the Central Arizona Project (CAP) canal. Studies in the Hawk Rock area in the northeast portion of the study area have been published by the USBR (*Salt-Gila Aqueduct Reach 1, 2, and 3, Subsidence Study*, Bureau of Reclamation (BOR), April, 1991; and "File SGA123C.WK1", U.S. Bureau of Reclamation, Arizona Projects Office, October 26, 1992).

The Natural Resources Conservation Services (NRCS) has also studied and investigated potential earth fissures in areas near any flood retarding structures they designed. In the past several years, the Arizona Department of Water Resources (ADWR) has successfully used Interferometric Synthetic Aperture Radar to estimate subsidence from satellite photos in areas of Arizona. ADOT and the United States Geologic Survey (USGS) have also studied land subsidence and potential fissure locations in the study area.

An earth fissure was first documented near Picacho in 1927 and has grown to over 10 miles long. Several fissures have been identified in the study area near Picacho, Queen Creek, and Eloy.

2.2.2 Hydrological Resources and Issues

All major watercourses in the study area are tributaries in the greater Gila River watershed. The smaller watersheds include the San Pedro River, the Santa Cruz River, Queen Creek, and the Salt River. All of these watercourses ultimately discharge into the Gila River.

Major Watercourses and Drainage Features

The Gila River is the major drainage watercourse in the study area. The Gila River traverses Pinal County from east to west through the middle of the study area. The river runs through the Needles Eye and White Canyon wilderness areas, crosses state routes 77, 177, 79 and 87, and runs parallel to the Copper Basin Railroad and a branch of the Union Pacific Railroad (UPRR) in a portion of the study area.

The San Pedro River runs from south to north in the southeast corner of the study area, and ultimately converges with the Gila River near the town of Winkelman. The San Pedro runs parallel to SR 77. Aravaipa Creek is a tributary to the San Pedro River.

The Santa Cruz River is located in the southern portion of the study area and runs from south to north parallel to a portion of I-10. The Santa Cruz River is less defined as it crosses the Pima County border into Pinal County, becoming shallower and wider. The river bed continues to have very little definition north and east of Picacho and Eloy. The Santa Cruz River discharges into the Gila River north and east of the study area, in the Gila River Indian Community near the Maricopa County line.

Queen Creek flows from east to west across northern portion of the study area. The headwaters are in the mountains above Superior. Queen Creek crosses US 60 north and west of Florence Junction, and discharges into the East Maricopa Floodway west of the study area boundary. The floodway, in turn, discharges into the Gila River outside the study area. As a result of significant flow in the 1954 Queen Creek storm, the Whitlow Ranch Dam, an 80-foot-tall earthen embankment dam, was constructed on Queen Creek by the U.S. Army Corps of Engineers to protect downstream population centers from flooding. The dam is located upstream of Queen Valley.

The northeast portion of the study area is in the Salt River watershed. Pinto and Pinal creeks near Miami and Globe flow into the Salt River upstream of Roosevelt Lake.

The CAP Canal flows from north to south, where it crosses the northwestern boundary of the study area near US 60. The CAP canal is operated by the Central Arizona Water Conservation District. The canal crosses SR 79 twice and the Gila River and it is near I-10 near Red Rock.

Greene Wash is located in the southwest portion of the study area and flows from south to north into the Tohono O'Odham Nation, where a series of check dams controls the discharge into the Santa Rosa Canal, located outside the study boundaries. There are several other major washes including the McClellan, which discharges into the Picacho Reservoir.

The study area contains major drainage features that affect the natural drainage paths. As stated, the CAP Canal traverses the entire study area and has a significant impact on drainage. The canal is a drainage barrier throughout its length in the study area. Steel culverts lined with concrete are used throughout the study area to convey stormwater across the canal.

Other canals in Pinal County affect the natural drainage pattern. Several canals in the county supply the Picacho Reservoir from various parts of the study area. The Florence Canal, Florence Casa Grande Canal, and Casa Grande Canal all stem from the Picacho Reservoir and supply portions of the study area. The Casa Blanca Canal, Casa Grande Canal, Pima Lateral, Santan Canal, and Southside Canal are all located in the Gila River Indian Community.

There are several flood control dams in the study area. The Powerline, Vineyard Road, Rittenhouse, Magma, and Florence Flood Retarding Structures were built by the Natural Resources Conservation Service between the 1960s and 1980s to control runoff and alluvial flooding upstream of the CAP. The structures were designed to detain storm water runoff from the 100-year storm event and slowly release it downstream. The Sonoqui Detention Dam was built by the USBR to protect the CAP canal from the effects of flooding along Sonoqui Wash upstream of the CAP. The dam is an extension of the Rittenhouse Flood Retarding Structure. Sononqui Wash is a tributary to Queen Creek.

Several dams not used for flood control purposes are associated with mines in the study area but they are typically in mountainous areas in the northeast portion of the area. The Picacho Dam stores irrigation water for the canals as previously mentioned.

The dams and CAP are the major drainage divides in the study area. All areas downstream of the CAP and dams are protected from the 100-year return frequency storm event by the CAP and dams. All of the dams have emergency spillways for the controlled release of storm water above the runoff volume associated with the 100-year storm event.

Flood Hazards

The most significant drainage issue for the study area is alluvial fan flooding. Alluvial fans are created where the topographic slope reduces from the mountains to the desert valleys and the capacity to move sediment is reduced and the sediment is carried out over a large area. The location and range of the flooding channel is uncertain due to the large area subjected to alluvial flooding. Flooding on an alluvial fan can quickly alter its course across the fan. This can increase the flood hazard on the entire floodplain.

Areas downstream of the CAP are protected from the 100-year storm by the dams mentioned previously. The most significant drainage issues in these lands downstream of

the dams is localized flooding and ponding that backs up behind the embankments used for roadways, railways, and agriculture ditches and infrastructure. In addition, the CAP and dams have cut off sediment sources from upstream watersheds. As a result, scour or degrading of downstream facilities can be problematic.

Scouring, erosion, and sediment deposition may have negative impacts in the study area. Mining has and will continue to alter the equilibrium of the Gila River, Santa Cruz River, San Pedro River and Queen Creek. Localized scour at roadway culverts can be prevented through the proper selection and construction of scour countermeasures. Places with topographic slope change or behind embankments are subject to sediment deposition.

Rare extreme rainfall events with larger discharges than the 100-year storm event are an additional drainage issue. The dams built upstream of the CAP were built to detain the 100-year storm event. Any runoff larger than the 100-year storm event would discharge through the emergency spillways. The emergency spillways are located on the ends of the dams and could cause widespread flooding if the emergency spillways are ever operated.

Flood hazards in the study area have been mapped for FEMA. Most of the study area is in a minimal flood hazard area where the flooding would only occur during events that exceed the one percent return frequency interval (100-year storm). There are several special hazard flood zones that have been mapped for FEMA in the study area. These lie along the major watercourses mentioned above as well as along many other washes in the study area. Development in these areas, as well as roadway crossings, is regulated by the individual municipal jurisdictions in the study area.

Impaired and Unique Waters

Section 303(d) of the Clean Water Act requires states to develop a list of impaired waters that is submitted every two years to the Environmental Protection Agency (EPA) for approval. The Impaired Water Identification Rule developed by the Arizona Department of Environmental Quality (ADEQ) (Arizona Administrative Code (AAC) § R18-11-600) defines an impaired water as a body of water that has exceeded the water quality standard for conventional pollutants 10 percent of the time with a minimum of a 90 percent confidence level, or has exceeded the criteria for toxic pollutants more than once in three years for acute criteria and more than once in five years for chronic criteria. Additionally, waters may be listed based upon exceeding the statistically based standards more than once, such as an annual mean nutrient standard or a geometric mean bacteria standard.

As reported on Arizona's 2004 303(d) List and 2006 Draft 303(d) List, there are 10 impaired waters that occur within the Central Arizona Regional Framework Study area and are identified on the 303(d) List as:

- Five Point Tributary (AZ 15060103-885) – 2.9 miles, from the headwaters to Pinto Creek;
- Gibson Mine Tributary (AZ 15060103-887) – 1 mile, from the headwaters to Pinto Creek;
- Gila River (AZ 15050100-008) – 19.8 miles, from San Pedro River to Mineral Creek;
- Mineral Creek (AZ 15050100-012B) – 19.6 miles, from Devils Canyon to the Gila River;
- Pinto Creek (AZ 15060103-018A) – 2.5 miles, from the headwaters to a tributary connection at 33°19'27"N/110° 54'56"W;
- Pinto Creek (AZ 15060103-018B) – 15.3 miles, from the tributary connection at 33°19'27"N/110° 54'56"W to West Fork Pinto Creek;

- Pinto Creek (AZ 15060103-018C) – 17.8 miles, from West Fork Pinto Creek to Roosevelt Lake;
- Queen Creek (AZ 15050100-014A) – 8.8 miles, from the headwaters to the Superior Mine Wastewater Treatment Plant;
- Queen Creek (AZ 15050100-014B) – 5.9 miles, from the Superior Mine WWTP to Potts Canyon;
- San Pedro River (AZ 15050203-001) – 14.8 miles, from Aravaipa Creek to the Gila River.

All identified segments within the Central Arizona Regional Framework Study Area were assessed as Category 5, requiring the impaired surface waters to be analyzed for the total maximum daily load (TMDL).

Five Point Tributary is approximately three miles long and located within the Salt River Watershed, originating from Five Point Mountain located south of US 60 and southwest of Miami, and flowing north toward Pinto Creek. The entire length of this drainage is classified as impaired and is listed for concentrations of copper.

Gibson Mine Tributary is one mile long and located just south of the Five Point Tributary in the Salt River Watershed, flowing northeast toward Pinto Creek. The entire length is classified as impaired and is listed for concentrations of copper.

The Gila River is 649 miles long and originates in western New Mexico and flows west to the Colorado River. In the study area, 19.8 miles of the river is designated as impaired. The impaired segment is listed for concentrations of suspended sediment. A TMDL analysis will be initiated in 2009.

Mineral Creek is approximately 26 miles long and located in the Middle Gila Watershed It originates from Devil's Canyon in the Tonto National Forest, southeast of Superior and flows south toward Kearny and into the Gila River. In the study area, 19.6 miles of Mineral Creek is designated as impaired. The impaired segment of Mineral Creek is listed for concentrations of copper, selenium, and low dissolved oxygen. Remediation activities are in place for this impaired segment, and a TMDL analysis will be initiated in 2011.

Pinto Creek is approximately 36 miles long and located within the Salt River Watershed. It originates southwest of Madera Peak in the Tonto National Forest south of Miami and flows northwest to Roosevelt Lake. Within the study area, the entire length of Pinto Creek is designated as impaired and divided into three impaired segments. The impaired segment of Pinto Creek headwaters is listed for concentrations of copper, while the lower two segments are listed for concentrations of copper and selenium.

Queen Creek is approximately 60 miles long and located within the Middle Gila Watershed. It originates from Queen Creek Canyon in the Tonto National Forest northeast of Superior and flows southwest to the Gila River. In the study area, 14.7 miles of Queen Creek is designated as impaired and divided into two impaired segments. Both segments of have impairments due to concentrations of copper in the water. Copper TMDL is currently in progress for both segments of Queen Creek.

Within Arizona, the San Pedro River is approximately 135 miles long and located in the San Pedro–Wilcox Playa–Rio Yaqui Watershed. It originates in Sonora, Mexico and flows north to Hayden and connects with the Gila River. In the study area, 14.8 miles of the San Pedro

River is designated as impaired. The impaired segment is listed for concentrations of selenium and *Escherichia coli* bacteria. TMDL will be completed in 2008.

Surface waters are designated as "unique waters" by ADEQ. Determination of a unique waterway is based on the decision criteria outlined in AAC R18-11-112. Decision criteria for a unique waterway include a perennial water designation, free-flowing condition, water quality that meets or exceeds applicable standards, and exceptional recreational or ecological significance or importance for threatened and endangered species or critical habitat (AAC R18-11-112).

Within the Central Arizona Regional Framework Study area there is one designated unique water. This is Aravaipa Creek (AZ 15050203-004B) from Stowe Gulch to the downstream boundary of Aravaipa Canyon Wilderness Area.

Unique waters are maintained and protected from degradation (AAC R18-11-107). New or additional discharge into a designated unique water or its tributaries is prohibited if the discharge will result in the degradation of the existing water quality.

The Wild and Scenic Rivers Act of 1968 protects and preserves select rivers of a free-flowing condition that provides outstanding scenic landscapes, recreational activities, geologic formations, fish and wildlife resources, and historic and cultural values. Designated Wild or Scenic Rivers are protected for the "benefit and enjoyment of future generations" (U.S. Code [USC], Section 16 Part 1271).

There are no designated Wild or Scenic Rivers within the boundary of the Central Arizona Regional Framework Study (U.S. Forest Service (USFS), 2008).

Sole Source Aquifers

The Sole Source Aquifer Program was established by the EPA under the Safe Drinking Water Act, Section 1424(e). The Sole Source Aquifer Program has been used to prevent contamination of groundwater from federally-funded projects and increase public awareness of the sensitivity and vulnerability of groundwater resources.

A portion of the Upper Santa Cruz and Avra Basin Sole Source Aquifer (49 Federal Register [FR] 2948) is located in the south central portion of the Central Arizona Regional Framework Study area. The Upper Santa Cruz covers portions of Pinal, Pima, and Santa Cruz counties, averages approximately 40 miles in width, and is approximately 90 miles long. Any federally funded project that is conducted on or near the Upper Santa Cruz and Avra Basin Sole Source Aquifer will require EPA review for potential contaminate impacts prior to any construction.

Drainage Studies

Drainage studies have been completed for portions of the study area. Pinal County has commenced area drainage master plans for the watersheds in the study area. Extensive drainage studies were completed for the CAP canal. The NRCS later developed extensive drainage studies in conjunction with flood retarding structures built by the NRCS between Florence and Apache Junction upstream of the CAP.