



Memorandum

Date: April 5, 2011
To: Joseph Peterson, David Yam - Caltrans
From: Chris Sewell, Kazuya Tsurushita
Project: SR128, Russian River Bank Stabilization – Phase 2
Subject: Technical Summary of Modeling Efforts

This memorandum summarizes our investigation into the various design options for Phase 2 of the Russian River at SR128 Bank Stabilization Project.

The investigation included:

- Development of proposed surface geometry corresponding to the proposed options
- Incorporation of the 3-D surface geometry into a two-dimensional hydraulic simulation using Aquaveo's Surface Water Modeling System (SMS) software using Finite Element Surface Water Modeling System - 2-Dimensional Hydrodynamic (FESWMS-2DH) Numerical Modeling System
- Hydraulic modeling and calibration of the design options with the 24,000 and 48,000 cfs events in the Russian River
- Review of existing conditions and relevant guidelines
- Compilation and summarizing of the result.

Descriptions, as well as plan views and velocity fields of the modeled options are included in Appendix A.

As an additional consideration, the proposed Syar Industries gravel skimming operation for Bar #8 and #9 were modeled in conjunction with the Caltrans alternatives. This consideration significantly affects the selection of alternatives for the crescent area and bridge abutment. The Caltrans alternatives were modeled with and without the Syar skimming proposal. The proposed gravel mining plans are included in Appendix B.

Summary of Findings

1. In all of the hydraulic model runs of the Caltrans alternatives without the Syar skimming, the resultant velocities on the opposite riverbank downstream of the bridge remained relatively unchanged from the existing condition. This includes proposals to add additional vanes contiguous to the re-built RSP at the abutment (See Figure 1).
2. The flow velocities in the vicinity of the Bridge from the modeling show a dramatic difference with all Caltrans alternatives and Syar Industries's proposed gravel skimming. The

velocities were effectively cut in half (10 ft/s vs 5 ft/s) at the bridge abutment in the vicinity of the RSP with Syars' removal of gravel at Bar 8 and 9. (See Figure 1).

3. The velocities from the modeling at the scoured crescent within the riverbank are minimal and the rate of river bank retreat has significantly slowed even without Syar's skimming. However, Caltrans Engineering Geologist recommends the crescent portion of the riverbank be filled to a stable 2:1 slope configuration. Cutting the vertical scarp to a 2:1 slope angle is an option, but not preferred. This activity is expected to improve the interim stability of the riverbank in the area of the crescent by vanes 3A and 4 and will further minimize undermining of the river bank by vane 4 during high flow events. Current evidence shows that the scarp is retreating naturally to about 1.5:1 along most sections of scarp except for the hook portion between vanes 3A and 4 below where the RSP was removed.
4. Syar's in-river gravel mining at Bar 8 and 9 improves the efficiency of the waterway area through the bridge by spreading the flow more uniformly through the existing bridge opening, reduces the Water Surface Elevation (WSE) during high flows and reduces the frequency of out of bank flows. It is these out of bank flows which have the potential of washing out the approach roadway to the bridge.
5. It should be noted that the modeling did not account for flows beyond what constitutes about a 10-year flow (48,000 cfs). At this flow, there would be vast flooding in all of the floodplains.
6. The existing vanes have been observed to be very successful in pushing the thalweg east, away from the scarp area. Extension of these vanes is expected to push the thalweg further east and reduce the impact and velocity of flows against the RSP embankment at the west SR128 bridge approach. This theory is supported by the modeling results. In addition, extension of the vanes would continue to provide natural scour to the opposite bar, reduces deposition along the opposite bank and reduces impingement of flow near the west bridge abutment.
7. The results of the modeling indicate that, with the aid of Syar's skimming, there is limited benefit to installing new vanes coupled with the rebuilding of the RSP embankment.
8. The existing RSP embankment was placed during an emergency situation (flood-fight) and did not include the standard engineered 'layered' RSP design. "Such practice will not work for long-term bank protection, because without layers of adequate thickness and gradation, erodible bank materials will ultimately pipe through voids and the bank will have failed again." (State of California, Department of Transportation California Bank and Shore Rock Slope Protection Design, October 2000).



Recommendations:

Based on the findings and the hydraulic modeling, there are preferred options based on whether skimming is performed.

Without skimming, the 'Preferred Option' is Option #7.

This includes:

- Extension of the existing vanes, to effectively push thalweg further east, reducing flow velocities directed to the RSP embankment at the west SR128 bridge approach, while maintaining flow direction
- Removal and reinstallation of the RSP embankment at 1.5:1 using standard design practices (including embedded or mounded toe, geotextile fabric, inner and outer layers of RSP).
- Filling in of the scoured crescent area using bar material or similar at a maximum slope of 2:1.
- Install appropriate erosion control materials and replant slope.

With skimming:

- Removal and reinstallation of the existing RSP embankment at 1.5:1 using standard design practices (including embedded or mounded toe, geotextile fabric, inner and outer layers of RSP).
- Filling in of the scoured crescent area using bar material or similar at a maximum slope of 2:1
- Install appropriate erosion control materials and replant slope.



Option	Description
1	Extend existing 5 vanes, install 4 new vanes along RSP embankment, and remove and replace RSP embankment at 1.5:1
2	Extend existing 5 vanes, install 4 new vanes along RSP embankment, and lay back existing scarp at 2:1 (cut only)
3	Extend existing 5 vanes, offset 4 new vanes along RSP embankment with a 20'+ flood plain (fill), lay back RSP embankment at 2:1 (cut/fill) and fill in existing scarp at 2:1 or greater (fill only).
4	Remove and replace RSP embankment at 1.5:1
5	Extend existing 5 vanes, and lay back existing scarp at 2:1 (cut only)
6	Extend existing 5 vanes, install 4 new vanes along RSP embankment, Remove and replace RSP embankment at 2:1 max (cut only) and fill in existing scarp at 2:1 or greater (fill only).
7	Extend existing 5 vanes, lay back RSP embankment at 1.5:1 (cut/fill) and fill in existing scarp at 2:1 or greater (fill only).
A*	Keep RSP embankment as existing
B*	Remove and Replace RSP embankment at 1.5:1
C*	Remove and Replace RSP embankment at 1.5:1 install 4 new vanes along RSP embankment
A w/ vane extension*	Extend existing 5 vanes, and keep RSP embankment as existing
B w/ vane extension*	Extend existing 5 vanes, and remove and replace RSP embankment at 1.5:1
C w/ vane extension*	Extend existing 5 vanes, remove and replace RSP embankment at 1.5:1 install 4 new vanes along RSP embankment

* indicates that these model run result figures are not included in Appendix A.