

Proposed MUN Delisting Boundary Description

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A methodical and systematic approach was used to develop the proposed MUN delisting study area (Study Area) boundary. Several parameters were used which ultimately defined the Study Area location. These parameters included: water quality of the first encounter groundwater, subsurface geology, surface features, cities and local communities, historic flood area, location of shallow wells and political boundaries. Each of these defining parameters along with background information about the area is discussed in greater detail below.

Background

The historical development, topography, soil, groundwater and flooding conditions of the Tulare Lakebed region truly make this area very unique. The following background information describes the uniqueness of the Tulare Lakebed area.

Historical Development

This unique area, located in the southern part of the Central Valley of California, is a closed basin from which there has been no runoff to the sea for more than 100 years. A combination of alkaline heavy clay soils, extremes of climate and a continuing flood hazard make the area unsuitable for crops such as orchards, vineyards and most fresh vegetable crops. The area has been quite successful in the production of cotton, wheat, safflower, alfalfa hay, processing tomatoes, and other field crops.

Before dams were constructed on the major tributary streams, the boundaries of the Tulare Lake were historically in flux because of the wide variation of inflow in various years. The maximum reported area of Tulare Lake was about 800 square miles in 1862 and again in 1868. The most recent time in which water flowed naturally from Tulare Lake to San Francisco Bay was 1878. At that time, the flooded lands covered an area of about 600 square miles, with a maximum depth of only about thirty feet. During the latter part of the 19th Century, Tulare Lake was considered to be a permanent part of the State's geography. There are records indicating that the Lake was navigated with docks and commercial fishing. The first record of agricultural activity was the 1880's. The Lake was first dry in historical times in 1898 or 1899.

Under conditions of subsequent development of irrigated agriculture in both the Tulare Lakebed and the Tulare Lake Basin as well as construction of foothill flood control reservoirs, uncontrolled stream flows that historically fed into the Lakebed have been significantly reduced and the flood hazard has been largely removed from the fringe portions of this land. Some of the fringe portions as defined by the 1876 map now have relatively dependable water supplies, so that they have lost much of their former Tulare Lake character. Hence the 400,000 acres of the maximum historical Lakebed has shrunk to slightly less than 200,000 acres.

Topography

The topography of the Tulare Lakebed is a gradually sloping trough from the former lake outer boundary toward the lowest region in the Tulare Lakebed. The lowest region of the Tulare Lakebed is approximately 175 feet above mean sea level (MSL) as shown in Figure 1. The generally flat terrain has an average slope of about one-foot per every mile from the lowest area towards the boundary. The Tulare Lakebed is a “closed” basin with no natural outlet. It is important to note that no natural outflow from the historic Tulare Lakebed has occurred since the late 1870’s. This is a result of upstream diversions on the eastside of the San Joaquin Valley from the four major river tributaries, Kings, Kaweah, Tule and Kern, to the area, and the U.S Army Corps of Engineers flood control projects on the tributaries. However, periodic floodwaters occurring in above-normal runoff years can inundate highly productive farmland within the Tulare Lakebed approximately 1 out of every 7 years.

Soil Conditions

Figure 2 is a Map of Kings River Service Area, showing zones of Alluvial Fan and Basin Soils. This map was prepared by overlaying the Kings River Service Area upon Plate 3 of U. S. Geological Survey Water Supply Paper 1618. As is evident from the map, the Tulare Lake area is largely underlain by relatively impermeable basin soils. The predominant soil is Tulare Clay, a deep and very finely textured soil.

The alluvial deposits of the western part of the valley are derived from the marine sedimentary deposits that comprise the Coast Ranges and tend to be of finer texture relative to those of the eastern part of the valley and have higher clay content. Lacustrine and marsh deposits exist beneath the Tulare Lakebed. These deposits are composed primarily of silts and clays. Several cross sections were prepared of which the locations are shown in Figure 3. The Tulare Lakebed clay can be seen for hundreds of feet deep in Figure 4.

The most laterally continuous of these units have been designated from the youngest to oldest by the letters A through F (Figures 4 and 5). The most prominent of these clay units is the E Clay or Corcoran Clay Member of the Tulare Formation (Corcoran Clay) which extends throughout the majority of western and southern Tulare Lake Basin (absent along the eastern boundary and in the Bakersfield area). The Corcoran Clay generally separates unconfined groundwater conditions above the clay to confined conditions below the clay. The Corcoran Clay is an impermeable hydrologic barrier that ranges from 400 to 600 feet below the surface. The Corcoran clay layer ranges in thickness from 50 to more than 200 feet. As a result of the clay strata, any economically feasible attempt to directly recharge the aquifer below the Corcoran Clay is impractical within the Tulare Lakebed. The very dense clays above and below the Corcoran clay layer extend several thousand feet from the surface down to the unknown.

The nearly impervious nature of the Tulare Lake clay soils is rather dramatically demonstrated by the fact that the 1969 flood runoff was impounded to an average depth of only about eleven feet at its peak level in June 1969 as shown in Figure 6. It was not completely dissipated until August 1971, more than two years after the inflow had ceased and the impounded flood water was used for irrigation. Engineering calculations indicate that about half of the total disposal was from evaporation, about half

from withdrawals for irrigation of surrounding lands. After making allowance for absorption upon initial wetting, the vertical percolation was calculated to be less than one-half foot per year that contributed to the very shallow perched water conditions. In 1983, large scale flooding again happened with similar results.

Groundwater Conditions

Groundwater conditions in and around the Tulare Lake area are described in a number of reports and studies of the U. S. Geological Survey, the California Department of Water Resources and others, and are substantiated from records of actual development and attempted development of groundwater resources. What is unique about the lakebed is the lack of usable groundwater resources within the lakebed.

First groundwater encountered is typically only a few feet deep, as indicated by DWR in Figure 7. There has been , and will continue to be, a substantial amount of time, effort and resources expended within the area to keep the poor quality first encountered groundwater from getting into the root zone which reduces the crop yields. This was the reason for the formation of the Tulare Lake Drainage District [TLDD]. TLDD manages and disposes of subsurface tile drainage waters that are received from its landowners.

With the exception of a few old deep wells, there are no wells in the Lake Bed proper. Wells must be drilled below the clay formations to a depth of about 1,500 to 2,000 feet to find any useable groundwater. Care must be given not to perforate the wells closer than about 600 feet to the land surface in order to avoid marsh gas and the highly saline and alkaline waters in sand lenses in the upper strata. The USGS and documents water quality problems natural to the Tulare Lake area in Figure 8. Tulare Lake operators own water wells, located on the outside fringe of the Tulare Lakebed. The Tulare Lake Groundwater Basin (TLGB) is described in studies conducted by the Department of Water Resources and the United States Geological Survey. In a simplistic view, the TLGB consists essentially of a shallow saline aquifer and a deep aquifer separated by the Corcoran Clay hydro-geologic barrier. The Corcoran Clay is located about 400 feet to 600 feet below the surface and ranges in thickness from about 50 to over 200 feet. The underlying soils are primarily low water-bearing, fine-textured clay materials, with interspersed silty sand lenses. The relatively impermeable heavy clay soils prevent any feasible attempt to directly recharge either the shallow or lower aquifers.

Water Quality

The first subsurface waters encountered in the interior portion of the Tulare Lakebed region have high concentrations of salts. Historical data from farm operators indicate that the Electrical Conductivity is in the range of 5,000 to greater than 35,000 microseimens per centimeter, which is clearly unusable for municipal and agricultural use. Thus, there is no shallow water suitable for these purposes. Extending outward from the proposed Study Area, the first encountered groundwater improves in quality. The Study Area encompasses the area where the Electrical Conductivity is documented to be 5,000 microseimens per centimeter or greater.

Subsurface Geology

The soils in the historic Tulare Lakebed are primarily impermeable clays. Soils along the rim of the historic Lakebed are primarily fine grained, silty alluvium which was deposited along the shoreline. Older Continental alluvium deposits have noticeably finer texture than the younger Sierra Nevada deposits. The Study Area boundary surrounds the relatively impermeable heavy clay soils that are several thousand feet deep with the Corcoran clay separating the confined from the unconfined aquifers. The clay layers rise and thin out near the fringe of the Study Area.

Surface Features

To geographically define and make the Study Area boundary more visually definable, several surface features were used. Major roads in the area are often easily identifiable on maps. The Study Area is bounded to the north by Laurel Avenue, on the west by Highway 41 and Interstate 5, and on the east by Highway 43. Where no roads existed, canals and ground surface contour lines were also used to delineate the boundary.

There are no natural waterways or bodies in the Study Area. All of the canals in the Lakebed are man-made and are not naturally occurring. It is a closed basin and there are no outlets to any natural waterways or bodies. Since the area is also prone to periodic flooding, there are no residential areas, permanent plantings or wells located in the interior portion of the Tulare Lakebed.

Cities and Local Communities

There are no towns or communities in the Study Area. The local towns and communities in the fringe area all draw on groundwater resources that are upslope from the Lake Bed and Study Area. Areas where groundwater is used as a potable water source were avoided. The community of Stratford is to the north of the Study Area, Kettleman City is west of the Study Area, the City of Corcoran is on the Northeast corner of the Study Area and the Community of Alpaugh is to the Southeast. The growth of these communities is away from the proposed Study Area, principally due to the flood risks. Groundwater on the fringe of the Study Area flows away from the domestic well fields and towards the center of the Study Area.

Political Boundaries

The political boundaries of the Tulare Lake Basin Water Storage District (TLBWSD) and the Tulare Lake Drainage District (TLDD) were also considered in the development of the proposed Study Area boundary. The boundaries of these two entities generally overlap in the interior portion of the Study Area. TLBWSD is the major water supplier to the area and TLDD is services the drainage needs of the landowners. While there are additional areas to the South and West of the Study Area that have similar elevated saline shallow groundwater, these areas have not been included in the Study Area for funding and lack of data reasons.

Methodology

The proposed MUN delisting study area is based on a multitude of factors. Initially, the location and extent of the high EC of the first encountered waters was determined. The extent of the impermeable clay soils and flood vulnerability further reduced the Study Area boundary. The towns and, communities that rely on groundwater as a potable water source further shaped the boundary as they include municipal uses and the municipal designation would remain. The surface features allowed the boundary to be physically defined and make it more readily identifiable. Lastly, the boundaries of the local water agricultural water purveyor (TLBWSD) and the entity tasked with reducing the salt load (TLDD) were included.

Study Area

Using the above methodology, the Proposed MUN Delisting Study Area is shown in Figure 9. The exclusion of the various cities, the boundaries of the various surface features including roads and waterways can be seen on the map.

Figure 1. Tulare Lake Basin Topography

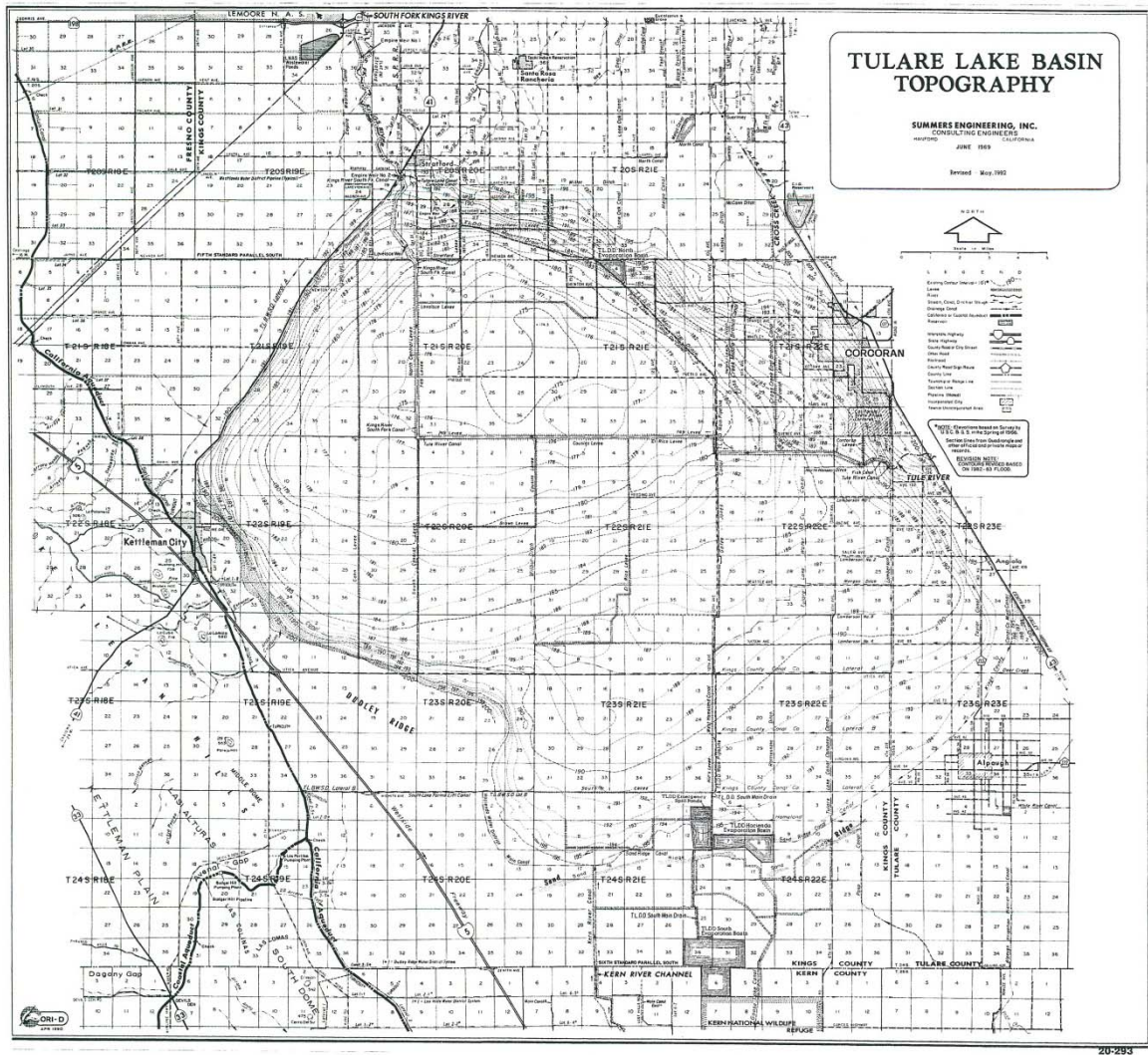


Figure 2. Zones of Alluvial Fan and Basin Soils

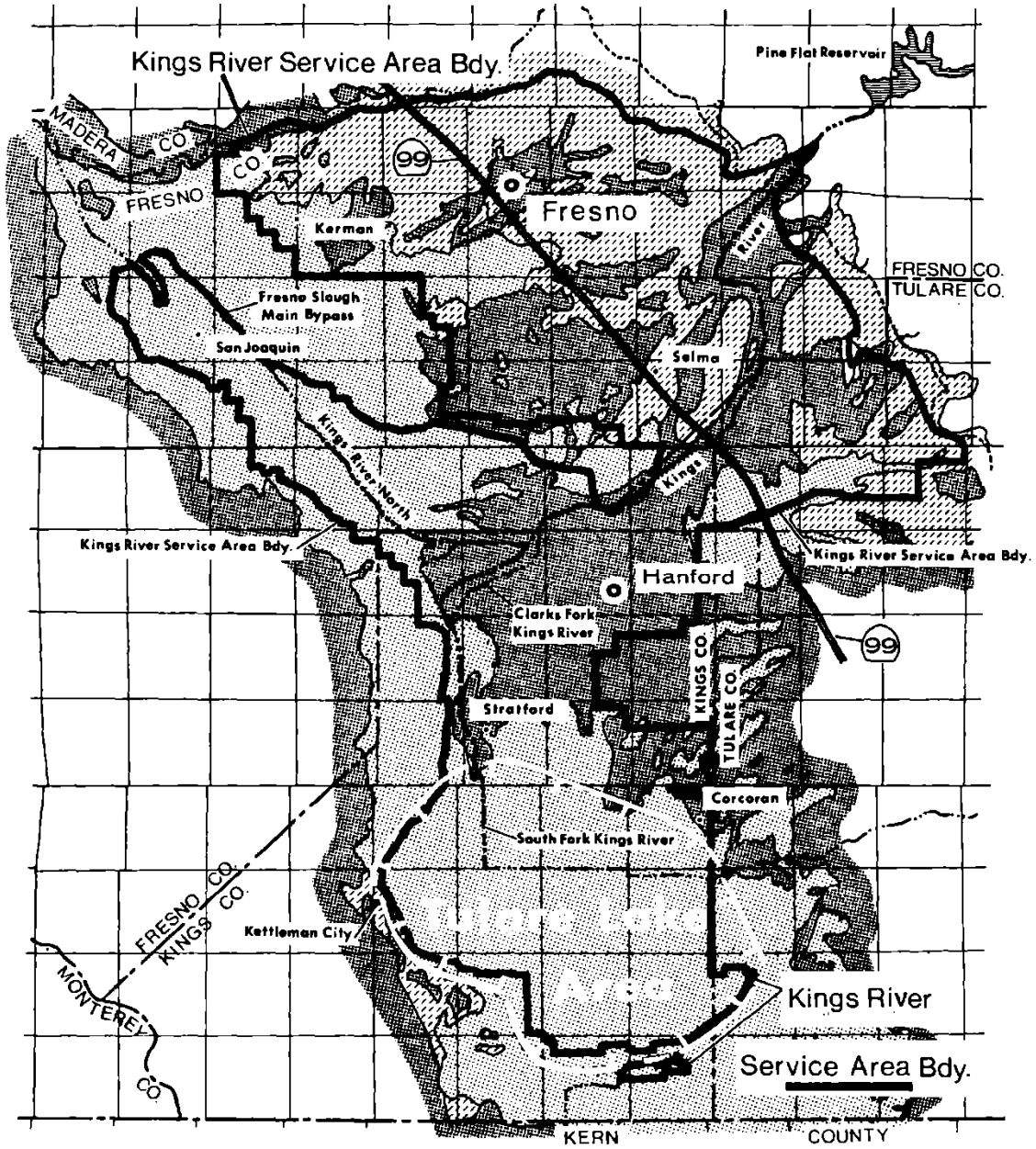


Figure 3. Location of Geological Cross Sections



Figure 4. Tulare Lake Cross section (North-South)

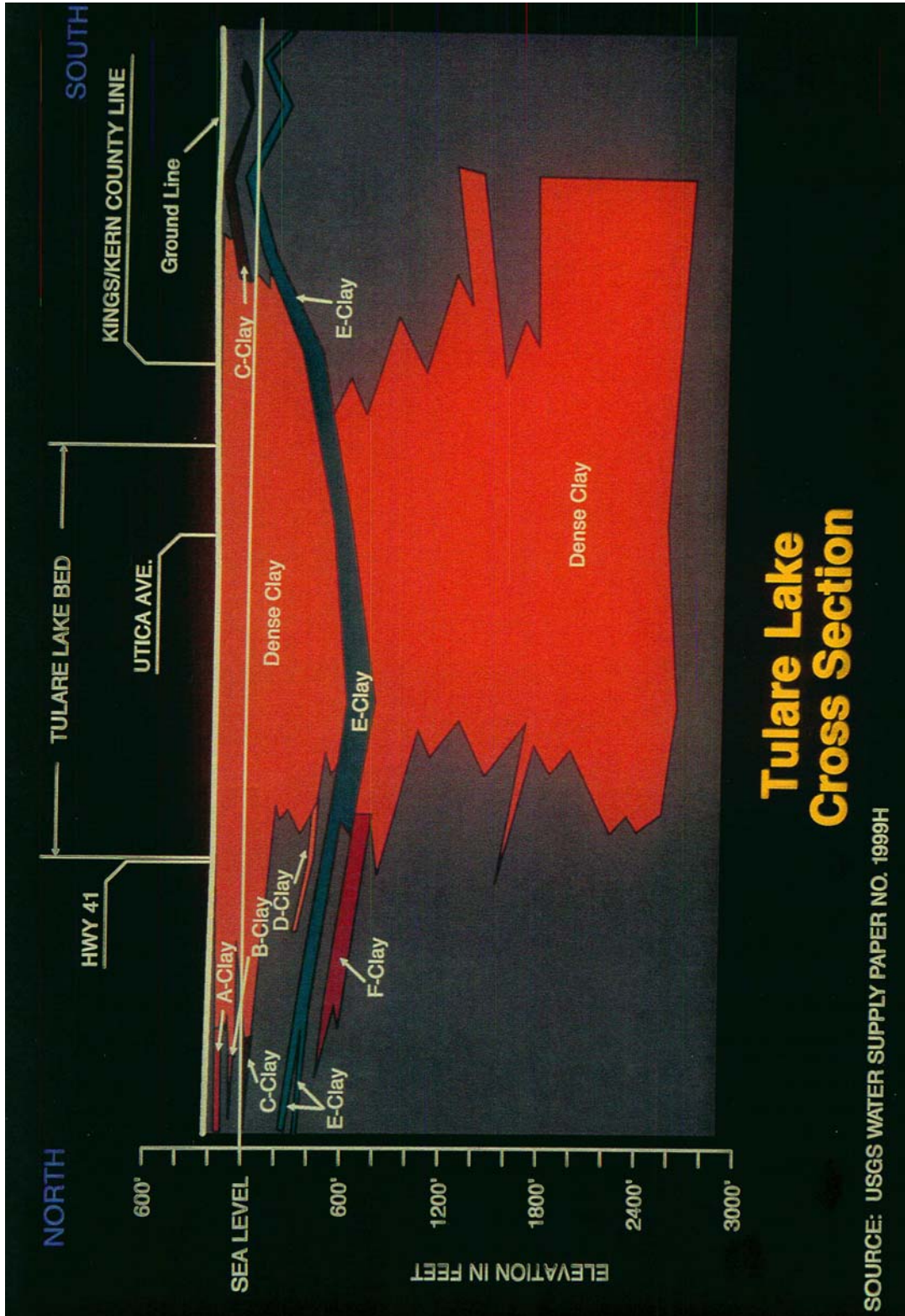


Figure 5. Highway 198 Cross section (East-West)

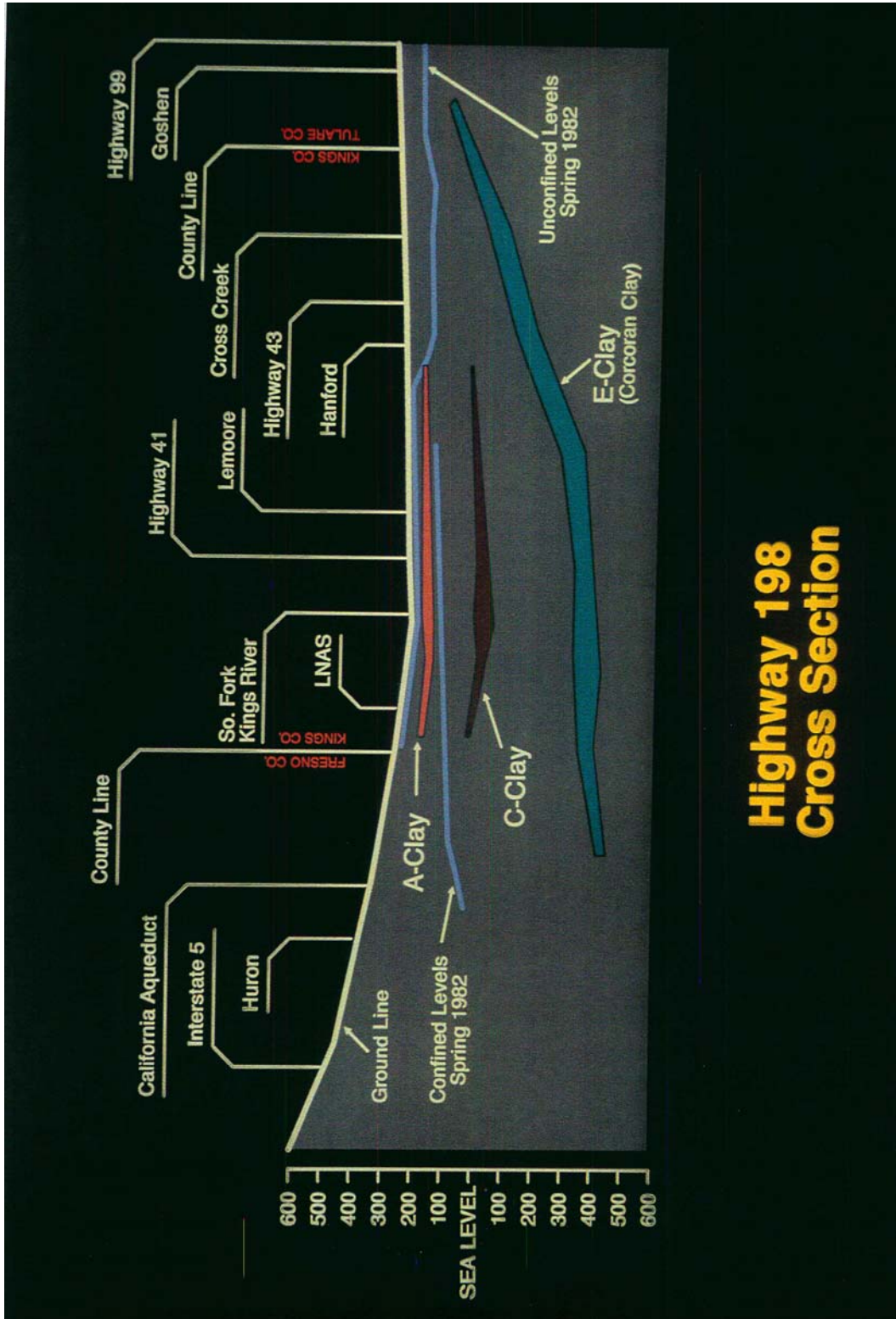


Figure 6. Extent of Flooded Cropland in the Tulare Lake Bed During 1969, 1983, 1997, and 1998

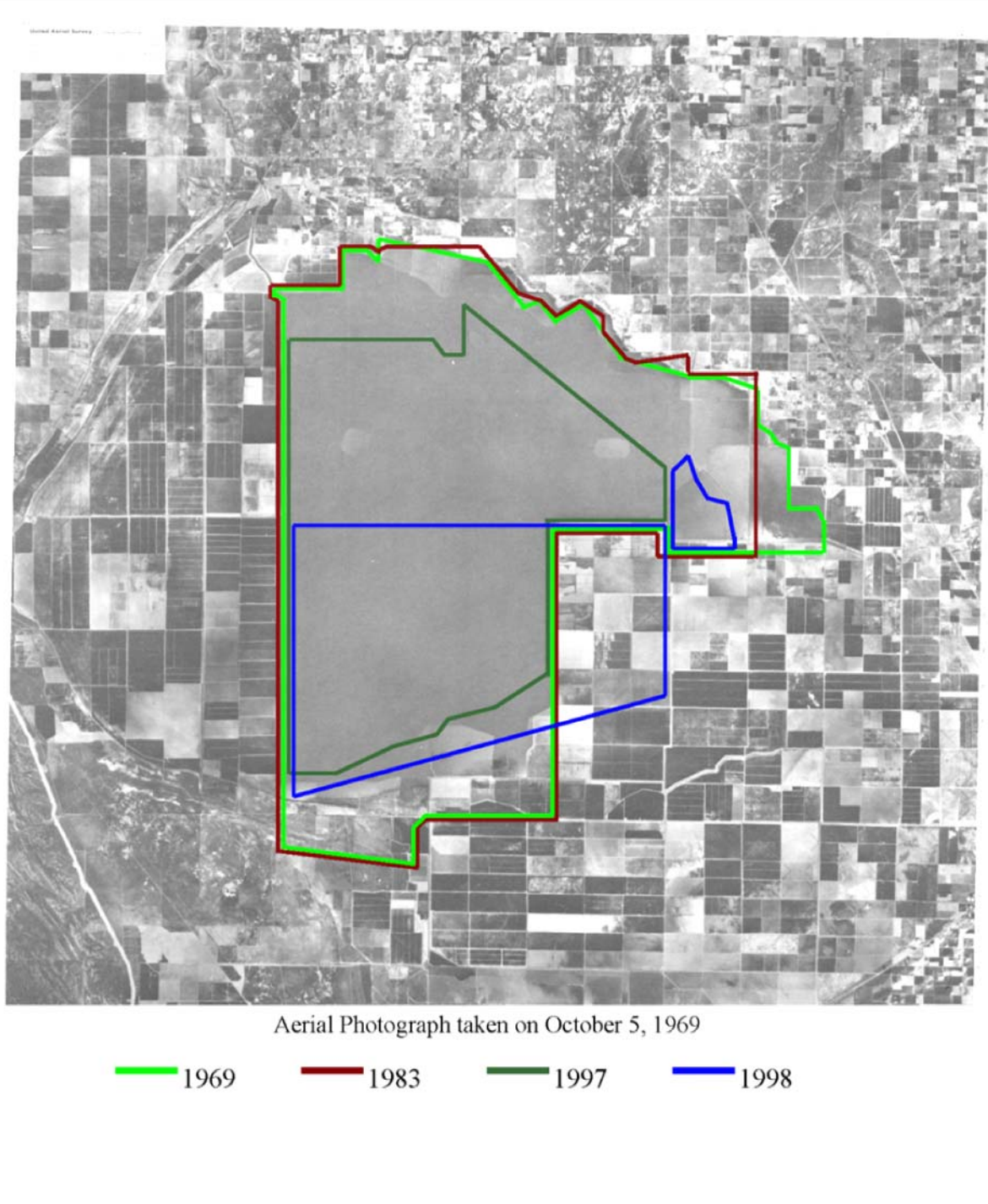


Figure 7. Depth to First Encountered Groundwater

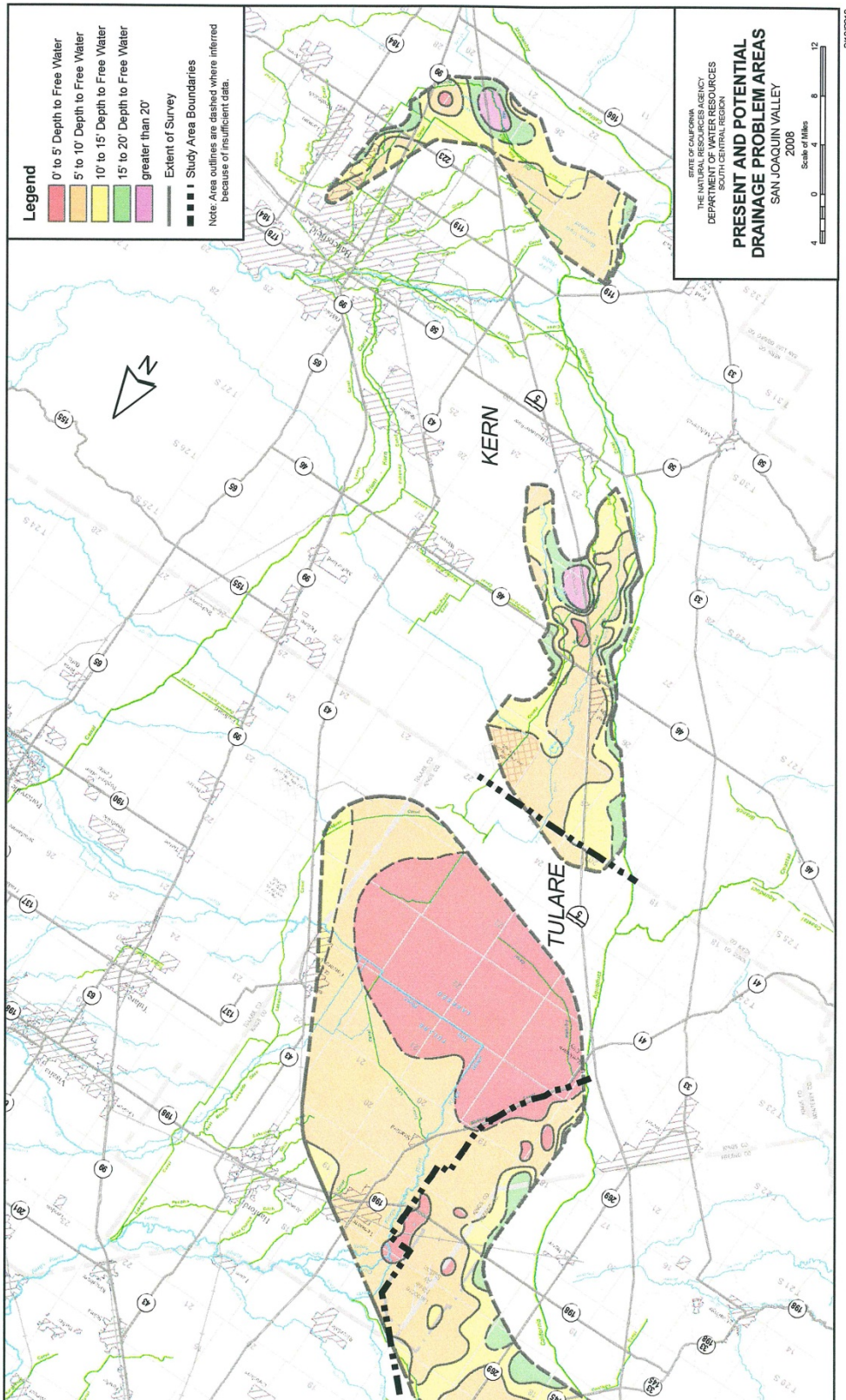


Figure 8. Salinity Distribution for all subzones in the Tulare Basin

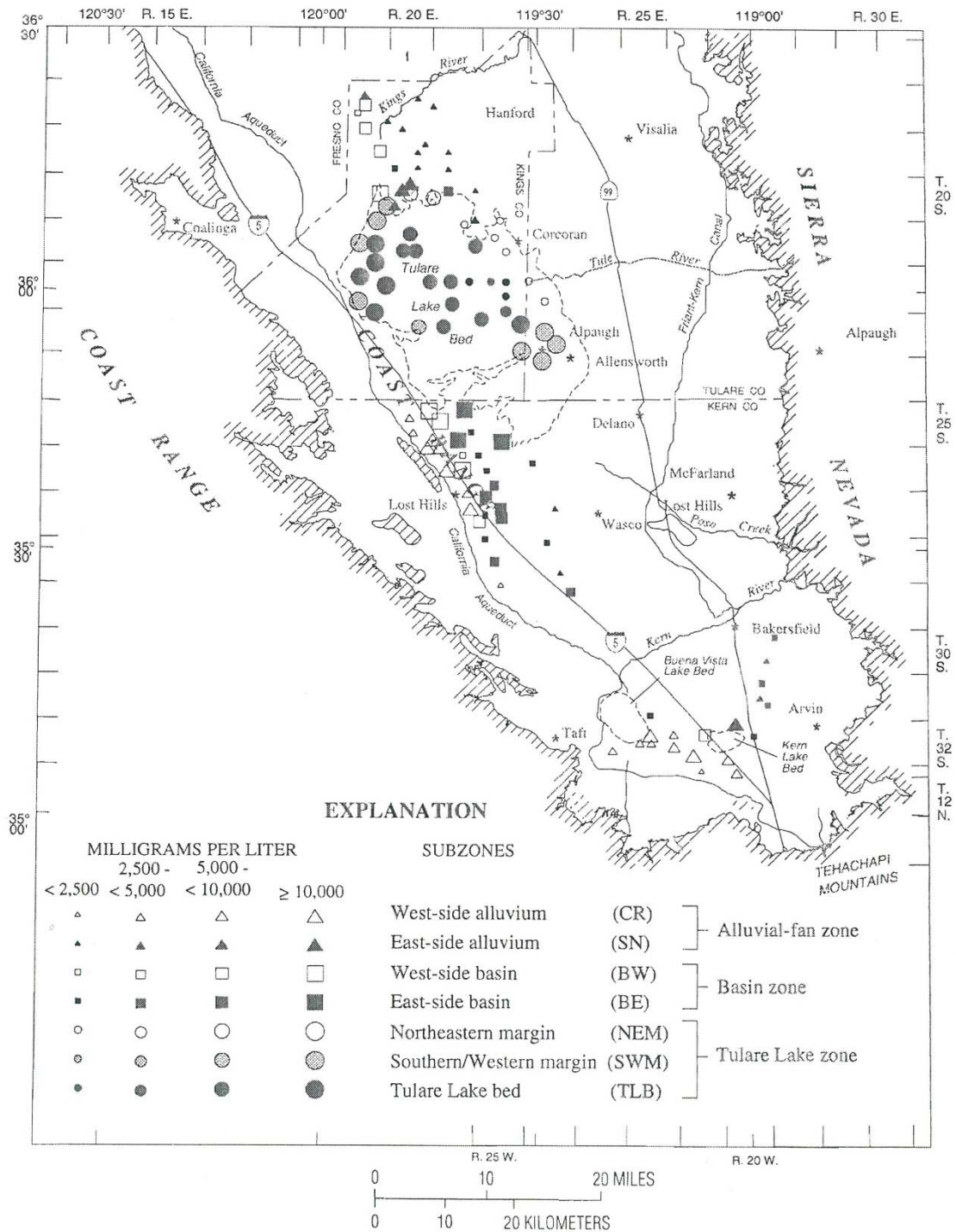
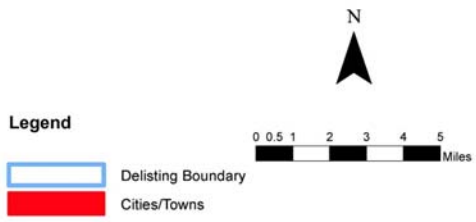
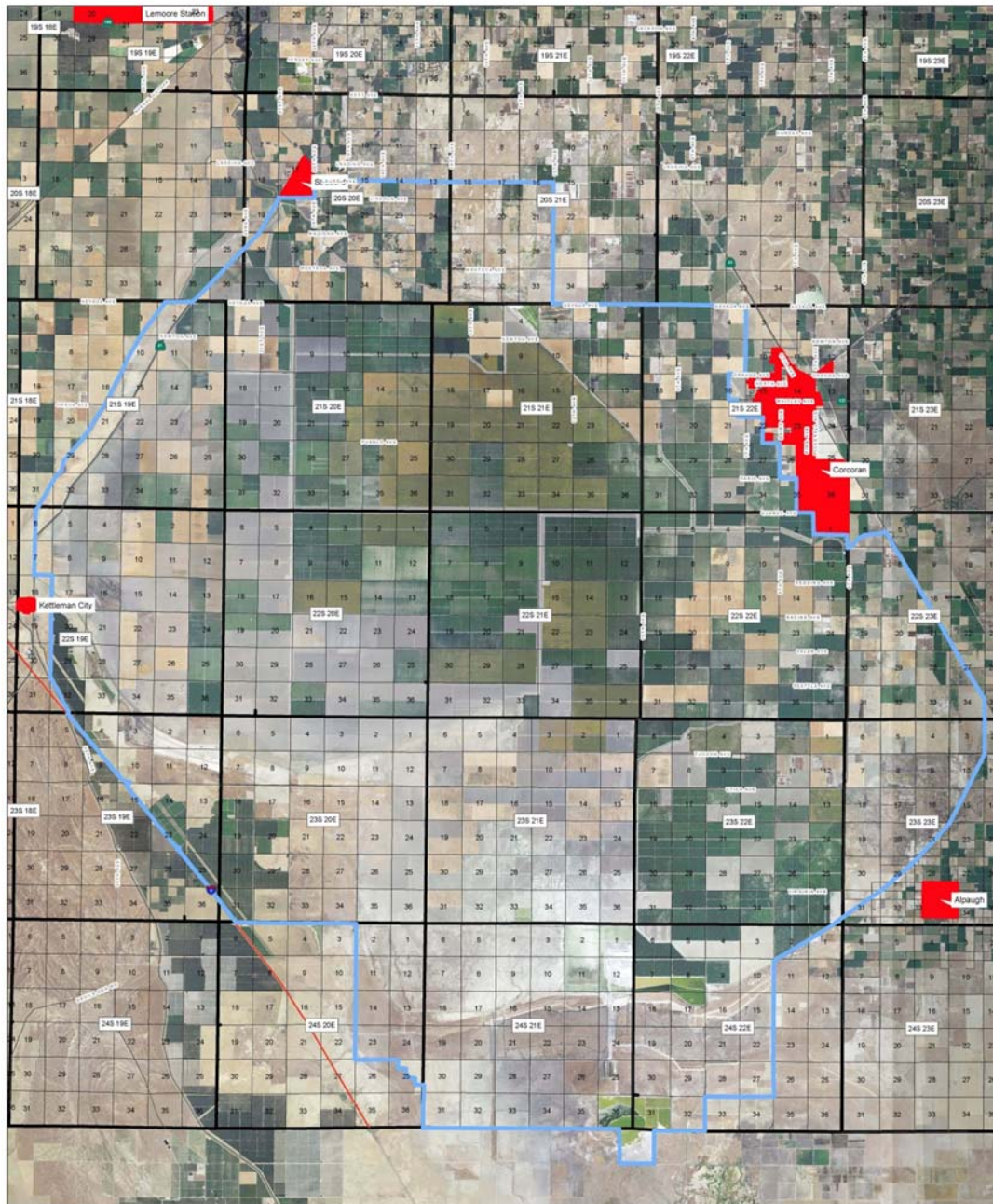


Figure 9. Proposed MUN Study Area



Tulare Lake Bed Proposed Delisting Boundary Discussion Draft