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MEMORANDUM

DATE: March 14, 2003

TO: Friends of the Napa River, St. Helena Comprehensive Flood Protection Plan Committee

FROM: Phil Williams and Julie Haas

RE: **Technical Review and Comments on the City of St. Helena Comprehensive Flood Protection Project Draft EIR¹**
PWA Ref. #: 1628.01

PWA was hired by Friends of the Napa River [FONR] to assist in reviewing and commenting on the technical merits of the City of St. Helena's proposed Enhanced Minimum Plan [EMP]. To this effect, we have reviewed all technical documents provided to us by the City's Study Team [Draft Feasibility Report, June 2002; Geomorphic & Riparian Assessment of the Proposed Napa River Flood Control Project near the City of St. Helena, Napa County, Ca, SHG October 31, 2002; A letter from MIG to Bernard Krevet of FONR responding to the 11/29/02 comments; A four page explanation of the plan formulation process from MKG; A new report entitled "Geomorphic Design Report" from SHG dated 1/06/03; and the City of St. Helena Draft EIR (DEIR), January 2003]. Based on our review, we prepared two sets of written comments [11/29/2002 & 01/20/2003] and met with the City's Study Team and technical advisory committee [TAC] to discuss our comments on 12/02/2002. The following represents our most recent effort, which is focused on the review of hydraulic models used by the City's study team in preparation of the Draft EIR and above background documents. We have applied these models, together with historic survey data, to test the resilience and sustainability of the EMP. This letter report summarizes our findings and recommendations.

We would like to reiterate that our intent is *to assist the City in formulating and assessing a multi-objective flood control and river restoration project in accordance with the Living River Principles [LRP]. We have expressed our opinion that the EMP has not been developed using the LRP, and we have outlined a rationale and methodology that could be used by the City to demonstrate why it considers the EMP to represent the most appropriate balancing of flood management and ecologic objectives, and why other alternatives were rejected. We believe that the City will need to follow a rigorous planning process*

¹ Revised from version submitted February 26, 2003 (see attached summary of revisions).

in order to prepare an understandable EIR that will meet the approval of funding and regulatory agencies. [PWA, 1/20/2003]

Our current analytical review has confirmed four areas of concern raised in our last set of comments: 1) Assumed geomorphic stability in the project reach; 2) Potential for significant deposition in the restored floodplain terrace reach; 3) Adaptive management not integrated with planning and design; and 4) Design criteria for floodplain terraces unresolved. If these concerns continue to go unaddressed in the planning process, the consequences for the City could be serious. *The EMP as proposed has a significant risk of neither achieving its flood management goals nor the intended riparian habitat. If implemented, the EMP could result in large long term maintenance costs and liability for the City. [PWA, 1/20/2003]* The HEC-RAS model results show that the EMP's flood benefit is not resilient to cyclical changes in channel profile and varied management strategies.

PWA has performed sensitivity testing of the EMP model (MBK, 12/16/2002) against five likely future scenarios:

- 1) Bridge obstruction at Pope Street due to the debris blockage and/or skewed angle of entrance flows to the bridge piers;
- 2) Sedimentation in the proposed overflow channels;
- 3) Sedimentation of the Napa River to 1984 elevations;
- 4) Vegetation growth in the overflow channels;
- 5) A combination of vegetation growth in the overflow channels, sedimentation of overflow and main channels, and bridge obstruction; and
- 6) Increased roughness (due to vegetation and/or sedimentation) in the reach downstream of the EMP focus reach to levels that are the same currently observed in the focus reach.

The effect of each of the above scenarios on water surface elevations in the project reach with the EMP in place are summarized in Table 1. Results are described in more detail below.

Before testing the sensitivity of the EMP HEC-RAS model, the models provided by the City's study team (MBK and SHG) were first examined for reasonableness and consistency. Results of this general review are summarized below.

Boundary Conditions:

- All three models used consistent boundary conditions, except SHG's model which added 500cfs and 1000cfs events, without tributary or intermediate inflows.
- Sulphur Creek inflows are underestimated in proportion to estimated ditch inflows upstream of Vineyard Valley Mobile Home Park [VVMHP] and Napa River flows. Because Sulphur Creek is in a backwater from the Napa River, inflows from Sulphur Creek are arbitrary (pers. comm.. Mark Fortner, MBK).

Geometry

- SHG and MBK have developed two significantly different models for evaluating/developing the EMP. There is no documentation of this; and it is not clear which of the two models is the official model.
 - i. SHG's overflow channels are 4-6 ft lower than MBK's
 - ii. SHG right bank (VVMHP) levees are up to 2 ft lower than MBK's.
 - iii. SHG appears to report MBK's results for water surface elevations and their own model results for shears/velocities.
 - iv. Modeled water surface elevations estimated by the SHG model are approximately 0.4 ft higher for the 100-year and 0.7 ft higher for the 500-year event than elevations estimated by the MBK model.
 - v. SHG models left bank levees, while MBK does not. SHG's use of left bank levees where none are planned effectively prevents flows in the designed left bank EMP overflow channels. This may explain the higher water surface elevations modeled by SHG, noted above.
 - vi. SHG contains more cross-sections, with different orientations and extents.
- Neither SHG's nor MBK's cross-sections reflect terracing as shown in the DEIR.
- Upstream 'backwater' effects of Pope Street on the right bank do not appear to be modeled (would expect ineffective flow areas) at this location.
- The MBK existing conditions and EMP models are based on February/April 2002 surveys (pers. comm. Mark Fortner, MBK). The SHG model appears to have been constructed from the same 2002 survey data.

Structures/junctions:

- Neither EMP model simulates the effect of the proposed Adams Street bridge. As with Pope Street, it is customary to model a bridge as a structure to estimate backwater and other hydraulic impacts.
- All 3 models appear to describe the river lengths across the junction with Sulphur Creek on the Napa River incorrectly, possible causing underestimated water surface elevations.

Miscellaneous

- Recommend adding a plan view of the project reach with clear, consistent stationing and cross-referencing all cross-sections, profiles based on the same convention.

As summarized above, the models provided to us lack consistency and clear documentation. Due to time and resource constraints, PWA has performed a sensitivity analysis of the EMP using only MBK's HEC-RAS model. Results of the sensitivity analysis are detailed below within the framework of our previous comments (1/20/2003), shown in *italics* below.

1. Geomorphic Stability

PWA comments from 1/20/03 memo:

We are not satisfied with the new SHG report's response to our comments on the importance of understanding and predicting channel stability as it relates to future erosion hazards, habitat evolution and maintenance requirements. The report states: It is apparent both from examination of the topographic profile measured in 2002 and field evidence that neither the Pope St bridge nor any artificial control holds the streambed grade in the project reach. [p34].

We disagree. As of October 2002 a concreted rock sill was exposed on the bed at the Pope St Bridge. This conclusion of channel stability underlies the design assumptions for channel modifications upstream, and if wrong would have important and costly consequences. If the sill is presently preventing upstream channel incision and were to fail in a large flood, bank protection upstream would be undermined and fail. We find it surprising that this question has not been thoroughly analyzed at this stage in the design because it can be resolved easily with accurate field surveys. The 2002 survey cited and shown in figure 16 in the HSG report is inconsistent with the other downstream surveys we have seen, including the one used for HEC-RAS modeling shown in the same report in figure 20, and the channel profile shown in figure 2 of appendix B of the CDM report. This latter profile indicates at least 5ft of potential degradation.

The report does acknowledge future uncertainty concerning possible aggradation as watershed conditions change. However, the potential effect this would have on increasing flood levels has not yet been incorporated in the plan.

Current findings:

To further examine the issue of the Napa River's vertical stability, we plotted a series of 8 historic profiles dating from 5 years: 1951, 1968, 1984, 1996, and 2002 (three profiles). The profiles are shown in Figures 1 and 2, for the project and focus reaches. Before analyzing the profiles, it should be noted that the profiles come from sources of varying accuracy and quality. The 1951 and 1968 profiles are from SHG's 2003 report, Figure 16. SHG cited sources of these profiles as the City of St. Helena (1968) and USGS quadrangle map (1951); we presume that these profiles were estimated from contour lines on large scale maps, which probably did not include survey data in the river channel. Therefore, the application of these surveys for channel profile analysis is questionable. The 1984 profile from the 1998 FEMA FIS is presumed accurate, but its accuracy is not certain. The 1996 RCD profile is based on field survey data, which was tied into a known datum using County and USGS benchmarks, is also presumed accurate. The accuracy of the 2002 SHG Historical Analysis profile from 2-ft aerial survey contours is questionable because it is markedly different from the other two 2002 profiles. The "2002 SHG Survey" profile is from a ground survey of cross-sections, and is presumably accurate. Finally, the 2002 MBK/SHG HEC-RAS profile is from February/April 2002 surveys (pers. comm. Mark Fortner, MBK) and is presumed accurate. As stated in our previous comments, and plainly visible in Figures 1 and 2, three significantly

different 2002 longitudinal profiles were used as a basis for the analysis and design. The three profiles appear in Figure 16, 20 and Appendix A in the SHG 2003 report, and are plotted here in Figures 1 and 2 as the dashed, thick and thin black lines, respectively. Since different conclusions can be drawn depending on which 2002 profile is used, it is essential that the study team establishes which of the surveys is the most accurate and adopts that as the base for project studies. In the meantime, we have adopted the 2002 MBK/SHG HEC-RAS profile, as the most complete and accurate of the three 2002 surveys for our analysis, below.

To the extent that the 1984 FEMA profile is accurate, a comparison of the 1984, 1996 and 2002 HEC-RAS profiles suggests that the Napa River has been in a downcutting phase over the last 18 years. Between 1984 and 2002, the River downcut up to 7 feet between Pope and Pratt Street, averaging approximately 4.2 ft of incision over this reach. One exception is that from Sulphur Creek downstream to Pope Street bridge, the channel aggraded between 1984 and 1996 and subsequently downcut between 1996 and 2002. In general though, the overall trend appears to one of incision in this reach. It is also noteworthy that incision downstream of Pope Street appears to have been occurring more recently, with most incision occurring between 1996 and 2002. This is contradictory to SHG's finding that the Napa River profile is in a stable, "dynamic equilibrium" in the project reach, based on the assumed accuracy of the 1951, 1968 and "2002 Historical Analysis" profiles. The amplitude of "dynamic equilibrium," of up to >10 feet in this reach, indicates that the channel may not be classified as stable.

The consistency of the Napa River bed elevation at Pope Street in the 1984, 1996, and 2002 profiles lends support to our observation of a rock sill that acts as a grade control at the bridge. The Limiting Factors Analysis for Napa River Basin also confirms the existence of this sill, which is mapped as a potential fish barrier in Map 12 (Stillwater Sciences, 2000). We maintain that the River has the potential to downcut at the Pope Street bridge if the artificial rock/concrete sill is not maintained. Maintenance of this sill has not been included as a criterion of the EMP. Consequences of a blowout of the sill could have devastating effects on the project and riparian habitat, including undercutting banks and bank protection, potentially causing mass bank failures and loss of riparian vegetation.

We also examined the effect that channel aggradation/sedimentation might have on EMP water surface elevations. The effects of aggradation, not the causes, are discussed here. The issue of sediment transport and its analysis are discussed further under item 4, below. In their 2003 report, as well as in the DEIR, SHG acknowledged the potential for aggradation in the project reach due to the backwater effect near the confluence of Sulphur Creek and the Pope Street bridge, but did not test its effect on the project. To test the resilience of the EMP to aggradation, we modeled a scenario where the River re-establishes its higher 1984 bed levels. Results indicate that the EMP appears fairly resilient to aggradation in the focus reach, but that the immediate upstream reaches are more sensitive. Near Pratt Avenue, 100-year water surface elevation increase up to 0.7 ft with the 1984 bed condition. Figure 3 compares the resulting water surface profile to those of the EMP and Existing conditions models. These results are also summarized in Table 1.

Sedimentation of the EMP overflow channels is discussed under 2) below.

2. Potential for significant deposition in the restored floodplain terrace reach

From PWA 1/20/03 comments:

Analysis presented in the new report [figs 20 through 22] indicates there is a substantial risk that the EMP will induce significant amounts of sedimentation in the channel in the restored reach during major flood events. Deposition of boulders, gravels, and sands can reduce flood conveyance or result in ecologically disruptive or expensive maintenance requirements. The Pope St Bridge acts as a major hydraulic constriction during flood events, backing up water upstream in a backwater pool. Floodwaters entering this pool slow down and the shear stress forces that convey sediment drop significantly, causing the coarser bed material to deposit in the channel. The restored terraces are located at the upper end of this backwater pool that extends upstream from the Pope St Bridge [see fig 20]. We suspect that these backwater effects are underestimated in this study because it appears that debris obstruction on bridge piers has not been considered in the hydraulic analysis. Even ignoring debris affects, the analysis of average shear stress [fig 21] shows reductions in the terraced reach to about one fifth of upstream values. With this expected high rate of deposition it is not clear whether the flood conveyance or ecologic benefits assumed for the terraces are sustainable in the long term.

Current analysis findings:

Modeled shear stresses in the project reach indicate a substantial risk of sedimentation in the overflow channels; and that material much larger than the sands described by SHG may be transported in the overflow channels. Upstream of the proposed Adams Street bridge, near the upstream end of the overflow channels, high shear stresses (~5 lb/sq ft) indicate that there is a potential for flood flows to transport larger coarser material into the overflow channels. Subsequent low shear stresses further downstream in the overflow channels (~0.1 lb/sq ft) indicate a high potential for deposition. This indicates that coarse bed materials may have a tendency to deposit in the EMP overflow channels. This issue of channel deposition has not been adequately examined by the study team and needs to be fully assessed in order to establish the EMP's viability. Under 4) below, we discuss the need for a complete sediment transport capacity analysis and determination of the 'dominant discharge' of the River.

To test the effect of sedimentation of the EMP overflow channels, PWA modeled the effect of 2 feet of sediment aggrading in the designed channels. This may seem excessive compared to the observed sediment in recent floods in VVMHP, but the overflow channels will be inundated much more frequently and therefore, we feel that 2 ft is a conservative estimate. There was a minor reduction in flood benefit in the EMP with 2 ft of sedimentation in the overflow channels of -0.2 ft for the 100-year event. Refer to Figure 3 to see the modeled water surface profile with sedimentation in overflow channels in comparison with EMP and existing conditions, as well as with other modeled scenarios.

3. Adaptive management not integrated with planning and design

From PWA 1/20/03 comments:

Although the new SHG report includes a discussion of an adaptive management plan [p59], what is described is a monitoring plan –not an integrated management plan. Because the EMP has not been developed based on a logical planning process that articulates objectives and measurable indicators of achievement of objectives, it is not possible to design a properly formulated adaptive management plan for this project. Instead what appears to be proposed is an expensive and complex annual decision making process, whose participants would become the de facto river managers and whose decisions would significantly affect flood hazards and the ecologic health of the river. This process does not constitute an adaptive management plan in part because there are no identified and agreed on benchmarks or thresholds that would initiate management actions.

Approaching river management in this way not only loses the opportunity for creating a resilient design that minimizes the need for maintenance intervention; it may also burden the City with indefinite, unrealistic and expensive maintenance responsibilities.

*Instead a true adaptive management plan needs to be developed as an integral part of the design process using an explicit logical planning methodology, as we have recommended. **Key design criteria such as levels of acceptable sedimentation, roughness and channel obstruction would be built into the initial grading design. By anticipating the major management actions a realistic assessment can be made of maintenance costs, the need for ecologic disturbance or the need for remedial actions.***

Current findings:

PWA conducted a preliminary sensitivity analysis of the EMP model to sedimentation, vegetation growth and bridge obstruction. Effects on water surface elevations for these different scenarios are summarized in Table 1.

Sedimentation or aggradation of the main river channel was discussed under 1) above. Briefly, aggradation to higher, 1984 bed conditions impacted the reach upstream of the project focus reach, near Pratt Avenue. Sedimentation in the overflow channels was also previously discussed under 2) above. The effect of 2 feet of sedimentation in the designed EMP overflow channels had minor effects on the water surface elevation, raising water surfaces up to 0.2 ft in the project reach.

Impacts of vegetation growth in the overflow channels were estimated based on USGS Water-supply Paper 2339 (Arcement, 1989). Results of increasing roughness values to those recommended for vegetated floodplains (see attached Figure16, from USGS Water-supply Paper 2339) increased water surface elevations to a point that almost completely eliminates any predicted benefit of the EMP. Without diligent clearing of the overflow channels to a level of roughness that is necessarily smoother than the

river channel itself, the EMP cannot provide flood level reduction. Such clearing of overflow channels can be invasive and may significantly reduce any proposed habitat benefits of the EMP.

Of all of the scenarios we modeled, the EMP appears most sensitive to increases in downstream roughness. Management decisions/practices in this adjacent reach (for about ¾ mile downstream of Pope St bridge) are critical to the success or failure of the EMP. Roughness values in this downstream reach were calibrated to much lower values than found in the project reach (n~ 0.048-channel/0.06-overbank). We tested the effect of increasing roughness in this reach to levels found under existing conditions upstream, in the project focus reach (n~0.075-channel/0.09-overbank). The resulting increase in water surface elevations is substantial. Water surfaces increase up to 1.7 ft near Pope St bridge, and 0.9 ft at the downstream end of the focus reach. Figure 3 compares the resulting water surface profile to the EMP and Existing conditions model results.

The obstruction of Pope Street Bridge was modeled for two cases: debris obstruction and bridge skew. For bridge skew, we followed Federal Highway Administration guidelines for estimating the reduction of bridge capacity due to skewed entrance flows relative to bridge piers. The Napa River enters the Pope Street bridge after completing a large meander that curves westward. Increasingly, this meander bend is eroding the outside bank, while the inside gravel bar is building out into the channel centerline. While this is a natural process, it is countered by maintenance of bank protection on the right bank and vegetation/sediment removal on the left bank point bar. Using aerial photographs reported in the DEIR (Figure 3-5), we estimated that the angle of approach of the River to the Pope bridge can vary up to 18.9° from normal to the bridge deck. Using Federal Highway Administration guidelines (Bradley, 1978), there is a resulting reduction in bridge capacity of approximately 25%. When incorporated into the model, bridge skew effects raise water surface elevations from Pope St upstream of the proposed Adams St bridge, up to 0.4 feet in the 100-year event. In addition, PWA examined a bridge obstruction from debris using the Sonoma County Water Agency Flood Control Design Criteria, which require an allowance of 2-feet of debris obstruction on either side of bridge piers (SCWA, 1983). The result is a 10% reduction in the capacity of Pope St Bridge. This results in minor increases in water surface elevation of up to 0.1 ft.

Combined effects of vegetation growth (in overflow channels), sedimentation in overflow channels and streambed (2ft), and a minor bridge obstruction due to debris blockage (10% reduction), are slightly greater than for vegetation growth (in overflow channels) alone. In this scenario, all anticipated EMP flood reduction benefit would be eliminated.

4. Design criteria for floodplain terraces unresolved

Summarized from PWA's 1/20/03 comments:

“Additional geomorphic concerns raised by the resource agencies and FONR” in the Draft Feasibility Report (June 2002), include impacts to sediment transport, stream bank stability and overall potential for channel migration of the river. We understand DFG and NMFS have raised specific concerns over the

connectivity of the overflow channels to the river during low flows, fish stranding and artificially high velocities in the overflow channels. These issues cannot be adequately addressed unless consistent bankfull and overflow channel design elevations are selected based on a consistent geomorphic rationale.

We also note there are discrepancies between the text description (for the EMP proposed overflow channel design) and the illustration, which shows overflow terraces at elevations higher than the 2-year flood level, described in the text.

These issues are still unresolved, as exemplified by the significantly different model topography being applied by SHG and MBK, neither of which matches the overflow terrace elevations and geometry described in the DEIR (Figure 4-8).

SHG assessed in their field study that “bankfull,” where flood plain formation takes place, in the project reach occurs at 500cfs (>98% chance of this event). SHG states in the DEIR that the flood terraces (100-300 feet in length and 5-8 feet deep) will be built at 4,500 to 5,000 cfs (1.5 - 2 year storm event), which is approximately 10-15 feet above “bankfull.” This is contradictory to what is shown in DEIR Figure 4-8, which depicts the overflow terraces at an elevation higher than the 2-year level. The only design criteria mentioned is that the overflow channels be 8 feet above the “low water level,” which can vary seasonally, depending on groundwater levels. As defined in SH&G’s 2002 report, “low water level” is approximately 2-5 feet below “bankfull;” and thus, approximately 12-20 feet below the 2-year level, not 8 feet as Figure 4-8 describes. This is not only inadequate/inconsistent design criteria, but it fails to incorporate a geomorphic rationale for determining terrace/overflow channel levels.

SHG was hired to resolve the issue of determining the appropriate “dominant discharge,” at which to design the terrace elevations, but has not done so. It is worth noting that “bankfull” and “dominant discharge” are not synonymous. “Dominant discharge” is defined as the discharge that, on average, transports the largest fraction of the annual sediment load in a channel. Rivers adjust their channel form and gradient to this dominant discharge, to convey the sediment supplied to it. With the expected changes in sediment supply to the project reach, with the removal of the York Creek dam and the closure of the gravel mining operation on Sulphur, the TAC raised a concern that the dominant discharge be evaluated, so that the design channel geometry would be appropriate to the sediment and discharge loads. Dominant discharge is determined by multiplying the frequency of different discharges times the corresponding sediment transport rate. SHG has not completed an assessment of the dominant discharge of the Napa River in the project reach, and thus, has not established a key geomorphic parameter for the flood project design.

References

Arcement, G.J. Arcement and V.R. Schneider, revised ???, USGS Water-supply Paper 2339: *Guidelines for Selecting Manning's Roughness Coefficients for Natural Channels and Flood Plains*

Bradley, Joseph N., consultant to U.S. Department of Transportation, Office of Engineering and Operations Bureau of Public Roads, Hydraulic Branch, Bridge Division, *Hydraulics of Bridge Waterways, Hydraulic Design Series No. 1, 2nd Edition*

CDM and MBK, June 2002, Comprehensive Flood Study for the City of St. Helena, CA, Draft Feasibility Report

CDM, MBK, MIG and SHG, January 2003, *City of St. Helena Comprehensive Flood Protection Project, Draft Environmental Impact Report* (State Clearinghouse #2002012078)

FEMA, Revised January 7, 1998, *Flood Insurance Study, City of St. Helena, Napa County, CA*

PWA, 11/29/2002, Memorandum: "Comments on the St Helena Napa River Flood Control Plan"

PWA, 1/20/2003, Memorandum: "Comments on recent revisions to the Napa River Enhanced Minimum Plan"

Sonoma County Water Agency, Santa Rosa, CA, Revised August 1983, *Flood Control Design Criteria for Waterways, Channels and Closed Conduits*

Stillwater Sciences, 2002, *Limiting Factors Analysis for the Napa River Basin*

Swanson Hydrology & Geomorphology (SHG) and Dennis Odion, PhD., January 6, 2003, *Geomorphic Design Report, Conceptual Plan and Adaptive Management Framework for the Enhanced Minimum Plan Flood Protection and Ecosystem Restoration Project, City of St. Helena, Napa County, CA,*

HEC-RAS models:

Existing conditions model provided by MBK, 10/30/2002 (napa_sulphur.p01)

Enhanced Minimum Plan A model provided by MBK, 12/16/2002 (napa_sulphur.p03)

SHG Proposed 1 (Enhanced Minimum Plan) model provided by SHG, 1/23/2003 (napa_sulphur.p04)

Table 1. Results of HEC-RAS Sensitivity Analysis¹

Location on Napa River	100-Year Water Surface Elevations, feet												
	Existing conditions	Enhanced Minimum Plan			Vegetation growth in overflow channels			Deposition of bed material to 1984 conditions			Bridge obstruction from skew and/or debris		
	Water Surface Elevation	Water Surface Elevation	Proposed Flood Reduction Benefit of EMP	Water Surface Elevation	Flood Reduction Benefit (compared to Existing)	Comparison to EMP Benefit	Water Surface Elevation	Flood Reduction Benefit (compared to Existing)	Comparison to EMP Benefit	Water Surface Elevation	Flood Reduction Benefit (compared to Existing)	Comparison to EMP Benefit	
	10-year flood elevations												
Pratt Street Bridge	223.0	222.9	0.0	223.0	0.0	0.0	223.7	-0.8	-0.8	222.9	0.0	0.0	
Adams Street Proposed Bridge	216.2	214.6	1.6	215.4	0.8	-0.8	214.7	1.5	-0.1	214.5	1.7	0.0	
Upstream end of Vineyard Valley MHP Wall	215.5	213.9	1.5	214.7	0.8	-0.7	214.0	1.5	0.0	213.9	1.6	0.1	
Downstream end of Focus Reach	213.6	213.2	0.4	213.4	0.2	-0.2	213.2	0.4	0.0	213.1	0.5	0.1	
Confluence with Sulphur Creek	212.0	212.1	-0.1	212.1	-0.1	0.0	212.1	-0.1	0.0	212.4	-0.4	-0.3	
Pope Street Bridge (upstream)	211.1	211.1	0.0	211.1	0.0	0.0	211.1	0.0	0.0	211.4	-0.3	-0.3	
	100-year flood elevations												
Pratt Street Bridge	225.4	225.4	0.0	225.4	0.0	0.0	226.0	-0.7	-0.7	225.4	0.0	0.0	
Adams Street Proposed Bridge	218.0	216.9	1.1	217.8	0.2	-0.8	217.0	1.0	0.0	217.1	0.9	-0.2	
Upstream end of Vineyard Valley MHP Wall	217.4	216.6	0.7	217.3	0.1	-0.6	216.6	0.7	0.0	216.8	0.5	-0.2	
Downstream end of Focus Reach	216.4	216.4	0.0	216.7	-0.3	-0.3	216.4	0.0	0.0	216.6	-0.2	-0.2	
Confluence with Sulphur Creek	215.7	215.8	0.0	215.8	0.0	0.0	215.8	0.0	0.0	216.0	-0.3	-0.2	
Pope Street Bridge (upstream)	214.8	214.8	0.0	214.8	0.0	0.0	214.8	0.0	0.0	215.1	-0.3	-0.3	
	500-year flood elevations												
Pratt Street Bridge	226.1	226.1	0.0	226.1	0.0	0.0	226.7	-0.6	-0.6	226.1	0.0	0.0	
Adams Street Proposed Bridge	218.2	217.6	0.6	218.3	-0.1	-0.7	217.6	0.6	0.0	217.6	0.6	-0.1	
Upstream end of Vineyard Valley MHP Wall	217.4	217.2	0.2	217.7	-0.3	-0.5	217.3	0.2	0.0	217.3	0.1	-0.1	
Downstream end of Focus Reach	217.1	217.0	0.2	217.1	0.0	-0.2	217.0	0.2	0.0	217.1	0.1	-0.1	
Confluence with Sulphur Creek	216.5	216.5	0.0	216.5	0.0	0.0	216.5	0.0	0.0	216.6	-0.1	-0.1	
Pope Street Bridge (upstream)	215.5	215.5	0.0	215.5	0.0	0.0	215.5	0.0	0.0	215.7	-0.2	-0.2	

NOTES

Vegetation growth in overflow channels	Represents growth of vegetation in floodplains/overbank channels/terraces (n=0.14) Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Flood Plains, USGS Water-supply Paper 2339
Deposition of bed material to 1984 conditions	Based on FEMA FIS, 1984 longitudinal bed profile data. Represents obstruction of the Pope Street bridge due to skewed angle of entrance flow to the bridge piers. An potential skew angle of 18.9° was estimated from a recent aerial photograph (DEIR, Figure 3-5).
Bridge obstruction from skew and/or debris	Hydraulics of Bridge Waterways By the Hydraulic Branch, Bridge Division Office of Engineering and Operations Bureau of Public Roads, U.S. Department of Transportation, Federal Highway Administration, Hydraulic Design Series No. 1, 2nd Edition, Reported by Joseph N. Bradley, Consultant Estimated 2 feet of deposition in overflow channels during higher frequency events. This depth is greater than that observed in past floods, due to the frequency of flooding of the overbank areas.
Deposition in overflow channels	Vegetation in overflow channels (n=0.14); bridge obstruction due to ske (18.9o); and sedimentation of 2 ft in channel and in overflow channels.
Combination of vegetation, bridge obstruction and sedimentation	
Downstream increases in roughness due to sedimentation and/or vegetation growth	Roughness downstream of Pope St increased from -0.048-channel/0.06-overbank to values found in existing conditions in the project reach: 0.075-channel/0.09-overbank.
Damaging Flood Level	Right overbank profile (HEC-RAS).

¹ Revised from version submitted February 26, 2003 (see attached summary of revisions).

Table 1. Results of HEC-RAS Sensitivity Analysis¹ (continued)

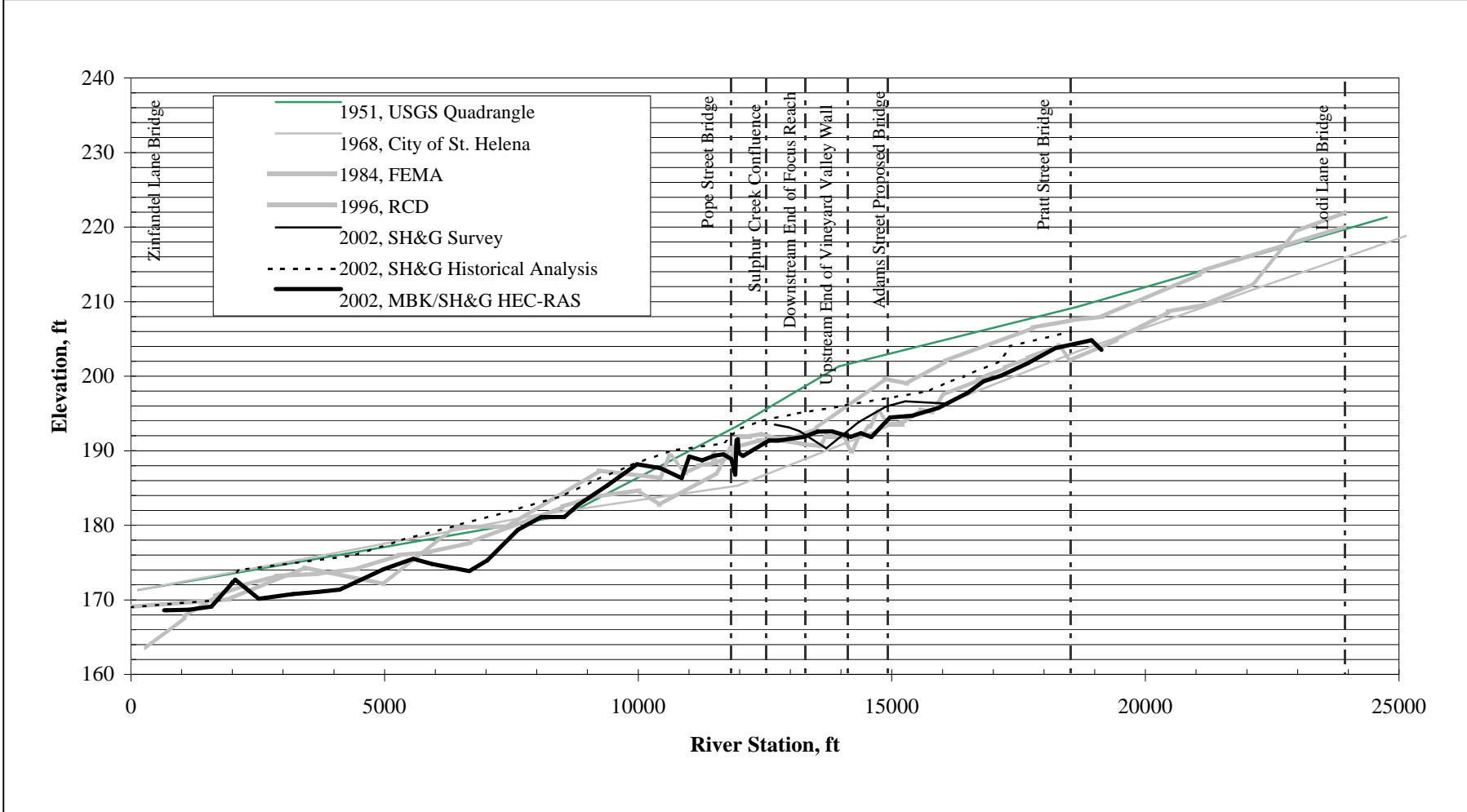
Location on Napa River	100-Year Water Surface Elevations, feet										Existing Conditions Damaging Flood Level	Enhanced Minimum Plan Top of RB Levee
	Deposition in overflow channels			Combination of vegetation, bridge obstruction and sedimentation			Downstream increases in roughness due to sedimentation and/or vegetation growth					
	Water Surface Elevation	Flood Reduction Benefit (compared to Existing)	Comparison to EMP Benefit	Water Surface Elevation	Flood Reduction Benefit (compared to Existing)	Comparison to EMP Benefit	Water Surface Elevation	Flood Reduction Benefit (compared to Existing)	Comparison to EMP Benefit			
Pratt Street Bridge	223.0	0.0	0.0	223.0	0.0	0.0	222.9	0.0	0.0	220.3	N/A	
Adams Street Proposed Bridge	215.0	1.2	-0.4	215.4	0.8	-0.9	215.4	0.8	-0.8	213.5	219.9	
Upstream end of Vineyard Valley MHP Wall	214.2	1.3	-0.3	214.6	0.8	-0.7	215.1	0.4	-1.1	216.4	220.0	
Downstream end of Focus Reach	213.4	0.2	-0.2	213.3	0.3	-0.1	214.8	-1.2	-1.7	215.5	220.0	
Confluence with Sulphur Creek	212.1	-0.1	0.0	212.2	-0.2	-0.1	214.4	-2.4	-2.3	214.0	N/A	
Pope Street Bridge (upstream)	211.1	0.0	0.0	211.1	-0.1	-0.1	213.9	-2.8	-2.8	218.5	N/A	
Pratt Street Bridge	225.4	0.0	0.0	225.4	0.0	0.0	225.4	0.0	0.0	220.3	N/A	
Adams Street Proposed Bridge	217.1	0.9	-0.2	217.8	0.2	-0.9	217.7	0.3	-0.8	213.5	219.9	
Upstream end of Vineyard Valley MHP Wall	216.7	0.6	-0.1	217.3	0.1	-0.6	217.5	-0.1	-0.8	216.4	220.0	
Downstream end of Focus Reach	216.4	0.0	0.0	216.7	-0.3	-0.3	217.3	-0.9	-0.9	215.5	220.0	
Confluence with Sulphur Creek	215.8	0.0	0.0	215.9	-0.1	-0.1	217.1	-1.3	-1.3	214.0	N/A	
Pope Street Bridge (upstream)	214.8	0.0	0.0	214.9	-0.1	-0.1	216.5	-1.7	-1.7	218.5	N/A	
Pratt Street Bridge	226.1	0.0	0.0	226.1	0.0	0.0	226.1	0.0	0.0	220.3	N/A	
Adams Street Proposed Bridge	217.7	0.5	-0.1	218.3	-0.1	-0.7	218.3	-0.1	-0.7	213.5	219.9	
Upstream end of Vineyard Valley MHP Wall	217.3	0.1	-0.1	217.7	-0.3	-0.5	218.0	-0.6	-0.8	216.4	220.0	
Downstream end of Focus Reach	217.0	0.1	0.0	217.1	0.0	-0.1	217.8	-0.7	-0.9	215.5	220.0	
Confluence with Sulphur Creek	216.5	0.0	0.0	216.5	0.0	0.0	217.8	-1.3	-1.2	214.0	N/A	
Pope Street Bridge (upstream)	215.5	0.0	0.0	215.5	0.0	0.0	217.2	-1.7	-1.7	218.5	N/A	

NOTES

Vegetation growth in overflow channels	Represents growth of vegetation in floodplains/overbank channels/terraces (n=0.14) Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Flood Plains, USGS Water-supply Paper 2339
Deposition of bed material to 1984 conditions	Based on FEMA FIS, 1984 longitudinal bed profile data.
Bridge obstruction from skew and/or debris	Represents obstruction of the Pope Street bridge due to skewed angle of entrance flow to the bridge piers. An potential skew angle of 18.9° was estimated from a recent aerial photograph (DEIR, Figure 3-5). Hydraulics of Bridge Waterways By the Hydraulic Branch, Bridge Division Office of Engineering and Operations Bureau of Public Roads, U.S. Department of Transportation, Federal Highway Administration, Hydraulic Design Series No. 1, 2nd Edition, Reported by Joseph N. Bradley, Consultant
Deposition in overflow channels	Estimated 2 feet of deposition in overflow channels during higher frequency events. This depth is greater than that observed in past floods, due to the frequency of flooding of the overbank areas.
Combination of vegetation, bridge obstruction and sedimentation	Vegetation in overflow channels (n=0.14); bridge obstruction due to ske (18.9o); and sedimentation of 2 ft in channel and in overflow channels.
Downstream increases in roughness due to sedimentation and/or vegetation growth	Roughness downstream of Pope St increased from -0.048-channel/0.06-overbank to values found in existing conditions in the project reach: 0.075-channel/0.09-overbank.
Damaging Flood Level	Right overbank profile (HEC-RAS).

¹ Revised from version submitted February 26, 2003 (see attached summary of revisions).

Figures



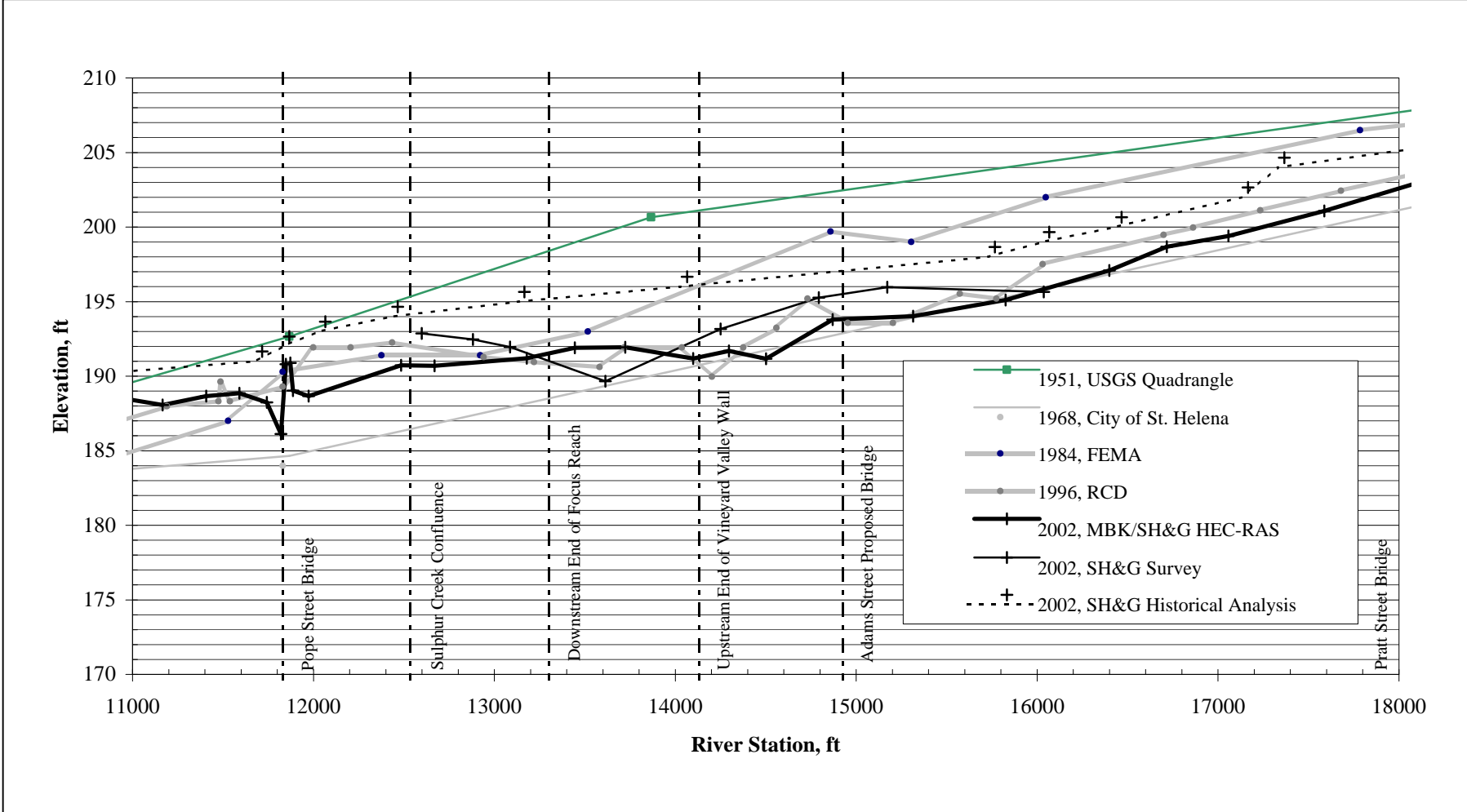
Sources: 1951, 1968, 2002 SH&G Survey, and 2002 SH&G Historical Analysis profiles from Geomorphic Design Report by Swanson Hydrology & Geomorphology (January 6, 2003). 1984 profile from Flood Insurance Study, City of St. Helena, Napa County, CA, FEMA (Revised January 7, 1998). 1996 profile from Napa County Resource Conservation District survey. 2002 MBK/SH&G HEC-RAS profile from HEC-RAS models by MBK and SH&G (profiles for Existing Conditions and EMP are the same).
 Notes: River stations were rectified to match MBK HEC-RAS convention.

figure 1

Technical Review of St. Helena Flood Control Project Draft EIR
Napa River Streambed Profile Over Time, Zinfandel Ln to Lodi

PWA Proj #: 1628.01




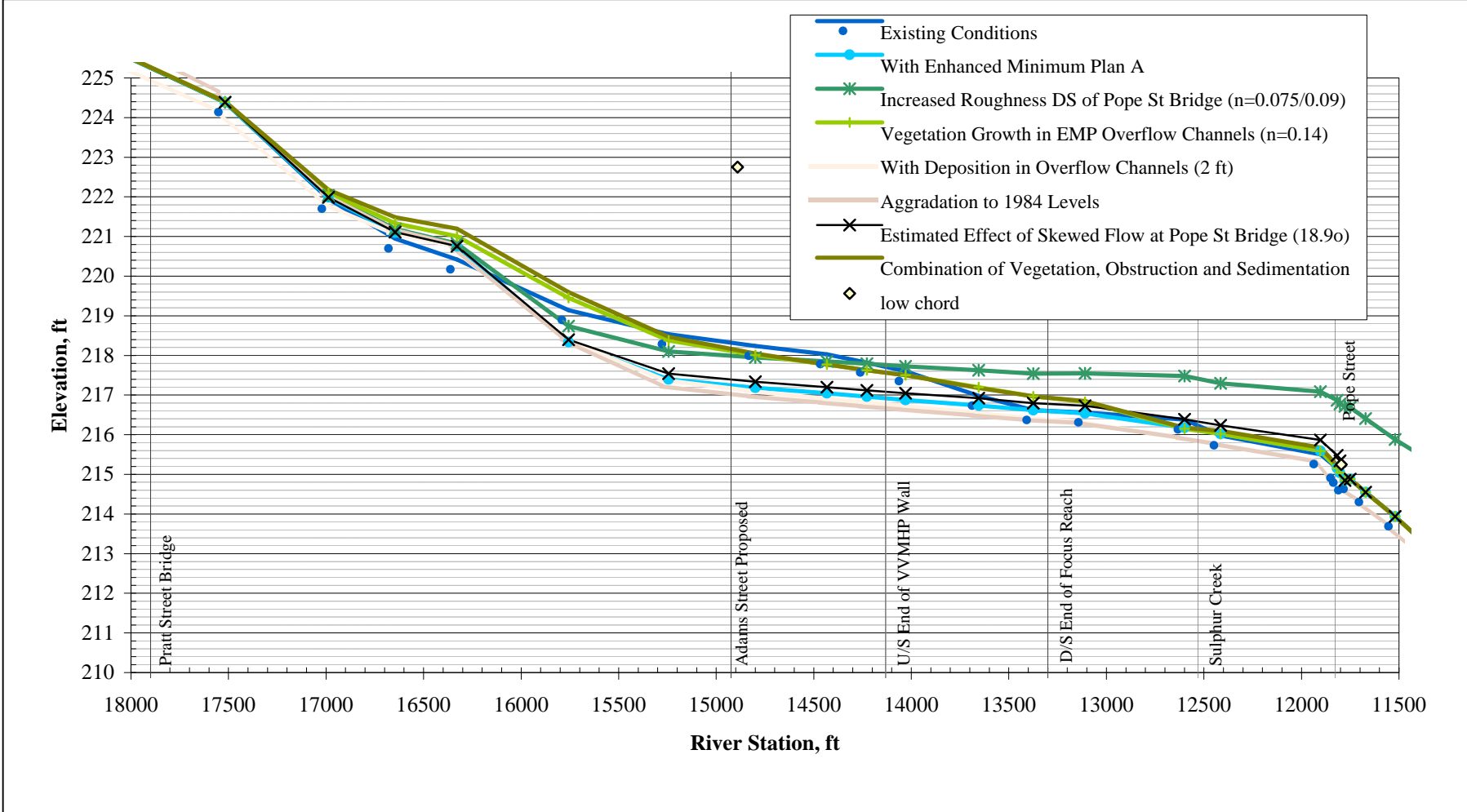


Sources: 1951, 1968, 2002 SH&G Survey, and 2002 SH&G Historical Analysis profiles from Geomorphic Design Report by Swanson Hydrology & Geomorphology (January 6, 2003). 1984 profile from Flood Insurance Study, City of St. Helena, Napa County, CA, FEMA (Revised January 7, 1998). 1996 profile from Napa County Resource Conservation District survey. 2002 MBK/SH&G HEC-RAS profile from HEC-RAS models by MBK and SH&G (profiles for Existing Conditions and EMP are the same).
 Notes: River stations were rectified to match MBK HEC-RAS convention.

figure 2

Technical Review of St. Helena Flood Control Project Draft EIR
Napa River Streambed Profile Over Time - Focus Reach
 PWA Proj #: 1628.01





Notes
 Base models: Existing conditions model provide by MBK, 10/30/2002 (napa_sulphur.p01); Enhanced Minimum Plan A model provided by MBK, 12/16/2003 (napa_sulphur.p04)

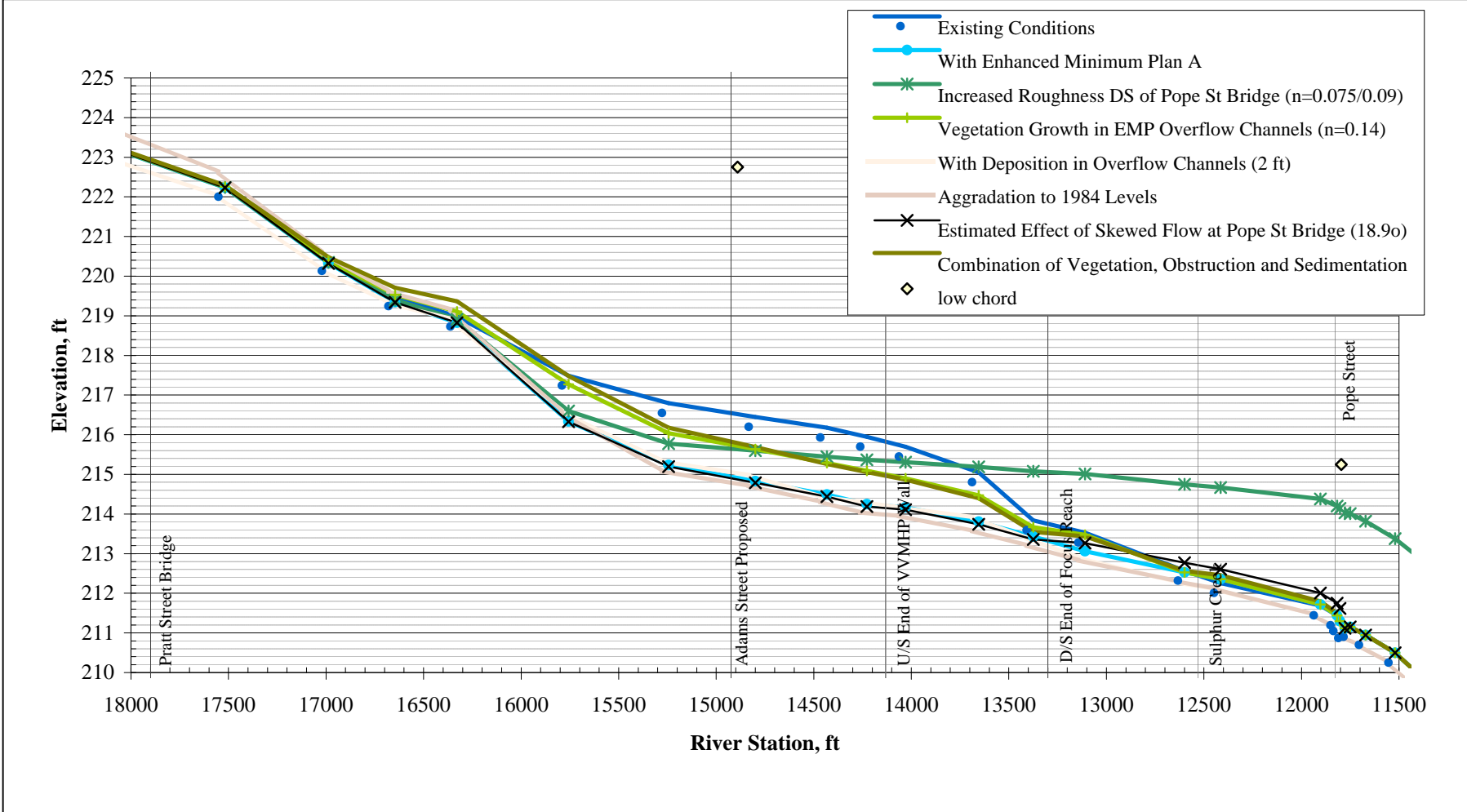
figure 3

Technical Review of St. Helena Flood Control Project Draft EIR
EMP Sensitivity Analysis: 100-year Water Surface



Appendices

HEC-RAS 10- and 500-year Water Surface Profiles

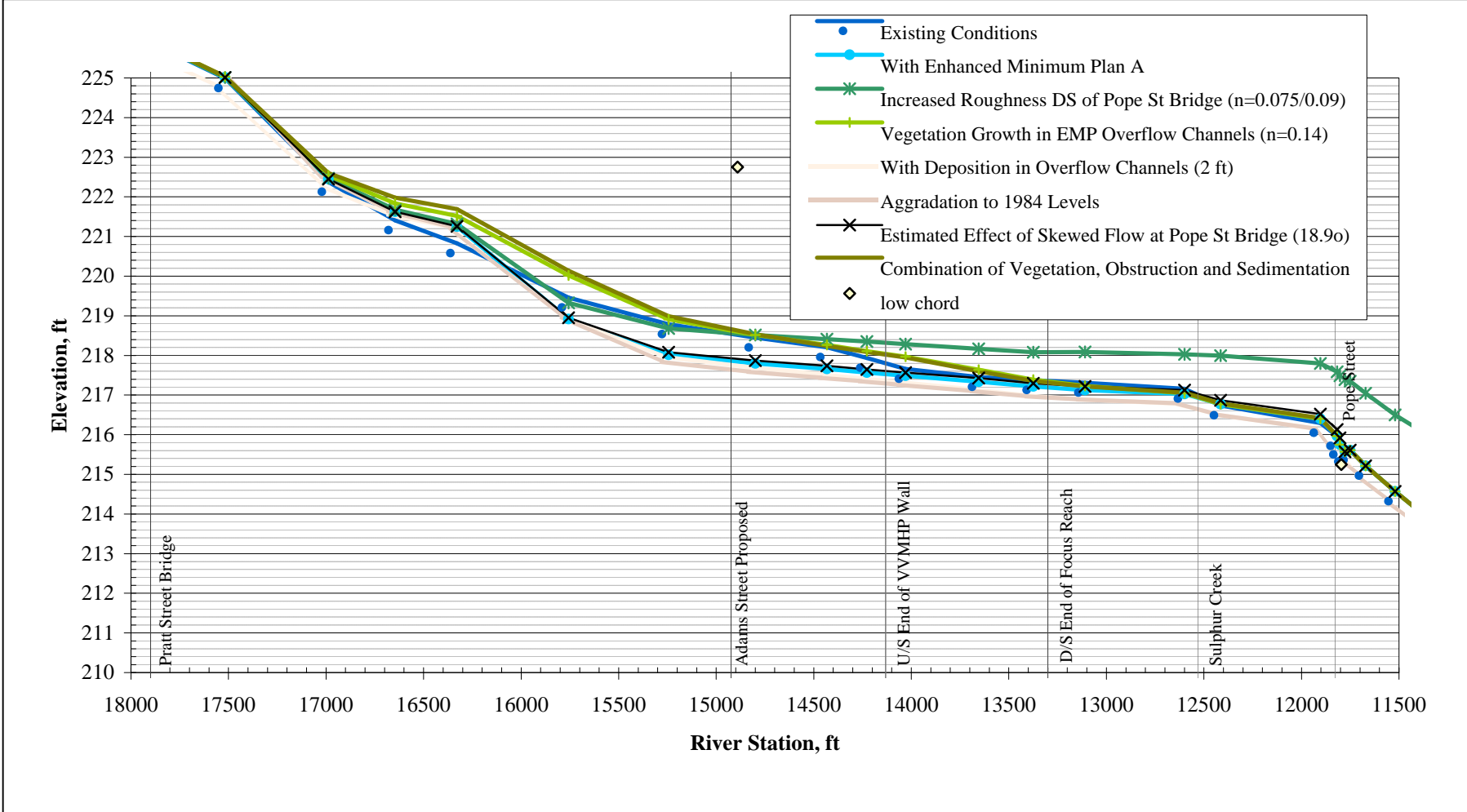


Notes
 Base models: Existing conditions model provide by MBK, 10/30/2002 (napa_sulphur.p01); Enhanced Minimum Plan A model provided by MBK, 12/16/2003 (napa_sulphur.p04)

figure A-1

Technical Review of St. Helena Flood Control Project Draft EIR
EMP Sensitivity Analysis: 10-year Water Surface Profiles





Notes
 Base models: Existing conditions model provide by MBK, 10/30/2002 (napa_sulphur.p01); Enhanced Minimum Plan A model provided by MBK, 12/16/2003 (napa_sulphur.p04)

figure A-2

Technical Review of St. Helena Flood Control Project Draft EIR
EMP Sensitivity Analysis: 500-year Water Surface



USGS Water-Supply Paper 2339, Figure 16



Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Flood Plains

United States Geological Survey Water-supply Paper 2339

Metric Version

Welcome to Manning's Roughness Coefficients for Natural Channels and Flood Plains



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[U.S. - SI Conversions](#)



Authors: G.J. Arcement, Jr. and V.R. Schneider, USGS

NOTE: WSP2339 is the USGS version of FHWA-TS-84-204 which has the same title. The publications are substantially the same, but have different arrangement of figures.

DISCLAIMER: During the editing of this manual for conversion to an electronic format, the intent has been to convert the publication to the metric system while keeping the document as close to the original as possible. The document has undergone editorial update during the conversion process.



Computed roughness coefficient: Manning's $n=0.14$

Date of flood: December 21, 1972

Date of photograph: March 13, 1979

Depth of flow on flood plain: .853 meters

Description of flood plain: The vegetation of the flood plain is a mixture of large and small trees, including oak, gum, and ironwood. The base is firm soil and has minor surface irregularities caused by rises and depressions. Obstructions are minor (downed trees and limbs and a buildup of debris). Ground cover is negligible and the small amount of undergrowth is made up of small trees and vines. $Veg_d=0.0335$, and $C^*=15.6$. The selected values are $n_b=0.025$, $n_1=0.005$, $n_3=0.015$, $n_4=0.005$, $n_o=0.050$.

Figure 16. Pea Creek Near Louisville, Ala. (Ming, Colson, and Arcement, 1979 HA-608, cross-section 4)



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DATE: March 14, 2003

TO: Friends of the Napa River, St. Helena Comprehensive Flood Protection Plan Committee

FROM: Phil Williams and Julie Haas

RE: **Summary of Revisions to: Technical Review and Comments on the City of St. Helena Comprehensive Flood Protection Project Draft EIR (2/26/2003)**
PWA Ref. #: 1628.01

Please note that the following revisions were made to our Comments (2/26/2003) which were distributed prior to the City of St. Helena public hearing on March 11, 2003.

Page 1: Based on our review, we prepared two sets of written comments [11/29/2002 & 01/20/2003] and met with the City's Study Team and technical advisory committee [TAC] to discuss our comments on ~~12/2002~~ 12/02/2002.

Page 5: The consistency of the Napa River bed elevation at Pope Street in the 1984, 1996, and ~~2001~~ 2002 profiles lends support to our observation of a rock sill that acts as a grade control at the bridge.

Page 5: Near Pratt Avenue, 100-year water surface elevation increase up to ~~0.6~~ 0.7 ft with the 1984 bed condition.

Page 7: Without diligent clearing of the overflow channels to a level of roughness that is necessarily smoother than the river channel itself, the EMP cannot provide flood level reduction benefits ~~or habitat~~ benefits.

Table 1: Revised.