Hawks & Associates

Engineering **Hydrology** **Planning** **Surveying**

August 20, 2012

City of Santa Paula
970 Ventura Street
Santa Paula, CA 93060

Attn: Janna Minsk, AICP, Planning Director

RE: Santa Paula Creek Hydraulic Modeling

In August 2011, the City of Santa Paula contracted with Hawks and Associates to complete an independent hydraulics analysis of Santa Paula Creek. Specifically, the City requested that Hawks & Associates analyze Santa Paula Creek for a 100-year flow rate of 39,400 cfs. A HEC-RAS analysis was completed with this 100-year flow rate.

The US Army Corps of Engineers (USACE) designed and constructed improvements to Santa Paula Creek extending from Santa Clara River to Stewart's crossing, 9,600 feet upstream of the river. Santa Paula Creek is designed to convey a 100-year flow rate of 28,000 cfs, which was the defined 100-year flow rate at the time the USACE began design of this flood control improvement project.

Since the elevation of the flow along the bottom of Santa Paula Creek varies due to sediment loading from the watershed, the model had to be created with different topographies. The attached study shows the results, assumptions, and methodology completed for the City by Hawks & Associates. The following alternatives were modeled using a 39,400 cfs flow rate:

- Existing condition of the Santa Paula Creek based on 2011 aerial topography and 2005 lidar topography combined.
  - Results are overtopping into East Area 2 and downstream.
- USACE Design conditions using their design drawings and converting from metric units to US feet.
  - Results are overtopping into East Area 2 and downstream, similar to the existing conditions alternative.
- Maintenance Target conditions for sediment on channel bottom to keep flooding at a minimum selected by Hawks and Associates for purposes of this modeling exercise.
  - Results are overtopping downstream by the Highway 126 bridge, but does not overtop into East Area 2.

After this study was completed, the USACE completed a Design Documentation Report

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for the Santa Paula Creek Flood Control Project in December of 2011 and provided this report to the City of Santa Paula and the Ventura County Watershed Protection District. This report also analyzes the hydraulic capacity of the channel to convey the 28,000 cfs 100-year flow rate that the channel was designed for with a sediment deposition profile and the current 39,400 cfs 100-year flow rate with a sediment deposition profile and recommends a sediment maintenance profile. At the City's request, Hawks and Associates, reviewed the USACE report and have compiled a summary of the findings of this report and comments on the analysis.

1. The USACE Santa Paula Creek Flood Control Project as designed has the capacity for 39,400 cfs, 900 feet upstream of the Santa Paula Branch line railroad bridge, a capacity for 28,000 cfs to 39,400 cfs from the Santa Paula Freeway to 900 feet upstream of the railroad bridge and a capacity for less than 28,000 cfs downstream of Highway 126. These conclusions are consistent with our October 2011 HEC-RAS studies.

2. A water surface elevation at the confluence of Santa Paula Creek and Santa Clara River of 267.9 feet NAVD 88 was used based on the *Memorandum for CESPL-ED-D9.* The report states that multiple water surface elevations were tried up to 273 feet; however there was no change in the water surface elevation upstream of station 10+00, which is downstream of Highway 126. Our study used a water surface of 271.3 feet.

3. An allowable sedimentation profile has been identified and suggests a clean out downstream of the railroad bridge with a volume equal to 65,200 cubic yards every 3 years.

4. Allowable sedimentation profiles in the channel were determined by a program called HEC-6T. This program was calibrated using historical sediment deposition patterns. Three sediment models were created:
    a. An allowable sediment model represents the sediment that can accumulate before cleanout is required.
    b. A design sediment model representing initial sediment plus sediment from an antecedent event leading up to a 28,000 cfs storm event. (per the report "smoothed maximum modeled invert")
    c. A design sediment model representing initial sediment plus sediment from an antecedent event leading up to a 39,400 cfs storm event. (per the report "smoothed maximum modeled invert")

5. A 28,000 cfs storm event on top of the design sediment profile in section 'b' above is contained within the channel upstream of Highway 126, but breaks out downstream.

6. A 39,400 cfs storm event on top of the design sediment profile in section 'c' above breaks out upstream of the railroad bridge, but downstream of the East Area One project boundary.

7. Floodplain inundation mapping was completed for both storm events with the peak flows on top of the design sediment profiles.

8. No attempt to identify locations of levees or to evaluate the ability to certify either existing or proposed levees was included in the USACE report. A levee condition can only be determined once the specific evaluation criteria are identified. In cases where the water in the creek overtops the earthen embankments, it was assumed they would fail to the landside toe elevation and that is the weir elevation. In cases where there is a concrete wall, the top of the wall was used as the weir elevation for overtopping. If this analysis was to be classified as a 'levee condition', the model would need to analyze three separate conditions with the worst case being mapped for FEMA; each side of the Creek failing and both sides failing at the landside toe elevation.

9. The main channel model for the 28,000 cfs event shows overtopping downstream of Highway 126, however no modeling of the overbanks was completed to accurately determine flooding depths.

10. The main channel model for the 39,400 cfs event is broken into two sections, upstream of the Railroad Bridge, and upstream of Highway 126 bridge.
    a. Flow leaving the Creek upstream of Railroad bridge is 6,630 cfs on the City side of the channel (right side) and 1,520 cfs on the left side of the channel.
    b. Flow leaving Creek between the Highway 126 bridge and the Railroad Bridge is 8,890 cfs on the right side and zero flow on the left side.
    c. A total of 22,360 cfs remains in the Creek to be routed under the Highway 126 bridge.

11. A flow path through the City on the right side of the Santa Paula Creek was assumed at a general location running east/west along SR-126. Cross sections were taken and obtained from 2005 LiDAR Data. Cross Sections were arbitrarily taken at intervals along the flowline. All general cross sections are at the surface elevations and obstructions such as structures were not included in the analysis, but were accounted for in the Manning's 'n' value of 0.063.

12. The total overflow of 15,520 cfs was routed through the City north of Highway 126. All storm drains, culverts, and underpasses through Highway 126, were conservatively assumed to be blocked with debris, which would not allow water to pass through in a flood event. The only breakout point for the water to get over the Highway 126 freeway in the modeling is at a low point west of Peck Road.

13. Flooding depths through the City on the west side of the creek range in depth from 0.10 feet to 9 feet, with 9 feet depth being closest to the freeway.

14. Flooding depths through East Area Two on the east side of the creek range in depth from 0.10 feet to 9 feet, with 9 feet depth being closest to the freeway at low points.

Jensen Design and Survey, Inc. prepared a map that converts the USACE metric 100-year flooding map included in the December 2010 (please verify year is it 2010 or 2011) USACE Santa Paula Creek Flood Control Project Design Documentation Report to US feet. This map reflects the above statements for floodplain inundation, and we believe it is a conservative representation of the possible flooding effects.

On the west side of Santa Paula Creek, the USACE floodplain model showed that all of the Highway 126 underpasses and storm drain culverts through the freeway were assumed to be blocked with one breakout point over the freeway west of Peck Road. This conservative assumption would create a pond with depths that are very conservative. The purpose of the underpasses and storm drain culverts are to allow stormwater to flow through the Highway to Santa Clara River. An analysis that takes into account these conveyances and produces a better representation of the overflow quantities and breakout out locations from the Creek would be more realistic. This map, therefore, presents a worst case representation of the potential flooding pattern.

In conclusion, the analysis we completed in October 2011 is consistent with the December 2011 USACE Studies. Santa Paula Creek can accommodate flows in excess of 28,000 cfs flow upstream of Highway 126. The 39,400 cfs flow rate may not be contained in the channel. The channel would need to be maintained with regular cleaning to maintain maximum capacities.

Based on both the USACE December 2011 report and our October 2011 analysis, the area proposed for annexation at this time as part of the proposed East Gateway project located near Santa Paula Creek would be affected by flooding from a 39,400 cfs storm, however the East Area 1 Specific Plan Area, and the proposed East Gateway Specific Plan Area would not be impacted by flooding from Santa Paula Creek. The areas proposed for annexation that would be affected by flooding from Santa Paula Creek consist of developed areas located immediately east of Santa Paula Creek and south of the East Area 1 Specific Plan Area. No specific development projects are proposed in these areas at this time. The City is annexing these areas to comply with a Ventura LAFCo condition of approval for the East Area 1 annexation.

USACE also completed an Overtopping Alternatives Report in December 2011, which Hawks and Associates reviewed. The report analyzed different options for Santa Paula Creek improvements from the railroad bridge to south of Highway 126 to contain different flow rates within the entire flood control channel. This area of Santa Paula Creek shows the most deposition of sediment and lack of capacity, and therefore possible improvements to the channel were focused here.

The three channel modifications for a flow rate and sediment profile for 28,000 cfs are:

Option 1: Constructing parapet walls downstream of Highway 126 extending to station 10+00. Flows are contained up to station 10+68 and therefore it is successful in conveying the 28,000 cfs flow rate with that sediment profile.

Option 2: Analyzing three channel improvement options beneath the Highway 126 Bridge. These options include removal of the side drain on the left side of the channel, removal of the side drain and changing the right side sloping embankment to vertical, and all of the above with the addition of moving the left side vertical wall all the way over to the left abutment. None of these alternatives will prevent channel overtopping downstream of the Highway 126 bridge. However, they will all reduce the water surface elevations upstream of the Highway 126 bridge.

Option 3: A combination of Options 1 and 2; widening the Highway 126 bridge and installing parapet walls downstream of Highway 126, extending to station 10+00. This option also fully contained flow downstream of Highway 126.

All three options were then analyzed with a flow rate of 39,400 cfs and a sediment profile leading up to the 39,400 cfs event. None of the conditions contained the flow within the channel upstream of Highway 126 due to overtopping at the railroad bridge. The USACE report also analyzed two alternatives for containing the 39,400 cfs event for the entire flood control channel reach. Both of the below options were capable of meeting this goal.

Option 1: Construction of parapet walls at all locations where flow overtopped the existing flood control channel banks. This option requires raising the railroad bridge by 1 meter.

Option 2: Removal of Highway 126 bridge piers and modifying the bridge to appropriately meet structural requirements without piers, raising the railroad bridge, channel widening through the Highway 126 bridge, channel widening and parapet walls between Highway 126 and Telegraph Road, and parapet walls downstream of Highway 126.

Sincerely,

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