and productivity as implementation occurs, but the long-term impacts from Alternative B would be beneficial. Ecosystem services such as pollination would be restored as quickly as possible.

5.2.4 RECREATIONAL RESOURCES

Under this alternative, primary restoration would return recreational opportunities more quickly to baseline levels. Aesthetics of the burned area would return to their baseline level quickly, thus adverse impacts to aesthetics would be short-term. Opportunities for hunting would not be affected.

5.2.5 CULTURAL RESOURCES

Under this alternative, the number of willows and cultural and spiritual opportunities would return to their original baseline more quickly. No adverse effects to cultural and archeological sites would be anticipated since this restoration would largely occur in the areas that were originally disturbed by the fire and which lie in the active floodplain of the river. Since floods in excess of 150,000 cfs have been documented on BWR in the past, any historical or cultural resources that were present would have removed or covered.

5.2.6 ENVIRONMENTAL JUSTICE

Under this alternative, primary habitat restoration would not cause any negative environmental justice impacts, Alternative B would not disproportionally affect any low-income or minority demographic group. Rather, all user groups of the refuge would be equally and positively, even if minimally, impacted by the restoration of the habitat to its original condition and function.

5.2.7 SOCIOECONOMIC IMPACTS

If this alternative were implemented, one positive, direct impact would be the short-term investment in local students, contractors, and supply stores to complete the restoration work. No adverse impacts would be expected.

5.2.8 CUMULATIVE IMPACTS

No cumulative impacts would be expected.

5.3 ALTERNATIVE C: ACQUISITION OF COMPARABLE HABITATS IN THE BILL WILLIAMS RIVER CORRIDOR AND/OR LOWER COLORADO RIVER VALLEY NEAR THE BILL WILLIAMS RIVER CORRIDOR

This alternative would purchase and/or set-aside additional habitats in the BWR corridor or in the vicinity of the BWRNWR and would protect habitat suitable for riparian-obligate species of concern. We would prefer parcels with similar resources and comparable ecological function, particularly those with potential for replacing the flood-regenerated ecological processes of the BWR habitats that were impacted as these have been shown to produce unique biodiversity. Overall, the impact of this alternative would be positive, since habitat, wildlife, and cultural resources would be protected from future development.

5.3.1 BIOLOGICAL RESOURCES

5.3.1.1 HABITATS AND VEGETATION

This alternative would result in the protection of functioning Riparian Woodlands, Desert Wash, and Upland Desert habitats, thus providing beneficial impacts. Implementation of Alternative C would have no adverse impacts to habitats and vegetationunless the property required some restoration to provide maximum ecosystem servicesIf habitat restoration is required, some short-term impacts would occur depending on what was required. The types of impacts that would occur were described under Alternatives D and E. However, preference will be for parcels that would not require restoration.

5.3.1.2 ALL WILDLIFE

Protection and enhancement of land would provide benefits to threatened, endangered and candidate species as well as migratory birds and other terrestrial wildlife by protecting habitat from development and by reducing habitat fragmentation. No adverse impact to wildlife would occur.

5.3.2 WATER RESOURCES

No long-term adverse impact to water resources would result from this alternative.

5.3.3 ECOSYSTEM SERVICES

Acquisition would provide positive long-term ecosystem benefits.

5.3.4 RECREATIONAL RESOURCES

While the primary purpose of the preservation of this land is for fish and wildlife, if natural resource-based recreational activities such as wildlife viewing, hiking, fishing or hunting are compatible, the public could use portions of the acquired properties. If it is necessary to restrict public access to the new acquisition or easement to protect resource values, there would be minimal negative impacts. The negative impacts due to restricted access would be minimal because there are multiple locations in the area where the public could choose to go instead. This alternative could result in either beneficial or negative impacts, but both would be minimal because there are many public lands available nearby.

5.3.5 CULTURAL RESOURCES

Acquisition could protect cultural and archeological sites in perpetuity. Opportunities to practice cultural and spiritual traditions would also increase. However, it may be necessary to restrict access if the acquisition properties contain cultural or historical sites. Therefore, the long-term impact is beneficial for Native Americans, but may be perceived negatively by other user groups. However, the overall negative impact would be minimal because there are many public lands available nearby.

5.3.6 ENVIRONMENTAL JUSTICE

We would only work with willing landowners to preserve habitat. No minority or low-income populations would be displaced or negatively impacted. The purchase of habitat would bring additional lands into the public domain. Although minimal, the local communities close to these parcels would benefit from the increase in available public land. Recreational opportunities for minority and low-income populations may even increase slightly. Therefore, Alternative B would result in beneficial impacts.

5.3.7 SOCIOECONOMIC IMPACTS

This alternative includes working with willing landowners to acquire or conserve private lands. Landowners would be under no obligation to sell to the government. Neighbors adjacent to land purchased under this restoration plan would retain all of the rights to their land. Availability of land for acquisition and/or conservation easements is dependent upon interested landowners and the appraisal of the land by the FWS. Payment in lieu of taxes by the Federal Government is made to maintain the local tax base if lands were acquired by the USFWS. This would remove parcels from future agricultural, residential, and commercial development and set them aside into permanent conservation status. If we acquire lands from a willing, adjacent farmer who is currently producing crops, it is possible a negative financial impact could result. However, depending on market values for agricultural commodities, it could also be financially beneficial. Therefore, the outcome of each acquisition or easement would be site-specific.

5.3.8 CUMULATIVE IMPACTS

Cumulative impacts from habitat acquisition or conservation would positively, if not minimally, affect the region as a whole. Approximately 90 percent of the mature riparian woodlands on the LCR have been permanently altered (LCR MSCP 2004). With land acquisition, more habitats for riparian-obligate species would be protected. If these lands need restoration, we could perform habitat enhancement to assist in recovery of ecosystem function. We do not anticipate any negative cumulative impacts.

5.4 ALTERNATIVE D: COMPENSATORY RESTORATION OF MIXED RIPARIAN WOODLAND AND DESERT WASH HABITATS ON-REFUGE BUT OFF-SITE

This alternative would restore the Mixed Riparian Woodlands and Desert Washes habitats on the refuge, but not in the primary areas affected by the spill and fire. This alternative is very similar to Alternative B, except it would require less salt cedar control and more Bermuda grass control because these areas are former ranches where Bermuda grass is a dominant species. Herbicides would be used to control the Bermuda grass in the former agricultural fields to reduce competition with the new plantings. Irrigation would be necessary to establish native tree and shrub species. The goal of this alternative would be to turn low quality wildlife habitat into higher quality habitat and improve the habitat's ecological function.

Short-term negative physical effects would be limited to soil disturbance during grass removal and tree/shrub planting and herbicide use. Herbicide applications would cause temporary adverse impacts. Impacts would be minimized by applications that would be low to the ground to control drift and minimize contact with non-target vegetation. Additional best management practices would be achieved by following herbicide application procedures as described in USFWS (2007). If we needed to apply herbicides near existing woody or herbaceous plants, hand applications would be used.

The long-term environmental impacts would be positive.

5.4.1 BIOLOGICAL RESOURCES

Most of the impacts to biological resources would be very similar to those in Alternative B, with the exception of the effects to the yellow-billed cuckoo and other riparian-obligate species. The habitats on the refuge infested with Bermuda grass would be converted to mesquite bosques, so southwest willow flycatchers would not benefit. Yellow-billed cuckoos would benefit from habitat restoration as they will use mesquite bosque as a foraging habitat, especially if it is in proximity to large native riparian trees as are present on areas of the Kohen Ranch bordering the field proposed for restoration.

5.4.2 WATER RESOURCES

Short-term impacts to water resources would include groundwater or surface water withdrawals to irrigate new plantings. The short-term negative impact would be a reduction in water available for other uses (e.g., in-stream). The long-term impact would be beneficial.

5.4.3 ECOSYSTEM SERVICES

Short-term disturbance would occur as the project is implemented, but the restoration would result in positive, long-term ecosystem benefits.

5.4.4 RECREATIONAL RESOURCES

Under this alternative, recreational opportunities would modestly increase as a result of restoration or enhancement on the refuge. Aesthetics of the restoration site would improve if the parcel was formerly used for agriculture. Opportunities for hunting would not be affected.

5.4.5 CULTURAL RESOURCES

Mesquites would be planted under Alternative D on former agricultural lands on the refuge, which would result in positive, cultural impacts since mesquites are important to many Tribes.

5.4.6 ENVIRONMENTAL JUSTICE, SOCIOECONOMIC, AND CUMULATIVE IMPACTS

Same as Alternative B.

5.5 ALTERNATIVE E: RESTORATION OF COMPARABLE HABITATS ALONG THE BILL WILLIAMS RIVER CORRIDOR OR THE LOWER COLORADO RIVER CORRIDOR BETWEEN NEEDLES, CALIFORNIA AND PARKER DAM, ARIZONA

Restoration and enhancement of riparian habitat off of the BWRNWR, but along the Bill Williams River Corridor or on the LCR nearby, including Havasu NWR, would include planting Mixed Riparian Woodland and Desert Wash species. The goal of this alternative would be to establish or enhance habitats to replace the injured habitats and resources lost in the Texmo spill and fire. Priority would be given to projects based on their proximity to the BRWNWR or Havasu NWR and similarity to the species and habitats injured.

5.5.1 BIOLOGICAL RESOURCES

This alternative would have short-term, negative environmental impacts through removal of non-native grasses, shrubs, and/or trees. We would perform infrastructure improvements, including moving soil and sediments, installing structures, and providing adequate access as needed depending on site specific conditions. These activities could require the use of heavy equipment to and would cause short-term impacts through soil disturbance and noise; however the impacts would be minimized by the use of best management practices. We would also need to use herbicides to remove and control non-native, invasive species such as salt cedar and Bermuda grass. However, the long-term environmental impacts would be positive, due to promotion of native species diversity and enhancing habitat for native species use.

Impacts to habitats and vegetation, listed species, migratory birds, and other wildlife would be the same as in Alternatives B and D. However, where cottonwood/willow habitat is restored or enhanced, the impacts would be positive for riparian-obligate species at the restoration site. Where mesquite habitat is restored or enhanced, the impacts would be positive for species that utilize bosques at the restoration site.

5.5.2 WATER, ECOSYSTEM, AND RECREATIONAL SERVICES/RESOURCES

The impacts from this alternative would be the same as those from Alternative D.

5.5.3 CULTURAL RESOURCES

This alternative would have positive, long-term, but minimal, impacts because willow and mesquite would be more available for traditional and cultural uses.

5.5.4 ENVIRONMENTAL JUSTICE, SOCIOECONOMIC, AND CUMULATIVE IMPACTS

The impacts from this alternative would be the same as those for Alternatives B and D.

5.6 ALTERNATIVE F: INVENTORY RESEARCH

Under this alternative, inventory research would be developed that focus on the effect and recovery of the spill and fire at BWRNWR as well as the effects of restoration, replacement, and acquisition on off-site habitats on the ecosystem. In addition, this alternative would provide more information on species or taxa that we have not inventoried in the past. Monitoring activities would be non-intrusive.

5.6.1 BIOLOGICAL RESOURCES

This alternative would not create any negative impact to biological resources. Positive impacts would result due to increased understanding of the ecology of the BWR and LCR, leading to enhanced Federal and state management actions.

5.6.2 WATER RESOURCES

No impact would be expected from monitoring activities.

5.6.3 ECOSYSTEM SERVICES

We would gain increased knowledge on how species in the desert and the BWR function; this would provide positive ecosystem benefits.

5.6.4 RECREATIONAL RESOURCES

We do not expect this alternative to impact recreation.

5.6.5 CULTURAL RESOURCE, ENVIRONMENTAL JUSTICE, AND SOCIOECONOMIC IMPACTS

This alternative might create beneficial educational opportunities for local Tribes and the public. No other adverse impacts would occur.

5.6.6 CUMULATIVE IMPACTS

This alternative would increase wildlife management success at the BWR and other habitats of the LCR due to better understanding of native species. There are no adverse cumulative impacts due to Alternative G.

5.7 ALTERNATIVE G: PREFERRED ALTERNATIVE; COMBINATION OF ALTERNATIVES B-F

A combination of Alternatives B-F would be undertaken as project feasibility, cost, land availability, and overall ecosystem benefit allow. This alternative would encompass the on- or off-site and/or on- or off-refuge restoration, land acquisition, constructing a breakwater and holding facility for endangered fish, and monitoring research. Although short-term, negative environmental impacts would occur as discussed above, the overall environmental impact, as measured by individual species, community development, and ecosystem services, would be positive.

See Alternatives B-F for a thorough discussion of the environmental consequences of each alternative.

5.7.1 CUMULATIVE IMPACTS

Cumulative impacts from habitat acquisition, restoration or enhancement implemented under Alternative G would positively affect the BWR and LCR as a whole since more habitats would be created and protected for fish and wildlife. Another positive impact of Alternative G is the broad focus of the activities we would implement. This is the only alternative that could be able to fully restore all of the resources lost. No adverse cumulative impacts would occur.

5.8 SUMMARY OF ENVIRONMENTAL IMPACTS BY ALTERNATIVE

Table 1 presents a summary of consequences for implementing each alternative. We used this analysis to aid in the selection of the preferred alternative. No significant adverse impact is expected from any of the identified alternatives.

Table 1. Summary of the environmental consequences by alternative for the Texmo Diesel Spill and Fire restoration.

Attribute	**Alt A** No Action	**Alt B** On-site Restoration	**Alt C** Acquisition	**Alt D** On-refuge, off-site	**Alt E** Off-refuge	**Alt F** Inventory Research	**Alt G** Mix of B-F
Threatened & Endangered Species – Terrestrial Habitat	Riparian woodlands: change % native to exotic tree community, possible negative impact on cuckoo but positive on flycatcher No T&E affected in the Desert Wash	Riparian woodlands: short-term impacts would be negative, but long-term would be neutral for cuckoo and none for flycatcher; Desert Wash: no T&E affected.	Positive impact on all since more habitat would be protected	Potential negative impact to cuckoo and other riparian obligate species that are dependent on cottonwood/ willow	Short-term impacts would be negative, but positive long-term impact for flycatcher and cuckoo and other riparian obligate species dependent on site selection.	Positive long-term benefits since our understanding of species would increase and we would be able to manage them better.	Positive long-term impacts but possible negative short-term impacts cuckoo
Threatened & Endangered Species – Aquatic Habitat	None	None	None	None	None	Positive long-term benefits since our understanding of species would increase and we would be able to manage them better.	Breakwater pens would improve T&E fish survivorship.

Attribute	**Alt A** No Action	**Alt B** On-site Restoration	**Alt C** Acquisition	**Alt D** On-refuge, off-site	**Alt E** Off-refuge	**Alt F** Inventory Research	**Alt G** Mix of B-F
Migratory Bird Habitat	Riparian woodlands: change % native to exotic tree community. Positive/Negative impact depending on bird species. Desert Wash: long-term negative impact.	Riparian woodlands and Desert Wash: negative in short-term, neutral in long-term.	Land acquisition has positive benefit to all migratory birds.	Short-term effects would be negative, but on-refuge restoration of old fields to bosques would positively benefit riparian migratory birds.	Short-term impacts would be negative, but positive long-term impact for flycatcher and cuckoo and other riparian obligate species dependent on site selection.	Enhanced understanding of riparian/ terrestrial species biodiversity, productivity, and ecosystem processes.	Positive long-term impacts but possible negative short-term impact during treatment and restoration.
Other Wildlife Species	As above – species dependent.	As above - species dependent.	All impacts would be beneficial.	As above - species dependent.	Short-term impacts would be negative, but long-term impacts would be positive	Positive impact as a result of enhanced understanding of riparian/ terrestrial species biodiversity, productivity, and ecosystem processes.	Positive long-term impacts.

Attribute	**Alt A** No Action	**Alt B** On-site Restoration	**Alt C** Acquisition	**Alt D** On-refuge, off-site	**Alt E** Off-refuge	**Alt F** Inventory Research	**Alt G** Mix of B-F
Water Resources	No negative or positive impacts.	None.	Long-term positive impacts.	Short term use of ground/surface water to establish plants would provide long-term resource benefit.	Short term use of ground/surface water to establish plants would provide long-term resource benefit.	No impact.	Short-term disturbance of small, localized area would include increased turbidity for breakwater construction and use of water for irrigation. Beneficial long-term impacts.

Attribute	**Alt A** No Action	**Alt B** On-site Restoration	**Alt C** Acquisition	**Alt D** On-refuge, off-site	**Alt E** Off-refuge	**Alt F** Inventory Research	**Alt G** Mix of B-F
Ecosystem Services	Long-term loss of aquatic and terrestrial species biodiversity and productivity, particularly for riparian obligate species, pollinators and lepidopterans.	Negative in short-term, positive in the long-term;	be offset by increases gained at the acquisition site.	Some ecosystem services would be negative impacted for a short-time, but long-term impacts would be positive.	Some ecosystem services would be negatively impacted for a short-time, but long-term impacts would be positive.	Enhanced understanding of riparian/ terrestrial species and other species biodiversity, productivity, and ecosystem processes would result in positive long-term impacts. Increased knowledge for post-fire management.	Some ecosystem services would be negatively impacted for a short-time, but long-term impacts would be positive. Impacts would be positive for endangered fishes as well as for future management decisions.

Attribute	Alt A No Action	Alt B On-site Restoration	Alt C Acquisition	Alt D On-refuge, off-site	Alt E Off-refuge	Alt F Inventory Research	Alt G Mix of B-F
Recreational Resources	Decline in avian abundance/biodiversity and riparian aesthetics. Short-term loss of fishing/boating access has recovered. Hunting opportunities would not be affected.	Would return to original, baseline level and would provide beneficial impacts.	Primary goal is to restore lost ecosystem services, but if recreational pursuits (hiking/wildlife viewing/hunting/fishing) are compatible, long-term impacts would be positive. Birding opportunities would slightly increase. If access is restricted, impacts would be negative, but minimal.	Hunting opportunities would not be affected. On-refuge, off-site restoration projects would improve habitat and aesthetics, providing positive long-term impacts. If access is restricted, impacts would be negative, but minimal	Hunting opportunities would not be affected. Off-refuge restoration projects would improve habitat and increase hiking options, providing positive long-term impacts. If access is restricted, impacts would be negative, but minimal	Not anticipated to interfere with recreation and would not result in any negative impacts.	Overall, some short-term negative impacts or insignificant negative impacts would occur, but long-term, the impacts would be positive.

Attribute	**Alt A** No Action	**Alt B** On-site Restoration	**Alt C** Acquisition	**Alt D** On-refuge, off-site	**Alt E** Off-refuge	**Alt F** Inventory Research	**Alt G** Mix of B-F
Cultural Resources	Loss of willows for traditional/spiritual uses would create a minimal negative impact.	This alternative would provide more willows for traditional harvesting, resulting in small, but long-term positive impacts.	Increase in willows and mesquites for traditional/ spiritual uses. Positive impact due to long-term protection of cultural/ archeological sites, but could create minimal negative impact if access is restricted.	Positive impacts would result as mesquites or willows increase.	Increase in willows and mesquites for traditional/spiritu al uses off-site.	Could create educational opportunities for local Tribes.	Increased abundance of desirable woody species for tribes would be positive, but restricted access would result in minimal negative impacts.

Attribute	**Alt A** No Action	**Alt B** On-site Restoration	**Alt C** Acquisition	**Alt D** On-refuge, off-site	**Alt E** Off-refuge	**Alt F** Inventory Research	**Alt G** Mix of B-F
Socio-economic Resources	Initial loss of short-term fishing/boating activities uncompensated. Decrease in land for recreation and loss of opportunity to protect ecologically valuable land into conservation status. Long-term impacts would be negative.	Increase in job opportunities and local store patronage during habitat restoration.	Potential for negative impacts if land was being farmed or developed. Positive impacts could result if overall transaction is beneficial for willing seller.	Increase in job opportunities and local store patronage during habitat restoration.	Increase in job opportunities and local store patronage during habitat restoration.	Could create opportunities to educate the public.	Overall impacts would be positive, but a few negative impacts could occur.
Cumulative Impacts	Negative because public not fully compensated for natural resources injuries.	None	Acquisition impact would be substantial and positive for all terrestrial habitats and native species. Enhanced protection of ecosystem services.	None	None	Positive impacts for native species because increased knowledge would lead to increased management success.	Positive impacts for native species through protection of ecosystem services.

CHAPTER 6: MONITORING PROGRAM AND PERFORMANCE CRITERIA

A monitoring program will be implemented to evaluate whether the goals to restore, rehabilitate, replace, or acquire the equivalent of the injured natural resources have been met. The monitoring program for each project will include provisions for project monitoring and reporting to ensure the specific project objectives and restoration actions are conducted as intended. Such provisions include performance standards and criteria for each restoration action, guidelines for implementing corrective actions, and a schedule for frequency and duration of monitoring.

A draft monitoring plan has been developed by the BWRNWR.

CHAPTER 7: COORDINATION WITH THE PUBLIC

Public review is an important component of the restoration planning process. The Trustee will provide the public with the opportunity to comment for a 30-day period. Comments received by the due date will be considered part of the official record and will be incorporated into the final restoration plan and environmental assessment. Separate NEPA and Endangered Species Act Section 7 compliance documents for each project will be developed as required.

Tribes with historic interests in the area will be contacted and consulted to allow comment on this document.

The RP/EA was advertised in the Parker Pioneer, the Lake Havasu News-Herald in Arizona as well as Needles, CA and Laughlin, NV papers since actions in the preferred alternative are within their geographic area. Copies were placed in the public libraries of each community as well as at the offices at the Bill Williams River NWR, Havasu NWR, and the USFWS's Arizona Ecological Services Office website (http://www.fws.gov/southwest/es/arizona/). Also, the Administrative Record was available for viewing at the Arizona Ecological Services Office. Copies of the RP/EA can also be requested from the USFWS at:

U.S. Fish and Wildlife Service
Bill Williams River National Wildlife Refuge
60911 Highway 95
Parker, AZ 85344
(928) 667-4144

CHAPTER 8: LIST OF PREPARERS

This RP/EA was prepared by representatives of the natural resource trustee agency listed below, in consultation with other partnering agencies and stakeholders. Report preparation assistance and review were provided by the DOI Office of Natural Resource Restoration's Restoration Support Unit.

Kathleen Blair, Lake Havasu NWR Complex Ecologist, U.S. Fish and Wildlife Service ,(Primary Author)

Carrie Marr, Wildlife Biologist, U.S. Fish and Wildlife Service

Karen Cathey, NRDAR Regional Coordinator, U.S. Fish and Wildlife Service

Dick Gilbert, Lake Havasu NWR Complex Manager, U.S. Fish and Wildlife Service

Bill Williams River Corridor Steering Committee, http://billwilliamsriver.org/Committee/

Colette Charbonneau, Restoration Biologist, DOI-Office of Natural Resource Restoration, Restoration Support Unit

CHAPTER 9: PUBLIC COMMENTS ON THE DRAFT RESTORATION PLAN/ENVIRONMENTAL ASSESSMENT AND RESPONSE

This document was available for public review. The public review period opened on August 24, 2011, and closed on September 23, 2011. A Notice of Availability was mailed to 50 interested parties, tribes, and agencies. The Notice of Availability and Draft Restoration Plan/Environmental Assessment were posted on the Arizona Ecological Services Internet homepage (http://www.fws.gov/southwest/es/arizona/). The Notice of Availability was also available through legal notices in Lake Havasu City's Today's News-Herald, the Needles Desert Star, the Laughlin Nevada Times, and The Parker Pioneer. A news release was sent to 15 reporters/editors at 13 different news media outlets on August 24, 2011. Additionally, it was posted to the Arizona Ecological Services Internet homepage and broadcast on the Service's Southwest Region social media sites. We received three comments on the Draft RP/EA during the 30-day public review and comment period.

RESPONSE TO COMMENTS

The Draft Restoration Plan/Environmental Assessment was reviewed by AGFD's Region IV Office, Yuma, Arizona; the Bureau of Reclamation, Yuma, Arizona; and the Arizona Department of Environmental Quality, Phoenix, Arizona.

Comment: One commenter requested additional review to ensure proposed restoration actions do not encroach on Bureau of Reclamation land or facilities on the lower Colorado River (i.e., levees or other water control structures). (Bureau of Reclamation)

Response: The Trustees will coordinate future restoration actions with adjacent landowners as well as other agencies that may be affected.

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Comment: One commenter brought some water quality issues to our attention. If project activities occur inside the Ordinary High Water Mark of any water of the U.S., then a CWA section 404 permit (a.k.a. dredge and fill) from the U.S. Army Corps of Engineers may be required. If a 404 permit (or any other Federal permit) is required for the project, a state-issued CWA section 401 certification of the permit may be required to ensure that the permitted activities will not result in a violation of Arizona's surface water quality standards. Also, the application of herbicides may require coverage under the Arizona Pollutant Discharge Elimination System Pesticide General Permit, which will become effective on October 31, 2011. (Arizona Department of Environmental Quality)

Response: We recognize that as project specifics are developed, we will need to continue coordinating with the adjacent landowners, affected cities, Tribes, and municipal, state, and Federal agencies in order to comply with appropriate regulations and obtain the necessary approvals, permits, or take statements.

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Comment: We received one general endorsement of the Preferred Alternative to restore and/or acquire habitat types impacted by the diesel spill (Alternative H). However, the same commenter does not believe that Alternative F in the Draft plan would assist in the recovery of the bonytail and razorback sucker. While this commenter supports the conservation of native fish species, he believes that native fish experienced little, if any, impact as a result of the spill. (Arizona Game and Fish Department)

Response: We appreciate the support of everyone that took the time to read the Draft RP/EA and to respond. We are glad that the Proposed Action was well received. We agree that the endangered fishes were probably affected very little by the spill and fire. Therefore, we removed 'Construction of Breakwater and Grow-out Area for Endangered Fish' as an alternative. This change prompted us to update the names of the alternatives. Alternative G is now called the 'Preferred Alternative; Combination of Alternatives B-F' in the Final RP/EA.

CHAPTER 10: ENVIRONMENTAL ACTION MEMORANDUM

Actions undertaken by a Federal Trustee to restore natural resources or services under OPA and other Federal laws are subject to NEPA, 42 U.S.C. 4321 *et seq.*, and the regulations guiding its implementation at 40 C.F.R. Parts 1500 through 1517. The NEPA and its implementing regulations outline the responsibilities of Federal agencies under NEPA, including preparing environmental documentation. In general, Federal agencies contemplating implementation of a major Federal action must produce an EIS if the action is expected to have significant impacts on the quality of the environment. When it is uncertain whether a contemplated action is likely to have significant impacts, Federal agencies prepare an EA to evaluate the need for an EIS. If the EA demonstrates that the proposed action will not significantly impact the quality of the environment, the agency issues a FONSI, which satisfies the requirements of NEPA, and no EIS is required. This RP/EA has integrated NEPA requirements by: summarizing the affected environment; describing the purpose and need for the restoration; identifying alternative restoration projects; assessing each alternative's applicability and environmental consequences; and, summarizing opportunities for public participation in the decision process.

If necessary, another NEPA analysis would be conducted for specific projects if they were not sufficiently described in this document. Specific projects will undergo an Endangered Species Act analysis (Section 7) and State Historic Preservation Office consultation before they are implemented. Each of these will be dependent on the specifics of each project's site selection, timing, construction techniques, and needs.

Based on the information contained in the final EA and supporting data in our files, we have determined that this action is not a major Federal action that would significantly affect the quality of the human environment within the meaning of section 102(2)(c) of the National Environmental Policy Act of 1969. Specifically, although effects to listed and candidate species; vegetation; wildlife; cultural resources; wetlands; and water resources are identified in this EA, effects are minor and may result in a net benefit.

This action is not an action that normally requires preparation of an Environmental Impact Statement (EIS) and is not similar to such actions. Accordingly, preparation of an EIS on the proposed action is not warranted.

The preferred alternative provides restoration activities that will meet the criteria detailed in 15 CFR 990. This Finding of No Significant Impact with the Final EA will be available on our website, and all who received the Draft RP/EA will receive notice of this decision and where it can be accessed.

CHAPTER 11: REFERENCES CITED

Abella, S.R. 2010. Disturbance and plant succession in the Mojave and Sonoran Deserts of the American Southwest. International Journal of Environmental Research and Public Health 7:1248-1284

American Bird Conservancy. 2010. http://www.abcbirds.org/abcprograms/domestic/sitebased/iba/arizona.html

Anderson, B. W., R. E. Russell, and R. D. Ohmart. 2004. Revegetation: An Account of 2 Decades of Experience in the Arid Southwest. Blythe, CA: Avvar Books. 268 p.

Arizona Game and Fish Department. 2010. http://www.azgfd.gov/h_f/hunting.shtml

Audubon. 2010. http://iba.audubon.org/iba/profileReport.do?siteId=1240&navSite=search&pagerOffset=0&page=1birds.org/

Bainbridge, D. A. 2007. A Guide for Desert and Dryland Restoration: New Hope for Arid Lands. Society for Ecological Restoration International. Island Press. Washington, DC. 391 pgs.

BASF. 2006. Typical concerns of herbicide Imazapyr (ARSENAL®, HABITAT®) use for saltcedar control.

Bestgen, K.R. and B. Mefford. 2010. Swimming Performance and Fishway Model Passage Success of Rio Grande Silvery Minnow. Transactions of the American Fisheries Society 2010; 139: 433-448.

Bill Williams River Corridor Steering Committee (BWRCSC). 2009. http://www.billwilliamsriver.org

Block, W. M., A. B. Franklin, J.P.Ward, J. L. Ganey, and G. C. White. 2001. Design andImplementation of Monitoring Studies to Evaluate the Success of Ecological Restoration on Wildlife. Restoration Ecology 9(3) 293-303.

Bolton, H. E. 1952. Original Narratives of Early American History: Spanish Exploration in the Southwest 1542-1706. Barnes and Noble N.Y. (reprint Orig 1908 Charles Scribner's Sons).

Busch, D. E. and S. D. Smith. 1995. Mechanisms associated with decline of woody species in riparian ecosystems of the southwestern U. S. Ecological Monographs 65: 347-370.

Busch, D. E. 1995. Effects of fire on southwestern riparian plant community structure. The Southwestern Naturalist 40(3):259-267.

Census. 2009. http://factfinder.census.gov. Accessed April 2011.

Dimmitt, M. A. 2000. Flowering plants of the Sonoran Desert, Pp. 153-264 *in* A Natural History of the Sonoran Desert. S. J. Phillips and P. W. Comus (eds.).Arizona-Sonora Desert Museum Press/University of California Press. Tucson, Arizona

Favour, A. 1962. Old Bill Williams, Mountain Man. University of Olkahoma Press. 234 pgs.

Fields, WL. 2009. Managing Alamo Dam to establish woody riparian vegetation on the Bill Williams River, Arizona. MS Plan II paper, University of California, Davis. 35 pp.

Garces, F. 1965. A Record of Travels in Arizona and California, 1775-1776. J. Galvin (ed.) John Howell Books, San Francisco, CA. 150 pp.

Johnson, M.J., Holmes, J.A., C. Calvo, I. Samuels, S. Krantz, and M. K. Sogge. 2007, Yellow-billed cuckoo distribution, abundance, and habitat use along the lower Colorado and tributaries, 2006 annual report: U.S. Geological Survey Open-File Report 2007-1097, 219 p. [http://pubs.usgs.gov/of/2007/1097/]

Koronkiewicz, T.J., M.A. McLoud, B.T. Brown, and S.W. Carothers. 2006. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2005. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, NV by SWCA Environmental Consultants, Flagstaff, AZ. 176 pp.

Lower Colorado River Multi-Species Conservation Program (LCR MSCP). 2004. Lower Colorado River Multi-Species Conservation Program, Volume II: Habitat Conservation Plan. Final. December 17. (J&S 00450.00.) Sacramento, CA.

McLoud, M. A. , T. J. Koronkiewicz, B. T. Brown, and S. W. Carothers. 2005. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2004. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, NV, by SWCA Environmental Consultants, Flagstaff, AZ. 155 pp.

McLoud, M.A., T.J. Koronkiewicz, B.T. Brown, and S.W. Carothers. 2007. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2006. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, NV by SWCA Environmental Consultants, Flagstaff, AZ. 194 pp.

Rich, T.D, C.J. Beardmore, H. Berlanga, P.J. Blancher, M. S. W. Bradstreet, G. S., G. S. Butcher, D. W. Demarest, E. H. Dunn, W.C. Hunter, E. E. Inigo-Elias, J. A. Kennedy, A. M. Martell, A. O. Panjabi, D. N. Pashley, K. V. Rosenberg, C. M. Rustay, J. S. Wendt, T. C. Will, 2004. Partners in Flight North American Landbird Conservation Plan. Cornell Lab of Ornithology. Ithaca, N.Y.

Russell, R. E. J.A. Royel, V. A. Saab, J. F. Lmkuhl, W. M. Block, and J. R. Saur. Modeling the effects of environmental disturbance on wildlife communities: avian responses to prescribed fire. Ecological Applications 19:1253-1263.

Shafroth, P. B. 1999. Downstream effects of dams on riparian vegetation: Bill Williams River, Arizona. Ph. D. diss. Arizona State University. 157 pgs.

Sowka, P. A. and P. E. Brunkow. 1999, Cage culturing the endangered Bonytail. North American Journal of Aquaculture 61:326-330.

Taylor, J. P. and K. C. McDaniel, 2004. Revegetation after saltcedar (*Tamarix* spp) control in headwater, transitional, and depositional watershed areas. Weed Technology 18:Suppl., pp. 1278-1282.

Taylor, J. P., 2000 Proceedings from the conference on fire in riparian areas (*ed.*). U. S. Fish and Wildlife Service, Bosque Initiative. Albuquerque, NM.

U.S. Bureau of Reclamation (USBR). 1998. Long-term Restoration Program for the Historical Southwestern Willow Flycatcher (*Empidonax traillii extimus*) Habitat along the Lower Colorado River. 70 pp.

U.S. Department of the Interior (USDOI). 2007. Draft Habitat Equivalency Analysis (HEA) Bill Williams River National Wildlife Refuge (BWRNWR) Near Parker, AZ. DOI, Office of Policy Analysis. March 6, 2007.

U.S. Fish and Wildlife Service (USFWS). 1994. Lower Colorado River National Wildlife Refuges Comprehensive Management Plan 1994-2014 Final Environmental Assessment. U.S. Fish and Wildlife Service, Albuquerque, NM. 113 pp.

U.S. Fish and Wildlife Service (USFWS). 2007. Recommended Protection Measures for Pesticide Applications in Region 2 of the U.S. Fish and Wildlife Service. By J. Allen White, Austin, TX. 79 pp.

U.S. Fish and Wildlife Service (USFWS). 2009a. Bill Williams River National Wildlife Refuge. Biological database.

U.S. Fish and Wildlife Service (USFWS). 2009b. Report on the Sixth Annual Native Fish Roundup on Lake Havasu, AZ-CA 13-16 February 2006. Document No.: USFWS-AZFRO--PA-06-003

U.S. Fish and Wildlife Service (USFWS). 2009c. Ninth annual native fish round-up on Lake Havasu, AZ 9-13 February, 2009. Document No.: USFWS-AZFRO--PA-09-002

U.S. Geological Society (USGS). 2011. http://nwis.waterdata.usgs.gov/az/nwis/peak?site_no=09426000&agency_cd=USGS&format=gif. Accessed July 2011.

Ward, D. L. and Hilwig, Kara D. 2004. Effects of holding environment and exercise conditioning on swimming performance of southwestern native fishes. North American Journal of fisheries management. vol. 24, n°3, pp. 1083-1087.

Webb. R. H. Stanley A. Leake, Raymond M. Turner. 2007. The Ribbon of Green: Change in Riparian Vegetation in the Southwestern United States. University of Arizona Press. Tucson. Pgs 170-184.

Appendix A

TYPICAL CONCERNS OF HERBICIDE IMAZAPYR (ARSENAL®, HABITAT®) USE FOR SALT CEDAR CONTROL

By Jennifer Volmer BASF Environmental Resource Specialist 2007.

Q: Is imazapyr only effective for salt cedar control when applied broadcast aerial?

A: The active ingredient imazapyr is in Arsenal, Stalker and Habitat herbicide. Arsenal is for use in rangeland and non-crop sites and can be applied aerial, ground broadcast, low volume back pack spot treatment or cut-stump for the control of salt cedar. Stalker is labeled for non-crop sites and can be applied as a solution in basal oil as a basal or cut-stump treatment. Habitat is registered for use in aquatic situations and can be applied aerial, ground broadcast, low volume back pack spot treatment or cut-stump for the control of salt cedar.

Q: Imazapyr does control salt cedar, but will the ecosystem be repaired in a manner that allows re-vegetation of native species?

A: Accurate low-volume applications to monoculture stands of dense canopy salt cedar has proven to allow recovery and release of desirable understory vegetation of forage grasses and native brush and trees. The recommendation for foliar application of imazapyr states to spray to wet. Do not over spray, resulting in spray runoff on to desirable understory plants. Typically aerial applications of imazapyr are made to dense, continuous stands of salt cedar. Little spray penetrates the canopy. Foliar treated salt cedar should be allowed to stand for 2 years before removal by mulching, mowing, cutting or burning. During this time of rest, the area will typically recover in remnant vegetation. If no remnant vegetation exists due to high salinity, toxic soils from salt cedar allopathic residues, revegetation efforts will need to be implemented. Imazapyr residues will no longer be a concern.

Q. Will repeated applications of imazapyr be needed to manage salt cedar? If so, what will be the impact to the ecosystem and revegetation efforts?

A. Applications of **Arsenal** or **Habitat** at 2qts/acre (broadcast) or 1% solution (low volume foliar back-pack spot treat) plus a quality adjuvant (such as a methylated seed oil) with good coverage typically yield control of 90% to 98% salt cedar control. Follow-up applications to control the remaining 2 to10% of plants should be selective, low volume spot treatments, or cut-stump, applied to give the least impact to the ecosystem. Reduced rates of **Arsenal** or **Habitat**, reduced rates in combination with other herbicides, or use of a poor quality or ineffective adjuvant, will result in less control. The reduced control will result in the need of additional applications that could be on a large scale, hindering revegetation efforts. In the long run, reducing rates of the initial application results in higher economic and ecological costs due to the need for retreats.

Q. Is imazapyr persistent in soil?

A. Persistence depends on soil type, moisture, and temperature. The more conducive environmental conditions are for promoting microbial activity, the faster imazapyr will break down. Half-life in soil, as determined by field studies, ranges from 64 – 143 days.

Laboratory studies have been reported out of context showing up to a 400 day half-life. Microbial activity under lab conditions is often much less than true field dissipation studies.

Q. Is imazapyr persistent in water?

A. Imazapyr dissipates rapidly in an aquatic systems (Leonard 1989). Imazapyr rapidly degrades in water by photolysis, with a half-life of 3 to 5 days (Mallipudi et. al. 1991, Curran et al. 1992). Faster half-lives are attributed to bright sunshine and clear water. Imazapyr has been found to have a half-life of <0.5 day and approaches zero asymptote at about 40 hrs (Journal of Aquatic Plant Management 2003).

Q. Is imazapyr persistent in sediment?

A. Imazapyr has been found to have a half-life of 1.6 days in sediment and approaches zero asymptote at about 400 hrs (Patten 2003).

Q. How is imazapyr broken down in soil?

A. The dissipation of imazapyr in soil occurs most rapidly under warm, humid conditions and is mainly a result of microbial degradation. Slow degradation in soil may also occur by soil photolysis (Mangels 1986).

Q. Are the degradation by-products of imazapyr toxic?

A. The organic by-products are not toxic.

FACT: Studies have shown metabolism of imazapyr to yield carbon dioxide and small amounts of several organic breakdown products. These results indicate that the imazapyr molecule undergoes extensive degradation at several sites.

Q. How is imazapyr broken down in water?

A. The dissipation of imazapyr in aqueous environments, generally as a result of photolysis.

FACT: The photodegradation of radio-labeled imazapyr was studied under borosilicate filtered Xenon-arc lamps at 25 °C . Photodegradation under continuous simulated sunlight resulted in half-lives of 2.7 days in pH 5 buffer, 1.9 days in distilled water, and 1.3 days in pH 9 buffer. The calculated half-life for a 12-hour light/12-hour dark cycle ranges from 2.5 to 5.3 days. (BASF 1983). These experiments demonstrate that if imazapyr herbicide were to enter surface waters, it may degrade very rapidly, with photolysis being the predominant degradation pathway.

Q. What is the potential of imazapyr to leach in to ground water?

A. Imazapyr can be strongly adsorbed in soils and is found usually in the “top few inches of the soil” (Infoventures, 2003).

FACT: The fate of imazapyr herbicide was studied extensively in two forest watersheds (Michael 1986). Soil analysis found 99% of the imazapyr residues in the top 30 cm of the soil. In general, the minimal movement of imazapyr residues indicates that the probability of groundwater contamination will be negligible.

In field dissipation studies with radio-labeled chemical, imazapyr residues were restricted mainly to the top 15 cm of soil (Mallipudi et al. 1983). No radiolabeled residues of imazapyr or metabolites, were found below a depth of 30 cm. This suggests that imazapyr is bound to soil more strongly, and is less likely to be mobile through the soil, than might be suggested on the basis of its physical chemical properties. The results from this study have been corroborated by field dissipation studies that demonstrated that the majority of applied imazapyr remains within the top 15 cm of the soil profile in field studies, with trace amounts being found between 15 and 30 cm.(Mallipudi et al. 1985, York 1992a, 1992b, 1993).

Additional field data, to support the contention that actual concentrations are likely to be much lower than modeled estimates, is available in studies conducted by USDA-Forest Service scientists. In one study the relative potential for soil mobility of four herbicides (imazapyr, hexazinone, picloram and triclopyr) was assessed through runoff and groundwater monitoring (Bush et al. 1995). Imazapyr was observed to be the least mobile, with limited potential for lateral movement or movement to the water table. Similar results were obtained in a more recent study (Wiley et al. 2000). No imazapyr residues were observed in surface water downstream of the application area and no imazapyr residues were detected in groundwater up to two years after the application. The authors of this study concluded it is unlikely that detectable concentrations of imazapyr would reach the water table.

Q. What is the toxicity of imazapyr to aquatic invertebrates?

A. Imazapyr is of very low toxicity to aquatic invertebrates.

FACT: In a study of macroinvertebrates response to imazapyr in wetlands, the "study suggests that imazapyr does not have acute or chronic effects . . . and is unlikely to pose a risk of harm to aquatic invertebrates" (Fowlkes et al., 2002).

Q. What is the toxicity of imazapyr to fish?

A. Imazapyr is of very low toxicity to fish and it has not shown any bioaccumulation features.

FACT: The results of the rainbow trout and fathead minnow early life-stage (ELS) toxicity studies demonstrated that continuous exposure to imazapyr concentrations as high as 92.4 mg a.i./L for rainbow trout and as high as 118 mg a.i./L for fathead minnow, did not adversely affect egg hatching, or survival and growth of fry during the early life-stages of development. In addition, the results of the fathead minnow full life-cycle study indicate no effect on survival, growth or reproduction of the fathead at concentrations as high as 120 mg a.i./L.

The State of Washington conducted additional trial to further determine the toxic level of imazapyr for the Risk Assessment for Willapa Bay. Results showed rainbow trout with a LC50 > 77,716 mg/L. This is a higher concentration than commercially available imazapyr in Habitat.

Q. What is the toxicity of imazapyr to mammals?

A. Imazapyr has a low mammalian toxicity partially because it acts by inhibiting a biosynthetic process which occurs in plants, but not animals (Stidham and Singh 1991). In addition, the herbicide is a weak acid which tends to be excreted before it can accumulate in tissues or blood (Miller et. al. 1991). Acute oral, acute dermal and acute inhalation toxicity studies place technical grade imazapyr in the lowest EPA toxicity category IV (relatively non-toxic).

Long-term Human Health and Environmental Risk Concerns

Q: What are the Imazapyr acute and chronic effects to wildlife?

A: The chronic affects of Imazapyr are known for fish (early life stage and full life cycle), shellfish (growth and development) and aquatic invertebrates (full life cycle), and as with the acute results, Imazapyr is essentially non-toxic.

Q: Has **Habitat** been thoroughly tested prior to being offered on the market?

A: Yes, Imazapyr, the active ingredient in **Habitat**, was one of the first imidizolinone herbicides discovered and has been commercially used since the mid 1980's. Imazapyr has been an EPA registered herbicide since 1985. The active ingredient is in over 11 commercial products. Even after the first registration, during the almost twenty years of extensive use in both forestry and industrial non-cropland areas, testing have continued to monitor long-term effects and to support the aquatic registration.

FACT: Herbicides are among the most exhaustively tested products on the market today. Registration of a new herbicide not intended for use on food crops requires approximately 90 or more tests, $50 million or more and 4 to 7 years of development time. It often takes 7 to 12 years to complete all the required tests for an aquatic product. Once a registration application is submitted to the EPA, the EPA takes a minimum of 24 months to review the submitted test results and decide whether to approve the herbicide. The active ingredient (the part of the herbicide that actually has an effect on plants) and the formulated product are tested repeatedly to determine whether they have any potentially harmful side effects. Herbicides are also studied to determine what happens to them after they are applied, and whether the by-products pose any threat to non-targeted plants or animals. In the end, only 1 out of approximately 100,000 chemicals tested meets the requirements to make it out of the laboratory and onto the market.

Q: Is it against the law to apply Habitat aquatic herbicide, even with an EPA and state registration, because water quality standards prohibit the introduction of toxic pollutants into state waters?

A: The 2nd Circuit Court asked EPA to submit a brief on pesticide regulation under FIFRA versus the Clean Water Act. EPA submitted a statement that approved aquatic pesticide use, following the manufacturer label, is not a toxic pollutant and is not in violation of the Clean Water Act. In addition, FIFRA states that any spray outside an approved use site is a violation to be judged by the EPA and Attorney General. A violation of the label cannot be judged in a court of law. Imazapyr is currently registered for use in water, riparian areas and non-cropland. EPA reasoned that pesticide products do not fall within the CWA definition of "pollutants" when used as directed and as approved by EPA, but rather are designed, approved by Federal and state governments, sold, purchased, and applied precisely because they will serve a useful and important beneficial purposes when used in accordance with their labeling. Persons who apply such products in accordance with their EPA-approved registrations should not be required to obtain an NPDES permit, unless in the district of the 9th Circuit Court. See HERBICIDE REGISTRATION, LABEL PRECAUTIONS, AND USE RESTRICTIONS, Application and Monitoring Regulations.

Groundwater Concerns

Q: Some reports quote Imazapyr solubility (1100 ppm), Koc – affinity for organic carbon (~100), and laboratory half-life in soil, indicating that Imazapyr would have an ability to leach into ground water. What is the potential leachability of Imazapyr?

A: Worst-case scenario for soil leaching and dissipation studies have been conducted with Imazapyr applied to bare ground. Under these conditions, Imazapyr had not been shown to move downward more than 24-36 inches in the soil, at concentrations greater than 1 ppb, over a period of 15 to 18 months. Furthermore, the amount of Imazapyr that could potentially enter surface or ground water is negligible and not a human health risk.

FACT: Looking only at the chemical/physical characteristics (water solubility, Kd, Koc, soil half life) of Imazapyr would predict that Imazapyr is likely to be mobile in the soil. In soil, Imazapyr is broken down by microbial activity, so factors which affect the level of soil microbial activity and/or the bioavailability of Imazapyr in the soil, will have a direct affect on its persistence and leachability. For a compound to be available for microbial breakdown, it must be present in the soil solution. Compounds that are tightly bound to the soil are not available (bioavailable) to the soil microbes for breakdown and are more persistent (example: glyphosate). Thus low soil moisture, low pH and high clay and/or organic matter content all cause Imazapyr to be more tightly bound to the soil and less available for microbial breakdown and leaching. Under these field conditions the half-life of Imazapyr will be longer, but its vertical movement will be limited. Under higher soil moisture and sandier soils, Imazapyr is more prone to leaching, but has a shorter soil half-life, which decreases its overall potential to leach. Also Imazapyr becomes more tightly bound to soil over time. This time dependent binding also serves to decrease the leaching potential. Other factors such as target vegetation and litter on the soil surface all serve to intercept the herbicide, decreasing the amount of herbicide that reaches the soil.

Q: If Imazapyr was to buildup in ground water, what is the threat to irrigated plants?

A: In preparation for an aquatic Imazapyr label, BASF has conducted irrigated field studies to determine the potential for Imazapyr residues in irrigation water to cause injury to sensitive crops. In those studies, Imazapyr concentrations as high as 50 ppb failed to cause any observable effect on emergence, growth, flowering and yield on several crops that are known to be particularly sensitive to Imazapyr. To date, no Imazapyr has been detected in ground water. Leeching studies show only trace amounts of Imazapyr, 1 ppb at 24 to 36 inches. The dilution factor of 1ppb in ground water applied for irrigation would result in part per trillion Imazapyr at the point of irrigation.

Q: If Imazapyr reaches groundwater, microbes and light, (the factors responsible for degradation) will drop out and much longer half-lives would be expected. Studies on plants show extremely wide ranges in susceptibility depending on species with some species being highly susceptible at parts per billion levels and others only susceptible at parts per million. Understandably a single small acreage application would not pose a significant risk to groundwater, but there is concern that the pesticide may buildup in groundwater over time because of lack of degradation once it reaches groundwater if there is large-scale or repeated use. Would there be a threat to any plants irrigated with the groundwater, once buildup occurs, and/or to certain aquatic plants if groundwater is recharging surface waters.

A: Imazapyr concentrations in groundwater, resulting from labeled uses of Imazapyr would be predicted to be extremely low. An advantage of Imazapyr use over competitive products is reduced number of applications and lower active ingredient. Given the low frequency of Imazapyr use in a given location, the potential for significant movement and accumulation of Imazapyr residues in groundwater would be extremely low. Furthermore dilution of Imazapyr residues in groundwater would also be significant and would further decrease the likelihood that Imazapyr residues could accumulate to phytotoxic levels. In addition, Imazapyr is not typically used on an annual base, decreasing threat to buildup in ground water.

Field experience with Imazapyr has shown that submerged aquatic plant species are not adversely affected by direct applications of Imazapyr to the water, at rates up to the maximum proposed aquatic use rate of 1.5 lb/A (3 quarts/A). In practical terms, this means that non-target plants, which are not directly contacted by the herbicide

spray, are highly unlikely to show any adverse response, and any response at all will likely be in the form of growth reduction, but not death.

Imazapyr was one of the first imidizolinone herbicides discovered and has been commercially used since the mid 1980's. Imazapyr is essentially non-toxic to all animal life forms and has a mode of action that is specific to green plants. During the almost twenty years of extensive use in both forestry and industrial non-cropland areas, there have been no substantiated reports of imazapyr residues in groundwater, nor any reports of injury to crops irrigated with either surface or groundwater.

Q: Will Imazapyr kill non-target native aquatic plant species including periphyton and phytoplankton?

A: Imazapyr is highly selective on aquatic plant species due to placement selectivity. In other words, Imazapyr is only effective as an herbicide on those sensitive plants that can be directly contacted by the herbicide spray. Submerged species are not significantly affected by direct over spray with Imazapyr. Even susceptible emergent or floating species will have very little if any response when exposed to surface water treated with Imazapyr, due to dilution factor and exposer time. Vegetation control can be expected on targeted emergence and floating vegetation only, with little to no herbicidal effect outside of the treatment area.

Risk/Benefit Considerations

Q: There is public concern that in the case of HABITAT registration; HABITAT was registered, not because it was safe to use, but because weed managers have insisted that they had to have it to manage salt cedar.

A: Imazapyr, the active ingredient in HABITAT, has been a registered active ingredient in over 11 products (not counting duplicate products with different trade names) since 1986. Imazapyr has been legally registered for the use of salt cedar control since 1986. Weed managers have had Imazapyr as a tool for salt cedar control since 1986. Since early 1990s, the Imazapyr registrant has been completing necessary studies for aquatic approval. Length of time to registration from original terrestrial Imazapyr products to aquatic approved Imazapyr, HABITAT, was due to the registrant's lack of placing this development as a priority. With greater awareness for the need of salt cedar control, including river banks, the priority for HABITAT registration was increased at the registrant and EPA level. Registration of HABITAT allowed land managers to utilize additional, more cost effective application methods in control of salt cedar. For discussion of product registration on risk/benefit EPA priority see HERBICIDE REGISTRATION, LABEL PRECAUTIONS, AND USE RESTRICTIONS <u>Risk/Benefit Considerations</u>.

Literature Cited and Further Reference Material on Herbicides Considered

BASF, 1983. ARSENAL Herbicide (AC 243,997): Photolysis of Carbon-14 Labeled AC 243,997 Nicotonic Acid, 2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)- in Aqueous Media. American Cyanamid Companpy Report No. PD-M, Volume 20-20. September 15, 1983.

Bush PB, Berisford YC, Taylor JW, Neary DG and KV Miller. 1995. Operational monitoring of forest site preparation herbicides in the Coastal Plain: Assessment of residues in perched water table. In Proceedings of the 48th Annual Meeting of the Southern Weed Science Society, January 16-18, 1995, Memphis Tennessee. pp. 115-120.

Curran, W. Loux, M. Liebl, A. and W. Simmons. 1992. Photolysis of Imidazolinone Herbicides in Aqueous Solution and on Soil. Weed Science Vol. 40 pp. 143-148.

Fowlkes, M.D., Michael, J.L., Crisman, T.L., and J.P. Prenger. 2002. Effects of the Herbicide Imazapyr on Benthic Macroinvertebrates in a Logged Pond Cypress Dome. Environmental Toxicology and Chemistry vol. 22:4.

Information Ventures, Inc. 2003. Imazapyr Pesticide Fact Sheet. Prepared for the U.S. Department of Agriculture, Forestry Service. http://infoventures.com/ehlth/pesticide/imazapyr.html.

Leonard, R. 1989. Aquatic Dissipation Study with Imazapyr. American Cyanamid Unpublished Study. Reprot No. AR89FL01.

Mallipudi NM., Knoll B. and P. Stanley-Millner. 1983. Arsenal Herbicide (AC 243997): Field Dissipation of Carboxyl Carbon-14 Labeled AC 243997. American Cyanamid Report No. PD-M Volume 20-19.

Mallipudi NM., Knoll B., Lee AH and E.J. Orloski. 1985. Absorption, translocation and soil dissipation of imazapyr under field conditions. Proceedings, North Central Weed Control Conference. 40:125.

Mallipudi M., Stout, S. Dacunha, A. and A. Lee. 1991. Photolysis of Imazapyr AC 243997 Herbicide in Aqueous Media. J. Agriculure Food and Chemistry. 39:2 pp 412-417.

Mangels, G. 1986. AC 243997 Soil Photolysis. American Cyanamid Co. Report PD-M Vol. 23-39.

Michael, J. L. 1986. Fate of ARSENAL in forest watersheds after aerial application for forest weed control, U.S. Forest Service, FS-SO-4105-1.20.

Miller, Phillip, Chien H. Fung and Barbara Gingher. 1991. Chapter 12, Animal Metabolism. In: In: The Imidazolinone Herbicides, Ed. Dale L. Shaner and Susan L. O'Connor, CRC Press, PP. 167-172.

Patten, K. 2003. Persistence and non-target impact of imazayr associated with smooth cordgrass control in an estuary. Journal of Aquatic Plant Management 41: 1-6

Stidham, Mark A. and Bijay Singh. 1991. Chapter 6. Imidazolinone – acetohydroxyacid synthase interactions. In: The Imidazolinone Herbicides, Ed. Dale L. Shaner and Susan L. O'Connor, CRC Press, PP. 71-90.

Wiley, TB, Bush PB, Berisford YC, Dowd JF and JW Taylor. 2000. ARSENAL movement in an Upper-Coastal Plain soil and watershed. *In* Proceedings of the 53rd Annual Meeting of the Southern Weed Science Society, Jan. 24-26, 2000, Tulsa Oklahoma. *In press.*

York, C. 1992a. CL 243997 (Imazapyr/AS) : Rate of Dissipation of CL 243997 in Soil (OR; 1990) American Cyanamid Co. Unpublished Report No. C-3766.

York, C. 1992b. CL 243997 (Imazapyr/AS) : Rate of Dissipation of CL 243997 in Soil (NC; 1990) American Cyanamid Co. Unpublished Report No. C-3767.

York, C. 1993. CL 243997 (Imazapyr/AS) : Rate of Dissipation of CL 243997 in Soil (Georgetown Ontario; 1991) American Cyanamid Co. Unpublished Report No. RES 93-001.

NOTE:

Imazapyr is a pesticide regulated under the Federal Insecticide, Fungicide and Rodenticide Act ("FIFRA"), and as such its use is regulated by product labels, including the terms and conditions of sale contained therein. ALWAYS READ AND FOLLOW LABEL DIRECTIONS! Nothing contained herein shall be deemed to modify the applicable product label, or the disclaimers of warranty contained therein.

APPENDIX B

FINDING OF NO SIGNIFICANT IMPACT

FINAL RESTORATION PLAN AND ENVIRONMENTAL ASSESSMENT FOR THE TEXMO DIESEL SPILL AND FIRE

NATURAL RESOURCE DAMAGE ASSESSMENT AND RESTORATION PROGRAM

DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE
BILL WILLIAMS RIVER NATIONAL WILDLIFE REFUGE
60911 HIGHWAY 95
PARKER, ARIZONA 85344

We prepared a National Environmental Policy Act (NEPA) Environmental Assessment (EA) (attached) for a Restoration Plan (RP) for the Texmo diesel spill and fire on the Bill Williams River National Wildlife Refuge (BWRNWR), Arizona. The RP/EA was prepared by the U.S. Fish and Wildlife Service (USFWS) pursuant to its authority and responsibilities as natural resource trustee under the Oil Pollution Act (OPA) (33 U.S.C. 2701, *et seq*.); the Federal Water Pollution Control Act, 33 U.S.C. § 1251, *et seq.* (also known as the Clean Water Act or CWA); other applicable federal and state laws, including Subpart G of the National Oil and Hazardous Substances Contingency Plan (NCP), 40 C.F.R. §§ 300.600 through 300.615; and the Consent Decree (United States versus Texmo Oil Jobbers, Inc. 2007, No. CIV 07-1401-PHX-DKD). The OPA, through its Natural Resource Damage Assessment and Restoration (NRDAR) provisions, provides for the designation of a federal, state (on behalf of the public), or Indian tribe to act as trustees for natural resources (15 C.F.R. 990.11). The damages recovered from parties responsible for the natural resource injuries must be used to restore, rehabilitate, replace, and/or acquire the equivalent of those trust natural resources injured (collectively "restoration"). The USFWS trust resources injured by the spill and resulting fire include, but are not limited to, migratory birds, federally-listed threatened and endangered species and their habitats, and lands and other natural resources owned and managed by the USFWS.

A 7,600 – 7,800-gallon diesel spill caught fire and flowed off the Highway 95 bridge over the Bill Williams River (BWR) and onto the BWRNWR on July 28, 2006. The fuel and fire ignited the cattail marsh and spread into woody riparian, desert wash, and upland desert habitats. Injury to trust species and natural resources occurred on 348 acres over five habitat types on the BWRNWR. The Texmo spill and fire injured some of the rarest habitats left on the Lower Colorado River (LCR), particularly the Mixed Riparian Woodlands, which include nearly the entire historical complement and the most intact community of riparian-dependent species left on the LCR.

The purpose of this RP/EA is to identify restoration project alternatives, evaluate the environmental impact of the alternatives, and select a restoration project to compensate the public for injuries to natural resources at the BWRNWR. The alternative selected will lead to recovery, restoration, or acquisition of natural resources and ecological services as compensation to the public for the injury of trust resources and services caused by the diesel spill and fire. Any selected alternative must be feasible, safe, cost-effective, address injured natural resources, consider actual and anticipated conditions, have a reasonable likelihood of success, and be consistent with applicable laws and policies. Implementation of selected restoration alternatives would occur over a period of time, dependent upon the type of projects involved.

PROPOSED ACTION

The goal of the proposed action is to restore, rehabilitate, replace, and/or acquire the equivalent of those trust natural resources injured (collectively "restoration"). The proposed action is the preferred alternative (Alternative G) in the Final RP/EA. The preferred alternative is a combination of Alternatives B-F which would provide a variety of restoration, rehabilitation, replacement, and/or acquisition actions to compensate the public for the natural resource injuries, rather than just one alternative or action. Our goal is to restore, enhance, or acquire approximately 10 to 64 acres of habitats in the BWRNWR or LCR corridor between Havasu National Wildlife Refuge (Havasu NWR) and the BWRNWR. Selecting a mixture of restoration projects from Alternatives B-F allows for more flexibility for cost-effectiveness and feasibility due to access to the possible restoration sites, availability of suitable restoration sites, and/or ability to find willing participants and sellers. Available settlement funds, restoration opportunities, and restoration costs will influence our success.

ALTERNATIVES CONSIDERED

ALTERNATIVE A: NO ACTION ALTERNATIVE

Under this alternative, no restoration actions (including on-site restoration or replacement) nor monitoring would be performed. This alternative would involve no further action to restore the loss to the natural resources or services at the impacted site. No compensatory restoration would be performed off-site. Therefore, there are no costs associated with this option.

ALTERNATIVE B: PRIMARY RESTORATION OF MIXED RIPARIAN WOODLANDS AND DESERT WASHES ON-SITE

Under this alternative, we would perform primary restoration of the burned area of the Mixed Riparian Woodland and Desert Washes to the maximum extent physically possible. Access to the site would be limited to transport with a small boat, precluding use of any heavy equipment; therefore, habitat restoration would be limited to personnel with hand tools. In addition, installing infrastructure such as a well and drip systems to irrigate newly planted trees would be cost prohibitive. Consequently, restoration actives would be restricted to limited areas of burned habitat which are presently close to the river edge and have adequate depth-to-groundwater. In the Desert Wash and Upland habitat, due to the intrinsic nature of the native vegetation and where it grows (i.e., cacti growing on cracked rock faces), restoration by natural succession over long time periods would be more appropriate. We considered on-site, primary restoration seriously, but access limitations prevent us from being able to install a well or irrigation system. Therefore, primary restoration opportunities in the Mixed Riparian Woodlands at the BWRNWR would be limited to small patches of habitat within the wetted floodplain.

ALTERNATIVE C: ACQUISITION OF COMPARABLE OFF-SITE HABITATS IN THE BILL WILLIAMS RIVER CORRIDOR AND/OR LOWER COLORADO RIVER VALLEY NEAR THE BILL WILLIAMS RIVER CORRIDOR

This alternative includes acquisition of land and/or conservation easements proximal to the BWRNWR, with comparable habitats along the BWR corridor, or near the Havasu NWR. Protection of such areas from residential or agricultural development would result in a net resource benefit through conservation of habitat that would otherwise be lost. There are private lands for sale near the BWRNWR refuge boundaries with habitats comparable to those that were injured. Preference for acquisition would be given to lands with ecological conditions and functions comparable to those injured. We would perform restoration or rehabilitation to lands with lower ecological function to maximize the habitat's potential.

ALTERNATIVE D: COMPENSATORY RESTORATION OF MIXED RIPARIAN WOODLAND AND DESERT WASH HABITATS ON-REFUGE BUT OFF-SITE

Restoration and enhancement of riparian habitats outside of the burned area (off-site) but on-refuge would include the expansion of the native bosque terrace plantings on the abandoned Kohen Ranch agricultural fields by approximately 20 acres. This area has a well and irrigation infrastructure. We would rehabilitate and expand the irrigation system and improve access for smaller heavy equipment. We would use a variety of methods to restore the habitat. These methods include applying herbicide to control invasive species, using prescribed burns to eliminate overgrowth, and mowing to reduce overgrowth. We would use the herbicide imazapyr and it would be applied by hand or by a sprayer attached to an all-terrain or utility vehicle. Then, we would plant container-grown native shrubs and trees, including species such

as mesquite, palo verde, ironwood and wolfberry and irrigate them until they become established.

ALTERNATIVE E: RESTORATION OF COMPARABLE HABITATS ALONG THE BILL WILLIAMS RIVER CORRIDOR OR BETWEEN NEEDLES, CALIFORNIA AND PARKER DAM, ARIZONA

There are other suitable areas for restoration of Mixed Riparian Woodlands and Desert Washes on other federal, state, or privately-owned lands between the Havasu NWR and the BWR corridor. If counties or cities are interested, we would also partner with them. For example, the Havasu NWR is located nearby on the LCR, and restoration could be performed on its lands. There are also BLM and state-owned lands within the BWR corridor upstream of the BWRNWR where we could perform restoration. The USFWS, as the Trustee, would work closely with partners to perform projects that would restore or protect natural resources. Restoration would likely include converting former agricultural fields to mesquite bosques or cottonwood-willow forests.

ALTERNATIVE F: INVENTORY RESEARCH

This alternative proposes to conduct inventory research related to the species or ecological habitats injured; this research would be performed in conjunction with primary or compensatory restoration. To better understand how the species, processes, or sites that were injured recover, inventories would also be conducted on non-disturbed sites for comparison. Baseline inventories for all sites and all alternatives will be performed prior to and after restoration. This alternative takes a step further from the baseline monitoring that helps us understand if we have been successful with our restoration implementation and fills large data gaps with respect to information for species and ecological functions where no information currently exists at BWRNWR. This alternative does not provide a detailed discussion of baseline monitoring nor success criteria. More information on performance-based monitoring can be found in the Draft Monitoring Plans for the BWRNWR Texmo Restoration. Inventory research on restoration sites for sensitive species and the supporting communities could enhance long-term management and recovery of all species and habitats.

ALTERNATIVE G: PREFERRED ALTERNATIVE: COMBINATION OF ALTERNATIVES B-F

This alternative allows any combination of alternatives B-F to be performed and would provide a variety of compensatory restoration or acquisition actions, rather than just one. Selecting a mix of restoration projects from Alternatives B-F allows for more flexibility for cost-effectiveness and feasibility due to possible future changes related to the ecology of the area, access to the restoration sites, and/or ability to find willing participants and sellers. This is the preferred alternative.

PUBLIC COMMENT

This document was available for public review. The public review period opened on August 24, 2011, and closed on September 23, 2011. A Notice of Availability was mailed to 50 interested parties, tribes, and agencies. The Notice of Availability and Draft Restoration Plan/Environmental Assessment were posted on the Arizona Ecological Services Internet homepage (http://www.fws.gov/southwest/es/arizona/). The Notice of Availability was also available through legal notices in Lake Havasu City's Today's News-Herald, the Needles Desert Star, the Laughlin Nevada Times, and The Parker Pioneer. A news release was sent to 15 reporters/editors at 13 different news media outlets on August 24, 2011. Additionally, it was posted to the Arizona Ecological Services Internet homepage and broadcast on the Service's Southwest Region social media sites. We received three comments on the Draft RP/EA during the 30-day public review and comment period.

This Finding of No Significant Impact with the Final EA will be available on our website, and all who received the Draft RP/EA will receive notice of this decision and where it can be accessed.

DETERMINATION

Based on the information contained in the final EA and supporting data in our files, we have determined that this action is not a major Federal action that would significantly affect the quality of the human environment within the meaning of section 102(2)(c) of the National Environmental Policy Act of 1969. Specifically, although effects to listed and candidate species; vegetation; wildlife; cultural resources; wetlands; and water resources are identified in this EA, effects are minor and may result in a net benefit.

This action is not an action that normally requires preparation of an Environmental Impact Statement (EIS) and is not similar to such actions. Accordingly, preparation of an EIS on the proposed action is not warranted.

The preferred alternative provides restoration activities that will meet the criteria detailed in 15 CFR 990.

Prepared by: Carrie Marr

Concurrence: _____ 10/19/2011
Project Leader — Date

Concurrence: _____ 11/1/11
Refuge Supervisor AZ/NM — Date

Concurrence: _____ 11/7/11
Refuge Chief — Date

Acting

Approval: _____ 11/9/11
Regional Director — Date

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