Removing Matilija Dam: Opportunities and Challenges for Ventura River Restoration

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ABSTRACT

The removal of Matilija Dam on a major tributary of the Ventura River presents an opportunity to achieve a number of community goals: restoring natural beach nourishment processes; restoring historic river related recreational opportunities; and re-establishing access to a significant portion of the steelhead spawning and rearing habitat within the Ventura River watershed.

Coastal beaches along Ventura County have experienced dramatic erosion as a result of the loss of natural sediment transport to the Ventura River marine delta, adversely affecting coastal development, nearshore habitats, and beach related recreational activities. Historic recreational uses of the Ventura River and access to Matilija Canyon located within the Los Padres National Forest have been curtailed as a result of the construction and operation of Matilija Dam as a water supply facility. Pre-dam estimates indicate that approximately 50% of the steelhead spawning and rearing habitat is located above the impassible Matilija Dam, contributing to the listing of southern California steelhead as a federally endangered species in 1997.

A major challenge to the removal of Matilija Dam is the management of approximately 6 million cubic yards of sediment impounded upstream of the facility. A variety of options have been identified for the removal of this sediment. Because none of the sediment management alternatives is free of environmental constraints or economic and societal costs, some combination of these options may provide the best strategy to minimize adverse impacts and costs, and maximize benefits within an acceptable time-frame to achieve community goals.

Introduction

Matilija dam is located on Matilija Creek, a tributary to the Ventura River, approximately 18 miles inland from the coast near the City of Ojai, and lies within the Los Padres National Forest (Ventura County, California). Matilija Dam was constructed in 1946 by the Ventura County Flood Control District (now the Ventura County Watershed Protection District), principally for local water supply and incidental flood control. Matilija Dam is currently leased to the Casitas Municipal Water District and operated in conjunction with the Robles Diversion on the mainstem of the upper Ventura River and the Casitas Dam on Coyote Creek, a tributary to the lower Ventura River. Matilija Dam

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is a concrete arch structure, approximately 200 feet high, over 600 feet wide, and a thickness varying from 50 feet at the base to 8 feet at the crest. The Matilija reservoir originally stored approximately 7,000 acre-feet of water, but is now 90% filled with 6 million cubic yards of sediments. (Brauner, 1998; U.S. Bureau of Reclamation, 1999, 2000)

Figure 1. Regional Setting of Matilija Dam and Ventura River

The Ventura River watershed encompasses 228 square miles of predominantly mountainous terrain. The principal geological formations are composed of recently uplifted, unconsolidated marine sediments, which are highly erosive. The processes of erosion are accelerated by periodic wildfires that denude the chaparral covered rock formations, exposing these formations to short duration but intense rainfall and runoff which in some circumstances can produce large debris flows.

Because of the high sediment load carried by the Ventura River during flood events, a distinct marine delta has formed at its mouth. This delta supports a coastal estuary which provides important habitat for a wide variety of migratory birds, and several federal and state listed endangered species, such as the Least tern, Western snowy plover, Tidewater goby, and the Southern steelhead. The upper portion of the Ventura River estuary is part of the California Department of Parks and Recreation's Emma Wood Sate Beach, while the lower portion and river mouth are part of the City of San Buenaventura's Seaside Wilderness Park (Capelli, 1997, 1999; Casitas Municipal Water District, et al., 1997; Ferren et al. 1990; Hunt, et al. 1992).

The Ventura River marine delta has been bisected by a major flood control levee and the eastern half developed with a variety of residential, commercial, industrial and recreational facilities within the City of San Buenaventura. The shoreline immediately downcoast of the mouth of the Ventura River has experienced severe coastal erosion as a result of the reduction of littoral sediments caused by the two major impoundments (Matilija Dam and Casitas Dam) in the watershed. (Noble Consultants, 1989; U.S. Army Corps of Engineers, 1997; Thompson, 1994) Portions of the lower Ventura River floodplain has been leveed on the east and west and developed with a variety of industrial, residential and recreational facilities. The upper portion of the watershed lies within the Los Padres National Forest, and with the notable exception of the City of Ojai (within the San Antonio Creek watershed), remains largely undeveloped.

Figure 2. Ventura River Marine Delta, looking northwest

In 1999, the County of Ventura proposed removing Matilija Dam in anticipation of the complete sedimentation of the reservoir, and expiration of the lease agreement in 2009 between the County and the Casitas Municipal Water District. The County of Ventura, along with the Ventura County Watershed Protection District, requested the U.S. Bureau of Reclamation and the U.S. Army Corps of Engineers to conduct an Appraisal Level Study and Preliminary Environment Impact Analysis of the removal of the Matilija Dam. Both preliminary assessments identified management of the sediment stored behind Matilija Dam as the major challenge to the dam's removal. (U.S. Bureau of Reclamation, 1999) While Matilija Dam has been notched several times to address deteriorating

concrete near its crest, these modifications have not lowered the level of the dam to the level of stored sediments. Further notching, however, would expose these sediments to the hydraulic action of Matilija Creek, and therefore requires consideration of the deliberate management of these mobilized sediments. (Gray, 1999)

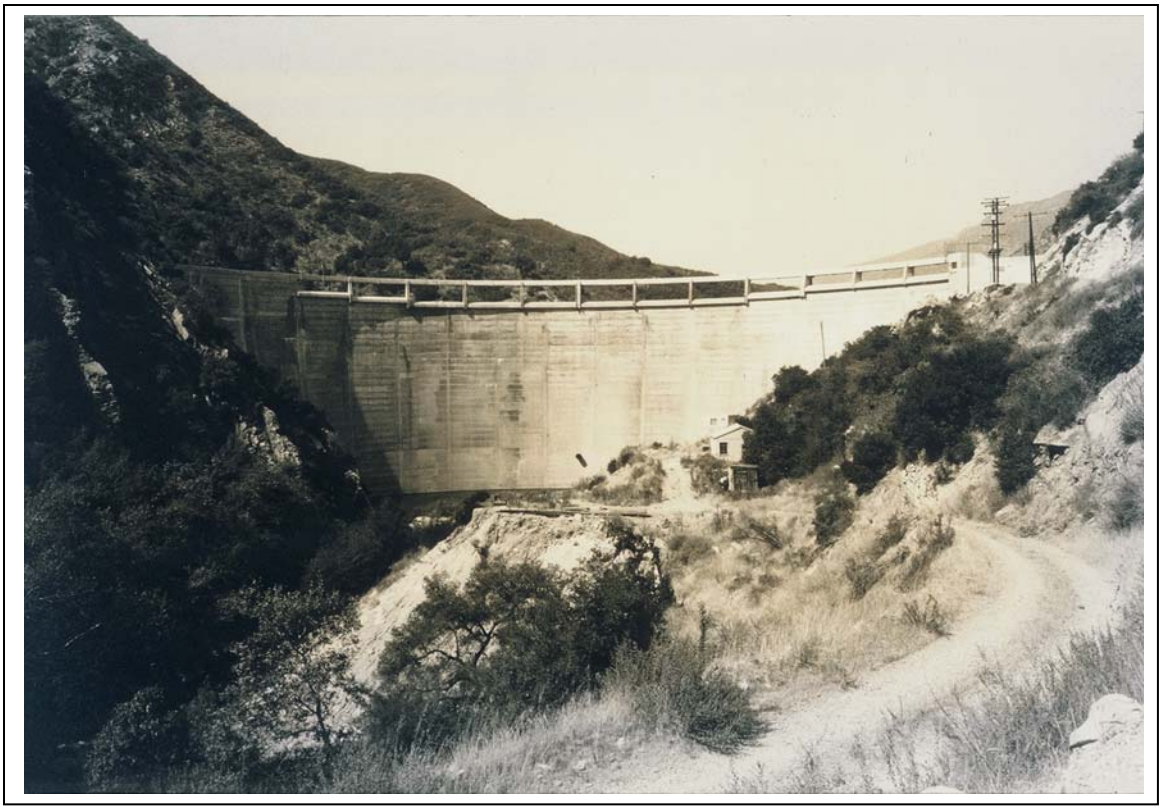

Figure 3. Matilija Dam circa 1948

The uncontrolled release of stored sediment following the removal of the Matilija Dam has the potential to adversely impact a number of natural riverine and coastal resources as well as roads, bridges, flood control structures, and residential properties along the Ventura River floodplain. Additionally, the elevation of sediment levels in the mainstem of the Ventura River could adversely affect the operation of major water supply facilities such as the Casitas Municipal Water District's Robles Diversion, which accounts for almost half of the water annually diverted and stored in the Casitas Reservoir, as well as the City of San Buenaventura's well-field and surface diversion facilities on the lower mainstem of the Ventura River. Some of these identified impacts would be relatively short-term, but others could be longer-term, and present unacceptable threats to either life or property, if not adequately addressed through design or mitigation measures. (U.S. Bureau of Reclamation, 1999, 2000; U.S. Army Corps of Engineers, 2003)

Coastal Beach Restoration

The sand beaches of Ventura County are naturally maintained by the transport of inland sediments to the coast via coastal river systems. Estimates of sediment transport rates for

coastal beaches along the south coast of Ventura County vary widely between 295,000 and 497,000 cubic yards per year. The amount of sediment annually contributed by the Ventura River before the construction of Matilija Dam has been estimated between 213,000 and 230,000 cubic yards. The construction of Matilija Dam in 1946 effectively trapped the majority of sediments originating from the upper watershed, and reduced the transport capacity of the river to transport sediments entering the system from downstream tributaries. The construction of Casitas Dam in 1958 further reduced sediment transport and delivery to the mainstem of the Ventura River and ultimately to the coast. The current annual sediment contribution of the Ventura River to littoral sediment transport is estimated at between 56,000 and 100,000 cubic yards. (Bailard, 1999; Brownlie and Taylor, 1981; Fall, 1981; U.S. Bureau of Reclamation, 2000; U.S. Geological Survey, 1988)

Figure 4. San Buenaventura coastline and lower Ventura River Valley (upper left)

As a result of these developments beaches downcoast of the Ventura River have experienced rapid erosion and retreat, eliminating coastal dune habitat, as well as recreational sand beaches. This impact has been partly off-set by the construction of a series of groins, but the beaches near the mouth of the river continue to experience significant coastal retreat. The removal of Matilija Dam and the remobilization of sediments stored in the reservoir would re-introduce stored sediments to the coast, and partly restore the natural sediment transport capacity of the Ventura River system. The removal of Matilija Dam therefore has the potential to rejuvenate coastal beaches with a portion of the 6 million cubic yards of sediment stored in the reservoir site

(approximately half of which is sand or gravel sized sediments), as well as to restore an estimated 16 percent of the pre-dam background sediment transport to the coast. Restoration of this sediment transport function is essential to the maintenance of the Ventura River Estuary and related coastal and nearshore habitats. (Capelli, 1991; Ferren, Jr., et al. 1990; Moffat & Nichols, 2003; Noble Consultants, 1989; Thompson, 1994)

Recreational Opportunities

Matilija Canyon has been an important recreational and tourist destination since the late 1800's with the commercial development of the natural hot springs at the dam site, and a trail system through the Los Padres National Forest in the 1930s. The original 460 acre site encompassing the dam and reservoir and the short reach of Matilija Creek immediately below the dam were purchased by the former Ventura County Flood Control District for construction of the Matilija Dam project in the 1940's. The reservoir and small public day-use recreational facilities immediately below Matilija Dam provided outdoor recreational opportunities until the lake was closed to public access in 1958, and the County owned recreational facilities were sold to private interests.

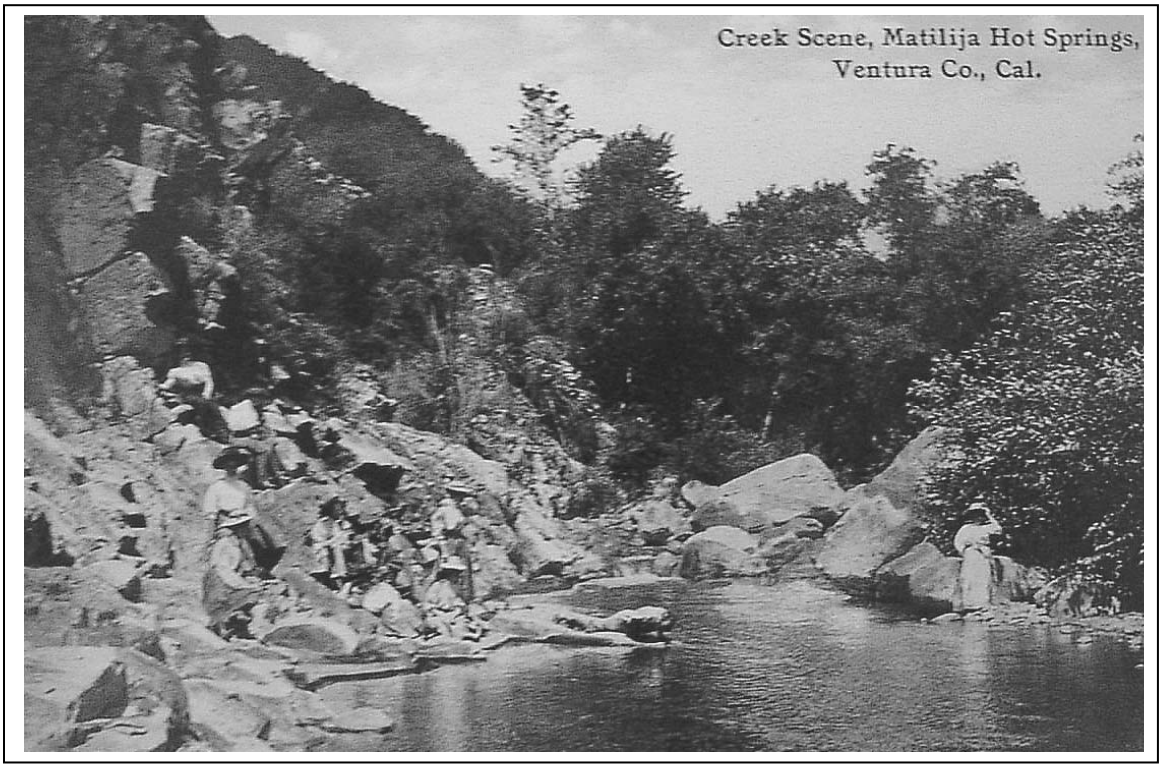

Figure 5. Matilija Canyon Recreations, late 1800s

The upper Matilija Canyon remains open to public access, and portions are currently proposed for inclusion in the federal Wild and Scenic Rivers Program. However, general public access to the lower Matilija Canyon is prohibited. Removal of Matilija Dam and the re-acquisition of the short reach of privately held property immediately below

Matilija Dam would allow for the re-establishment of public access to lower Matilija Canyon, and the development of outdoor recreational and interpretive facilities; it also has the potential to create a link between the existing multi-use Ventura River and Ojai trails which currently extend from the mouth of the Ventura River to the City of Ojai, thus providing a unique coast-to-mountains trail system.

Steelhead Restoration

Prior to the constructing of Matilija Dam in 1946 the Ventura River system supported one of the largest and most consistent runs of steelhead trout in Southern California; this run was estimated to between 4,000 and 5,000 adult fish annually. This run of adult fish, and the juveniles which occupied the mainstem and major tributaries, supported an important winter and summer sport fishery valued at the time at $100,000 per year. The remnant steelhead run was further diminished by the construction in 1958 of Casitas Dam on Coyote Creek (the other major spawning tributary of the Ventura River) and the Robles Diversion on the mainstem of the Ventura River, which eliminated access to the upper Ventura River and North Fork of Matilija Creek. (Capelli, 1999; McEwan and Jackson, 1996; Meyer Resources, 1988)

Figure 6. Ventura River Steelhead, 1919

The elimination of access to spawning habitat characterized by year-round surface flows with suitable water temperature and rearing conditions for juvenile steelhead has been one of the principal causes for the sharp decline and near extinction of steelhead in Southern California. Construction of water supply facilities have also reduced the magnitude and duration of winter high flows which serve as cues to adult steelhead entering coastal river systems, and provide the necessary medium for migration to spawning and rearing areas; additionally reduction of winter and spring flows reduces the opportunity of juvenile steelhead (smolts) to emigrate to the ocean and complete their growth and sexual maturation before returning to their natal streams to complete their life-cycle. (Capelli, 1999; McEwan and Jackson, 1996)

The construction of Matilija Dam cutoff one of the principal spawning and rearing tributaries in the Ventura River system, estimated to account for over half of the spawning and rearing habitat in the system, and resulted in the virtual elimination of the steelhead run, and the related recreational fishery. Removal of Matilija Dam, in conjunction with the recent provision of fish passage at the downstream Robles Diversion, would re-establish access to one of the prime steelhead spawning and rearing habitats in the headwaters of Matilija Canyon, and contribute significantly to the restoration of the historic steelhead runs of the Ventura River system.

Sediment Management

The management of sediment stored behind Matilija Dam has been the single biggest factor shaping the dam removal project. After consideration of various options for dealing with the stored sediments, a tentative preferred alternative has been developed which incorporates a combination of sediment management options, and would result in the full removal of the dam structure and the phased transport of the stored sediments out of Matilija Canyon and eventually back to the riverine and coastal environment.

The basic components which have been included in this alternative include the following:

1. Removal of Matilija Dam in single phase;

2. Surrying approximately 2.1 million cubic of fine sediments downstream to a temporary disposal site;

3. Excavation of a 100-foot wide channel through the coarse sediments and temporarily stock-piling this material within the reservoir site;

4. Temporary stabilization of the coarse sediments to permit their phased erosion and transport through the natural channel to the coast;

5. Installation of a high-flow sediment bypass at the Robles Diversion to allow mobilized coarse sediments to be transported downstream of the diversion facilities;

6. Installation of a temporary fine-sediment catchment basin with a capacity of approximately 22 acre feet along the Robles-Casitas Diversion Canal;

7. Enlargement of several existing flood control levels along the mainstem of the Ventura River to off-set any temporary reduction in channel capacity as the result of natural transport of coarse sediments stored behind Matilija Dam;

8. Retrofitting of several bridges to accommodate increased flood flow elevations;

9. Acquisition of selected properties immediately downstream of Matilija dam for use as project staging and public access.

The principal goal of this combination of components is to deliver the stored coarse sediments to the mainstem of the Ventura River and eventually to the coastal beaches in a manner which reduces the potential adverse impacts to downstream infrastructure (principally water supply and transportation facilities) and developed properties. Eventual removal of the sediments stored behind Matilija Dam will also result in restoration of the pre-dam riverine geomorphology of the reservoir site and restoration of the ecological functions of the riverine, riparian, and floodplain terrace habitats of Matilija Canyon (extending approximately one mile upstream of the dam) that are now inundated with sediments.

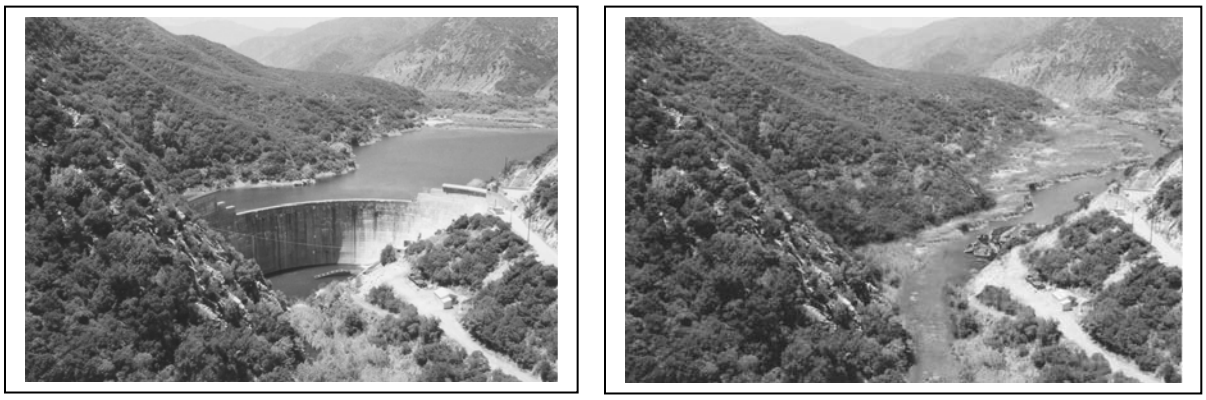

Figure 7. Projected geomorphology of Matilija Canyon after removal of Matilija Dam

Discussion

The physical removal of Matilija Dam can be accomplished by using relatively straightforward construction techniques for cutting, blasting, decomposing, and removing concrete. However, the removal and disposal of the large amount of sediment stored behind the dam has complicated the planning and removal of Matilija Dam. The stored sediments consist of native sedimentary materials, ranging is size from silts and clays to larger sandstone boulders. Because these materials would have been naturally transported to the coast in the absence of the dam, and therefore contributed to the maintenance of beaches, there is considerable interest in using the stored sediments for beach nourishment, as well as restoration of downstream riverine and coastal habitats.

An accurate estimate of the total volume of stored sediments, as well as the relative amount of sediment sizes, has been developed for the Matilija reservoir. Additionally, the presence of contaminants (including organic materials) in the sedimentary material stored behind the dam has been investigated, with no significant contaminants detected. Aside from the detailed design of the various infrastructure modifications, the two outstanding planning issues which remain to be further explored are the response of the stored sediments to hydraulic forces created by the removal of the dam, and the transport of mobilized sediments downstream to the coast. Preliminary modeling of the latter has been performed, but a geomorphologic analysis of the former remains to be completed. Only through the successful management of the estimated 6 million cubic yards of sediments stored behind Matilija Dam can the three basic community objectives (restoring natural beach nourishment processes, restoring historic recreational opportunities in Matilija Canyon, and re-establishing steelhead spawning and rearing access) be fully realized.

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