

Summary Feasibility Report and Conceptual Planning for Whitewater and Habitat Improvements Project Kern River Kernville, California

April 2011



Prepared For
The Kern Valley River Council (KVRC)

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Figure 1: A busy weekend at the San Marcos Whitewater Park

Introduction

Whitewater kayaking is one of the fastest growing outdoor sports in the country and whitewater parks are an emerging trend as a way to provide river-related recreation near population centers. Diverse communities varying in population and geographic characteristics are turning back to their rivers as a source of recreation, education, and local pride. Whitewater parks attract citizens of all ages and cross all socio-economic lines (see Figure 1). The operation of whitewater parks across the country has shown that these types of projects provide a number of benefits including new recreational opportunities, economic stimulus, enhanced aquatic habitat, floodplain stabilization, and environmental education opportunities.

Flowing near downtown Kernville, the Kern River has great potential to host a multi-use park. Improvements to the bank and channel would help open up the river to recreational

use by paddlers, anglers, and other users, as well as help enhance the habitat for the fish, native vegetation, and waterfowl that inhabit the river. The banks are highly degraded as a result of flooding. The project will stabilize the banks and control grade within the channel.

In-stream river improvements were originally done in the early 1980's to create grade stabilization and enhanced recreational opportunities (See Figure 2). Portions of those improvements are still visible in the channel, but now have minimal grade stabilization and recreational value. In addition, it appears the west bank has been stabilized with a combination of concrete floodwalls, dumped boulder riprap, and trees currently providing partial protection for a steep and eroding bank.

Recreation Engineering and Planning (REP) completed a conceptual planning drawing in-kind for modifications to the Kern River, dated February 18, 2011. The drawing includes fish habitat and recreational boating improvements, as well as related bank and access improvements. The design of these bank, whitewater, and fishing improvements should include Americans with Disabilities Act (ADA) access and opportunities. The improvements will help strengthen the tie between the river and the community, provide a whitewater paddling amenity for the local community, and create a whitewater and fishing resource for the region.



Figure 2: Construction photo of the original bank barbs



Feasibility Report

REP completed site feasibility and collection of pertinent data for conceptual planning purposes. REP visited one site on the Kern River near Riverside Park and toured upper sections of the Kern upstream of Kernville. During the site visit, REP consulted with local project proponents, collected photos, took field notes, and managed and directed collection of bathymetric and acoustic Doppler data to be used during later stages of the project.

Based on the data collected during the site visit and subsequent analysis, REP believes the site is feasible for whitewater improvements and possesses characteristics that have supported some of the more successful whitewater parks. Specifically, the site contains hydraulic gradient sufficient to develop whitewater and habitat enhancements. Parking exists near the site providing site users with easy access. Parking and infrastructure could be improved to allow ADA access to the river, pools, and viewing areas. Restaurants, shops, and local infrastructure are nearby. Finally, the area contains access points both upstream and downstream that are conducive to river users wishing to have a “float-through” experience. Based on these qualities, REP recommends site improvements.

Multiple Objectives

This project will serve many different types of users (See Figure 4 and Figure 5). The reach currently is used for fishing, and any changes will be made with a goal of maintaining and increasing fishing opportunities. The proposed whitewater drops and pools provide excellent fish habitat. Fishermen will continue to frequent the area both during boating season and during the off-season. Selective creative play areas with natural boulders and accessible riverside play areas will be fun for kids and families. The area will be enhanced for walkers, joggers, picnickers, and bird watchers, and will provide ample opportunity for simply spending time by the river watching boaters and fishermen. ADA access for whitewater and fishing opportunities will also be included. In addition, many youth-oriented paddling and angling programs have sprung up around the development of whitewater parks as a way to provide healthy, accessible recreation and education for young people. All improvements are designed to stabilize the banks and bed of the river, and mitigate the potential for flood damage.



Figure 4: ADA access point at a REP whitewater park in Johnstown, PA



Figure 5: A fisherman enjoying the Salida Whitewater Park

Project Description

The project area spans from just downstream of the Burlando Road Bridge to an existing pool approximately 0.34 miles downstream. An aerial image of the project site is shown below in Figure 6. Modifications associated with this project include in-stream modifications, bank restoration and terracing, improved access points, and trails.



Figure 6. Aerial image of the Kern River near Kernville, CA showing the project area.

Existing Conditions

The existing conditions of the project reach can be characterized as “extremely disturbed” with significant human and flood impact. The river corridor is disturbed as a result of prior river improvements and cumulative flooding causing significant erosion, undermining of existing floodwalls, and degradation of the west bank. Bankside erosion is evident at multiple locations as a result of flooding and human trampling. Upland erosion in the park is evident as a result of trampling, trail cutting, lack of established trails, lack of established access points, flooding, and unstabilized slopes.

Previous river improvements include portions of multiple bank barbs that extend into the low flow portion of the river to stabilize grade and create whitewater features, random boulders placed near the thalweg to create whitewater features, and bank improvements for access (See Figure 7). Those improvements were completed in the 1980’s and REP understands no additional maintenance or improvements have occurred since that time. Because of that, only portions of the original improvements are still functioning as originally designed. Significant portions of the barbs have moved or washed downstream.

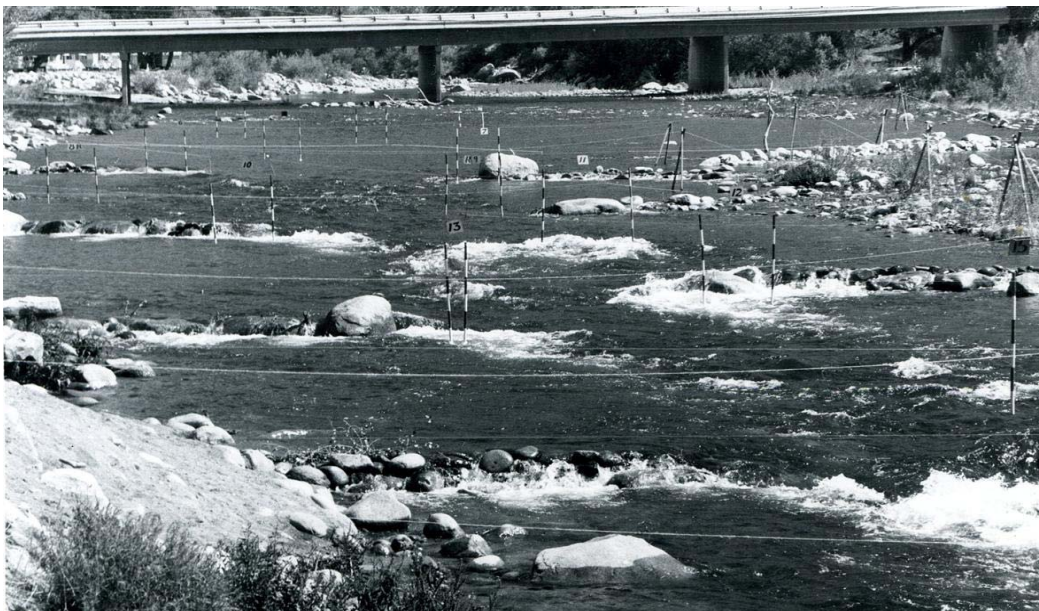


Figure 7: Original Instream improvements for recreation and habitat improvement

The access points on the west bank associated with Riverfront Park have aggravated bank erosion primarily because of over-use (See Figure 8) and insufficient stabilization (see Figure 9 and Figure 10). No hardened access points exist within the park.



Figure 8: Existing use at Riverfront Park during low water conditions



Figure 9: Erosion exacerbated by insufficient stabilization



Figure 10: Erosion at Riverfront Park

The Kern River peaked at a flow of approximately 22,000 cubic feet per second (cfs) during December 2010. There have been four floods since 1966 with equivalent or greater magnitude (Figure 11 and Figure 12).



Figure 11: Erosion and degradation of longitudinal floodwall



Figure 12: Degradation associated with flooding

The existing east bank can be characterized as moderately disturbed with a low floodplain terrace. Vegetation on the bank near the upstream end of the project has either been mechanically removed, trampled, or scoured by flooding. A private enterprise offers access in this area and camping/RV accommodations. Near the downstream end of the project, the area is less disturbed and contains a natural and moderately-stable riparian corridor.

Hydrology

The mean monthly streamflow at the site is shown in Figure 13.

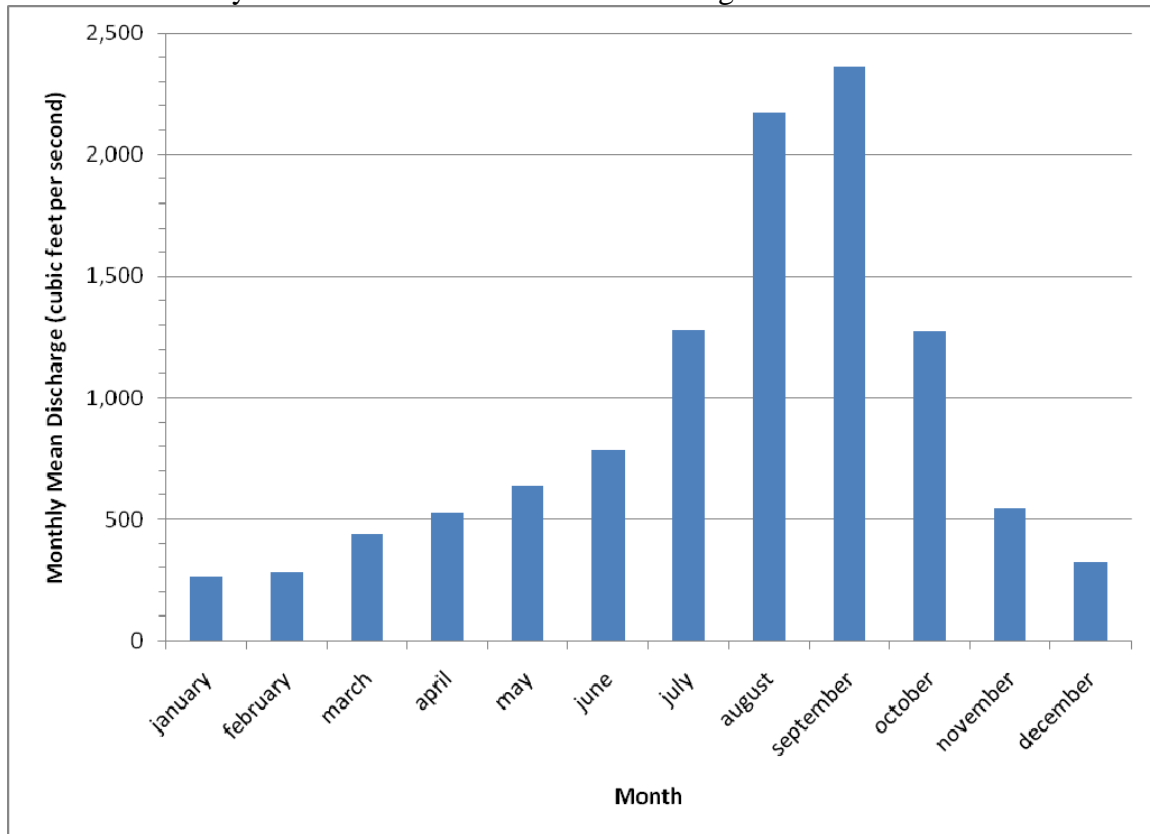


Figure 13: Mean monthly stream flow at USGS Gauge 11187000 located within the project area (Source <http://pubs.usgs.gov/wri/wri934076/stations/11187000.html> period of record 1874-1988 (discontinuous record))



High flows on the Kern River near Kernville, CA generally occur in the months of June through October, and drop in the winter. Mean monthly flows range from less than 300 cubic feet per second (cfs) in January to approximately 2,300 cfs in September (Figure 13). The peak flow on record (according to conversations with Mr. Derrick Tito, Hydrographer for Southern California Edison) reached over 100,000 cfs in 1966. Although the weather in the area may not be hospitable during all months, the flow conditions support whitewater recreation all year long.

Proposed Improvements

In-stream, bank stabilization, river access, and trail improvements are proposed along the reach of the Kern River shown in the attached Conceptual Planning Drawing (See Appendix 1). The improvements are designed to complement each other and provide a recreational facility for users from advanced freestyle paddlers to streamside picnickers. Typical drawings of these improvements are shown in Appendix 3 and are further described below.

Users

This project will serve three main types of users: in-stream users, on-bank users and anglers. The primary in-stream users will be whitewater enthusiasts including kayakers, canoeists, rafters, tubers, stand-up paddlers (SUP) (See Figure 14), swimmers and boogie-board surfers. On-bank users include pedestrians, joggers, picnickers, bird watchers and spectators. The design elements accommodate anglers with improved river access, an enhanced casting pool, and fish habitat improvements.



Figure 14: Stand Up Paddling on an REP Wave

The project includes both float-through and park-and-play type whitewater features designed to provide a variety of difficulties, depending on discharge. At higher flows the course will become more challenging and the hydraulics featured at the “U” structures will become more dynamic and powerful. At lower flows these same structures will accommodate beginner and intermediate boaters who seek to develop their skills. Many other whitewater parks have been used extensively for instruction, and accommodate beginners and children. Figure 15 shows an instructional clinic at an REP-designed park in Colorado.



Figure 15 Beginner instruction at an REP Whitewater Park in Salida, CO

On-bank users will be able to take advantage of easy riverside access, improved trails for walking and jogging, as well as new terraced areas for lounging and spectating.

An additional design objective is ensuring that this whitewater project is ADA-friendly. This will include (but is not limited to) construction of paved access points, deflectors at the put-ins and take-outs, and paved trails. REP has worked closely with disabled river users to incorporate specific design elements into the access points and those elements will be included in this project.

Typically, whitewater parks are popular fishing areas due to the deep water habitat and aerated water. The drop structures create drops and pools providing excellent fish habitat in the summer and excellent overwinter habitat in the colder months. Currently, the area is commonly used for casting and drift practice by active fly fishermen, in addition to lure and bait fishing by more passive fishermen. The design incorporates a casting pool near the downstream end of the project to facilitate casting and drift techniques in a relatively controlled situation. In addition, bank terracing within the project caters to lure and bait fishermen by providing resting zones and increased access to prime fish holding water.

Design Elements

Bank and River Access Improvements

Several bank stability and river access improvements are included within the conceptual design. Access points are important for minimizing the impact of river usage, funneling users to specific areas, and providing safe access to the water. Multiple river access



points are proposed in this conceptual design. These access points provide public access for users parking at Riverside Park. It is anticipated that users will access from both sides of the river and all of the improvements will be on the west bank.

The first access point is strategically located just downstream of the Burlando Road Bridge to provide improved accessibility for users exiting the river at this location, plus it provides in-stream users the ability to warm-up prior to negotiating the drop structures. This access point includes a flat concrete pad near the water's edge for ADA access and provides links to the existing parking lot and the bankside trail continuing downstream.

An existing unimproved intermittent trail runs along the terrace near the west bank. REP proposes hardening this trail and creating a ten-foot wide concrete trail in its place. This trail would provide a stabilized ADA access with minimal-to-no maintenance. The trail would allow users easy access between the ingress/egress points along the bank.

Within the park, river access points are located near the wings of the structures. These points allow boaters, fishermen, and bank users the ability to access the river near the features. The areas between the access points will be restored to improve the degraded riparian zone on this bank, deter the public from accessing the river in these locations, and minimize trampling of existing and proposed vegetation.

The last proposed access point is downstream of Structure #5 on the west bank. This access point includes trails and terracing leading to the river. This point should be ADA accessible and REP anticipates it will be a focal point of the park. This access point would serve as a final take-out for in-stream park users and a place for beginners to practice their skills in tranquil, yet moving, water. All of these improvements are envisioned to be attractive, functional, permanent, and designed to blend with and improve the natural environment. Figure 16 shows an example of bank terracing and trail work completed by REP.



Figure 16. Before and after example of bank terracing and trail improvements in Salida, CO

Restoration and Vegetation Enhancement

A key aspect of the project is restoration of a highly degraded section of the west bank and enhancement of existing vegetation on the east bank. Because of the high volume of human use at this park, REP's experience with other busy parks will prove to be invaluable during design stages.

Our experience suggests that specific access points in the area of the wings of the structures are highly used and vegetation enhancement is not feasible in this area. These areas must be hardened to prevent increased erosion. The interstitial banks between structures should be planted with native riparian vegetation and preferably lower woody debris such as willows. These types of plants render the area unusable by humans. Split-rail wood fences ensure that new trails and trail-cutting do not occur. The buffer zones between the planted areas and the hardened wings should include planting pockets with higher overhead cover to provide both shading and cover for aquatic species, and areas usable by more athletic and adventuresome humans.

The east bank is currently vegetated with a mix of native and invasive species. In addition, the bank may be partially disturbed during construction activities. REP plans to work closely with regulatory agencies, the National Resource Conservation Service (NRCS) and other consultants to determine the most valuable alternatives for enhancing vegetation in this area. A stabilized climax vegetative boundary in this area provides significant environmental enhancement and an aesthetic background for users on the west bank viewing the project.

Feature Boulders (bouldering rocks)

Parks designed by REP tend to attract adventurous, athletic, curious, and outdoors-oriented people of all ages. To provide additional activities, attract diverse users, and dissipate high-use areas, REP promotes amenities such as feature boulders, picnic tables, park benches, courts, and adjacent local establishments. Feature boulders have proven to be a valuable asset in other parks and provide another amenity to attract park users.

In-Stream Improvements

The in-stream improvements include six drop structures, random boulders, boulder clusters, four ungrouted grade stabilization structures, and a minor deflector.

The six drop structures will be designed using REP’s experience with in-stream structures and the subtle geometric characteristics that have proven to create valuable features (See Figure 17). The structures are generally called “U” structures, which are typical REP whitewater structures that create waves or holes that cater to recreational and freestyle kayakers and fishermen. These structures are constructed using large, grouted rock anchored into the bed and bank of the river. The structures have a gradual slope to allow for fish passage. In addition, the deep pools downstream of “U” structures provide excellent habitat for fish, especially during spring and summer runs. Figure 18 shows examples of two typical “U” structures. Each feature will be constructed slightly different to create diverse wave, wave-hole, hole, and jet features. It is anticipated the structures will create valuable features for slalom and downriver training and racing, including eddies, complex pool currents, waves, jets, and pillows.



Figure 17: A state-of-the-art REP feature built in 2010



Figure 18. (top to bottom) A "U" structure designed for instruction in Salida, CO and freestyle kayakers utilizing another "U" structure in Steamboat Springs

Random boulders and random boulder clusters have been included primarily for habitat enhancement. The boulders provide deep habitat, seams and pools to create valuable feeding zones, velocity refuge zones, and associated gravel/cobble substrate conducive to macroinvertebrate production.

Although the thalweg of the channel is generally constrained by the west bank, the preliminary geomorphological analysis suggests the channel has historically braided in this area and it is likely the thalweg was further east at one time. The possibility of the channel doing an end run around and carving a new channel to the east necessitates grade stabilization structures to ensure the existing channel does not migrate. The structures should be ungrouted, placed relatively low, and finished with native vegetation to soften the aesthetics.

On the downstream end of the west pier on the Burlando Drive Road Bridge, the Conceptual Drawing shows a proposed minor deflector and associated pier stabilization. The minor deflector should provide minimal velocity vector deflection to enhance the eddy downstream of the bridge and facilitate ingress and egress to the river at this location.

Flat-Top Boulders in the eddy below Structure #5

Based on conversations with local fishermen and observations during the site visit, REP included two-foot diameter flat-top boulders in the eddy below Structure #5. These boulders are designed to provide aquatic habitat and stepping stones for fishermen and recreationists wishing to enter the river, but not fully submerge. The boulders provide a stable standing platform for casting practice and facilitate fly fishing. In addition, the boulders provide enhanced ingress and egress for in-stream users.

Floodplain Impacts

Most REP projects result in no negative upstream flood impact. It is standard engineering protocol to create a calibrated flood modeling study in order to ensure that there will be no rise in water surface elevations during 100-year flood events. Other techniques that may also be used to accommodate high flows include increasing the cross-sectional area, over-bank grading, and pool excavation. Similar whitewater improvement projects that have been built in the United States have required a floodplain analysis to ensure there will be no negative impact on the floodplain.

Accessibility

The project, as mentioned, is located within Riverside Park. Improved parking already exists at the location and there are facilities. However, access and infrastructure improvements will be required at the site due to increased use, as well as accommodations for ADA access.

Maintenance

In-stream improvements are virtually maintenance-free assuming they are designed and built correctly. During the design phase careful attention should be paid toward anchoring these structures well into the banks and beds of the river so that there is no possibility of failure. Regular inspections should be scheduled to evaluate any significant erosion during the first year and every year thereafter. Some parks require minor “tweaking” following the first significant flood event. Many projects of this type, in free-flowing rivers that experience high spring flows and flood flows, have proven these whitewater features to be structurally and hydraulically sound. Other free-flowing rivers experiencing powerful peak flows that have whitewater improvements on them are: the Truckee River in Nevada; the Arkansas, Yampa and Gunnison Rivers in Colorado; the Bear River in Wyoming; and the Clark’s Fork River in Montana. Trees, ice and woody debris will be passed in the course of normal flows, but should be removed if suspended during high-use times as they represent an immediate in-stream hazard.

Anticipated Use

Given the flow rates and weather at the site, it is expected the majority of boaters and fishermen will visit the park throughout the months of March through November. After the weather deteriorates, it is expected that in-stream use by paddlers will decrease, but bank use will continue.

Costs

See the attached cost estimate in Appendix 2. Normally, the bulk of this cost is in construction of in-channel improvements. In-stream drops and pools should be constructed, along with any related ingress/egress points, during low-flow periods. Many towns and cities have much of the required rock available at active work sites or in storage. Reduction in rock costs can have a significant impact on the total cost of the project.

Future Work

If the City decides to go forward with this project, future tasks include but are not necessarily limited to:

1. Preliminary Design
2. Detail Design
3. Flood/Fluid Modeling



4. Permit Applications
5. Construction and Bid Documents
6. Construction and Construction Inspections

It is recommended that the design team open a dialogue with related planning and government agencies as soon as possible following the decision to proceed, since it is imperative that these stakeholders be included in the design process.

Construction Priorities

The attached drawing includes multiple elements that should be constructed based on funding availability. REP recommends the elements are prioritized as follows:

- 1) Completion of Structures #1, #5, and #6, and associated bank improvements. The related bank terracing, pier stabilization, and trail access points should be included.
- 2) Completion of Structures #3 and #4, and associated bank improvements. The related bank terracing and trail access points should be included.
- 3) Completion of the ten-foot concrete trail.
- 4) Completion of Structure #2 and associated bank improvements. The bank terracing and trail access points should be included.
- 5) Completion of Feature Boulders.

Conclusion

Modifications to the Kern River at Kernville are feasible and recommended. The river is a valuable resource to adjacent communities, and could become even more valuable with the implementation of proposed improvements. The modifications outlined in this report would open the river to more recreational use and improve fish habitat through the reach while at the same time enhance the riparian vegetation and lessen the flood impacts.

REP has presented improvements at this site that include, but are not limited to, in-stream drop structures for whitewater and fishing recreation, trails and access improvements, enhancement of riparian vegetation, and feature boulders. These improvements are designed to provide a recreational amenity for in-stream and bank users alike.

Similar improvements have had enormous impacts on the quality of life and local economies of communities throughout the country. For example, our \$170,000 whitewater park in Golden, Colorado has had an estimated \$1.7 to 2 million per year influx to the local economy. Similar estimates have been made for our parks in



Breckenridge and Vail. Another project, a two-channel whitewater park on the Truckee River at Wingfield Island in Reno, Nevada, has transformed a neglected and denuded section of downtown into a revitalized urban greenway with walking paths, shaded riverside seating, and picnic areas all surrounded by world-class whitewater that has already hosted major national competitions.

Appendices

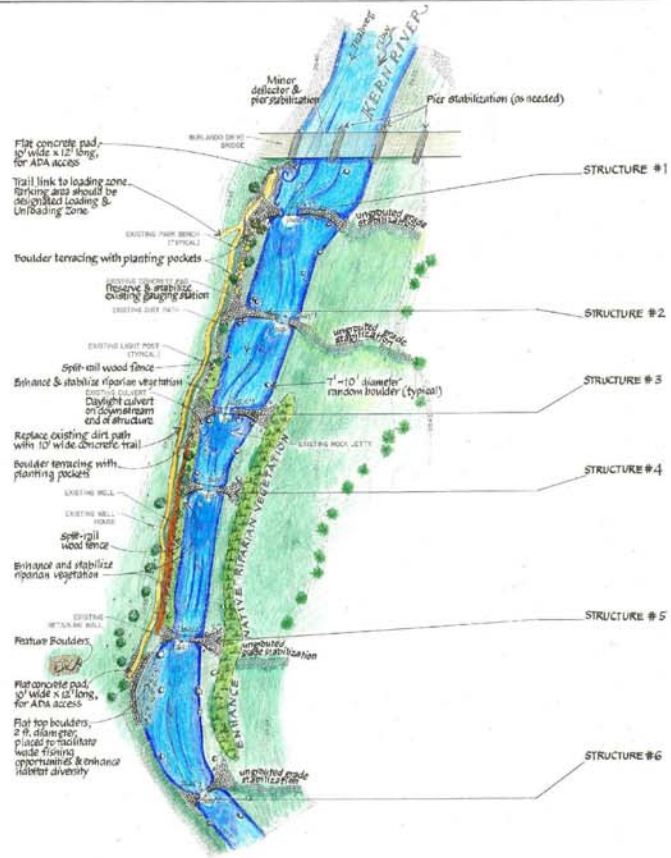
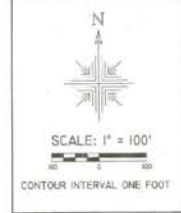
1) Conceptual Design

LEGEND

- EXISTING CONTOUR LINES
- THALWEG AND DIRECTION OF FLOW
- WATER SURFACE ELEVATION (DAY OF SURVEY)
- DAMAGE TO BANK

GENERAL NOTES:

1. ALL ELEVATIONS GIVEN IN FEET ABOVE SEA LEVEL (NAV 1929).
2. THE BATHYMETRIC SURVEY WAS COMPLETED ON JANUARY 8, 2011 BY DERRICK TITO SURVEYOR/HYDROLOGIST. THE MEAN FLOW ON THIS DAY WAS 750 CUBIC FEET PER SECOND. FLOW DATA WAS TAKEN FROM PUBLISHED DATA FOR THE DAILY OPERATION OF THE ISABELLA RESERVOIR, KERN RIVER, CALIFORNIA OPERATED BY THE US ARMY CORP OF ENGINEERS.
3. ADDITIONAL SURVEY DATA AND/OR INTEGRATION WITH EXISTING DATA WILL BE NECESSARY DURING MODELING AND FUTURE DESIGN PHASES.



CONCEPTUAL - NOT FOR CONSTRUCTION



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River Improvements Project

RIVERSIDE PARK Kernville, California

CLIENT:
KERN VALLEY RIVER COUNCIL

DESIGNED: SS, ARI
DRAFTED: AR, SS
CHECKED: SS, ARI
DATE: 15 FEBRUARY 2011
REVISIONS:

PAGE NUMBER
1





2) Cost Estimate

Whitewater and Habitat Improvements Project
Kern River
Kernville, California
Conceptual Cost Estimate
26-Apr-11

Item Number	Description	Estimated Quantity	Unit	Unit Price	Item Total Price
1	Mobilization to include costs for bonding, insurance, traffic control, staging, etc.; no measurement for payment shall be made of any of the work, materials and equipment used for mobilization.	1	L.S.	\$30,000	\$30,000
2	Water Control (will depend on permitting requirements)	1	L.S.	\$60,000	\$60,000
3	Structure #1- Upstream "U" Structure. Includes rock acquisition, excavation, placement, grouting (partial), backfill, pool excavation	1,050	cubic yards grouted rock (includes 300 non-grouted)	\$125	\$131,250
4	Structure #2- Downstream "U" Structure. Includes rock acquisition, excavation, placement, grouting, backfill, pool armoring	1,050	cubic yards grouted rock (includes 420 non-grouted)	\$125	\$131,250
5	Structure #3- Downstream "U" Structure. Includes rock acquisition, excavation, placement, grouting, backfill, pool armoring	910	cubic yards grouted rock	\$125	\$113,750
6	Structure #4- Downstream "U" Structure. Includes rock acquisition, excavation, placement, grouting, backfill, pool armoring	875	cubic yards grouted rock	\$125	\$109,375
7	Structure #5- Downstream "U" Structure. Includes rock acquisition, excavation, placement, grouting, backfill, pool armoring	950	cubic yards grouted rock	\$125	\$118,750
8	Structure #6- Downstream "U" Structure. Includes rock acquisition, excavation, placement, grouting, backfill, pool armoring	910	cubic yards grouted rock	\$125	\$113,750
9	UngROUTED Grade Stabilization Structures (count:2)	380	cubic yards rock	\$95	\$36,100
10	Large random boulders, 8' diameter	45	each	\$400	\$18,000
11	Small Random Boulders (2' diameter)	11	each	\$100	\$1,100
12	Pier Stabilization	450	cubic yards Class E riprap	\$65	\$29,250
13	Bank Terracing: Double Row of 2'-4' diameter Boulders	1,050	L.F.	\$75	\$78,750
14	Ten Foot Concrete Trails	1,300	L.F.	\$135	\$175,500
15	Four-foot high, split rail fence	350	L.F.	\$15	\$5,250
16	West Bank Landscaping and Restoration	14,000	S.F.	\$6	\$84,000
17	East Bank Landscaping and Restoration	23,100	S.F.	\$2	\$46,200
18	Miscellaneous equipment hours	250	hours	\$150	\$37,500
Subtotal					\$1,319,775

19	Design, permitting support, construction observations (estimate) ⁽¹⁾	12%			\$158,373
20	Contingency	20%			\$263,955
Total					\$1,742,103

General Notes:

- A) Cost estimates are provided for conceptual level planning and should not be used for construction.
- B) Assumes all rock is within a 20 mile radius. Rock acquisition and stockpiling costs vary from 30%-70%.

Notes:

- 1) These costs may vary depending on permitting requirements and other unforeseeable variable.