

Chapter 3. Project Elements and Alternatives

INTRODUCTION

This chapter presents a discussion of proposed project elements followed by descriptions of alternatives. The technical team developed the project elements based on existing site conditions, project goals, background studies, and planning workshops. For the purposes of this project, project elements are features or actions that, if implemented, would satisfy one or more of the project goals; Project Alternatives are combinations of the various project elements that form a design solution.

The relatively large size of the Jensen River Ranch allows for the consideration of numerous future visions for the property. To facilitate the Advisory Committee's development of a preferred vision, four Project Alternatives, have been developed. The alternatives are listed below.

- No-Project
- Oxbow Lake (Alternative 1)
- High Terrace (Alternative 2)
- Lowered Floodplain (Alternative 3)

Each alternative represents a different habitat restoration vision for the Jensen River Ranch; however, all Project Alternatives meet the project goals of restoring biologically diverse riparian habitats and preserving open space.

PROJECT ELEMENTS

The following section describes the project elements used to develop the alternatives. The elements are separated into three categories: habitat protection and enhancement, land management, and public access. These elements are intended to be general design concepts, but the background analysis and general construction parameters are described for each element. More complete description and analysis of construction techniques is presented in Chapter 5.

Habitat Protection and Enhancement Elements

Element 1: Preserve and Expand Cottonwood and Mixed Riparian Forest along Intermediate Terrace

The existing riparian forest is limited to the floodplain and intermediate terrace along the river edge where grazing has been restricted. Several areas on the intermediate terrace have been actively grazed, suppressing the natural recruitment of riparian vegetation. The existing riparian corridor can be expanded along the intermediate terrace through moderate grading to expand the terrace into the adjacent upland, actively planting riparian species, and eliminating grazing. This element is consistent with recommended treatment of the “Wildlife Corridor” zone as described in the Parkway Plan (Dangermond & Associates, Inc. 1992). Typical dominant tree species consistent with the mixed riparian forest vegetation association (Holland 1986) include Fremont cottonwood, box elder, Goodding’s black willow, Oregon ash, white alder, California sycamore, and valley oak. Shrub species include red willow, arroyo willow, and buttonbush. The understory vegetation includes native grasses and forbs, such as creeping wildrye, nettle, and Barbara sedge.

Element 2: Plant Valley Oak/Sycamore Woodland

Based on existing soil and groundwater hydrologic conditions, a large portion of the site will support valley oak/sycamore woodland. Valley oak/sycamore woodland is a tree-dominated vegetation community with open to closed canopy. This vegetation type is usually found on higher portions of the floodplain or terraces 15–25 feet above the average summer river stage elevation. Woodland stands of this vegetation type are documented along the river upstream of Herndon (Jones & Stokes Associates 1998a). Valley oak is the dominant tree in this vegetation type; California sycamore is also present. Oregon ash and Fremont cottonwood occur in small numbers. Common understory species include creeping wildrye, California wild rose, and California blackberry.

The spacing and distribution of plants would vary depending on the restoration measure option selected.

Element 3: Plant Valley Oak/Sycamore Savannah

Valley oak/sycamore savanna is similar to the valley oak/sycamore woodland described above, but it is an upland rather than a floodplain community. The savanna is a vegetation community dominated by trees, with a largely grassland understory. Valley oak is the dominant tree species; sub-trees and shrubs, including Mexican elderberry, coyote brush, western redbud, California wild rose, and coffeeberry, are also present. Grasses may include blue wild rye, California brome, and California meadow barley. Valley oak savanna intergrades with valley oak/sycamore woodland and perennial grassland, depending on soils, depth to groundwater, and proximity to the active floodplain.

Similar to the valley oak/sycamore woodland element described above, the spacing and distribution of plants would vary depending on the restoration option and irrigation method selected. Please refer to Chapter 5 for a discussion of restoration methods.

Element 4: Install Visual Buffer Plantings Near Adjacent Private Property

Land uses adjacent to the east and west of the project may not be wholly compatible with public access and restoration activities on the site. An irrigated and managed buffer planting of native oak woodland and riparian plants would provide appropriate visual screening into and out of the project site. This buffer planting would protect the privacy of adjacent land owners from trail users and restoration activities. Some of the restoration Project Alternatives would create an excess amount of excavated material. If these project elements are part of the preferred restoration scenario, this material could be used to create a low, naturally shaped berm along either of these edges. Figure 3-1 is a conceptual illustration of the visual buffer near the western edge of the site.

Element 5: Establish Native Grassland

In selected areas that can be managed independently from other restoration zones on the project site, native grassland could be established. The establishment of native grassland areas will require an intensive site preparation and weed control program to ensure its success. Weeds can be controlled by mechanical methods, chemicals, or prescribed burns. The ability to burn a small grassland depends on many factors, and at this stage in the planning process there is no reason not to consider prescribed burns. However, detailed consideration and plans would be needed and, in the end, prescribed burning may not be appropriate. For the purposes of cost estimating, weed control is assumed to utilize a combination of mechanical and chemical treatments.

Element 6: Excavate Wetland/Riparian Backwater Slough

This project element proposes to excavate a backwater slough from the active river floodplain to bring a finger of floodplain, seasonal wetland, willow riparian, and cottonwood riparian habitat into the site. The primary benefit of this project element is to create greater habitat diversity within the site and expand the connection with the river floodplain. River water would back up into the slough during high flow events, creating seasonal wetland habitat and naturally irrigating a fringe of cottonwood riparian forest. Dominant trees would include Fremont cottonwood and Goodding's black willow. Mid-story species would include California wild grape, Oregon ash, California box elder, button bush, and willow species.

This feature would be a gradually sloping channel of approximately 1% slope, from 18 inches deep at the head to 10 feet deep at the river floodplain. The side slopes would vary from 1:3 to 1:5 and the channel width would vary depending on the location and size of this feature. Figure 3-2 depicts the slough channel and its target vegetation communities.

If this element is selected it would create unique opportunities for interpretive exhibits and wildlife viewing. The proposed multiple-use trail could cross the slough feature via a pedestrian bridge and provide a more diverse river-related environment for visitors to experience.

Element 7: Excavate Seasonal and Perennial Wetland Oxbows

This project element proposes to expand seasonal and perennial wetland habitat on the site and to utilize the stormwater from the DK area channel by excavating an oxbow near the toe of the bluff. The oxbow feature would capture stormwater from the DK area channel and during the winter months direct water through a series of shallow excavated crescent features before returning it to the existing outfall structure and into the San Joaquin River. This method is an innovative means of expanding riparian and wetland habitat through a moderate level of excavation and providing this habitat with a mostly guaranteed water source. The side slopes and benches of the oxbow would be planted with willow and cottonwood riparian species. Portions of the oxbow bottoms would be planted with cattail and common tule marsh species.

The oxbow would incorporate the same water quality features as the existing grassy swale, settling 75% of sediment and particulate matter from stormwater runoff. Sediment and particulate matter would be removed periodically from a settling basin similar to the existing one. The existing DK area channel infrastructure would be maintained, including the concrete weir, the inlet and outfall structures, and the underground diversion pipe. The following is a description of the conceptual design for the oxbow features. Additional design, hydraulic modeling, and coordination with FMFCD engineers would be required in Phase 2 detailed design.

Water would flow from the current concrete inlet structure into a primary sediment basin before entering the first oxbow. This sediment basin would be cleaned out annually and would be maintained by the FMFCD. A debris barrier would separate the sediment basin from the first oxbow. Stormwater would be directed laterally into the first oxbow by construction of a weir across the existing grassy swale. The existing grassy swale would remain and serve as additional floodplain during more severe storms. The first oxbow (oxbow 1) would receive water primarily from the DK area outfall, with the exception of a very small amount of runoff from the project watershed. The second oxbow (oxbow 2) would receive water when oxbow 1 is full (which occurs on average 4–5 times each year) and spill through a shallow, constructed swale. In addition, oxbow 2 would receive flood irrigation runoff from the adjacent field. A small, 2-foot-high berm at the mouth of the second oxbow would periodically flood the oxbow. Oxbow 2 would overflow into the DK area channel and maintain the existing outfall into the San Joaquin River.

Oxbow 1 would be roughly 2,000 feet long, have an average bottom width of 15 feet, and have 6:1 side slopes. The depth would range from 6–4 feet, with an average of 5 feet (see Figure 3-8). The deepest portion would be near the DK area channel. The bottom of the oxbow would gradually slope to four feet deep at the southern end. The average channel width from top-of-bank to top-of-bank would be 85 feet, with a maximum of 100 feet and a minimum of 70 feet. At maximum capacity, the oxbow would hold approximately 225,000 cubic feet of water and have a surface area of 75,000 square feet. Oxbow 2 would be roughly 1,000 feet long, have an 8-foot-wide

bottom, and have 4:1 side slopes. Figure 3-3 illustrates the two oxbows and their target vegetation communities.

The basic oxbow design is based on a simple model that predicts the water depth within each oxbow (Figures 3-4 and 3-5). To understand depth and duration of flooding in each oxbow, the design parameters (e.g., depth, length, and side slopes) were adjusted to test various configurations. The model accounted for precipitation, watershed area (2,179 acres), watershed urbanization or percent impermeable surface (33%), summer urban runoff, soil moisture, percolation, evapotranspiration, and surface area of the oxbow. Measurements from a local weather station provided 17 years of daily precipitation and evapotranspiration for the model. Model results predicting daily water depth in the oxbows for the last ten years are shown in Figure 3-4. The secondary axis shows daily precipitation for the same time period. During most years there is sufficient winter rain to fill the oxbows entirely, with depth fluctuations between storms that do not completely dry out the oxbows. However, during the summer the oxbows will likely dry out.

Modeling results based on 17 years of rainfall data are summarized in Figure 3-5. This graph illustrates runoff depth and duration and design parameters for each oxbow. According to the model, there would be a minimum of 1 foot of water in the oxbow 1 for more than 250 days each year (on average), and it would be full 35–45 days per year. However, as shown in Figure 3-4, the consistency of the inundation at different depths will vary. During the winter, the depth of water in the oxbow will typically be at least 1 foot, but it will rarely be more than 5 feet deep for more than a few days in a row. This indicates that the water level at the upper banks will fluctuate roughly two feet for most of the winter, and then will slowly draw down in the summer.

Element 8: Create Seasonal Wetland Depressions

This restoration element focuses on creating small depressions (approximately 0.25–0.5 acre) that would pond water during winter storms and support seasonal wetland vegetation. Each depression or group of depressions would hold water for 2–3 months, depending on the amount of precipitation that year. Initially the depressions may pond water only slightly longer than the surrounding landscape, providing some additional natural irrigation for valley oak and sycamore trees planted near their perimeter. It is anticipated, however, that over time the soils in the depressions may naturally seal and pond water long enough to support seasonal wetland vegetation.

The seasonal wetlands are a series of two to three depressions approximately 18–24 inches deep at the center and linked together by shallow swales, allowing each to fill and then spill into the lower pool. The construction of these seasonal depressions would be similar to techniques used to create vernal pools, compacting the underlying soils in a series of lifts to promote ponding. However, these seasonal wetlands would not and are not intended to have the floristic diversity found in natural Central Valley vernal pool habitats. The depressions could be actively managed by manually flooding the areas using irrigation water in spring or summer. This could also be a method of providing supplemental irrigation for trees planted near its perimeter.

Element 9: Extend Woodward Park Drainage

A substantial amount of irrigation runoff in Woodward Park flows into a drainage lined with cottonwood and willow trees, creating a pleasant amenity within the park. This drainage flows into a ditch on the project site adjacent to the main access road. This design element would extend the drainage in Woodward Park through the project site, linking the two properties visually by the swath of cottonwood and willow trees lining the banks. The drainage would meander along the edge of the multi-use trail and connect into the second oxbow or the existing drainage ditch (depending on the elements and alternative selected), providing supplemental water to vegetation in these areas.

Currently there are no measurements for the amount of flow in the existing the Woodward Park drainage. The flow could be measured using a hydrometer as part of detailed design in Phase 2. This procedure would allow for more accurate sizing of the extended swale and greater understanding of the amount of vegetation that could be supported by the existing seasonal runoff. This extended seasonal drainage is conceptually shown in Figure 3-6.

Element 10: Meander DK Area Channel

This element proposes to modify the DK area channel to expand riparian and wetland habitat and create a more aesthetic landscape feature. In general, the channel would have a gentle “S” curve to appear more natural and accommodate woody vegetation. The channel can also be modestly reshaped to include more defined “floodplain” terraces. A low terrace or channel would transport summer flow, trap sediment, and be vegetated with seasonal wetland and possibly some permanent wetland plants. A middle terrace would be inundated during most of the winter months when stormwater runoff is greatest and would be vegetated with seasonal wetland plants and willow riparian shrubs. The high terrace would be inundated only during peak storm events and would be vegetated with woody mixed riparian species. The high terrace would likely be dominated by willow, cottonwood, button bush, and ash with additional species establishing naturally based on the hydrologic conditions. Figure 3-7 illustrates a typical cross section of this element. Portions of the low terrace or low flow channel would be maintained on an as needed basis (every 2–3 years) to remove accumulated sediment and excessive or nuisance plant material the feature would be designed to naturally minimize mosquito populations and accommodate mosquito abatement if necessary.

Element 11: Construct Wildlife Enhancement Features

There are many small-scale wildlife enhancement features that can be installed to increase nesting and foraging habitat at the site with minimal cost and technical ability. They are frequently popular projects for community service groups to initiate and manage. These features include brush piles, bird boxes, bat boxes, snags, and downed woody material. Boxes could be constructed for the project or purchased from commercial sources or conservation groups, such as Bat Conservation International. Maintaining and monitoring boxes can become a time consuming endeavor for an organization with limited staff. In this case, it is recommended that wildlife boxes be sponsored and cared for by interested individuals, community service and wildlife groups, or school science

programs. Guidelines for placement of boxes are provided below. Proper placement of nest boxes increases the likelihood that they will be occupied by target wildlife species. Placement of wildlife habitat enhancement structures would be coordinated with planting and irrigation layouts in the detailed design phase of the project.

Brush Piles. Brush piles are tree branches or limbs placed in a conical formation (with branches leaning in on each other). They provide escape cover for wildlife and link existing habitat areas by creating cover in open areas. Brush piles are typically constructed in a tepee shape at dimensions of 3–4 feet high by 6–8 feet in diameter. They should be open enough for sparrows and other small birds to move through and reach the ground but contain enough protruding limbs for perching and singing. They should be spaced approximately 100–200 feet apart, depending on field conditions, to provide expansion of scrub cover. Brush piles should be placed near the edges of mixed riparian zones and near resting spots for visitors using the trails. However, to reduce the chance of vandalism, brush piles should not be placed near the main public use area. Blackberry bushes may be planted around the perimeter of each brush pile to provide additional cover for wildlife.

Woody Debris. Downed woody debris, such as dead trees deposited by large floods at the high water line (e.g., during the 1998 flood), provide excellent wildlife habitat. Woody debris placed in the excavated oxbows would provide perching and loafing sites for amphibians, herons, egrets, and ducks. Logs and root wads should be placed perpendicular to the shorelines of the oxbows and be firmly anchored into the bank, with the majority of the tree exposed above the waterline. Other types of woody debris, including snags, should be left standing onsite for raptor perching and nesting, unless its location is a potential hazard to visitors.

Bluebird Boxes. Bluebird boxes provide nesting sites for bluebirds and a variety of other small birds, including tree swallows, house wrens, and ash-throated flycatchers. The boxes should be installed in pairs approximately 25 feet apart on trees or posts. Boxes should be installed approximately 5–6 feet off the ground. Each pair of boxes should be a minimum of 100 yards apart from the next pair. The entrance hole should face north, east, or northeast to minimize heating of the box interior from direct sun exposure. These boxes might be used by nontarget species, such as bees or large birds (e.g., starlings). However, if these boxes are indeed used by the target species, additional boxes could be installed in the future. Bluebird boxes should be periodically inspected, cleaned, and repaired, as necessary. Bird nesting materials or any bees that may be occupying the boxes should be removed. Maintenance should occur between December 1 and January 31 in order to avoid disturbing the birds during the nesting season.

Bat Boxes. Bat boxes provide roosting, brooding, and overwintering sites for bats. Bat boxes should be mounted on poles 20–30 feet off the ground along the edge of the mixed riparian forest habitat along the San Joaquin River. The boxes could be hung on trees in pairs, with one box facing east and the other facing southeast. One box should be hung 12 feet off the ground and the other 15 feet off the ground. Variation in the placement of the boxes provides roosting options for the bats and increases the likelihood that the boxes will be used. It may take 1 or 2 years for bats to occupy the boxes. The boxes should be monitored and relocated if they are not used after 3–4 years. To ensure that they remain in good condition, the boxes should be checked and maintained between

September and December each year. The boxes do not need to be cleaned after they have been occupied; occupied boxes should not be disturbed.

Barn Owl Boxes. Suitable barn owl foraging habitats (e.g., grasslands and agricultural fields) are near the site, but it is possible that not enough suitable cavity sites are available for nesting. (The existing hay barn may be suitable but is undesirable from a management perspective.) Where natural nest cavities are lacking, artificial nest boxes can supplement roosting and nesting sites for barn owls. Barn owl nest boxes should be placed on trees along the edge of woodland clearings where barn owls can easily access the boxes. The boxes should face the open area and be installed approximately 20–25 feet off the ground. One barn owl nest box should be installed for every 10 acres, and the boxes should be placed at least 200 feet apart. Preferably, the nest boxes should be installed before the barn owl nesting season begins, which is usually January or February in California, but they can be placed any time of the year. Maintenance should occur between October and December. A well-maintained owl box should last approximately 10–15 years. The most desirable materials for owl boxes are bald cypress, red cedar, and redwood. Barn owl boxes should be periodically inspected, cleaned, and repaired, as necessary.

Wood Duck Boxes. Wood duck boxes could be installed to provide additional wood duck nesting sites along the San Joaquin River. Boxes should be installed 8–12 feet off the ground, in trees that are within approximately 25 yards of the river. A maximum of 2–3 boxes per acre should be provided. Boxes near the water should be oriented so that entry holes face the water. Otherwise, entry holes should face south or west. A minimum of 4 inches of cedar shavings should be placed in each box to serve as nesting material. The wood on the interior of the box under the entrance hole should be roughened with a chisel or rough grade redwood should be used to ensure that the ducklings have a toe-hold for climbing out of the boxes. The roughened area should extend 1 foot below the entrance hole. Wood duck boxes should be periodically inspected, cleaned, and repaired, as necessary. Duck nesting materials or any bees that may be occupying the boxes should be removed and the cedar shavings should be replaced as necessary. Maintenance should occur between December 1 and January 31 in order to avoid disturbing the ducks during nesting season.

LAND MANAGEMENT ELEMENTS

Element 12: Control Non-Native Invasive Plant Species

The control of non-native invasive plant species will be crucial to the success of the enhancement efforts and the long term sustainability of the site. Invasive species, such as yellow star thistle and some annual grasses, can compete with plantings and prevent or slow down the establishment of desired plant communities. Critical species to remove and actively control are giant reed (*Arundo donax*) and scarlet wisteria (*Sesbania punicea*). These species invade riparian areas in California. They are found along the San Joaquin River and are currently found within the riparian areas of Jensen River Ranch. Without control, these invasive species may come to dominate the riparian areas and reduce the habitat quality of the existing and proposed riparian areas. The management of other non-native, invasive species, both long- and short-term, should also be addressed in Phase 2 detailed design.

Element 13: Interim Grazing

Grazing portions of the site could be an important method of controlling weeds and allowing the establishment of woodland and savanna habitat. Properly controlled grazing would allow for weed control and continued maintenance of the irrigation system. Areas of tree plantings would be fenced to exclude cattle. Grazing could also be a useful tool to manage the weed populations if construction of the selected alternative is phased over a number of years. If the Conservancy wishes to allow for limited grazing to reduce the weed population, guidelines of where to graze, how much to graze, and the timing of grazing will be developed as part of Phase 2 detailed design.

Public Access Elements

Public access, next to habitat restoration, is a primary feature of this project. With the site easily accessed from the existing Lewis S. Eaton trail and Woodward Park, the Jensen River Ranch will be well received by the public. Because of the importance of public access, the quantity and quality of public access does not vary between alternatives. The Advisory Committee has determined that one public access plan will be overlaid onto the selected alternative. A complete description of the public access plan is provided in Appendix B.

In general, the public will access the site via Woodward Park and the Lewis S. Eaton trail on a paved multiple-use trail known as the Tom MacMichael Sr. Loop Trail. A public use area would be developed near the hay barn. This area naturally provides physical and visual access to the river and is the best location for picnic shelters, horse hitching, bicycle parking, restroom and drinking water facilities, and other public access amenities.

Signs. Interpretive and public safety signs should be located appropriately throughout the project site, but signs should generally be concentrated at entrance points to the ranch, at trail intersections, and in the primary public use area. Future exhibits could be based on the following interpretive themes:

- the conceptual restoration plan and construction phasing;
- the importance of the San Joaquin River Parkway's wildlife corridors, water quality function, and habitat value of the restoration features;
- wildlife and plant communities on the site; and
- site history.

Public use and safety signs should be sited at appropriate locations to remind people of local laws and ordinances, as well as special circumstances associated with the site. These may include:

- use restrictions;
- share-the-trail messages;
- notice of local leash laws;
- restrictions to public access;
- sensitivity of particular wildlife habitat areas; and
- notice not to harass grazing animals.

Fencing. The site is currently divided into 3 or 4 pastures, each fenced with 3-strand barbed wire. If grazing is continued as a land management tool, these fences will need to be replaced and/or relocated to accommodate the proposed trail layout. The fences should be removed if grazing is eliminated. If the fences are removed, new welded wire fence may be desirable to control public access in some locations such as along the river’s wildlife corridor.

RESTORATION ALTERNATIVES

The following section describes four Project Alternatives: No-Project Alternative, Alternative 1–Oxbow Lake, Alternative 2–High Terrace, and Alternative 3–Lowered Floodplain. The project elements included in each alternative are summarized in Table 3-1. A summary of preserved and restored habitat in acres for the No-Project and Project Alternatives is presented in Table 3-2. Descriptions of each alternative follow.

No-Project Alternative

The No-Project Alternative would leave the site in its current condition of irrigated pasture and seasonal grazing. The site would not be actively altered to promote riparian or woodland expansion. However, natural regeneration may occur along the periphery of existing habitats if grazing is eliminated in these areas. The DK area channel would also be maintained in its current condition.

Alternative 1. Oxbow Lakes

The central feature of alternative 1 is a redesign of the DK area channel into a few shallow oxbows, described in Element 7 (Figure 3-8). Excavation of the oxbow feature creates access to groundwater suitable for supporting riparian habitat. In addition, the oxbows would create a combination of seasonal and perennial wetland habitat, incorporate existing sediment trap functions of the grassy swale, and maximize use of stormwater runoff by redirecting flows to other areas of the site. The engineering of the oxbow features would need to be coordinated with Fresno Water Quality and Flood Control District (FWQFCD).

This alternative also incorporates Element 6: Excavate Backwater Slough. In this application of Element 6, the backwater slough is created by moderate excavation near the existing irrigation pump to expand the area supporting riparian habitat.

Overall, this alternative provides a diverse habitat mosaic utilizing a number of creative restoration design features and a moderate amount of earthwork. The percentage of each target restored habitat type is summarized below.

Portion of Project Site	Habitat Type
5%	seasonal and perennial wetland
20%	mixed riparian woodland
21%	valley oak/sycamore woodland (includes buffer planting)
33%	valley oak/sycamore savannah
6%	native grassland
15%	existing preserved habitat

Alternative 2. High Terrace

Alternative 2 maintains the current high terrace geomorphology of the site and focuses on creating sustainable vegetation communities and wildlife habitat with minimal earthwork (Figure 3-9). Minimizing earthwork activities eliminates some restoration design elements, including construction of the oxbow and seasonal wetland-riparian slough. In this scenario, the DK area channel is modestly reshaped into a meandering channel with widened banks to accommodate riparian vegetation along its perimeter (Element 10). The channel would serve primarily as a water quality feature and provide additional value as seasonal and perennial wetland. Seasonal wetland depressions and pockets of mixed riparian and valley oak/sycamore woodland vegetation are located in areas that could sustain this vegetation over time.

This alternative provides a habitat mosaic dominated by oak savannah and grassland. The percentage of each target habitat type is summarized below.

Portion of Project Site	Habitat Type
3%	seasonal and perennial wetland
14%	mixed riparian woodland
20%	valley oak/sycamore woodland (includes buffer planting)
41%	valley oak/sycamore savannah
7%	native grassland
15%	existing preserved habitat

Alternative 3. Lowered Floodplain

Alternative 3 significantly lowers the floodplain surface through gravel extraction. This alternative would connect the site hydraulically and hydrologically to the San Joaquin River floodway system (Figure 3-10). As described in Chapter 1, the site is not currently part of the active river floodplain. In order to establish more extensive riparian vegetation, the site needs to be reconnected with the post-Friant Dam river hydrology. Reconnecting the site can only be accomplished through extensive earthwork. This earthwork would create a significant amount of material that would need to be exported off site. The most feasible way to lower the floodplain would be to mine the subsurface sand and gravel and sell the material to cover the mining expenses. It is unclear whether the gravel's quality is high enough to let it be sold as construction grade material at market value. However, if the materials are of low quality, a cost sharing relationship could probably be arranged whereby the cost of material extraction and hauling could be paid for by another restoration project on the San Joaquin River in need of a large quantity of fill material.

This alternative would require additional engineering research and economic and environmental analysis to determine its feasibility. In addition, this alternative would require an Environmental Impact Report to comply with the California Environmental Quality Act, an Environmental Impact Statement to comply with the National Environmental Protection Act, and multiple state and federal regulatory agency permits. Analysis of these issues is not covered by this document. In addition, it would postpone restoration activities and public access for 5 to 10 years at a minimum.

The primary restoration feature used in the post-mining restoration plan is Element 6: creation of a riparian wetland backwater slough. Unlike the slough in Alternative 1, this feature would be broad and relatively shallow. It would connect directly into the river at the downstream end, bringing shallow aquatic and seasonal wetland habitat into the heart of the site. During rising river stage, water would back into the feature and inundate adjacent wetland and woody-riparian habitat. The existing high ground surrounding the barn would be maintained to provide recreation opportunities. The conceptual trail plan presented in Appendix B would need to be revised for this alternative to provide year-round access to the site. In addition, the DK area channel would need to be substantially modified in coordination with FWQFCD.

This alternative provides a habitat mosaic dominated by mixed riparian and seasonal wetland habitats. The percentage of each target habitat type is summarized below.

Portion of Project Site	Habitat Type
11%	seasonal and perennial wetland
60%	mixed riparian woodland
11%	valley oak/sycamore woodland (includes buffer planting)
0%	valley oak/sycamore savannah
6%	native grassland
7%	existing preserved habitat

ESTIMATED CONSTRUCTION COSTS

Order-of-magnitude construction cost estimates were prepared for each alternative based on the general restoration elements presented in this chapter. The estimates for alternatives 1, 2, and 3 are summarized in Table 3-3; detailed cost estimates are located in Appendix C. They are intended for general planning purposes and as a basis for the cost benefit analysis presented in Chapter 4. The estimates are based on engineering estimates and contractor bids prepared for similar restoration projects.

The estimates do not include costs for long-term maintenance, remedial actions, or contingency. They also do not include costs associated with vegetation, hydrology, or wildlife monitoring. Assumptions for planting density, size of plant material, irrigation design, maintenance period, and earthwork calculations are summarized within the estimate.