4.1.1 History of Development

The history presented is based on Lindstrom et al. (2000). Markets created by teamsters traveling through the South Lake Tahoe area in the mid 1850s – 1860s prompted the development of seasonal farming and ranching. As this started, large meadowlands were quickly preempted. By 1860, a pony express route was designated through the area over Echo Summit and Daggett Pass; a post office soon followed. This route was heavily used by passenger and freight wagon traffic en route to the Comstock during the early 1860s.

As shown by the 1870 "California Products of Agriculture" census, hay was a major business in the area in the 1860s. This census shows that 232 metric tons (228 tons) of hay were baled in the region. The 1875 "Resources and Wonders of Tahoe" publication cited that the South Lake Tahoe area was primarily a "hay and dairy producing center, dotted with fertile ranches" and that the ranchers contributed most of the 726 metric tons (800 tons) of hay cut along Tahoe's shoreline in 1875. An estimated 1,800 cows were grazed in the area by 1880, including a pasture on Barton Meadows near the lake shore.

A dairy ranch was in operation in beginning in the late 1920s on a 6 square kilometer (1,600-acre) tract of land on the west side of the Upper Truckee River floodplain in what is now Gardner (Tahoe) Mountain, Tahoe Island Park, Tahoe Keys, and Tamarack Subdivision.

By the 1930s, the Meyers, Al Tahoe, and Bijou subdivisions were thriving, and additional lots were developed at Al Tahoe in the mid 1940s. The 1950s brought the expansion of the gaming industry, which was soon followed by a building boom. This brought on discussions about water and sewage problems as development put more pressure on the existing sewage disposal system. A temporary solution was found by spraying effluent directly onto the land.

Heavenly Valley, a major ski resort, opened in 1956 drawing more tourism into the basin. Soon after, the Squaw Valley Winter Olympics were held, bringing even more attention and visitors to the area. The new subdivision developments of Tahoe Paradise, Golden Bear, and Meadow Lakes were established in the 1960s, and South Lake Tahoe became an incorporated city in 1965. Between 1960 and 1980 Tahoe's population multiplied five times, along with the construction of several major housing developments. The most notable and extensive was the Tahoe Keys subdivision, which required 3 square kilometers (750 acres) of functioning wetland at the mouth of the Upper Truckee River to be dredged and filled.

4.1.2 Local Geology

Ice Advance into the South Lake Tahoe Basin

Several glacial advances into the South Shore area correspond with those into the Upper Truckee Canyon. Burnett (1971) in mapping the area has identified moraines from these events. The Hobart and Donner glaciations flowed out of Christmas Valley and covered the Meyers area. The ice would have been blocked to the north by Twin Peaks and Tahoe Mountain, and to the west by ice flowing into the Fallen Leaf Lake basin, which eventually resulted in a moraine being deposited between the two ice streams. The result was that ice flowed to the east, around the Twin Peaks and deposited the Airport Moraine, the sedimentary ridge adjacent to the South Lake Tahoe Airport. Burnett has mapped a Tahoe age-end moraine in the Meyers area just north of Tahoe Paradise, while Tioga age moraines have been identified near Meyers Grade. This indicates that Wisconsinan age ice advanced into the Meyers area at least twice.

Bedrock Geometry

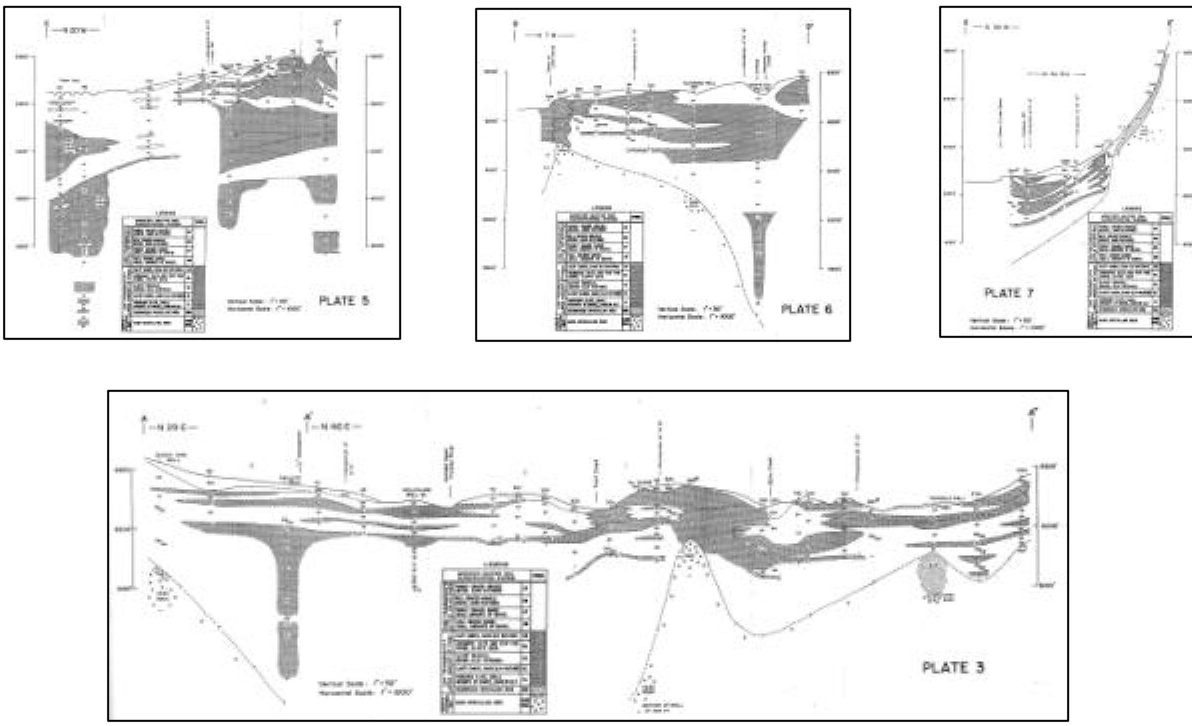
The basin geometry is characterized by two deep subbasins that have been defined using detailed gravity surveys (Appendix A; Blum 1979, Bergsohn 2003). Both of these basins appear to reach depths in excess of 274 meters (900 ft) below the current land surface. One basin is centered below the Meyers area while the other is situated just south of the Tahoe Keys. A low that extends from the South Shore near Bijou towards the Airport probably corresponds to the Stateline Fault that has been mapped just offshore by Kent (2003). Tahoe Mountain and Twin Peaks are situated between these subbasins. A ridge to the west of the Meyers subbasin lies between this subbasin and a basin occupied by Fallen Leaf Lake and is mantled by morainal deposits.

Hydrogeology of the Meyers and South Lake Tahoe Area

The hydrologic basin that is occupied by Meyers and South Lake Tahoe is roughly triangular with its apex to the south near Meyers Grade. It extends northward to the south shore of Lake Tahoe where it runs from the west of Camp Richardson to Stateline, NV. The surface topography is generally smooth and gently dipping to the north. Near the lake, surface topography is low lying and poorly drained resulting in the Truckee and Pope marshes. Geologic mapping by Bonham and Burnett (1976) indicates that the surficial deposits are composed of lake and fluvial deposits. East of Twin Peaks, a terraced feature is cored by glacial moraine deposits and flanked by older lake deposits. Twin Peaks and Tahoe Mountain, which project above this depositional surface, are characterized by unweathered and weathered granite.

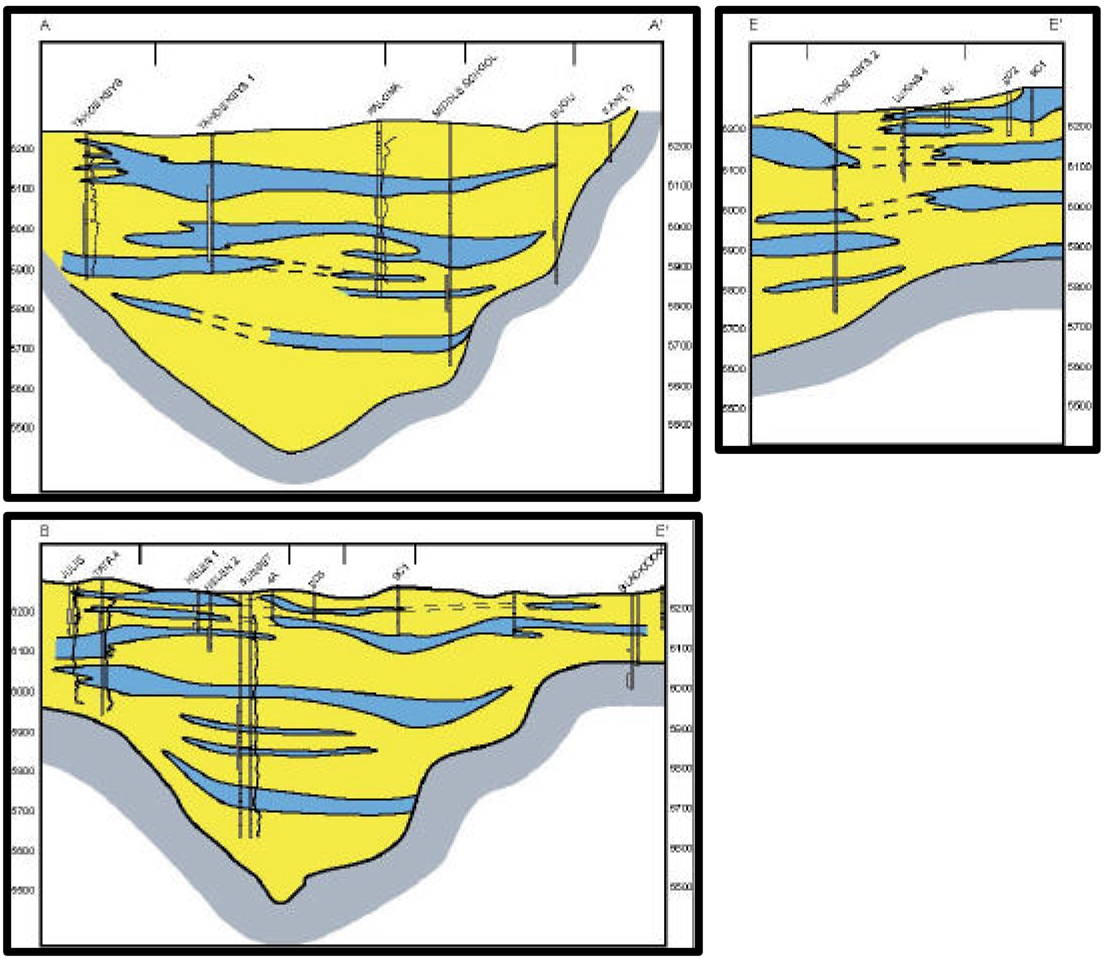
The stratigraphy of the sedimentary fill has been investigated in various phases over the past few decades. The most comprehensive investigation published to date was performed by Scott et al. (1978) in a report for the South Tahoe Public Utility District (STPUD). The investigation was conducted to evaluate potential water reserves for STPUD below South Lake Tahoe. Several of their geologic cross-sections are shown in Figure 4-2. An important feature in these sections is a preponderance of more or less continuous fine-grained units in the upper 30 meters (100 ft). There are several relatively thin units nearer the surface and a thick unit at 18 m (60 ft) to 30 m (100 ft) depth. Cross-sections prepared by Avalex (2002) also show thin, fine-grained units in the upper section and a thicker, more continuous unit at depth. These units dip gently to the north, towards Lake Tahoe.

Figure 4-2. Geologic cross-sections of the South Lake Tahoe area from Scott et al. (1978). Zones shaded in gray indicate fine-grained units that are hydrologically significant.



More recently, Einarson (2003) developed a series of geologic cross sections for the South Lake Tahoe and Meyers areas. Due to inconsistent lithologic logging techniques, also previously noted by Scott et al. (1978) who stated "the inconsistent nature of well log descriptions, especially in shallower wells", Einarson utilized borehole geophysical data collected by STPUD in their production wells. Borehole geophysical data represents a nonbiased source of information that can be used for stratigraphic correlation (Keys 1997). Examples of these cross-sections are presented in Figure 4-3. Deflections in the geophysical logs have been used to correlate several thick fine-grained units across the basin as well as other less continuous units. It should be noted that due to the nature of the data used, the fine stringers observed by Scott et al. (1978) and the environmental investigations near the "Y" area of South Lake Tahoe are not identified, but much thicker units have been detected. In his interpretation of these data, Einarson further alludes to these being correlative to the bright reflectors seen offshore by Hyne et al. (1972) and identified as marking the Hobart, Donner and Tahoe glacial events. Regardless of the chronologic interpretation, all of these data indicate that there are several more or less continuous fine-grained units under both South Lake Tahoe and the Meyers area that would impact downward infiltration of groundwater.

Figure 4-3. Geologic cross-sections derived from borehole geophysical logs by Einarson (2003). Blue indicates fine-grained units while yellow indicates sand and gravel.



Conceptually, the majority of the deposits comprising the sedimentary fill in the South Lake Tahoe basin would have been deposited in a lacustrine environment. This interpretation is driven largely by the bedrock surface configuration as defined by gravity surveys conducted for STPUD (Blum 1979, Bergsohn 2003). These indicate that the floor of the subbasins below both Meyers and South Lake Tahoe are least 274 m (900 ft) below the land surface. For most of the Quaternary, the minimum lake level was controlled by the sill at Tahoe City near the mouth of the Truckee Canyon (~6220 ft) above mean sea level (m.s.l.). However, at least once, the lake level may have reached about 6220 ft above m.s.l., as is indicated by the submerged shoreline and *in situ* tree stumps (Figure 4-4). However, dating back to the Pliocene, there have also been several high stands, up to at least 7000 ft above m.s.l. During the Quaternary, lake highstands between 18 m (60 ft) and 183 m (600 ft) above the current lake level have been correlated by Birkeland (1962, 1964) to ice damming events during glacial maxima. As a result, even at minimum lake level and compensating for current topography, the basin floor below Meyers was at a bathymetric depth of about 244 m (800 ft) and at least 274 m (900 ft) in South Lake Tahoe near the "Y." Thus, lacustrine processes must account for the majority of the sedimentary fill in both areas. Under these conditions, processes controlling underflow, suspension settling, and surge deposition would have predominated[1].

[1] Underflow: water denser than ambient lake water that flows along the bottom of the lake.
Suspension settling: the process of particles falling through the water column.
Surge deposition: Deposition of sediment that has been re-mobilized by sediment failure processes (e.g., debris flow, turbidite, etc.).