US Army Corps
of Engineers ®
Los Angeles District

SECTION 216
REVIEW OF COMPLETED PROJECTS

DRAFT INITIAL APPRAISAL REPORT
VENTURA RIVER 1 LEVEE (VR-1)
VENTURA COUNTY, CALIFORNIA

LOS ANGELES DISTRICT
U.S. ARMY CORPS OF ENGINEERS

AUGUST 2013

SECTION 216
REVIEW OF COMPLETED PROJECTS

Draft Initial Appraisal
Ventura River 1 Levee (VR-1)
Ventura County, California

1. Introduction

The Ventura River Levee project in Ventura County, California, was constructed by the US Army Corps of Engineers in 1948. There is evidence that portions of the project are showing deficiencies per an evaluation of the existing levee for Federal Emergency Management Agency (FEMA) levee certification. This evaluation provides the impetus for studying requested changes to the existing Ventura River Levee project. This is consistent with the general policy of the U.S. Army Corps of Engineers (Corps) that completed projects be observed and monitored to ascertain whether they continue to function as intended and whether there is a potential for modifications to better serve the public interest.

The project area is located within San Buenaventura (Ventura), California, along the Ventura River. Figure 1 shows the Ventura River Watershed, with the study area outlined at the bottom center. Figure 2 is an aerial photograph showing the levee alignment from the Pacific Ocean to the Canada de San Joaquin.

2. Study Authority

This initial appraisal is authorized by Section 216 of the Flood Control Act of 1970 (Public Law 91-611) as amended, which reads:

"The Secretary of the Army, acting through the Chief of Engineers, is authorized to review the operation of projects the construction of which has been completed and which were constructed by the Corps of Engineers in the interest of navigation, flood control, water supply, and related purposes, when found advisable due to significantly changed physical or economic conditions, and to report thereon to Congress with recommendations on the advisability of modifying the structures or their operation, and for improving the quality of the environment in the overall public interest."

The Section 216 process starts with the preparation of an initial appraisal. This initial appraisal has been completed by the Ventura County Watershed Protection District and has been provided to the Corps for its consideration.

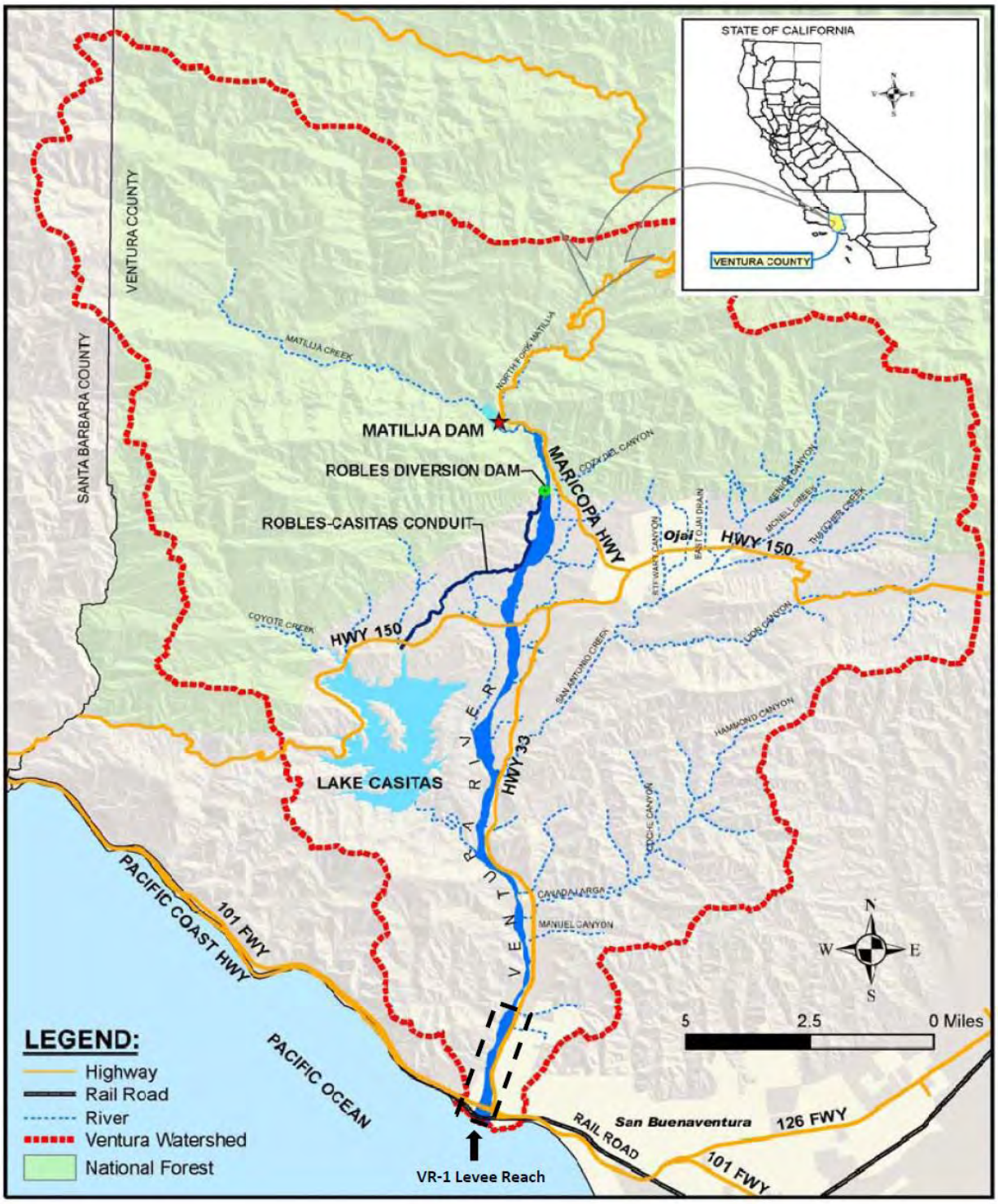

Figure 1: Ventura River Watershed. (Matilija Dam Ecosystem Restoration Feasibility Report, USACE 2004)

Figure 2: Location Map for Ventura River Levee (VR-1)

3. Authorized Project

a. Name of Completed Project: Ventura River, Ventura County, California.

b. Authorized Purpose: Section 10 of the Flood Control Act of 1944 authorized the project in accordance with recommendations of the Chief of Engineers Report in House Document No 323, 77th Congress, 1st Session, for local flood protection.

c. Date Constructed: The project was constructed between April 2 and December 31, 1948.

d. Non-Federal Project Sponsor: Ventura County, California.

e. Project Location and Description: The project is located on the Ventura River in San Buenaventura, California, which is approximately 60 miles northwest of Los Angeles. The completed project includes a levee for flood risk management along the east bank of the lower Ventura River and a debris basin and channel in Stewart Canyon to protect the city of Ojai.

The 2.65-mile-long earthen levee extends from the Pacific Ocean to the Canada de San Joaquin. It has 1-foot-thick grouted-stone slope protection on its riverward face upstream of Main Street and loose riprap revetment from downstream of Main Street to the Pacific Ocean. The levee was completed by the Corps in December 1948.

The Stewart Canyon Debris Basin and channel—approximately 12 miles upstream of the 2.65-mile-long earthen levee—was constructed by the Corps in January 1963. It consists of a 40-foot-high earth-filled embankment debris basin with a storage capacity of 300,000 cubic yards, along with a 4,500-foot-long box and open rectangular concrete-lined channel that extends from the basin through Ojai to a natural channel south of the city.

The 2.65-mile-long Ventura River Levee is the only portion of the project under review in this initial appraisal.

4. Study Purpose

The purpose of this initial appraisal is to determine whether there is a potential federal interest to undertake modifications to the existing Ventura River Levee, which is designated as VR-1. It includes the 2.65 miles of levee extending from the Pacific Ocean to the Canada de San Joaquin.

This Initial Appraisal is based on the review of existing, readily available information. The results of this appraisal will be used to determine whether the identified problems warrant a Reconnaissance Study under the Section 216 authority.

5. Review of Existing Studies

Ventura River 1 Levee (VR-1), Ventura County, California, Periodic Inspection Report No. 1, Submitted: June 2011. Under the Corps' Levee Safety Program, periodic inspections of levee systems are conducted to verify proper operation and maintenance; evaluate operational adequacy and structural ability; identify features to monitor over time; and improve the ability to communicate the overall condition and safety of the levee system. In 2010, the Corps performed a periodic inspection on the VR-1 system. This report presents the findings of the inspection and the final Corps rating for the VR-1 system as "minimally acceptable."

FEMA Levee Certification: Ventura County, California, Ventura River Levee (VR-1), Pacific Ocean to Canada de San Joaquin, Evaluation Report, February 20, 2009. As part of the nationwide effort to certify all existing flood control levees, FEMA has identified existing levee facilities within Ventura County. FEMA has requested that the Ventura County Watershed Protection District evaluate VR-1 and prepare documents for the certification process, based on FEMA's regulatory requirements as identified in Title 44 of the Code of Federal Regulations, Section 65.10 (44 CFR 6510). Based on the review of existing data and observations during the field investigation, this evaluation report recommended that the VR-1 system be classified as a Category 3 levee. A Category 3 levee does not meet the regulatory requirements (44 CFR 65.10).

Matilija Dam Ecosystem Restoration Feasibility Study, U.S. Army Corps of Engineers, Los Angeles District, September 2004. This feasibility study focused on ecosystem restoration in the Ventura River Watershed to benefit native fish and wildlife of the Ventura River and Matilija Creek in the vicinity of the Matilija Dam. It proposed improvements to the natural hydrologic and sediment transport regime to support the replenishment of coastal beach sand from the Ventura River. The recommended plan includes removal of the dam, with most of the deposited reservoir sediments removed by slurry line to a downstream disposal site and the remaining sediments contoured to restore a fish-passage channel. The restoration of the river to pre-dam conditions will increase the risk of flooding for infrastructure developed along the river corridor after the construction of the Matilija Dam. The recommended plan includes (1) features for mitigating the increased flood risk due to the removal of the structures, (2) replacing a bridge, and (3) raising and extending some downstream levees. The plan does not include VR-1, but it does include several other upstream levee systems.

Ventura River Basin, California, Flood Control, Operation and Maintenance Manual for Ventura River Levee, Ventura River Improvement, U.S. Army Corps of Engineers, Los Angeles District, January 1963. This operation and maintenance (O&M) manual includes the original O&M requirements, dated May 1949, as well as updates. The manual applies to project works along the left bank of the Ventura River from the Pacific Ocean to the Canada de San Joaquin, including the levee and all side-drainage structures. It describes the O&M requirements, regulations, and flood-fighting recommendations.

6. Problems and Opportunities

Problems

The Ventura River Levee was evaluated as indicated in the 2009 levee evaluation report described in Section 5. The levee evaluation identified several issues related to the levee that must be addressed to obtain certification. The most significant issues are deficient toedown protection and encroachments on the landward side embankment upstream of the ocean outlet and upstream of Main Street. There are also areas along the levee where vegetation (trees and shrubs) has grown within 15 feet of the levee toe and requires removal.

Embankment Protection. The 1949 as-built plans show that a minimum of 8 feet of toedown was provided when the levee was constructed. A preliminary evaluation of the levee system's current top, toe, toedown, and river thalweg has been performed, and field investigations have identified several locations where the levee embankment has been adversely affected and requires restoration/mitigation.

Additional concerns associated with the toedown include the following:

- Approximately 1.4 miles of the Ventura River thalweg along VR-1, from Station 64+00 to Station 138+50, is either below or very close to the existing levee toedown. There are no geological features, such as bedrock, or manmade feature, such as rock groins, that would prevent the thalweg from migrating toward the levee and undermining the toedown. Therefore, in its current condition, VR-1 has a reasonable potential for failure due to toedown undermining during major flood events.

- From approximately levee Station 119+00 to Station 124+00, the river channel along VR-1 has eroded near the levee structure. There is a high potential for undermining of the levee at this location.

- From Station 39+80 to Station 46+24, modifications to the landside slope of VR-1 that have been made over time, such as undercutting and construction of retaining structures, have potentially resulted in adverse effects on the stability of the slope.

- At Station 35+33, the adjacent landside slope along VR-1 has been subjected to heavy erosion. In some areas on the embankment slope, the ungrouted riprap is not visible, because it is either missing or buried beneath soil/debris.

- The maintenance road is failing near VR-1 Station 121+00.

- There are concerns about whether the riprap revetment is adequate to protect VR-1 because of undermining of the levee toe and the potential for direct, high-angled flow impingement at unpredictable future locations.

The Matilija Dam feasibility study and associated reports describe the fluvial geomorphologic characteristics of the Ventura River, including results of the analysis of erosion rates along the river. These reports describe Reach 2 (river mile [RM] 0.6 to RM 5.95) as having experienced the most erosion of any reach of the river. The VR-1 study area is within Reach 2 (RM 0.05 to RM 2.37), as described in these reports. The feasibility study refers to surveys that found that since 1971, the active channel has degraded at RM 3 by as much as 16 feet. This is consistent with the degradation of the channel and the loss of toedown since the construction of VR-1.

Physical Changes to the Watershed: Since the time that VR-1 was first planned (1941) and constructed (1948), there have been changes to the watershed, including the construction of dams and debris basins within the watershed. Although population growth and urban development have occurred in the past 60 years, most of the land within the watershed remains open space.

Large manmade features affecting the watershed include the following dams and debris basins. Figure 3 depicts locations of structures throughout the watershed.

- Matilija Dam, built in 1948
- Casitas Dam, built in 1959
- Robles Diversion Dam, built in 1958
- McDonald Detention Basin, built in 1998
- San Antonio Creek Debris Basin, built in 1986
- Stewart Canyon Debris Basin, built in 1963
- Dent Debris Basin, built in 1950, modified in 1981

The draft report *Hydrology, Hydraulics, and Sediment Studies for the Matilija Dam Ecosystem Restoration Project, Ventura, California* by the Bureau of Reclamation describes potential causes of erosion within the channel. The listed causes include shift from a dry to wet period since 1969 and trapping of sediment associated with the Matilija and Casitas Dams and the Robles Diversion Dam. The report suggests that the wet cycle is likely the largest factor, but that sediments removed by the dams are also likely contributing to channel degradation, especially in the upstream reaches.

Historical disruption of system-wide sediment continuity has occurred along the Ventura River that, over time, has had a significant impact on the fluvial geomorphology of VR-1. What was historically a braided channel system, created by an over-abundance of sediments emanating from upstream steep-sloped mountainous regions was abruptly modified by significant downstream sediment depletion initiated after the construction of the Matilija Dam in 1947. This sediment depletion was further exacerbated by the subsequent construction of the Robles Diversion Dam (1958), the Casitas Dam in 1959, and several small debris basins, as well as ongoing watershed urbanization that has occurred in the upstream contributing watershed areas of the Ventura River during the past 65 years. The downstream depletion of sediment supply, in turn, has led to degradation of the stream channel, which has created a more pronounced, higher-capacity

primary flow channel that conveys ordinary flows more in the center and on the west side of the Ventura River, partly due to flow confinement on the east by VR-1.

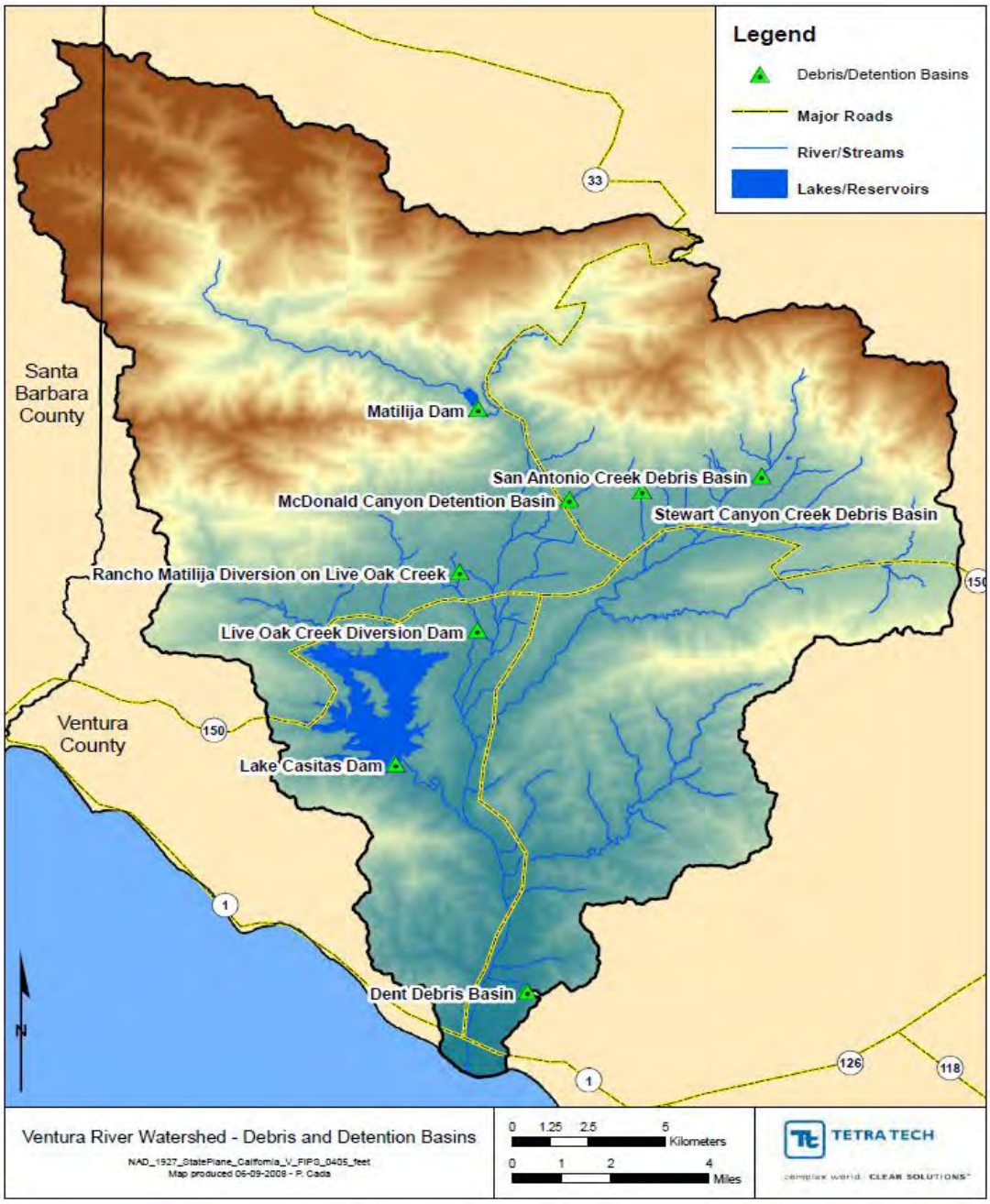

Figure 3: Dams and Debris Basins within the Ventura River Watershed

In addition, this pronounced, higher-capacity primary flow channel has developed a more defined inner thread (low-flow thalweg) that meanders in a gradual fashion inside the primary flow channel, exacerbating the unanticipated scour problems. Furthermore, the depletion of the upstream sediment supply, which has led to long-term channel degradation (i.e., channel deepening), has also coarsened the in-situ distribution of

streambed sediments to some extent, thereby increasing the tendency of the low-flow channel to meander within the primary channel of the Ventura River. In addition, due to a reduction in flood magnitude and sediment supply, created by upstream flood-control impoundments and watershed urbanization, respectively, a significant increase in both in-channel and near-channel riparian growth has occurred, which to some extent has tempered the meandering of the low-flow thalweg.

During both ordinary and extraordinary flow events, a wandering low-flow channel will create a highly non-uniform flow distribution along VR-1, which in turn will increase the potential for the initiation of high-angled flow impingements against the levees at various locations along the system, such as those that occurred in 1945 before the presence of the extensive flood-control works and the current urbanization within the upstream watershed areas. As stated above, these altered flow conditions have, over the past 65 years, undoubtedly led to greater than originally anticipated channel degradation at the toe of VR-1.

Future Watershed Change*:* In the future, once the planned removal of Matilija Dam has occurred, the system-wide sediment continuity will again be disrupted because historical rates of sediment supply will be partially restored to the system, and the pronounced single-channel geometry that currently exists along VR-1 will attempt to partially reverse its ongoing degradational trend. In fact, the Ventura River as a whole will likely attempt to return to its historical flow profiles (i.e., more like the braided flow conditions that existed before the Matilija Dam and other flood-retarding structures were constructed in the Ventura River watershed). However, past (and future) manmade "improvements" along the VR-1 levee will likely arrest the tendency of the river to braid to historical proportions. Consequently, the sediments transported from the upstream watershed areas will likely be deposited in the channel. The sediment deposits will both lower the flood-carrying capacity of the channel and create bars and islands that will likely create multiple low-flow thalwegs, like those that existed in 1945, thereby increasing the potential for high-angled flow impingement along VR-1. In order to mitigate this potential condition, it is necessary to predict, with reasonable certainty, site-specific locations where the braiding and high-angled impingements will affect VR-1; however, no one can predict, with any real accuracy, where these problems might occur in the future.

Vegetation and Encroachments.: At several areas along the levee, unwanted vegetation and encroachments have been identified within 15 feet of the levee toe, including vegetation on both the riverward and landward sides of the levee and landscaping, fencing, and outbuildings on the landward side. The Ventura County Watershed Protection District has been unable to implement certain maintenance improvements due to permitting and environmental constraints. However, these locations need to be repaired or remediated in order for the levee system to meet the levee certification criteria established by the Corps and FEMA and to be in compliance as a fully operational levee system.

Opportunities

There are opportunities to increase public safety, while addressing the issues identified for the levee system in its current condition with minimal toedown. This may result in reduced risk to lives and properties currently protected by the levee.

As part of the levee certification process Ventura County has estimated that the VR-1 levee currently protects approximately $38,950,170 of property and improvements and prevents $8,560,728 of flood damages[1]. Failure of the levee could result in millions of dollars of urban infrastructure and commercial/residential property losses, not to mention the potential for significant loss of life—particularly if a portion of the levee were to collapse suddenly during the night.

7. Preliminary Alternatives

The following preliminary alternatives are recommended for consideration at this time. Due to the limited nature of this initial appraisal and the use of only existing information, these alternatives have not been developed in detail but are presented for use in making the federal interest determination.

- Extending the toe of the levee protection deeper
- Driving sheet piles to deepen the levee protection
- Adding launch stone to the existing toe of the levee protection
- Removing vegetation and preventing encroachment

8. Recommendation

On the basis of the changed conditions within the watershed, the potential for increasing public safety, and the continued provision of flood risk management benefits, there is sufficient reason to further investigate the feasibility of modifying the levee to better serve the public interest by continuing with the preparation of a Reconnaissance Report. If a determination is made that there is a federal interest, a feasibility-level report should be initiated to analyze alternatives for addressing the identified problems by means of modifications to the project.

[1] http://www.vcwatershed.com/levee/vr1_main.html