3.3.1 Earthquake Hazard to Local Water Tanks/Reservoirs

Earthquakes can generate floods by causing the failure of water retention structures such as reservoirs. Flood control and reservoir facilities, even when empty, can be damaged by strong ground shaking, and pose an inundation hazard if they are not repaired soon after an earthquake and prior to the next wet season. Another common agent of earthquake damage is a seiche. A seiche is a seismically-induced wave that reverberates on the surface of water in an enclosed or semi-enclosed basin like a lake, reservoir, bay or harbor. The wave period (how quickly it repeats its motion) will vary depending on the dimensions of the basin. The periods that can damage a structure will depend on the physical characteristics of the structure, including size, shape and materials. Seiches can continue to oscillate for a time after the earthquake shaking ceases.

Seismically-induced inundation can also occur if strong ground shaking causes structural damage to above-ground water tanks. If a tank is not adequately braced and baffled, sloshing water can lift the tank off its foundation, splitting the shell, damaging the roof, and bulging the bottom of the tank (causing "elephants foot") (EERI, 1992). Movement can also shear the pipes leading to the tank, allowing water to escape through the broken pipes. This type of damage was reported in the Landers, Big Bear and Northridge earthquakes. Houses downgradient from a damaged water tank in the Santa Clarita area were inundated due to the Northridge earthquake. Thanks to lessons learned from recent earthquakes, new standards for design of steel water tanks were adopted in 1994 (Lund, 1994). The new tank design includes flexible joints that can accommodate movement in any direction.

3.3.2 Bridge Scour

Scour at highway bridges involves sediment transport and erosion processes that remove streambed material from the bridge vicinity. Scour can occur within the main channel, on the flood plain, or both. Scour processes are generally classified into separate components:

- **Pier scour** occurs when flow impinges against the upstream side of the pier. The flow is forced downward, causing scour of the streambed adjacent to the pier.

- **Abutment scour** happens when flow impinges against the abutment. Flow changes direction and mixes with adjacent main-channel flow, scouring the abutment toe.

- **Contraction scour** occurs when flood-plain flow is forced back through a narrower opening at the bridge. This increases velocity and can produce scour.

- Total scour for a particular site combines effects from all three components.

While different materials scour at different rates, the eventual scour attained is similar regardless of material. It depends primarily on the duration of peak streamflow acting on the material (Lagasse and others, 1991).

Nationwide, several catastrophic collapses of highway and railroad bridges have occurred due to scouring and a subsequent loss of foundation support. This has led to a nationwide inventory and evaluation of bridges (Richardson and others, 1993). The State of California participates in the bridge scour inventory and evaluation program. In addition, California's program to seismically retrofit bridges includes underpinning foundations. In western Riverside County, this should help reduce the vulnerability of foundations to scour. However, since the eastern portion of the County has only a moderate seismic risk, scheduling bridges in these areas for seismic underpinning is of lower priority.