

2009 Western Regional Dam Safety Forum

Inundation maps in GIS format with digital files of inundation zones

Including a test case of the effects of alternative analyses on prediction of inundation limits for a key PG&E dam

Presented by Rob White, PG&E

Extent of PG&E's EAP program

160 low to high hazard dams

52 dams with EAPs

97 inundation map index sheets, 797 detail sheets

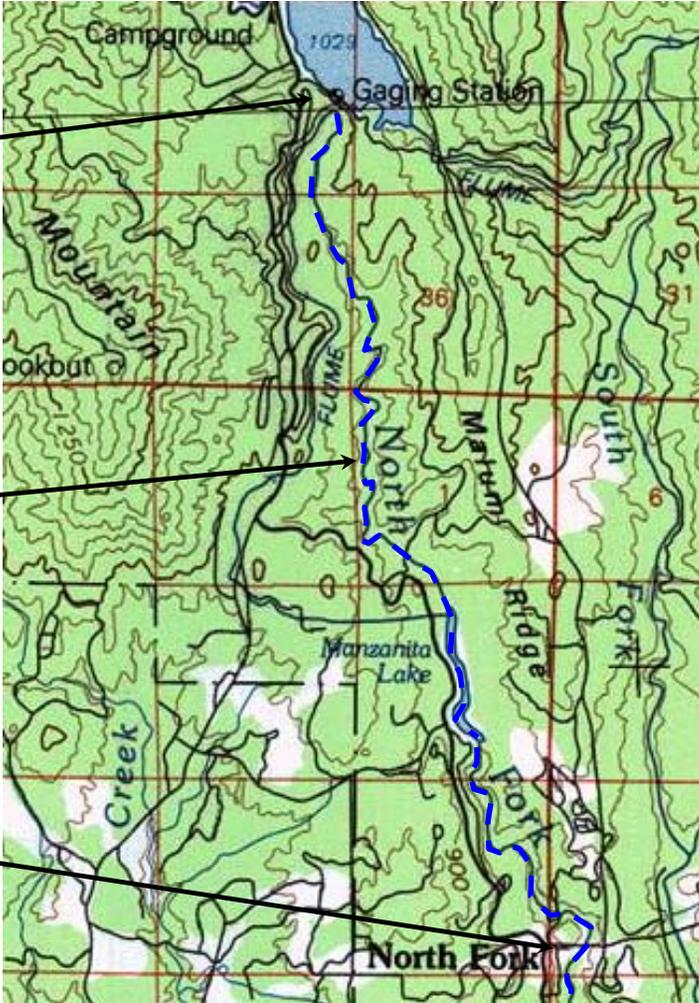
Most analyses for inundation limits done circa 1981-1983

Crane Valley Dam in relation to town of North Fork

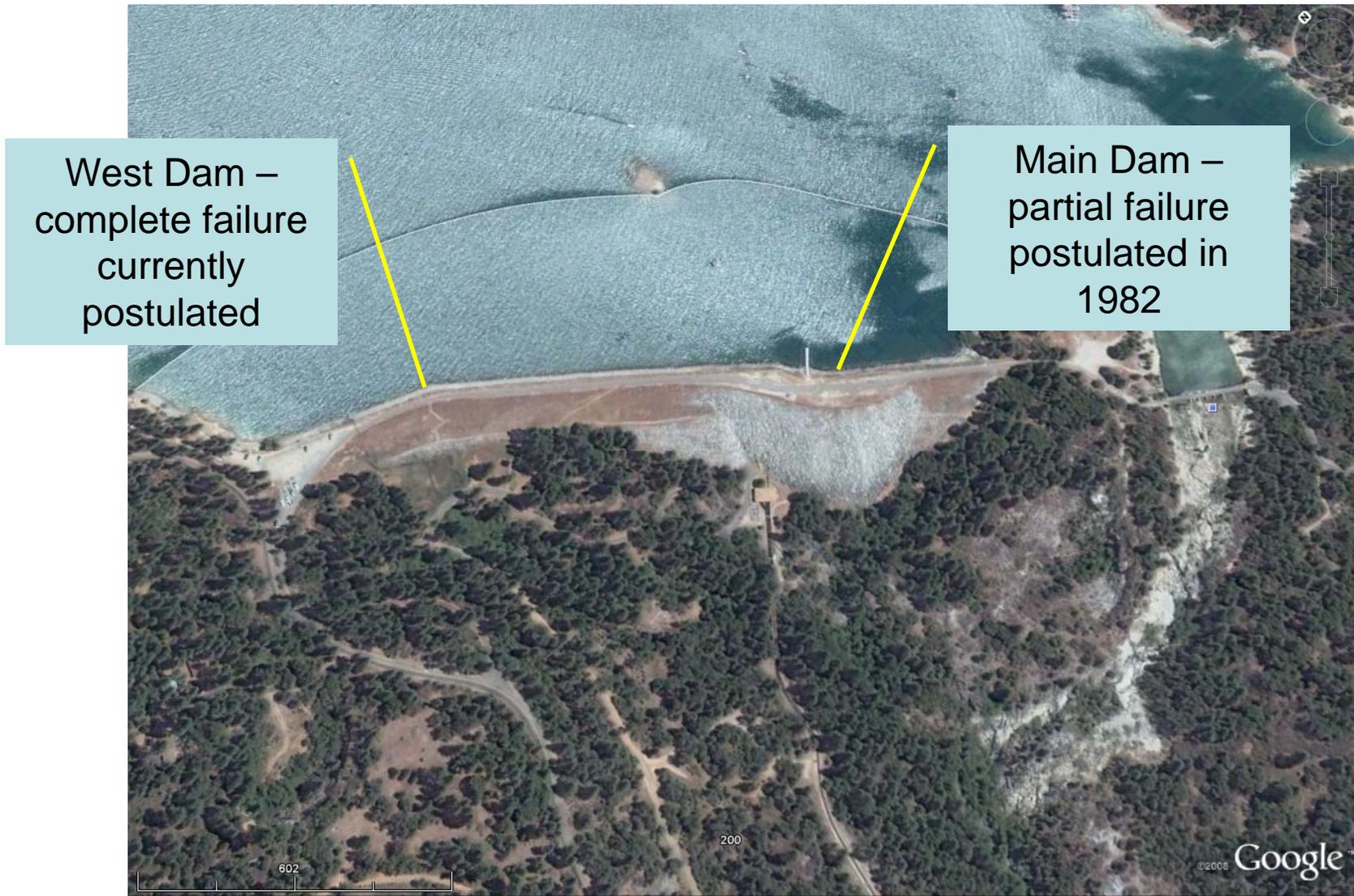
Crane Valley Dam

North Fork Willow Creek

Town of North Fork, 6 miles downstream



dam failure scenarios for Crane Valley Dam



Former method of inundation map preparation

Obtain USGS topographic sheets

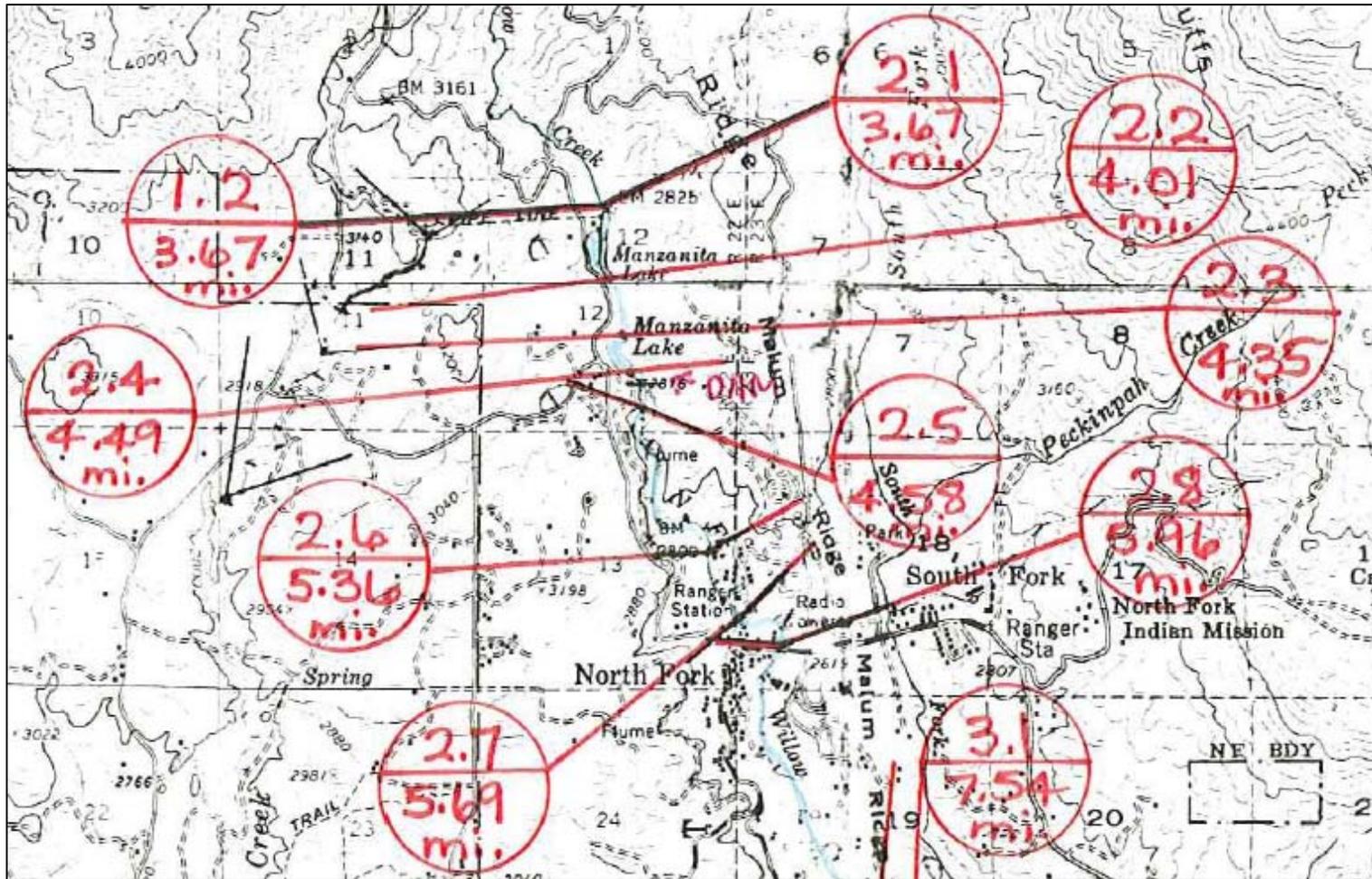
Develop cross sections downstream of dam by hand

Drive/fly along downstream reach to identify structures

Run DAMBRK analysis to obtain inundation limits

Transfer resulting limits to enlarged topos by hand

Example map marked up by hand

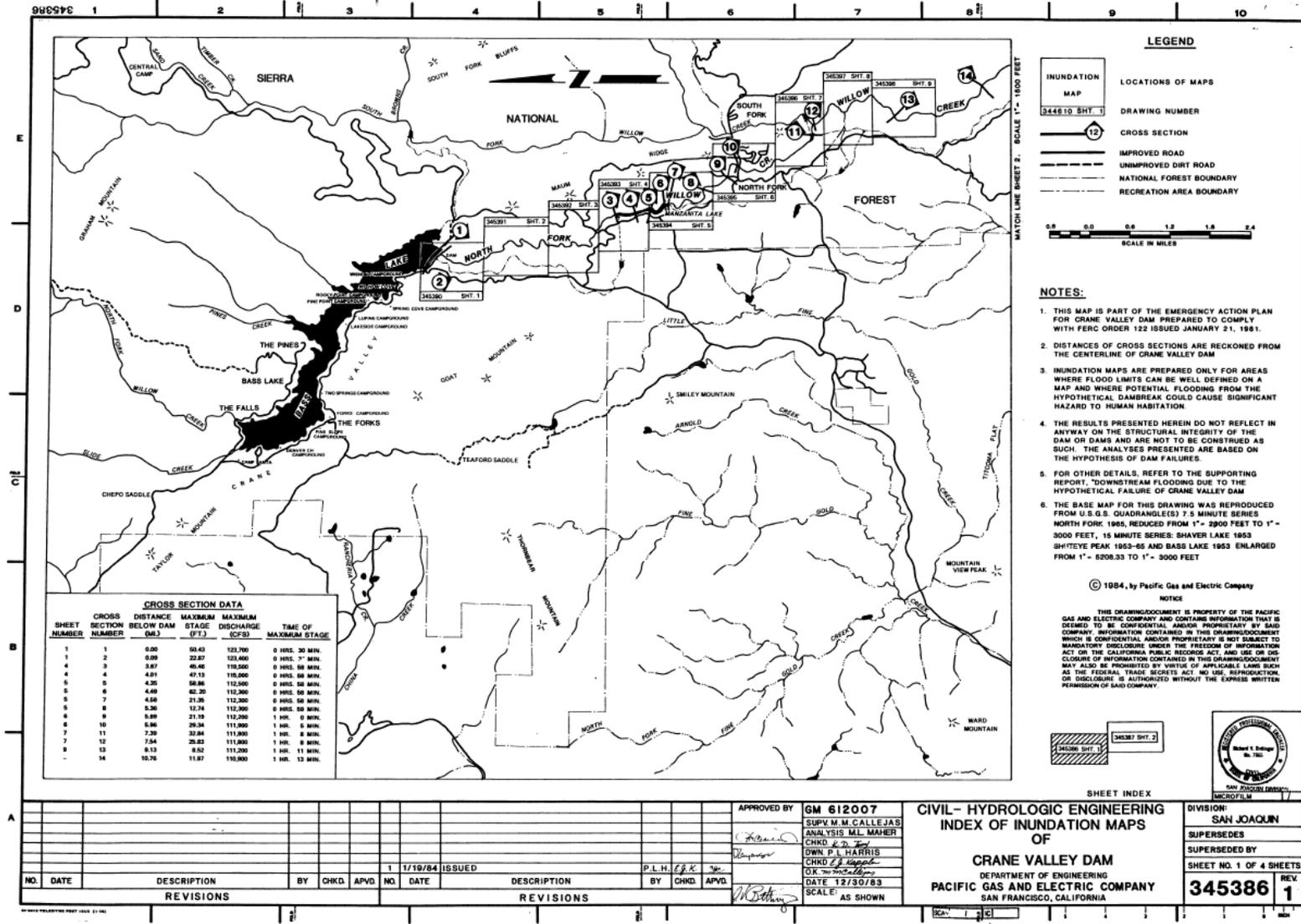


1982: 8 hand-drawn sections, hand-measured distances off USGS quads

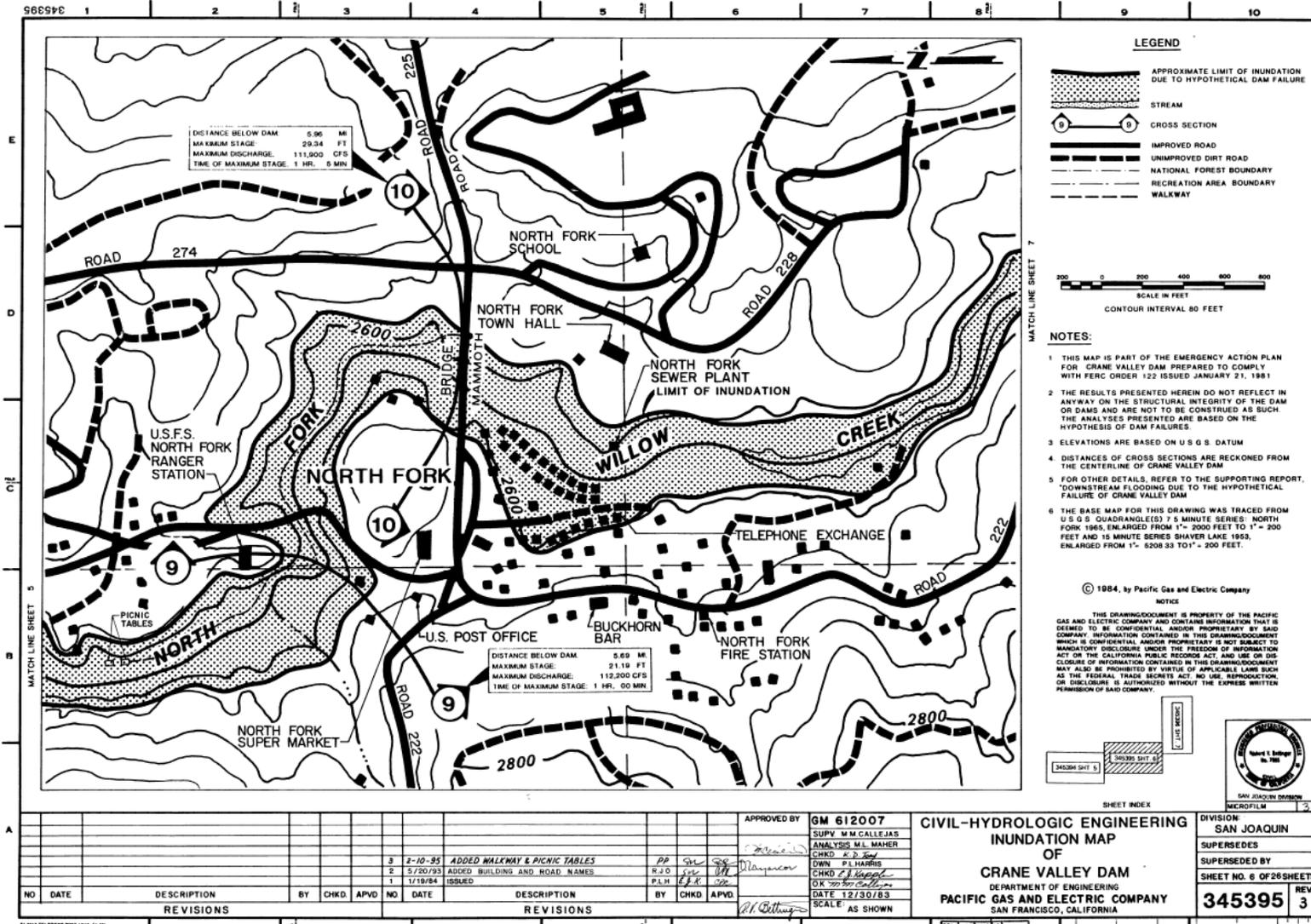
Dam failure inputs

Initial Reservoir Elev, ft	3376.76
Dam Crest Elev., ft	3380.86
Min. Foundation Elev. ft	3335
Max Height of Dam, ft	46
Top Breach Width, ft	162
Average Breach Width, ft	116
Bottom Breach Elev. ft	3335
Dam Breach Ht, ft	46
Bottom Breach Width, ft	70
Side Slopes, H:V	1
Time to Failure, hours	0.5
Manning's n-values	0.065, 0.12

Example existing overview sheet



Example existing detail sheet



DISTANCE BELOW DAM 5.96 MI
 MAXIMUM STAGE 29.34 FT
 MAXIMUM DISCHARGE 111,900 CFS
 TIME OF MAXIMUM STAGE 1 HR. 5 MIN

DISTANCE BELOW DAM 0.69 MI
 MAXIMUM STAGE 21.16 FT
 MAXIMUM DISCHARGE 112,200 CFS
 TIME OF MAXIMUM STAGE 1 HR. 00 MIN

LEGEND

- APPROXIMATE LIMIT OF INUNDATION DUE TO HYPOTHETICAL DAM FAILURE
- STREAM
- CROSS SECTION
- IMPROVED ROAD
- UNIMPROVED DIRT ROAD
- NATIONAL FOREST BOUNDARY
- RECREATION AREA BOUNDARY
- WALKWAY



NOTES:

- 1 THIS MAP IS PART OF THE EMERGENCY ACTION PLAN FOR CRANE VALLEY DAM PREPARED TO COMPLY WITH FERC ORDER 122 ISSUED JANUARY 21, 1981
- 2 THE RESULTS PRESENTED HEREIN DO NOT REFLECT IN ANYWAY ON THE STRUCTURAL INTEGRITY OF THE DAM OR DAMS AND ARE NOT TO BE CONSTRUED AS SUCH. THE ANALYSES PRESENTED ARE BASED ON THE HYPOTHESIS OF DAM FAILURES.
- 3 ELEVATIONS ARE BASED ON U.S.G.S. DATUM
- 4 DISTANCES OF CROSS SECTIONS ARE reckoned FROM THE CENTERLINE OF CRANE VALLEY DAM
- 5 FOR OTHER DETAILS, REFER TO THE SUPPORTING REPORT, "DOWNSTREAM FLOODING DUE TO THE HYPOTHETICAL FAILURE OF CRANE VALLEY DAM"
- 6 THE BASE MAP FOR THIS DRAWING WAS TRACED FROM U.S.G.S. QUADRANGLES 7 5 MINUTE SERIES: NORTH FORK 1965, ENLARGED FROM 1" = 2000 FEET TO 1" = 200 FEET AND 15 MINUTE SERIES SHAVER LAKE 1953, ENLARGED FROM 1" = 5208.33 TO 1" = 200 FEET.

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APPROVED BY **GM 612007**
 SUPV. M.M. CALLEJAS
 ANALYSIS M.L. MAHER
 CHKD. *[Signature]*
 DWN. P.L. HARRIS
 CHKD. *[Signature]*
 DATE 12/30/83
 SCALE AS SHOWN

**CIVIL-HYDROLOGIC ENGINEERING
 INUNDATION MAP
 OF
 CRANE VALLEY DAM**
 DEPARTMENT OF ENGINEERING
PACIFIC GAS AND ELECTRIC COMPANY
 SAN FRANCISCO, CALIFORNIA

DIVISION: **SAN JOAQUIN**
 SUPERSEDED BY
 SUPERSEDED BY
 SHEET NO. 6 OF 26 SHEETS
345395 REV 3

Recent FERC initiative to transfer files to GIS

“During functional exercises over the past few years, representatives of several emergency management agencies (EMAs) have requested that dam owners submit digital files of inundation zones to be incorporated into their agencies’ geographic information systems.”

“The EMAs can use the files to access additional information from their databases, such as contact information for all residences within the inundation zones, which would aid their warning and evacuation procedures.”

Recent FERC requests to update maps

- rerun analyses for revised inputs
- perform sensitivity analyses
- update base maps for new development

Updated method of inundation map preparation

Import USGS digital elevation models (DEMs) into GIS

Develop cross sections downstream of dam using GIS

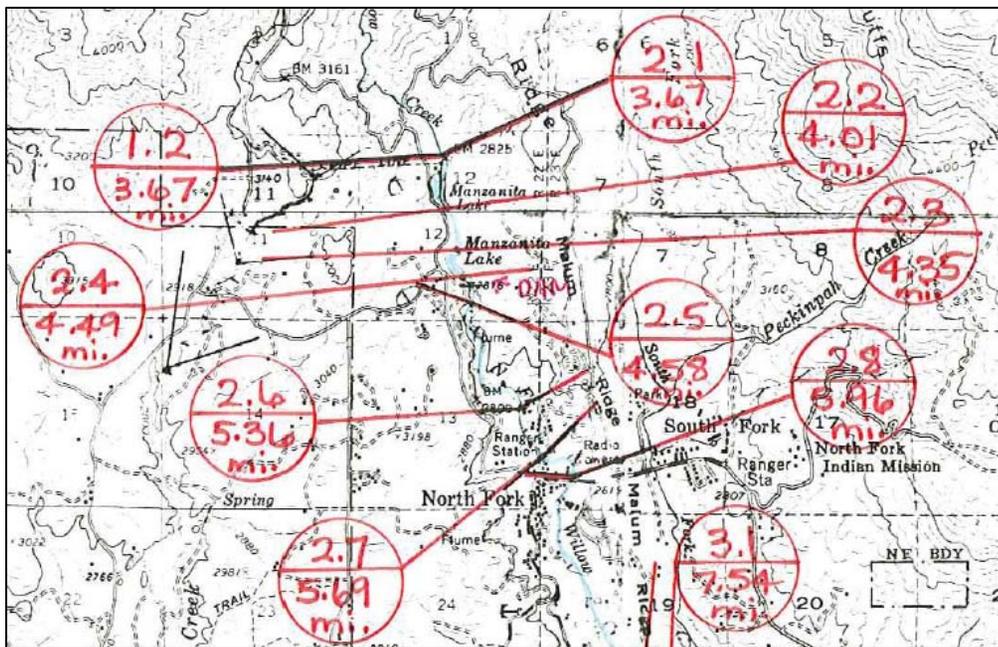
Review satellite imagery along reach for structures

Run HEC-RAS analysis to obtain inundation limits

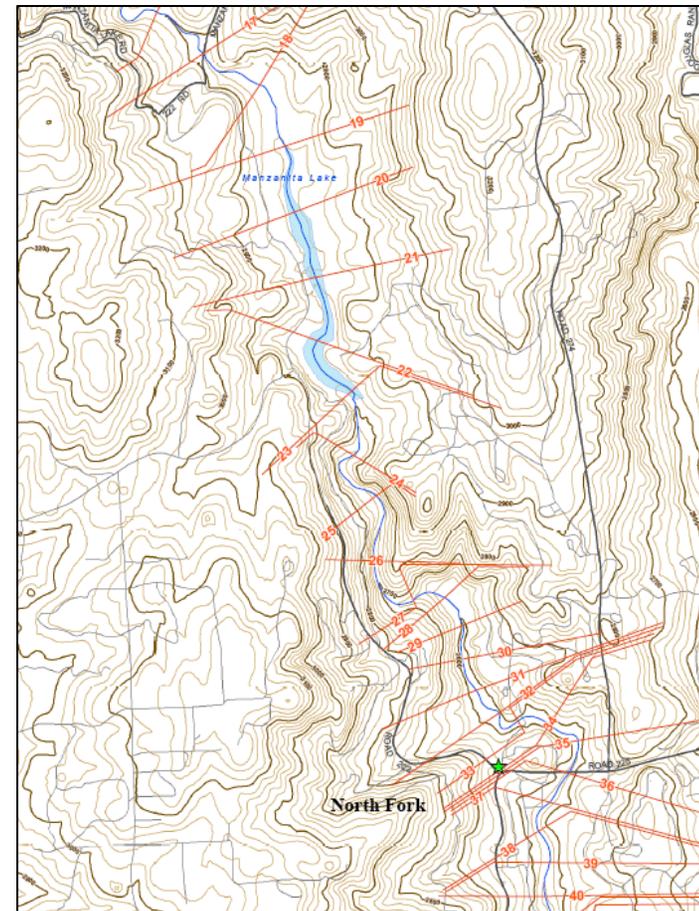
Import limits to GIS for assessment and plotting to scale

PG&E PMF, dambreak, and GIS map upgrade schedule

2008 pilot program with consultant to rerun Crane Valley dam failure with HEC-RAS

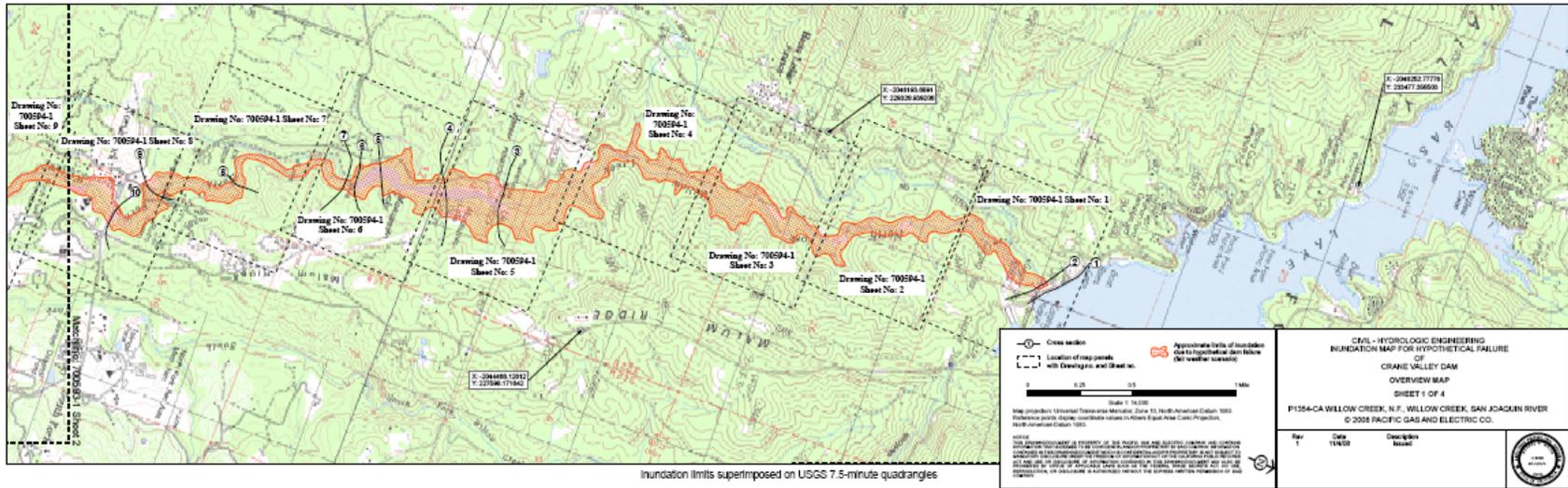
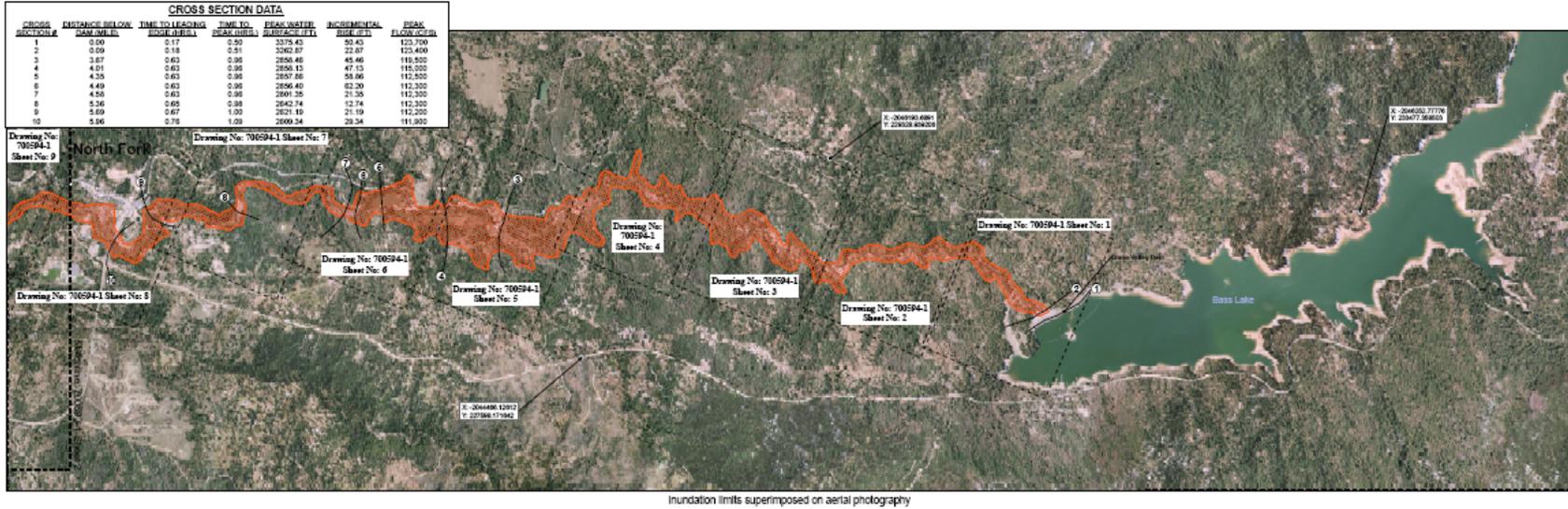


1982: 8 hand-drawn sections, hand-measured distances off USGS quads

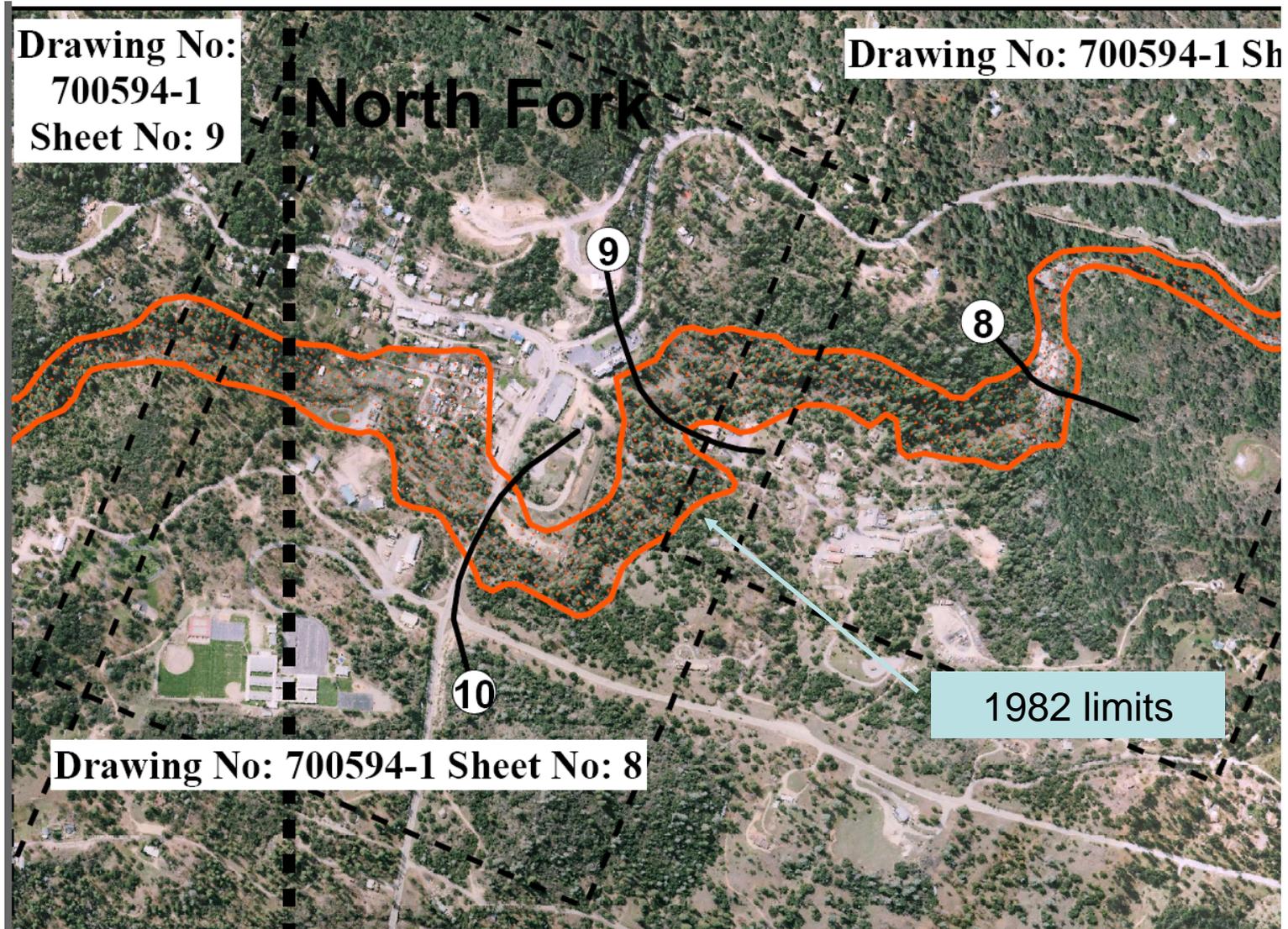


2008: 20 computer-generated sections, distances off USGS DEMs

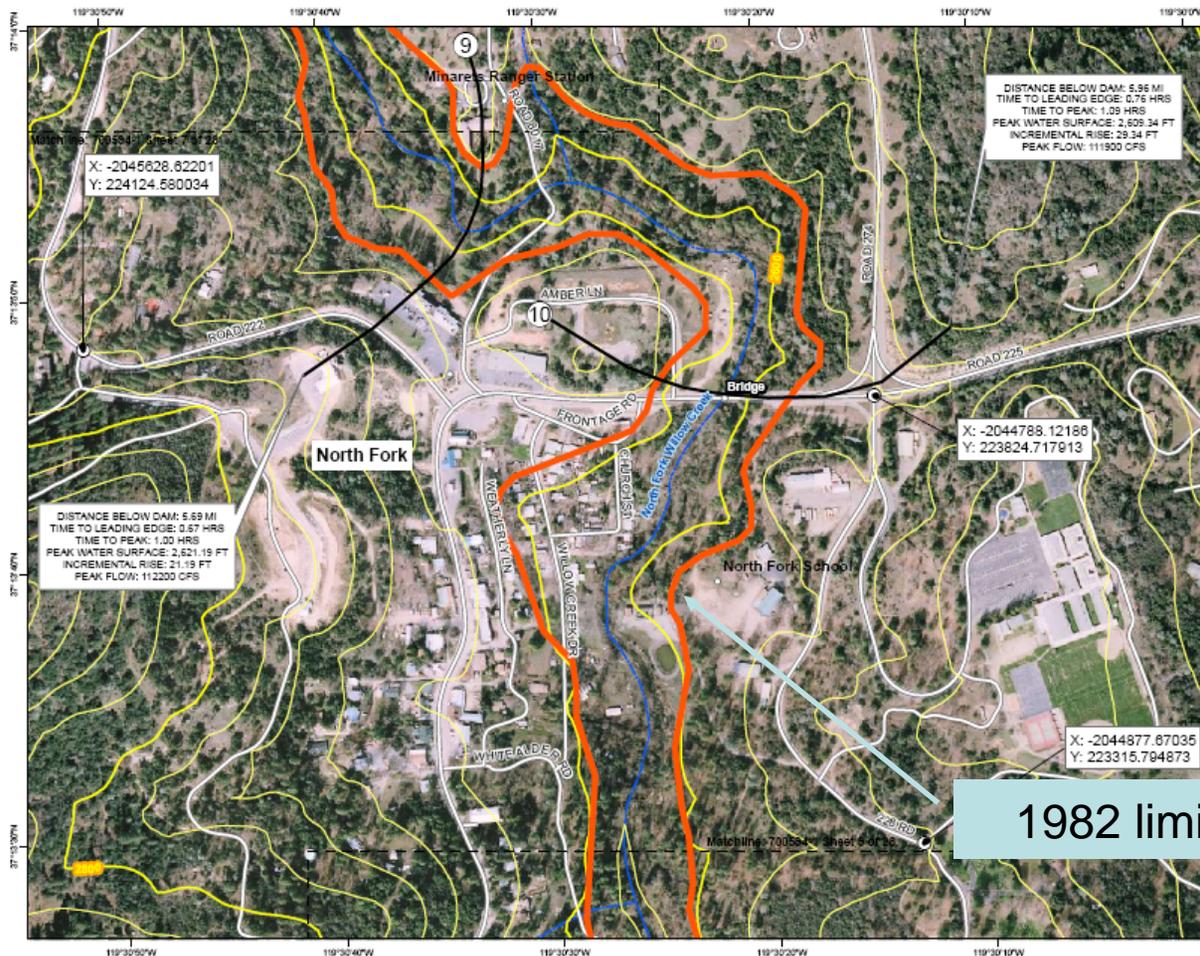
Example proposed overview sheet



Enlarged area of overview sheet



Example proposed detail sheet

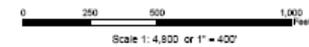


LEGEND

- Approximate limits of inundation due to hypothetical dam failure (fair weather scenario)
- Cross Section
- Selected buildings in or near the inundation limits ⁵
- Waterway
- Matchline between inundation map sheets
- Highway
- Road
- 40-ft Contour Line
- Reference Point

Notes:

1. This map is part of the emergency action plan for Crane Valley dam prepared to comply with FERC order 122 issued January 21 1981.
2. The results presented herein do not reflect in anyway on the structural integrity of the dam and are not to be construed as such. The analysis presented is based on the hypothesis of dam failure.
3. Distances of cross sections are reckoned from the centerline of Crane Valley dam.
4. For other details refer to the supporting report 'Downstream Flooding Due to the Hypothetical Failure of Crane Valley Dam', dated September 1982.
5. Structures highlighted on the maps are selected to assist in locating individual structures in rural areas but are not intended to represent all possible structures potentially within the inundation limits.
6. Aerial photography base was obtained from AirPhoto USA company and is dated from February 2007.
7. 40-ft interval contour lines were developed with ArcGIS Spatial Analyst 9.2 software using the 1/3 arc second (10-meter) National Elevation Dataset released from USGS in 2000/01. This National Elevation Dataset has a vertical accuracy of +/- 7 meters.
8. Map projection: Universal Transverse Mercator, Zone 10, North American Datum 1983. Reference points display coordinate values in Albers Equal Area Conic projection, North American Datum 1983.



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CIVIL - HYDROLOGIC ENGINEERING
INUNDATION MAP FOR HYPOTHETICAL FAILURE
OF
CRANE VALLEY DAM

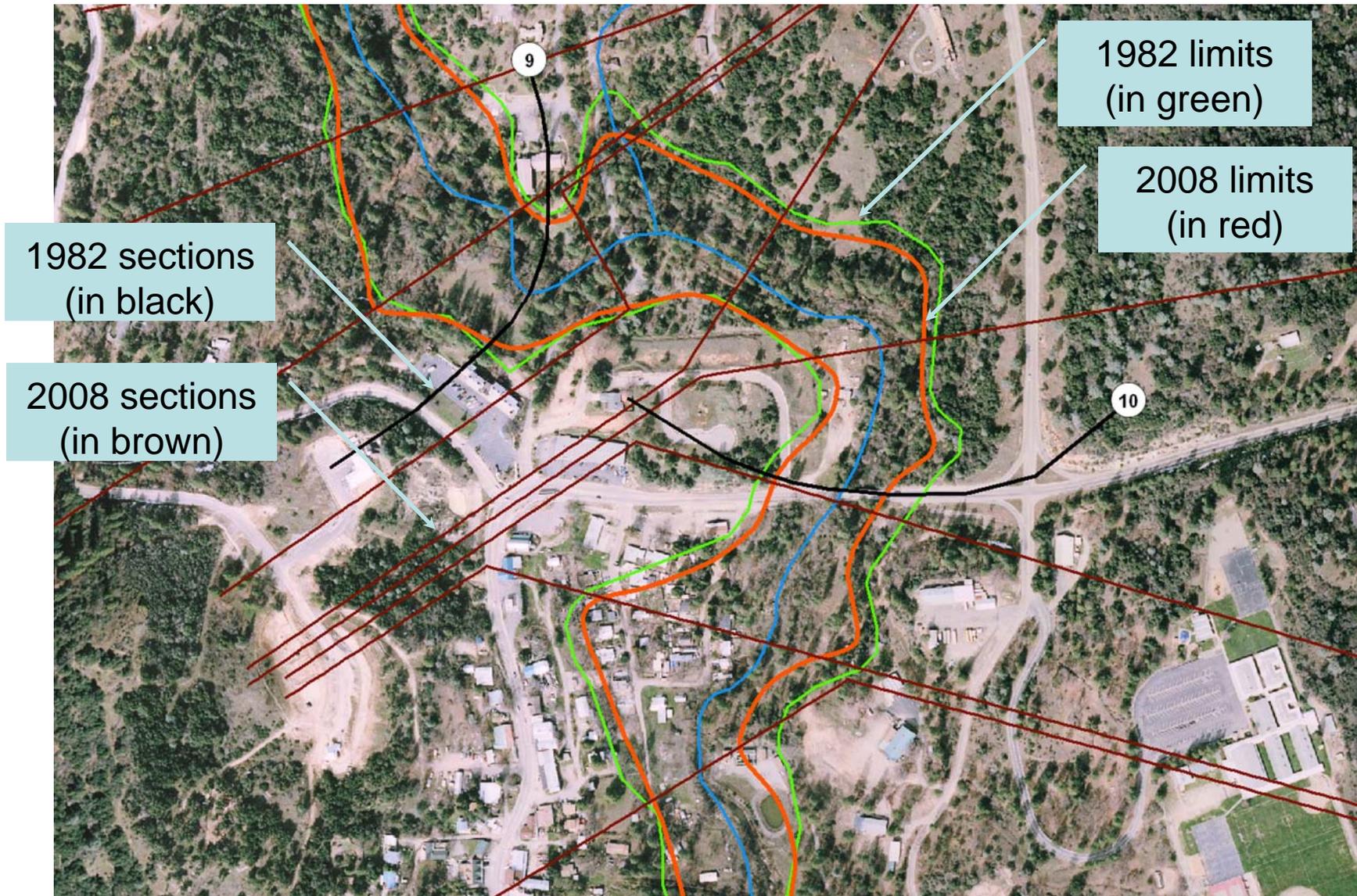
SHEET 8 OF 28

P1354-CA WILLOW CREEK N.F., WILLOW CREEK, SAN JOAQUIN RIVER
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Rev	Date	Description
1	11/4/08	Issued



Comparison of inundation limits from DAMBRK and HEC-RAS



Schedule for providing GIS data to EMAs

digitize all existing inundation limits by end of 2009

- digitize remaining ~800 overview and detail sheets throughout 2009
- provide georeferenced GIS shape files data to EMAs as they desire
- updated inundation limits, basemaps are NOT part of this interim effort

update dam failure analyses, inundation limits over five years (tie to Part 12's)

- revise existing dam failure analyses using HEC-RAS
- update inundation limits using GIS
- provide georeferenced GIS shape files and inundation maps to EMAs

PG&E dam failure analyses going forward

case history conclusions

- DAMRBK and HEC-RAS results can provide comparable results
- HEC-RAS supported by Corps, recommended by FERC
- sensitivity analyses can be run more quickly using HEC-RAS
- GIS can develop inundation maps in much less time
- GIS inundation maps can show much more information