Flood Control District
of Maricopa County

MEMORANDUM

Date: November 22, 2010

To: Theresa Pinto, CFM, Project Manager, Planning Branch, Planning and Project Management Division

From: Richard Waskowsky, Hydrologist, Engineering Application Development and River Mechanics Branch, Engineering Division

CC: Bing Zhao, PhD, PE, Engineering Application Development and River Mechanics Branch Manager, Engineering Division

Subject: Data Collection and Modeling Approach for Selected River Mechanics Tasks of Phase II of the Lower Hassayampa Watercourse Master Plan (WCMP)

This memorandum was prepared to document the data collection and the modeling approach for selected river mechanics tasks of Phase II of the Lower Hassayampa WCMP. There are two selected tasks. The first task is to compare three different sediment transport software packages (HEC-6T, Fluvial-12 and HEC-RAS) for the entire reach of the Lower Hassayampa River under the same conditions (i.e., same topography, hydrology, and other required parameters). The models developed using the three software packages should be based on the topographic data from the HEC-6 model of Phase I of the Lower Hassayampa WCMP. The sediment transport function should be the same for the three models. River Research & Design, Inc. (R2D) will convert the existing HEC-6 model to HEC-6T and HEC-RAS models. The Fluvial-12 model was already developed by Chang Consultants. If any changes are needed for the Fluvial-12 model, FCDMC will perform the changes.

The second task is to study the headcut/tailcut due to sand and gravel mines, in particular the Pioneer mine, for the major flows from 2002 to 2010 using HEC-6T, Fluvial-12, HEC-RAS, RMA-2/SED2D, RiverFLO-2D, and FLO-2D. This task is divided into two sub-tasks. The sub-tasks are 1) model the January 2010 event only and 2) model either the two or three largest events from 2002 to 2010, depending on the results from the January 2010 event. To model the topographic change from 2002 to 2010, it is very important to understand the mining history (i.e., the mining depth and surface area) between 2002 and 2010. Therefore, the depths and surface area were also estimated. R2D will develop the HEC-6T, HEC-RAS and RMA-2/SED2D models, while Chang Consultants will develop the Fluvial-12 model. FCDMC will develop both the RiverFLO-2D and FLO-2D models.

The discussion below documents the collection and source of the input data for the sediment transport models.

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1) The initial topography for all the models (for both tasks) is from Phase 1 of the Lower Hassayampa WCMP (WEST, 2006). The 2D models use the original Digital Terrain Model (DTM), while HEC-6T, Fluvial-12 and HEC-RAS use the cross-sections from the Phase 1 HEC-RAS and HEC-6 models (originally developed using the same DTM). As a note, the Phase 1 DTM was developed from multiple sources; however, the majority of the area was flown in 2002 or 2004. Older topography was only used for a very small portion of the river. The final vertical datum for the DTM was NAVD 88. The areal extent and vertical datum for the topography set are shown in Figure 1, while the flight dates and conversion (between NGVD 29 and NAVD 88) are shown in Table 1. This topography is known as the Phase I topography.

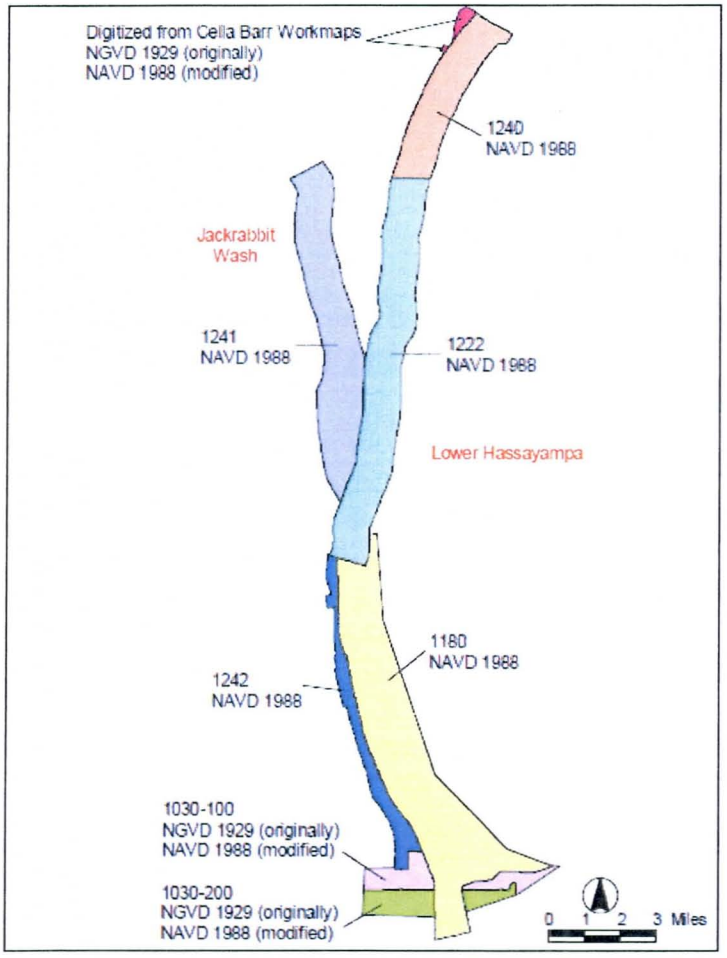

Figure 1. Extent and vertical datum of topography for Phase 1 (from WEST, 2006)

Table 1. Flight dates, vertical datum and conversion factor for the topography in Figure 1 (from WEST, 2006)

Topography ID	Flight Date	Vertical Datum of DTM	Adjustment to convert NGVD 1929 values to NAVD 1988
1030-100	12/14/1991	NGVD 1929	+2.08
1030-200	02/07/1993	NGVD 1929	+2.08
1180	04/08/2002	NAVD 1988	-
1222	11/02/2002	NAVD 1988	-
1240	04/21/2004	NAVD 1988	-
1241	04/21/2004	NAVD 1988	-
1242	04/22/2004	NAVD 1988	-
Digitized from Cella Barr work maps	03/18/1988	NGVD 1929	+1.98

2) The inflow hydrograph for the first task is the 100-year flood hydrograph, which was used in the original HEC-6 from Phase 1 (JEF, 2006). However, because the input procedures between the sediment transport models are different, the 100-year hydrograph should be verified to ensure consistency between models.

3) In the second task, there are two sub-tasks. The first sub-task is to model the January 2010 event with the Phase I topography and mine configurations prior to the January 2010 event. This subtask is designed to view the impact of the larger 2010 event in relation to the earlier smaller events (see Figure 3). If the 2010 event is sufficient to yield the 2010 topography in the various models the two smaller events may be eliminated from consideration.

   The second sub-task is to model the major events from 2002 to January 2010 with the Phase I topography as the initial condition and mine configurations as the mines changed in time. The modeling results will be compared with the post-event topography obtained in the summer of 2010, but it should be noted that the post-event topography should only be used for comparison. The initial modeling should not be calibrated based on the new topography. If there is any need to calibrate the model, all changed parameters must be documented.

   There are three pits (the Hanson, Cemex and Pioneer mines) near the Tonopah-Salome Highway. The depths were estimated based on reports from the sand and gravel mining inspector at the Flood Control District (Wergen, 2010) and from aerial photographs. The areas of the mines were estimated from aerial photographs and the 2010 topography. The pit locations are labeled in Figure 2. The pit characteristics are summarized in Table 2. Aerial photographs of the mines for different years are included in the appendix.

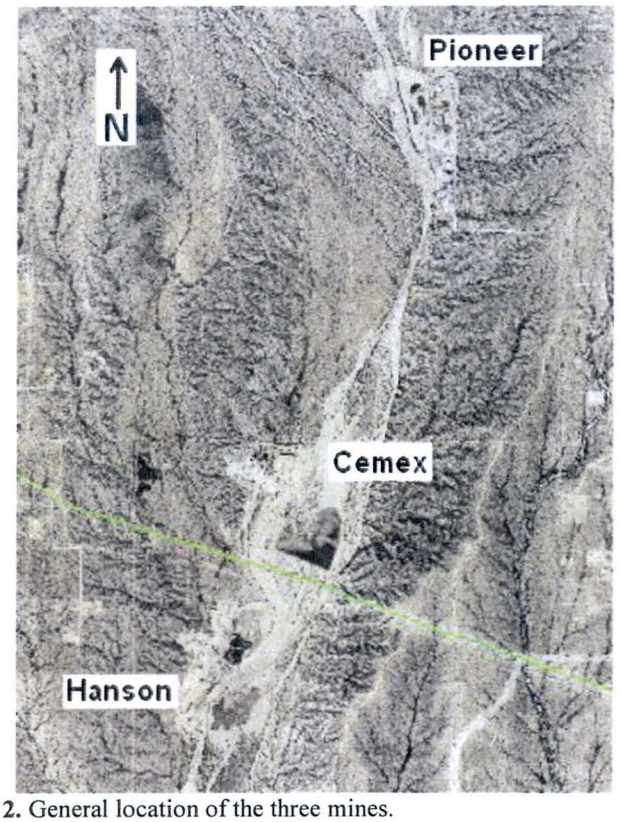

Figure 2. General location of the three mines.

Table 2. Estimated mine depths and areal extents

	Hanson		Cemex*		Pioneer	
	Depth (ft)	Area (acres)	Depth (ft)	Area (acres)	Depth (ft)	Area (acres)
2002 (information only)	4	0.5	12, 20	4.3	N/A	N/A
2004 (before '05 events)	5-9	15	10-15, 10-15, 15-20	1.1, 1.1, 14	N/A	N/A
2005 (after '05 events)	5-9	10	mine filled	mine filled	8-10	3.3
2009 (before Jan. 2010 event)	10	22	10	45	28-30	23

*There are separate pits for this owner. See the photograph in the Appendix for estimate limits

4) The inflow hydrographs for the second task are based on the two largest events that occurred on the Hassayampa River from September 2002 to January 2010. The third (smallest) event may be added if results do not match the 2010 topography. The events were recorded on the Flood Control District of Maricopa County (FCDMC) gage

(number 5283) at the I-10 Bridge. The events are circled (in red) in Figure 3. These three events will serve as the inflow hydrographs for Task 2 with priority given to the 2010 event (largest) and the 2005 (second largest event). The dates of the events are as follow (based on 15 minute data):

Largest:	2010: January 20-21, 2010	11,600 cfs peak
2nd Largest:	2005: February 11-12, 2005	5,500 cfs peak
Smallest:	2005: February 22-23, 2005	2,000 cfs peak

There are a number of small events in the intervening eight years but they are less than 1,000 cfs with most being below about 600 cfs. As such it is anticipated that they will not have major impacts on the river but may have had some local impacts in or very near the mine pits.

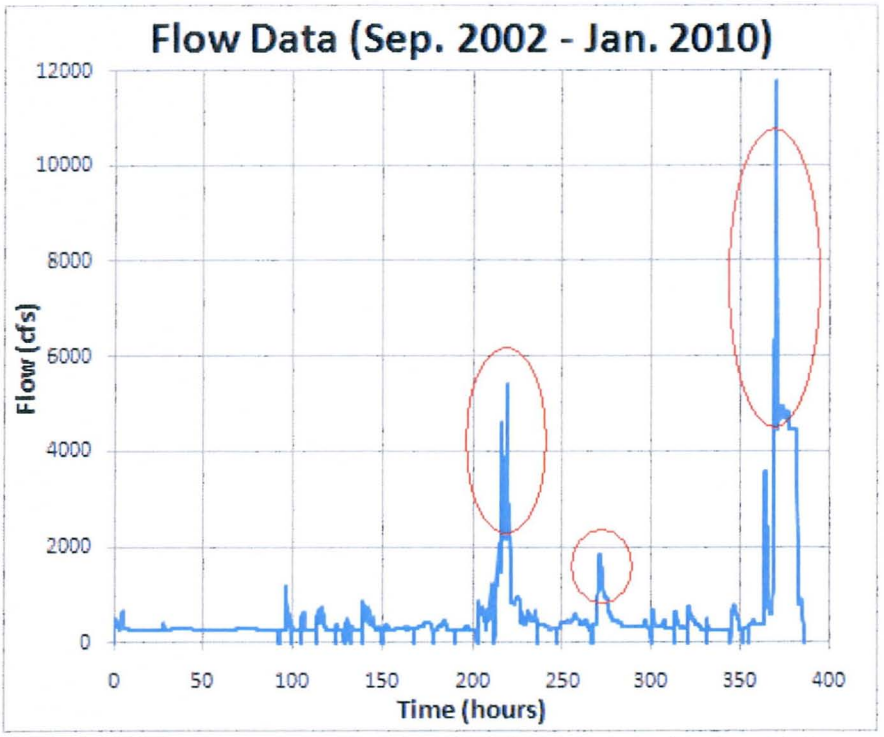

Figure 3. Flow data for the Hassayampa River from the I-10 Bridge gage (number 5283)

5) The attached CD contains the following data:

   a. original DTM for Phase I

   b. HEC-6 and HEC-RAS models for Phase I

   c. Fluvial-12 model and report by Chang Consultants (based on Phase I topography)

   d. Aerial photos that show the changes for mining surface area

   e. Topographic data that was obtained in summer of 2010 (after January 2010 event) for an approximately 11 mile reach

   f. Flow data from 2002 to 2010 in Excel format at I-10 (note: this will data will be used for the second task: pit headcut/tailcut)

   g. Phase I Report (River Behavior Report)

   h. Miscellaneous items

References

JE Fuller Hydrology and Geomorphology, Inc. (JEF). 2006. Lower Hassayampa River Watercourse Master Plan, River Behavior Report. Final HEC-6 model dated May 2007.

Wergen, Thomas. 2010. personal communication.

WEST Consultants, Inc. (WEST). 2006. Lower Hassayampa River Watercourse Master Plan, Final Hydraulics Report, Hassayampa River. Prepared for JE Fuller Hydrology & Geomorphology, Inc.

Appendix

Pioneer Photographs

21 acres: 28-30 feet deep

3.3 acres: 8-10 feet deep

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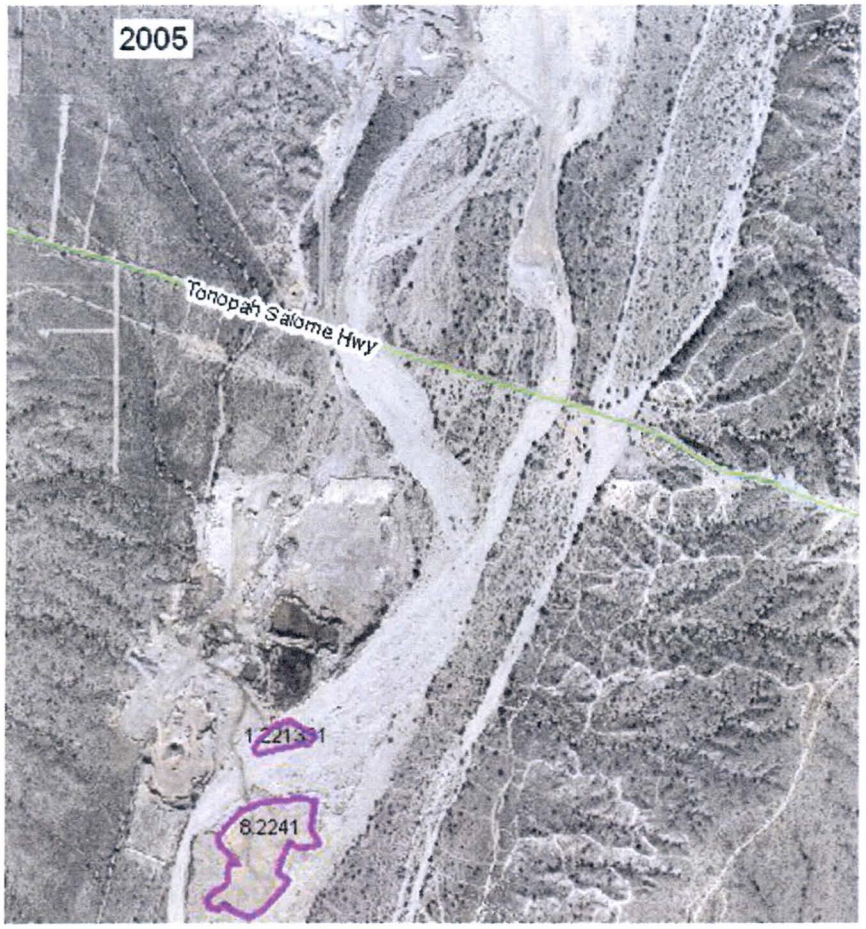
Hanson/Cemex Photographs

Hanson/Cemex 2009

22 acres: 10 feet deep

45 acres: 10 feet deep

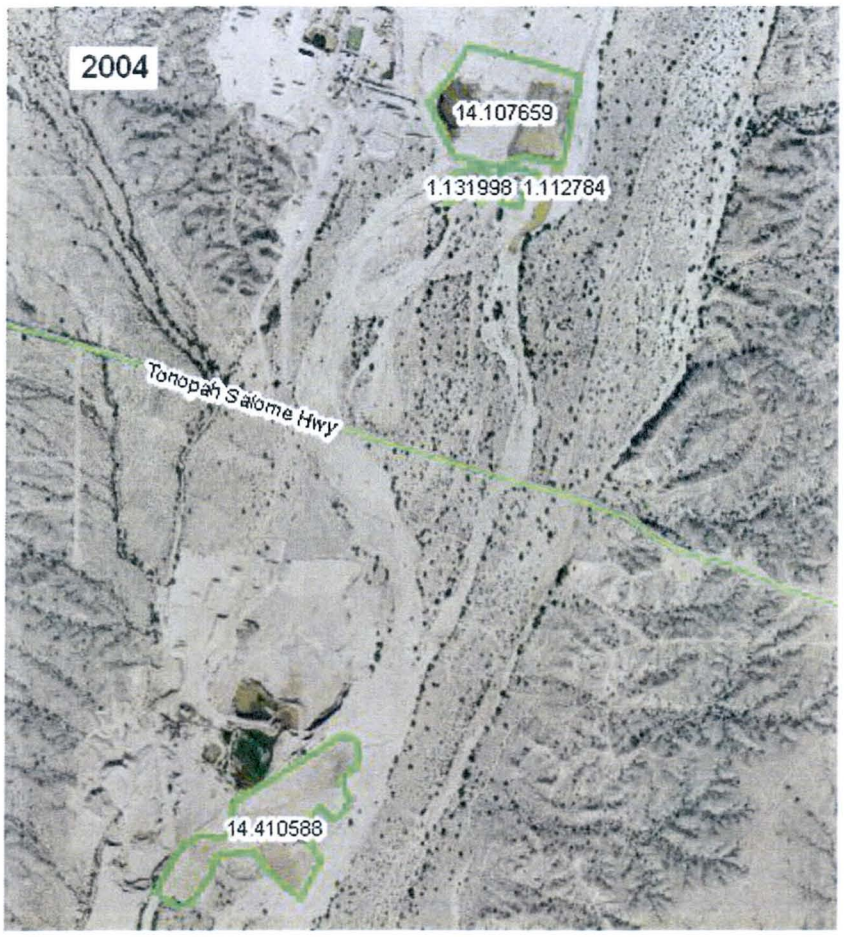


Hanson/Cemex 2005

8.22 acres: 5-9 feet deep

1.22 acres: 5-9 feet deep

Cemex pits filled



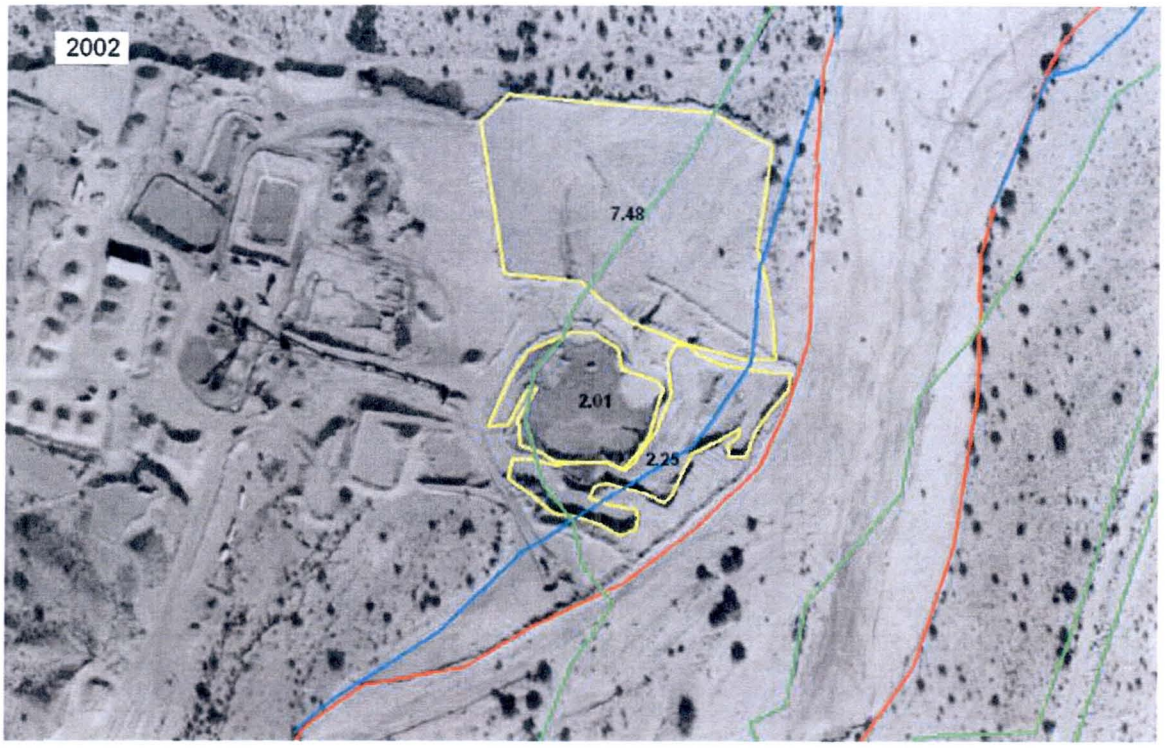
Hanson/Cemex 2004

14.41 acres: 5-9 feet deep

14.10 acres: 15-20 feet deep

1.13 acres: 10-15 feet deep

1.11 acres: 10-15 feet deep



Cemex 2002 (information only)

11.7 total but 7.48 does not appear to have impacted the flow so the net impacted area is:
4.3 acres

2.0 acres – 20 ft deep (2002 topo)
2.25 acres – 12 ft deep (2002 topo)

The bank lines are also shown in this figure – green are 2010, red are 2002 and blue are 2004.