APPENDIX B

GEOLOGY AND SOILS

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Geology and Soils

Along the western side of the Sacramento Valley, rocks of the Great Valley province include: Upper Jurassic to Cretaceous marine sedimentary rocks of the Great Valley Sequence; fluvial deposits of the Tertiary Tehama Formation; Quaternary Red Bluff, Riverbank, and Modesto Formations; and Recent alluvium.

Water gaps in the sandstone and conglomerate ridges form the dam sites for all four of the proposed reservoirs. The Great Valley Sequence was formed from sediments deposited within a submarine fan along the continental edge. The sediment sources were the Klamath Mountains and Sierra Nevada to the north and east.

The mudstones of the Great Valley Sequence are typically dark gray to black. Generally, the mudstones are thinly laminated and have closely spaced and pervasive joints. When fresh, the mudstones are hard, but exposed units weather and slake readily. Mudstones generally underlay the valleys.

Fresh sandstones are typically light green to gray; weathered sandstones are typically tan to brown. They are considered to be graywackes in some places because of the percentage of fine-grained interstitial material. Sandstone beds range from thinly laminated to massive. In many places, the sandstones are interlayered with beds of conglomerates, siltstones, and mudstones. Massive sandstones are indurated and hard, with widely-spaced joints, forming the backbone of most of the ridges.

The conglomerates are closely associated with the massive sandstones and consist of lenticular and discontinuous beds varying in thickness from a few feet to more than 100 feet. Conglomerate clasts range in size from pebbles to boulders and are composed primarily of chert, volcanic rocks, granitic rocks, and sandstones set in a matrix of cemented sand and clay. The conglomerates are similar to the sandstones in hardness and jointing.

Tertiary and Quaternary fluvial sedimentary deposits unconformably overlie the Great Valley Sequence. The Pliocene Tehama Formation is the oldest. It is derived from erosion of the Coast Ranges and Klamath Mountains and consists of pale green to tan semiconsolidated silt, clay, sand, and gravel. Along the western margin of the valley, the Tehama Formation is generally thin, discontinuous, and deeply weathered.

The Quaternary Red Bluff Formation consists of reddish poorly sorted gravel with thin interbeds of reddish clay. The Red Bluff Formation is a broad erosional surface, or pediment, of low relief formed on the Tehama Formation between 0.45 and 1.0 million years ago. Thickness varies to about 30 feet. The pediment is an excellent datum to assess Pleistocene deformation because of its original widespread occurrence and low relief. Red Bluff Formation outcrops occur just east of the project sites.

Alluvium is a loose sedimentary deposit of clay, silt, sand, gravel, and boulders. Deposits include landslides, colluvium, stream channel deposits, floodplain deposits, and stream terraces. Quaternary alluvium is a major prospective source of construction materials. Colluvium, or slope wash, consisting mostly of soil and rock, occurs at the face and base of a hill. Landslide deposits are similar but more defined and generally deeper. Landslides occur along the project are but are generally small, shallow debris slides or debris flows. These deposits may be incorporated as random fill in project construction.

Stream channel deposits generally consist of sand and gravel. Potential construction material uses include concrete aggregate, filters, and drains. Floodplain deposits are finer grained and consist of clay and silt. Floodplain deposits may be used for impervious core and for random fill.

The stream terraces form flat benches adjacent to and above the active stream channel. Up to nine different stream terrace levels have been identified. Terrace deposits consist of several to 10 feet of clay, silt, and sand overlying a basal layer of coarser alluvium containing sand, gravel, cobbles, and boulders. Four terrace levels have been given formational names by the U.S. Geological Survey (Helley and Harwood 1985)—the Upper Modesto, Lower Modesto, Upper Riverbank, and Lower Riverbank—and they range in age from 10,000 to several hundred thousand years old.

Soils of the Coast Range and western Sacramento Valley are highly diverse. Mountain soils are generally shallow to deep and well drained to excessively well drained and mostly steep to very steep. Foothill soils are formed from hard, unaltered sedimentary rock and poorly consolidated siltstone of the Tehama Formation. Soils of older alluvial fans and terraces are well drained to poorly drained and have moderate to low permeability. Interior valley basin soils are generally fine textured and poorly drained, with very slow runoff.

Predominant soil associations within the Colusa and Sites Reservoir sites are the Altamont and Contra Costa clay loam series. These are young, eroded and shallow, well to excessively drained clay to clay loam soils that have developed in place over hard sandstone and shale. Runoff is slow to moderate. Erosion is slight to severe, depending on slope and relief. Terrain is nearly level to steep, and in many areas the surface yields many outcrops of the parent material.

The general soil associations of the Thomes-Newville Reservoir area are the Millsholm and Lodo series. The Millsholm series are shallow, well drained, moderately coarse to moderately fine textured clay-loam soils that are formed from sandstone, mudstone, and shale. Terrain is hilly to steep, with numerous outcrops scattered throughout the landscape. In this area, outcrops occur on 30% to 50% slopes where runoff is medium to high, permeability is moderate, and erosion potential is severe. Lodo series are shallow, somewhat excessively drained, shaley-clay loam soils that formed in weathered, hard shale and fine-grained sandstone. In this area, the soils occur on mountainous terrain with slopes ranging from 30% to 65 percent. Runoff is medium to high, permeability is moderate, and erosion potential varies from moderate to severe, depending on slope and relief.

Predominant soil associations within the Schoenfield Reservoir site are the Maymen-Los Gatos-Parrish series and, to a lesser extent, the Sheetiron-Josephine association. The Maymen-Los Gatos-Parrish series are shallow to moderately deep, gravelly to rocky clay loam soils that are formed in hard sandstone and shale and, in some areas, in hard mica schist. These soils occur on slopes ranging from 5% to nearly vertical. Terrain is steep, with deep canyons and narrow ridges. Most soils are well drained to excessively drained, and runoff is rapid to very rapid. Permeability is moderately slow to slow in the Parrish component, moderate to moderately rapid in the Maymen component and moderate in the Los Gatos component. The Sheetiron Josephine associations are well drained, shallow, gravelly loam soils found in strongly sloping to very steep terrain, and they are formed in altered sedimentary and extrusive igneous rock. This series comprises a very small portion of the area.

The general soil associations within the Dippingvat Reservoir are the Millsholm and Lodo series. The Millsholm series are shallow, well drained, moderately coarse to moderately fine textured clay-loam soils that are formed from sandstone, mudstone, and shale. Terrain is hilly to steep, with numerous outcrops found scattered throughout the landscape. In this area, they occur on 30% to 50% slopes where runoff is medium to high, permeability is moderate, and erosion potential is severe. Lodo series are shallow,

somewhat excessively drained, shaley-clay loam soils that are formed from weathered, hard shale and fine-grained sandstone. In this area, the soils occur on mountainous terrain with slopes ranging from 30% to 65 percent. Runoff is medium to high, permeability is moderate, and erosion potential varies from moderate to severe, depending on slope and relief.

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