# Memorandum

**To:** Dr. Bridget Bero & Mark Lamer

**From:** Fawaz Alotaibi, Devin Kelley, Hilary Sizemore, and Bruce Connolly

**Date:** 9/20/2013

**Re:** Team Understanding of "Oak Creek" Capstone Project

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## 1.0 Purpose of Project

The residents of the Rancho Mission Shangri-La Subdivision, located in Oak Creek Canyon, have only one road access that connects their subdivision to the outside world. The road to their homes crosses Oak Creek via a low water earth and concrete crossing built over culverts that allow the creek to pass under the crossing the majority of the year.

In times of flooding, however, Oak Creek rises above the crossing to a point where passage is dangerous or impossible. During these times of flooding, the residents are either confined to their homes or locked outside until the water level reaches levels conducive to crossing. The residents are worried about the long-term structural integrity of the crossing. The residents have requested the current crossing to be protected to prevent erosion to the existing foundation. The residents would also like a new crossing design on hand in the event that the existing crossing is washed out.

## 2.0 Background Information

During a large flood in 1993, the low water crossing used by the residents of the Mission Rancho/ Rancho Shangri-La subdivision to cross Oak Creek was washed out. The flood reached a historical peak of 23,200 cfs at the downstream gaging station in Sedona on February 19, 1993. After the floodwaters abated, a temporary crossing was devised using fill dirt compacted over a few small culverts. This allowed residents to drive to their residence until a more permanent solution could be constructed. The existing structure was built near the end of the 1993 and is the sole means of vehicular transportation to and from the subdivision (see Appendix A).

## 3.0 Key Stakeholders

The members of the Shangri-La subdivision are the key stakeholders of the project. Members of the subdivision use the crossing daily as it is the only egress in and out of their neighborhood. The access across the creek is vital for services such as the filling of propane, trash pick-up, delivery of materials, and access for fire protection as well.

Beth Ann Dzierson is the head of the neighborhood HOA and is our main liaison to communicate any concerns to the HOA during our study and research on this project.

## 4.0 Existing Conditions

The existing crossing is approximately 40 feet long and 14 ½ feet wide. During flows below that of overtopping, the creek flows through four 48" concrete culverts (see Appendix B). The elevation of the roadway is approximately four feet above the water line at base flow. The existing crossing has a weight limit of 30 tons.

The residents of the subdivision are concerned with erosion that is taking place and are concerned that this erosion could lead to the failure of the crossing during a large flood. Of most concern is the erosion that is occurring under the downstream apron and the western downstream retaining wall (see Appendix C). Erosion extends up to three feet under the downstream apron and up to seven feet under the downstream retaining wall used to support the roadway across the creek.

The site is located on the Oak Creek Fault. Due to fault slip, the soil consists only of pulverized soil and stream deposits. There has been no bedrock found during a fifteen foot excavation conducted at the site and it has been assumed that the fault has eliminated any chance of anchoring to solid bedrock.

## 5.0 Technical Tasks

After discussing the issues with the low water crossing, technical tasks must be completed before potential solutions can be produced. The Army Corps of Engineers records of the project site have been provided to show the documented history of the crossing. A complete modeling of the low water crossing must be constructed. This would include a revision of all previous hydrologists' work on the crossing, an average discharge per the watershed, and a model of the as-built culverts and overtopping capacity. The three capacities must be compared and evaluated for differences and circumstantial discharges. The need for updated hydrology information is imperative before serious design alternatives can be recommended. The topography of the project site must be generated in order to better understand the elevation changes in both the creek and the surrounding banks.

This will give the team needed information to discuss measures to prevent further deterioration of the crossing. Simultaneously, the as-built low water crossing's structure must be evaluated for load capacity, lateral water and debris forces encountered. Due to the position of the crossing over the Oak Creek Fault line, the soil characteristics must be evaluated for load capacity and erosion possibilities. The nature of the Oak Creek Fault Line makes the task of protecting the current base important to ensure that the crossing will withstand another large flood event. To assist further design possibilities and modeling, a complete survey of the low water crossing and upper and lower stream reaches will be necessary. All other areas of concern mentioned by the client will be addressed accordingly and evaluated with urgency within this layout.

## 6.0 Potential Challenges

The project has challenges that must be addressed by the group from the beginning. The design of any structure built near or on Oak Creek must abide by the rules of many government agencies. Agencies such as the Arizona Department of Transportation, Arizona Department of Environmental Quality, National Forest Service, Game and Fish, Army Corps of Engineers, and Coconino County must be consulted. Any construction must have the approval of the agencies listed above. The client has informed the group that an encroachment permit petition has been filed in order to allow construction to take place on and around Oak Creek.

Property owners will need to have access during the construction phase. Construction will have to be done in stages in order to give residents access to the crossing without any interruption. Environmental challenges will need to be studied and plans will have to be developed in order to maintain the environmental quality of Oak Creek. Oak Creek approaches the crossing at an angle which creates an imbalance of flow through all the culverts. This situation will be discussed further on whether or not future action will need to be taken.

The risk of a vehicle washing off the crossing presents another major challenge. Solutions for the safety of the crossing users will have to be made a high priority. A possible solution is an addition of railing to ensure that no vehicles or pedestrians are washed off the crossing in the event of flooding. This will help protect Oak Creek from contaminants entering the water and help keep pedestrians and vehicles on the crossing.

The new crossing will need to have a long service life as well. The community is willing to pay money for improvements to the current crossing and invest money in a new crossing in the future.

## 7.0 Appendix

### 7.1 Appendix A

The crossing can be seen in its entirety. This is looking towards 89-A.

## 7.2 Appendix B

The four circular culverts are shown in the picture above. The culvert on the far right receives much more water due to the river coming in from the right side of the crossing.

### 7.3 Appendix C

The apron can be seen to the left of the culverts and is circled. This is the downstream end of the culverts.

### 7.4 Appendix D

The signed Technical Advisor Agreement is located behind the memorandum.

### 7.5 Appendix E

The cover letter is located behind the memorandum.

### 7.6 Appendix F

The copy of the client and technical advisor meeting minutes are located behind the memorandum.