

2870 Gateway Oaks Drive, Suite 150
Sacramento, CA 95833
Tel: 916.679.2000 Fax: 916.679.2900

Prepared For Michael Bessette, PE
SBFCA
Christopher Krivanec, PE, GE
HDR Engineering, Inc.

Project Feather River West Levee

Date January 13, 2016

Subject Recommendation for Levee Degrade at Cultural Site 10 I

Prepared By Michael Hughes, PE

Reviewed By Robert Green, PE, GE

1.0 INTRODUCTION

The HDR team is providing design services to the Sutter Butte Flood Control Agency (SBFCA) for the Feather River West Levee (FRWL) Project. URS Corporation (URS), as a member of the HDR team, has been providing geotechnical engineering services for the FRWL Project.

For the area between approximately Station 1455+00 and 1461+00, the original design called for a full levee degrade to address animal burrows that were identified in this section of the levee during the investigation phase. Following full degrade, the levee was to be rebuilt up to the elevation of the working platform and a cutoff wall installed.

Following detailed evaluation of cultural resource sites along the FRWL alignment, the area proposed for full levee degrade between 1455+00 and 1461+00 was identified as a culturally sensitive site, Cultural Site 8. During levee degrade in the 2014 construction period, midden soils were encountered in the center of the levee between approximately Station 1456+50 and 1460+00 at an elevation of approximately +83 feet (Figure 1). Based on discussions with representatives from the United Auburn Indian Community the area was not to be disturbed further using mechanical excavation techniques. As such, full levee degrade within the current constraints of the construction schedule was not feasible and an alternative solution was needed, details of which are presented below.

2.0 BACKGROUND

Following observation of midden soils in the levee degrade, test pitting was performed to identify the approximate width of midden soil in center of the levee. This indicated that the midden soils were approximately 60 feet wide at the base of the levee and 20 feet wide below the working

2870 Gateway Oaks Drive, Suite 150
Sacramento, CA 95833
Tel: 916.679.2000 Fax: 916.679.2900

platform. This compares to a levee width of approximately 110 feet at the base and 50 feet at the elevation of the working platform. Refer to sketches in Attachment A for details.

3.0 RECOMMENDATIONS

From a geotechnical perspective, the purpose of the full levee degrade was to remove existing animal burrows that appear to be prevalent in this area and could provide preferential seepage paths through the levee and then replace with engineered fill compacted in accordance with contract specification. Given the cultural constraints, in lieu of removing and recompacting the entire levee, it is recommended that at a minimum an outer shell of recompacted material be placed to remove the entranceway to existing animal burrows and deter animals from creating new burrows.

From a seepage perspective, the soil-bentonite cutoff wall along the centerline of the levee provides the necessary seepage barrier to meet exit gradient criteria and as such leaving the midden soils in the central portion of the existing levee will not affect intent of the original design.

Based on the above and discussions with the project team and with DWR, it was recommended to remove the maximum amount of material on both the landside and waterside levee slopes as possible without impacting midden soils. Based on the cross-section of midden soils, this should create a compacted zone at least 10 feet thick on either side of the levee. To address cases where midden soils were potentially wider in the levee profile, a minimum width of removal of 2 feet beyond the 0.5 foot stripping limit was specified.

Following removal of material, the excavated side slopes were to be benched in accordance with the "Fill Key and Benching Detail" shown on Drawing No. C-303, Sheet 43, of the design drawings prior to placement and compaction of backfill materials.

In addition to the removal and replacement work, a new access ramp was constructed on the waterside of the levee between approximately Station 1457+50 and 1460+00, which resulted in a significantly wider levee cross-section in this area. Refer to sketches in Attachment A for details.

5.0 LIMITATIONS

This technical memorandum was prepared in accordance with the standard of care commonly used as the state-of-practice in the engineering profession. Standard of care is defined as the ordinary diligence exercised by fellow practitioners in this area performing the same services under similar circumstances during the same period. The limitations section of the final Geotechnical Data Recommendation Report for the FRWL is applicable for this technical memorandum also.

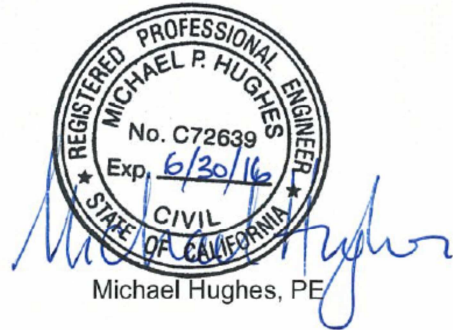


Technical Memorandum

2870 Gateway Oaks Drive, Suite 150
Sacramento, CA 95833
Tel: 916.679.2000 Fax: 916.679.2900

This technical memorandum is for the use and benefit of the HDR Design Team and SBFCA. Use by any other party is at their own discretion and risk.

Michael Hughes, PE
Senior Project Manager (URS)



Robert Green, PE, GE
Principal Geotechnical Engineer (URS)





2870 Gateway Oaks Drive, Suite 150
Sacramento, CA 95833
Tel: 916.679.2000 Fax: 916.679.2900

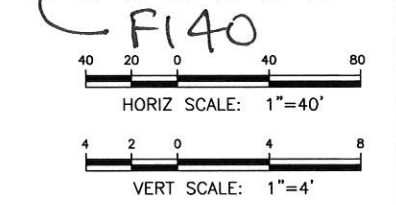
Technical Memorandum

Attachment A

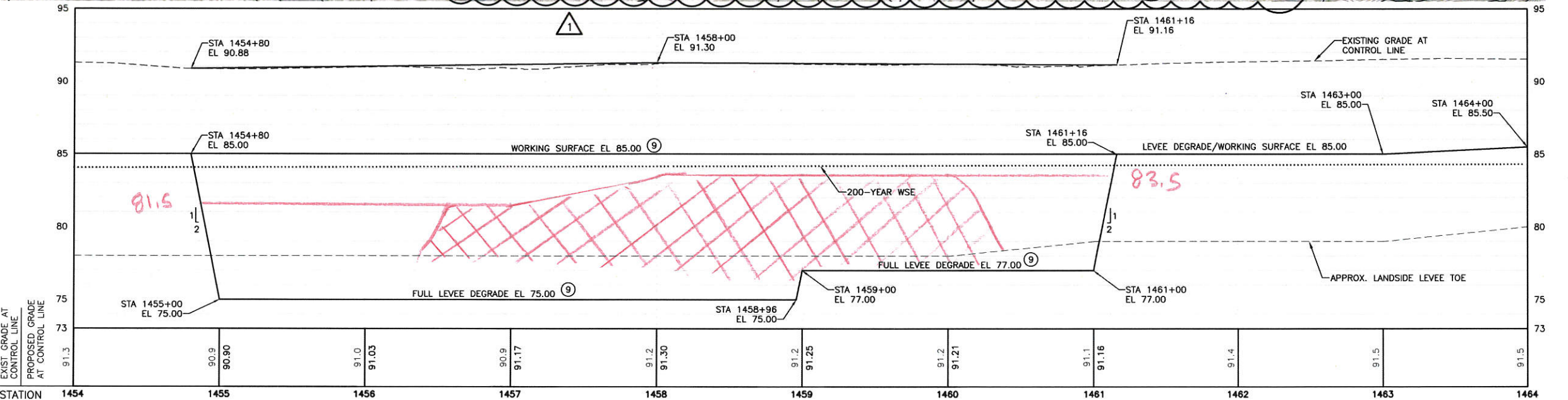
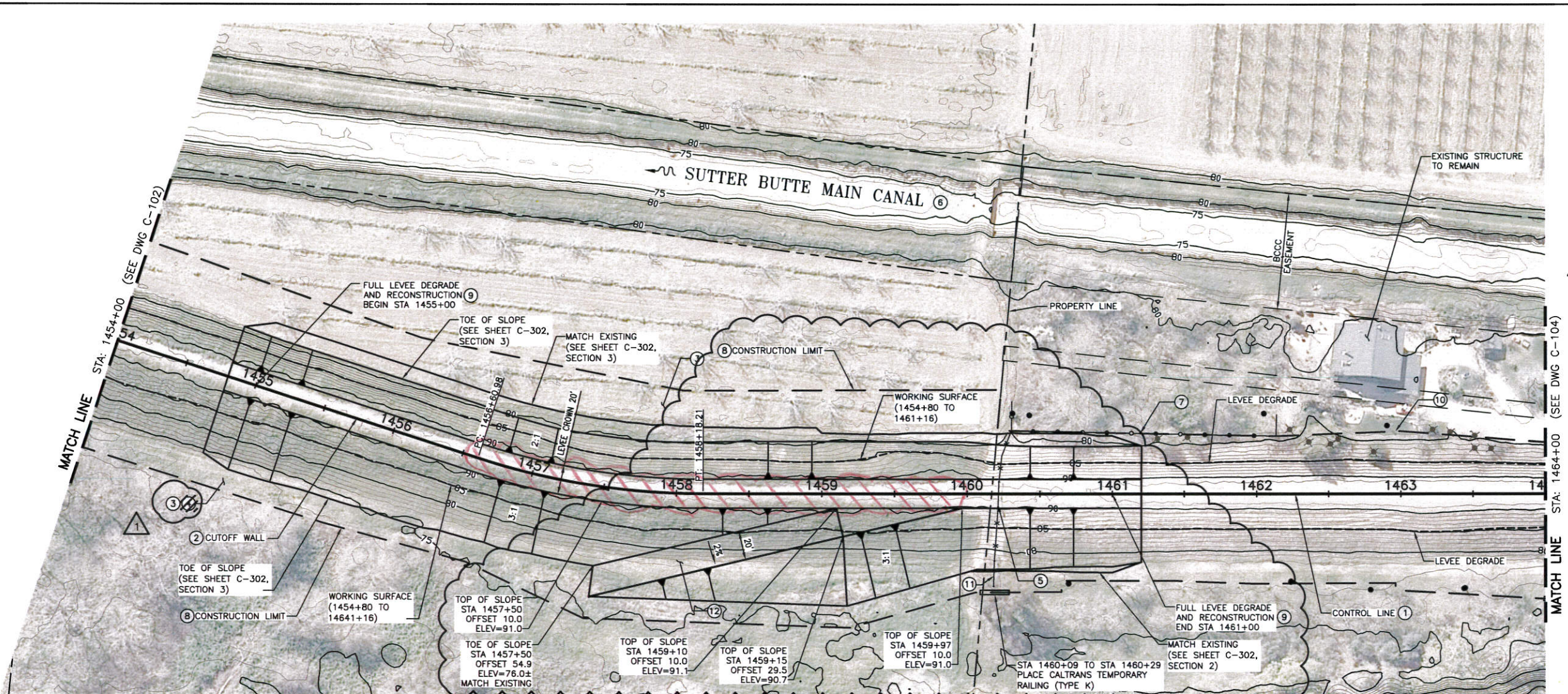


CONSTRUCTION NOTES:

- ① SEE SHEETS G-009 FOR CONTROL LINE TABLES.
- ② SEE SHEETS C-401 TO C-404 FOR CUTOFF WALL PROFILES.
- ③ **ALL TREES ALONG THE LANDSIDE OF THE LEVEE AND WITHIN THE CONSTRUCTION LIMIT SHALL BE REMOVED IN ACCORDANCE WITH THE CONSTRUCTION PLAN. SEE TREE REMOVAL PLAN ON SHEET C-304.**
- ④ **TREES TO BE REMOVED. REFER TO SHEET C-304.**
- ⑤ **TREES ALONG THE WATERSIDE OF THE LEVEE AND WITHIN THE CONSTRUCTION LIMIT MAY BE REMOVED AT THE CONTRACTOR'S OPTION. SEE TREE REMOVAL PLAN ON SHEET C-304.**
- ⑥ NOT USED
- ⑦ EXISTING PIPE GATE AND BARB WIRE FENCES ALONG LEVEE LANDSIDE AND WATERSIDE SLOPES, CONTRACTOR TO REMOVE AND REINSTALL. SEE TYPICAL GATE FOOTING DETAIL ON SHEET C-304.
- ⑧ SUTTER BUTTE MAIN CANAL TO REMAIN. CANAL WILL BE IN OPERATION (FULL OF WATER) DURING CONSTRUCTION. CONTRACTOR TO PROTECT CANAL IN PLACE AND PROVIDE FENCING CONSISTENT WITH THESE PLANS.
- ⑨ EXISTING FENCE TO REMAIN. CONTRACTOR TO PROTECT IN PLACE AND REPLACE IN KIND IF DAMAGED DURING CONSTRUCTION.
- ⑩ CONTRACTOR SHALL PROVIDE HIGH VISIBILITY CONSTRUCTION FENCING AT THE CONSTRUCTION LIMIT LINE. SUCH FENCING SHALL BE OMITTED WHERE SILT FENCING OR CALTRANS TEMPORARY RAILING (TYPE K) IS REQUIRED AT THE CONSTRUCTION LIMIT LINE BY THE PROJECT SWPPP OR IS SHOWN ON THE PLANS. FENCING MAY BE OMITTED WHERE THE CONSTRUCTION LIMIT COINCIDES WITH EXISTING FENCING.
- ⑪ PRIOR TO CUTOFF WALL CONSTRUCTION, CONTRACTOR SHALL FULLY DEGRADE THE LEVEE AS SHOWN THEN RECONSTRUCT TO THE WORKING SURFACE ELEVATIONS NOTED ON THIS PLAN. FULL LEVEE DEGRADE NOT SHOWN IN PLAN VIEW FOR CLARITY. REFER TO THE PROFILE. LEVEE RECONSTRUCTION PER TYPICAL DETAIL 3 ON SHEET C-302 AND LEVEE SECTIONS ON SHEET C-603.
- ⑫ CONTRACTOR SHALL LIMIT ACCESS TO LEVEE TOE ALONG EXISTING RESIDENCE. EXISTING LAWN, DRIVEWAY AND STRUCTURES SHALL BE REPLACED IN KIND IF DAMAGED DURING CONSTRUCTION.
- ⑬ EXISTING PIPE GATE TO REMAIN. CONTRACTOR TO PROTECT IN PLACE AND REPLACE IN KIND IF DAMAGED DURING CONSTRUCTION.
- ⑭ **CONSTRUCT ACCESS RAMP AS SHOWN. RAMP SHALL BE 20-FT WIDE WITH 10% MAXIMUM LONGITUDINAL SLOPE AND 2% CROSS SLOPE. RAMP SURFACING SHALL BE PER DETAIL ON SHEET C-303. AB SHALL EXTEND FROM RAMP TOE TO MATCH AB GRADES AT LEVEE CROWN.**



FOR CONSTRUCTION



| REV. | DATE | BY | CHK. | APPR. | DESCRIPTION | REV. | DATE | BY | CHK. | APPR. | DESCRIPTION |
|------|---------|----|------|-------|--------------------------------|------|------|----|------|-------|-------------|
| Δ | 3/6/14 | JN | DJ | CK | ADDED RAMP/MODIFIED TREE NOTES | | | | | | |
| 0 | 5/20/13 | JN | DJ | CK | CONFORMED SET | | | | | | |

DESIGNED BY:
J. NETTLETON

DRAWN BY:
A. JACKSON

IN CHARGE:
D. JABBOUR

PROJECT MANAGER:
C. KRIVANEC

DATE:
03/18/13

HDR HDR Engineering Inc.
2365 Iron Point Rd. Suite 300
Folsom, CA 95630

REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA
C 63110
Exp. 6/20/14
CIVIL

SUBMITTED _____ APPROVED _____

SUTTER BUTTE FLOOD CONTROL AGENCY

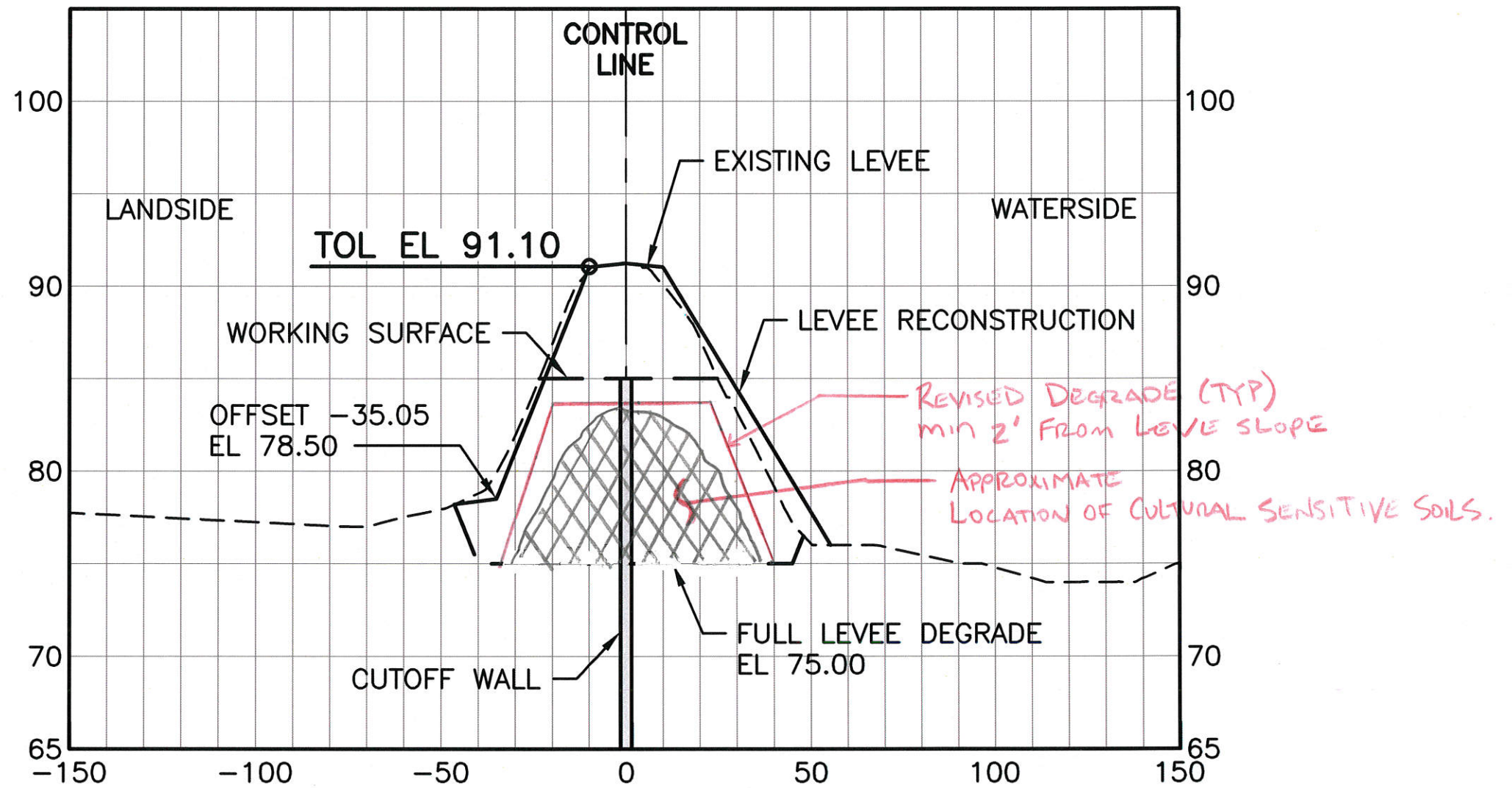
VOLUME 4: FEATHER RIVER WEST LEVEE IMPROVEMENT PLANS

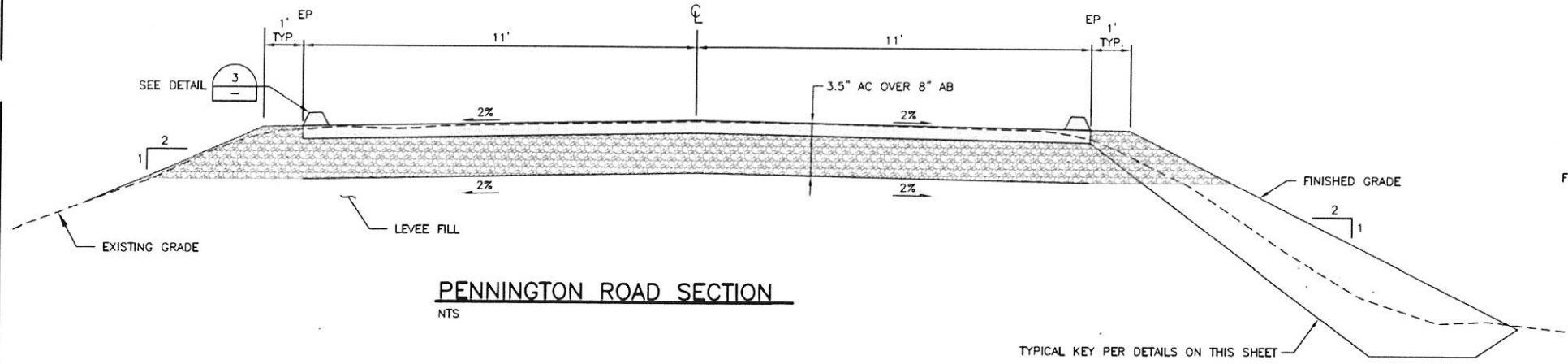
PLAN AND PROFILE
STA: 1454+00 TO 1464+00

VERIFY SCALES
BAR IS ONE INCH ON
ORIGINAL DRAWING.
ADJUST SCALES FOR
REDUCED PLOTS
0"=1"

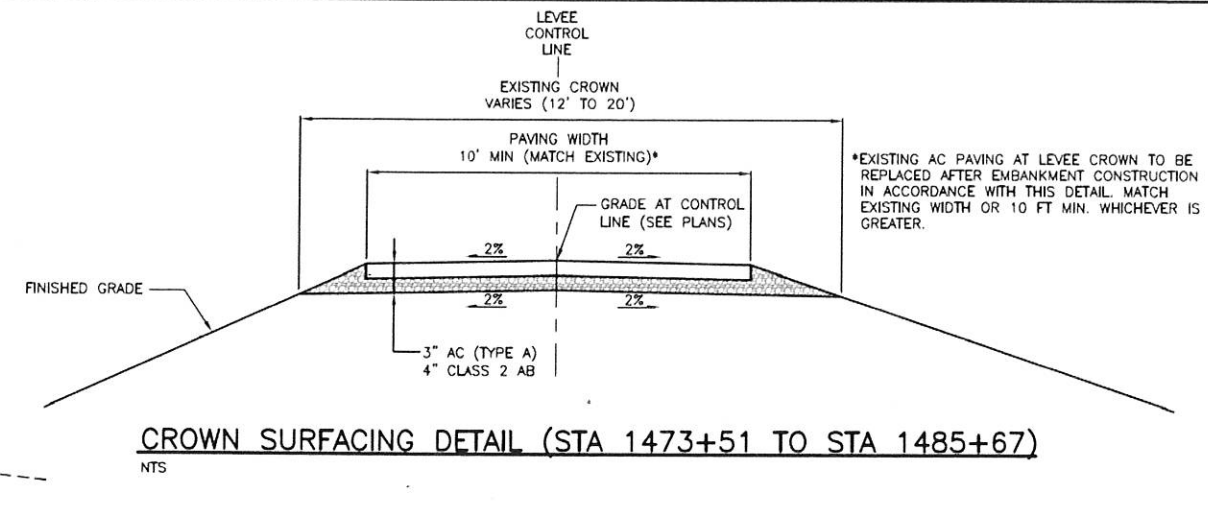
DRAWING NO. C-103 SHEET 22

TYPICAL CROSS SECTION STA 1455+00 to 1461+00

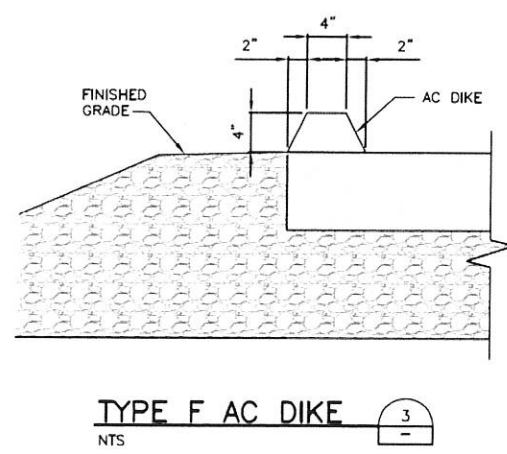




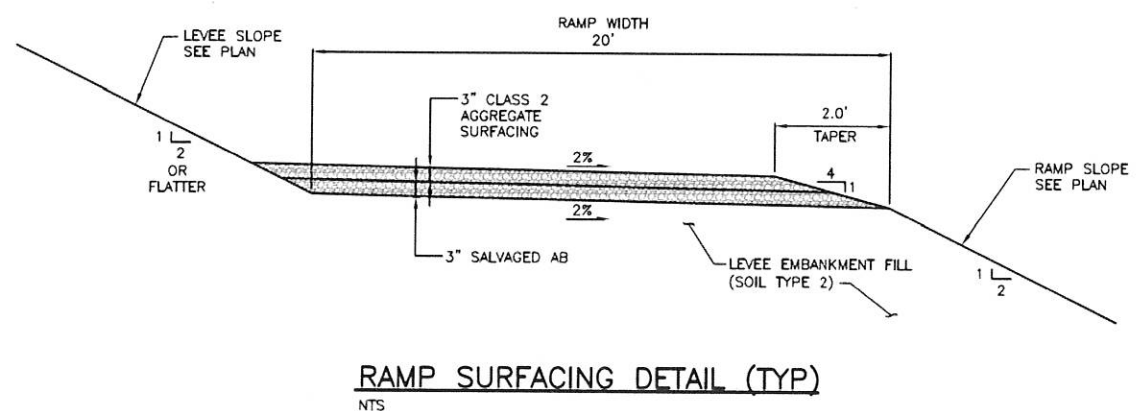
PENNINGTON ROAD SECTION
NTS



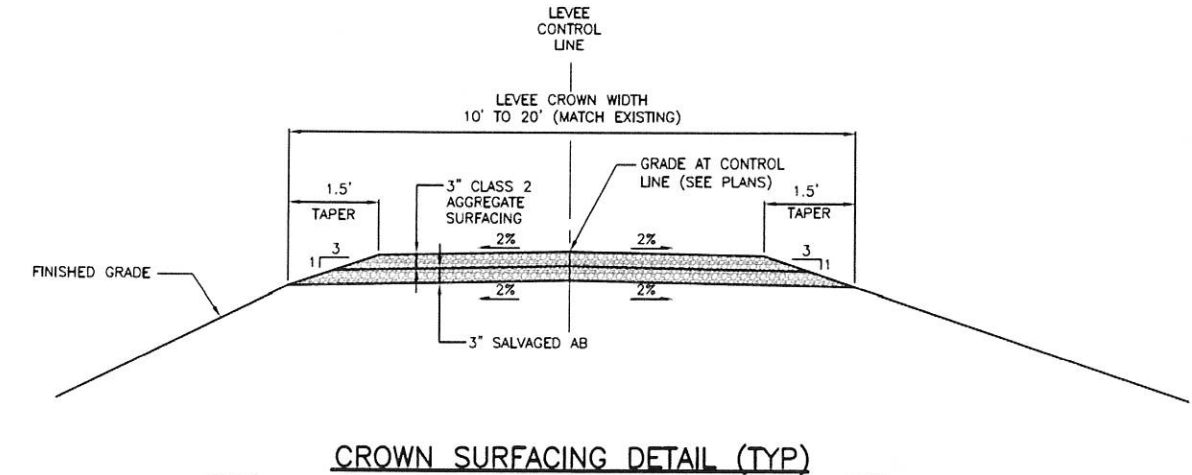
CROWN SURFACING DETAIL (STA 1473+51 TO STA 1485+67)
NTS



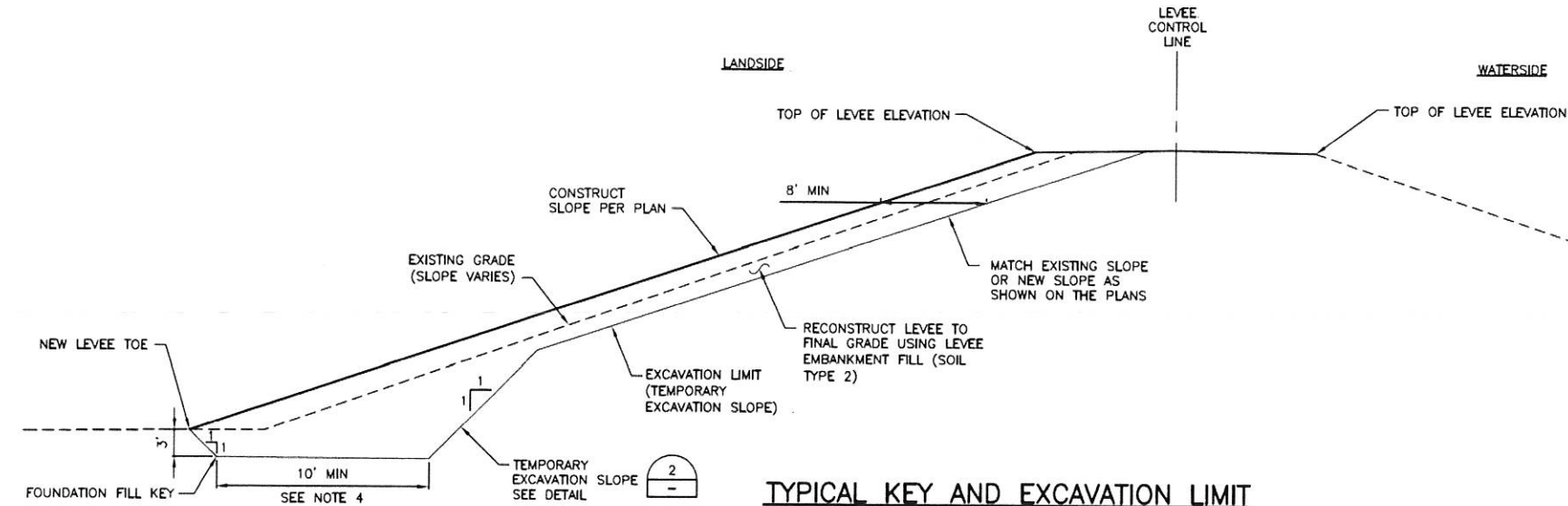
TYPE F AC DIKE
NTS



RAMP SURFACING DETAIL (TYP)
NTS

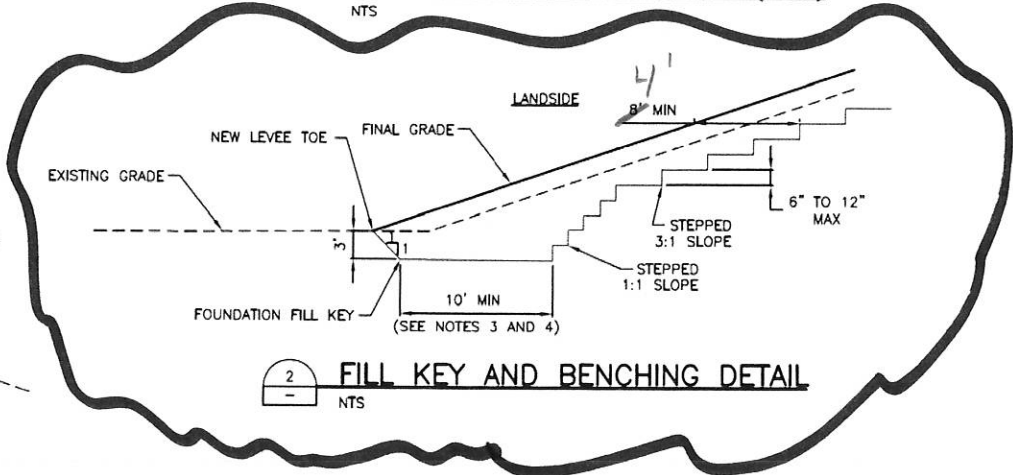


CROWN SURFACING DETAIL (TYP)
NTS



TYPICAL KEY AND EXCAVATION LIMIT
NTS

- STA 1481+80 TO STA 1482+75: LEVEE EMBANKMENT
- STA 1484+69 TO STA 1485+66: LEVEE EMBANKMENT
- STA 1520+04 TO STA 1520+28: LEVEE EMBANKMENT
- STA 1612+05 TO STA 1612+37: LEVEE EMBANKMENT



FILL KEY AND BENCHING DETAIL
NTS

TYPICAL KEY & BENCHING NOTES:

- PLACE FILL IN HORIZONTAL LIFTS AGAINST VERTICAL FACES CUT INTO EXISTING LEVEE MATERIAL.
- THE BOTTOM OF THE KEY TRENCH SHALL BE SCARIFIED TO A DEPTH OF 8 INCHES AND RECOMPACTED TO 95% MAXIMUM DENSITY PER ASTM D698.
- THE LEVEE KEY TRENCH SHALL BE INSPECTED BY THE AGENCY'S GEOTECHNICAL ENGINEER BEFORE PLACEMENT OF FILL.
- WHERE EMBANKMENT FILL IS GREATER THAN 10' IN WIDTH, FOUNDATION KEY SHALL EXTEND FROM THE TOE OF THE NEW LEVEE TO THE TOE OF THE EXISTING LEVEE. IN NO CASE SHALL THE FOUNDATION KEY WIDTH BE LESS THAN 10'.

FOR CONSTRUCTION

C:\working\ca03\dwg_5152013_42803_PM_jnetlib

| REV. | DATE | BY | CHK. | APPR. | DESCRIPTION | REV. | DATE | BY | CHK. | APPR. | DESCRIPTION |
|------|---------|----|------|-------|---------------|------|------|----|------|-------|-------------|
| 0 | 5/20/13 | JN | DJ | CK | CONFORMED SET | | | | | | |

DESIGNED BY: J. NETTLETON
 DRAWN BY: A. JACKSON
 IN CHARGE: D. JABBOUR
 PROJECT MANAGER: C. KRIVANEC
 DATE: 03/18/13

HDR HDR Engineering Inc.
 2365 Iron Point Rd. Suite 300
 Folsom, CA 95630

REGISTERED PROFESSIONAL ENGINEER
 D. JABBOUR
 C 63110
 Exp. 12/31/14
 CIVIL
 STATE OF CALIFORNIA

SUBMITTED _____ APPROVED _____

SUTTER BUTTE FLOOD CONTROL AGENCY
VOLUME 4: FEATHER RIVER WEST LEVEE IMPROVEMENT PLANS

TYPICAL LEVEE SECTIONS

VERIFY SCALES. BAR IS ONE INCH ON ORIGINAL DRAWING. ADJUST SCALES FOR REDUCED PLOTS.
 0" = 1"

DRAWING NO. SHEET
 C-303 43