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2 GUIDELINES AND SPECIFICATIONS FOR STUDY CONTRACTORS “FEMA 37” FEMA, JANUARY 1995
3 CALTRANS “BRIDGE DESIGN SPECIFICATIONS – LFD VERSION,” APRIL 2000
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INTRODUCTION

Based upon the flood risk assessment and evaluation of mitigation measures performed for the Butte Creek Watershed Floodplain Management Plan (FMP), as well as input provided at the public meetings held as part of this process, it was determined a closer evaluation was required of the bridges on Butte Creek. Input from the public included concerns about the hydraulic conveyance capacity of various bridges on Butte Creek and the excessive debris loading witnessed during high flow events.

To address these concerns, the Butte Creek FMP Steering Committee recommended that Wood Rodgers Inc., perform hydraulic analyses and propose replacements for four bridges on Butte Creek that include: Nelson Road Bridge, Midway Road Bridge, Southern Pacific Railroad Bridge, and Durham-Dayton Highway Bridge (Figure 1).

BACKGROUND

High flow events as recent as the 1997 flood resulted in overtopping and damage to the bridges included in this analysis. The bridges do not have clear-span configurations, but rather several smaller diameter piers with limited spans between them. This has led to significant damage to the bridges due to debris loading, as witnessed at the Durham-Dayton Highway Bridge in 1997. The Federal Emergency Management Agency (FEMA) produced the effective Flood Insurance Study (FIS) in April 2000. The FIS provided the basis for the 100-year flow rates used in this analysis. Additionally, the flow rate of 37,500 cfs measured during the 1997 flood event was considered as part of this analysis to evaluate the conveyance capacity of the proposed bridge replacements.

Durham-Dayton Highway Bridge
Debris loading and pier damage during the 1997 flood event

DATA AVAILABLE

On November 16, 2004, Wood Rodgers met with Butte County staff including the Butte County Bridge Engineer to review available data and as-built drawings. This was followed by a field-reconnaissance to several Butte Creek bridges, including the four bridges for which this analysis was performed. A photographic log was developed following the visit. Additionally, several Caltrans and FEMA references were used to complete the analysis. A list of the references and data include:

1. Flood Insurance Study for Butte County, California and Incorporated Areas. FEMA, April 20, 2000 (Attachment 1).

2. Guidelines and Specifications for Study Contractors "FEMA 37," FEMA, January 1995 (Attachment 2).

3. Caltrans, "Bridge Design Specifications – LFD Version," April 2000 (Attachment 3).

4. Caltrans "Comparative Bridge Costs," January 2002 (Attachment 4).

5. Caltrans "Seismic Design Criteria, Version 1.2," December 2001 (Attachment 5).

6. Caltrans Butte Creek bridge as-built drawings provided by Butte County on November 16, 2004.

7. CCR, TITLE 23, Division 1, Chapter 1, Article 8, §128. Bridges. (10)(A).

8. HEC-2 hydraulic models for the Butte County FIS performed in 1994 by Borcalli & Associates, Inc.

9. Photographs of Butte Creek bridges at Nelson Road, Durham-Dayton Highway, Midway Road, and Southern Pacific Railroad during the 1997 flood, provided by

Mr. Raymond Cooper, Butte County Bridge Engineer, November 16, 2004 and January 10, 2005

ASSUMPTIONS

The following assumptions were made in performing the hydraulic analyses and design for the four bridges:

- Freeboard requirements are governed by:

  FEMA 37 – Guidelines and Specifications for Study Contractors, Chapter 7. Evaluation of Levee Flood Control System: "Freeboard. A minimum levee freeboard of 3 feet shall be necessary, with an additional 1 foot of freeboard within 100 feet of either side of structures within the levee or wherever the flow is constricted, such as at bridges. An additional 0.5 foot above this minimum is also required at the upstream end, tapering to the minimum at the downstream end of the levee."

  CCR, TITLE 23, Division 1, Chapter 1, Article 8, §128. Bridges. (10)(A): "The bottom members (soffit) of a proposed bridge must be at least three (3) feet above the design flood plane. The required clearance may be reduced to two (2) feet on minor streams at sites where significant amounts of stream debris are unlikely."

- Following construction, an operation and maintenance program will be in place and that channel n-values can be kept within the values determined in the effective FIS.

- Hydraulic bridge design was performed assuming that levees would be improved to have three feet of freeboard and certified.

ANALYSIS

The HEC-2 hydraulic model prepared as part of the Butte Creek effective FIS was converted into the latest version "user friendly" HEC-RAS hydraulic model. The following modifications were applied to the HEC-RAS model:

- Channel bank stations were modified to reflect the actual top-of-bank at each cross-section. Levee and ineffective flow definitions were modified accordingly.

- For bridge design purposes, it was assumed that all Butte Creek levee improvements would be implemented. As such, all flow was modeled as contained within the levees.

- Design capacity will be the 100-year flow rate provided in the FIS.

- Where bridges are being replaced, the typical structural section is assumed to be type Cast-in-Place\Pre-Stressed (CIP/PS) concrete box. This section type is among the most common used in California. For this section type, bridge spans typically range between 100-150 feet. To minimize the bridge deck thickness, standard pier spacing is assumed to be 100-feet. For the SPRR Bridge, a steel I-Girder bridge is proposed with a pier spacing of approximately 100 feet.

- Based upon Caltrans' Bridge Design Specifications – LFD Version, the structure depth to span ratio is 0.04 for continuous span structures of this section type. With piers spaced 100 feet apart, the bridge deck is assumed to be four feet thick.

- Caltrans' Seismic Design Criteria, Version 1.2, requires that every effort shall be made to limit the column cross-sectional dimensions to the depth of the superstructure. As such, pier widths should be four feet.

Bridge pier protection methods could be adopted to protect the piers from damage due to debris loading and allow the debris to flow through the bridge. These measures can be adopted for the existing or proposed bridges. Examples of these products are the MOAB and the Bridgeshark from Debris Free, Inc. The cost of these products and the installation were included in the cost estimates to show how the cost of such pier protection and debris control methods factor into the overall cost. Following is a discussion of the analyses performed at each of the four bridges:

Nelson Road

At this location, Butte Creek is divided into two channel sections, which include the main reach and a bypass channel parallel to the creek. Only the structure crossing the main channel was evaluated as part of this analysis. The effective FIS model indicates that although the roadway is not overtopped at this location, the water surface at the upstream face of the bridge is less than 0.1 foot from overtopping the bridge deck. The FIS model assumed that no debris impingement would be concurrent with the 100-year storm. However, previous large storm events have routinely deposited large quantities of debris at the upstream face of the bridge (Figure 2), due in large part to the narrow pier spacing of the existing structure. This would suggest that during the 100-year event flow would be obstructed and may exceed the capacity of the bridge and may result in overtopping the road and potentially flooding surrounding areas.

During the 100-year flow event, both reaches flow full. The two reaches become hydraulically separated between Station 12554 and Station 12285. It was determined that the main reach of Butte Creek would convey approximately 23,000 cfs, while the bypass would convey approximately 11,900 cfs.

Midway Road

The crossing at Midway Road consists of two separate reaches, which include the main reach and a bypass channel north of the main reach. During a 100-year flow event, both reaches flow full. Under existing conditions, Midway Road is overtopped during the 100-year flow event due to a depression in the road profile between the two bridges crossing the creek (Figure 3). In this analysis, both bridges were replaced with a single bridge alternative that would span the two levees.

Southern Pacific Railroad Crossing Upstream of Midway Road

The Railroad crossing consists of two separate reaches, which include the main reach and a bypass channel west of the main reach. During the 100-year flow event, both reaches flow full. The railroad grade does not include a depression in its span similar to that of Midway Road. Under these existing conditions, the railroad would potentially be overtopped during the 100-year event due to insufficient conveyance capacity and potential loss of conveyance due to significant debris loading (Figure 4). As part of this analysis, both bridges were replaced with a single bridge alternative that would span the two levees.

Durham-Dayton Highway

Although this crossing has adequate freeboard under the effective FIS, the existing pier configuration at this crossing has historically been susceptible to debris impingement during large storms (Figure 5). The FIS model assumed that no debris impingement would be concurrent with the 100-year flow. As such, the effective FIS may have overestimated the capacity of this structure during large storm events. Therefore, an alternative bridge configuration was proposed with a pier configuration that would allow debris loads to pass under the bridge while causing negligible damage.

RESULTS

A comparison between the Effective FIS water surface profile and the proposed water surface profile is presented on Figure 6.

Nelson Road

The FEMA FIS indicated that at the upstream face of Nelson Road., the 100-year WSEL would be at El. 113.94. By replacing the existing bridge and implementing levee improvements and certification, as well as debris load control and bridge pier protection measures, the 100-year WSEL can be reduced to El. 112.59 (Figure 7). At this design WSEL, the top of the bridge deck would be at El. 119.59, and the low chord would be at El. 115.59. The low chord elevation would meet both the FEMA and Reclamation Board freeboard criteria. With these bridge improvements implemented, debris impingement would be significantly reduced at this crossing. Additionally, Nelson Road would no longer be subject to potential overtopping during a 100-year storm and the flow would be contained within the levees.

Midway Road

The FEMA FIS indicated that at the upstream face of Midway Road, the 100-year WSEL would be at El. 137.36. By replacing the existing bridge and implementing levee improvements and certification, as well as debris load control and bridge pier protection measures, the 100-year WSEL can be reduced to El. 137.32 (Figure 8). At this design WSEL, the top of the bridge deck would be at El. 144.32, and the low chord would be at El 140.32. The low chord elevation would meet both the FEMA and Reclamation Board freeboard criteria. These bridge improvements would raise the portion of Midway Road that is currently overtopped above the 100-year flood event WSEL. Additionally, the revised pier configuration evaluated in this analysis would leave the bridge less subject to debris impingement. Improvements to the levees at this location would ensure that the 100-year storm could be contained within the banks of the levees.

Southern Pacific Railroad

The FEMA FIS indicated that at the upstream face of the Railroad, the 100-year WSEL would be at El. 140.62. By replacing the existing bridges with a single bridge, as well as debris load control and bridge pier protection measures, the 100-year WSEL can be reduced to El. 137.79 (Figure 8). At this design WSEL, the top of the bridge deck would be at El. 144.79, and the low chord would be at El. 140.79. This low chord elevation would meet both the FEMA and Reclamation Board freeboard criteria. Once these bridge improvements are implemented, the railroad bridge would no longer be subject to overtopping during a 100-year storm and the amount of levee raising required upstream of the bridge would be reduced. Additionally, the revised pier configuration evaluated in this analysis would leave the bridge less subject to debris impingement, which has historically proved to be a significant problem at this location.

Durham-Dayton Highway

Although this bridge crossing has adequate freeboard under existing conditions, the dense pier configuration leaves it susceptible to potential damage due to debris loading. The FEMA FIS assumed that no debris impingement would occur concurrently with a 100-year storm and determined that at the upstream face of the Highway, the 100-year WSEL would be at El. 165.5. By replacing the existing bridge and installing debris load control and bridge pier protection measures, the reduction in the 100-year WSEL would not be significant in this case (Figure 9). The main benefit from the proposed configuration would be in the reducing the debris load and significantly reducing the potential for pier damage and loss of bridge functionality during high flow events.

COST ESTIMATE

According to the January 2002 Caltrans Comparative Bridge Costs, the cost range for bridge replacement using a CIP/PS box bridge is approximately $80-150/ft^2 and $150-215 for a steel I-Girder bridge for the Southern Pacific Railroad The cost for removing a box girder structure is approximately \$15-20/ ft^2. The above cost/ ft^2 estimates include cost for mobilization at 10 percent and contingency at 25 percent. For a more conservative estimate and to account for adjustment to 2005 dollars, this cost estimate is based upon a total of \$170/ft^2 for the Nelson, Midway, and Durham-Dayton bridges (150/ft^2 for construction and \$20/ ft^2 for removing the existing structure) and \$235 for the SPRR bridge replacement (\$215/ft^2 for construction and \$20/ ft^2 for removing the existing structure). The cost for replacement of the SPRR Bridge does not account for realignment of the Kinder-Morgan 8-inch-diameter petroleum pipeline.

Additionally, debris control and bridge pier protection measures could be adopted for the existing or proposed bridges. As previously mentioned, examples of these products are the MOAB and the Bridgeshark from Debris Free, Inc. The cost of these products and the installation were included in the cost estimates to show how the cost of such pier protection and debris control methods factor into the overall cost estimate.

Below is a summary of the cost estimate for protecting the existing bridges and piers, and the cost for replacing these bridges. A more detailed cost estimate is included in the tables located at the end of this report.

TABLE 1
COST ESTIMATES

Bridge	Existing Bridge Pier Protection $	Bridge Replacement Cost Including Pier Protection $
Nelson Bridge	345,200	1,413,300
Midway Bridge	189,300	5,816,300
SPRR Bridge	365,300	4,847,300
Durham-Dayton Bridge	460,800	2,225,700

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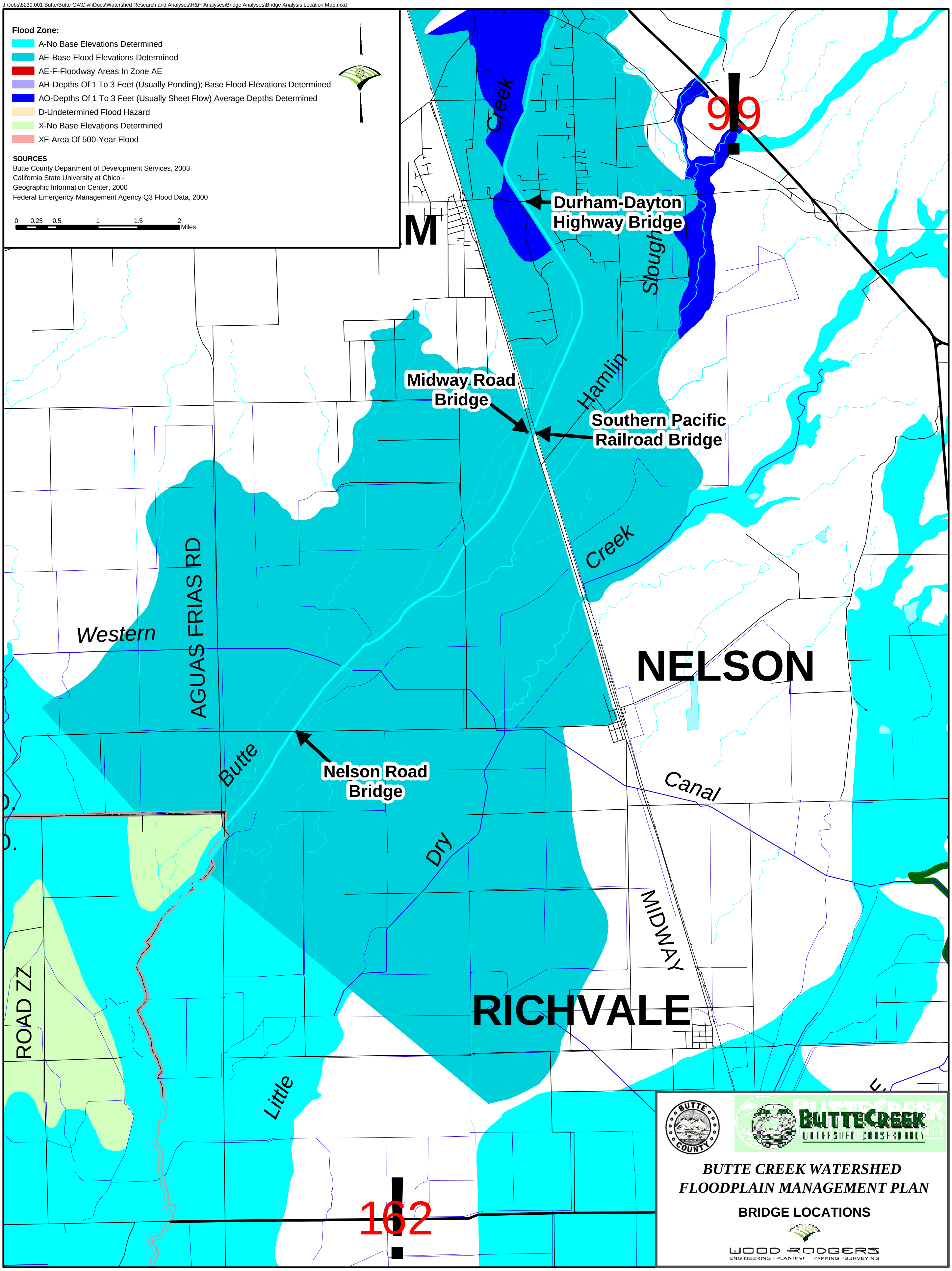


FIGURE 1

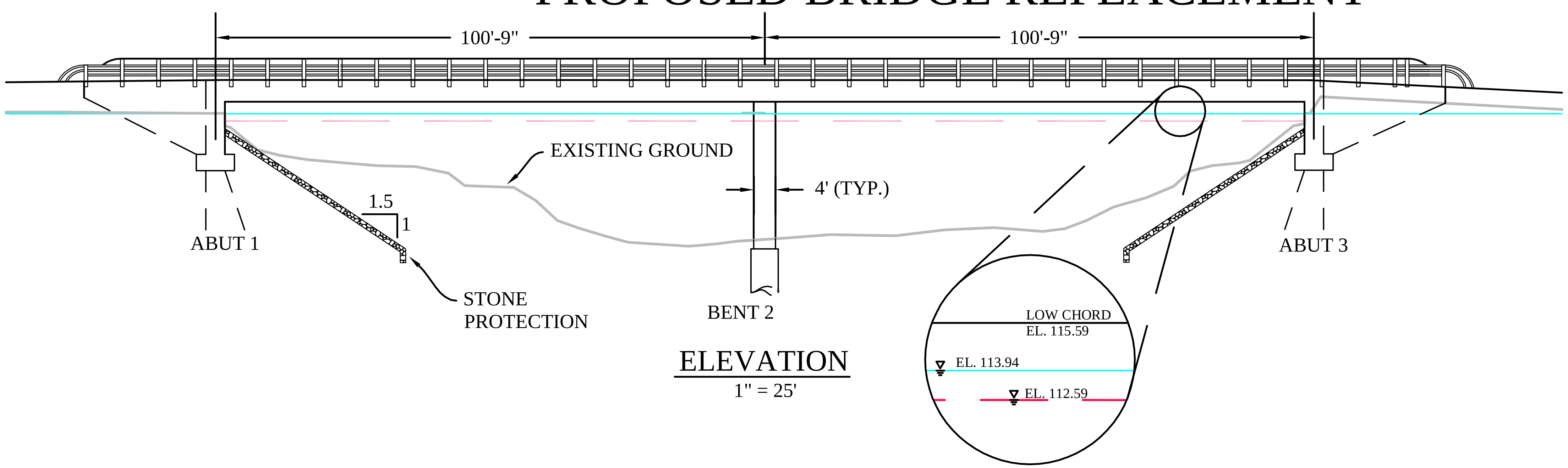
EXISTING CONDITIONS

NELSON ROAD, DOWNSTREAM FACE - 1997 FLOOD

NELSON ROAD, UPSTREAM FACE - 1997 FLOOD

NELSON ROAD - NOVEMBER 2004

PROPOSED BRIDGE REPLACEMENT



ELEVATION
1" = 25'

Proposed bridge features include:
1. Pier spacing at approximately 100'.
2. A single pier (existing bridge has 28 piers).
3. Installation of debris reduction and removal mechanism.

LEGEND
EFFECTIVE 100-YEAR WSEL SHOWN DOES NOT ACCOUNT FOR DEBRIS IMPINGEMENT (El. 113.94)
100-YEAR WSEL WITH PROPOSED BRIDGE MODIFICATION (El. 112.59)

PRELIMINARY

BUTTE CREEK WATERSHED FLOODPLAIN MANAGEMENT PLAN

NELSON ROAD BRIDGE PROPOSED REPLACEMENT

WOOD RODGERS
ENGINEERING • MAPPING • PLANNING • SURVEYING

FIGURE 2

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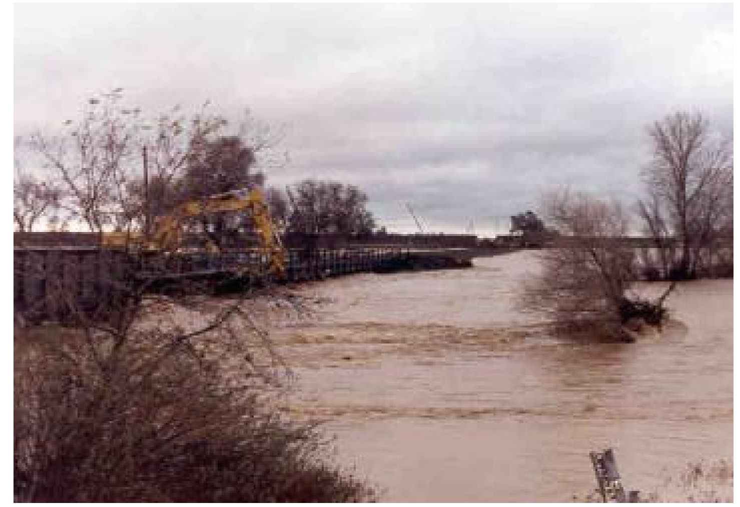
EXISTING CONDITIONS

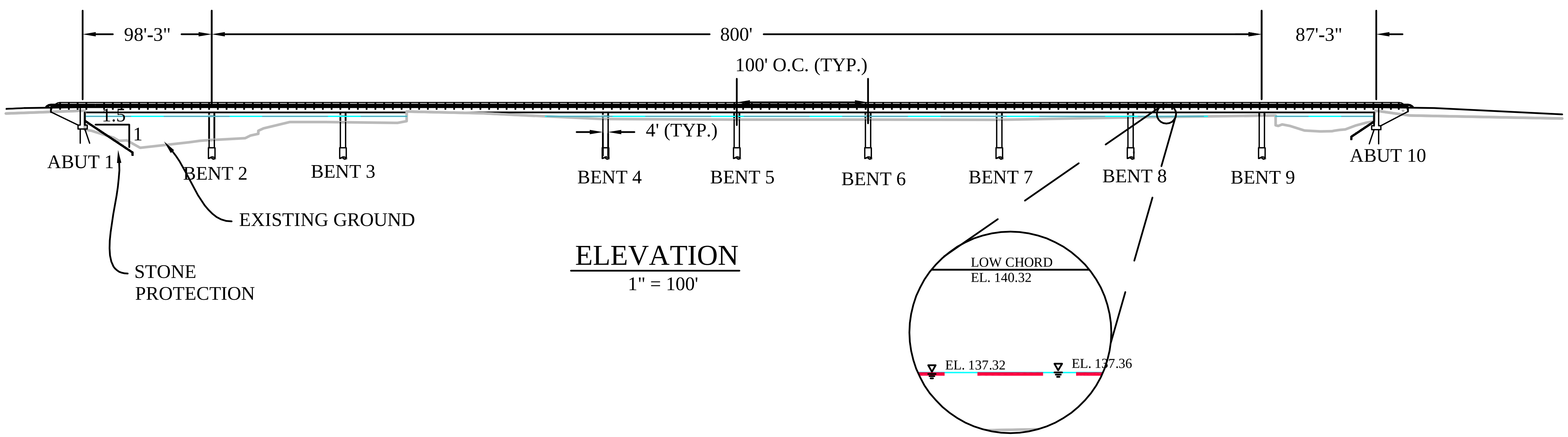
SOUTHERN PACIFIC RAILROAD AND MIDWAY ROAD - 1997 FLOOD



SOUTHERN PACIFIC RAILROAD AND MIDWAY ROAD - 1997 FLOOD

MIDWAY ROAD - NOVEMBER 2004

PROPOSED BRIDGE REPLACEMENT



ELEVATION
1" = 100'

Proposed bridge features include:
1. Pier spacing at approximately 100'.
2. Span length increased to 1000' (approximate)
3. 8 piers (existing bridge has 84 piers).
4. Installation of debris reduction and removal mechanism.

LEGEND
- EFFECTIVE 100-YEAR WSEL SHOWN DOES NOT ACCOUTNT FOR DEBRIS IMPINGEMENT (El. 137.36)
- 100-YEAR WSEL WITH PROPOSED BRIDGE MODIFICATION (El. 137.32)

PRELIMINARY

BUTTE CREEK WATERSHED FLOODPLAIN MANAGEMENT PLAN

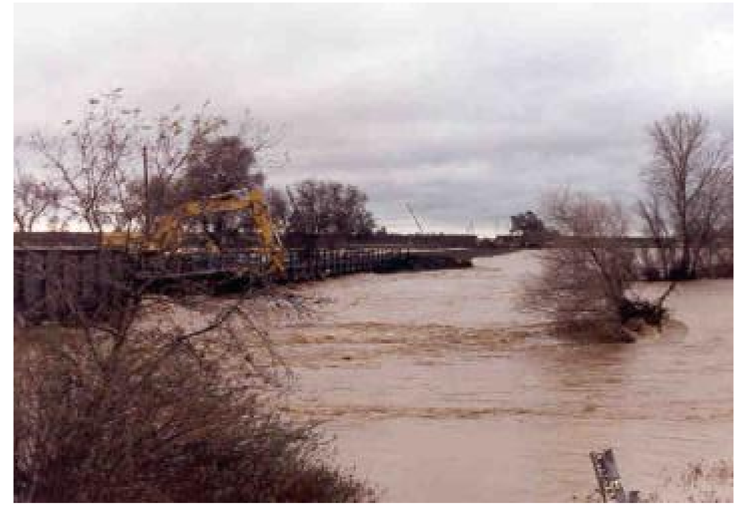
MIDWAY ROAD BRIDGE PROPOSED REPLACEMENT

WOOD RODGERS
ENGINEERING • MAPPING • PLANNING • SURVEYING

FIGURE 3

EXISTING CONDITIONS

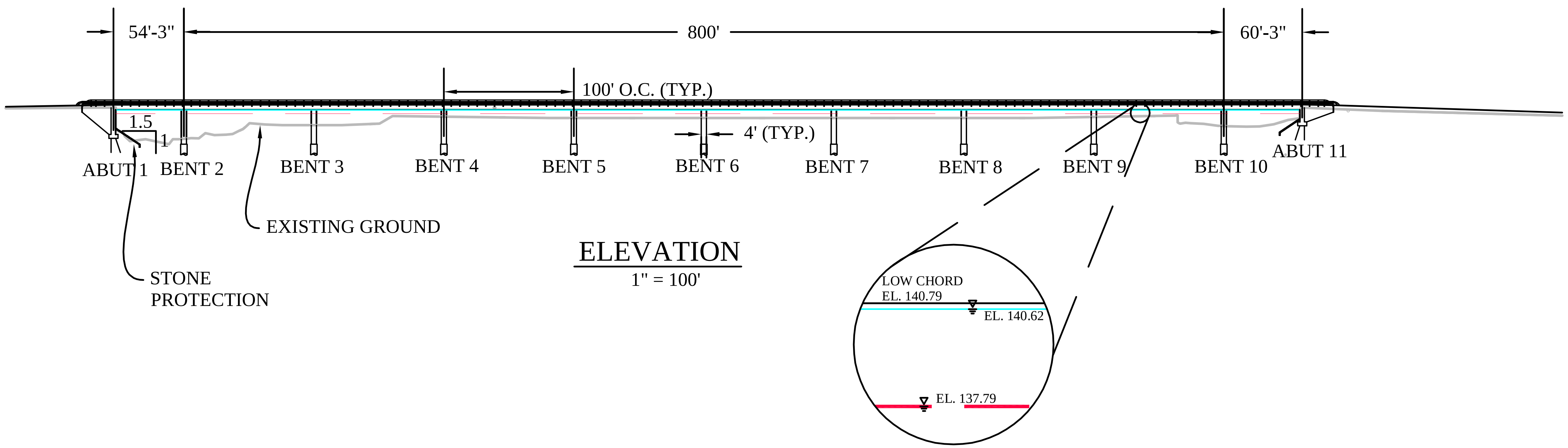
SOUTHERN PACIFIC RAILROAD AND MIDWAY ROAD - 1997 FLOOD



SOUTHERN PACIFIC RAILROAD AND MIDWAY ROAD - 1997 FLOOD

SOUTHERN PACIFIC RAILROAD - NOVEMBER 2004

PROPOSED BRIDGE REPLACEMENT



ELEVATION
1" = 100'

LEGEND
EFFECTIVE 100-YEAR WSEL SHOWN DOES NOT ACCOUNT FOR DEBRIS IMPINGEMENT (El. 140.62)
100-YEAR WSEL WITH PROPOSED BRIDGE MODIFICATION (El. 137.79)

Proposed bridge features include:
1. Pier spacing at approximately 100'.
2. Span length increased to 900' (approximate)
3. 9 piers (existing bridge has 71 piers).
4. Installation of debris reduction and removal mechanism.

PRELIMINARY

BUTTE CREEK WATERSHED FLOODPLAIN MANAGEMENT PLAN

SOUTHERN PACIFIC RAILROAD BRIDGE PROPOSED REPLACEMENT

WOOD RODGERS
ENGINEERING • MAPPING • PLANNING • SURVEYING

FIGURE 4

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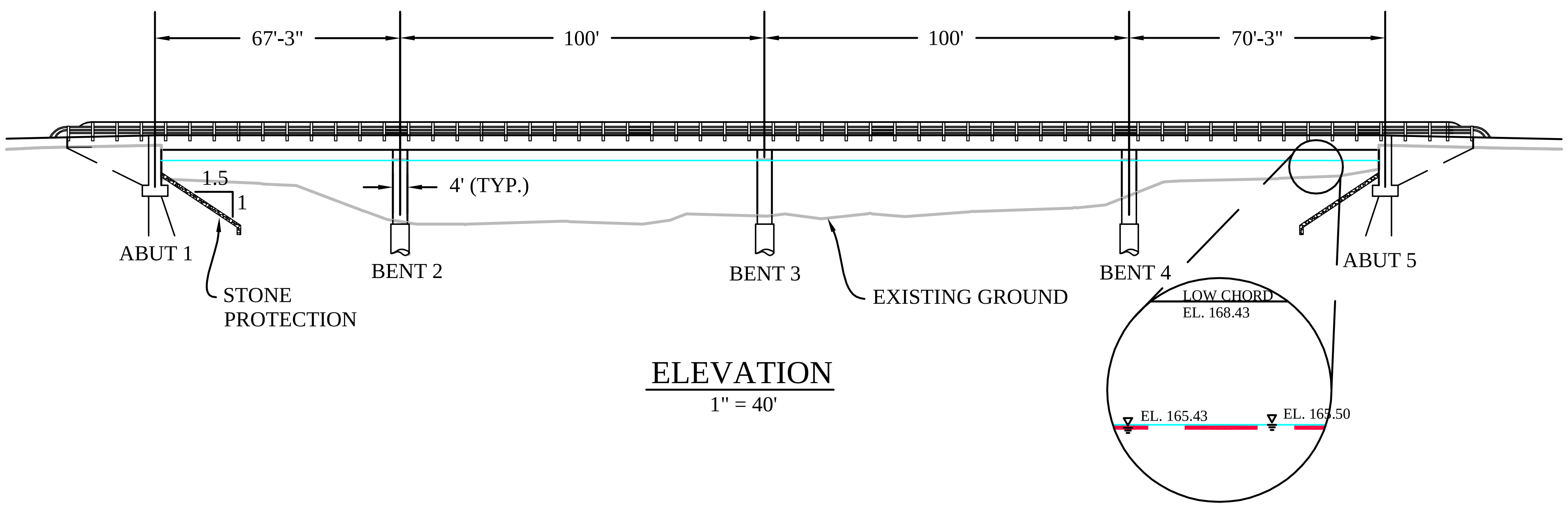
EXISTING CONDITIONS

DURHAM-DAYTON HIGHWAY - 1997 FLOOD

DURHAM-DAYTON HIGHWAY - 1997 FLOOD

DURHAM-DAYTON HIGHWAY - NOVEMBER 2004

PROPOSED BRIDGE REPLACEMENT



ELEVATION
1" = 40'

Proposed bridge features include:
1. Pier spacing at approximately 100'.
2. 3 piers (existing bridge has 55 piers).
3. Installation of debris reduction and removal mechanism.

LEGEND
- EFFECTIVE 100-YEAR WSEL SHOWN DOES NOT ACCOUNT FOR DEBRIS IMPINGEMENT (El. 165.50)
- 100-YEAR WSEL WITH PROPOSED BRIDGE MODIFICATION (El. 165.43)

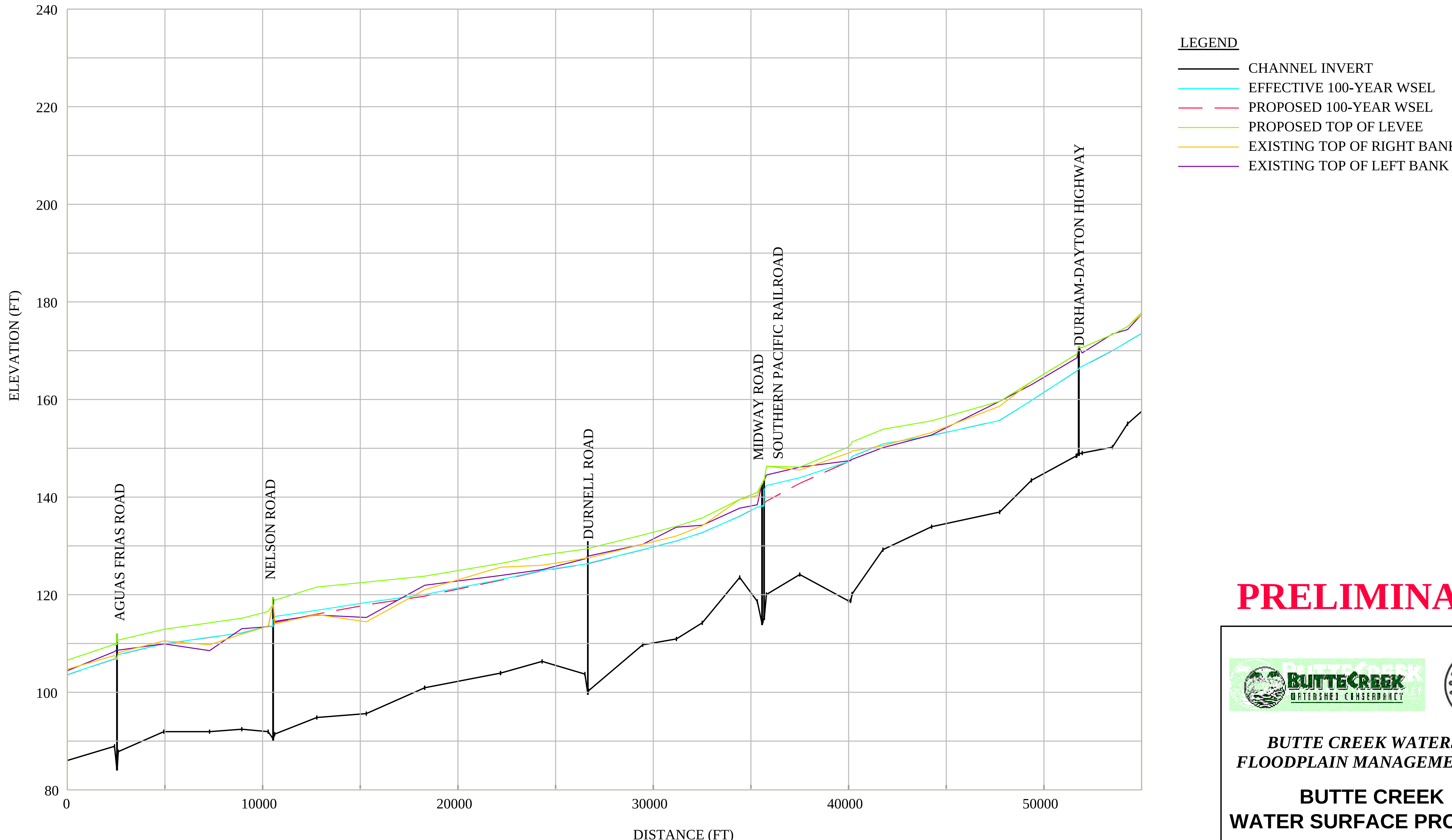
PRELIMINARY

BUTTE CREEK WATERSHED FLOODPLAIN MANAGEMENT PLAN

DURHAM-DAYTON HIGHWAY BRIDGE PROPOSED REPLACMENT

WOOD RODGERS
ENGINEERING • MAPPING • PLANNING • SURVEYING

FIGURE 5



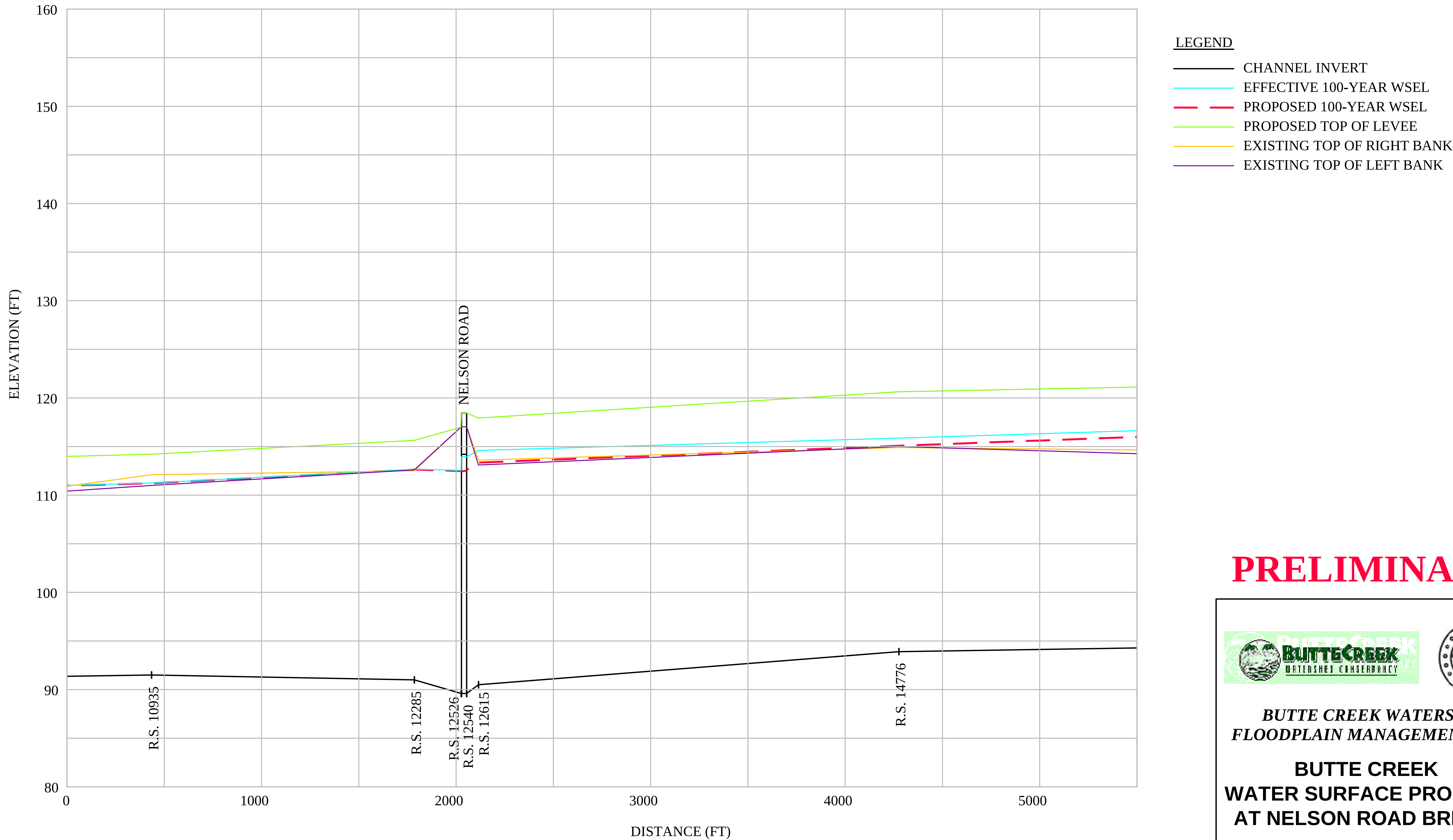
PRELIMINARY

BUTTE CREEK WATERSHED
FLOODPLAIN MANAGEMENT PLAN

BUTTE CREEK
WATER SURFACE PROFILES

WOOD RODGERS
ENGINEERING • MAPPING • PLANNING • SURVEYING

FIGURE 6



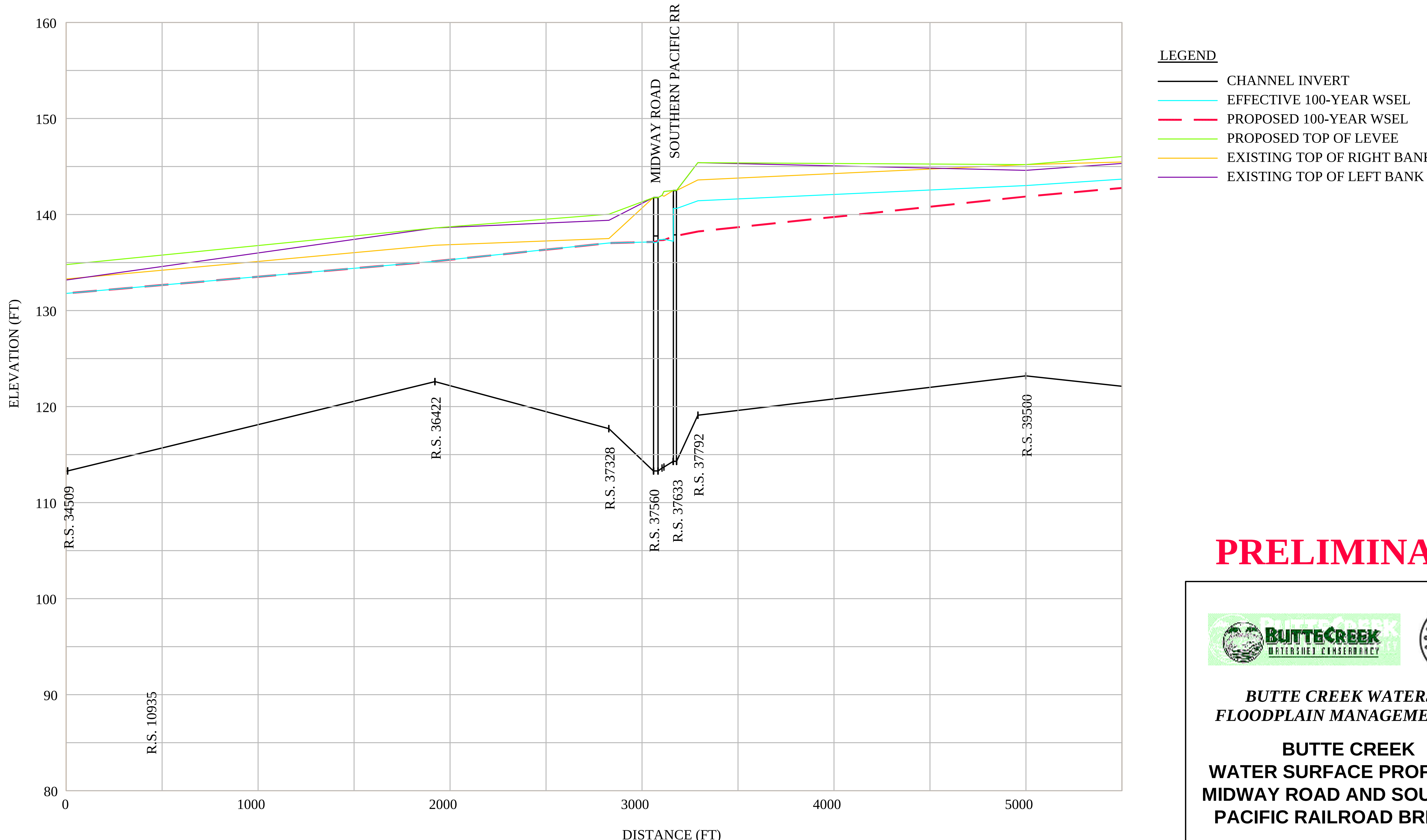
PRELIMINARY

BUTTE CREEK WATERSHED
FLOODPLAIN MANAGEMENT PLAN

BUTTE CREEK
WATER SURFACE PROFILES
AT NELSON ROAD BRIDGE

WOOD RODGERS
ENGINEERING • MAPPING • PLANNING • SURVEYING

FIGURE 7



PRELIMINARY

BUTTE CREEK WATERSHED FLOODPLAIN MANAGEMENT PLAN

BUTTE CREEK WATER SURFACE PROFILE AT MIDWAY ROAD AND SOUTHERN PACIFIC RAILROAD BRIDGES

WOOD RODGERS
ENGINEERING • MAPPING • PLANNING • SURVEYING

FIGURE 8

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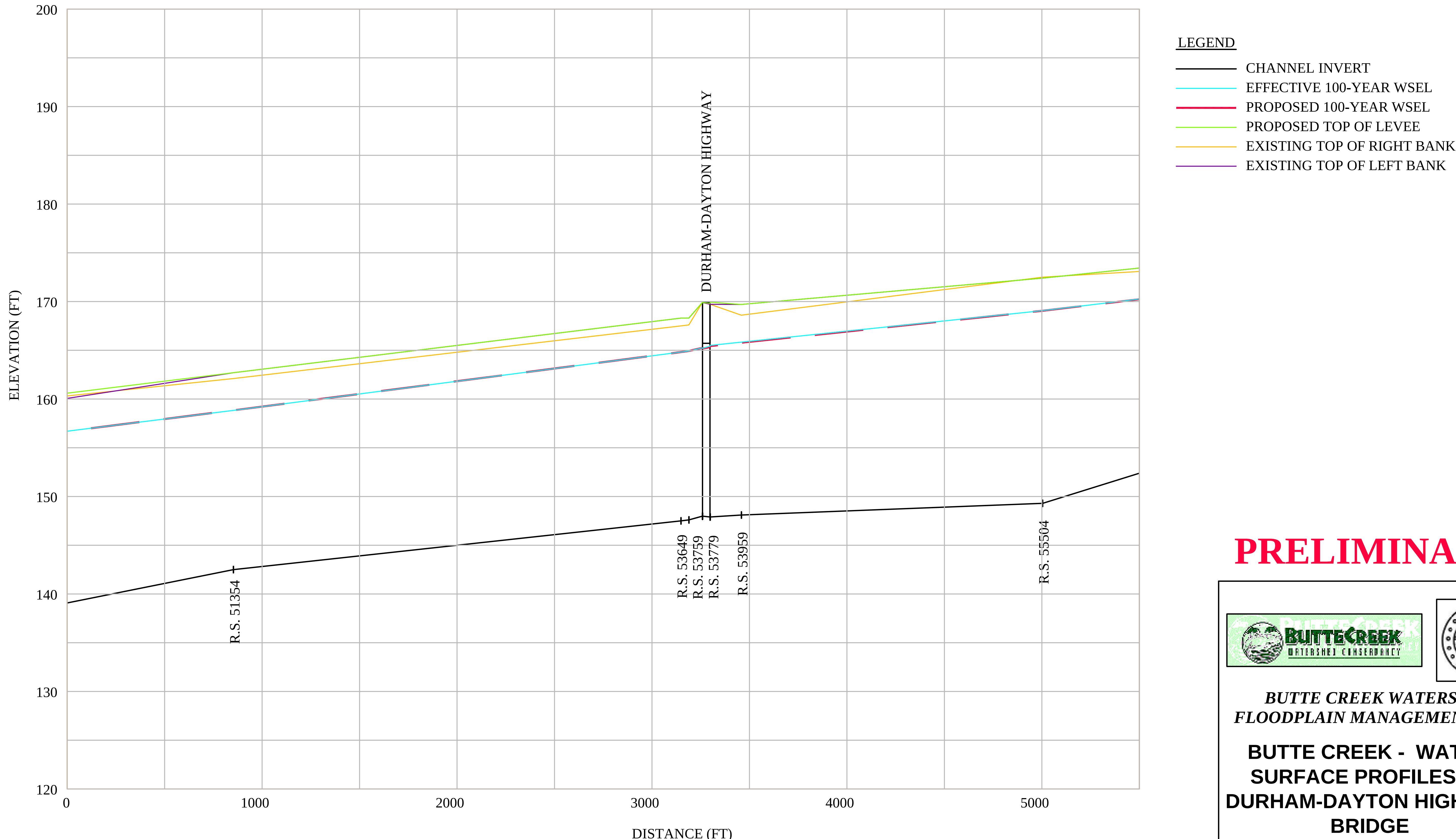


PRELIMINARY

BUTTE CREEK WATERSHED
FLOODPLAIN MANAGEMENT PLAN

BUTTE CREEK - WATER SURFACE PROFILES AT DURHAM-DAYTON HIGHWAY BRIDGE

WOOD RODGERS
ENGINEERING • MAPPING • PLANNING • SURVEYING

FIGURE 9

TABLE 1

BUTTE CREEK WATERSHED FLOODPLAIN MANAGEMENT PLAN

RETROFIT FOR EXISTING BRIDGES
PRELIMINARY COST ESTIMATE SUMMARY[1]

			Nelson Road Bridge		Midway Road Bridge		Southern Pacific Railroad Bridge		Dayton-Durham Highway Bridge		Total	
Item	**Unit**	**Unit Cost, $**	**Quantity**	**Total Cost, $**	**Quantity**	**Total Cost, $**	**Quantity**	**Total Cost, $**	**Quantity**	**Total Cost, $**	**Quantity**	**Total Cost, $**
Box Girder CIP/PS Bridge Deck	sf	150	0	0	0	0	0	0	0	0	0	0
Removal/Demolition of Existing Bridge	sf	20	0	0	0	0	0	0	0	0	0	0
Estimated Uninstalled Cost of Bridgesharks/MOABs	ls	n/a	1	243,000	1	122,500	1	283,500	1	317,500	4	966,500
Drive first 40-foot x 12" pile (Initial mob.)	ea	21,800	1	21,800	1	21,800	1	21,800	1	21,800	4	87,200
Additional Piles	ea	7,500	7	52,500	6	45,000	8	60,000	10	75,000	31	232,500
Bracket for model 10 Bridgeshark	ea	4,650	6	27,900	0	0	0	0	10	46,500	16	74,400
Temporary Bridge	sf	120	0	0	0	0	0	0	0	0	0	0
Flagman/Railroad Force	ea	100,000	0	0	0	0	0	0	0	0	0	0
Shoefly	shift	100,000	0	0	0	0	0	0	0	0	0	0
Total				**345,200**		**189,300**		**365,300**		**460,800**		**1,360,600**

[1]Costs include Mobilization and Contingency

TABLE 1A

BUTTE CREEK WATERSHED FLOODPLAIN MANAGEMENT PLAN

RETROFIT FOR EXISTING BRIDGE AT NELSON ROAD
PRELIMINARY COST ESTIMATE SUMMARY

			Nelson Road - Existing	
Item	**Unit**	**Unit Cost, $**	**Quantity**	**Total Cost, $**
Box Girder CIP/PS Bridge Deck	sf	150	0	0
Removal/Demolition of Existing Bridge	sf	20	0	0
Estimated Uninstalled Cost of Bridgesharks/MOABs, Includes: 6 Bridgeshark Pile Applications 6 Bridgeshark Model 10 pier attachments 2 MOAB Pile Applications 8 Plastic Piles 55' x 13.25" OD 6 Model 10 Brackets	ls	243,000	1	243,000
Drive first 40-foot x 12" pile (Initial mob.)	ea	21,800	1	21,800
Additional Piles	ea	7,500	7	52,500
Bracket for model 10 Bridgeshark	ea	4,650	6	27,900
Temporary Bridge	sf	120	0	0
Flagman/Railroad Force	ea	100,000	0	0
Shoefly	shift	100,000	0	0
Total				**345,200**

TABLE 1B

BUTTE CREEK WATERSHED FLOODPLAIN MANAGEMENT PLAN

RETROFIT FOR EXISTING BRIDGE AT MIDWAY ROAD
PRELIMINARY COST ESTIMATE SUMMARY

			Midway Road - Existing	
Item	**Unit**	**Unit Cost, $**	**Quantity**	**Total Cost, $**
Box Girder CIP/PS Bridge Deck	sf	150	0	0
Removal/Demolition of Existing Bridge	sf	20	0	0
Estimated Uninstalled Cost of Bridgesharks/MOABs Includes: 7 Bridgeshark Pile Applications 7 Plastic piles 55' x 13.25" OD	ls	122,500	1	122,500
Drive first 40-foot x 12" pile (Initial mob.)	ea	21,800	1	21,800
Additional Piles	ea	7,500	6	45,000
Bracket for model 10 Bridgeshark	ea	4,650	0	0
Temporary Bridge	sf	120	0	0
Flagman/Railroad Force	ea	100,000	0	0
Shoefly	shift	100,000	0	0
Total				**189,300**

TABLE 1C

BUTTE CREEK WATERSHED FLOODPLAIN MANAGEMENT PLAN

RETROFIT FOR EXISTING BRIDGE AT SOUTHERN PACIFIC RAILROAD
PRELIMINARY COST ESTIMATE SUMMARY

			Southern Pacific Railroad - Existing	
Item	**Unit**	**Unit Cost, $**	**Quantity**	**Total Cost, $**
Box Girder CIP/PS Bridge Deck	sf	150	0	0
Removal/Demolition of Existing Bridge	sf	20	0	0
Estimated Uninstalled Cost of Bridgesharks/MOABs Includes: 7 MOAB Pile Applications 7 Plastic piles 55' x 13.25" OD	ls	283,500	1	283,500
Drive first 40-foot x 12" pile (Initial mob.)	ea	21,800	1	21,800
Additional Piles	ea	7,500	8	60,000
Bracket for model 10 Bridgeshark	ea	4,650	0	0
Temporary Bridge	sf	120	0	0
Flagman/Railroad Force	ea	100,000	0	0
Shoefly	shift	100,000	0	0
Total				**365,300**

TABLE 1D

BUTTE CREEK WATERSHED FLOODPLAIN MANAGEMENT PLAN

RETROFIT FOR EXISTING BRIDGE AT DURHAM-DAYTON HIGHWAY
PRELIMINARY COST ESTIMATE SUMMARY

			Southern Pacific Railroad - Proposed	
Item	**Unit**	**Unit Cost, $**	**Quantity**	**Total Cost, $**
Box Girder CIP/PS Bridge Deck	sf	150	0	0
Removal/Demolition of Existing Bridge	sf	20	0	0
Estimated Uninstalled Cost of Bridgesharks/MOABs Includes: 11 Bridgeshark Pile Applications 10 Bridgeshark Model 10 Pier Attachements 11 Plastic Piles 55' x 13.25" OD 10 Model 10 Brackets	ls	317,500	1	317,500
Drive first 40-foot x 12" pile (Initial mob.)	ea	21,800	1	21,800
Additional Piles	ea	7,500	10	75,000
Bracket for model 10 Bridgeshark	ea	4,650	10	46,500
Temporary Bridge	sf	120	0	0
Flagman/Railroad Force	ea	100,000	0	0
Shoefly	shift	100,000	0	0
Total				**460,800**

TABLE 2

BUTTE CREEK WATERSHED FLOODPLAIN MANAGEMENT PLAN

BRIDGE REPLACEMENT
PRELIMINARY COST ESTIMATE SUMMARY [1]

			Nelson Road Bridge[2]		Midway Road Bridge[2,3]		Southern Pacific Railroad Bridge[4]		Dayton-Durham Highway Bridge[2]		Total	
Item	**Unit**	**Unit Cost, $**	**Quantity**	**Total Cost, $**	**Quantity**	**Total Cost, $**	**Quantity**	**Total Cost, $**	**Quantity**	**Total Cost, $**	**Quantity**	**Total Cost, $**
Box Girder CIP/PS Bridge Deck	sf	150	8,000	1,200,000	33,100	4,965,000	0	0	12,320	1,848,000	53,420	8,013,000
Structural Steel I-Girder	sf	215	0	0	0	0	12,000	2,580,000	0	0	12,000	2,580,000
Removal/Demolition of Existing Bridge	sf	20	8,000	160,000	14,230	284,600	12,000	240,000	12,320	246,400	46,550	931,000
Estimated Uninstalled Cost of Bridgesharks/MOABs	ls	n/a	1	31,500	1	122,500	1	220,500	1	94,500	4	469,000
Drive first 40-foot x 12" pile (Initial mob.)	ea	21,800	1	21,800	1	21,800	1	21,800	1	21,800	4	87,200
Additional Piles	ea	7,500	0	0	6	45,000	6	45,000	2	15,000	14	105,000
Bracket for model 10 Bridgeshark	ea	4,650	0	0	0	0	0	0	0	0	0	0
Temporary Bridge	sf	120	0	0	0	0	12,000	1,440,000	0	0	12,000	1,440,000
Flagman/Railroad Force	ea	100,000	0	0	0	0	1	100,000	0	0	1	100,000
Shoefly	shift	100,000	0	0	0	0	2	200,000	0	0	0	200,000
Total				**1,413,300**		**5,438,900**		**4,847,300**		**2,225,700**		**13,625,200**

[1]Costs include Mobilization and Contingency.

[2]Cost for removal of existing bridge and construction of new bridge is estimated using Caltrans "Bridge Design Specifications," January 2002, at $\$110/\text{ft}^2$ for a new bridge and $\$20/\text{ft}^2$ for removal of existing bridge. Surface area for proposed bridge is calculated as follows: Bridge surface area = bridge length * ((2 lanes * 12') + (2 shoulders * 4 feet)). Example: for proposed Nelson Bridge, surface area = 250*((2*12)+(2*4)) = 8000 ft^2.

[3]Existing Midway Road crossing consists of two bridges. Proposed crossing will consist of a single span between the levees on either side of Butte Creek.

[4]Assuming removal and replacement of a single 12-foot rail approximately 1000 feet long. Cost for removal of existing bridge and construction of new bridge is estimated using Caltrans "Bridge Design Specifications," January 2002, at $215/ft2 for a new bridge and $20/ft2 for removal of existing bridge. The cost for replacement of the SPRR bridge may be higher once the cost for transfer of the Kinder-Morgan petroleum pipeline is included.

TABLE 2A

BUTTE CREEK WATERSHED FLOODPLAIN MANAGEMENT PLAN

BRIDGE MODIFICATIONS AT NELSON ROAD
PRELIMINARY COST ESTIMATE SUMMARY

			Nelson Road - Proposed Bridge	
Item	**Unit**	**Unit Cost, $**	**Quantity**	**Total Cost, $**
Box Girder CIP/PS Bridge Deck	sf	150	8,000	1,200,000
Removal/Demolition of Existing Bridge	sf	20	8,000	160,000
Estimated Uninstalled Cost of Bridgesharks/MOABs, Includes: 1 MOAB Pile Application 1 Plastic Piles 55' x 13.25" OD	ls	31,500	1	31,500
Drive first 40-foot x 12" pile (Initial mob.)	ea	21,800	1	21,800
Additional Piles	ea	7,500	0	0
Bracket for model 10 Bridgeshark	ea	4,650	0	0
Temporary Bridge	sf	120	0	0
Flagman/Railroad Force	ea	100,000	0	0
Shoefly	shift	100,000	0	0
Total				**1,413,300**

TABLE 2B

BUTTE CREEK WATERSHED FLOODPLAIN MANAGEMENT PLAN

BRIDGE MODIFICATIONS AT MIDWAY ROAD
PRELIMINARY COST ESTIMATE SUMMARY

			Midway Road - Improved	
Item	**Unit**	**Unit Cost, $**	**Quantity**	**Total Cost, $**
Box Girder CIP/PS Bridge Deck	sf	150	33,100	4,965,000
Removal/Demolition of Existing Bridge	sf	20	14,230	284,600
Estimated Uninstalled Cost of Bridgesharks/MOABs Includes: 7 Bridgeshark Pile Applications 7 Plastic piles 55' x 13.25" OD	ls	122,500	1	122,500
Drive first 40-foot x 12" pile (Initial mob.)	ea	21,800	1	21,800
Additional Piles	ea	7,500	6	45,000
Bracket for model 10 Bridgeshark	ea	4,650	0	0
Temporary Bridge	sf	120	0	0
Flagman/Railroad Force	ea	100,000	0	0
Shoefly	shift	100,000	0	0
Total				**5,438,900**

TABLE 2C

BUTTE CREEK WATERSHED FLOODPLAIN MANAGEMENT PLAN

BRIDGE MODIFICATIONS AT SOUTHERN PACIFIC RAILROAD
PRELIMINARY COST ESTIMATE SUMMARY

			Southern Pacific Railroad - Proposed	
Item	**Unit**	**Unit Cost, $**	**Quantity**	**Total Cost, $**
Structural Steel I-Girder	sf	215	12,000	2,580,000
Removal/Demolition of Existing Bridge	sf	20	12,000	240,000
Estimated Uninstalled Cost of Bridgesharks/MOABs Includes: 7 MOAB Pile Applications 7 Plastic piles 55' x 13.25" OD	ls	220,500	1	220,500
Drive first 40-foot x 12" pile (Initial mob.)	ea	21,800	1	21,800
Additional Piles	ea	7,500	6	45,000
Bracket for model 10 Bridgeshark	ea	4,650	0	0
Temporary Bridge	sf	120	12,000	1,440,000
Flagman/Railroad Force	ea	100,000	1	100,000
Shoefly	shift	100,000	2	200,000
Total				**4,847,300**

TABLE 2D

BUTTE CREEK WATERSHED FLOODPLAIN MANAGEMENT PLAN

BRIDGE MODIFICATIONS AT DURHAM-DAYTON HIGHWAY
PRELIMINARY COST ESTIMATE SUMMARY

			Southern Pacific Railroad - Proposed	
Item	**Unit**	**Unit Cost, $**	**Quantity**	**Total Cost, $**
Box Girder CIP/PS Bridge Deck	sf	150	12,320	1,848,000
Removal/Demolition of Existing Bridge	sf	20	12,320	246,400
Estimated Uninstalled Cost of Bridgesharks/MOABs Includes: 3 MOAB Pile Applications 3 Plastic piles 55' x 13.25" OD	ls	94,500	1	94,500
Drive first 40-foot x 12" pile (Initial mob.)	ea	21,800	1	21,800
Additional Piles	ea	7,500	2	15,000
Bracket for model 10 Bridgeshark	ea	4,650	0	0
Temporary Bridge	sf	120	0	0
Flagman/Railroad Force	ea	100,000	0	0
Shoefly	shift	100,000	0	0
Total				**2,225,700**

Item	Unit	Unit Cost, $
Box Girder CIP/PS Bridge Deck	sf	150
Removal/Demolition of Existing Bridge	sf	20
Bridgeshark/MOAB Installation	ls	attached
Drive first 40-foot x 12" pile (Initial mob.)	ea	21800
Additional Piles	ea	7500
Bracket for model 10 Bridgeshark	ea	4650
Temporary Bridge	sf	170
Flagman/Railroad Force	ea	100000
Shoefly	shift	100000

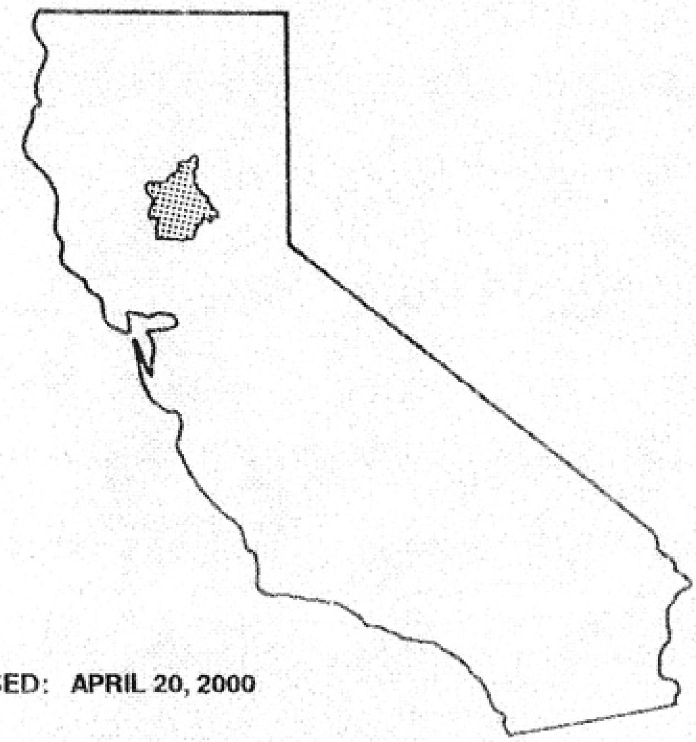
Source
Caltrans "Bridge Design Specifications", January 2002 and Raymond Cooper - Butte County Bridge Engineer
Caltrans "Bridge Design Specifications", January 2002 and Raymond Cooper - Butte County Bridge Engineer
Estimate received from Debris Free, Inc.
Estimate received from Edward Kraemer and Sons, Inc.
Estimate received from Edward Kraemer and Sons, Inc.
Estimate received from Edward Kraemer and Sons, Inc.
Caltrans "Bridge Design Specifications", April 2000 and Raymond Cooper - Butte County Bridge Engineer
RS Means
RS Means

FLOOD INSURANCE STUDY

BUTTE COUNTY, CALIFORNIA AND INCORPORATED AREAS

COMMUNITY NAME	COMMUNITY NUMBER
*BIGGS, CITY OF	060437
CHICO, CITY OF	060746
*GRIDLEY, CITY OF	060019
OROVILLE, CITY OF	060020
*PARADISE, CITY OF	060748
BUTTE COUNTY, UNINCORPORATED AREAS	060017

*NON-FLOODPRONE COMMUNITIES



REVISED: APRIL 20, 2000

Federal Emergency Management Agency

ATTACHMENT 1 1/2

Table 1. Summary of Discharges

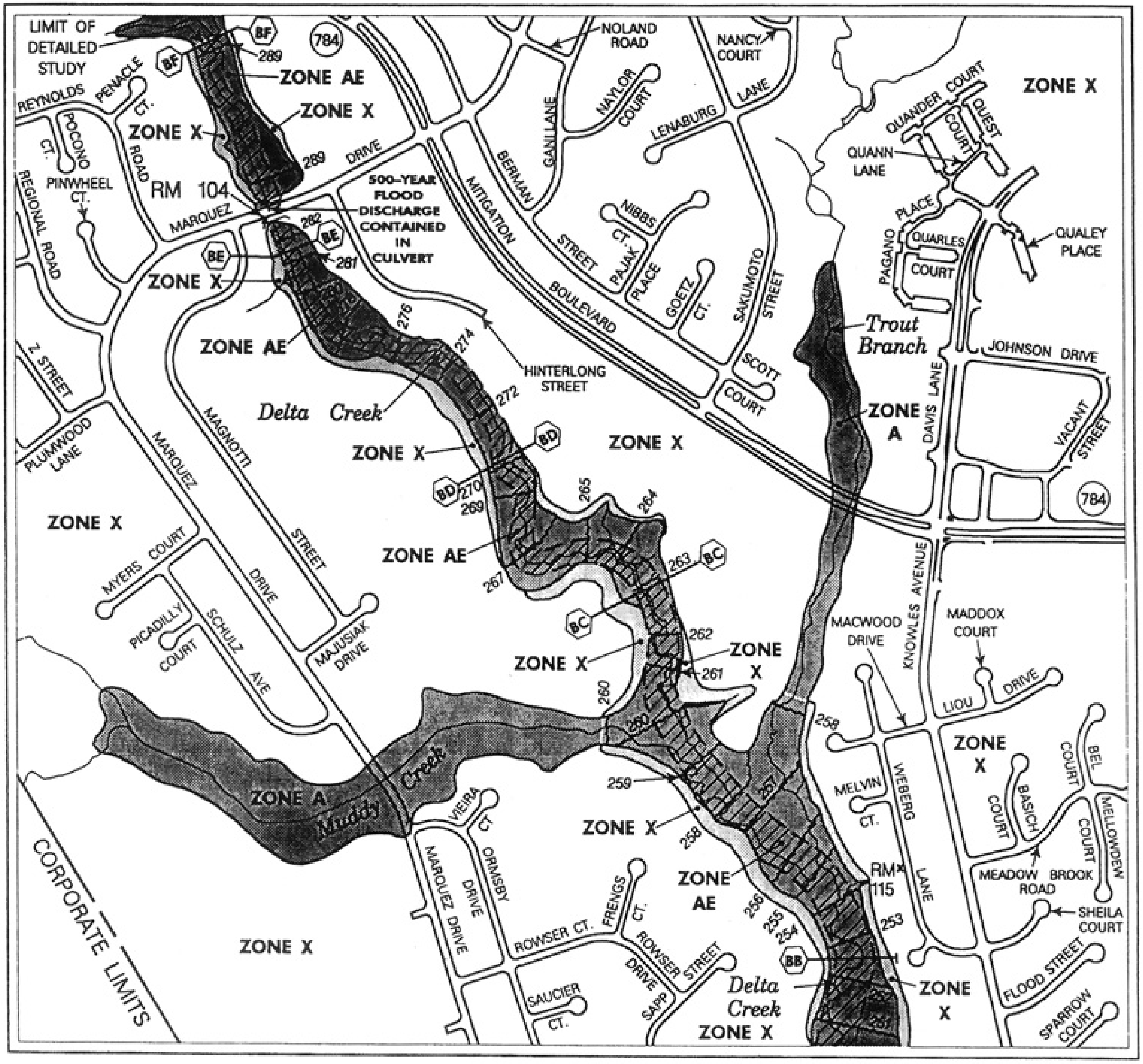
Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharge (cfs) 10-Year	50-Year	100-Year	500-Year
Butte Creek					
At Skyway	151.4	13,200	21,300	25,000	34,000
Approximately 930 feet upstream of confluence with Little Butte Creek	117.6	10,560	17,040	20,000	27,200
At Hamlin Slough	N/A	13,200	24,400	30,300	44,800
At Aquas Frias Road	N/A	13,600	28,000	34,900	51,100
Wyman Ravine					
At Stimpson Lane	28.4	1,775	2,230	2,390	2,700
Approximately 6,800 feet downstream of Lone Tree Road	26.2	1,570	1,845	1,920	2,060
Approximately 3,580 feet downstream of confluence with Wyman Ravine Tributary No. 1	21.6	2,145	3,010	3,290	3,840
Approximately 200 feet upstream of confluence with Wyman Ravine Tributary No. 1	16.4	1,950	2,710	2,930	3,390
Approximately 690 feet downstream of Palermo Road	16.0	1,950	2,620	2,770	3,020
Approximately 2,470 feet[1] downstream of Western Pacific Railroad	14.3	340	385	400	425
Approximately 90 feet[1] downstream of Western Pacific Railroad	12.6	1,660	2,200	2,310	2,465
Approximately 220 feet downstream of Lincoln Boulevard	12.6	1,670	2,390	2,625	2,970
Wyman Ravine Tributary No. 1					
At confluence with Wyman Ravine	5.2	440	530	550	600
At Western Pacific Railway Culvert[1]	4.9	370	430	450	480
At confluence with Palermo Tributary[1]	4.9	490	610	660	740
Approximately 950 feet downstream of Melvina Avenue[1]	2.8	80	100	100	110
Approximately 60 feet upstream of Melvina Avenue	2.8	560	790	870	1,070

[1]See Section 3.2 for an explanation of the reduction in flow.

ATTACHMENT 1 2/2

FLOOD INSURANCE STUDY **FEMA 37**

Guidelines and Specifications for Study Contractors



FEDERAL EMERGENCY MANAGEMENT AGENCY

January 1995

FEDERAL EMERGENCY MANAGEMENT AGENCY

ATTACHMENT 2 1/2

CHAPTER 7. EVALUATION OF LEVEE FLOOD CONTROL SYSTEMS

The following paragraphs describe procedures for evaluating earthen riverine levees. Procedures for evaluating concrete dikes, floodwalls, seawalls, and other structures shall be coordinated with and approved by the Regional PO. The Regional PO should also be contacted to obtain the appropriate criteria in analyzing agricultural levees. Specific guidance addressing coastal structures are contained in Appendix 1A.

In evaluating the ability of levee systems to provide protection against the 100-year flood, the criteria outlined in Section 65.10 of 44 CFR and the step-by-step procedures as summarized on the proceeding pages should be used. The SC should always initiate its analyses by evaluating the levee's freeboard and maintenance plan and should only proceed with further analyses if these requirements are met.

1. Freeboard. A minimum levee freeboard of 3 feet shall be necessary, with an additional 1 foot of freeboard within 100 feet of either side of structures within the levee or wherever the flow is constricted, such as at bridges. An additional 0.5 foot above this minimum is also required at the upstream end, tapering to the minimum at the downstream end of the levee. The criteria concerning freeboard is detailed in 44 CFR 65.10(b)(1).

2. Structural Design Analyses. The SC must review the structural analyses which address closures, embankment protection, embankment and foundation stability, and settlement. The structural analyses must meet the criteria detailed in 44 CFR 65.10(b)(2),(3),(4) and (5).

3. Interior Drainage. Where credit will be given to levees providing 100-year flood protection, the adequacy of interior drainage systems will be evaluated. Interior drainage systems associated with levee systems usually include storage areas, gravity outlets, pumping stations, or a combination thereof. These drainage systems will be recognized by FEMA only if the criteria outlined in 44 CFR 65.10 (b)(6) and (c)(2) are met.

4. Operations. In general, levee evaluation shall not consider human intervention (e.g., capping of levees by sandbagging, earthfill, or flashboards) for the purpose of increasing a levee's design level of protection during an imminent flood. Only in exceptional cases where no practicable alternative exists and technical justification is provided, will FEMA permit sandbagging to satisfy freeboard requirements. The Regional PO must coordinate all such cases with FEMA. Human intervention will normally only be accepted for the operation of closure structures (e.g., gates or stoplogs) and manual back-up for pumping stations in a levee system designed to provide at least 100-year flood protection, including adequate freeboard as described earlier. Where levee closures and/or pumping stations are

ATTACHMENT 2 2/2

Bridge Design Specifications

LFD Version
April 2000

State of California
Department of Transportation

ATTACHMENT 3 1/2

8.8.3 The effective span length of slabs shall be as specified in Article 3.24.1.

8.9 CONTROL OF DEFLECTIONS

8.9.1 General

Flexural members of bridge structures shall be designed to have adequate stiffness to limit deflections or any deformations that may adversely affect the strength or serviceability of the structure at service load plus impact.

8.9.2 Superstructure Depth Limitations

The minimum depths stipulated in Table 8.9.2 are recommended unless computation of deflection indicates that lesser depths may be used without adverse effects.

TABLE 8.9.2 Recommended Minimum Depths for Constant Depth Members

Superstructure Type	Minimum Depth[a] in Feet	
	Simple Spans	Continuous Spans
Bridge slabs with main reinforcement parallel to traffic	$1.2(S+10)/30$	$(S+10)/30 \geq 0.542$
T-Girders	$0.070\,S$	$0.065\,S$
Box-Girders	$0.060\,S$	$0.055\,S$
Pedestrian Structure Girders	$0.033\,S$	$0.033\,S$

[a] When variable depth members are used, values may be adjusted to account for change in relative stiffness of positive and negative moment sections.

S = span length as defined in Article 8.8, in feet.

8.9.3 Superstructure Deflection Limitations

When making deflection computations, the following criteria are recommended.

8.9.3.1 Members having simple or continuous spans preferably should be designed so that the deflection due to service live load plus impact shall not exceed 1/800 of the span, except on bridges in urban areas used in part by pedestrians, whereon the ratio preferably shall not exceed 1/1000.

8.9.3.2 The deflection of cantilever arms due to service live load plus impact preferably should be limited to 1/300 of the cantilever arm except for the case including pedestrian use, where the ratio preferably should be 1/375.

8.10 COMPRESSION FLANGE WIDTH

8.10.1 T-Girder

8.10.1.1 The total width of slab effective as a T-girder flange shall not exceed one-fourth of the span length of the girder. The effective flange width overhanging on each side of the web shall not exceed six times the thickness of the slab or one-half the clear distance to the next web.

8.10.1.2 For girders having a slab on one side only, the effective overhanging flange width shall not exceed 1/12 of the span length of the girder, six times the thickness of the slab, or one-half the clear distance to the next web.

8.10.1.3 Isolated T-girders in which the T-shape is used to provide a flange for additional compression area shall have a flange thickness not less than one-half the width of the girder web and an effective flange width not more than four times the width of the girder web.

8.10.1.4 For integral bent caps, the effective flange width overhanging each side of the bent cap web shall not exceed six times the least slab thickness, or 1/10 the span length of the bent cap. For cantilevered bent caps, the span length shall be taken as two times the length of the cantilever span.

8.10.2 Box Girders

8.10.2.1 The entire slab width shall be assumed effective for compression.

8.10.2.2 For integral bent caps, see Article 8.10.1.4.

ATTACHMENT 3 2/2

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING SERVICES
DIVISION OF STRUCTURE DESIGN SERVICES & EARTHQUAKE ENGINEERING
OFFICE OF STRUCTURE OFFICE ENGINEER
P.O. BOX 942874
SACRAMENTO, CA 94274-0001

COMPARATIVE BRIDGE COSTS

JANUARY 2002

The following tabular data gives some **general guidelines** for structure type selection and its relative cost. These costs should be used just for **preliminary estimates** until more detailed information is developed.
These costs reflect the **'bridge costs'** only and ***do not*** include items such as: bridge removal, approach slabs, slope paving, soundwalls or retaining walls.

The following factors ***must*** be taken into account when determining a price within the cost range:

Factors for Lower End of Price Range	Factors for Higher End of Price Range
Short Spans, Low Structure Height, No Environmental Constraints, Large Projects, No Aesthetic Issues, Dry Conditions, No Bridge Skew	Long Spans, High Structure Height, Environmental Constraints, Small Project, Aesthetic Issues, Wet Conditions (cofferdams required), Skewed Bridges
Urban Location	Remote Location
Seat Abutment	Cantilever Abutment
Spread Footing	Pile Footing
No Stage Construction	2 Stage Construction

Factors That Will Increase the Price Over the High End fo the Price Range
Structures With More Than 2 Construction Stages
Unique Substructure Construction
Widenings Less Than 15 ft.

STRUCTURAL SECTION	(STR. DEPTH/MAX SPAN) SIMPLE	CONTINUOUS	COMMON SPAN RANGE (feet)	COST RANGE ($ / FT2)	REMARKS
RC SLAB	0.06	0.045	16-44	85-120	THESE ARE THE MOST COMMON TYPES AND ACCOUNT FOR ABOUT 80% OF BRIDGES ON CALIFORNIA STATE HIGHWAYS.
RC T-BEAM	0.07	0.065	40-60	90-180	
RC BOX	0.06	0.055	50-120	100-170	
CIP/PS SLAB	0.03	0.03	40-65	95-130	
CIP/PS BOX	0.045	0.04	100-150	80-150	
PC/PS SLAB	0.03 (+3" AC)	0.03 (+3" AC)	20-50	120-180	
PC/PS T, TT, ⊥	0.06 (+3" AC)	0.055 (+3" AC)	30-120	100-170	
BULB T GIRDER	0.05	0.045	90-145	100-195	
PC/PS I	0.055	0.05	50-120	115-175	
PC/PS BOX	0.06	0.045	120-200	140-250	NO FALSEWORK REQUIRED
STRUCT STEEL I-GIRDER	0.045	0.04	60-300	150-215	NO FALSEWORK REQUIRED

NOTE: Removal of a box girder structure costs from $15 - $20 per square foot.

COSTS INCLUDE 10% MOBILIZATION AND 25% CONTINGENCY

ATTACHMENT 4

7.5 Bearings

For Ordinary Standard bridges bearings are considered sacrificial elements. Typically bearings are designed and detailed for service loads. However, bearings shall be checked to insure their capacity and mode of failure are consistent with the assumptions made in the seismic analysis. The designer should consider detailing bearings so they can be easily inspected for damage and replaced or repaired after an earthquake.

7.5.1 Elastomeric Bearings

The lateral shear capacity of elastomeric bearing pads is controlled by either the dynamic friction capacity between the pad and the bearing seat or the shear strain capacity of the pad. Test results have demonstrated the dynamic coefficient of friction between concrete and neoprene is 0.40 and between neoprene and steel is 0.35. The maximum shear strain resisted by elastomeric pads prior to failure is estimated at $\pm 150\%$.

7.5.2 Sliding Bearings

PTFE spherical bearings and PTFE elastomeric bearings utilize low friction PTFE sheet resin. Typical friction coefficients for these bearings vary between 0.04 to 0.08. The friction coefficient is dependent on contact pressure, temperature, sliding speed, and the number of sliding cycles. Friction values may be as much as 5 to 10 times higher at sliding speeds anticipated under seismic loads compared to the coefficients under thermal expansion.

A common mode of failure for sliding bearings under moderate earthquakes occurs when the PTFE surface slides beyond the limits of the sole plate often damaging the PTFE surface. The sole plate should be extended a reasonable amount to eliminate this mode of failure whenever possible.

7.6 Columns & Pier Walls

7.6.1 Column Dimensions

Every effort shall be made to limit the column cross sectional dimensions to the depth of the superstructure. This requirement may be difficult to meet on columns with high L/D ratios. If the column dimensions exceed the depth of the bent cap it may be difficult to meet the joint shear requirements in Section 7.4.2, the superstructure capacity requirements in Section 4.3.2.1, and the ductility requirements in Section 3.1.4.1.

The relationship between column cross section and bent cap depth specified in equation 7.24 is a guideline based on observation. Maintaining this ratio should produce reasonably well proportioned structures.

$$0.67 < \frac{D_c}{D_s} < 1.33 \qquad (7.24)$$

ATTACHMENT 5

Debris Free, Inc.
Bridge systems
Ojai, California

Estimated Systems and Costs

Existing Conditions	**Proposed Conditions**
Nelson Road Bridge	**Nelson Road Bridge**
6 Bridgeshark Pile Applications	1 MOAB Pile Application
6 Bridgeshark Model 10 pier attachments	1 Plastic Pile 55'x 13.25" OD
2 MOAB Pile Applications	
8 Plastic Piles 55'x 13.25" OD	
6 Model 10 brackets	
Uninstalled price = $ 243,000	Uninstalled price = $31,500
Midway Road Bridge	**Midway Road Bridge**
7 Bridgeshark Pile Applications	7 Bridgeshark Pile Applications
7 Plastic piles 55' x13.25" OD	7 Plastic piles 55'x 13.25" OD
Uninstalled price = $ 122,500	Uninstalled price = $ 122,500
Southern Pacific Railroad Bridge	**Southern Pacific Railroad Bridge**
9 MOAB Pile Applications	7 MOAB Pile Applications
9 Plastic Piles 55' x 13.25" OD	7 Plastic Piles 55' x 13.25" OD
Uninstalled Price = $ 283,500	Uninstalled Price = $ 220,500

Durham/Dayton Road Bridge	**Durham/Dayton Road Bridge**
11 Bridgeshark Pile Applications	3 MOAB Pile Applications
10 Bridgeshark Model 10 Pier Attachments	3 Plastic Piles 55’ x 13.25” OD
11 Plastic Piles 55’ x 13.25” OD	
10 Model 10 Brackets	
Uninstalled Price = $ 317,500	Uninstalled Price = $ 94,500

The above systems and prices include consultation engineering fees, pile stabilizer brackets and shipping to a pre determined site. Installation of piles and Model 10 brackets will be provided at an additional cost by our Certified Approved Contractor, Ed Kraemer and Sons. All debris shall be removed prior to the installations by the governing agencies.

Thank you for allowing us to prepare this estimate,

Mike Collier, President

Debris Free Inc.

January 25, 2005

EDWARD KRAEMER & SONS, INC.

Debris Free, Inc.
1694 South Rice Road
Ojai, California 93023

Attention: Mr. Mike Collier

Reference: Pile Installation & Bracket Installation

Subject: Cost Proposal for Installation at Four Locations – Chico, California

Gentlemen:

Edward Kraemer & Sons, Inc. is pleased to provide labor, material, and equipment necessary to drive one steel pile for the installation of one Moab Bridge Shark deflectors at four separate locations. We offer the following proposal per bridge location:

Nelson Bridge – Butte River:

Initial Mobilization including furnish & drive one 40 foot x 12" pile	$21,800.00
Each additional pile at this location (potentially 5 addt'l.)	$ 7,500.00
Installation of one Bracket for model 10 Bridgeshark	$ 4,650.00

Midway Bridge – Butte River:

Initial Mobilization including furnish & drive one 40 foot x 12" pile	$21,800.00
Each additional pile at this location (potentially 6 addt'l.)	$ 7,500.00
Installation of one Bracket for model 10 Bridgeshark	$ 4,650.00

S.P. Railroad Bridge – Butte River:

Initial Mobilization including furnish & drive one 40 foot x 12" pile	$21,800.00
Each additional pile at this location (potentially 8 addt'l.)	$ 7,500.00
Installation of one Bracket for model 10 Bridgeshark	$ 4,650.00

Durham/Dayton Road Bridge – Butte River:

Initial Mobilization including furnish & drive one 40 foot x 12" pile	$21,800.00
Each additional pile at this location (potentially 10 addt'l.)	$ 7,500.00
Installation of one Bracket for model 10 Bridgeshark	$ 4,650.00

We include the following in our proposal:
Initial mobilization of truck crane and pile driving equipment to each location.
Furnishing of one 12 inch by .375 wall pipe 40 foot length, uncoated black pipe.
Installation of the pipe pile including installing the Moab bridgeshark.
Installation of the bracket for the bridgeshark.
Insurance including workman's compensation

We exclude the following:
Traffic control, Permits, Survey
Removal of subsurface obstructions.
Railroad Insurance.
Diversion of water.

The installation of piles for the S.P. railroad bridge is based on accessing the railroad bridge from either side of the structure on top of the railroad tracks and ballast. All coordination with the railroad including permits, flagging, temporary road access to the tracks is excluded from our pricing.

We anticipate using a 50 –65 ton truck crane for the pile installation and accessing the installation from the deck of the bridges. It is assumed that the bridges will withstand this loading.

We require at least 30 days notice prior to mobilization to the proposed locations in order to schedule the manpower and equipment.

If additional information is necessary, we will furnish it upon request.

Sincerely,

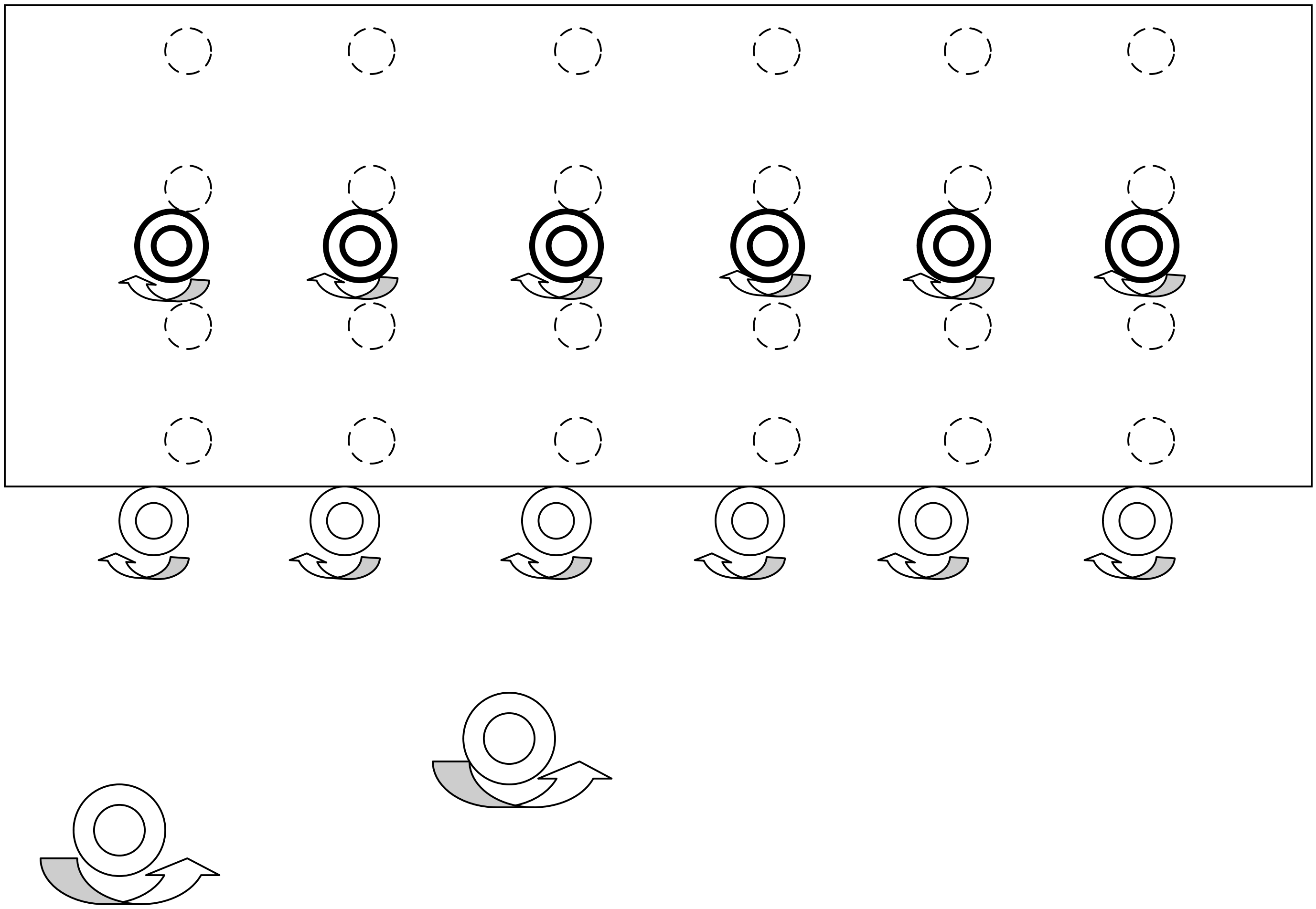
Edward Kraemer & Sons, Inc.

Peter A. Clark
Utah Region Manager

Nelson Road Bridge, Butte Creek

Butte County, California

Existing Conditions



Key:

Under deck Bridgesharks with Model 10 pier attachments installed at 12.5 degree offset

Bridgeshark Pile Application installed at 25 degree offset for skew

MOAB Remote Pile Application drift training

Clockwise Rotation

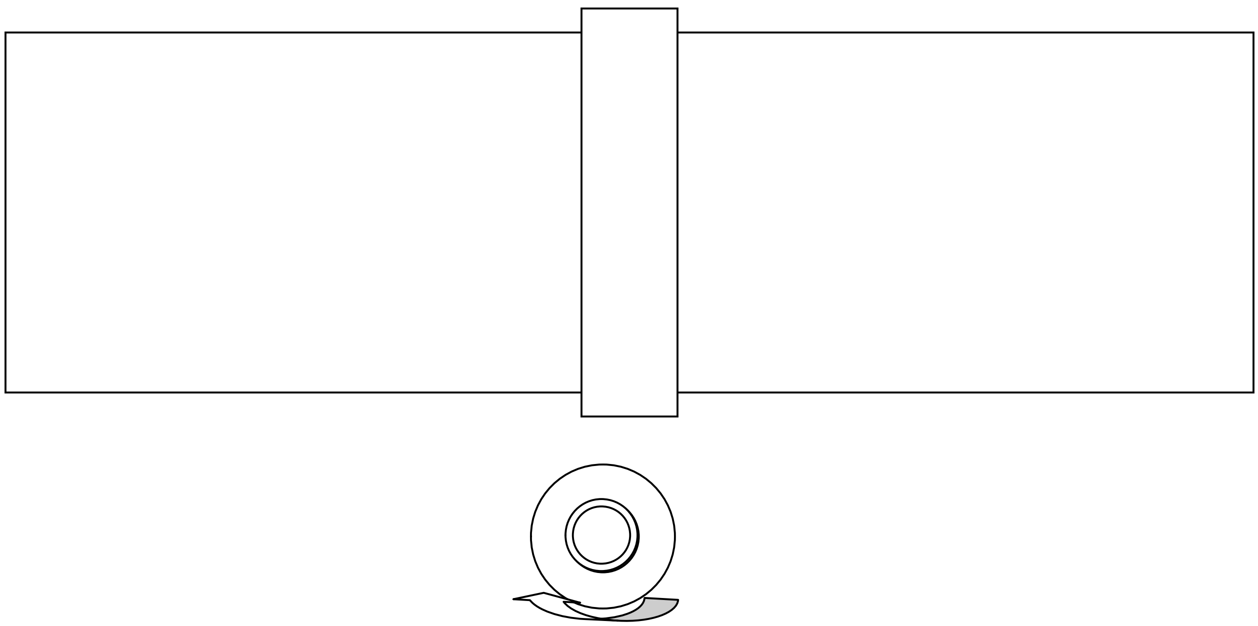
Counterclockwise Rotation

Total Bridgesharks = 12   Total MOAB = 2

Nelson Road Bridge, Butte Creek

Butte County, California

Proposed Conditions



Key:

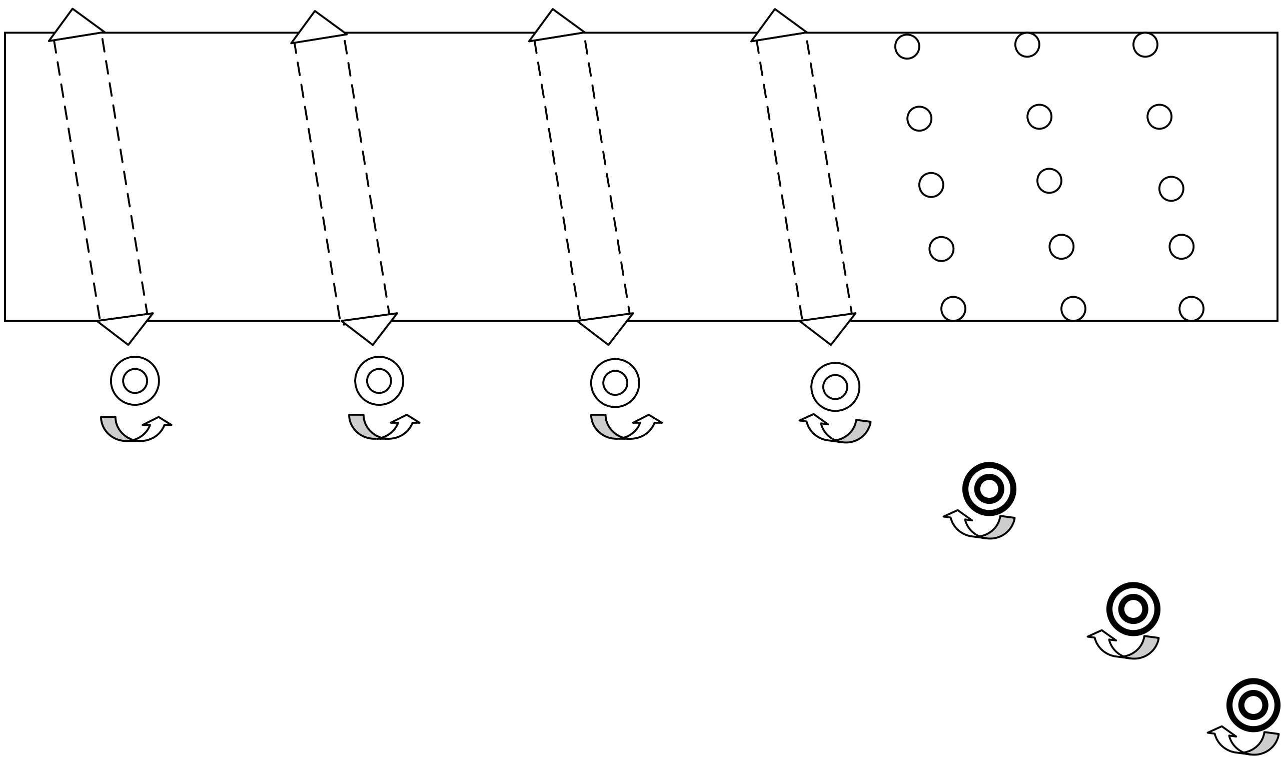
MOAB

Clockwise Rotation

Total MOAB = 1

Midway Road Bridge, Butte Creek

Butte County, California
Existing Conditions



Key:

Bridgeshark Pile Application

Remote Pile Application – Drift Training

Counterclockwise Rotation

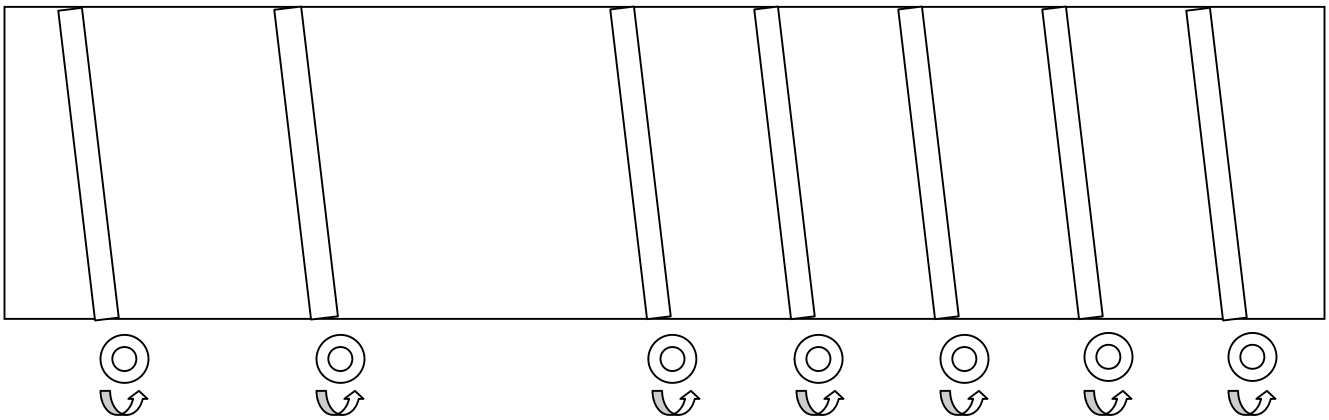
Clockwise Rotation

Total Bridgesharks = 7

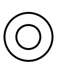
Midway Road Bridge, Butte Creek

Butte County, California

Proposed Conditions



Key:

 Bridgeshark Pile Application

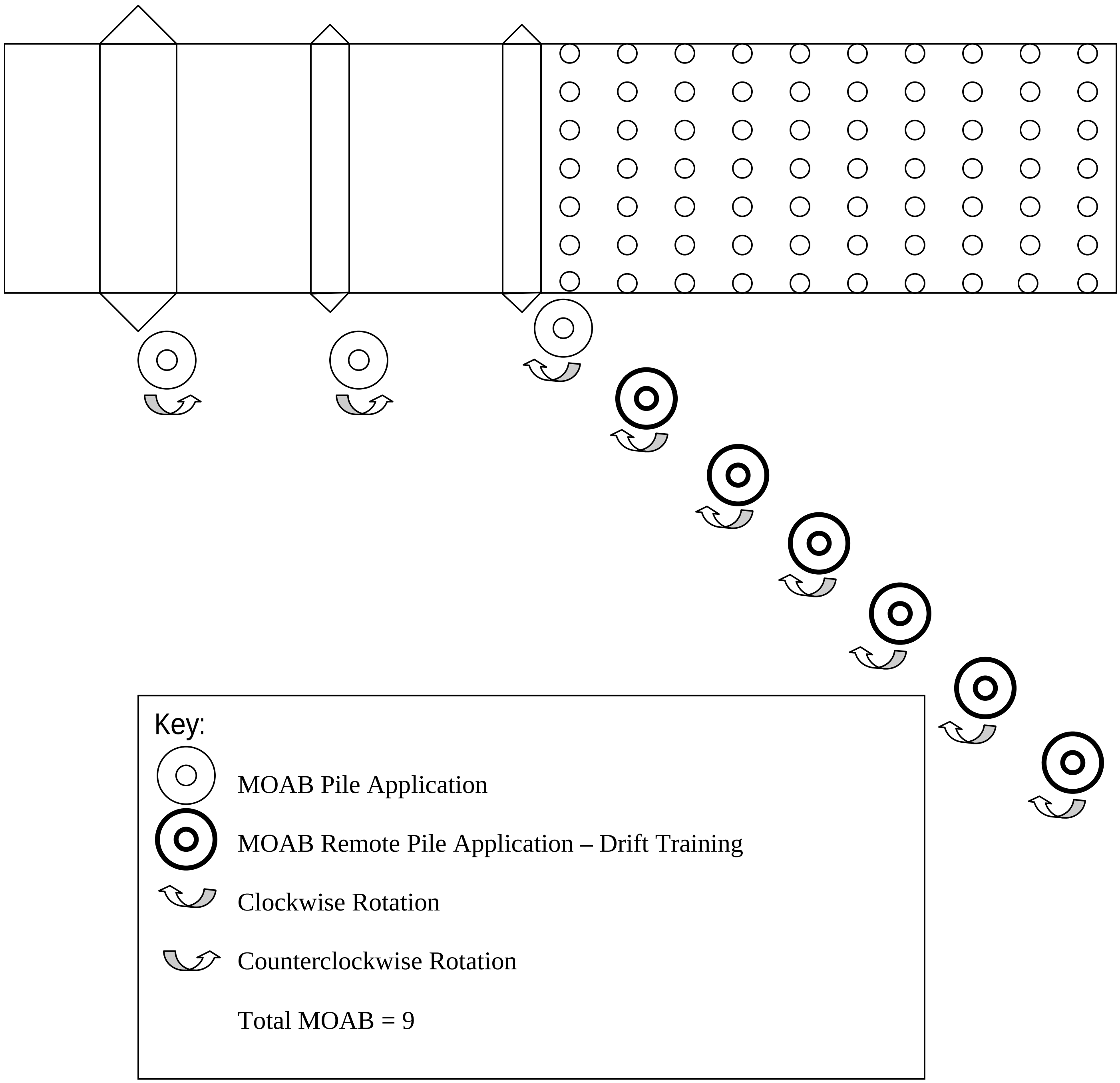
 Counterclockwise Rotation

Total Bridgesharks = 7

Southern Pacific Railroad Bridge, Butte Creek

Butte County, California

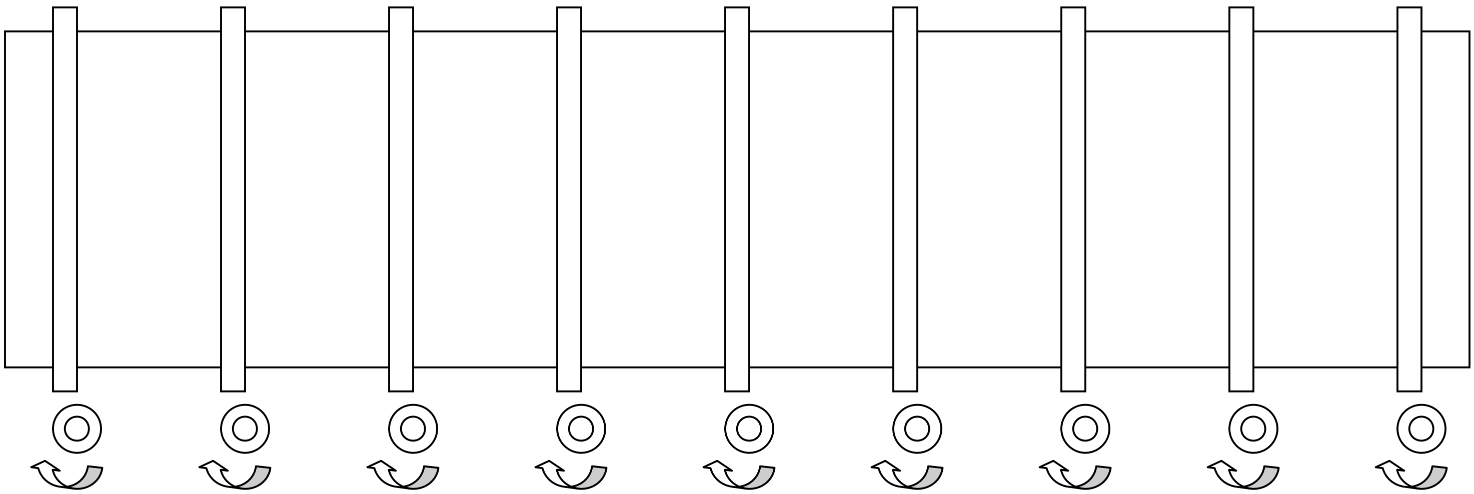
Existing Conditions



Southern Pacific Railroad Bridge, Butte Creek

Butte County, California

Proposed Conditions



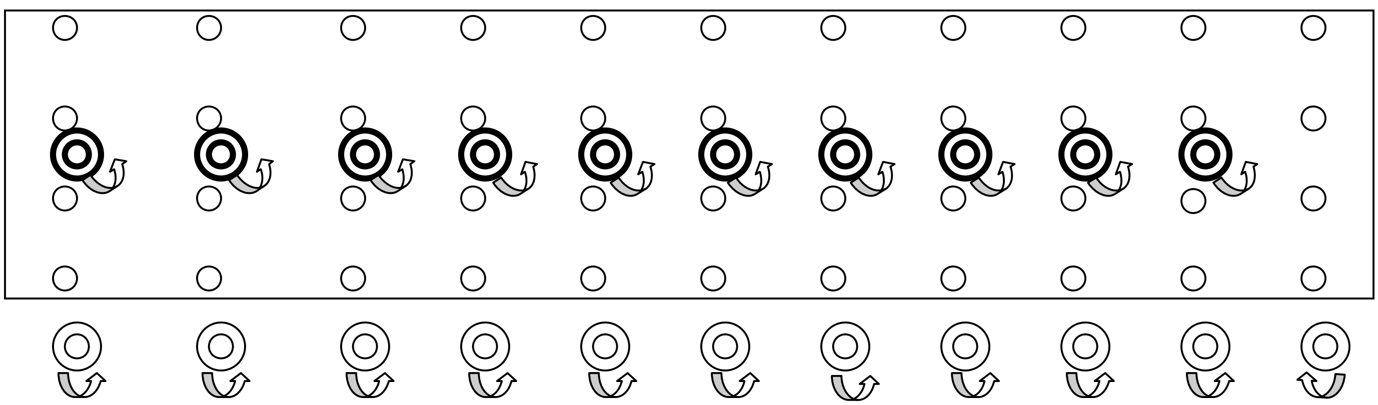
Key:

MOAB

Clockwise Rotation

Total MOAB = 9

Durham/Dayton Bridge, Butte Creek
Butte County, California
Existing Conditions



Key:

Bridgeshark Pile Application installed at 29 degree offset for skew

Under deck Bridgeshark with Model 10 pier attachments installed at 12.5 degree offset

Clockwise Rotation

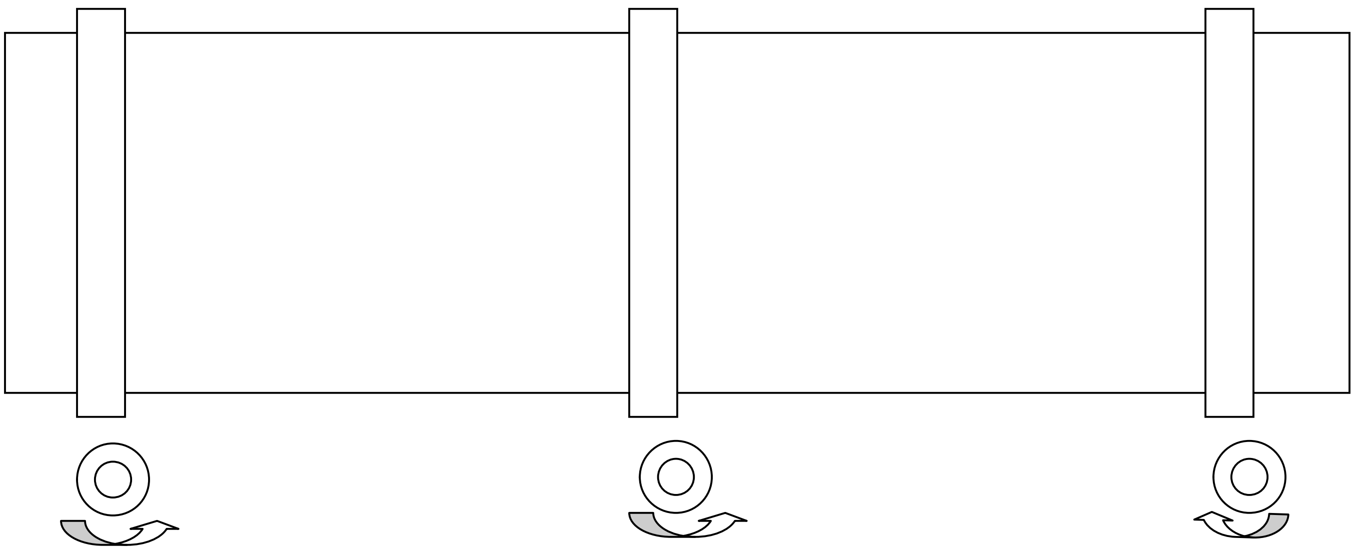
Counterclockwise Rotation

Total Bridgesharks = 21

Durham/Dayton Bridge, Butte Creek

Butte County, California

Proposed Conditions



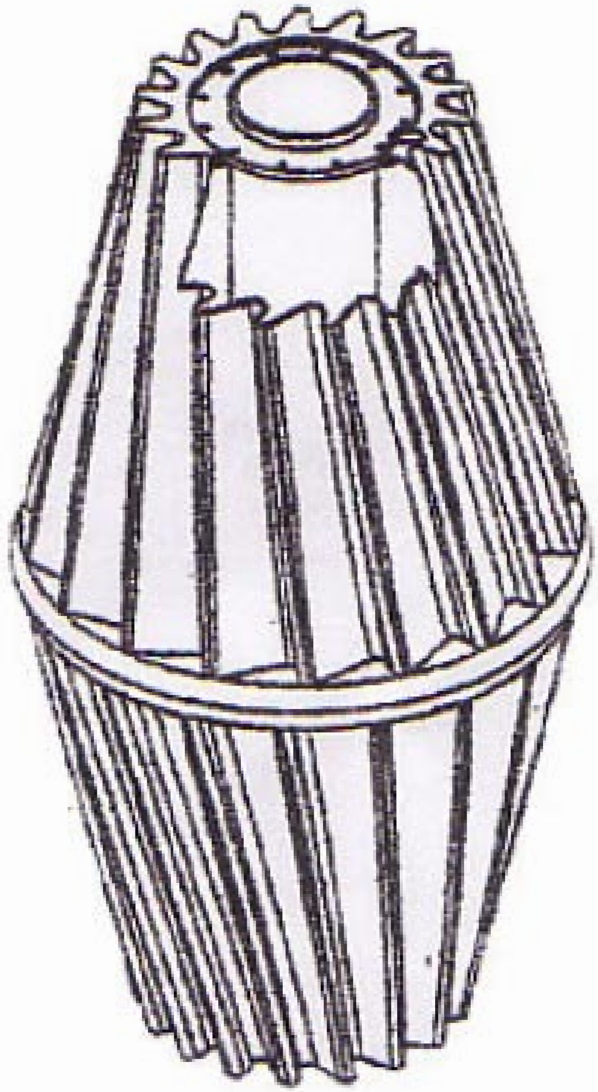
Key:

MOAB Pile Application offset for 29 degree skew

Clockwise rotation

Counterclockwise rotation

Total MOAB = 3



- Debris Free, Inc - 805.640.9520 - Ojai, California - info@debrisfree.com - www.debrisfree.com -

DEBRIS FREE INC

Debris & Scour: The Problem

Local scour and drift accumulation have plagued our nation's bridge infrastructure for many years. Crews currently spend precious time and financial resources applying retroactive countermeasures. No cost-effective preventive method of reducing scour and drift accumulation has been introduced to maintenance engineers to remedy this problem. Let us introduce to you Debris Free, Inc. and our cost effective, preventive solutions. Instead of paying yearly costs to clear debris, Debris Free, Inc. offers a number of mitigating means with which to handle debris issues. Our various products are customizable and allow us to carefully craft each project to the needs and specifications of your structure. Specialty engineering is no problem and actually helps us to ensure that the job is done right, and provides you with the best solution we can offer.

Drift accumulation has become one of the most costly problems in bridge maintenance. Our products allow large woody debris to pass through your structures. They allow fish free migratory movement without structure restrictions. On top of it all of our products help to avoid washouts and potential scour. We can help you to save significantly on maintenance budgets.

Product Line:

Debris Free, Inc. has pioneered the drift deflection industry. We have developed sole source technologies that solve many of drift deflection's largest problems.

The Bridgeshark:

The Bridgeshark was engineered and designed as a water velocity powered turbine to deflect drift from bridge piers and box culvert center diaphragm walls. It will handle small to medium drift loads.

Specifications:

- Durable cross-linked polyethylene outer-wall
- Bridgeshark dimensions are 60" long by 30" wide, its weight is 90 lbs.
- 3/8"wall thickness w/ 9000 lb. tensile strength before yield
- Powered by 29 longitudinal compound radial arc fins
- Interior foam floatation helps the system to adjust to changing elevations of the river
- Interchangeable bushings with various center-bores for various bracketing configurations

Top: Cougar Creek, Washington, near Mt. St. Helens.

Bottom: Bridgeshark double-stack. Kalama River, Washington.

Bracketing Configurations:

The Bridgeshark is a versatile unit that can be placed in a variety of locations. Debris Free has developed different bracketing applications for specific situations.

Model 10

The standard bracket is the Model 10. This bracket is most suitable for box culverts and bridges with smaller debris, handling force-loads of up to 10,000 lbs.

Features:
- 3/4"Stainless steel cable
- Seal welded 4"x4"x 3/8" wall square tubing, hot dipped galvanized after the weld
- UHMW thrust rollers
- Cable tension eye-bolts
- Available in elevation ranges from 6'0" to 40'- 0"
- Multiple Bridgesharks can be stacked on the Model 10

Model 20

The Model 20 is our mid-range bracket. This bracket is most suitable for bridges with mid sized debris with force loads of up to 20,000 lbs.

Bracket mounted Bridgeshark, Navarro River, California.

Features:
- 1 1/2"Stainless steel cable
- Seal welded 6"x 6" x 1/2" wall square tubing, hot dipped galvanized after the weld
- UHMW thrust rollers
- Cable tension eye-bolts
- Available in elevation ranges from 6'-0" to 40'-0".
- Multiple Bridgesharks can be stacked on the Model 20.

Pile Applications:

We are not limited to attaching Bridgesharks just to the pier. Piles can go out in front or be offset for skewed approaches. Drift can be trained to flow through desired spans.

Stacking of the Bridgeshark or MOAB on the pipe will enable it to cover tumbling to intermediate to floating ranges of debris flows at the same time.

The length of the pile and the end user specifications determines the elevation. The pile is then back-filled with concrete and a pipe collar is added. A telescoping bracket is attached to the deck fascia. The sleeve is a polyethylene pipe welded to the UHMW bushings on the Bridgeshark. Welded polyethylene pipe elevations range from 5' to 30'.

All piles are supplied and driven by the government agencies. The government agencies or private contractors can install Bridgesharks.

The MOAB:

The MOAB, or Mother of all Bridgesharks, has been designed to meet the demands of the most debris-infested rivers. The MOAB can be strategically placed in rivers to turn and deflect the largest trees and direct them to the open spans of the structure.

MOAB Specifications:
- With a domineering size of 9’ 6” tall, 5 ft in width and weight of 800 lbs, the MOAB comes ready to tackle the toughest of jobs in the drift deflection field
- Interior closed-cell foam allows the MOAB to adjust to the changing water elevations
- Interior sleeve is a 14” I.D. polyethylene pipe welded to the UHMW bushings on each end
- The MOAB requires a round steel pile to be driven to 25 ft in appropriate locations
- The MOAB can be stacked in multiples where applicable

The MOAB is only available for pile application because of its size. Government agencies supply the pile and installation. A Debris Free Representative will be present to ensure correct installation of all MOAB units.

Top: MOAB, Obion River, Tenesse.

Bottom: MOAB detail, Obion River, Tenesse.

Escambia River, Florida

This bridge over the Escambia River in Florida was once one of the worst trouble spots for Florida Department of Transportation. The maintenance crews spent countless hours and thousands upon thousands of dollars each year clearing drift from this bridge.

In March, Debris Free equipped this bridge with Bridgeshark systems. After enduring multiple high-water events, the bridge has been clean. The crews have spent their time working on other valuable projects, and those thousands of dollars of maintenance monies have been allocated to other places.

While Debris Free can handle such massive problems as the Escambia River it is also capable of handling much smaller problems spots. Our Bridgeshark and MOAB systems can be arrayed and individually tailored to virtually any river environment from the Mighty Mississippi to slower, more shallow settings.

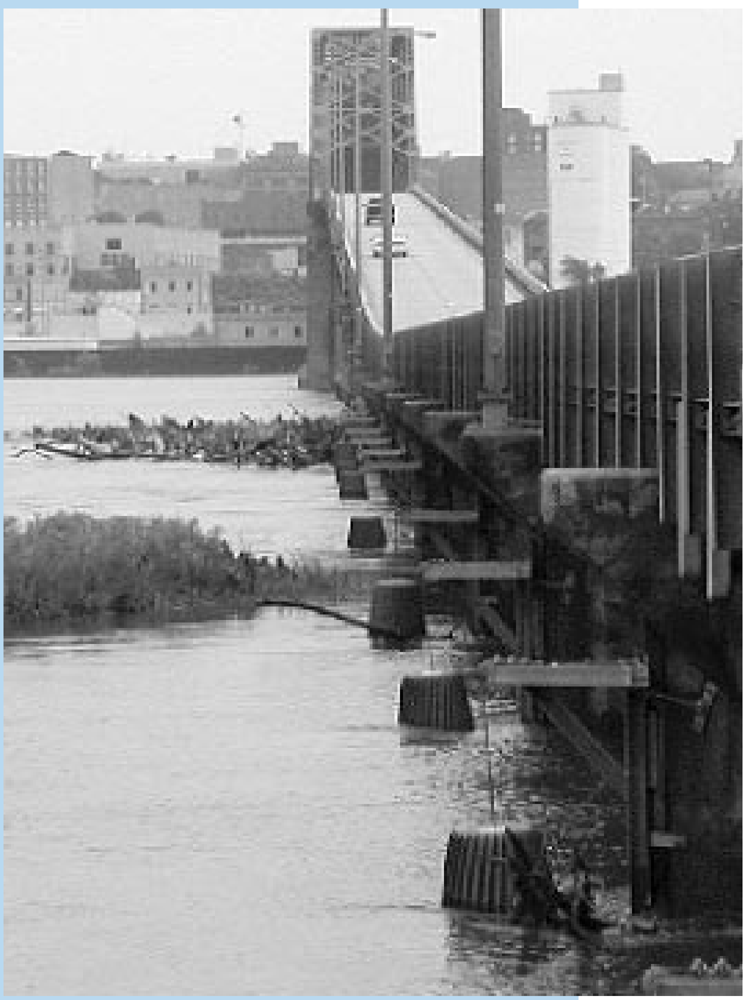
Top: Escambia River, Florida. Prior to installation, debris accumulation was a serious seasonal issue. Note the van in the upper right hand corner for scale comparison.

Bottom: Escambia River, Florida. After installation debris accumulation is non-existent.

Mississippi River, Illinois

The Mississippi River created large drift problems for maintenance crews in Quincy, Illinois. These pictures show the severity of the problem before Bridgeshark installation.

Ten Bridgeshark systems have been deflecting drift from this structure since September 2003. It has incurred a large high-water event for over four weeks in March 2004, with waters reaching over three feet above flood-stage. The success of these units has again saved countless maintenance dollars. Debris Free is proud to have corrected a recurring maintenance issue.



Top: Mississippi, River, Quincy, Illinois. Heavy debris accumulation is evident, prior to installation.

Bottom: Same bridge, after installation. Note the total lack of debris at Bridgeshark installations in foreground while debris has accumulated in background, where no Bridgesharks were installed.

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