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2255-0030
05-300-7.08

TECHNICAL MEMORANDUM

March 3, 2016

Project: Cities of Lathrop and Manteca
Urban Levee Design Criteria (ULDC) Evaluation

Subject: 7.8 – Levee Geometry

Prepared by: Erik E. Almaas, P.E.

Reviewed by: Christopher H. Neudeck, P.E.
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1.0 PURPOSE

Detailed analyses and documentation have been performed and developed of the existing levee system of Reclamation District No. 17 (RD17) in order to determine the extent of Urban Levee Design Criteria (ULDC) compliance. The purpose of this technical memorandum is to present the data sources, assumptions, analyses, and results as they pertain to ULDC Item No. 7.8 – Levee Geometry. The team responsible for undertaking this effort consists of Peterson, Brustad, Inc. (PBI), Kjeldsen, Sinnock and Neudeck, Inc. (KSN), and ENGEO, Inc.

2.0 PROJECT BACKGROUND

Legislation passed in 2007 substantially limits the ability of urban communities to approve residential, commercial and industrial development after July 2016 unless they have an Urban Level of Flood Protection (ULOP) or are making adequate progress toward achieving ULOP 200-year flood protection. Background on this mandate was summarized in "*Position Paper for City of Lathrop, Compliance with SB5: ULOP 200-Year Flood Protection for Lathrop (RD 17)*" dated February 3, 2014, by Glenn Gebhardt, City Engineer for the City of Lathrop.

In April 2014, PBI prepared a Strategic Plan for ULOP Compliance for RD17 communities, which outlined a strategic plan for complying with SB5 for the area protected by RD17 levees on a schedule that will meet the requirements of the law. The main component of this Strategic Plan was to perform a comprehensive ULDC analysis and identify areas of deficiencies for each of the ULDC criteria. The analyses presented in this technical memorandum pertain to one of these ULDC criteria: 7.8 – Levee Geometry.

3.0 LEVEE ASSESSMENT

The analyses described in this technical memorandum have been developed at a detailed level using an assessment of the existing levee system to determine the extent of ULDC deficiencies. The assessment was based on a combination of new and existing information.

3.1 Data Sources

Existing data sources that were utilized in the levee assessment are as follows:

- Levee Topographic Survey, performed by KSN and Aerial Photomapping Services in 2014
- "*200-Year Freeboard Analysis & Floodplain Mapping within RD 17*", prepared by PBI, dated May 23, 2014
- *Supplement to Standard Operation and Maintenance Manual, Lower San Joaquin River & Tributaries Project, Unit 2, Right Bank Levee of San Joaquin River and Left Bank of French Camp Slough within Reclamation District No. 17*, dated May 1963

3.2 Assumptions

Assumptions that were made in the levee assessment are as follows:

Separate Ongoing Projects:

Construction is currently underway on the RD17 Levee Seepage Repair Project (LSRP). The purpose of this project is to provide seepage remediation of various RD17 levee reaches along the San Joaquin River. Phase I and Phase II have both been completed at a combined cost of approximately $9 million. Phase III is in the midst of the design and permitting stages and is estimated to cost $35 million. The source of funding for LSRP is primarily from annual RD17 property owner assessments and DWR Early Implementation Program (EIP) grants. For purposes of this ULDC analysis, it was assumed that LSRP Phase III will be completed.

Prior Construction and Utilized Levee Geometry:

According to ULDC, minimum levee geometry criteria have previously been specified by various U.S. Army Corps of Engineers (USACE) and State guidance documents, such as USACE Engineering Manual EM 1110-2-1913 (April 30, 2000), Central Valley Flood Protection Board Title 23, and USACE Sacramento District Geotechnical Levee Practice SOP (April 22, 2008). In addition, the USACE's Operation and Maintenance Manual for RD17 describes minimum levee geometry is indicated below in Table 1.

Table 1 - USACE O&M Manual - Minimum Levee Geometry

Minimum Criteria	Downstream of Old River	Upstream of Old River
Crown Width	12'	20'
Waterside Levee Slope	2h:1v	3h:1v
Landside Levee Slope	2h:1v	2h:1v

The minimum levee geometry shown in Table 1 was employed when the USACE performed major levee improvements to the RD17 levee system in the mid to late 1950's. Additional improvements were performed in the late 1980's and early 1990's in order to meet Federal Emergency Management Agency (FEMA) levee accreditation. These additional improvements consisted of heightening the levee, widening the levee crown, and flattening the landside levee slope.

Basis of ULDC Analysis:

ULDC stipulates minimum levee geometry for new levees, or levees with extensive reconstruction. It also specifies that *"exceptions may be allowed for reconstruction of existing levees where the authorized geometry provides for a steeper slope or narrower crown, the levee has performed well, and it meets stability and seepage criteria"*. Taking into account new levee requirements, past levee construction, and historical performance of the levee system, the

minimum levee geometry used as a basis of analysis was established as indicated below in Table 2.

Table 2 - Basis of ULDC Analysis - Minimum Levee Geometry

Minimum Criteria	Downstream of Old River	Upstream of Old River
Crown Width	20’	20’
Waterside Levee Slope	2h:1v	3h:1v
Landside Levee Slope	3h:1v	3h:1v

3.3 Analysis

The analysis of levee geometry consisted of cutting cross sections from the topographic survey data at 200-foot intervals. These cross sections were compared against the appropriate ULDC levee prism (as indicated above in Table 2) oriented to coincide with the Minimum Top of Levee (MTOL). The MTOL was determined by PBI as part of a prior analysis. A full set of cross sections is located in **EXHIBIT 1.**

Sections in which all minimum levee geometry criteria was met were deemed Acceptable. Sections that indicated the need for minor landside slope sliver fills or minor crown reconstruction were deemed a Low Hazard. Sections that indicated the need for extensive reconstruction were deemed a High Hazard.

4.0 DEFICIENCY RESULTS

The levee reaches that were identified as a Low Hazard are indicated below in Table 3. These reaches require only minor landside slope sliver fills or minor crown reconstruction, have historically performed well, and generally meet stability and seepage criteria. Therefore, they are deemed compliant and no further action is required.

Table 3 - Levee Geometry - Low Hazard

Station from	Station to	Length (feet)
257+00	259+00	200
263+00	269+00	600
271+00	273+00	200
277+00	279+00	200
341+00	347+00	600
355+00	359+00	400
391+00	393+00	200
397+00	399+00	200
421+00	423+00	200
449+00	453+00	400
487+00	489+00	200
507+00	509+00	200
821+00	822+80	180
855+00	875+00	2,000

Station from	Station to	Length (feet)
907+00	917+00	1,000
925+00	931+00	600
		7,380

A separate, comprehensive stability and seepage study will be performed as part of the analyses of ULDC Item Nos. 7.4 and 7.5. Any levee reaches that are determined to NOT meet stability and seepage criteria will be reconstructed accordingly.

The levee sections that were identified as a High Hazard are indicated below in Table 4. These sections are deemed deficient.

Table 4 - Levee Geometry - High Hazard

Station from	Station to	Length (feet)
822+80	825+00	220
931+00	972+25	4,125
		4,345

It is recommended that all levee sections deemed a High Hazard be reconstructed in compliance with ULDC guidelines. Resolution to the identified deficiencies has been addressed as indicated in the proposed ULDC improvement plans and cost estimate. Figure 1 consists of an overall map that summarizes the deficiencies of the RD17 levee system with respect to levee geometry.

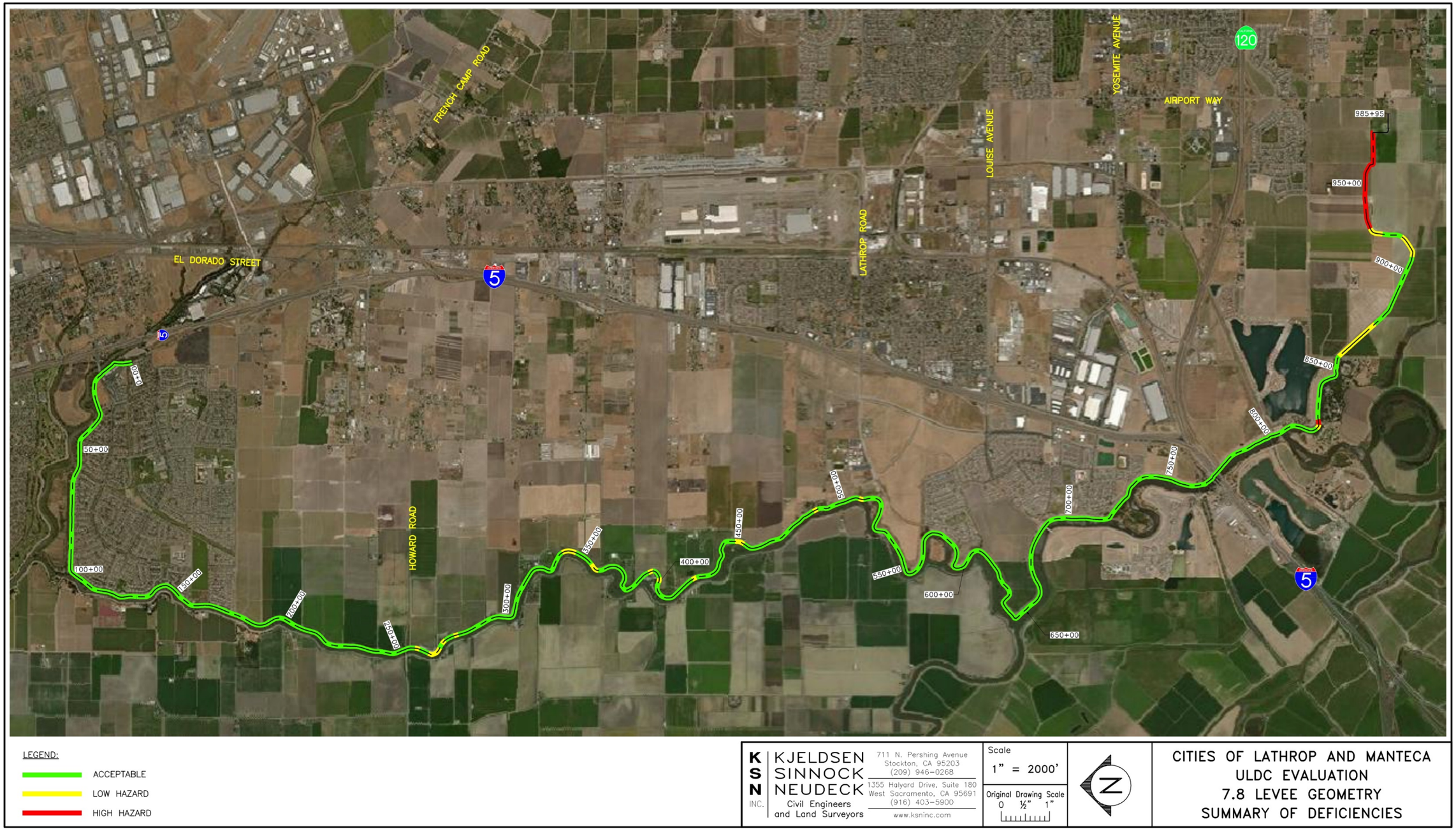


Figure 1 - Summary of Deficiencies

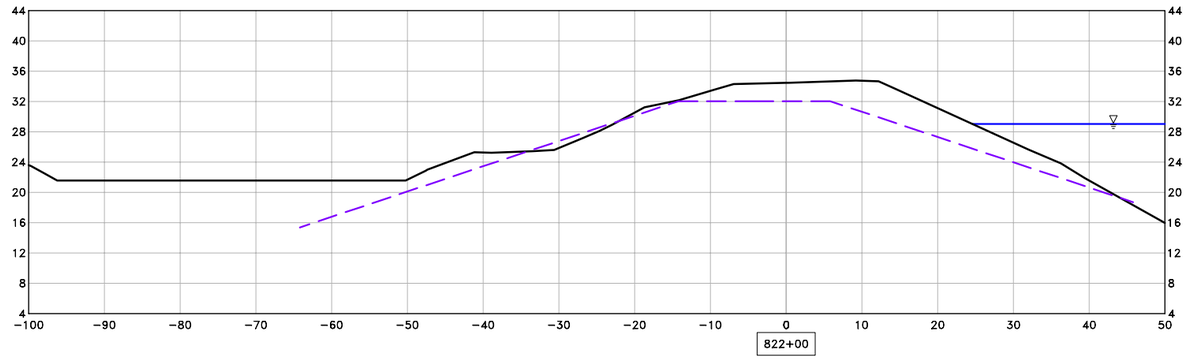
Cities of Manteca and Lathrop

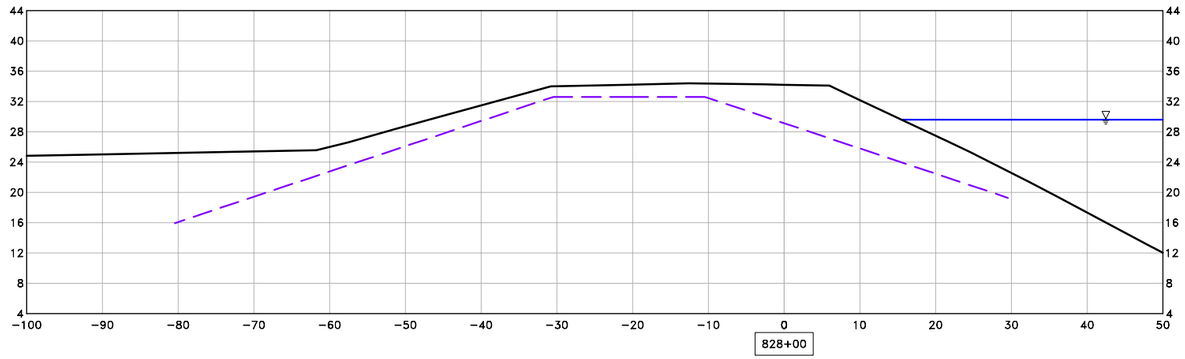
ULDC Evaluation

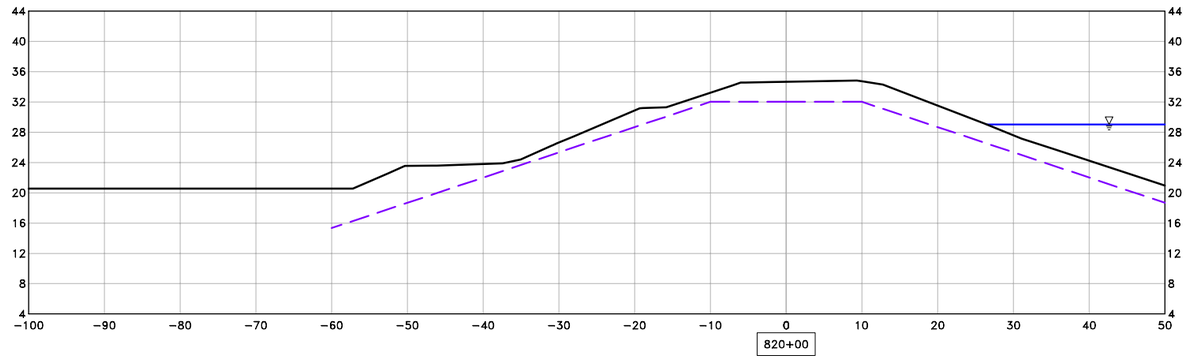
7.8 Levee Geometry

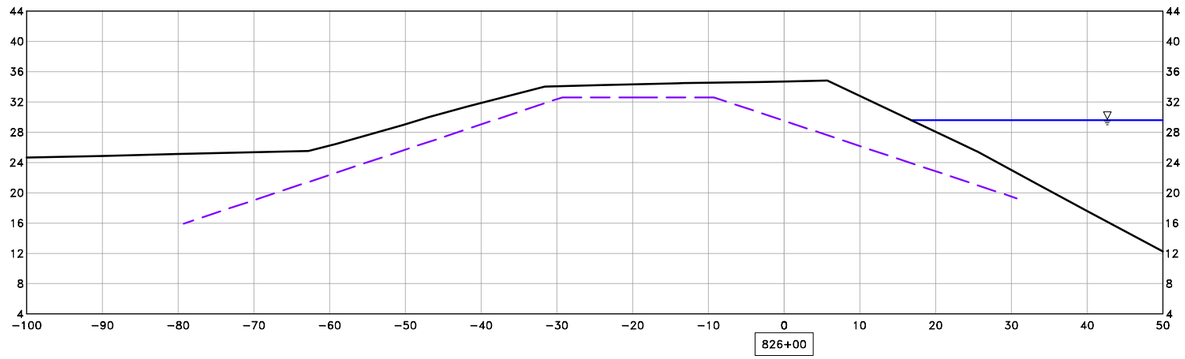
EXHIBIT 1

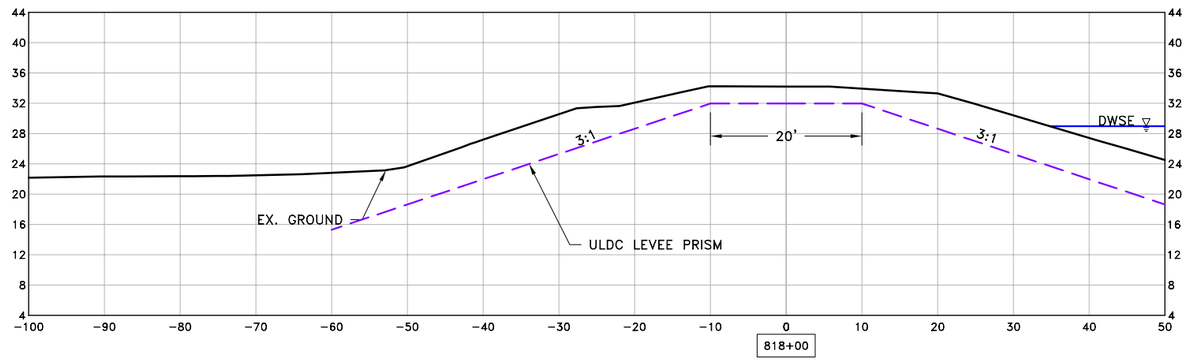
Cross Sections

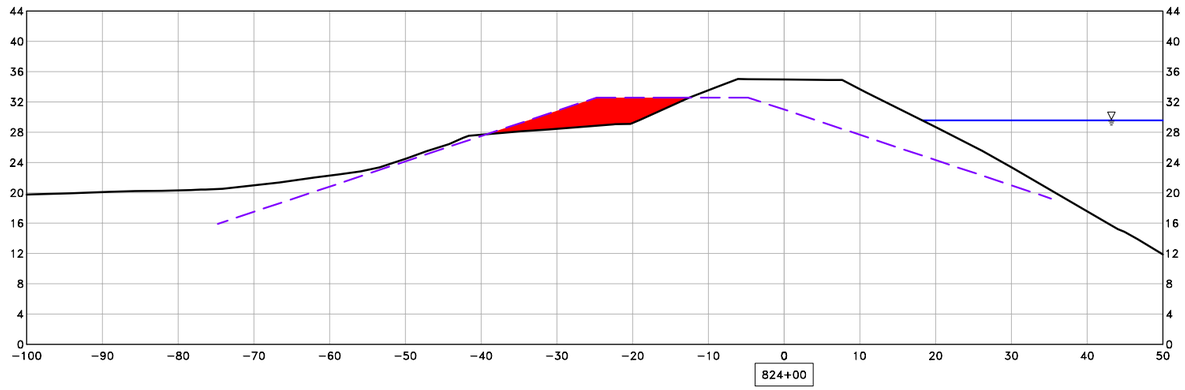












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CITIES OF LATHROP AND MANTECA
ULDC EVALUATION
SAN JOAQUIN COUNTY, CALIFORNIA

7.8 LEVEE GEOMETRY
LEVEE SECTIONS
STA. 818+00 TO 826+00

Revisions				
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Date	AUGUST 2015
Sheet Number	70 Of 82
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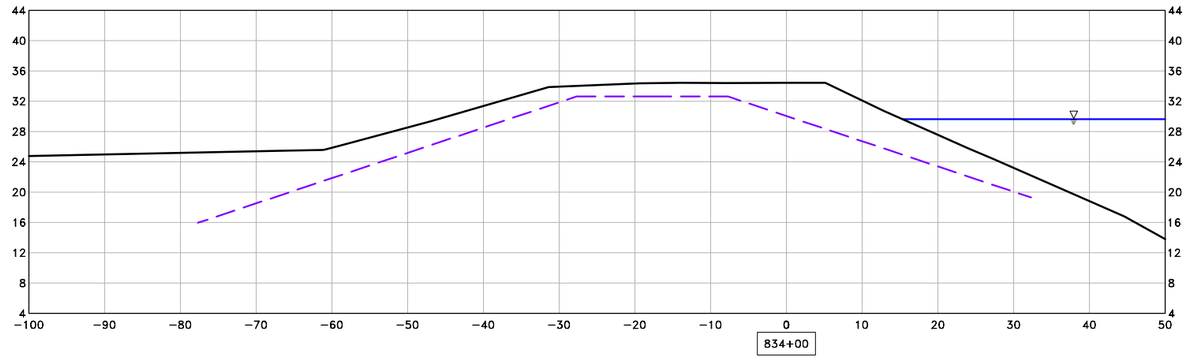

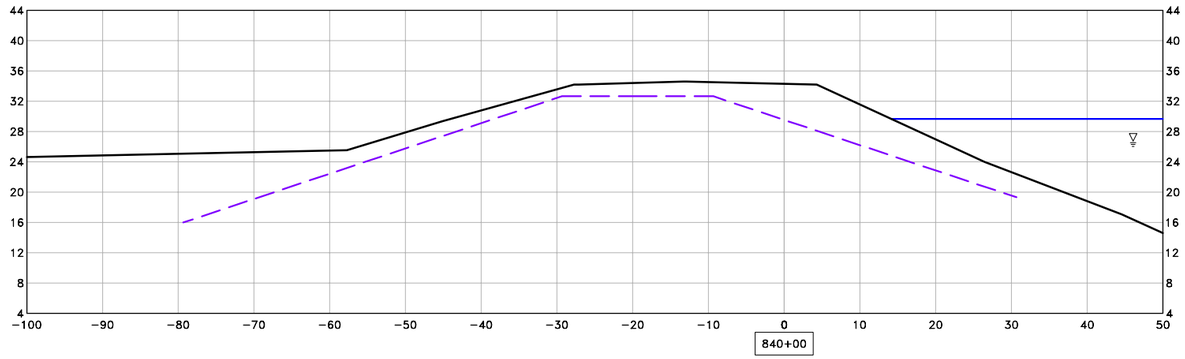

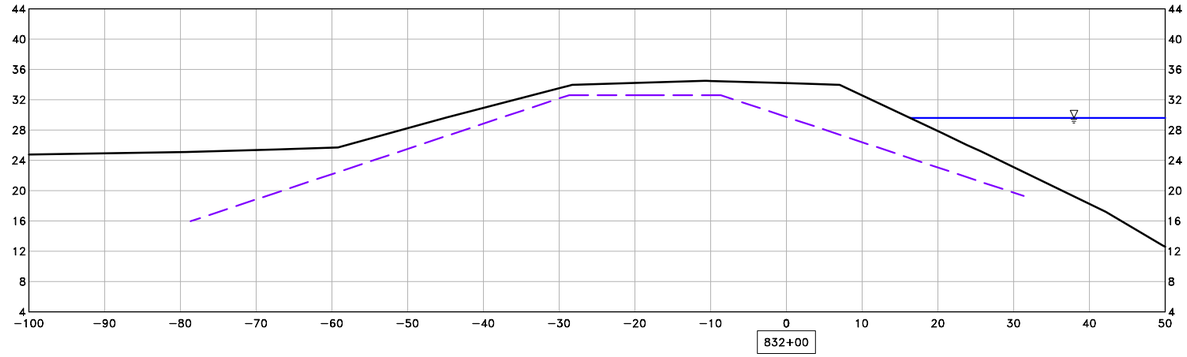

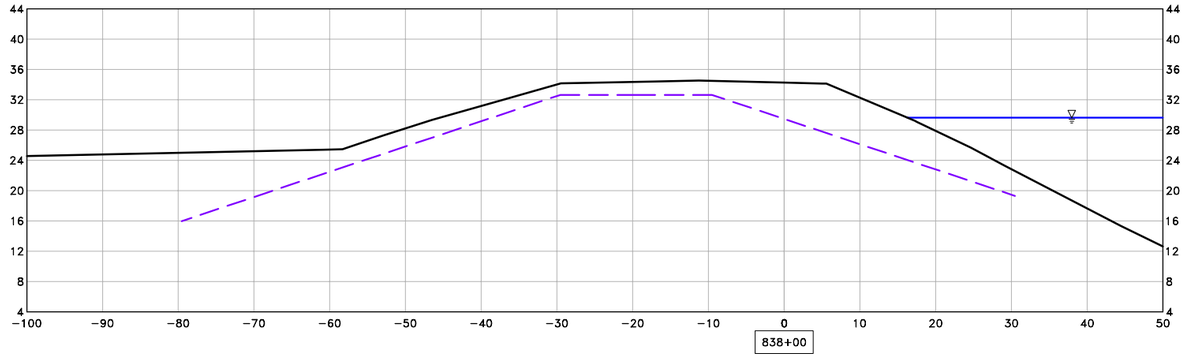

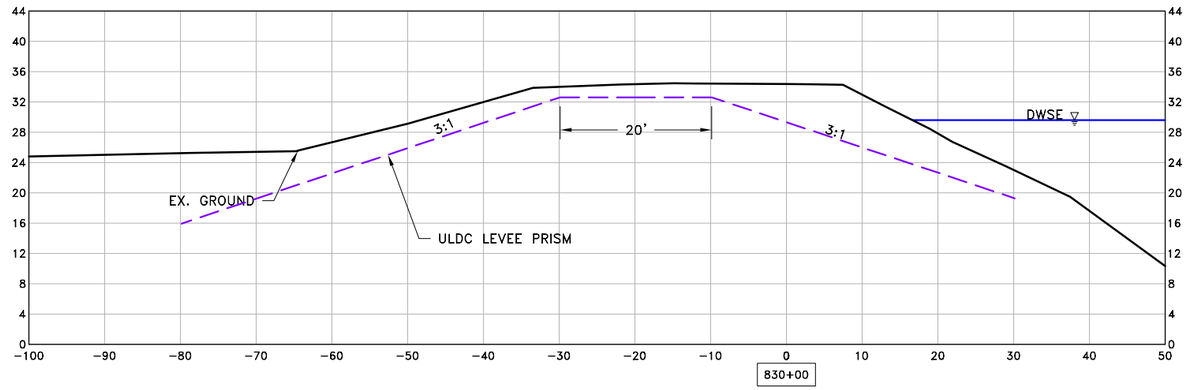

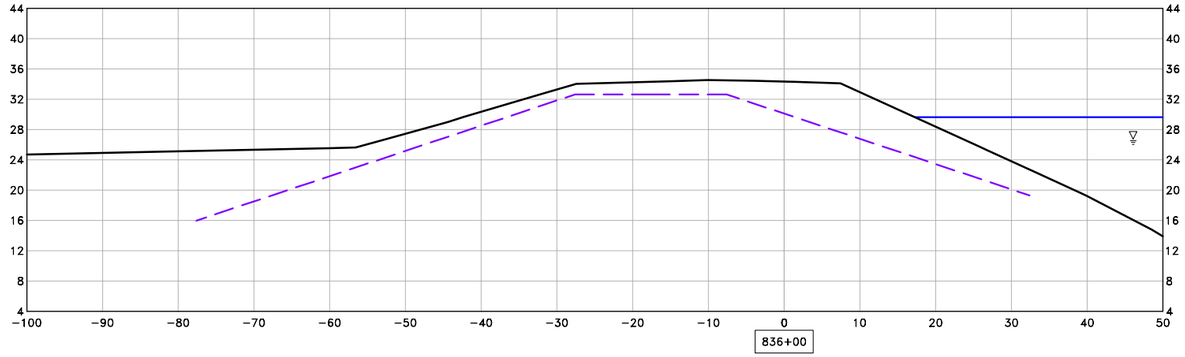

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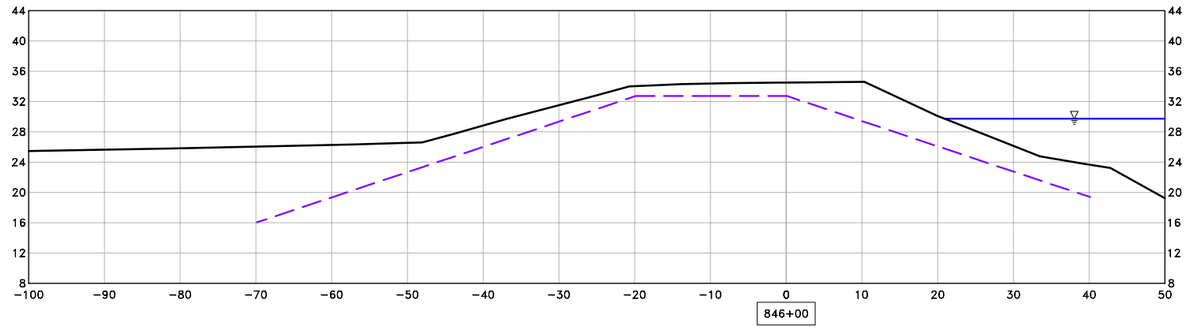

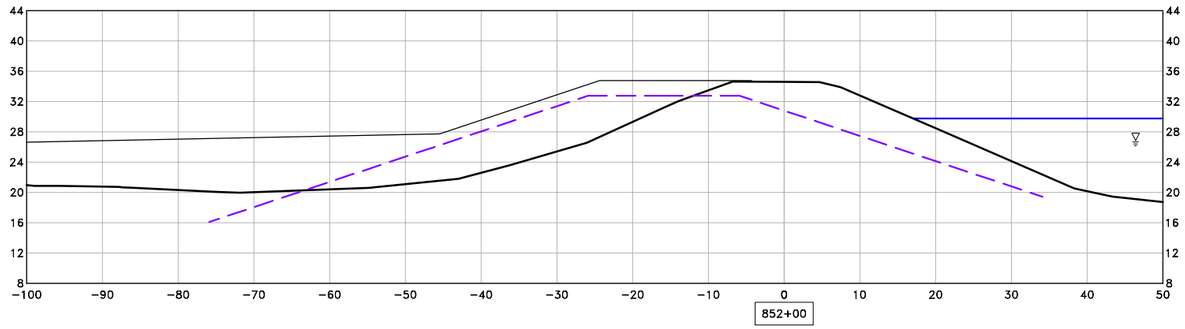

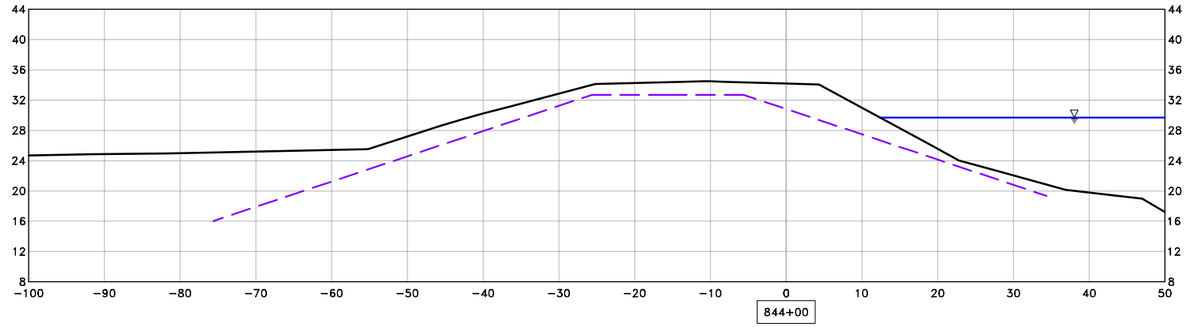

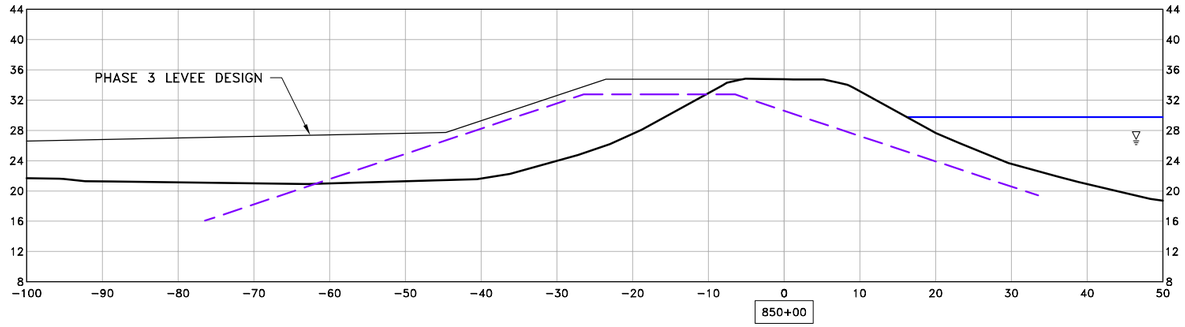

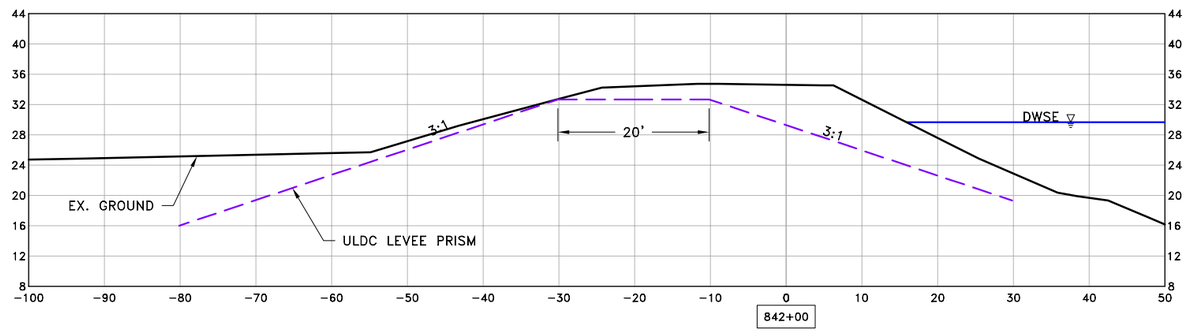

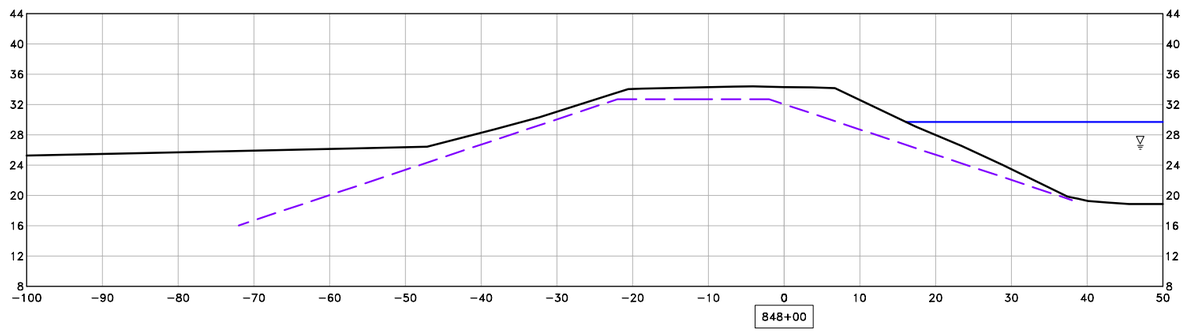

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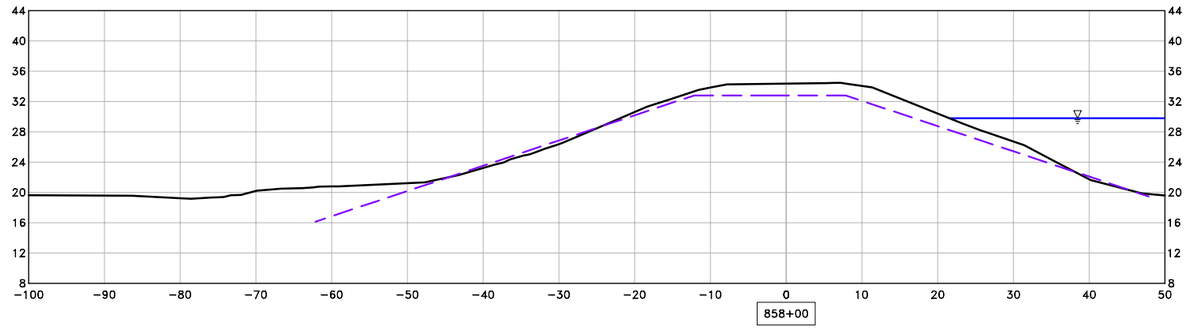

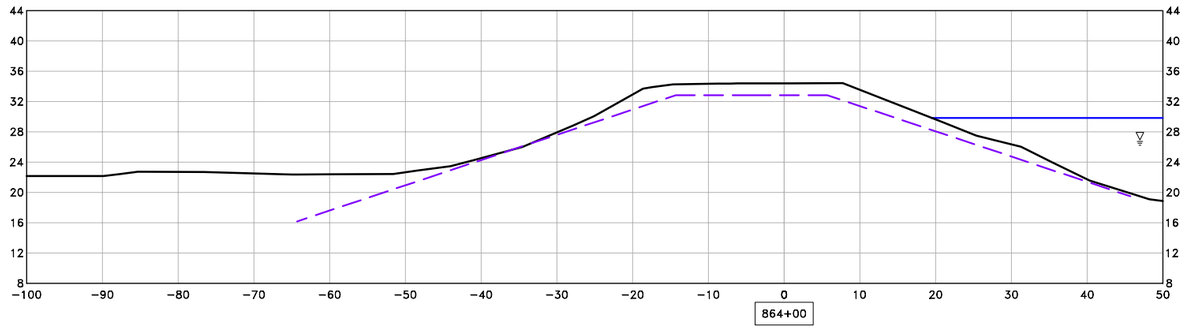

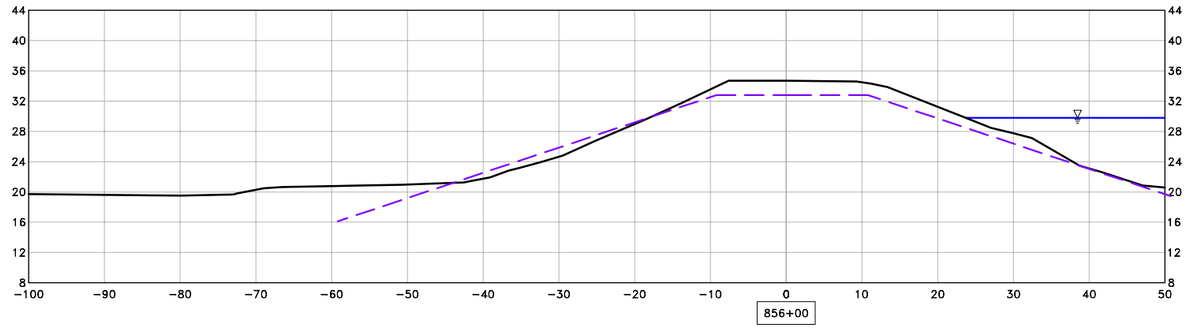

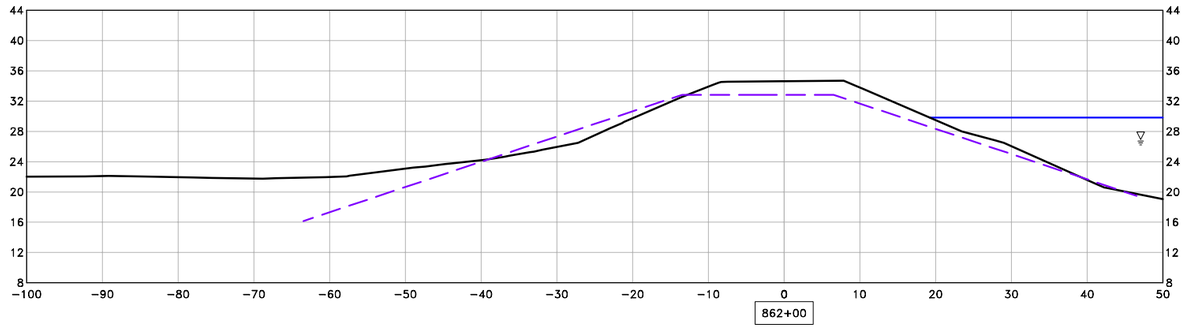

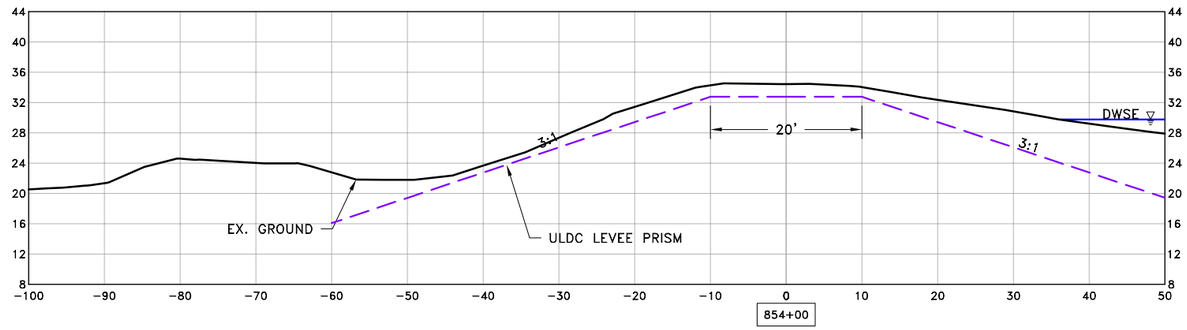

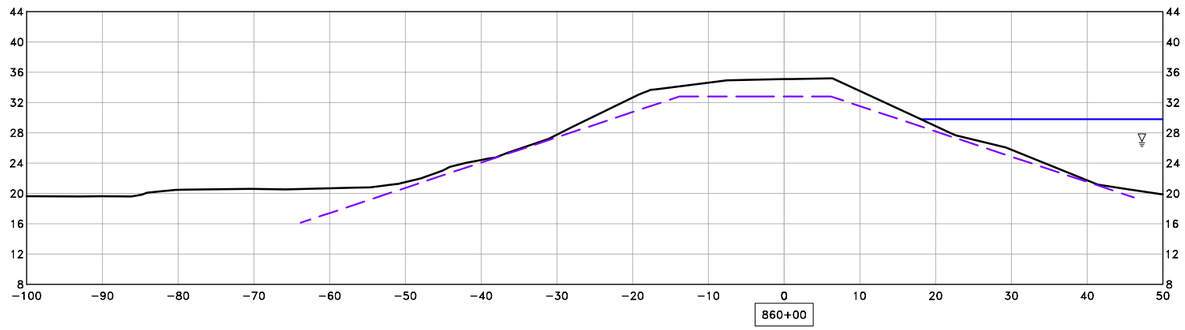

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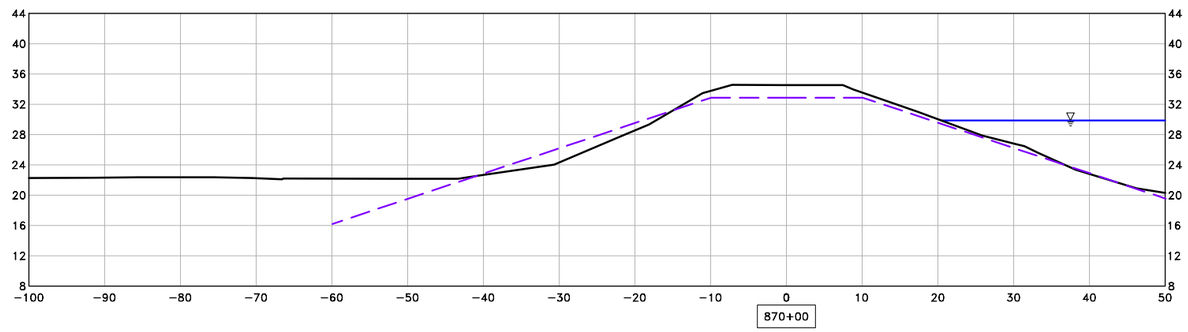

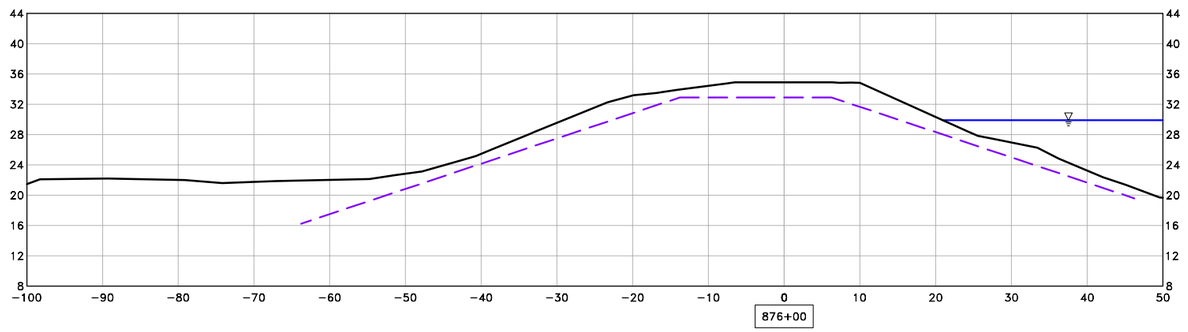

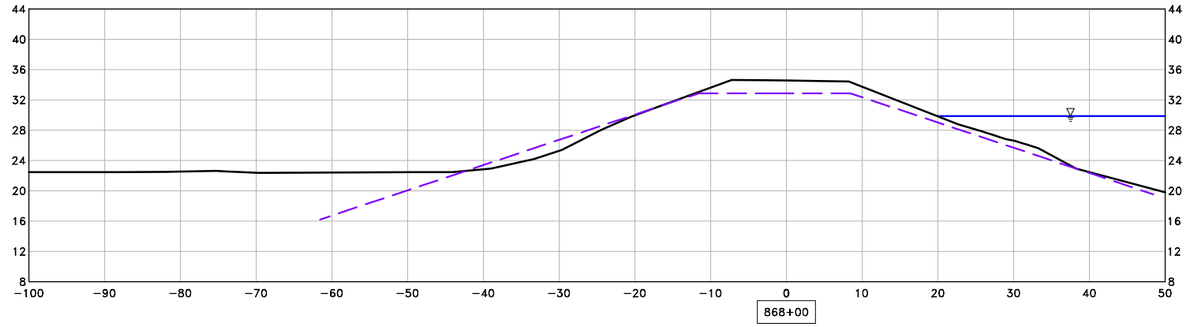

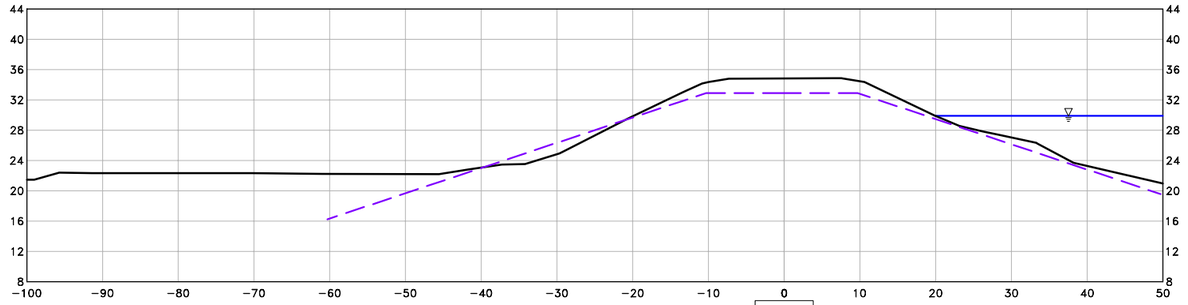

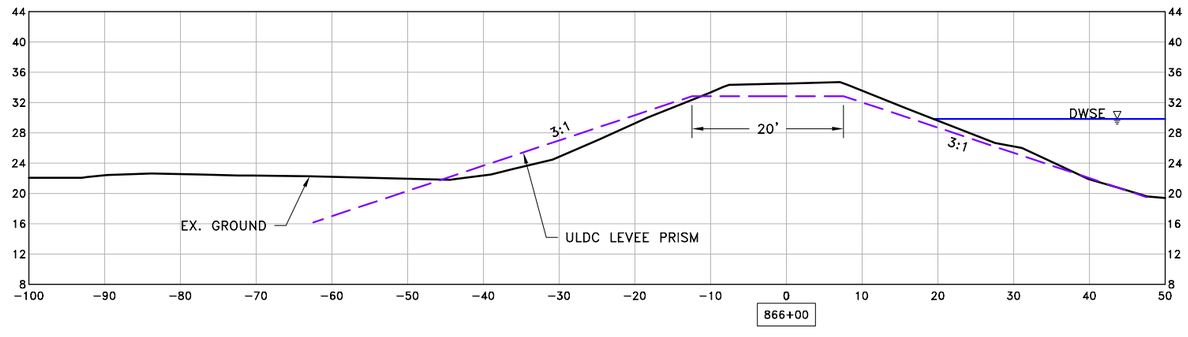

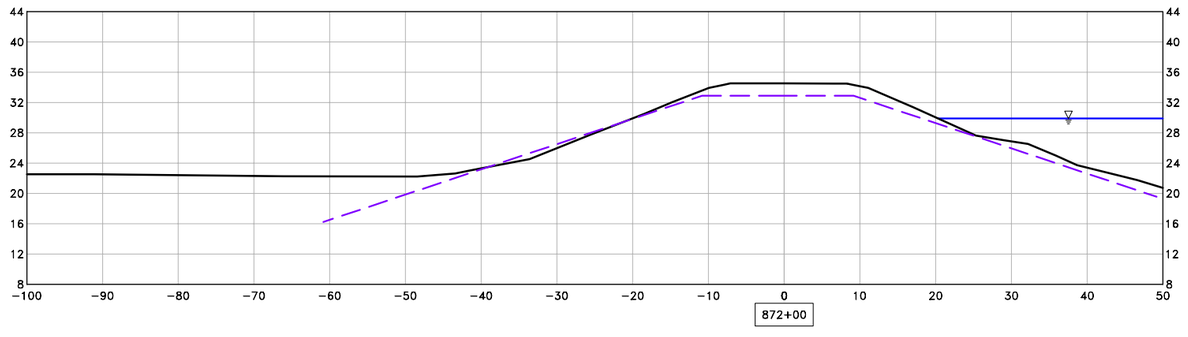

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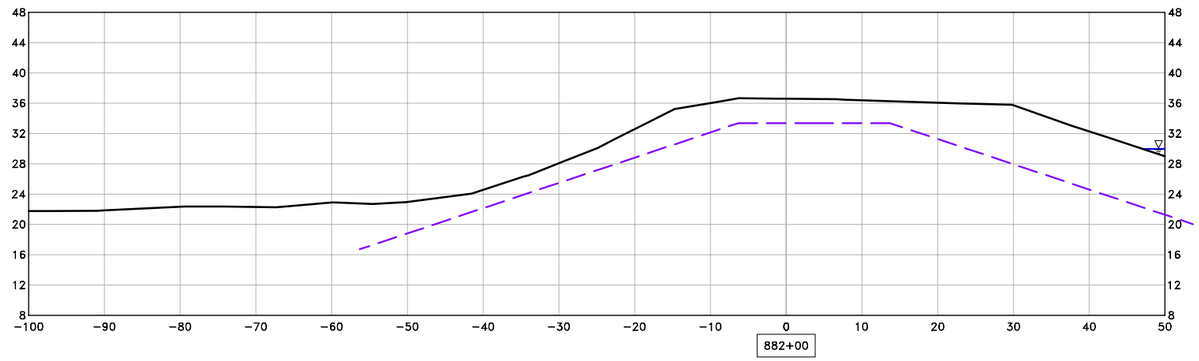

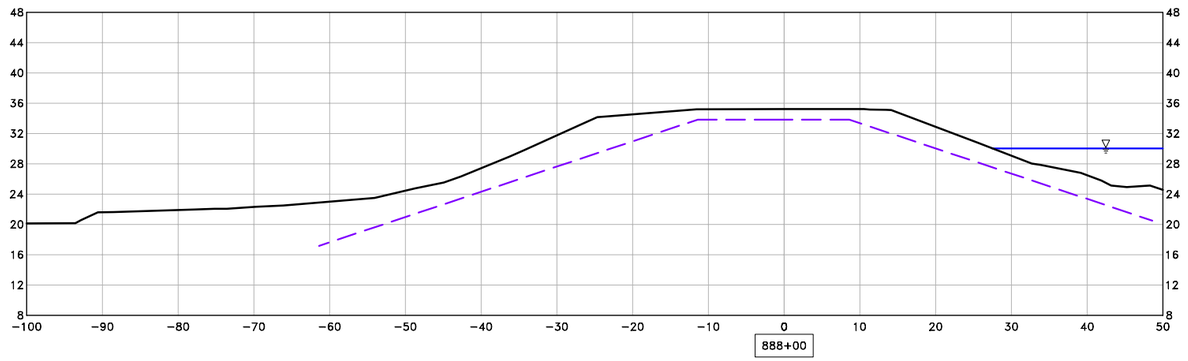

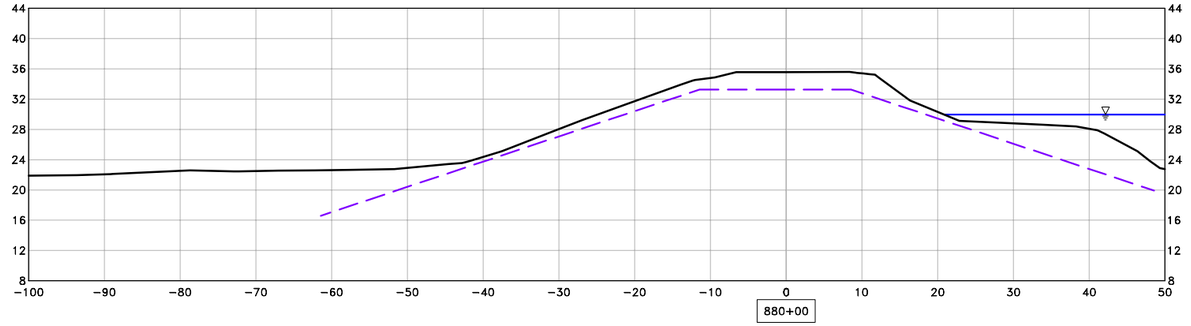

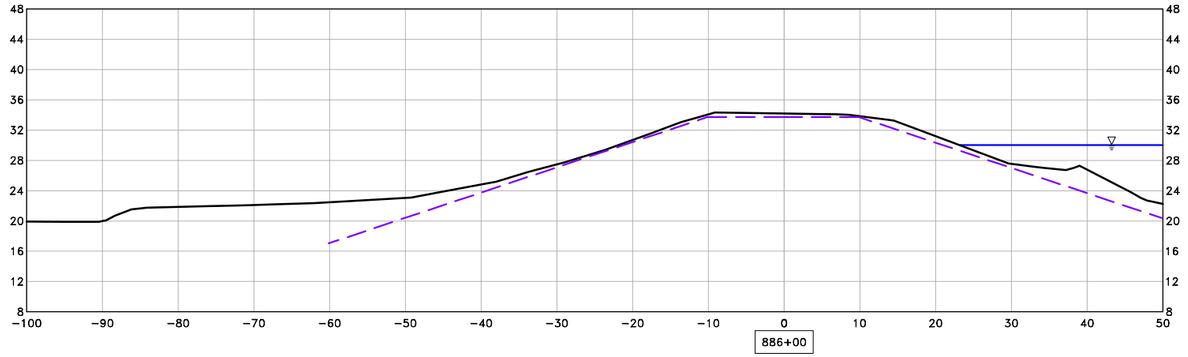

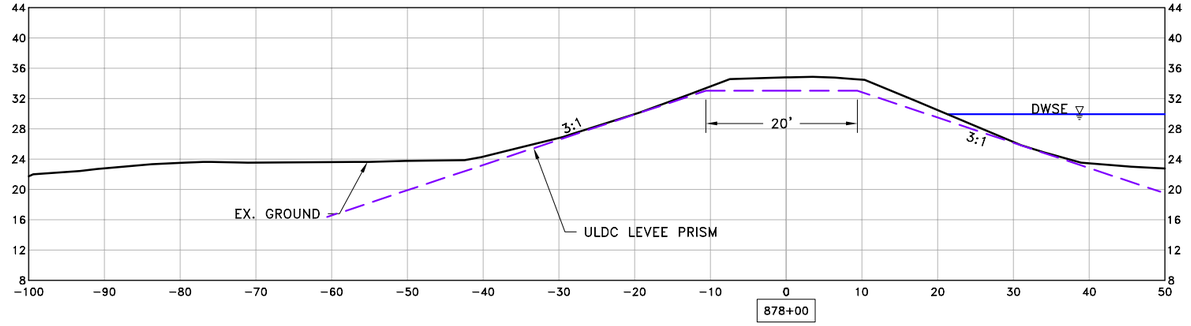

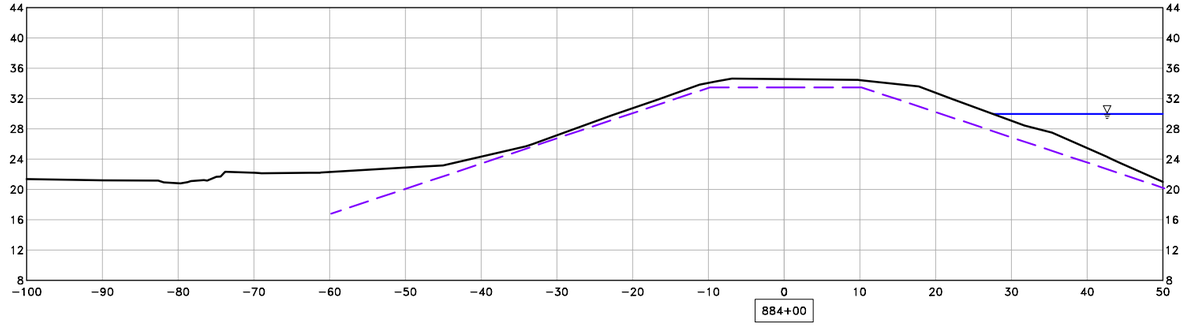

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CITIES OF LATHROP AND MANTECA
ULDC EVALUATION
SAN JOAQUIN COUNTY, CALIFORNIA

7.8 LEVEE GEOMETRY
LEVEE SECTIONS
STA. 866+00 TO 878+00

Revisions				
No.	Description	Date	By	Aprvd. By

Design EEA

Drawn EEA

Check CHN

Scale 1" = 10'

Original Drawing Scale 0 ½" 1"

Date AUGUST 2015

Sheet Number 75 Of 82

Project File No. 2255-0030

FILE SPEC: P:\2255_Lathrop_Manteca_ULDC Evaluation\0030_ULDC_Analyze and Identify Deficiencies\05_Civil\CAD\Sheets\Sht_7-08_Levee Geometry.dwg
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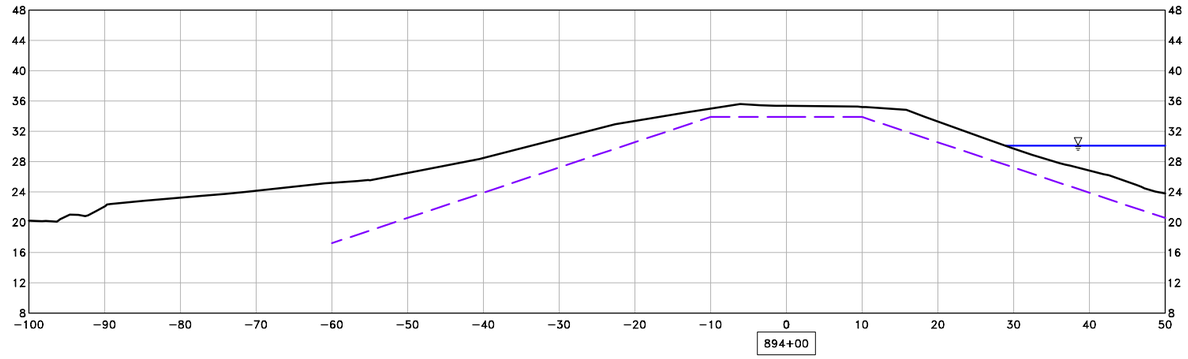

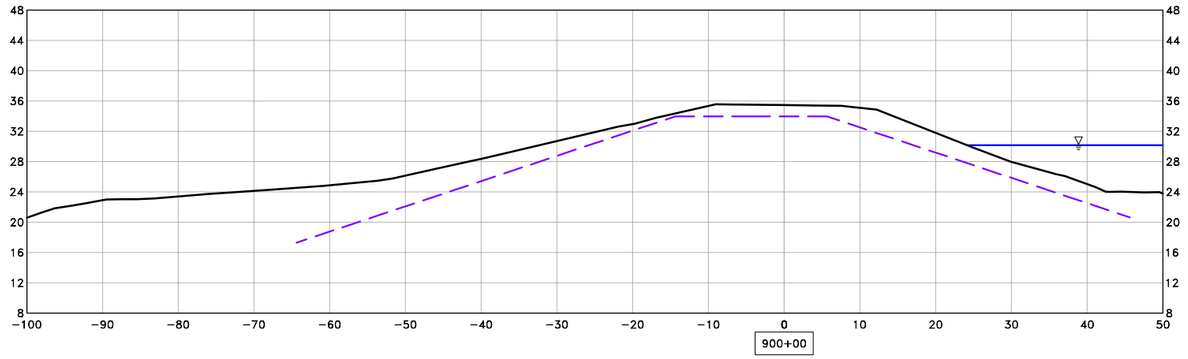

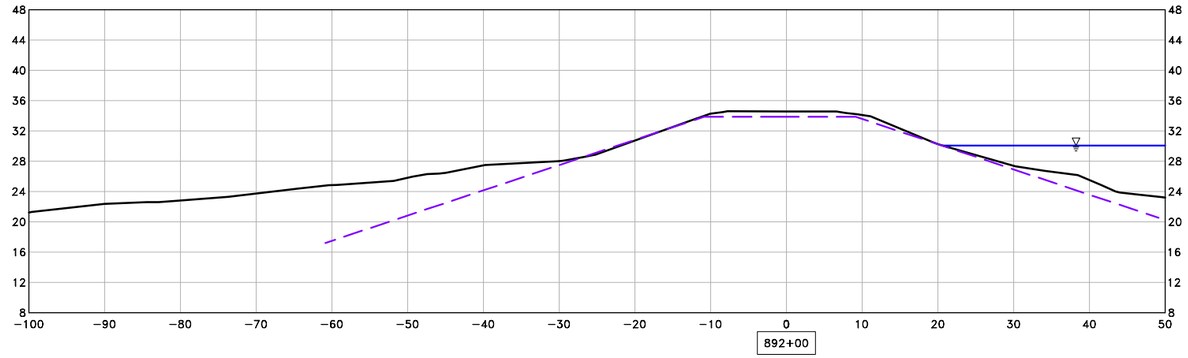

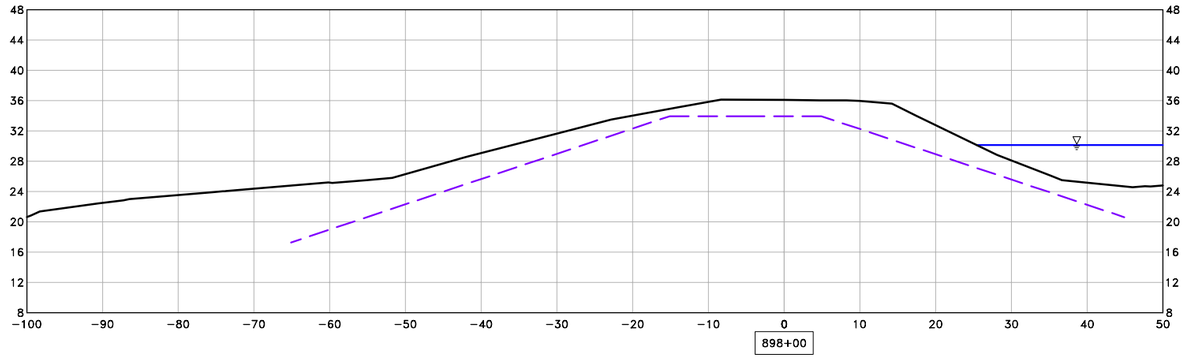

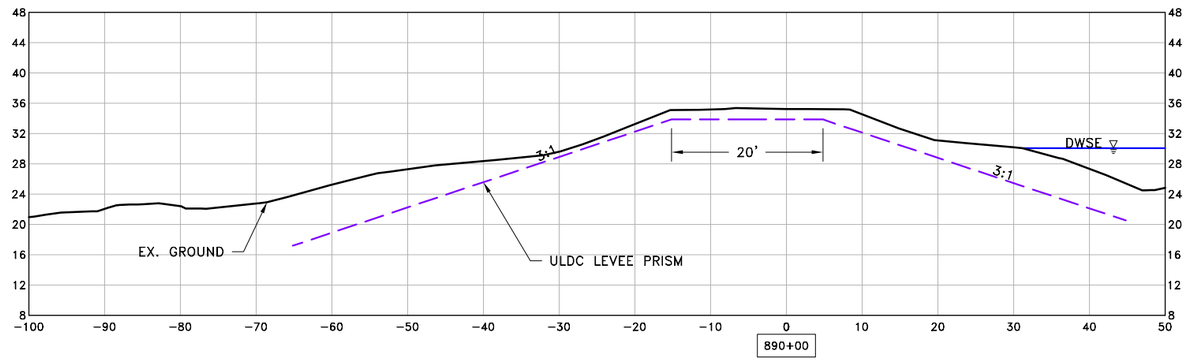

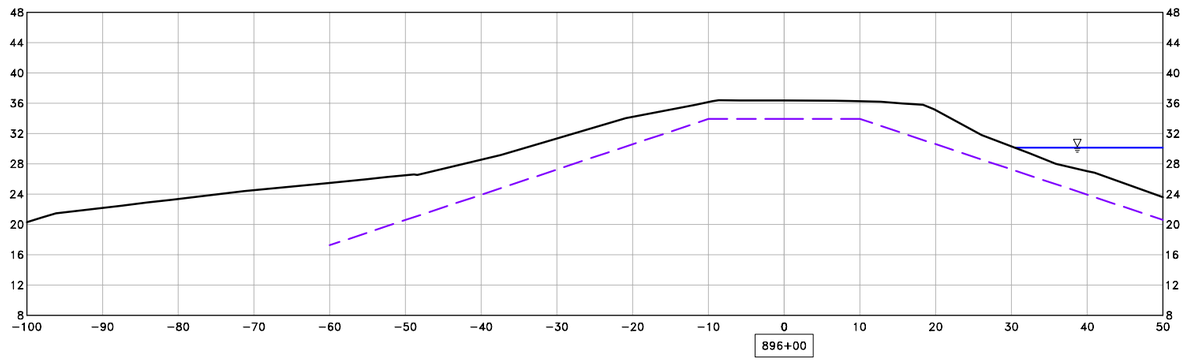

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ULDC EVALUATION
SAN JOAQUIN COUNTY, CALIFORNIA

7.8 LEVEE GEOMETRY
LEVEE SECTIONS
STA. 878+00 TO 890+00

Revisions				
No.	Description	Date	By	Aprvd. By

Design EEA
Drawn EEA
Check CHN

Scale 1" = 10'
Original Drawing Scale 0 ½" 1"

Date AUGUST 2015
Sheet Number 76 Of 82
Project File No. 2255-0030

FILE SPEC: P:\2255_Lathrop_Manteca_ULDC Evaluation\0030_ULDC_Analyze and Identify Deficiencies\05_Civil\CAD\Sheets\Sht_7-08_Levee Geometry.dwg
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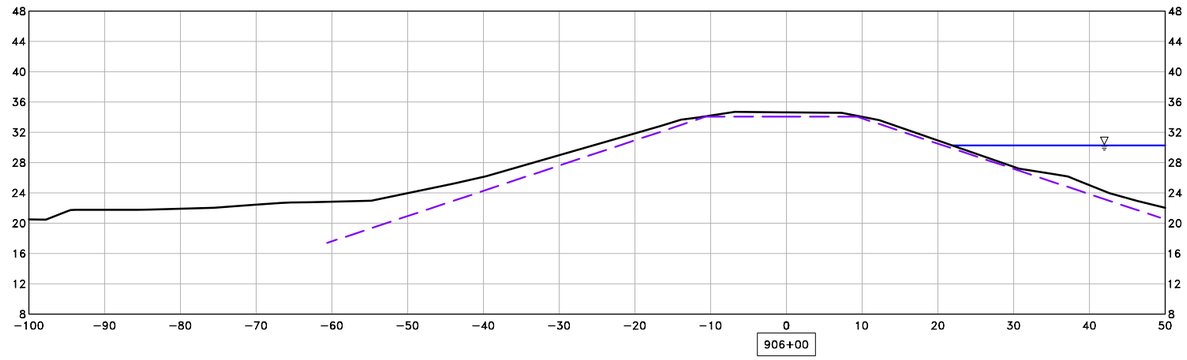

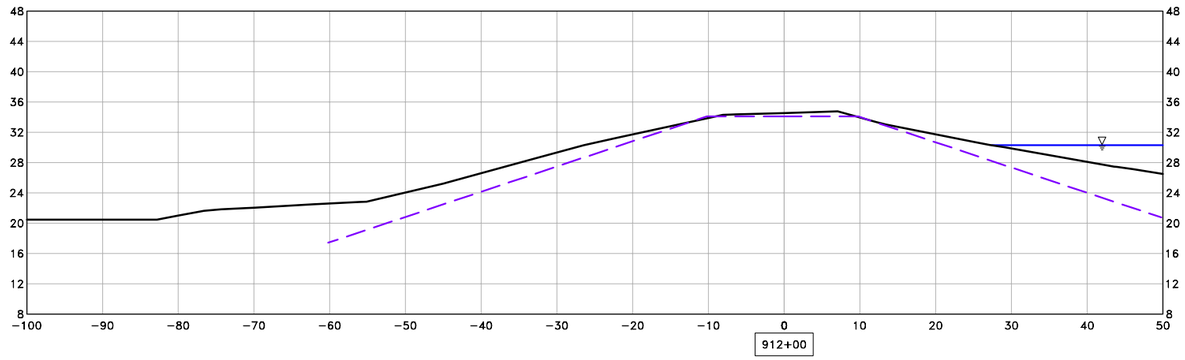

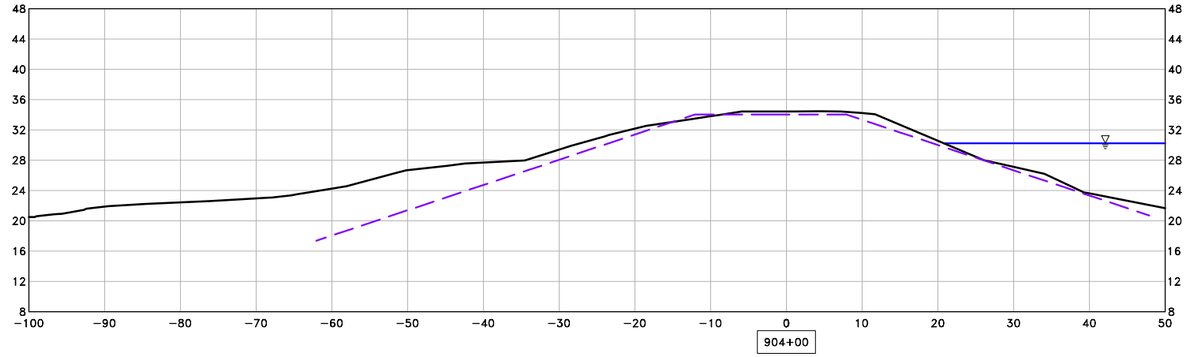

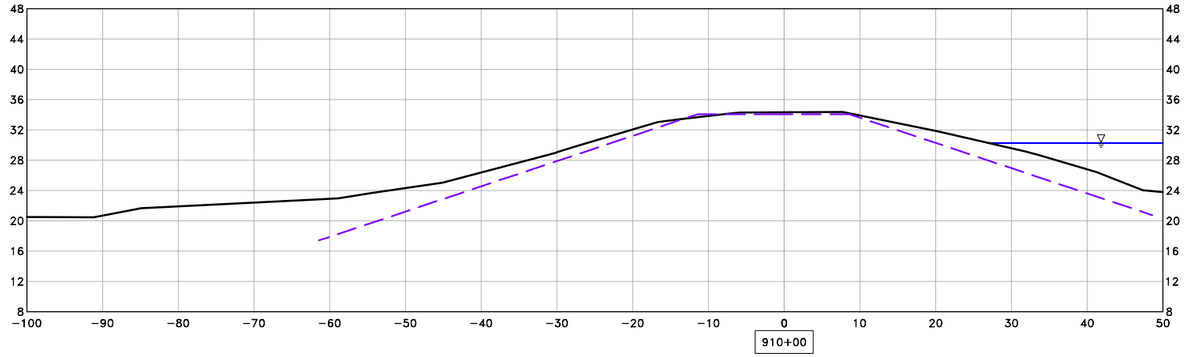

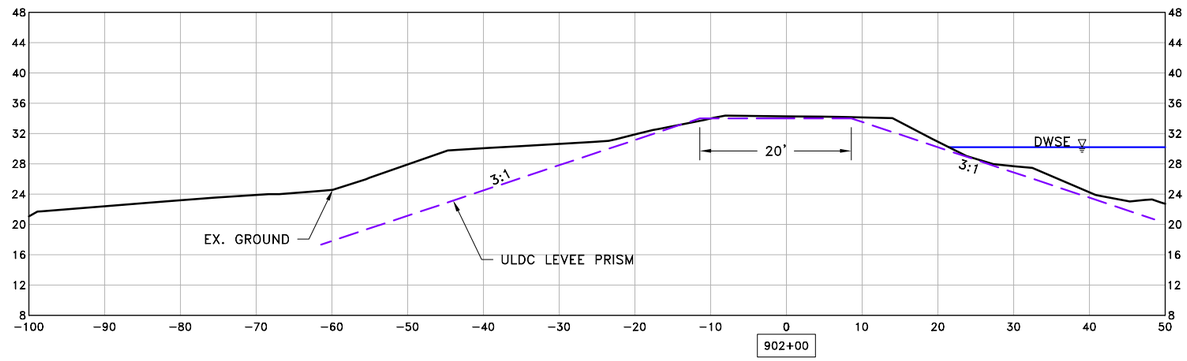

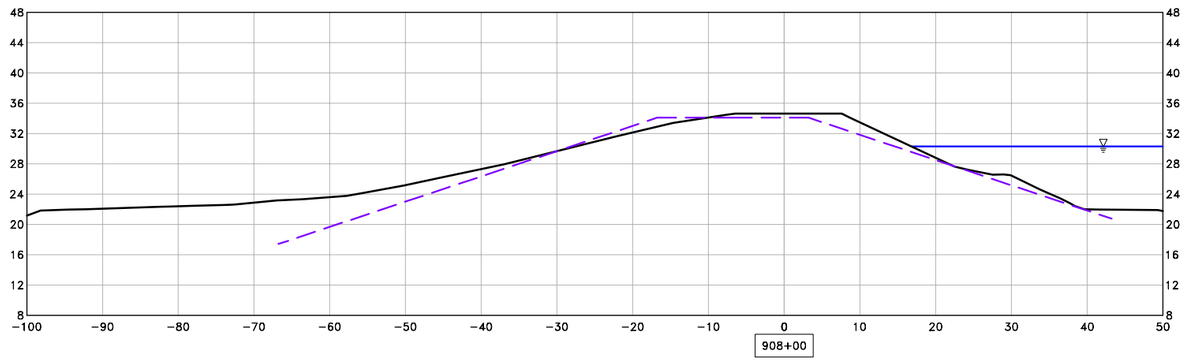

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SAN JOAQUIN COUNTY, CALIFORNIA

7.8 LEVEE GEOMETRY
LEVEE SECTIONS
STA. 890+00 TO 902+00

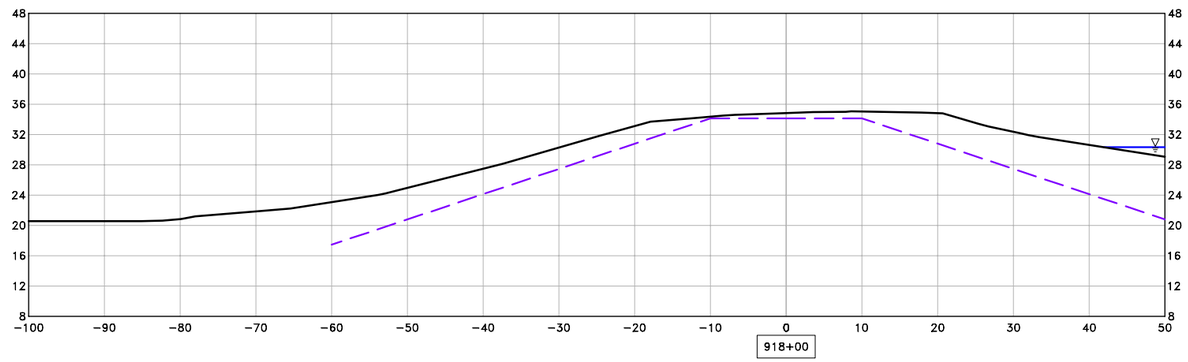
Revisions				
No.	Description	Date	By	Aprvd. By

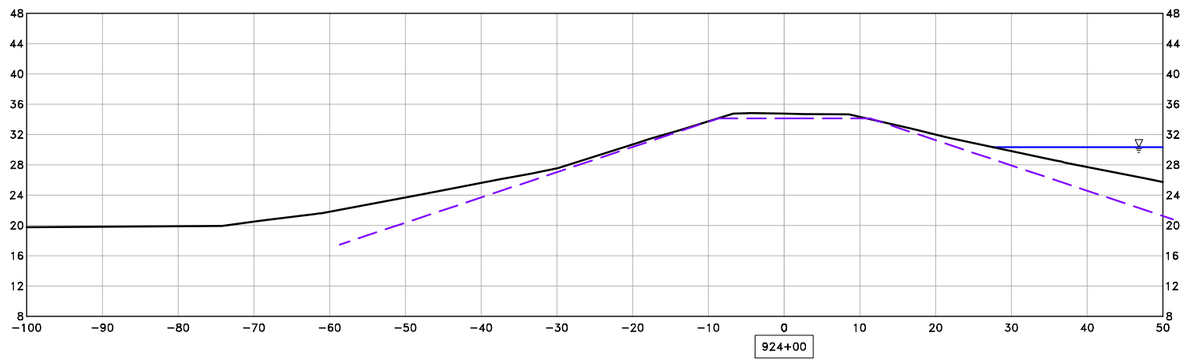
Design EEA
Drawn EEA
Check CHN

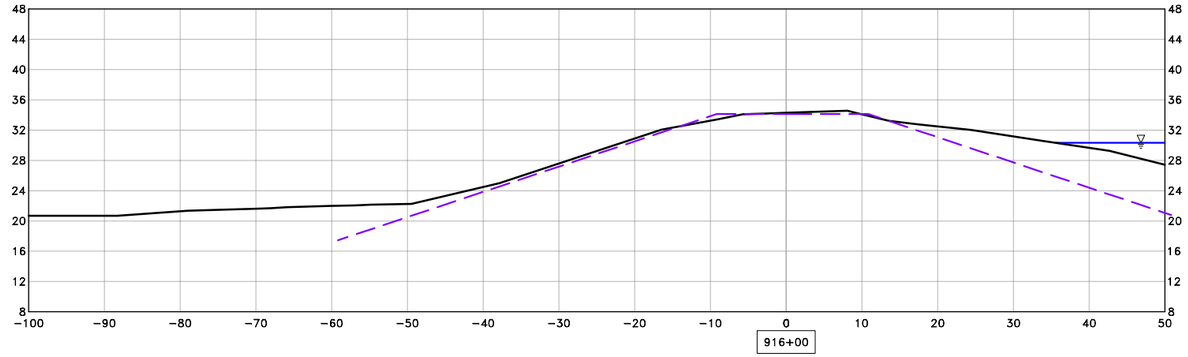
Scale 1" = 10'
Original Drawing Scale 0 ½" 1"

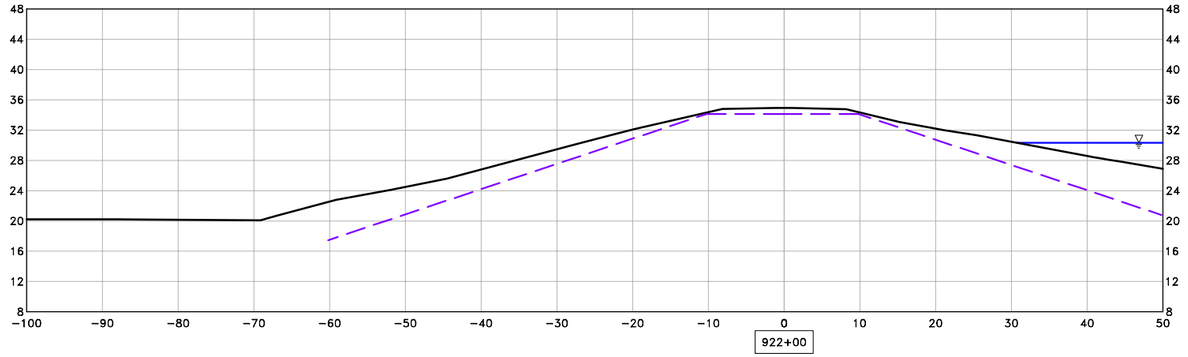
Date AUGUST 2015
Sheet Number 77 Of 82
Project File No. 2255-0030

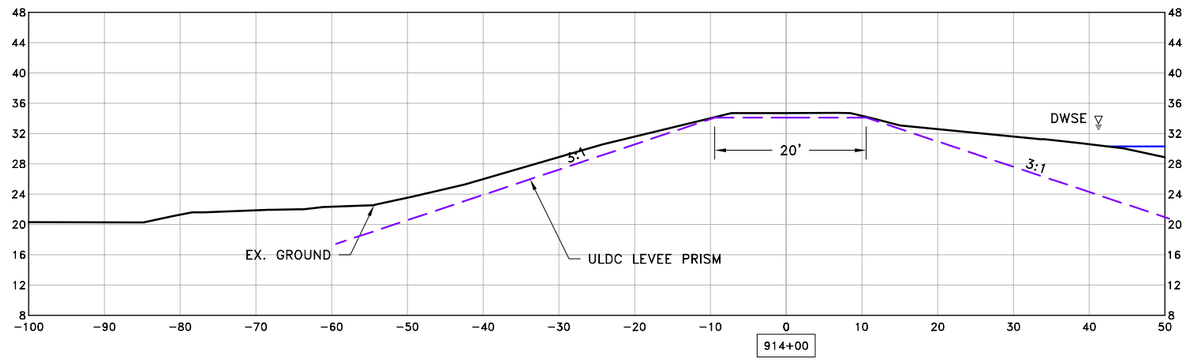
FILE SPEC: P:\2255_Lathrop_Manteca_ULDC Evaluation\0030_ULDC_Analyze and Identify Deficiencies\05_Civil\CAD\Sheets\Sht_7-08_Levee Geometry.dwg
PLOT DATE: Mar 04, 2016 - 12:30pm

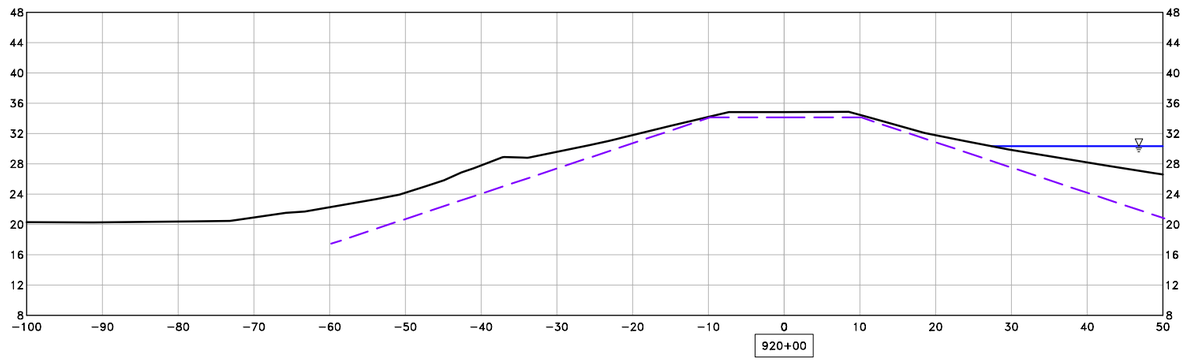












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SAN JOAQUIN COUNTY, CALIFORNIA

7.8 LEVEE GEOMETRY
LEVEE SECTIONS
STA. 902+00 TO 914+00

Revisions				
No.	Description	Date	By	Aprvd. By

Design: EEA
Drawn: EEA
Check: CHN
Scale: 1" = 10'
Original Drawing Scale: 0 ½" 1"
Date: AUGUST 2015
Sheet Number: 78 Of 82
Project File No.: 2255-0030

FILE SPEC: P:\2255_Lathrop_Manteca_ULDC Evaluation\0030_ULDC_Analyze and Identify Deficiencies\05_Civil\CAD\Sheets\Sht_7-08_Levee Geometry.dwg
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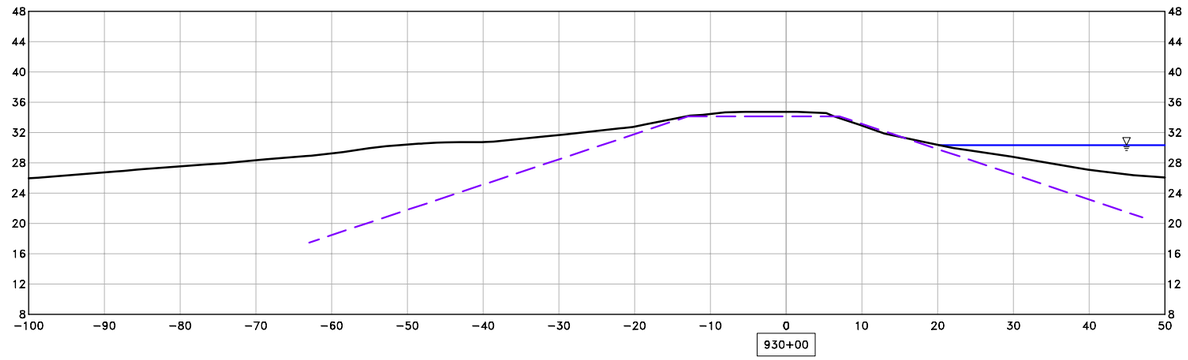

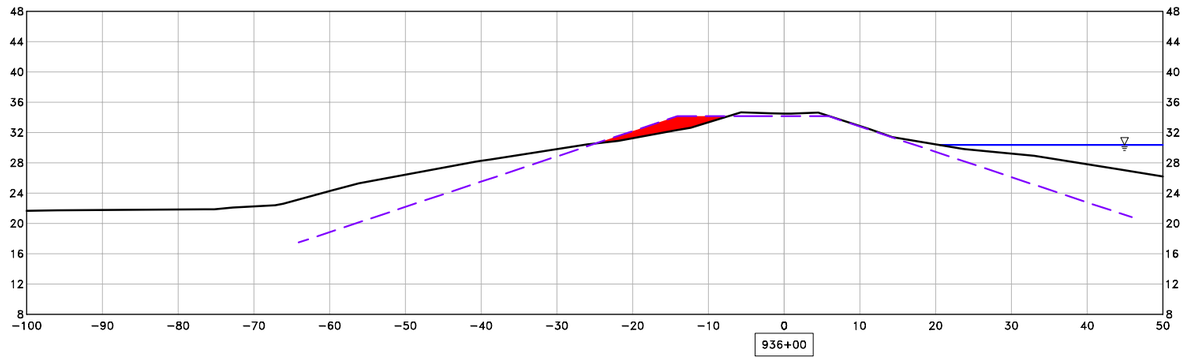

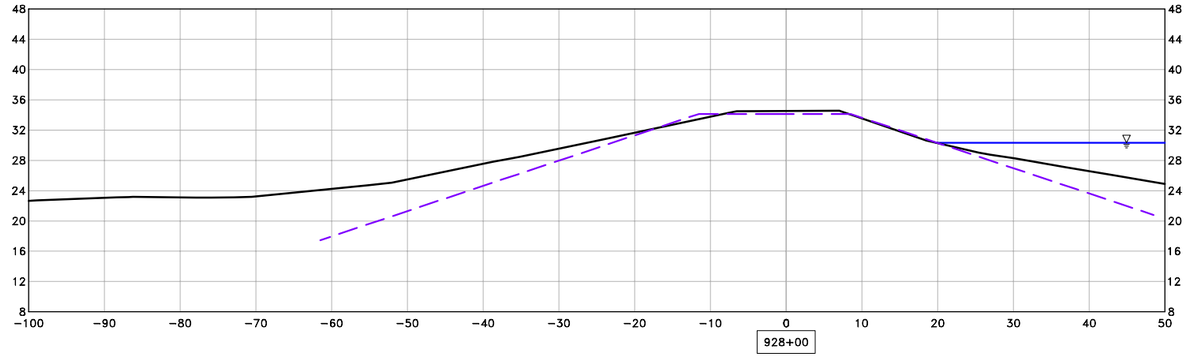

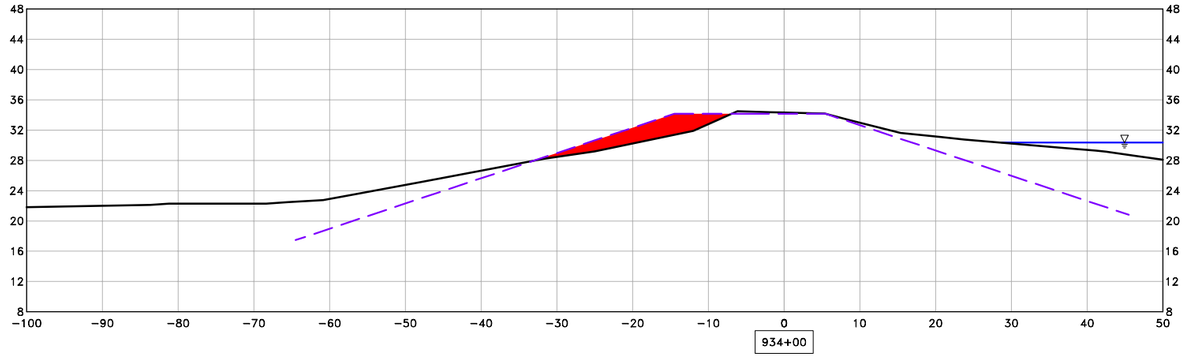

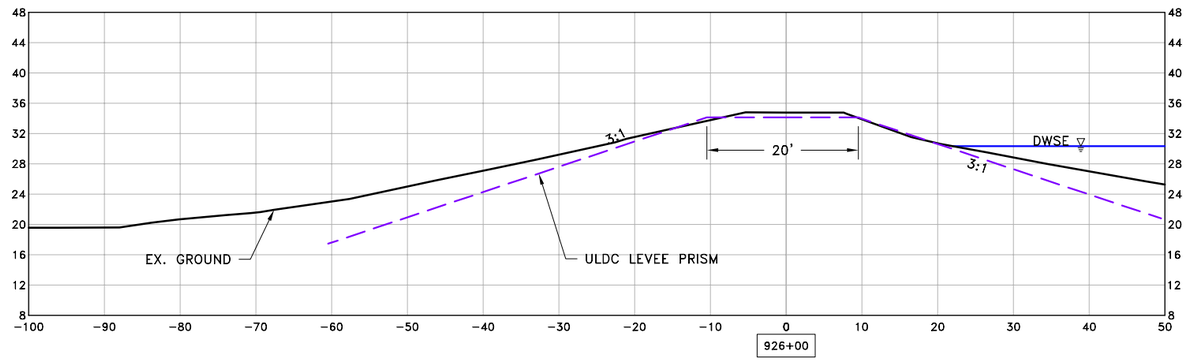

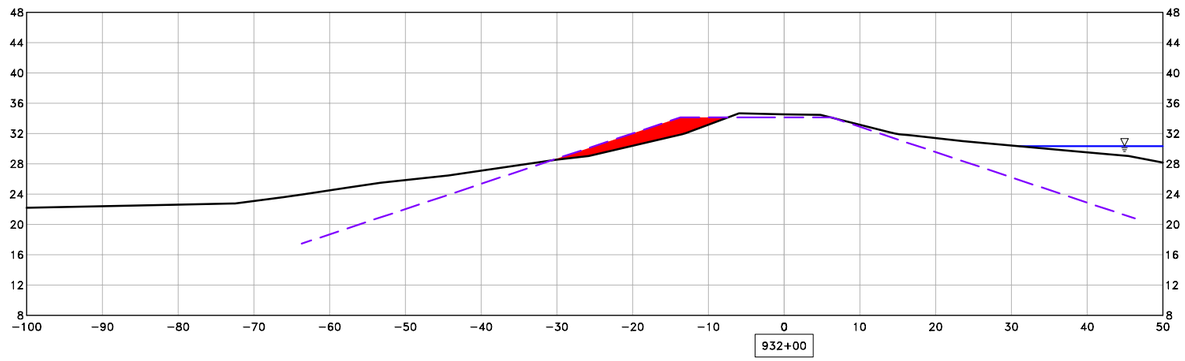

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7.8 LEVEE GEOMETRY
LEVEE SECTIONS
STA. 914+00 TO 926+00

Revisions				
No.	Description	Date	By	Aprvd. By

Design EEA
Drawn EEA
Check CHN

Scale 1" = 10'
Original Drawing Scale 0 ½" 1"

Date AUGUST 2015
Sheet Number 79 Of 82
Project File No. 2255-0030

FILE SPEC: P:\2255_Lathrop_Manteca_ULDC Evaluation\0030_ULDC_Analyze and Identify Deficiencies\05_Civil\CAD\Sheets\Sht_7-08_Levee Geometry.dwg
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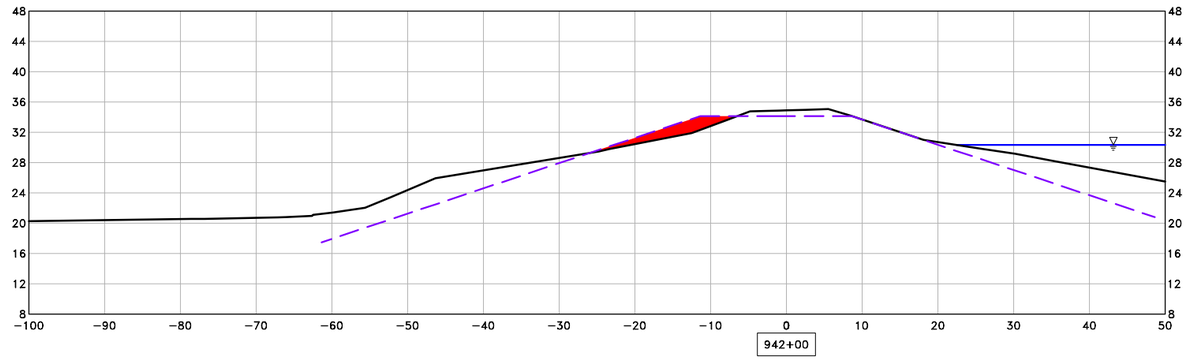

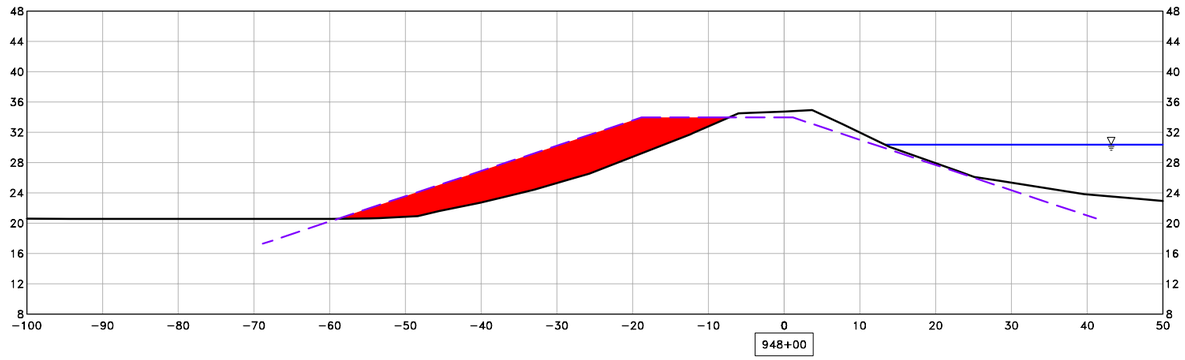

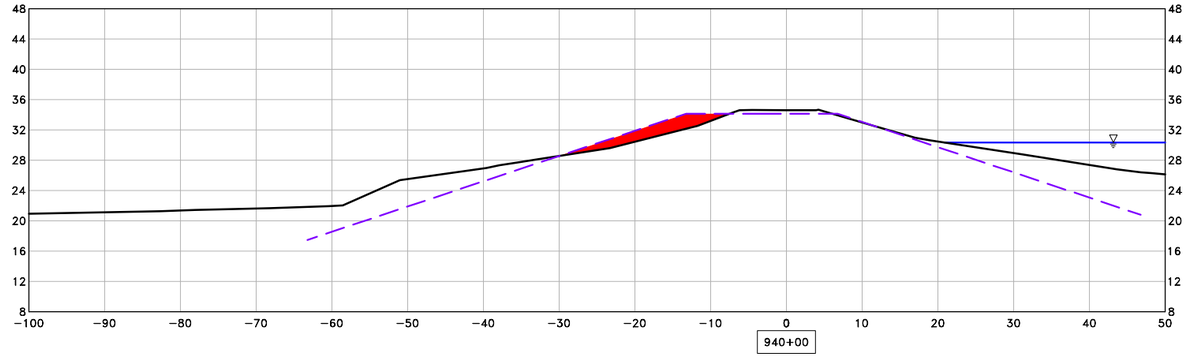

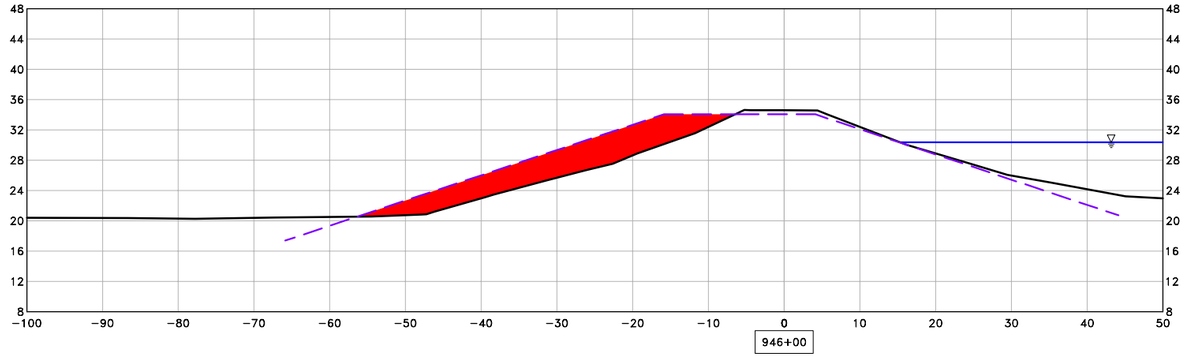

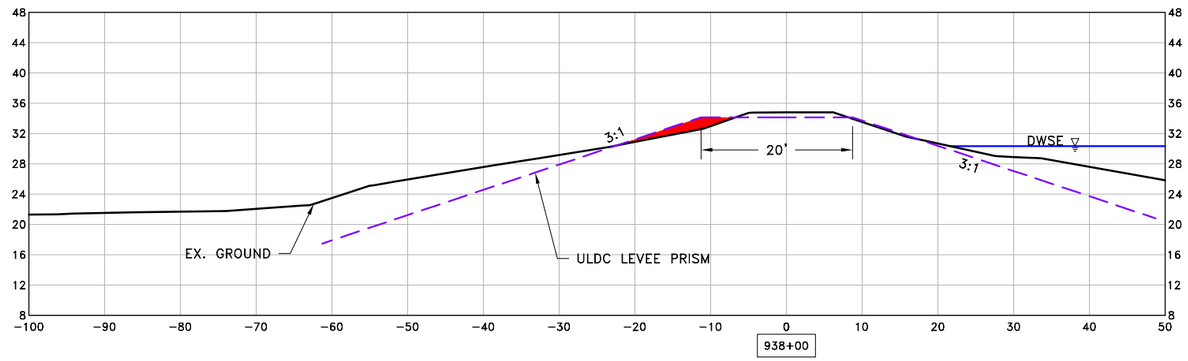

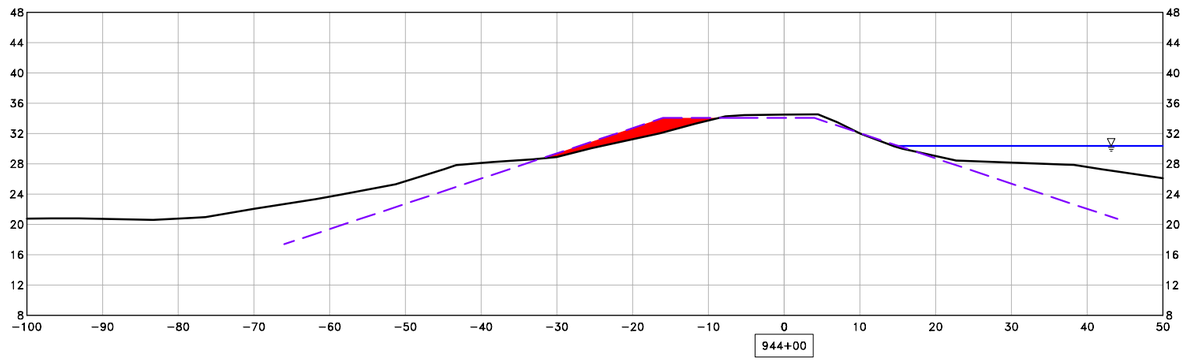

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7.8 LEVEE GEOMETRY
LEVEE SECTIONS
STA. 926+00 TO 938+00

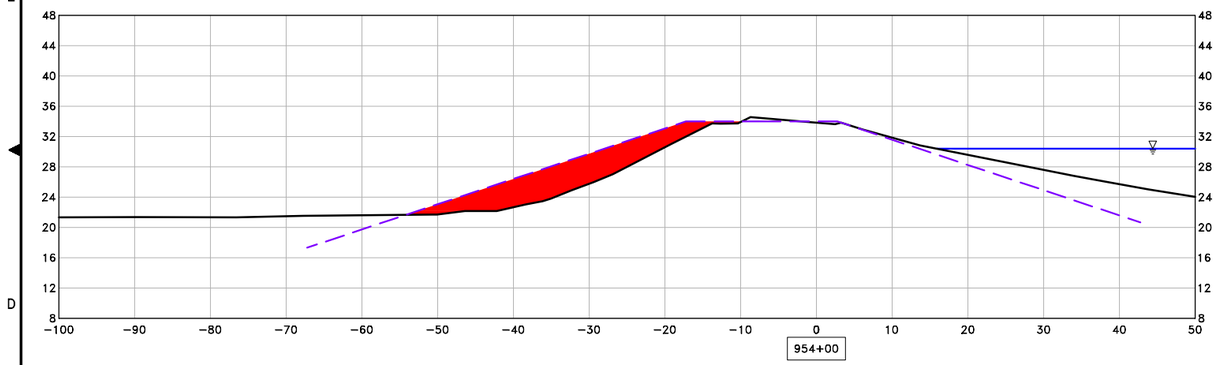
Revisions				
No.	Description	Date	By	Aprvd. By

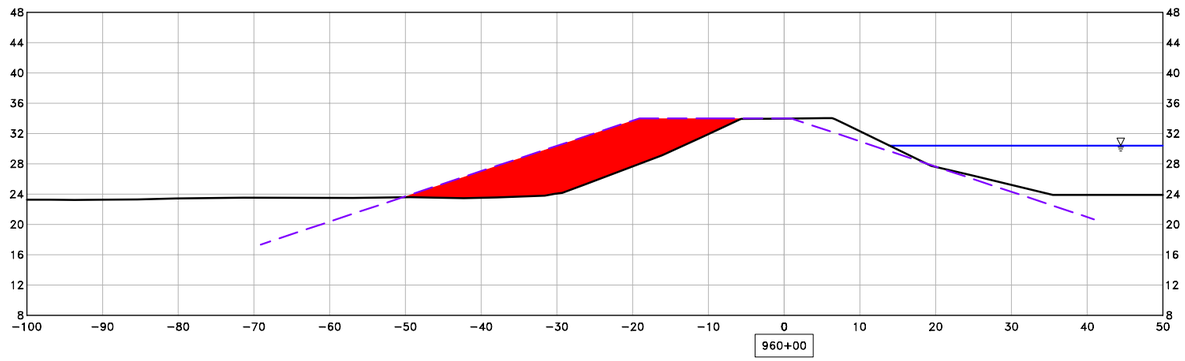
Design EEA
Drawn EEA
Check CHN

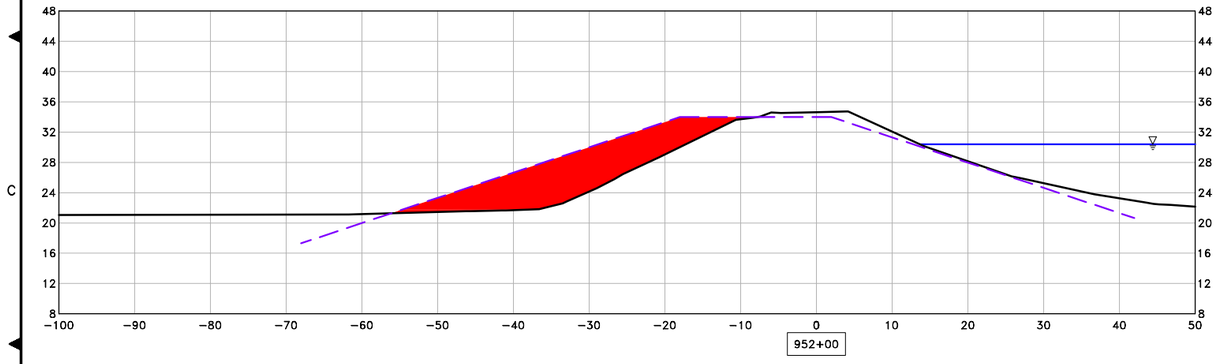
Scale 1" = 10'
Original Drawing Scale 0 ½" 1"

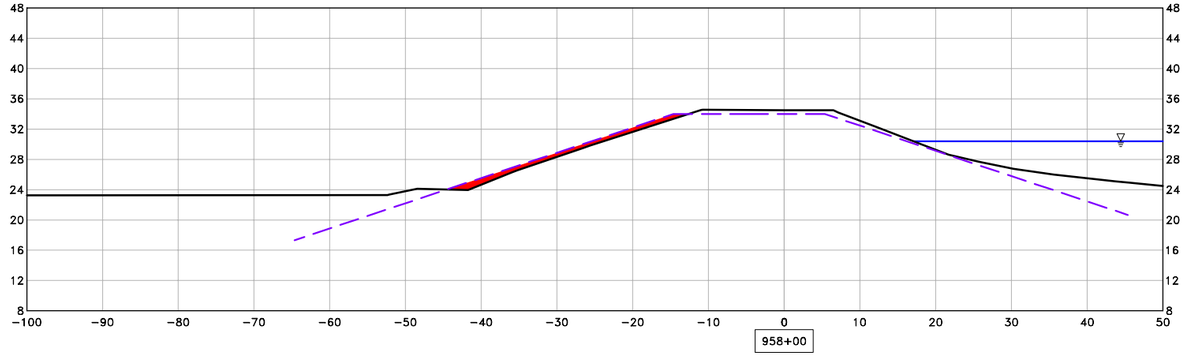
Date AUGUST 2015
Sheet Number 80 Of 82
Project File No. 2255-0030

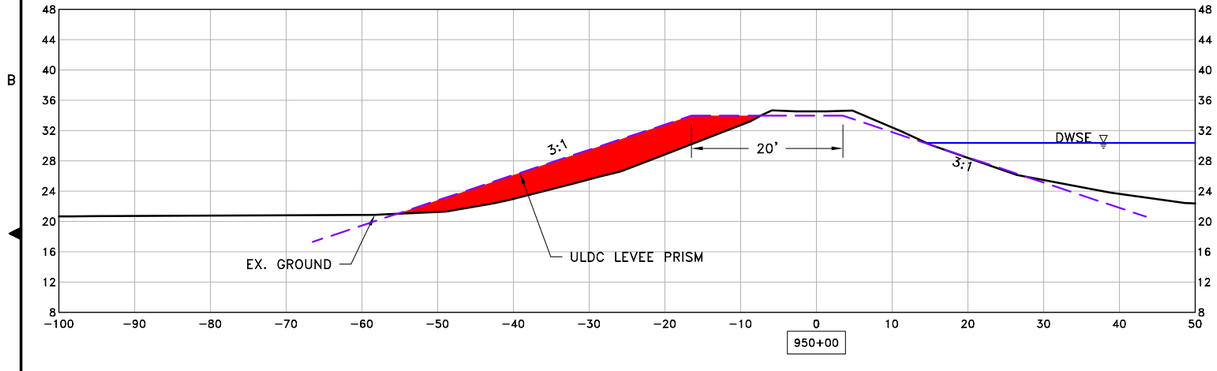
FILE SPEC: P:\2255_Lathrop_Manteca_ULDC Evaluation\0030_ULDC_Analyze and Identify Deficiencies\05_Civil\CAD\Sheets\Sht_7-08_Levee Geometry.dwg
PLOT DATE: Mar 04, 2016 - 12:32pm

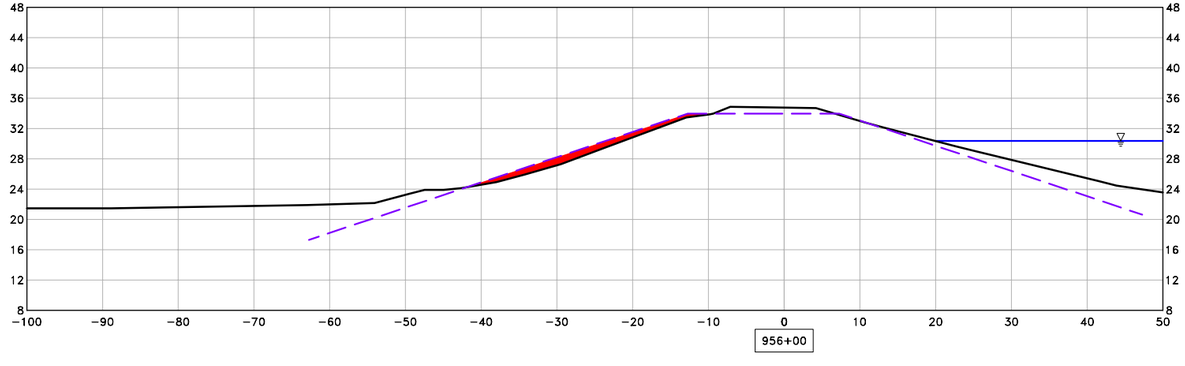












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7.8 LEVEE GEOMETRY
LEVEE SECTIONS
STA. 938+00 TO 950+00

Revisions				
No.	Description	Date	By	Aprvd. By

Design EEA
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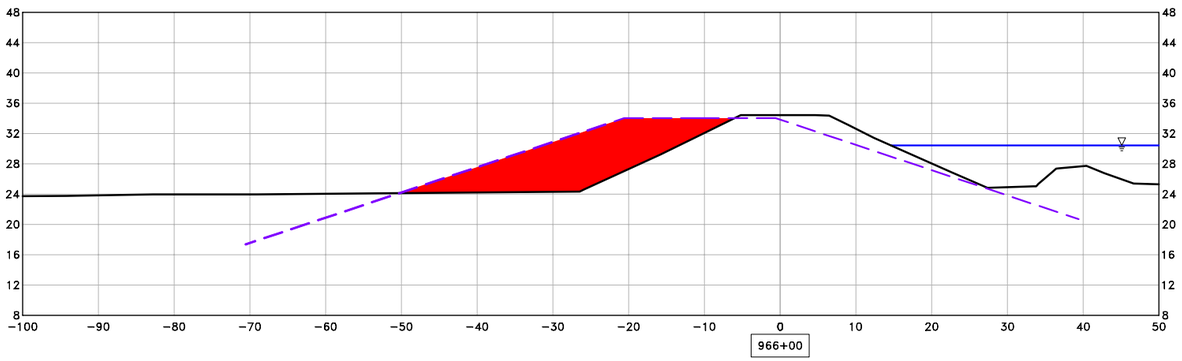
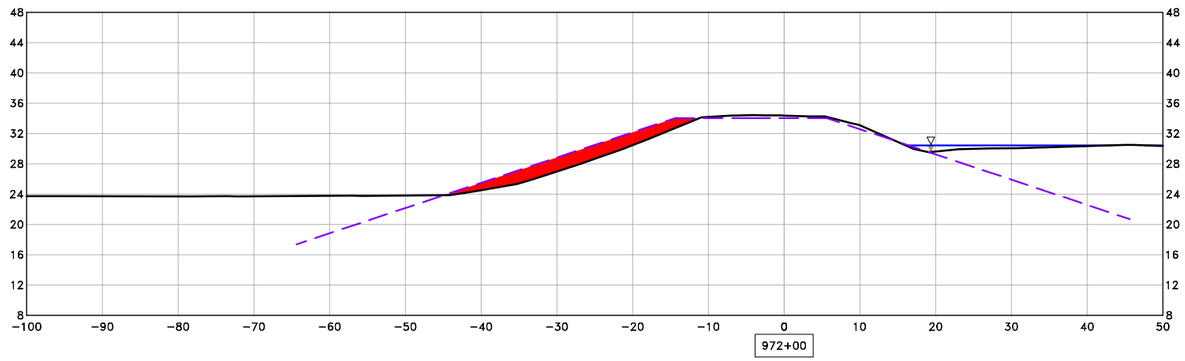
Check CHN

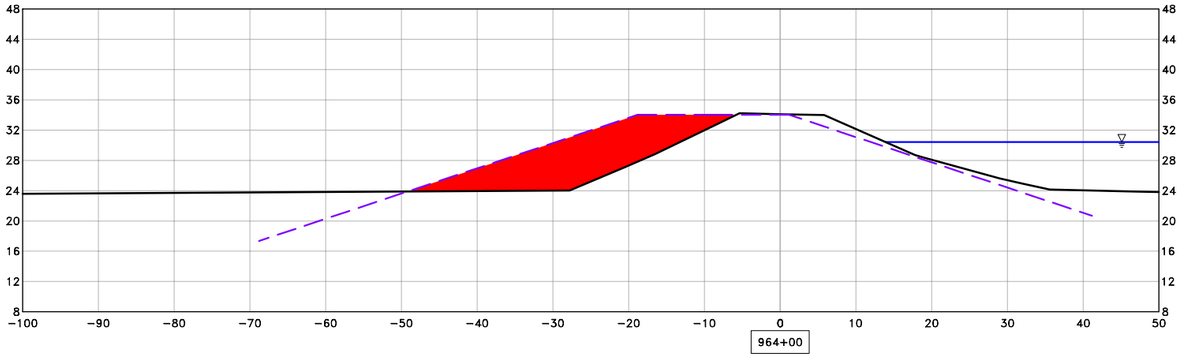
Scale 1" = 10'
Original Drawing Scale 0 ½" 1"

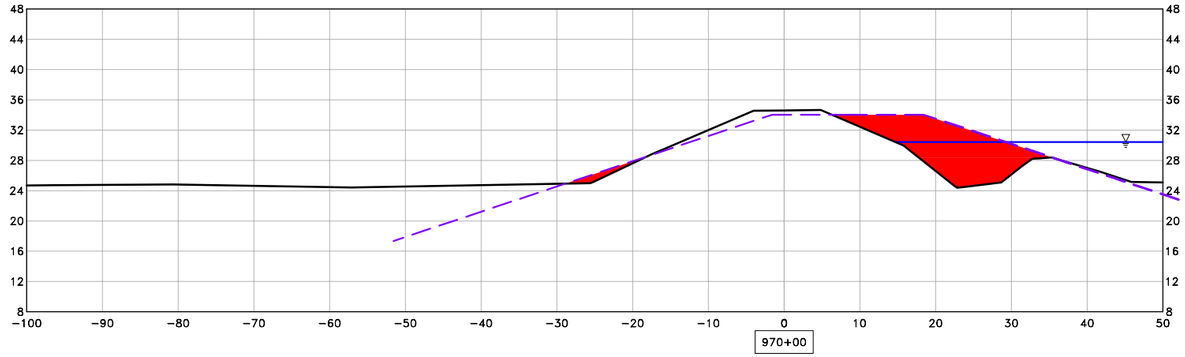
Date AUGUST 2015
Sheet Number 81 Of 82
Project File No. 2255-0030

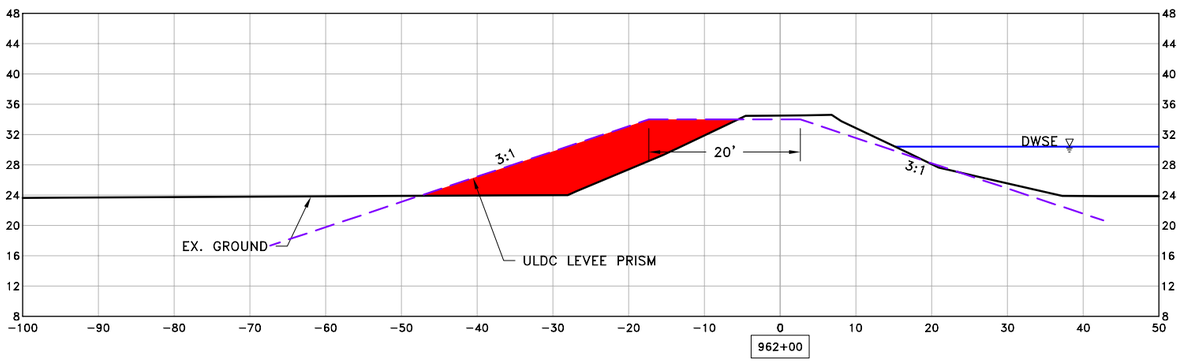
FILE SPEC: P:\2255_Lathrop_Manteca_ULDC Evaluation\0030_ULDC_Analyze and Identify Deficiencies\05_Civil\CAD\Sheets\Sht_7-08_Levee Geometry.dwg
PLOT DATE: Mar 04, 2016 - 12:32pm

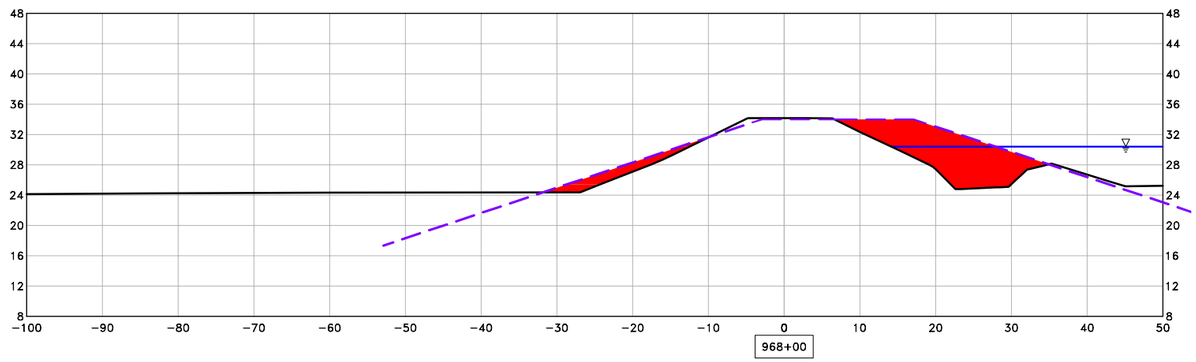












PRELIMINARY

NOT FOR CONSTRUCTION

- FOR STUDY ONLY -

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CITIES OF LATHROP AND MANTECA
ULDC EVALUATION
SAN JOAQUIN COUNTY, CALIFORNIA

7.8 LEVEE GEOMETRY
LEVEE SECTIONS
STA. 950+00 TO 962+00

Revisions				
No.	Description	Date	By	Aprvd. By

Design EEA
Drawn EEA
Check CHN

Scale 1" = 10'
Original Drawing Scale 0 ½" 1"

Date AUGUST 2015
Sheet Number 82 Of 82
Project File No. 2255-0030

FILE SPEC: P:\2255_Lathrop_Manteca_ULDC Evaluation\0030_ULDC_Analyze and Identify Deficiencies\05_Civil\CAD\Sheets\Sht_7-08_Levee Geometry.dwg
PLOT DATE: Mar 04, 2016 - 12:32pm