



**Ventura County  
Watershed Protection District**

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**FEMA Levee Certification  
Ventura County, California**

**Calleguas Creek Levee and Somis Drain Floodwall (CC-2)  
Mission Oaks Boulevard to Adolfo Road**

**Evaluation Report**

February 13, 2009



**TETRA TECH, INC.**

17770 Cartwright Road, Suite 500  
Irvine, California 92614

# **FEMA Levee Certification**

## **Ventura County, California**

### **Calleguas Creek Levee and Somis Drain Floodwall (CC-2) Mission Oaks Boulevard to Adolfo Road**

#### **Evaluation Report**

February 2009

Prepared for:

**Ventura County  
Watershed Protection District**

Prepared by:

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## Executive Summary

As nation-wide efforts to certify all the existing flood control levees, FEMA has identified existing levee facilities within Ventura County. As part of this effort FEMA has requested the Ventura County Watershed Protection District (District) to evaluate the Calleguas Creek Levee and Somis Drain Floodwall (CC-2) and prepare documents for the certification process based on FEMA's regulatory requirements as identified in Title 44 of the Code of Federal Regulations (CFR), Section 65.10 (44 CFR 65.10).

Certification Criteria are as follows:

- Design criteria (freeboard, closures, embankment protection, embankment and foundation stability, settlement, and interior drainage)
- Operation plans and criteria (for closures and interior drainage)
- Maintenance plans and criteria
- Actual certification requirements (i.e. as-builts, forms, documentation, and data)

As part of the Phase 1 process, Tetra Tech was contracted by the District to evaluate the CC-2 levee system and to recommend a levee categorization to facilitate the levee certification.

Levee Categorizations are as follows:

- Category 1 – Levees meet 44 CFR 65.10 requirements and all data or complete documentation is available
- Category 2 – Levees may meet 44 CFR 65.10, but additional data or documentation is needed
- Category 3 – Levees do not currently meet 44 CFR 65.10
- Not a Levee – Based on physical conditions, low WSEL, no SFHA, and/or not providing flood protection

A levee that is assigned a Category 1 or 2 ratings will be further evaluated in the Phase 2 or 3 processes, respectively, in order to finalize its certification status. A levee that is assigned a Category 3 rating will require a Pre-Design Study in the Phase 4 process and implementation of the required improvements to achieve certification status.

Data collection efforts have been performed to determine what information is available in support of levee certification. Existing information collected and reviewed at the time of preparation of this report includes the following:

- Hydrologic Analysis
- LiDAR Topographic data
- As-built Plans
- Operation and Maintenance Manual
- Inspection/Maintenance Records

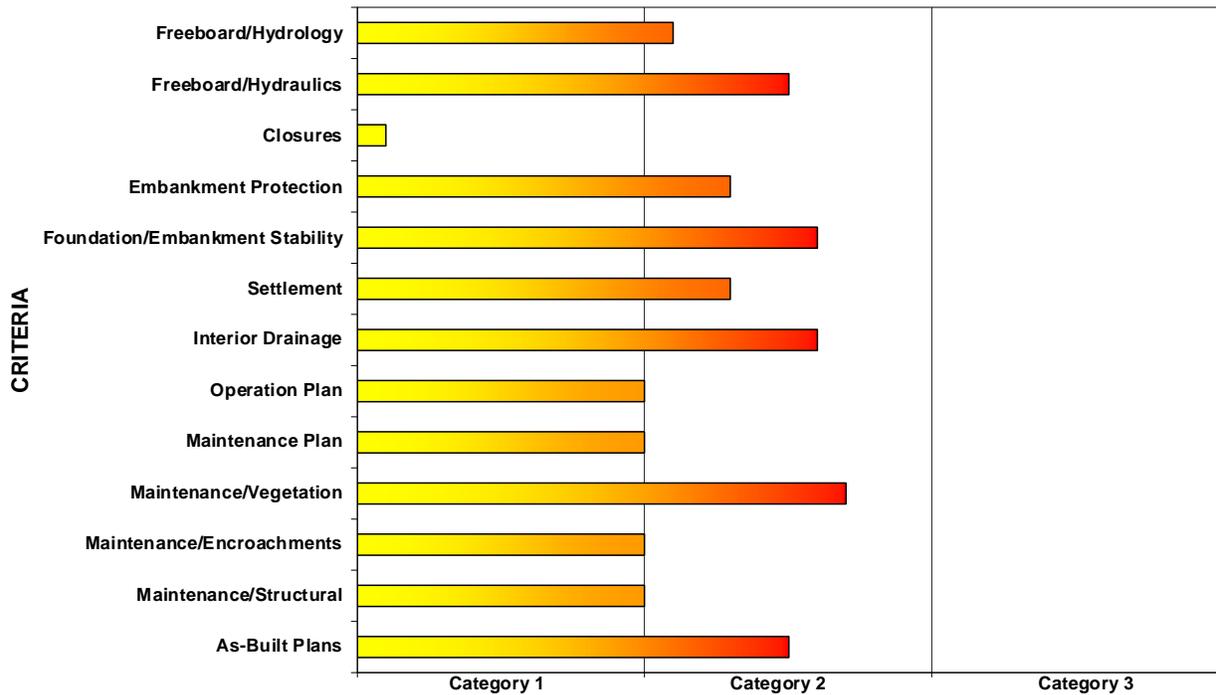
A field investigation conducted in early December identified several maintenance issues that will need to be addressed prior to levee certification. Additional field investigations to obtain



geotechnical data and additional engineering analyses to support certification requirements will be required to complete levee certification. The specifics of the work required are discussed in this report.

The graphic presented below identifies the extent of work to be accomplished related to each criterion for levee certification. The longer the task bar the more work required to complete certification. This is a subjective analysis that can be best used to compare the relative amount of work required for all the levees being considered as part of the Levee Certification program within Ventura County. The extent of work required can also be used to categorize the levee. The longest task bar determines the recommended categorization of the levee.

**CALLEGUAS CREEK LEVEE AND SOMIS DRAIN FLOODWALL (CC-2)**



**CATEGORY EVALUATION OF EACH CRITERIA**

Based on the review of existing data and observations from the field investigation, it is recommended that the CC-2 levee system be classified as a Category 2 Levee. The suggested critical path to achieve levee certification for the CC-2 levee system is outlined in Section F Recommendation.



## FEMA Levee Certification

### Calleguas Creek Levee and Somis Drain Floodwall (CC-2) Mission Oaks Boulevard to Adolfo Road

#### Evaluation Report

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#### EXHIBITS

- Exhibit 1 – Field Investigation Report
- Exhibit 2 – Preliminary Evaluation of Levee System Profiles
- Exhibit 3 – As-Built Plans Status List
- Exhibit 4 – Responses to Comments on Draft Evaluation Report



## A) Introduction

The Calleguas Creek Levee (VCWPD ID No: CC-2) is located in the City of Camarillo in Ventura County. The location of the levee system is from the Mission Oaks Boulevard to Adolfo Road and is shown on Figure 1. The CC-2 levee system is located along the right side of the Calleguas Creek. The levee system consists of embankment levees, side drainage penetrations, and a floodwall. The protective works of the Calleguas Creek Levee were designed to provide protection from the 1-percent-annual-chance discharge (base flood) in conformance with FEMA required freeboard and other regulations. The levee system is intended to protect existing commercial property in low lying areas within the base flood floodplain of the Calleguas Creek Watershed.

The levee system begins at the Highway 101 in Ventura County and continues upstream to downstream of the Adolfo Road Bridge. The length of the levee along the Calleguas Creek is approximately 0.60 miles, with an embankment height up to 4 feet above natural ground on the landward side. The levee's earthen berm is protected by loose riprap and grouted riprap with an access road that runs along the top which is approximately 18 to 26 feet wide. The levee system also includes a floodwall located along the top of the Somis Drain concrete trapezoidal channel's right bank. The floodwall begins at a pedestrian bridge that crosses over the Somis Drain and continues upstream to Flynn Road. The length of the floodwall is approximately 0.35 miles, with a height of 8.83 feet above the top of the channel's bank. The upstream 0.12 miles of the floodwall is 3 feet high.

For purposes of the NFIP, FEMA will only recognize in its flood hazard and risk mapping effort those levee systems that meet, and continue to meet, minimum design, operation, and maintenance standards that are consistent with the level of protection sought through the comprehensive floodplain management criteria established by Section 60.3 of the NFIP regulations. Section 65.10 of the NFIP regulations describes the types of information FEMA needs to recognize, on NFIP maps, that a levee system provides protection from the flood that has a 1-percent chance of being equaled or exceeded in any given year (base flood). This information must be supplied to FEMA by the community or other party seeking recognition of a levee system at the time a study or restudy is conducted, when a map revision under the provisions of Part 65 of the NFIP regulations is sought based on a levee system, and upon request by the Administrator during the review of previously recognized structures. The FEMA review is for the sole purpose of establishing appropriate risk zone determinations for NFIP maps and does not constitute a determination by FEMA as to how a structure or system will perform in a flood event. (FEMA, 2007a)

## B) Design Criteria

For the purposes of the NFIP, FEMA has established levee design criteria for freeboard, closures, embankment protection, embankment and foundation stability, settlement, interior drainage, and other design criteria. These criteria are summarized in subsections below.

### B.1) Freeboard

Section 65.10(b)(1) of the NFIP regulations identifies a minimum freeboard requirement of 3 feet along river levees with an additional 0.5 feet required at the upstream limit of the levee and an additional 1.0 foot on both sides of structures (such as bridges). Freeboard is



# CALLEGUAS CREEK LEVEE AND SOMIS DRAIN FLOODWALL (CC-2) EVALUATION REPORT

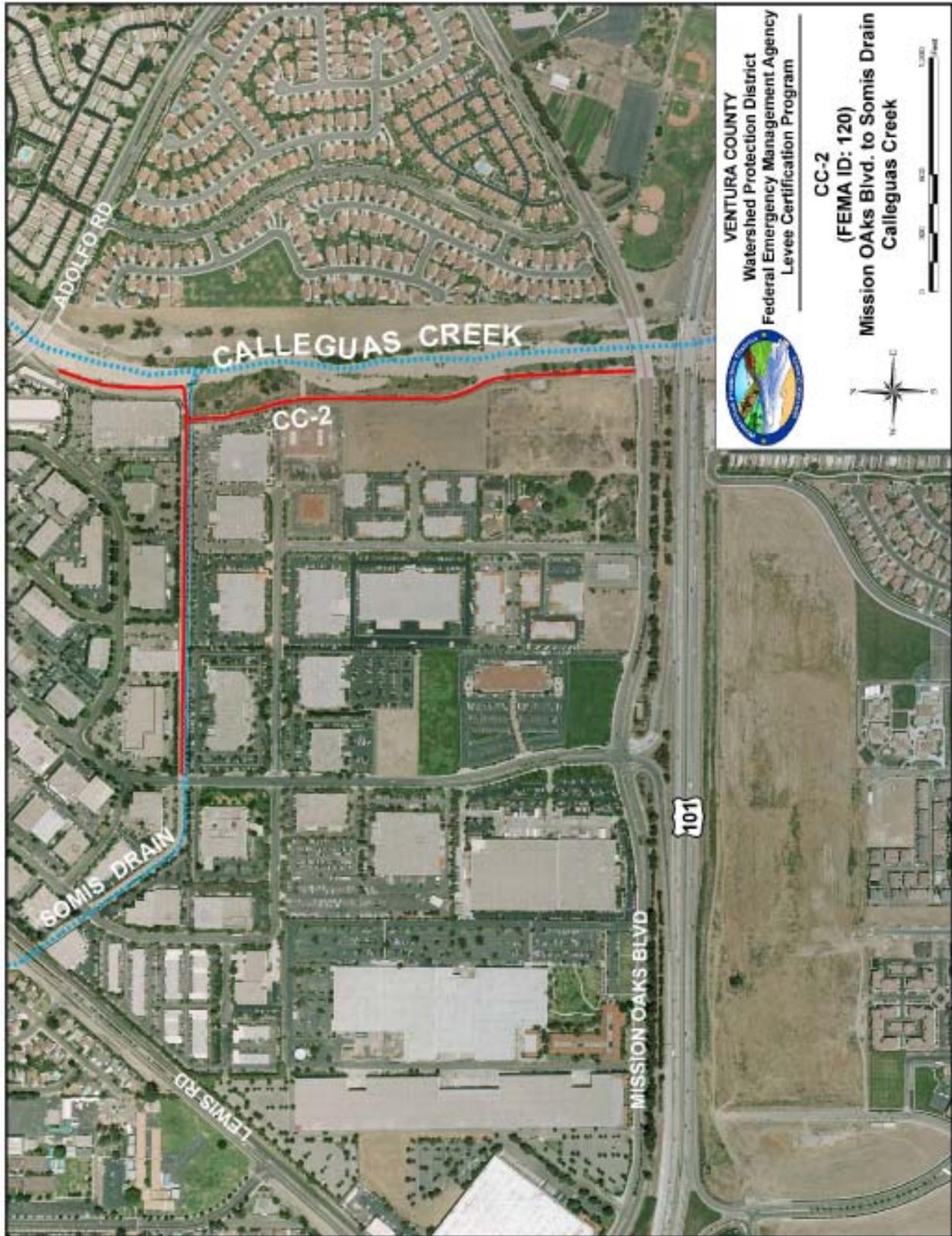


Figure 1 – Location Map



determined by comparing the 100-year water surface elevation with the top of levee elevation. The water surface elevation is derived from hydrologic and hydraulic analyses.

The U.S. Army Corps of Engineers, Los Angeles District, Calleguas Creek Watershed Feasibility Study, Hydrology Appendix dated February 2003 provides discharge frequency values appropriate for levee certification along the Calleguas Creek mainstem, however, discharge frequency values for the CC-2 floodwall system will need to be computed using the Corps HEC-HMS rainfall-runoff model.

The HEC-HMS rainfall-runoff model generates 100-year hydrographs that can be used for baseflood hydrographs. Some additional volume-frequency analysis will be required to meet geotechnical analysis needs for levee long duration seepage and stability evaluation.

The current FEMA FIS hydraulic model for the Calleguas Creek Watershed is available. The current FEMA FIS hydraulic model will be useful as a base model to develop the freeboard analysis. In addition, the existing topographic information may need to be verified with a survey due to vegetation that may have created inaccuracies in the LiDAR data.

The existing sediment study prepared by Howard H. Chang Consultants, Sediment Studies for Channel Improvements of Calleguas Creek, Conejo Creek and Revlon Slough, dated February 2004 will be useful as a reference, however, additional sedimentation and scour analyses will need to be performed to support the freeboard analysis and embankment stability analysis.

## **B.2) Closures**

Section 65.10(b)(2) of the NFIP regulations requires that all openings be provided with closure devices that are structural parts of the system.

Review of the as-built plans and results from the field investigation (Field Investigation Report included as Exhibit 1) indicate that the system does not include a stop log system that acts as a closure.

## **B.3) Embankment Protection**

Section 65.10(b)(3) of the NFIP regulations requires that engineering analyses be submitted that demonstrate that no appreciable erosion of the levee embankment can be expected during the 100-year flood.

Data needed to perform this analysis includes results from the hydraulic analysis, scour analysis, as-built plans, and field verification of the existing embankment protection. The hydraulic analysis and scour analysis would be developed as part of the freeboard assessment. As-built plans are available and field verification has been completed.

A preliminary evaluation of the floodwall system's current top, toe, toedown and creek thalweg has been prepared and is presented in Exhibit 2.

Field investigations have identified several locations where the levee embankment has been impacted and requires restoration/mitigation.



#### **B.4) Embankment and Foundation Stability**

Section 65.10(b)(4) of the NFIP regulations requires that engineering analyses be submitted that evaluate the levee embankment stability. Borings of the levee are required to support this analysis.

As of January 22, 2009, no geotechnical design or construction information has been made available for review.

During field inspections, erosion of the access ramp into the channel was observed. Although the levee itself is not impacted, the stability of the access ramp is questionable. Numerous drainage pipes were observed during the site visit which outlet on the riverside of the levee. The purpose of these drains was not clear on the as-built drawings and if not functioning properly may impact the levee.

Further analysis and evaluations would include the following:

- Geotechnical borings for determining existing geologic conditions, obtaining geologic samples, and performing in-situ permeability testing.
- Laboratory analysis to determine soil properties and strength parameters.
- Seepage and stability analysis for static and flood conditions.

#### **B.5) Settlement**

Section 65.10(b)(5) of the NFIP regulations requires that engineering analyses be submitted that assess the potential and magnitude of future losses of freeboard as a result of levee settlement.

As of January 22, 2009, no geotechnical design or construction information has been made available for review.

During field inspections, no obvious evidence of adverse settlement was observed.

Further analysis and evaluations would include the following:

- Geotechnical borings for determining existing geologic conditions, obtaining geologic samples, and performing in-situ permeability testing.
- Laboratory analysis to determine soil properties and consolidation potential.
- Analysis of potential long term settlement and seismic deformation.

#### **B.6) Interior Drainage**

Section 65.10(b)(6) of the NFIP regulations requires that an analysis be submitted that identifies the sources, extent, and depth of interior flooding.

Interior drainage analyses would be required at all storm drain penetrations. Based on the field investigation and review of the as-built plans, there are 5 storm drain penetrations through the levee and floodwall combined. All storm drains have flap gates with the exception of the two storm drains penetrating the levee along Calleguas Creek upstream of the Somis Drain. GPS locations and descriptions for each are included in Table 1 of the field investigation report included as Exhibit 1. Photographs of the outlets are also included in the report. For storm drains that continue underground into the City of Camarillo, additional



documents will be required including the master plan of drainage to develop the interior drainage analyses.

### **C) Operation Plans and Criteria**

Section 65.10(c) of the NFIP regulations requires submittal of appropriate documentation of the operation of the system.

An operation plan exists that is in use for this levee. For certification this operation plan will need to be updated to meet the NFIP requirements including the attachment of the County's Flood Warning System and Emergency Response Plan. The operation plan will need to include the procedures for operating the entire system including the interior drainage system.

### **D) Maintenance Plans and Criteria**

Section 65.10(d) of the NFIP regulations requires submittal of appropriate documentation for the maintenance of the system.

A maintenance plan exists that is in use for this levee. For certification this maintenance plan will need to be updated to meet the NFIP requirements.

The field investigation report included as Exhibit 1 documents maintenance issues that were identified during the field investigation. Those issues are summarized in Table 2 of that report. The 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 set by USACE and FEMA and to be fully operational. Table 2 also provides possible repair or remediation actions for the locations along with the GPS points. Photos taken at the maintenance required locations are included in Appendix C of the report. Major maintenance issues are related to vegetation and debris removal, and erosion of the earthen terrace in front of the revetment downstream of the drop structure.

### **E) Certification Requirements**

Section 65.10(e) of the NFIP regulations requires that in addition to the above-described analyses, certified as-built plans of the levee must be submitted.

Most as-built plans obtained through data collection efforts have appropriate approvals to be used for certification; however, there are some outstanding as-built documents that still need to be obtained to complete the analysis and certification process. A list of the as-built plans and their status for this project is presented in Exhibit 3.

A complete system and structural evaluation should be performed as part of the certification.

Additional work to complete this task includes preparation of a Levee Certification Report that includes all analyses to meet the Section 65.10 NFIP requirements as well as the FEMA MT-2 application package.

### **F) Recommendation**

The field investigation identified several critical issues that must be resolved prior to certification. The most significant issue is the vegetation at the toe and top of the levee embankment. Other issues that require evaluation is the erosion of the earthen terrace in front of the revetment downstream of



the drop structure, and the subdrains. Engineering analyses will also need to be performed to verify that this levee meets the NFIP Section 65.10 requirements. Based on the review of existing data and observations from the field investigation, it is recommended that the CC-2 levee system be classified as a Category 2 Levee.

The suggested critical path to achieve levee certification for the CC-2 floodwall system is outlined below and a tentative schedule of actions is shown on Figure 2.

- Vegetation Removal
- Maintenance Repairs
- Topographic Survey
- H&H Analyses/Interior Drainage
- Sediment/Scour Analyses
- Geotechnical Field Investigation and Analyses
- Title Search and Boundary Survey
- Public Outreach/Workshop
- Easement Acquisition (if needed)
- Environmental Documents/Permits
- Engineering Analysis and Design
- Plans, Specifications and Estimate
- Construction/As-builts
- Operation and Maintenance Manuals
- Levee Certification Report





## G) References

- FEMA. 2005a. *Title 44 of the Code of Federal Regulations (CFR), Section 65.10 (44 CFR 65.10)*, Federal Emergency Management Agency.
- FEMA. 2005b. *Procedural Memorandum 34 – Interim Guidance for Studies Including Levees*, Federal Emergency Management Agency.
- FEMA. 2007a. *Fact Sheet Requirements of 44 CFR, Section 65.10 Mapping of Areas Protected by Levee Systems*, Federal Emergency Management Agency.
- FEMA. 2007b. *Revised Procedural Memorandum 43 – Guidelines for Identifying Provisionally Accredited Levees*, Federal Emergency Management Agency.
- Howard H. Chang Consultants. 2004. *Sediment Studies for Channel Improvements of Calleguas Creek, Conejo Creek and Revlon Slough*. Prepared for the Ventura County Watershed Protection District, Ventura, California.
- Tetra Tech. 2008. *Calleguas Creek Levee and Somis Drain Floodwall (CC-2) Mission Oaks Boulevard to Adolfo Road, Field Investigation Report*. Prepared for the Ventura County Watershed Protection District, Ventura, California.
- U.S. Army Corps of Engineers, Los Angeles District. 2003. *Calleguas Creek Watershed Feasibility Study, Hydrology Appendix*.
- U.S. Army Corps of Engineers. 2006. *Levee Owner's Manual for Non-Federal Flood Control Works*. Prepared for the Rehabilitation and Inspection Program, Public Law 84-99.
- U.S. Army Corps of Engineers. 2008. *EC 1110-2-6067 - Certification of Levee Systems for the National Flood Insurance Program (NFIP)*.
- Ventura County Watershed Protection District. 2007. *Calleguas Creek Levee, Mission Oaks to Somis Drain, Operation and Maintenance Manual*.



# Exhibit 1

## Field Investigation Report



**Ventura County  
Watershed Protection District**

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### Field Investigation Report

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#### APPENDIX

- Appendix A – Levee Inspection Log
- Appendix B – Photos of Penetrations and Typical Levee Features
- Appendix C – Photos of Maintenance Required Sites



## **FEMA Levee Certification**

### **Calleguas Creek Levee and Somis Drain Floodwall (CC-2) Mission Oaks Boulevard to Adolfo Road**

#### **Field Investigation Report**

#### **Introduction**

Calleguas Creek Levee (VCWPD ID No: CC-2) is located in the City of Camarillo between Mission Oaks Boulevard and Adolfo Road in Ventura County. Somis Drain is located between the confluence with Calleguas Creek and Flynn Road. The location of the levee system is shown on Figure 1.

As part of the FEMA levee certification process, field investigations of the Calleguas Creek Levee (CC-2) were conducted on December 8, 2008. The team included representatives from the Ventura County Watershed Protection District (District), Tetra Tech, and AMEC. The investigation was conducted by walking the entire length of the levee system while visually assessing the existing conditions of the flood protection elements. The visual assessment included thirteen (13) different evaluation items such as unwanted vegetation growth, signs of depression/rutting and erosion/bank caving, slope stabilities, penetration, etc. The description of these 13 items can be found in the Levee Inspection Log (Appendix A). Separate inspection logs were completed by Tetra Tech and AMEC at the end of the field visit. The log in Appendix A is a team log that comprises the assessments from the individual inspection logs.

Any notable findings and existing conditions of the levee during the walk were documented with photos and their geo-referenced locations were recorded with a GPS unit. Photos taken during the field investigation along with maps showing their location are presented in Appendix B and Appendix C.



# CALLEGUAS CREEK LEVEE AND SOMIS DRAIN FLOODWALL (CC-2) FIELD INVESTIGATION REPORT



Figure 1 – Location Map



## **General Descriptions**

- The levee system includes 0.63-miles (3,326-feet) of a trapezoidal embankment located on the right bank of Calleguas Creek from the Mission Oaks Boulevard Bridge to the Adolfo Road Bridge. The levee system also includes 0.34-miles (1,795-feet) of floodwall located on the top of the Somis Drain's right bank from Calleguas Creek to Flynn Road.
- The protective works of the Calleguas Creek Levee was designed to provide protection from the 1-percent-annual-chance discharge (100-year flood event) in conformance with FEMA required freeboard and other regulations.
- The FIRM dated September 29, 1986 shows non-containment of Zone A.
- The levee system is intended to protect existing commercial, and industrial property in low lying areas within the Calleguas Creek Watershed.
- The Calleguas Creek levee is a traditional trapezoidal shaped, earth fill embankment. The river side slope is faced with rip-rap, the majority of which is grouted. The maintenance road that runs along the top is approximately 15-foot wide. The Somis Drain floodwall is typically 8.83-feet high. The county access road that runs in front the floodwall is 4-foot wide.
- An approximately 4-foot tall right-of-way vinyl white picket fence runs along most of the Calleguas Creek levee.

## **General Field Observations**

### **a) Riverward side of Levee:**

1. Removal of vegetation (trees and shrubs) within 15 feet of levee toe and within the levee itself is required at downstream end near Mission Oaks Blvd.
2. Active bank erosion of an earthen terrace is occurring along the grouted stone revetment. This erosion may not be an issue since the available as-built shows that the revetment was placed behind the earthen terrace and the existence of the revetment was verified in the field during the inspection. However, the channel invert elevation needs to be verified to confirm the toedown elevation of the revetment is lower than the current invert elevation.
3. Subdrainage PVC pipes were observed along the levee downstream of the confluence with Somis Drain. Geotech inspection crews were unsure about the purpose of these pipes considering the location/ elevations of the pipes. Verification as to the purpose of the drains should be obtained from the geotechnical design documents. Additional inspection of the drains may be required if the drains are required for hydrostatic relief for the levee.
4. The reach between the Somis Drain confluence and Adolfo Bridge may not be a levee condition, because existing ground elevations behind the levee appears to be higher than the top of levee.



**b) Landward side of Levee:**

1. Removal of vegetation (trees and shrubs) is required along the Calleguas Creek Levee. This vegetation consists of: (a) vegetation on levee embankment and within 15 feet of levee toe (riverward side); (b) five (5) groups of three (3) large diameter trees with individual 36-inch CMP tree pots that have been planted at the top of the levee slope at approximately 50 to 100 intervals; and (c) vegetation within 15 feet of levee toe between Somis Drain confluence and Adolfo Rd. (landward side)
2. Removal of vegetation (trees and shrubs) behind the Somis Drain Floodwall is required. Landscaping vegetation including large diameter trees have been planted immediately behind the floodwall on the dry-side throughout the entire reach within 5 feet from the wall face.

**Levee Penetrations**

Levee closure of the Calleguas Creek Levee and Somis Drain Floodwall (CC-2) system during storm events must consider the existing storm drain outlets. The storm drain outlets should include closure devices at the end of each storm drain penetration. The need for closure devices for each penetration should be verified with additional engineering analysis. A summary of levee system penetrations is presented in Table 1.

**Table 1 – Summary of Levee Penetration**

River* Station	GPS		**Photo No.	Description
	Lat	Long		
<i>Calleguas Creek Levee (CC-2) – Along Calleguas Creek Levee</i>				
14+85	N34.21666	W119.01558	P1	48” RCP with a flap gate
18+00	N34.22275	W119.01659	P2	Somis Drain confluence with Calleguas Creek
7+55	N34.22325	W119.01610	P3	10” steel pipe w/o a closure device located upstream of Somis Drain
14+10	N34.22484	W119.01560	P4	18” RCP w/o a closure device located upstream of Somis Drain. (Not shown on as-built plan.)
<i>Calleguas Creek Levee (CC-2) – Somis Drain</i>				
87	N34.22278	W119.02223	P5	18” RCP with a flap gate near Flynn Street Bridge. (Not shown on as-built plan.)

\* Based on as-built plans available, the river station along Calleguas Creek resets upstream of the Somis Drain confluence.

\*\* Photos can be found in Appendix C.



## **Maintenance Required Locations**

During the field inspection, locations where maintenance is required were documented and are summarized in Table 2. The 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 set by USACE and FEMA and to be fully operational. Table 2 also provides possible repair or remediation actions for the locations along with the GPS points. Photos taken at the maintenance required locations are included in Appendix C.

## **Inspection Conclusion**

Once maintenance at the locations identified in Table 2 are complete, the field inspection of the levee system indicates that the Calleguas Creek Levee and Somis Drain Floodwall (CC-2) system may be certified as providing base flood protection if all other criteria are satisfied. Some maintenance improvements may require additional engineering analyses, design, construction and preparation of as-constructed documents.



**CALLEGUAS CREEK LEVEE AND SOMIS DRAIN FLOODWALL (CC-2)  
FIELD INVESTIGATION REPORT**

**Table 2 – Summary of Maintenance Required Locations**

GPS		*Photo No.	Description	Action Required
Lat	Long			
<i>Calleguas Creek Levee (CC-2) – Along Calleguas Creek Levee</i>				
N34.21666	W119.01558	M1	Vegetation within 15’ of toe (Riverward side)	Remove vegetation and root ball, fill voids with impervious material and firmly compact.
N34.21697 to N34.21824	W119.01570 to W119.01585	M2	Five (5) groups of three (3) large diameter trees with individual 36-in CMP tree pots planted at top of slope at approximately 50 to 100 feet intervals (Riverward side)	Remove vegetation, root balls, and CMP tree pots, fill voids with impervious material and firmly compact.
N34.21710	W119.01570	M3	A group of three (3) empty 36-in CMP tree pots at top of slope (Riverward side)	Remove empty CMP tree pots and root balls, if found, fill voids with impervious material and firmly compact.
N34.21811	W119.01581	M4	An empty 36-in CMP tree pot at top of slope (Riverward side)	Remove an empty CMP tree pot and root ball, if found, fill void with impervious material and firmly compact.
N34.21697 to N34.21824	W119.01570 to W119.01585	M5	Vegetation within 15’ of toe (Riverward side)	Remove vegetation and root ball, fill voids with impervious material and firmly compact.
N34.21868 to N34.22120	W119.01595 to W119.01609	M6	(1) Earthen terrace in front of revetment is experiencing toe erosion (Riverward side); (2) Vegetation within 15’ of toe (Riverward side)	(1) Verify rock revetment under terrace has enough toedown depth against current channel invert; (2) Vegetation may need to be removed, in which case, remove vegetation and root ball, fill voids with impervious material and firmly compact.
N34.22120	W119.01609	M7	Debris (a stockpile of dead trees) on top of grade control structure (Riverward side)	Remove debris from the channel.
N34.22325	W119.01610	M8	10” steel pipe w/o a closure device (Sta.7+55)	Install a closure device, if appropriate.
N34.22484	W119.01560	M9	18” RCP w/o a closure device	Install a closure device, if appropriate.
N34.22275 to N34.22484	W119.01659 to W119.01560	M10	Vegetation (Landscaping) within 15’ of toe between Somis Drain Confluence and Adolfo Road (Landward side)	Vegetation may need to be removed. In which case, remove vegetation and root ball, fill voids with impervious material and firmly compact.



**CALLEGUAS CREEK LEVEE AND SOMIS DRAIN FLOODWALL (CC-2)  
FIELD INVESTIGATION REPORT**

GPS		*Photo No.	Description	Action Required
Lat	Long			
<i>Calleguas Creek Levee (CC-2) – Somis Drain</i>				
N34.22287 to N34.22275	W119.01660 to W119.02259	M11	Vegetation (Landscaping) within 15' of floodwall for its entire length (Landward side)	Vegetation may need to be removed. In which case, remove vegetation and root ball, fill voids with impervious material and firmly compact.
N34.22278	W119.02223	M12	A flap gate for 18" RCP is fixed open by debris. (Riverward side)	Remove debris from pipe opening and ensure complete seal around the gate.

\* Photos can be found in Appendix C.



# Appendix A

## Levee Inspection Log



## CALLEGUAS CREEK LEVEE AND SOMIS DRAIN FLOODWALL (CC-2) FIELD INVESTIGATION REPORT

### Levee Inspection Log

Facility Name/ID: <u>Calleguas Creek Levee (CC-2)</u>	Date: <u>12/8/2008</u>
Watercourse: <u>Calleguas Creek</u>	By: <u>Jung Suh, Nathan Schreiner</u>
Reach: <u>From Mission Oak Blvd. to Adolfo Rd.</u>	<u>(Tetra Tech), Daniel Costamagna,</u>
	<u>Chris Spitzer (AMEC), and Jim</u>
	<u>(Ventura Co. O&amp;M personnel)</u>

RATED ITEM	A	M	U	N/A		EVALUATION	LOCATIONS / REMARKS / RECOMMENDATIONS
1. Unwanted Vegetation Growth					A	The levee has a good grass cover with little or no unwanted vegetation (trees, bushes, or undesirable weeds) and has been recently mowed. Except in those cases where a vegetation variance has been granted by the Corps, a 15' zone, free from all woody vegetation, is maintained adjacent to the landward/riverside toe of the FCW for maintenance and flood-fighting activities. Additionally, a 3' root free zone is maintained to protect the external limits of the levee cross section. Reference EM 110-2-301 and/or local Corps policy.	<ul style="list-style-type: none"> <li>- Five groups of three large diameter trees inside 35-inch CMP tree pots were observed along the top of slope on the riverward side and may need to be removed.</li> <li>- Vegetation was present along the toe on the riverward side near Mission Oaks Blvd bridge.</li> <li>- Heavy vegetation was present on the earthen terrace.</li> <li>- Trees planted behind the floodwall along the Somis Drain.</li> </ul>
					M	Minimal number of trees (2" diameter or smaller) and /or brush present on the levee or within the 15' zone, that will not threaten the integrity of the project but which need to be removed.	
			X			U	
2. Depressions /Rutting	X				A	There are no ruts, pot holes, or other depressions on the levee. No evidence of levee settlement. The levee crown, embankments, and access road crowns are well established and drain properly without any ponded water.	
					M	Some minor depressions in the levee crown, embankment, or access roads that will not pond water and do not threaten the integrity of the levee.	
					U	There are depressions greater than 6 inches deep that will pond water, endangering the integrity of the levee.	
3. Erosion / Bank Caving					A	No active erosion, undermining, or bank caving due to riverbed degradation or flow impingement, observed on the landward or on the riverward side of the levee.	<ul style="list-style-type: none"> <li>- Earthen terrace in front of the revetment on the riverward side was experiencing erosion. The condition of the riprap revetment under the terrace needs to be verified to ensure the erosion activity on the terrace would not affect the structural integrity of the levee.</li> </ul>
		X			M	There are areas where active erosion is occurring or has occurred on or near the levee embankment, but levee integrity is not threatened.	
					U	Erosion, undermining, or caving is occurring or has occurred along the toes that threatens the stability and integrity of the levee. The erosion or caving has progressed into the levee section or into the extended footprint of the levee foundation and has compromised the levee foundation stability.	
4. Surficial Slope Stability	X				A	No slides present.	
					M	Minor superficial sliding that with deferred repairs will not pose an immediate threat to FCW integrity.	
					U	Surficial instabilities that will require more than typical or periodic repair and that threatens FCW integrity. Repairs are required to reestablish FCW integrity.	
5. Deep Seated Slope Stability					A	No slides present.	
		X			M	Signs of deep seated instability can not be determined from site assessment or evidence may or may not be an indicator of deep seated stability. .	
					U	Evidence of deep seated sliding that threatens FCW integrity. Repairs are required to reestablish FCW integrity.	
6. Cracking	X				A	No cracking observed on the levee greater than 6 inches deep.	<ul style="list-style-type: none"> <li>- Some cracking along pavement and along grouted stone was observed but vertical offsets were not observed.</li> </ul>
					M	Longitudinal and/or transverse cracking greater than 6 inches deep. No evidence of vertical movement along the crack.	
					U	Longitudinal and/or transverse cracking present and exhibits signs of vertical movement.	
7. Animal Burrows					A	No animal burrows present on the levees.	<ul style="list-style-type: none"> <li>- Several animal burrows were present but do not appear to impact the levee at this time.</li> </ul>
		X			M	Several animal burrows present which may lead to seepage or slope stability problems, and they require immediate attention.	
					U	Significant maintenance is required to fill existing burrows, and the	



## CALLEGUAS CREEK LEVEE AND SOMIS DRAIN FLOODWALL (CC-2) FIELD INVESTIGATION REPORT

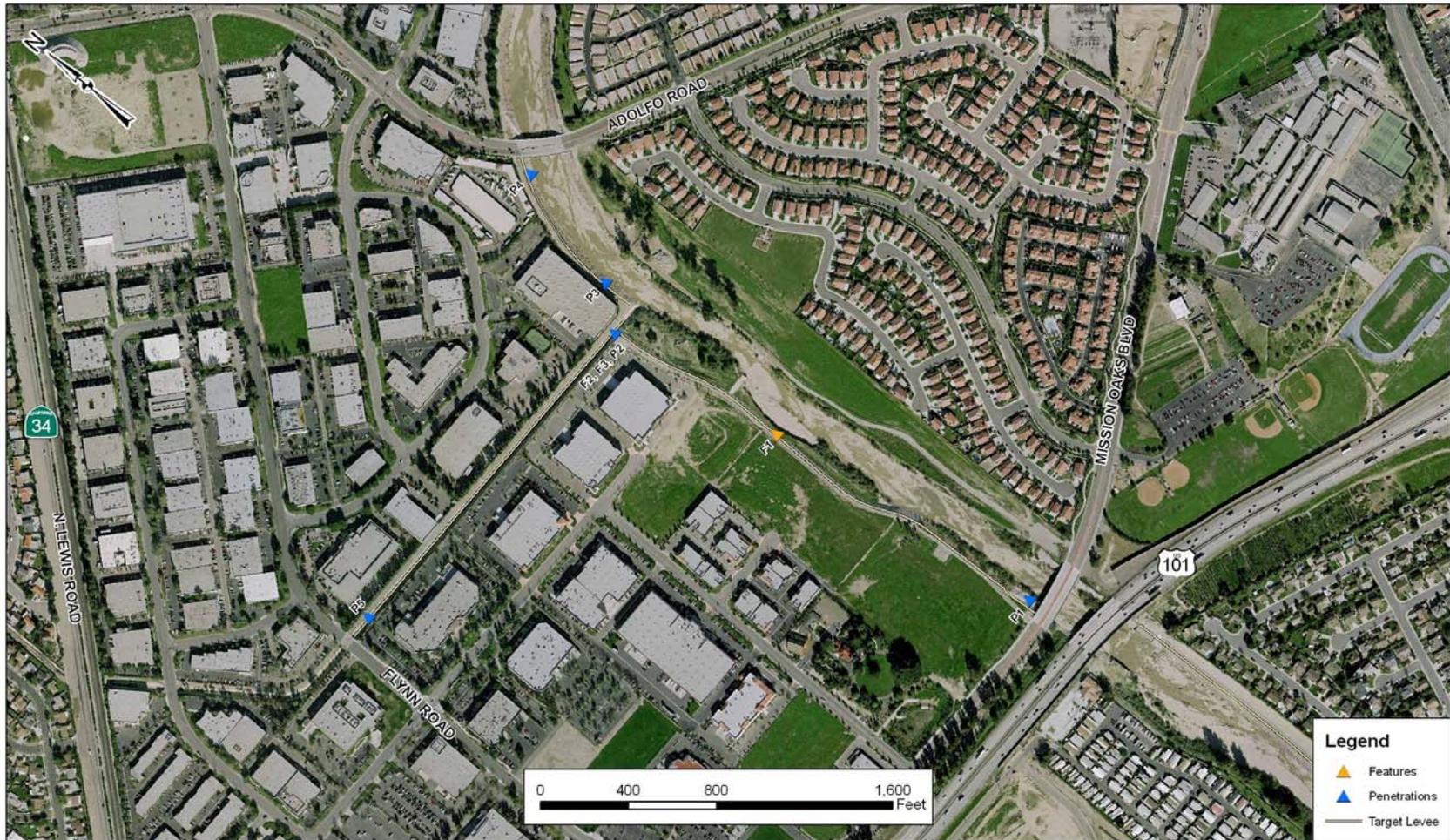
RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS / REMARKS / RECOMMENDATIONS
					levee will not provide reliable flood protection until this maintenance is complete.	
8. Encroachments				A	No trash, debris, excavations, structures, adverse sediment accumulation, or other obstructions present within the project easement area.	- A plastic fence was installed by the City along the top of the slope on the riverward side and may prevent easy access to the levee slope.
		X		M	Trash, debris, excavations, structures, adverse sediment accumulation, or other obstructions present, or inappropriate activities that will not inhibit project operations and maintenance or emergency operations.	
				U	Trash, debris, excavations, structures, adverse sediment accumulation, or other obstructions present, or inappropriate activities that will inhibit project operations and maintenance or emergency operations.	
9. Revetments & Banks				A	Existing revetment protection is properly maintained and is undamaged. Revetment protection clearly visible and revetment materials are of sound quality.	- See Note for Item No.3. The condition of the revetment behind the earthen terrace may need to be verified.
		X		M	No revetment displacement or scouring activity that could undercut banks, erode embankments, or restrict desired flow. Unwanted vegetation must be cleared and sprayed with an appropriate herbicide.	
				U	Dense brush, trees, or grasses hide the revetment protection or meandering and/or scour activity is undercutting banks, eroding embankments, or impairing channel flows by causing turbulence or shoaling.	
				N/A	There is no revetment protecting the levee.	
10. Closure Structures (Stop Log, Earthen Closures, or Gates)				A	Closure structure in good repair. Placing equipment, stoplogs, and other materials are readily available at all times. Components of closure clearly marked and installation instructions/procedures readily available.	- Side drains along Calleguas Creek did not have any closure devices. Additional engineering analysis is required to determine the need for closure devices for each penetration.
			X	U	Closure structure in poor condition. Parts missing or corroded. Placing equipment may not be available within normal warning time.	
				N/A	There are no closure structures along the levee.	
11. Underseepage Relief Wells / Toe Drainage Systems				A	Toe drainage systems and pressure relief wells necessary for maintaining FCW stability during flood events functioned properly during the last flood event and no sediment is observed in horizontal system (if applicable). No signs of adverse seepage conditions adjacent to or within the levees. Nothing is observed which would indicate that the system won't function properly during the next flood.	
				M	Toe drainage systems or pressure relief wells are damaged and may become clogged if they are not repaired. Signs of adverse seepage such as sand boils, spring lines, vegetation change or other seepage indicators are present but do not directly affect the stability of the levee.	
				U	Toe drainage systems or pressure relief wells necessary for maintaining FCW stability during flood events have fallen into disrepair or have become clogged. Signs of adverse seepage such as sand boils, spring lines, vegetation change or other seepage indicators are present and directly affect the stability of the levee.	
			X	N/A	There are no relief wells/toe drainage systems along the levee.	
12. Maintenance and Emergency Access				A	Maintenance/emergency accesses are clear of obstructions and in good condition.	- See Note for Item No.8.
		X		M	Minor obstructions and/or damages to the maintenance/emergency access are present, but would not directly affect the accessibility of the levee..	
				U	Numerous obstructions and/or damages to the maintenance/emergency access are present that would directly affect the accessibility of the levee.	
13. Deviation from As-Built Plans	X			A	There are no deviations from the as-built plans.	
				M	There are minor deviations from the as-built plans that would not affect the functionality of the levee.	
				U	There are major deviations from the as-built plans that could affect the functionality of the levee. Additional engineering analyses are recommended.	

Key: A = Acceptable. M = Minimally Acceptable; Maintenance is required. U = Unacceptable. N/A = Not Applicable. RODI =Requires Operation during Inspection.



## Appendix B

### Photos of Penetrations and Typical Levee Features



Appendix B – Penetration and Site Feature Photograph Locations along Calleguas Creek Levee (CC-2)



## CALLEGUAS CREEK LEVEE AND SOMIS DRAIN FLOODWALL (CC-2) FIELD INVESTIGATION REPORT



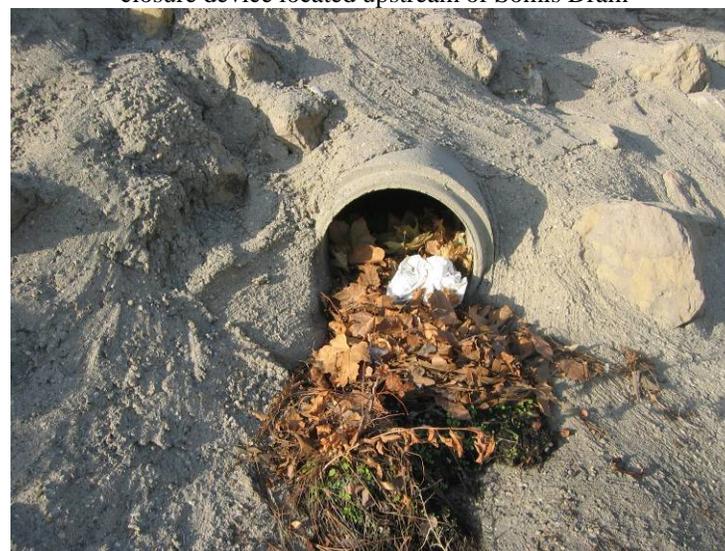
Calleguas Creek Levee (CC-2) (Photo No. P1) – 48” RCP with a flap gate



Calleguas Creek Levee (CC-2) (Photo No. P3) – 10” steel pipe w/o a closure device located upstream of Somis Drain



Calleguas Creek Levee (CC-2) (Photo No. P2) – Somis Drain confluence with Calleguas Creek



Calleguas Creek Levee (CC-2) (Photo No. P4) – 18” RCP w/o a closure device located upstream of Somis Drain. (No as-built plan available)



## CALLEGUAS CREEK LEVEE AND SOMIS DRAIN FLOODWALL (CC-2) FIELD INVESTIGATION REPORT



**Calleguas Creek Levee (CC-2) (Photo No. P5)** – 18” RCP with a flap gate near Flynn Street Bridge. As-Built unavailable



**Calleguas Creek Levee (CC-2) (Photo No. F2)** – Looking at the Somis Drain outlet into Calleguas Creek



**Calleguas Creek Levee (CC-2) (Photo No. F1)** – Looking downstream at an earthen construction ramp down to the earthen terrace (Riverward side)



**Calleguas Creek Levee (CC-2) (Photo No. F3)** – A typical pair of weep holes along Somis Drain banks



## Appendix C

### Photos of Maintenance Required Locations



Appendix C – Photograph Locations of Maintenance Required Areas along Calleguas Creek Levee (CC-2)



## CALLEGUAS CREEK LEVEE AND SOMIS DRAIN FLOODWALL (CC-2) FIELD INVESTIGATION REPORT



**Calleguas Creek Levee (CC-2) (Photo No. M1)** – Vegetation within 15' of toe (Riverward side)



**Calleguas Creek Levee (CC-2) (Photo No. M3)** – A group of three (3) empty 36-in CMP tree pots at top of slope (Riverward side)



**Calleguas Creek Levee (CC-2) (Photo No. M2)** – Five groups of three trees planted at approximately 50 to 100 feet intervals (Riverward side)



**Calleguas Creek Levee (CC-2) (Photo No. M4)** – An empty 36-in CMP tree pot at top of slope (Riverward side)



## CALLEGUAS CREEK LEVEE AND SOMIS DRAIN FLOODWALL (CC-2) FIELD INVESTIGATION REPORT



**Calleguas Creek Levee (CC-2) (Photo No. M5) – Vegetation within 15' of toe (Riverward side)**



**Calleguas Creek Levee (CC-2) (Photo No. M7) – Debris (a stock pile of dead trees) on top of grade control structure (Riverward side)**



**Calleguas Creek Levee (CC-2) (Photo No. M6) – (1) Eroding earthen terrace in front of revetment; (2) Vegetation within 15' of toe**



**Calleguas Creek Levee (CC-2) (Photo No. M8) – 10" steel pipe w/o a closure device (Sta.7+55)**



## CALLEGUAS CREEK LEVEE AND SOMIS DRAIN FLOODWALL (CC-2) FIELD INVESTIGATION REPORT



**Calleguas Creek Levee (CC-2)** (Photo No. M9) – 18” RCP w/o a closure device



**Calleguas Creek Levee (CC-2)** (Photo No. M11) – Vegetation (Landscaping) within 15’ of floodwall for its entire length (Landward side)



**Calleguas Creek Levee (CC-2)** (Photo No. M10) – Vegetation within 15’ of toe between Somis Drain confluence and Adolfo Road (Landward side)



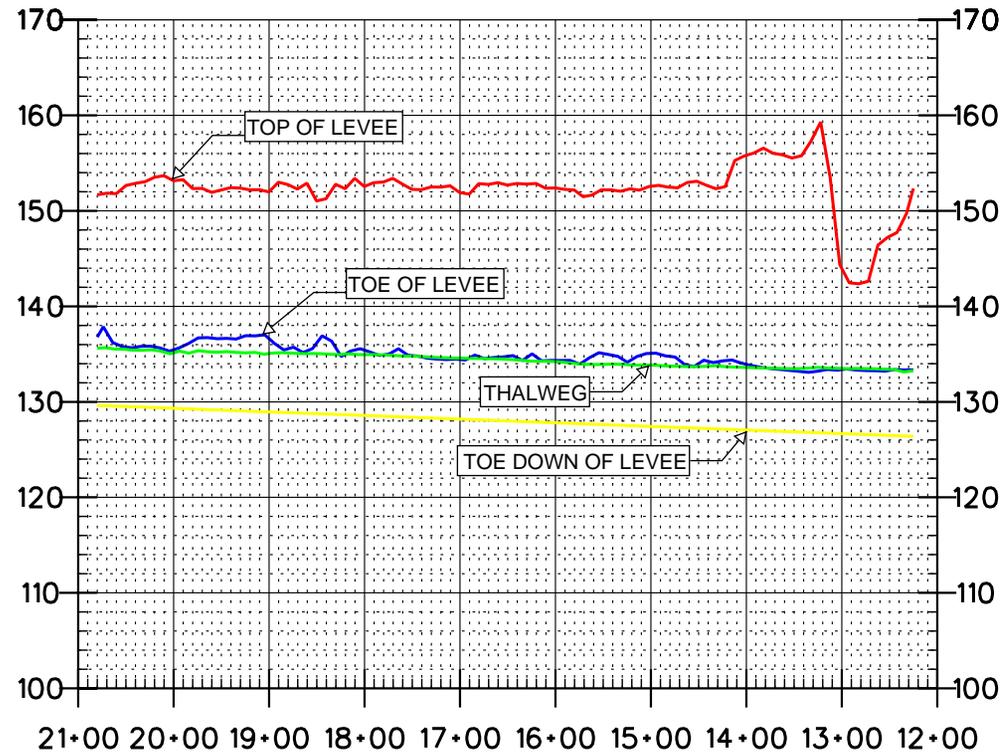
**Calleguas Creek Levee (CC-2)** (Photo No. M12) – A flap gate for 18” RCP is fixed open by debris. (Riverward side)



## Exhibit 2

### Preliminary Evaluation of Levee System Profiles

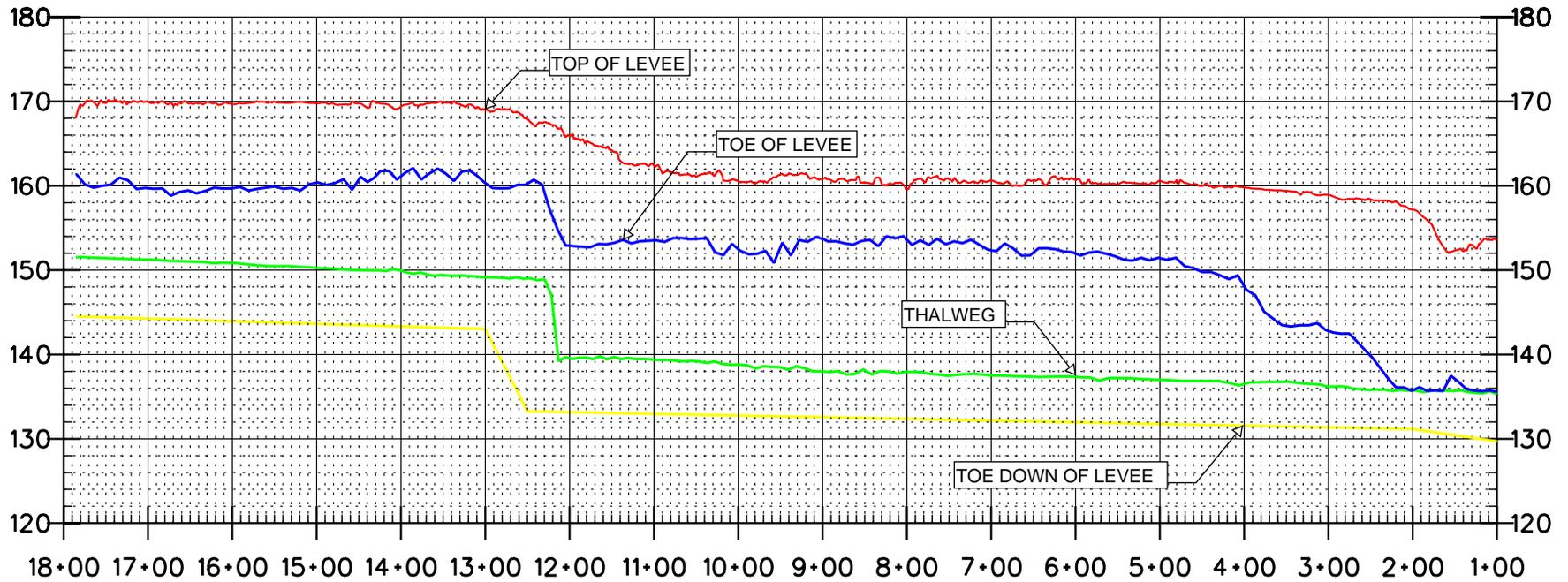
CALLEGUAS CREEK NEAR MISSION OAKS ROAD (CC-2)  
STATION 12+00 TO 21+00



LEGEND:  
— TOP OF LEVEE  
— TOE OF LEVEE  
— THALWEG  
— TOE DOWN OF LEVEE

SCALE:  
HORIZONTAL: 1" = 200'  
VERTICAL: 1" = 20'

CALLEGUAS CREEK NEAR SOMIS DRAIN (CC-2)  
STATION 1+00 TO 18+00



- LEGEND:
- TOP OF LEVEE
  - TOE OF LEVEE
  - THALWEG
  - TOE DOWN OF LEVEE

SCALE:  
HORIZONTAL: 1" = 200'  
VERTICAL: 1" = 20'



## **Exhibit 3**

### **As-Built Plans Status List**

**Calleguas Creek Levee (CC-2) & Somis Drain Floodwall -  
Mission Oaks Blvd to Somis Drain & Calleguas Creek to Flynn Rd, Respectively**

<b>Bridge Crossings (U/S to D/S)</b>	<b>As-Builts Provided to Consultant by County</b>	<b>County Dwg. No.</b>	<b>Date*</b>	<b>Action</b>
Adolfo Rd Bridge	No			Request from County.
Flynn Rd Bridge and Culvert	No			Request from County.
Mission Oaks Blvd Bridge	No			Request from County.
<b>Levee System (U/S to D/S)</b>				
CC-2 Levee System U/S of the Somis Drain	Yes	Y-3-2571 to 2575	1985	
~3' high Somis Drain Floodwall (near Flynn Rd)	No			Request from County.
8'-10" high Somis Drain Floodwall	Yes	Y-3-3875 to 3885	1980	
Somis Drain Trapezoidal Channel	Yes	Y-3-101 to 113	1962	
CC-2 Levee System D/S of the Somis Drain	Yes	Y-3-3875 to 3885	1980	
CC-2 Levee System (from the U/S end of Mission Oaks Blvd to ~700' U/S)	No	Y-3-3580 to 3891	1997	We have dwgs, but they're not stamped as "Record Dwgs." Request from County.
<b>Future Repairs</b>				
Vegetation removal repairs			TBD	To be constructed.
<b>Penetrations (U/S to D/S)</b>				
18" RCP along CC in the vicinity of Adolfo Rd.	No			Request from County.
10" Steel Pipe along CC	Yes	Y-3-2575	1985	
18" RCP w/ Flap Gate along Somis Drain nr Flynn Rd.	No			Request from County.
48" RCP w/ flap gate along CC	No	Y-3-3581	1997	We have dwgs, but they're not stamped as "Record Dwgs." Request from County.

\*Date indicates as-built date. Design plan dates were used if the plans were available, but were not stamped and/or signed as-built.



## **Exhibit 4**

### **Responses to Comments on Draft Evaluation Report**

**FEMA Levee Certification -VCWPD**  
**Project Team Comments on Tetra Tech's Draft Evaluation Reports**  
**January 2009**

Maint. Defect	Description	Recommended Action by Tetra-Tech	Recommended Response by O&M Division	Environ. Permit Codes	Environmental Services Section Comments	R.O.W. Issue*	Levee Certification Project Team's Comments to Draft Evaluation Reports	Tetra Tech's Response
<b>Calleguas Creek Levee (CC-2) – Along Calleguas Creek Levee Category 2</b>								
M1	Vegetation within 15' of toe (Riverward side)	Remove vegetation and root ball, fill voids with impervious material and firmly compact.	C1	E2	Agency notification required for thick veg			
M2	Five (5) groups of three (3) large diameter trees with individual 36-in CMP tree pots planted at top of slope at approximately 50 to 100 feet intervals (Riverward side)	Remove vegetation, root balls, and CMP tree pots, fill voids with impervious material and firmly compact.	C5 - Obtain direction from D&C.	E2	Agency notification for removal of ornamental trees and recompaction		The businesses are higher than the invert. Is this a levee?	Determination of the levee situation on certain lengths of the levee system will require a hydraulic analysis. This analysis will be performed during the next phase of work.
M3	A group of three (3) empty 36-in CMP tree pots at top of slope (Riverward side)	Remove empty CMP tree pots and root balls, if found, fill voids with impervious material and firmly compact.	C5 - Obtain direction from D&C.	E2	Same as M2		The businesses are higher than the invert. Is this a levee?	Determination of the levee situation on certain lengths of the levee system will require a hydraulic analysis. This analysis will be performed during the next phase of work.
M4	An empty 36-in CMP tree pot at top of slope (Riverward side)	Remove an empty CMP tree pot and root ball, if found, fill void with impervious material and firmly compact.	C5 - Obtain direction from D&C.	E2	Same as M2		The businesses are higher than the invert. Is this a levee?	Determination of the levee situation on certain lengths of the levee system will require a hydraulic analysis. This analysis will be performed during the next phase of work.
M5	Vegetation within 15' of toe (Riverward side)	Remove vegetation and root ball, fill voids with impervious material and firmly compact.	C5 - Obtain direction from D&C.	E1	Veg at toe on terrace & outside creek, ok to rem.		The businesses are higher than the invert. Is this a levee?	Determination of the levee situation on certain lengths of the levee system will require a hydraulic analysis. This analysis will be performed during the next phase of work.
M6	(1) Earthen terrace in front of revetment is experiencing toe erosion (Riverward side); (2) Vegetation within 15' of toe (Riverward side)	(1) Verify rock revetment under terrace has enough toedown depth against current channel invert; (2) Vegetation may need to be removed, in which case, remove vegetation and root ball, fill voids with impervious material and firmly compact.	C3/C4 - Toe evaluation C1 - Vegetation	E2	Agency notification required for veg removal			
M7	Debris (a stockpile of dead trees) on top of grade control structure (Riverward side)	Remove debris from the channel.	C1	E1	OK to remove dead trees			
M8	10" steel pipe w/o a closure device (Sta.7+55)	Install a closure device, if appropriate.	C5 - Survey needed for drain elevation	E2	Install of headwall =excav/concrete in levee	X	Is this flap gate required? Who will determine ownership?	Determination of the need for a flap gate will require a channel hydraulic analysis and an interior drainage analysis. These analyses will be performed during the next phase of work. If as-builts are not available to determine ownership a survey will be required to establish elevations of the storm drain inverts and tops of outlet, inlets, manholes,.etc.
M9	18" RCP w/o a closure device	Install a closure device, if appropriate.	C5 - Survey needed for drain elevation	E2	Install of headwall =excav/concrete in levee	X	Is this flap gate required? Who will determine ownership?	Determination of the need for a flap gate will require a channel hydraulic analysis and an interior drainage analysis. These analyses will be performed during the next phase of work. If as-builts are not available to determine ownership a survey will be required to establish elevations of the storm drain inverts and tops of outlet, inlets, manholes,.etc.
M10	Vegetation (Landscaping) within 15' of toe between Somis Drain Confluence and Adolfo Road (Landward side)	Vegetation may need to be removed. In which case, remove vegetation and root ball, fill voids with impervious material and firmly compact.	C1	E1	OK to remove landscaping			

\*Right of Way column reflects the Operation and Maintenance Division's preliminary opinion based on their field inspections. That opinion will be vetted through the Real Estate Services Division of the Public Works Agency.

**FEMA Levee Certification -VCWPD**  
**Project Team Comments on Tetra Tech's Draft Evaluation Reports**  
**January 2009**

Maint. Defect	Description	Recommended Action by Tetra-Tech	Recommended Response by O&M Division	Environ. Permit Codes	Environmental Services Section Comments	R.O.W. Issue*	Levee Certification Project Team's Comments to Draft Evaluation Reports	Tetra Tech's Response
<b>Calleguas Creek Levee (CC-2) – Somis Drain Category 2</b>								
M11	Vegetation (Landscaping) within 15' of floodwall for its entire length (Landward side)	Vegetation may need to be removed. In which case, remove vegetation and root ball, fill voids with impervious material and firmly compact.	C1 - Up to the fence, C5 - Beyond the fence	E1	Landscaping not regulated			
M12	A flap gate for 18" RCP is fixed open by debris. (Riverward side)	Remove debris from pipe opening and ensure complete seal around the gate.	C1	E1	Debris removal OK, use BMPs			

\*Right of Way column reflects the Operation and Maintenance Division's preliminary opinion based on their field inspections. That opinion will be vetted through the Real Estate Services Division of the Public Works Agency.

Draft Evaluation Report  
January 2009  
Reviewer Comments

Levee ID	Author	Page Number	Revision Requested	Tetra Tech's Annotations
VR-3	Zia	i	Change 'for' to 'in'. Data collection efforts have been performed to determine what information is available for support of levee certification.	<b>Change made.</b>
		i	Under LiDAR Topographic data, reviewer requests addition of 1. Compare the river bed vertical elevation and cross section changes by topo & survey. 2. There are some areas always need repair by records. Point out the areas need re-study.	<b>This entire levee was severely damaged in the 2005 flood. This levee is being re-designed by the Corps of Engineers from Santa Ana Blvd to the Live Oaks Diversion. Tetra Tech would need to review the Corps design to see if new topographic data was used.</b>
		1	Change 'give year' to 'given year'. "... or exceeded in any give year (base flood).	<b>Change made.</b>
		3*	Change 'addition' to 'additional'. "...however addition sedimentation and scour analyses..."	<b>Change made.</b>
		3	Change 'the' to 'that'. "...NFIP regulations requires the engineering analyses..."	<b>Change made.</b>
		4	Question: Are interior flooding and interior drainage the same? Please clarify the use of these terms. Are they to be used interchangeably?	<b>Interior flooding is caused from impeded interior drainage.</b>
		4	To the Levee Penetration portion, add: 1. Is the flap gate work fine? 2. Sediment deposition in the gate area? 3. Describe existing condition and pictures.	<b>The flap gate is in working order unless it is listed in Table 2 where its condition is described and associated photos are referenced in Appendix C.</b>
	Jaques	<b>General Comment</b>	The middle section of this reach is not a levee. Does it make sense to split this into two separate levees? 1. Near Santa Ana Blvd and 2. Live Oak Creek Diversion to where the levee terminates?	<b>A determination of segmenting this levee system would have to be made during the hydraulic analysis which is the next phase of work.</b>
		ii	Why is as-built plan show as Category 3?	<b>The construction of the Corps' proposed design is not expected to happen with in the PAL time schedule (Nov.30,2009) therefore as-builts would not be prepared.</b>
		3	Why is a hydrograph needed for levee certification?	<b>For geotechnical seepage analyses which requires the baseflood stage duration.</b>
		3	See the Bureau of Reclamation report "Hydrology, Hydraulics, and Sediment Studies for the Meiners Oaks and Live Oak Levees-Draft Report (July 2007) for the information on scour analysis, toe down and rock size requirements.	<b>Noted, Tetra Tech has obtained this document and will be used during the next phase of work.</b>
		4	Check with Corps of Engineers on geotechnical available for the levees.	<b>Noted, all available Corps of Engineers' design work will be obtained for use in the next phase of work.</b>
		6	Since the levee and floodwall up to Live Oak Creek Diversion will be improved by the Corps with the Matilija project, should we pursue improvements required on the Diversion portion in anticipation of the Corps certifying this entire levee once their work is complete?	<b>This work needs to be done to certify the entire system however the schedule of this Category 3 levee is to be determined.</b>
		6	Should we ask Tetra Tech to review Corps construction documents as part of their contract?	<b>Yes we will need to review design for certification.</b>
		4	Check with the Corps of Engineers on geotechnical information available for the levees.	<b>Noted, all available Corps of Engineers' design work will be obtained for use in the next phase of work.</b>
		6	Table 2-Summary of Maintenance Required, add the River Stations to the table.	<b>There are many different as-built drawings with different stationing. It was determined the best way to convey the location of the required maintenance was with a Lat. Long. GPS point.</b>

\*Indicates comment made by more than one reviewer.

Draft Evaluation Report  
January 2009  
Reviewer Comments

Levee ID	Author	Page Number	Revision Requested	Tetra Tech's Annotations
VR-1	Jaques	3*	Change 'addition' to 'additional'. "...however addition sedimentation and scour analyses..."	Change made.
		field investigation report, page 3	Remove "Show desktop.scf"	Change made.
		Appendix B, photos of penetrations	P6 (Stanley Drain) missing from map. Please include.	P6 is shown on pages B-1 and B-2.
		B-4	per Sec. 2.16 USACE levee Owner Manual, Aluminum stop logs should be supported along entire length where stored.	Noted this will be evaluated in the structural analysis.
		Exhibit 2, Preliminary Evaluation of levee system profiles	Station 90+00 to 140+00, is there an additional toe down for green and yellow lines between 140+ and 130+?	We do not have any additional available information showing additional toe down.
SC-1	Jaques	3	Add 'to' between 'used' and 'shape'. "...flood even would be used shape the base flood..."	Change made.
		4	Remove 'it'. Their findings are that only 5% of the rock is breaking down and they do not anticipate it the break down to continue at ..."	Change made.
		field investigation report, page 1	Insert 'County' between Ventura and Watershed. "The team included representatives from the Ventura Watershed Protection District..."	Change made.
		B-2	per Sec. 2.16 USACE levee Owner Manual, Aluminum stop logs should be supported along entire length where stored.	Noted, this will be evaluated in the structural analysis.
AS-6	Jaques	3	Insert commas as follows: "reference, however, additional sedimentation and scour..." "...dated February 2004 will be useful as a reference however addition sedimentation and scour analyses..."	Change made.
		Field investigation report page 3	Change "borrows" to "burrows" throughout.	Change made.
		Levee Inspection Log, A-1	Change "borrows" to "burrows" throughout.	Change made.
		B-5	per Sec. 2.16 USACE levee Owner Manual, Aluminum stop logs should be supported along entire length where stored.	Noted, this will be evaluated in the structural analysis.
		Appendix C, Photos of Maintenance Required Locations	M22R Photo Caption, revise borrow to read "burrow"	Change made.
	Joe Lampara	General Comment	Similar to AS-7, this levee system is identified as extending along Arroyo Simi from f <sup>l</sup> . Street to Erringer Road. In actuality this reach is a combination of a series of levees, including a floodwall located immediately upstream of f <sup>l</sup> Street, and levees located in the immediately vicinity of the channel drop structures, and along one reach of low land at the upstream end adjacent to the channel. Between these locations there are reaches of incised channel which do not meet the definition of a levee or levee system.	Determination of the levee situation on certain lengths of the levee system will require a hydraulic analysis. This analysis will be performed during the next phase of work.

\*Indicates comment made by more than one reviewer.

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Reviewer Comments

Levee ID	Author	Page Number	Revision Requested	Tetra Tech's Annotations
AS-7	Jaques	General Comment	A LOMR was accepted FEMA on March 4, 2003.	<b>All Current LOMRs have been requested from FEMA, if the County has a copy Tetra Tech would like to obtain a copy.</b>
		6	Application of 44 CFR65.10 criteria should be applied only to the reaches of the channel between 1 <sup>st</sup> and Erringer that meet the definition of a levee.	<b>Determination of the levee situation on certain lengths of the levee system will require a hydraulic analysis. This analysis will be performed during the next phase of work.</b>
		field investigation report, page 1	Insert 'County' between Ventura and Watershed. "The team included representatives from the Ventura Watershed Protection District..."	<b>Change made.</b>
		field investigation report, page 4	Table 1-Summary of Penetrations. River Station 120+72 and 125+66.1, reviewer indicates the WSL is below the existing ground.	<b>Noted</b>
CC-3	Jaques	General Comment	If this levee is 2' above adjacent ground (page 1) and FEMA requires 3' minimum levee height above the 100 yr flood, how is this a levee? It looks like this should be re-categorized as Not a Levee.	<b>The 2' height is based on a visual inspection. Determination of the levee situation will require a hydraulic analysis to compare the 100-yr WS to adjacent ground. This analysis will be performed during the next phase of work. If the analysis shows the 100-yr WS is below adjacent ground then de-listing this stretch of channel as a levee will be pursued.</b>
		Field Investigation Report, 1	Has the Kasraie Report and Draft D-Firm maps been reviewed? I believe that they show breakout to the east in this reach of Calleguas Creek.	<b>They have not been reviewed. Tetra Tech has requested all current D-Firm analyses and Appeals from FEMA. If the County has a copy Tetra Tech would like a copy.</b>
	Joe Lampara	General Comment	The efforts under Phase 1 involve the categorization of the nine Provisionally Accredited Levees in Ventura County. Levee categories include: Category 1 – levee meets 44CFR65.10 requirements and all data or complete documentation is available, Category 2 – levee may meet 44CFR65.10 criteria , but additional data or documentation is needed, Category 3 – levee does not currently meet 44CFR65.10 criteria, Not a levee – Based on physical conditions, low WSEL, no SFHA, and/or not providing flood protection. This levee system, which extends along Calleguas Creek from Pleasant Valley Road to Hwy 101, may not be a levee in the sense as a levee is defined. Phase 1 efforts must include this determination prior to the final categorizing of this "levee system." Determination under Phase 3 efforts that Phase 1 efforts were incomplete.	<b>The 2' height is based on a visual inspection. Determination of the levee situation will require a hydraulic analysis to compare the 100-yr WS to adjacent ground. This analysis will be performed during the next phase of work. If the analysis shows the 100-yr WS is below adjacent ground then de-listing this stretch of channel as a levee will be pursued.</b>
CC-2	Joe Lampara	General Comment The reach between Mission Oaks and this point no longer meet the definition of a levee.	This levee system is identified as extending along Calleguas Creek from Mission Oaks Blvd. upstream to Adolfo Road. It includes the reach of Somis Drain from Calleguas Creek up to The reach upstream of Somis Drain along Calleguas Creek to Adolfo Road is not a levee in that the surface of the ground landward of the Calleguas Creek Channel is higher than the streambank protection placed along the channel bank. As originally constructed the levee did extend from Mission Oaks Blvd to Somis Drain. Subsequent to the completion of construction of this levee developers were granted permits to fill in portions of the land behind the levee to allow for industrial development. As a result there is a reach of the original levee extending from Mission Oaks Blvd. upstream for approximately 1500 feet that no longer meets the definition of a levee. The surface of the ground landward of the levee now exceeds base flood elevation in the channel, or is at or above the top of levee elevation. Suggest revising the downstream terminus of CC-2 from Mission Oaks Blvd. to the point upstream where the permitted fill placed behind the original levee alignment ends.	<b>Determination of the levee situation on certain lengths of the levee system will require a hydraulic analysis and verification of the higher adjacent ground due to recent improvements. This analysis will be performed during the next phase of work.</b>

\*Indicates comment made by more than one reviewer.

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Levee ID	Author	Page Number	Revision Requested	Tetra Tech's Annotations
ASR-2	Jaques	Field investigation report, A-2	Number 8, Encroachments, remarks are included, but no rating is given. Please add an A, M or a U.	<b>Change made to reflect a U.</b>
		B-2	per Sec. 2.16 USACE levee Owner Manual, Aluminum stop logs should be supported along entire length where stored.	<b>Noted, this will be evaluated in the structural analysis.</b>
		Exhibit 2, Preliminary Evaluation of levee system profiles	Station 120+00 and 130+00, is there an additional toe down for green and yellow lines between 129+ and 128+?	<b>We do not have any additional available information showing additional toe down.</b>
All Levee Reports	Tony Chen	General Comment		
			Please extend the tree removal to a flexible limit. For some trees, the 15' buffer belt is not enough. We need to remove the vegetation and trees within 15' buffer belt. As I learned from FMA classes. I understand some of the special kinds of the tree roots can extend and penetrate the levee. These trees shall be cleaned within a certain distance. I suggest to ask the Environmental Section set up a list of trees need to install an underground buffer wall or remove the special trees within a defined distance.	<b>The Corps guidelines in EM 1110-2-301 are the current standard for vegetation on levees.</b>
			There are power poles in the defined levee area. Do we need to relocate them?	<b>Utility poles within the embankment prism (only 1 on SCR-1) must be relocated.</b>
			A new aero-photo map is necessary to get for study, planning, design and construction purposes. Please put some budget for survey purposes.	<b>Noted</b>
			How to get rid of small animals like gofers.	<b>According to O&amp;M the WPD currently has a plan to control burrowing animals</b>
			A levee Certification Work Team is necessary. It could be consisted by Advanced Planning, O&M, Design and Construction, Environmental Section, and Real Estate Section.	<b>Noted</b>
			There are many small lateral storm drain pipes, how to prevent the backup water?	<b>An interior drainage analysis will be performed on each drain to determine if a flap gate is required.</b>
			There are some developed areas behind the levee. How to get the required land from the land owners?	<b>This is a County Real Estate issue.</b>
			The flood control annually budget is limited. How to get the required money to finish the work?	<b>This is a County Budget issue.</b>

\*Indicates comment made by more than one reviewer.

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Levee ID	Author	Page Number	Revision Requested	Tetra Tech's Annotations
All Levee Reports	Joe Lampara	General Comment		
		All levees categorized as Category 2	Include in the work to be done as noted in Figure 2 for each levee a Right of Way survey to establish in the field the actual limits of County owned property and easements.	This is part of the Title Search/Boundary Survey task.
		CC-2, AS-6, SCR 1, VR-1, ASR-2, CC-3	Figure 2 of each report contains a list of work that needs to be completed for levee certification to be done for each levee. One of the items is Topographic Survey Verification. For selected levees, VR-1 being one, there is a time interval indicated for this work. For the majority of the remaining levees no verification is required. Recommend that topographic survey verification being included the levees noted with this comment. The reasoning for including it with VR-1 can be applied to the others, i.e. ASR-1 – concerns exists regarding the elevation of the channel, including the stabilizer, relative to the footing of the floodwall. Without a survey it may not be possible to discern the relationship of these two items. For CC 3, if this levee is not categorized as "not-a-levee" in Phase 1, verification of the topography is required under Phase 3 in order to finalize whether or not CC-3 is a levee.	Tetra Tech will provide the District with a standard specification sheet and survey topo exhibit describing minimum survey requirements for levee certification requirements for all levees, and additional levee-specific survey requirements and locations of additional topo required.
All Levee Reports	Zia	General Comment	What is the plan for soil testing?	A scope of work detailing the subsurface exploration, laboratory testing and geotechnical assessment is being prepared for the next Phase of work.
			Why is the consultant requesting consolidation tests?	The purpose for the consolidation testing is three-fold. The first reason is to determine the existing conditions of the alluvium and levee material and evaluate if any material may experience consolidation with future loads that could be detrimental to the levee. The second, and in this case more critical, is to determine if any consolidation as a result of the original levee construction is anticipated. Secondary compression or consolidation in fine grained soils is dependant on the time needed for the excess pore pressures created by imposed loads to dissipate allowing the soil to consolidate. Typically the finer grained a soil and the thicker the soil deposit, the longer amount of time is needed for consolidation to take place. By running time based consolidation tests on samples collected, we can anticipate the amount of settlement that is to occur, as well as the time needed, as a result of implied loads on the soil. If we have a condition, say, that just meets the 3 feet of freeboard and we are anticipating another 6 inches of settlement in the foreseeable future, something will need to be done to ensure that the levee can maintain that 3 feet of freeboard. The third reason is to evaluate the potential for hydro-collapse. If soils are rapidly deposited and are buried quickly by subsequent depositional events, the soil structure may develop such that they have not been allowed to consolidate fully. Additionally, mineral accumulation, such as salts or caliche, may also develop giving the soil added strength. When these soils are subsequently saturated during a future event, the potential for consolidation of the loose soils or dissolution of the mineral content, collectively know as hydro-collapse, exists. In some cases this collapse can be significant and has caused failure of structures built over the collapsible soils. The testing for this potential is similar to consolidation testing, although slightly less time consuming, and will be conducted if the field investigation reveals the potential.
			Could the consultant please be more specific when commenting on areas of concern? Please quantify problems, instead of making general comments.	Tetra Tech would be happy to answer any specific questions, however for most items specific data is not required and with the accelerated schedule detailing and quantifying each problem is not feasible.

\*Indicates comment made by more than one reviewer.

## VCWPD OPERATION & MAINTENANCE DIVISION RFI

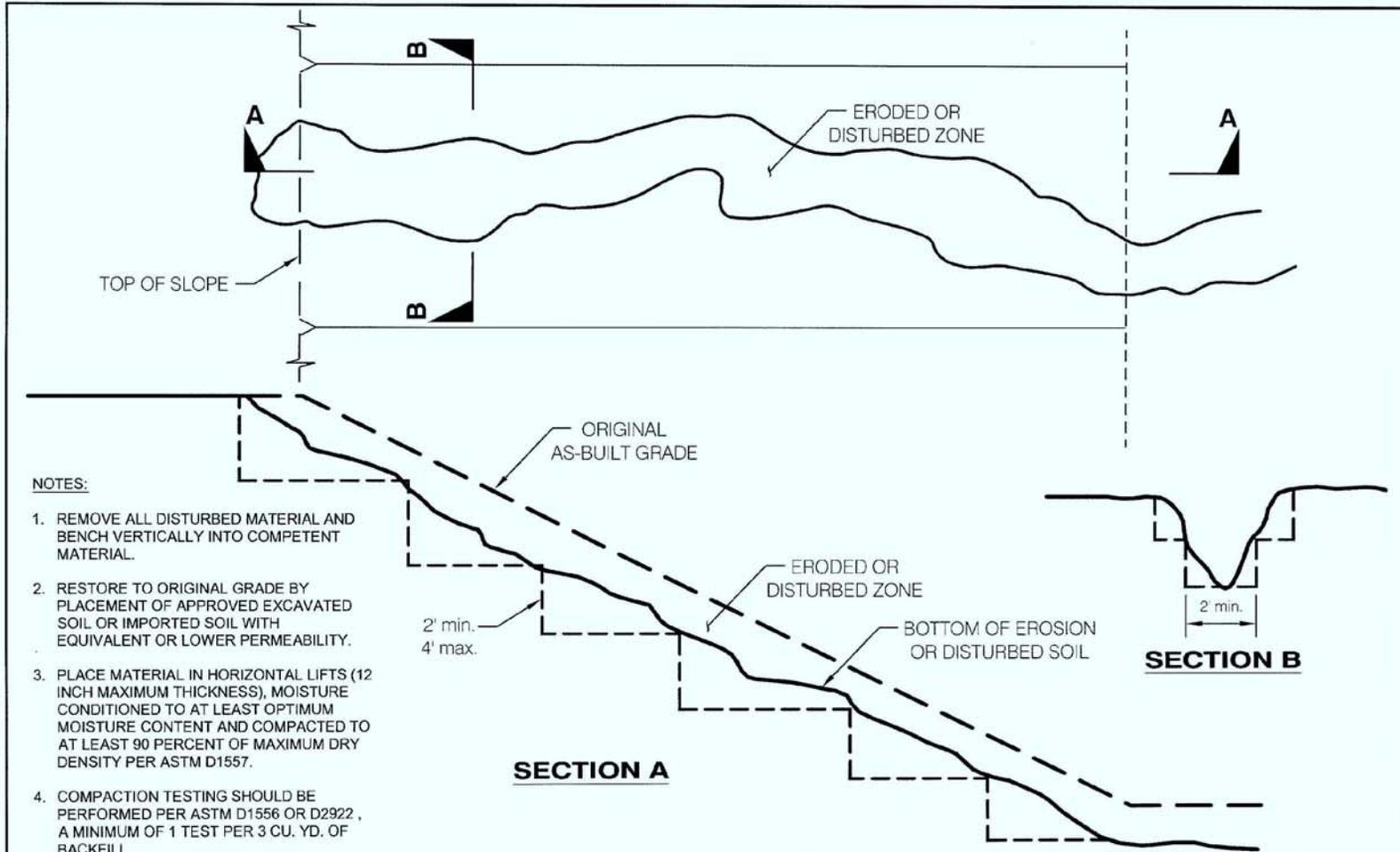
VCWPD O&M QUESTION	TETRA TECH/AMEC RESPONSE
<p>1. Animal burrow/hole repair procedures. Please confirm acceptable methods. Also confirm acceptable documentation method.</p>	<p>For small isolated burrows, infilling of the burrow with grout is sufficient. The grout should be relatively free flowing to permeate the burrows. A typical grout specification would be similar to CalTrans Specifications Section 41-1. A copy of this section is attached but should be modified to suit the conditions.</p> <p>For areas where a large number of interconnected burrows exist or the amount of burrows present has caused surficial instability, removal and replacement/re-compaction of the impacted material is needed. The attached Figure 1 presents a typical detail and backfilling requirements.</p> <p>Documentation for the singular burrows shall consist of a documentation of the location, size, volume of grout placed, and other pertinent details. Documentation of the removal and replacement/re-compaction of the impacted material shall be conducted by a certified testing and materials lab that the District is familiar with. The documentation shall include a report provided by the testing and materials lab. AMEC will periodically observe these locations and will require a copy of the report for documentation and review.</p>
<p>2. Please describe methods for vegetation and rootball removal.</p>	<p><b>4" DIAMETER TRUNK OR GREATER:</b> Cut the woody vegetation approximately two (2) feet above ground level leaving a prominent stump for use in the rootball extraction process. Remove the stump and rootball by pulling or extracting with a backhoe or similar equipment. Clean the rootball cavity of all loose soil and remaining root system (roots greater than 1/2" diameter). Prepare the cavity by excavating per FIGURE 2. Backfill with excavated soil or imported soil with equivalent or lower permeability. Place material in horizontal lifts no greater than twelve (12) inches. Moisture conditioned to at least optimum moisture content and compacted to at least ninety (90) percent of the maximum dry density of the fill soil per ASTM D1557. Compaction typically requires the use of manually operated compaction equipment or compaction attachment to a backhoe. Compaction testing should be performed per ASTM D1556 or D2922. A minimum of one (1) test per three (3) cubic yards of backfill.</p> <p><b>2"-4" DIAMETER TRUNK:</b> Cut the woody vegetation stump flush with the ground. Treat the stump with a protective coating similar to polyurethane to prolong the decay process.</p>

<b>VCWPD O&amp;M QUESTION</b>	<b>TETRA TECH/AMEC RESPONSE</b>
	<p>2" DIAMETER TRUNK OR LESS: Cut the woody vegetation to twelve (12) inches of height above the ground level.</p> <p>For all vegetation removal under 4" trunk diameter, no documentation is necessary. For larger rootball removal in which excavation and compaction is required, documentation of the impacted material shall be conducted by a certified testing and materials lab that the District is familiar with. The documentation shall include a report provided by the testing and materials lab. AMEC will periodically observe these locations and will require a copy of the report for documentation and review.</p>
<p>3. Where is 15' buffer from toe measured from (buried portion or at ground level)?</p>	<p>The fifteen (15) foot vegetation line is measured from the visual toe of slope to the center line of the trunk (tree), the closest trunk to the toe (multiple trunk trees/plants) or the stock/stem protruding through the soil (large plant connected to a root system)</p>
<p>4. Can Tetra Tech provide specs for compaction and grading requirements? Discuss major and minor repair examples.</p>	<p>Compaction requirements are detailed on the attached Figures 1 and 2. Major repair examples include any erosion feature that is deeper than 1 foot or that is greater than 2 feet wide. Major and minor animal burrows are discussed in item 1.</p>
<p>5. Can in-kind materials be used for backfill?</p>	<p>In-kind backfill would be materials free of organic or deleterious debris that has similar or lower permeability than the levee material. These materials could consist of excavated soil, imported soil, concrete, or slurry, and shall be evaluated by the testing and materials lab.</p>
<p>6. Discuss documentation/inspection requirements for verification of grading.</p>	<p>The requirements for verification of grading are discussed above.</p>

<b>VCWPD O&amp;M QUESTION</b>	<b>TETRA TECH/AMEC RESPONSE</b>
7. Can Tetra Tech provide weekly inspection of work completed to date?	Future work can be observed by AMEC. It is suggested that scheduling field time be conducted to maximize the efficiencies of the site visits. AMEC will provide a site visit to each levee during repair work preferably before backfill commences. Additional site visits would likely incur additional costs.
8. Please provide a procedure for concrete patching.	<p>All repairs should extend at least three (3) inches beyond the area of delaminated or broken concrete and should be chipped out to at least 3/4 inch below any exposed reinforcing. Concrete patch edges should be sawcut without damaging embedded reinforcing bars. Sandblast clean all exposed concrete and steel surfaces in repair opening and paint any exposed reinforcing bars and tensioning posts with a protective anti-corrosive coating. After coating cure, recast the repair opening using concrete patching material.</p> <p>In the case of minor chipping of concrete surface – no deep concrete cracks or steel exposure – a high performance urethane polymer or industrial bonding epoxy may be used to restore the concrete surface.</p> <p>The documentation shall include a report documenting the statement of work, list of materials used and photos. Tetra Tech will make a final inspection of the completed work.</p>
9. Is a headwall needed for flap gate attachment?	<p>No. Different styles of heavy-duty flap gates can be attached directly to an exposed corrugated pipe. If the pipe already ends directly at a headwall or culvert, then it is recommended the flap gate be attached to the concrete surface. In either application the flap gate needs to remain operational and achieve the goal of backflow prevention.</p> <p>The documentation shall include a report documenting the statement of work, list of materials used and photos. Tetra Tech will make a final inspection of the completed work.</p>
10. Are rock or soil piles (or ramps) a problem for certification?	Any trash, debris or other obstructions that inhibit operations and maintenance performance and visual inspection of a levee will affect the completion of certification. Unauthorized levee debris that causes obstruction from routine levee inspection and management, obstruction to flood-fighting zones, and debris flow/breeching during storm events must be removed.

<b>VCWPD O&amp;M QUESTION</b>	<b>TETRA TECH/AMEC RESPONSE</b>
11. AS-7, M4R: Is this a levee? Is veg removal required within only 8' of the foundation of the wall?	Determination of the levee situation on certain lengths of the levee system will require a hydraulic analysis. This analysis will be performed during the next phase of work. A levee is an earthen embankment, floodwall, or structure along a water course whose purpose is flood risk reduction or water conveyance. In the case of a floodwall, the root-free zone is the greater of either eight (8) feet from toe of the floodwall foundation or fifteen (15) feet from face of floodwall. If there is a drainage system at the toe, then the eight (8) feet is measured from the outside of the drainage system. All vegetation growing over the floodwall's foundation heel/toe as well as the eight (8) feet root-free zone must be removed.
12. AS-7, M4L: Is seepage a problem for certification?	Further analysis is required to make that determination. Provided that the wall and channel bottom have been designed to accommodate this condition and that existing and anticipated future groundwater conditions are within the anticipated ranges utilized in design, certification may proceed.
13. AS-7, M8L: What is considered the top of the levee? Is there a floodwall?	Determination of the levee situation on certain lengths of the levee system will require a hydraulic analysis. This analysis will be performed during the next phase of work.
14. AS-6, M13L: Does not appear to be a levee.	Determination of the levee situation on certain lengths of the levee system will require a hydraulic analysis. This analysis will be performed during the next phase of work.
15. AS-6, M23R: Does not appear to be a levee.	Determination of the levee situation on certain lengths of the levee system will require a hydraulic analysis. This analysis will be performed during the next phase of work.

FILE: 8212100132-001 EROSION REPAIR - PLOT DATE: 2/4/2009

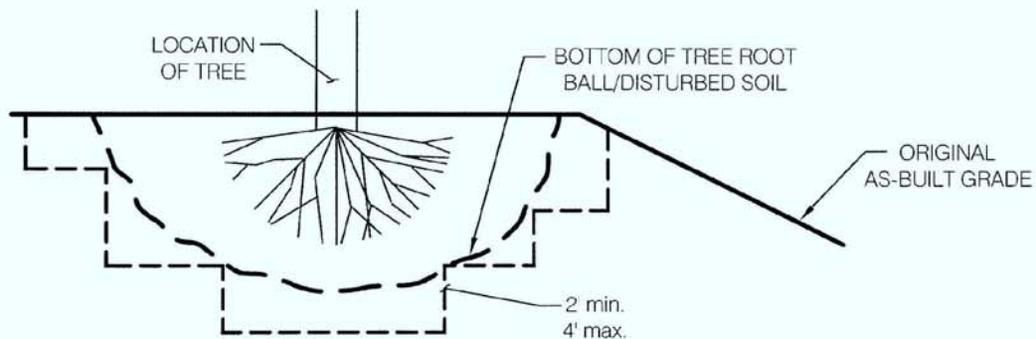


**NOTES:**

1. REMOVE ALL DISTURBED MATERIAL AND BENCH VERTICALLY INTO COMPETENT MATERIAL.
2. RESTORE TO ORIGINAL GRADE BY PLACEMENT OF APPROVED EXCAVATED SOIL OR IMPORTED SOIL WITH EQUIVALENT OR LOWER PERMEABILITY.
3. PLACE MATERIAL IN HORIZONTAL LIFTS (12 INCH MAXIMUM THICKNESS), MOISTURE CONDITIONED TO AT LEAST OPTIMUM MOISTURE CONTENT AND COMPACTED TO AT LEAST 90 PERCENT OF MAXIMUM DRY DENSITY PER ASTM D1557.
4. COMPACTION TESTING SHOULD BE PERFORMED PER ASTM D1556 OR D2922, A MINIMUM OF 1 TEST PER 3 CU. YD. OF BACKFILL.

<b>TYPICAL EROSION OR SURFICIAL SLOPE INSTABILITY REPAIR</b>			
<b>LEVEE CERTIFICATION PROJECT VENTURA COUNTY, CALIFORNIA</b>			
<b>AMEC Earth &amp; Environmental</b> 1290 N. HANCOCK STREET, SUITE 102 ANAHEIM, CA 92807-1924 www.amec.com/earthandenvironmental		DWN BY: JBD	DATE: February 2009
	CHKD BY: DRB	SCALE: Not To Scale	PROJECT NO: 8212100132
		FIGURE No. <b>FIGURE 1</b>	

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**NOTES:**

1. REMOVE ALL DISTURBED MATERIAL AND BENCH VERTICALLY INTO COMPETENT MATERIAL.
2. RESTORE TO ORIGINAL GRADE BY PLACEMENT OF APPROVED EXCAVATED SOIL OR IMPORTED SOIL WITH EQUIVALENT OR LOWER PERMEABILITY.
3. PLACE MATERIAL IN HORIZONTAL LIFTS (12 INCH MAXIMUM THICKNESS), MOISTURE CONDITIONED TO AT LEAST OPTIMUM MOISTURE CONTENT AND COMPACTED TO AT LEAST 90 PERCENT OF MAXIMUM DRY DENSITY PER ASTM D1557.
4. COMPACTION TESTING SHOULD BE PERFORMED PER ASTM D1556 OR D2922, A MINIMUM OF 1 TEST PER 3 CU. YD. OF BACKFILL.

		<b>TYPICAL VEGETATION REMOVAL REPAIR</b>		
		<b>LEVEE CERTIFICATION PROJECT VENTURA COUNTY, CALIFORNIA</b>		
<b>AMEC Earth &amp; Environmental</b> 1290 N. HANCOCK STREET, SUITE 102 ANAHEIM, CA 92807-1924 <a href="http://www.amec.com/earthandenvironmental">www.amec.com/earthandenvironmental</a>		DWN BY:	DATE:	PROJECT NO:
		CHK'D BY:	SCALE:	FIGURE No.
		JBD	February 2009	8212100132
		DRB	Not To Scale	FIGURE 2

## SECTION 41: PAVEMENT SUBSEALING AND JACKING

### 41-1 PAVEMENT SUBSEALING

#### 41-1.01 DESCRIPTION

This work shall consist of filling voids beneath existing portland cement concrete pavement, at the locations shown on the plans, by drilling holes through the existing pavement, injecting grout through the holes and filling the drilled holes with mortar or concrete.

#### 41-1.02 MATERIALS

- Grout for filling the voids beneath the existing pavement shall be composed of portland cement, fly ash and water. Portland cement and fly ash shall be proportioned by weight at the rate of one part portland cement to 2.4 to 2.7 parts fly ash. Water shall be added in an amount to provide a grout efflux time of 10 to 16 seconds as determined by California Test 541, Part D.
- Portland cement for the grout shall be Type II Modified conforming to the provisions in Section 90-2.01, "Cement."
- Fly ash shall conform to the requirements in ASTM Designation: C 618 for either Class C or Class F fly ash, except that the loss on ignition shall not exceed 4 percent. The brand of fly ash used in the work shall conform to the provisions for approval of admixture brands in Section 90-4.03, "Admixture Approval."
- When fly ash, cement, or fly ash and cement are delivered in packages, each package shall be marked plainly with the class, type, name and brand of producer, and the weight of material contained therein. Similar information shall be provided in the shipping invoices accompanying the shipment of packaged or bulk fly ash and cement.
- Chemical admixtures and calcium chloride conforming to the provisions in Section 90-4, "Admixtures," may be used in the grout mixture, subject to the Engineer's written approval.
- In advance of grouting operations, the Contractor shall submit a proposal for the materials to be used in the work accompanied with independent laboratory test data that indicates the initial set time and the one-day, 3-day, and 7-day compressive strengths of the grout at 10-second, 12-second and 14-second efflux times using specimen molds and curing conditions specified in ASTM Designation: C 109.
- Grout having a 7-day compressive strength of less than 750 psi at a 12-second efflux time as determined by the independent laboratory tests will not be acceptable.
- No change in the grout materials shall be made unless a resubmittal of the above information and requirements is furnished to the Engineer.
- Mortar for filling the holes in the concrete pavement shall be composed of one part portland cement to 3 parts fine aggregate, by volume, and only enough water to permit placing and packing of the mortar in the holes. A commercial quality premixed rapid set mortar or concrete may be used to fill the holes.

## SECTION 41

## PAVEMENT SUBSEALING AND JACKING

#### 41-1.03 CONSTRUCTION

- Holes shall be drilled through the pavement and underlying base to a depth of 15 inches to 18 inches below the pavement surface. The holes shall be drilled to the diameter necessary to accommodate the equipment used for injecting the grout. Care shall be taken to protect the pavement surrounding each hole from damage.
- The location of the holes shall conform to the configuration shown on the plans unless otherwise directed or permitted by the Engineer. Before beginning grouting operations, and continuing thereafter to the end of each run or work shift, the holes in at least 2 consecutive slabs requiring subsealing shall be drilled ahead of the grouting operations.
- Open drilled holes shall not remain ungrouted for more than 2 working days.
- The side of the injection hole shall be washed with a minimum water gage pressure of 40 psi just prior to grout injection. The washing device shall be constructed such that a minimum of 4 jets shall direct water horizontally at the slab-base interface.
- The grout plant shall consist of a positive displacement cement injection pump and a high-speed colloidal mixer. The colloidal mixer shall operate between a minimum speed of 800 RPM and a maximum speed of 2,000 RPM. The injection pump shall be capable of sustaining a gage pressure of 150 psi when pumping a grout mixed to a 12-second flow time. A pressure gage shall be located immediately adjacent to the grout hose supply valve and shall be positioned so it can be easily monitored by the Engineer.
- Dry cement and fly ash shall be accurately measured by weight, if in bulk, or shall be packaged in containers of uniform weight.
- Water shall be introduced into the mixing process through a meter or scale.
- Grout not used in the work within one hour after mixing shall be disposed of as directed by the Engineer.
- Grout shall be pressure injected through the holes until all voids under the pavement slab are filled. No portion of the slab shall be moved or raised more than 0.050-inch as a result of pressure grouting. The Engineer will furnish and utilize suitable devices to monitor slab movement during pressure grouting.
- The injection nozzle shall prevent leakage during injection and shall not protrude below the concrete slab. Grout shall be injected into only one hole at a time on any slab. When grout appears at any longitudinal or transverse joint, crack, or adjacent hole, or when monitoring devices indicate slab movement in excess of 0.050-inch, pressure injection of grout shall cease at that hole.
- In the event that grout flow does not occur after 7 seconds of sustained 150 psi injection pump gage pressure and if there is no indication of slab movement, continued injection at that hole shall cease.
- Immediately after the nozzle is removed, the hole shall be temporarily plugged with a round, tapered wooden plug. The plug shall remain in place until pressure grouting at adjacent holes progresses to the point where grout will not be forced up through previously grouted holes.
- In the event the Engineer determines that continued grouting at a location is no longer advantageous, the Engineer may direct the Contractor to cease subsealing operations at that location.

## SECTION 41

### PAVEMENT SUBSEALING AND JACKING

- Grouting shall not be performed when the atmospheric or subgrade temperature is below 40° F, or during inclement weather. When standing rainwater is present in the holes, grouting shall not be performed unless permitted by the Engineer.
- The Contractor shall take necessary precautions to prevent grout from being injected into any drainage facility or other open structure.
- Cracks in the pavement which occur during the injection of grout will be considered as damage to the pavement due to the Contractor's operations. The damage shall be repaired by the Contractor at the Contractor's expense and as directed by the Engineer.
- Upon completion of the grouting operation, grout shall be removed from the drilled holes to a depth of not less than 4 inches below the pavement surface. The holes shall be cleaned and then filled with mortar or premixed, rapid set concrete and finished flush with the concrete pavement surface.
- At the end of each work shift, the work area shall be left in a clean, swept and neat condition.

#### 41-1.04 MEASUREMENT

- The quantity of drilled holes will be measured as units determined by actual count. Any hole drilled that is not shown on the plans or ordered by the Engineer will not be measured nor paid for.
- The quantities of dry cement and fly ash used in the grout mix will be measured by the ton and will be paid for as grout (subsealing). Quantities of grout not used in the work and grout that is wasted by leaking through to the pavement surface because of not taking preventative measures to avoid wasting of grout, will not be paid for. The quantity of grout wasted or disposed of will be determined by the Engineer. Quantities of grout, cement or fly ash remaining on hand after completion of the work will not be paid for.

#### 41-1.05 PAYMENT

- Items of work, measured as specified in Section 41-1.04, "Measurement," will be paid for at the contract unit price for drill hole (subsealing) and the contract price per ton for grout (subsealing).
- The above prices and payments shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in subsealing existing portland cement concrete pavement as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.
- Full compensation for furnishing and placing mortar or concrete for filling the drilled holes shall be considered as included in the contract unit price paid for drill hole (subsealing) and no additional compensation will be allowed therefor.

### 41-2 PAVEMENT JACKING

#### 41-2.01 DESCRIPTION

- This work shall consist of raising existing portland cement concrete pavement to grade, at the locations shown on the plans, by drilling holes through the existing

## SECTION 41

### PAVEMENT SUBSEALING AND JACKING

pavement, injecting grout through the holes to fill voids beneath the pavement and raise the pavement to grade, and filling the drilled holes with mortar or concrete.

#### 41-2.02 MATERIALS

- The grout for pavement jacking and mortar or concrete for filling the drilled holes shall conform to the provisions for grout and mortar or concrete for pavement subsealing in Section 41-1.02, "Materials," except that the grout for pavement jacking shall contain water in an amount to provide a grout efflux time of 16 seconds to 26 seconds. Additional water may be added to reduce the grout efflux time to not less than 10 seconds to initiate the pressure injection of the grout.

#### 41-2.03 CONSTRUCTION

- Pavement jacking shall conform to the provisions for pavement subsealing in Section 41-1.03, "Construction," except for the following:

The positive displacement grout injection pump shall be capable of providing a sustained gage pressure of 200 psi. Gage pressures exceeding 200 psi, but not exceeding 600 psi, may be used for brief periods of time to start the movement of the slab.

Slabs shall be raised uniformly to grade. The Contractor shall furnish and utilize stringlines to monitor the movement of the pavement.

The final elevation of the surface of the concrete pavement shall not vary at any point more than 0.01-foot above or below the grade established by the Engineer. If the surface of the pavement at any point is higher than 0.01-foot above the grade established by the Engineer, the surface shall be ground to meet the above specified tolerance; however, the entire slab shall be removed and replaced with new concrete pavement if the surface at any point is higher than 0.10-foot above the grade established by the Engineer. Grinding of the concrete pavement or removal and replacement of the pavement, if necessary, shall conform to the provisions in Section 42-2, "Grinding," except for payment.

Adjacent slabs, not requiring adjustment in grade, shall not be moved. Corrections to grade of adjacent slabs, if necessary, and as determined by the Engineer, shall be made in the same manner that is required for pavement that is raised to grade.

#### 41-2.04 MEASUREMENT

- The quantity of drilled holes will be measured as units determined by actual count. Any hole drilled that is not shown on the plans or ordered by the Engineer will not be measured nor paid for.
- The quantities of dry cement and fly ash used in the grout mix will be measured by the ton and will be paid for as grout (jacking). Quantities of grout not used in the work and grout that is wasted by leaking through to the pavement surface because of not taking preventative measures to avoid wasting of grout, will not be paid for. The quantity of grout wasted or disposed of will be determined by the Engineer. Quantities of grout, cement or fly ash remaining on hand after completion of the work will not be paid for.