The BLM Hassayampa Field Office has prepared an Environmental Assessment (DOI-BLM-AZ-P010-2011-021-EA)for a proposed riparian vegetation treatment project on the Agua Fria River. The following **Environmental Assessment** and associated unsigned **Finding of No Significant Impact** are available for public review and comment through November 30, 2011. Comments should be emailed to BLM_AZ_AFNM_Bradshaw.gov.

When reviewing the document and preparing your comment, please consider that comments providing relevant and new information with sufficient detail are most useful to the BLM. These are referred to as substantive comments. The BLM reviews all comments and identifies the topics that are substantive for consideration in the final published document. A substantive comment is a comment that does one or more of the following:

- Questions, with reasonable basis, the accuracy of information in the Environmental Assessment;
- Questions, with reasonable basis, the adequacy of, methodology for, or assumptions used for the environmental analysis;
- Presents new information relevant to the analysis;
- Presents reasonable alternatives other than those analyzed in the Environmental Assessment; or
- Causes changes or revisions in one or more of the alternatives.

Pending receipt of substantive comments, the BLM will update the **Environmental Assessment**, issue a final **Finding of No Significant Impact** and **Decision Record**. Parties who comment on this document will receive notice of decision and directions on appeal opportunities.

If you have questions about the Environmental Assessment and unsigned Finding of No Significant Impact, **please contact Codey Carter, wildlife biologist, at cdcarter@blm.gov**.

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Reviewed by:	Leah Baker, Planning & Environmental Coordinator
Approved by:	Steve Cohn, Manager: Hassayampa Field Office

Riparian Vegetation Propagation Environmental Assessment

Contents

Introduction

Historical grazing practices, OHV damage, invasive nonnative plants, and periodic intense flooding, have reduced native riparian vegetation densities in some areas of the Hassayampa Field Office and Agua Fria National Monument. This reduction of vegetation density has led to stream bank destabilization in some areas. Remediation of these areas is needed to prevent further degradation. Increased native riparian vegetation cover would help stabilize stream bands and improve wildlife habitat

This environmental assessment will analyze impacts of the proposed BLM action. The NEPA Number is: DOI-BLM-AZ-P010-2011-021-EA.

Purpose and Need for Action and Decision to be Made

The purpose of this action is to increase native riparian vegetation along the banks of streams in the Hassayampa Field Office. This action is needed to increase stream bank stability, improve wildlife habitat, and to meet objectives for riparian health as outlined in the Approved Bradshaw-Harquahala Resource Management Plan (2010). The decision to be made is whether or not to approve the project as proposed or modified.

Land Use Plan Conformance

This action conforms to the Bradshaw-Harquahala Resource Management Plan and the Agua Fria National Monument Resource Management Plan decisions:

VM-1 - Maintain, restore, or enhance the diversity, distribution, and viability of populations of native plants, and maintain, restore, or enhance overall ecosystem health.

RP-1 - Riparian areas will include a plant community that consists of stream banks dominated (> 50 percent) by native species from the genera Scirpus, Carex, Juncus, and Eleocharis. The size class distribution of native riparian obligate trees will be > 15 percent seedlings, > 15 percent mid-size, and > 15 percent large size (depending on existing conditions and the site potential). Size classes are defined as follows:

- Seedlings are < 1 inch in basal diameter.
- Mid-sizes are 1 to 6 inches in basal diameter.
- Large sizes are > 6 inches in basal diameter.

TE-8 - Riparian areas that could physically support (due to floodplain width and gradient) yellow-billed cuckoo habitats will attain the vegetation structure, plant species diversity, density, and canopy cover to constitute suitable habitat. Livestock utilization will not substantially reduce the abundance, density or distribution of native riparian tree species through herbivory.

LH-3 - Productive, diverse upland and riparian-wetland plant communities of native species exist and are maintained.

Scoping and Issues

Scoping & Public Participation

Internal scoping was conducted with Hassayampa Field Office and Agua Fria National Monument specialists. Prior to making a decision, The BLM will make the Environmental Assessment available for 30 days for public review and comment. All substantive comments will be incorporated into the final Environmental Assessment.

Issues

Issues/Questions identified during internal scoping include:

1. How would this project improve wildlife habitat?
2. How would this project promote stream bank stability?
3. What would be the impacts of this project on water quality, fish, and fish habitat?
4. Would this project promote the spread of nonnative invasive weeds?
5. How would this project impact sites where donor plants are taken?
6. How would this project implement the Bradshaw-Harquahala RMP?
7. How would these activities affect migratory birds and BLM special status wildlife species and their habitat?
8. What impact would this project have on cultural resources?

Alternatives

Proposed Action

The proposed project consists of propagating riparian woody and herbaceous plants along stream banks on BLM administered lands in the Hassayampa Field Office. This project would also involve planting xeroriparian trees and shrubs in the riparian buffer zone at selected areas along the Agua Fria River. Species type and propagation techniques are discussed below.

Four site-specific project areas are identified in the proposed action. These sites have been previously impacted by OHV use. OHV use has now been restricted from these areas through the installation of vehicle barriers.

Future riparian revegetation projects would be tiered to this EA with the addition of site-specific analysis. This project would begin in the winter of 2012 and would continue for a maximum of ten years.

Propagation of cottonwood and willow

Cuttings from cottonwood trees *Populus fremontii* and willows *Salix gooddingii* would be taken from trees along the Agua Fria River and transplanted along the river in other areas that lack riparian trees. This would be accomplished according to Natural Resource Conservation Service guidelines, as outlined in Appendix A.

Propagation of other woody riparian and riparian transition zone plants

Other woody species that may be propagated on the Hassayampa Field Office in riparian and riparian transition zone areas include: velvet mesquite (*Prosopis velutina*), seep willow (*Baccharis salicifolia*), desert broom (*Baccharis sarothroides*), ironwood (*Olneya tesota*), and desert willow (*Chilopsis linearis*). Velvet mesquite, seep willow, desert broom, and desert willow can be propagated by cuttings similar to willow and cottonwood trees, but with a lower success rate. All of these species, with the addition of Ironwood, can be propagated by transplanting the entire plant. Some species of *Baccharis* and mesquite have been successfully propagated by deep longstem plantings. Methods for transplanting these species are described in Appendix A. These trees or shrubs to be planted would be taken from areas near the planting sites where a high density of trees or shrubs exist, or salvage trees and shrubs may be obtained from construction zones if the opportunity arises, or certified disease free trees and shrubs may be obtained from commercial nursery stock.

Propagation of herbaceous plants

Herbaceous species from the genera *Scirpus*, *Carex*, *Eleocharus*, and *Juncus* would be transplanted on other areas along the Agua Fria that lack riparian herbaceous plant cover. This would be accomplished according to NRCS guidelines (see Appendix A).

Propagation Sites

Four specific sites have been identified for propagation of native riparian species thus far. These areas have been heavily impacted by off-road vehicles in the past, but recently BLM has installed vehicle barriers to help protect these areas. Other riparian areas that are identified in the future may be tiered to this EA and further analyzed for site specific impacts.

Site One – River Bend Site

This site is located on the banks of the Agua Fria River in the northern end of the Agua Fria River National Monument (Figure 1). The legal description is: Township 11N Range 3 E Section 20. The site is approximately 1 mile long, stretching from the confluence of Big Bug Creek upstream to the private property boundary at the southern edge of Township 11N Range 3 E Section 17 (See Figure 1 for UTM coordinates). The width of the site would be from the edge of the water out 6 meters on both sides of the stream. Gooding's willow, Fremont cottonwood, and herbaceous species from the genera *Scirpus*, *Carex*, *Eleocharus*, and *Juncus* are proposed to be planted at this site.

Site Two – Little Pan Crossing 1

This site is located on the banks of the Agua Fria River in the Table Mesa Recreation Area (Figure 2). The legal description is: Township 8N Range 2 E Section 28. The center of the crossing is located at UTM NAD 83 12 392163E 3764424N. The site includes both sides of the road crossing. The crossing is approximately 50 meters long. Vegetation is proposed to be planted in an approximately 10m wide belt on both sides of the road where the road crosses through the riparian area, for a total project footprint of 1000 square meters. Gooding's willow, Fremont cottonwood, and herbaceous species from the genera *Scirpus*, *Carex*, *Eleocharus*, and *Juncu* are proposed to be planted at this site. Riparian transition zone woody

vegetation is also proposed (including velvet mesquite, desert broom, seep willow, ironwood, and desert willow).

Site Three – Little Pan Crossing 2

This site is located on the banks of the Agua Fria River in the Table Mesa Recreation Area (Figure 2). The legal description is: Township 8N Range 2 E Section29. The center of the crossing is located at UTM NAD 83 12 391488E 3764485N. The site includes both sides of the road crossing. The crossing is approximately 50 meters long. Vegetation is proposed to be planted in an approximately 10m wide belt on both sides of the road where the road crosses through the riparian area. This would equal an area of 1000 square meters. Gooding's willow, Fremont cottonwood, and herbaceous species from the genera *Scirpus*, *Carex*, *Eleocharus*, and *Juncus* are also proposed to be planted at this site. We also propose to plant riparian transition zone woody vegetation including velvet mesquite, desert broom, seep willow, ironwood, and desert willow.

Site Four – River Terrace Site

This site is located on the banks of the Agua Fria River in the Table Mesa Recreation Area (Figure 3). The legal description is: Township 8N Range 2 E Section 32. The center of the crossing is located at UTM NAD 83 12 390497E 3762664N. The site includes both sides of the road crossing. The crossing is approximately 50 meters long. Vegetation is proposed to be planted in an approximately 10m wide belt on both sides of the road where the road crosses through the riparian area. This would equal an area of 1000 square meters. Gooding's willow, Fremont cottonwood, and herbaceous species from the genera *Scirpus*, *Carex*, *Eleocharus*, and *Juncus* are proposed to be planted at this site, along with riparian transition zone woody vegetation including velvet mesquite, desert broom, seep willow, ironwood, and desert willow.

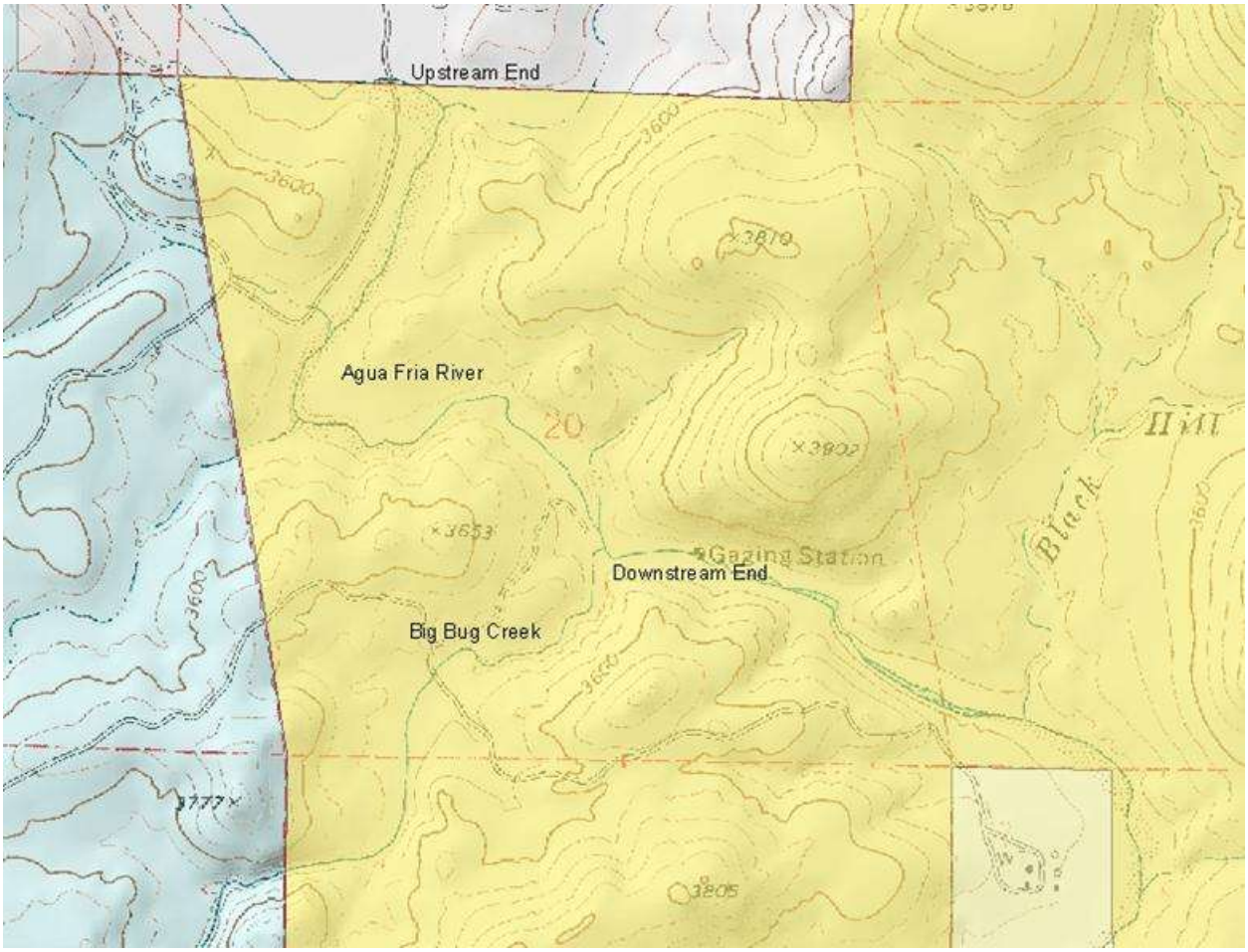

Figure 1. The downstream end of site one is located at the confluence with Big Bug Creek (UTM NAD 83 12 401887E 3797601N). The upstream end is located at the private property boundary (UTM NAD 83 12 401426E 3798714N). Private lands are depicted in white, state trust lands are depicted in blue, and BLM lands are depicted in yellow.

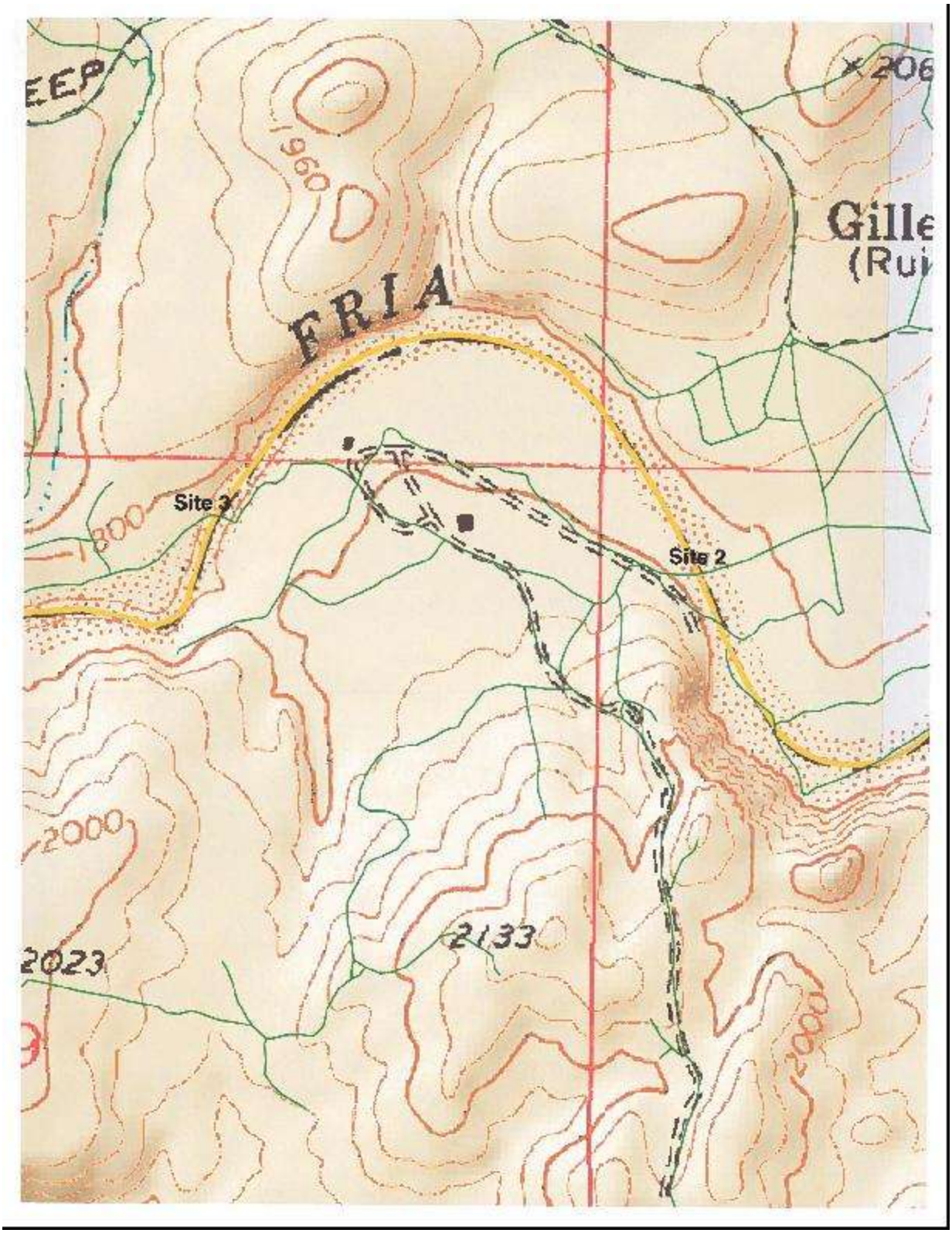

Figure 2. Location of sites 2 and 3.

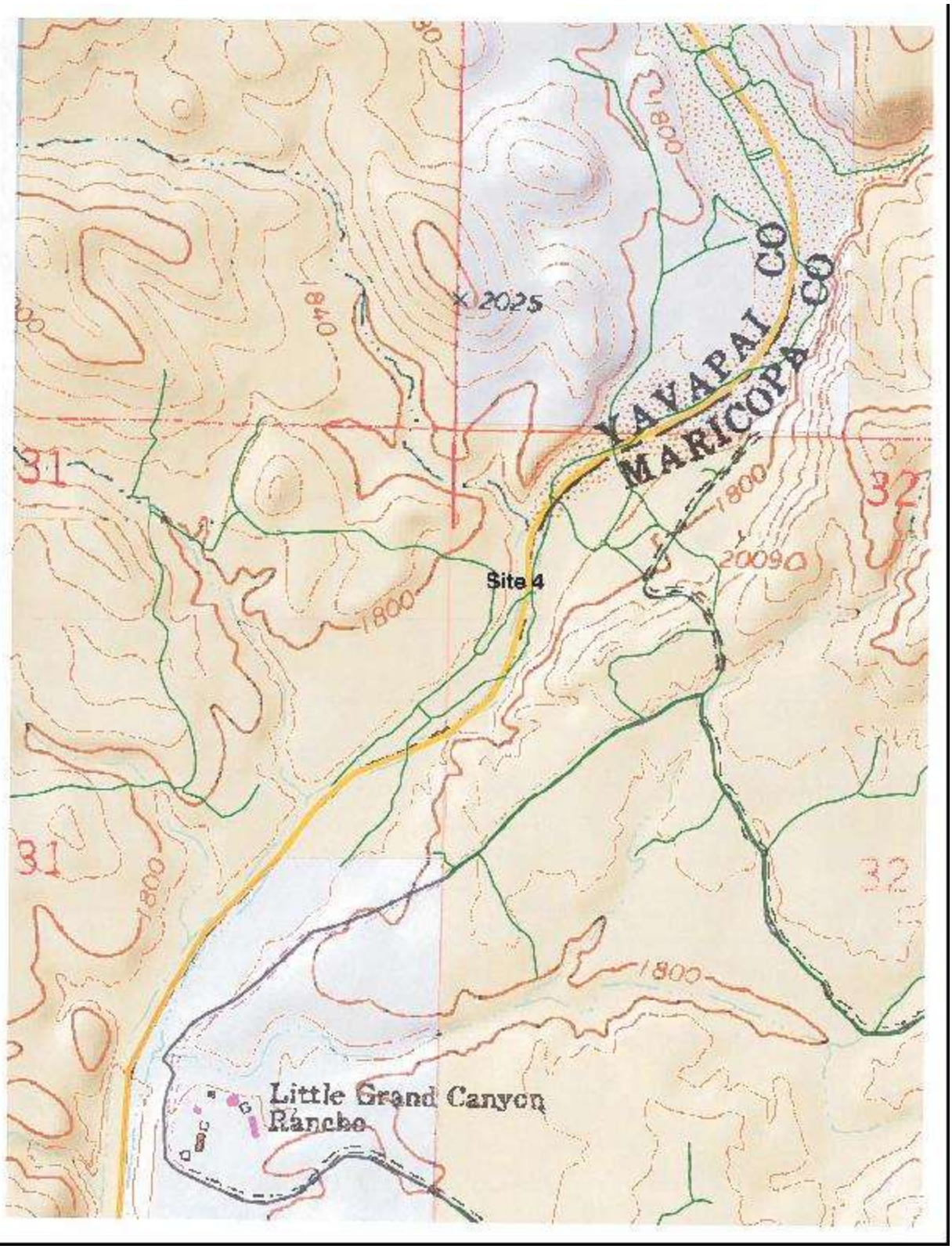

Figure 3. Location of site 4.

No Action Alternative

In the no action alternative, no plant propagation/transplanting would occur.

Affected Environment

Biological Resources

The BLM Hassayampa Field Office manages approximately one million acres of public lands north and west of Phoenix, Arizona, including the Agua Fria National Monument. Habitat varies from upper Sonoran desert scrub to broad expanses of grassland. Lush desert riparian habitats occur in many areas of the Field Office. Riparian habitat on the Hassayampa Field Office supports many native riparian obligate wildlife species such as lowland leopard frogs, longfin dace, desert sucker, Sonoran mud turtle, and a variety of migratory birds such as the yellow-billed cuckoo, an ESA candidate species. The endangered Gila chub, desert pupfish and Gila top minnow also depend on healthy riparian areas to maintain water quality and aquatic habitat structure.

Cultural Resources

BLM Arizona manages some of Arizona's best-preserved prehistoric and historic sites, which span the human occupation in North America. The Agua Fria National Monument alone contains more than 400 archaeological sites, spanning some 2,000 years of human history. Rivers and the surrounding riparian areas were no doubt important for these early inhabitants.

Rangeland Management

The BLM administers 93 grazing allotments on the Hassayampa Field Office and 10 grazing allotments on the Agua Fria National Monument. The BLM activities for Arizona's grazing and rangeland program include resource monitoring, conducting land health assessments and evaluations, use authorizations, allotment planning and administration, developing vegetation objectives, integrating weed management and activity plan development in connection with land use planning. Maintaining riparian proper functioning condition is a key element of the land health standards in *Arizona Standards for Rangeland Health and Guidelines for Grazing Administration*. The specific sites addressed in this EA are located in the Boulder Creek allotment and the Box Bar allotment.

Recreation Management

The BLM Hassayampa Field Office provides for a wide array of outdoor recreation activities such as hiking, mountain biking, hunting, camping, fishing, wildlife viewing, OHV riding, horseback riding, and auto touring. Riparian areas are focal points for wildlife dependent recreation such as fishing, hunting, and bird watching; as well as for swimming, hiking and camping. The specific sites addressed in this EA are located within the Agua Fria National Monument and within the Table Mesa Recreation Area. All of these sites have been previously impacted by OHV riding in the riparian area, and all of these sites have been recently secured

with barriers to prevent vehicle entry. The Table Mesa Recreation Area is heavily used by OHVs. The Table Mesa Area is also heavily used by recreational target shooting.

Soil, Water and Air Resources

Soil is a fragile, finite resource that has a critical function in supporting land health, ecosystem sustainability, and promotes biological diversity. Healthy soils sustain plant communities, keep sediment out of streams, and dust out of the air. Riparian soils share many characteristics with their terrestrial upland counterparts, but they also differ in several ways. One of these differences is related to frequent flood events and associated depositional and erosional processes. Because of the continuous influences of these processes, riparian soils have higher spatial diversity, are typically younger and lack well-developed soil horizons relative to their terrestrial upland counterparts. Another major difference of riparian soils compared to adjacent terrestrial uplands is that they generally tend to be wetter and are subject to fluctuating water tables that may reach the soil surface (USDA-NRCS, 2005). Clean and adequate supplies of water are necessary to promote healthy watersheds, provide fish and wildlife habitat, maintain drinking water sources, and allow safe recreational use of our surface water. Riparian areas play a key role in maintaining water quality by stabilizing soils and filtering upland sediment during runoff events. Vegetation within these riparian areas is critical in reducing water velocity during flood events which reduces erosion. The air resource includes both climate and air quality. Climate is a driving force for all ecologic processes on earth and air quality affects human health and visibility.

Environmental Consequences

Biological Resources

Proposed Action

The environmental consequences are positive over the long-term for all biological resources that may be affected as a result of this action. The cover of riparian vegetation would increase. Native aquatic species such as native fish, leopard frogs and garter snakes would benefit from increased habitat diversity that riparian vegetation creates such as undercut banks, submerged plants and roots for cover. This project should improve water quality by stabilizing the banks, reducing erosion, slowing flood flows, increasing the deposition of suspended sediments, reducing water temperature through shading and increasing stream depth. This project would increase habitat for many bird species especially riparian obligate species such as the yellow-billed cuckoo, an ESA candidate species. No threatened or endangered species or critical habitat would be affected by this project.

Short-term negative impacts to riparian vegetation would occur. Branches from trees and shrubs as well as plugs from patches of riparian herbaceous plants would be collected. This may temporarily reduce habitat for riparian-dependent wildlife such as the yellow-billed cuckoo and other riparian and migratory birds. Nesting riparian birds would not be disturbed because cuttings would only be taken during the winter when birds are not nesting. Riparian trees are

fast-growing so the reduction of habitat would likely be short-lived. Plugs taken out of patches of riparian herbaceous vegetation typically fill in within one year (USDA NRCS 2007).

Weeds could potentially be spread from one area to another through transplanting plugs riparian herbaceous vegetation. To mitigate for the potential spread of weeds plugs of riparian vegetation would not be taken from areas where weeds are present.

No Action

In areas that lack sufficient vegetative cover, streambanks could further destabilize resulting in the loss of soil, vegetation, and wildlife habitat.

Cultural Resources

Proposed Action

Prehistoric and historic artifacts may be disturbed or damaged by digging holes for vegetation transplant. To mitigate for this potential, site-specific clearances would be obtained prior to ground disturbance.

No Action

In areas that lack sufficient cover of riparian vegetation, streambanks could erode at an accelerated rate. This could further reduce vegetative cover needed to stabilize banks and dissipate energy during high flow events. This may result in increased loss of cultural resources through erosion.

Rangeland Management

Proposed Action

Implementation of the proposed action would increase riparian vegetation cover and would further stabilize streambanks and help to meet standard two (riparian-wetland areas are in properly functioning condition) and standard three (productive, diverse upland and riparian-wetland plant communities of native species exist and are maintained) of the Land Health Standards described in *Arizona Standards for Rangeland Health and Guidelines for Grazing Administration*). No anticipated negative impact to rangeland management is expected as a result of this project. In some areas, temporary fences may need to be constructed around newly planted vegetation to prevent damage from cattle.

No Action

In areas that lack sufficient cover of riparian vegetation, streambanks could erode at an accelerated rate. This could further reduce vegetative cover needed to stabilize banks and dissipate energy during high flow events. This would reduce the ability of the riparian area to meet Standard Two of the Land Health Standards (riparian areas are in properly functioning condition) required in *Arizona Standards for Rangeland Health and Guidelines for Grazing Administration*.

Recreation Management

Proposed Action

No anticipated negative impact to recreation management is expected as a result of this project. Stabilizing streambanks and improving wildlife habitat should have beneficial impacts for recreational activities such as hunting, fishing, bird watching. In places where roads cross a stream, planting riparian vegetation would help to define the road crossing and help prevent off-road travel in riparian areas.

No Action

In areas that lack sufficient cover of riparian vegetation, streambanks could erode at an accelerated rate. This could negatively impact wildlife habitat which could in turn negatively impact wildlife dependent recreation such as hunting, fishing and wildlife watching.

Soil, Air and Water Resources

Proposed Action

This project would help preserve soil through the anchoring the soil with riparian vegetation. Water quality should improve by further stabilizing the banks and reducing erosion. No adverse impacts to air resources are expected as a result of this project.

No Action

In areas that lack sufficient cover of riparian vegetation, streambanks could erode at an accelerated rate. This could lead to soil loss and an increase in suspended sediments in the stream.

Cumulative Impacts

Proposed Action

This project would increase streambank vegetation, improving bank stability, water quality, and wildlife habitat. Other actions on BLM public lands such as the current winter-only grazing policy on the Agua Fria National Monument, exclosures around riparian areas to exclude cattle, and barriers to prevent vehicle entry into riparian areas have an additive effect of increasing the quality and quantity of riparian habitat across a broader extent of the Hassayampa Field Office over time.

There are other factors in the region outside of public lands that may have a negative impact to riparian habitat including increased groundwater pumping, increased use of off-highway vehicles, and urbanization. These impacts would make intact riparian habitat on BLM lands all the more valuable.

No Action

In areas that lack sufficient cover of riparian vegetation, streambanks could erode at an accelerated rate. This could lead to soil loss and an increase in suspended sediments in the

stream, as well as loss of wildlife habitat. This would be an additive negative impact on top of other region-wide impacts on lands outside of BLM public lands.

Tribes, Individuals, Organizations or Agencies Consulted

National Resources Conservation Service
Arizona Game and Fish Department
The Arizona Audubon Society

References

USDA NRCS 2007. A guide for planning riparian treatments in New Mexico. 41 pp.
USDA NRCS 2005. Riparian Area and recognition part 411. In: Ecological Sites Title 110. General Manual.

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Appendix A – Techniques

NRCS Guidelines (USDA NRCS 2007)

- Select sites as close to the area as possible to conserve genetic diversity. Try to match donor site and re-vegetation site in terms of soils, elevation, hydro-dynamics, permanent groundwater table, and soil salinity (which should be low).
- Select willow cuttings from a local, native stand in healthy condition. Prune no more than 2/3 of plants in an area. Willow cuttings for pole plantings should generally be at least 1/2 inch in diameter or larger. Select the longest, straightest poles available. Use only two to four-year old wood. Vigorous young poles with larger diameters establish more readily and successfully than older or skinny poles. The total length of the poles needed depends upon the water table depth.
- Cut poles while dormant during January and February.
- Remove all side branches except the top two or three - making sure to keep the branch collars intact while pruning.
- Prepare cuttings by trimming off the top to remove the terminal bud, allowing a majority of the energy in the stem to be sent to the lateral buds for root and shot development.
- Soak poles in water for at least 5 to 7 days before planting. The stump ends of poles should be placed in water tanks, streams or ditches to keep them hydrated between harvest and planting. Pole cuttings tolerate being out of water briefly during transport; this interval of desiccation should be minimized.
- Dig holes to the depth of the lowest anticipated water table. Sites where the water table will be within one foot of the ground surface during the growing season are better suited for willows than cottonwoods. The depth of the planting hole must be sufficient for the stump end of the pole to be in ground water throughout the growing season even if the water table drops. The hole depth and the desired aboveground height of the planted pole will determine the length of pole needed.
- The cuttings should extend several inches into the permanent water table to ensure adequate moisture for sprouting. At least 1/2 to 2/3 of the cutting should be below ground to prevent the cutting from being ripped out during high water flows. Usually, at least 2 to 3 feet should be below ground. It should also be long enough to emerge above adjacent vegetation such that it will not be shaded out.
- Place cuttings in the hole the same day they are removed from the soak treatment. Set the butt as close to the lowest annual water table elevation as possible.
- It is critical to ensure the soil is packed around the cutting to prevent air pockets. "Mudding" (filling the hole with water and then adding soil to make a mud slurry) can remove air pockets.
- As buds begin to swell (usually in April or May), wipe them off the lower two-thirds of the pole. This will reduce evapotranspiration water loss and stimulate root growth.
- To determine appropriate species and pole lengths for revegetation, measurement of depth to ground water is highly recommended. Inexpensive shallow monitoring wells will confirm the depth and seasonal fluctuation of the water table. These groundwater

depth measurements can help in the selection of appropriate species; for example, shrub willow species in general can tolerate shallower ground water depths (1.5 ft or deeper) than cottonwoods (4 ft or deeper).

Transplanting

Standard Planting Techniques (USDA NRCS 2007):

Dig a hole of a depth about equal to the height of the root ball and at least three times as wide. Be sure not to disturb the soil any deeper directly under the location where the tree would be replaced to keep it from sinking. Rapidly so as to prevent the roots from drying out, remove the tree from the pot, place it in the hole, and backfill the hole with the original soil. The original soil without amendments should be used so that the roots would spread outward as they grow rather than coiling in circles inside the hole. Be careful not to cover the trunk of the tree higher than the original soil line and slope the backfill soil away form the trunk for drainage. Form a watering basin at the edge of the dripline. As the tree grows and the dripline expands, gradually move the water basin farther out. The tree should be watered infrequently but deeply during hot weather for the first 2 to 3 years. Excessive watering can loosen the soil and make the tree top heavy causing it to blow over in a storm.

Deep Longstem Planting Techniques (USDA NRCS 2007):

Deep planting of longstem stock has the advantage of placing the plant in the capillary fringe of the water table so that irrigation is unnecessary. Methods: If possible, insert the auger to the depth of the water table to disrupt any compacted zones that might restrict rapid root extension into the capillary fringe. Add enough backfill to the hole so the bottom portion of the root ball is in contact with the capillary fringe. Set the root ball to the desired depth and place a watering tube in the planting hole to allow deep irrigation if the water table declines or if a severe drought occurs. Backfill carefully around the root ball and stem to the ground surface. If sufficient water is available, thoroughly water the backfilled material immediately after planting. This is beneficial to collapse voids in the backfill and enhance soil-to-rootball contact.

Wetland plan propagation (USDA NRCS 2007):

Wetland plants are readily transplanted because of their tremendous root systems and the fact that the remaining plants would fill in the harvest hole rapidly. One rule of thumb is to dig no more than 1 ft2 (0.09 m2) of plant material from a 4 ft2 (0.4 m2) area. It is not necessary to harvest deeper than 5 to 6 in (13 to 15 cm). This depth would provide enough root mass to ensure good establishment at the project site. It would also retain enough of the transplants' root system below the harvest point to allow the plants to grow back into the harvest hole in one growing season assuming good hydrology and some sediment deposition (Hoag 1994, Bentrup and Hoag 1998). Plug spacing of 30-45 cm would fill in within one growing season. Transplants can be taken at almost any time of the year. Collections in Idaho have been taken from March to October with little or no difference in transplant establishment success. If plugs are taken during the summer months, cut the top growth to about 4 to 5 in (10 to 13 cm) above the potential standing water height or 10 in (26 cm) whichever is higher. Research at the Aberdeen, Idaho Plant Materials Center (Aberdeen PMC) has shown that covering the cut ends with water would not necessarily kill the plant, but would significantly slow establishment rates.

The plants may die if left covered for extended periods of time (Hoag et al. 1992). Cutting the tops also increases the survival rate of transplants that are transported long distances (Hoag 1994). Leaving the soil on the plug increases the establishment rate by about 30%. Beneficial organisms that are typically found on the roots of the wetland plants are important in the nitrogen and phosphorous cycles. These organisms that may not be present at the new site. Leaving soil on the plug however, would increase the volume of material that needs to be transported. There is a good chance that weed seeds could be transported in the soil if collected from a weed-infested area. Washed plugs reduce weed seed transport and can be inoculated with mycorrhizae purchased from dealers if the project objectives require it. The collection location should be inventoried to help determine whether the soil should be left on the plugs or washed off (Hoag 1994). If 1 ft2 (0.09 m2) of plant material is harvested, it is possible to get 4 to 5 individual plant plugs from the larger plug (Hoag 1994). The plugs can either be chopped with a shovel very rapidly or the plugs can be cut relatively accurately with a small saw so they will easily fit into a predrilled, set diameter hole. To get the right length of plug, lay the large plug on its side on a sheet of plywood and use a saw to cut the bottom off level and to the desired length. After this, stand the plug up and slice smaller plugs off like a cake. Make sure the length of the plug is related to the saturation zone at the planting site. The bottom of the plug should be in contact with the saturation zone.