# Vernal Pools

**Vernal pool description**

Vernal pools are seasonally flooded digressional wetlands underlain by a drainage- limited subsurface layer and dominated by endemic plant species. These ephemeral shallow ponds are fed primarily by precipitation. Although vernal pools may occur individually, they generally occur together and can be described as a vernal pool complex that often also includes mima mounds interspersed within the surrounding matrix. Some vernal pools are characterized by alkali though the seasonally flooded depressions remain distinguishable features. In the delta, vernal pool complexes intermix with wet meadow and seasonal wetlands, and alkali seasonal wetland complexes. Consequently there is some inevitable overlap in these categories (Delta Historical Ecology report).

**Mima mound description**

Mima mounds (called Hog Wallows in Delta Historical Ecology report) are dome-shaped soil mounds (up to 2 m high and 10-50 m in diameter), thought to be formed over long periods of time by gopher colonies. Mima mounds are often associated with adjacent, internally drained depressions (vernal pools), especially in the Central Valley of California (Reed & Amundson \*\*). The mound-pool complex creates a unique seasonal set of wetlands that harbor endemic and endangered plants and aquatic species.

**How to arrange the VP flowers**

Flowers should be arranged in two concentric rings, with pool associated species in the center, and matrix/edge associated species forming the outer edge. As the edge blends into the surrounding matrix, the species gradually become more like the matrix around them, which can either be alkaline wet meadows or grassland depending on the location of the vernal pool.

**General Pool Characteristics**

Looking at the historical imagery, you can see that there are three general categories of pools that can be grouped together.

1. **Large pools** - (>5 ha) already mapped in the Delta Transformed historical ecology map.
2. **Intermediate pools** – pools of variable shape and size, qualitatively, these pools occur in groups, but are not as numerous or as dense as the small pools. Their average size (calculated from 14 representative pools) is 1.09 ha (SD 0.889 ha). These pools are sometimes occur on their own, and other times they occur within a matrix of smaller pools and mima mounds. They are highly variable in shape and size, and seem to occur in depressions around other landscape features such as small hills and mima mounds. Their average density on the landscape, from 6 representative areas is 0.47 pools/ha (SD 0.624 pools/ha).



Fig 1. In this image you can see an intermediate pool (yellow) occurring in a depression with mounds both within and around the pool. Mima mounds are dark green, and surrounding matrix is brown in this image. You can see the complex and variable shape of the pools.

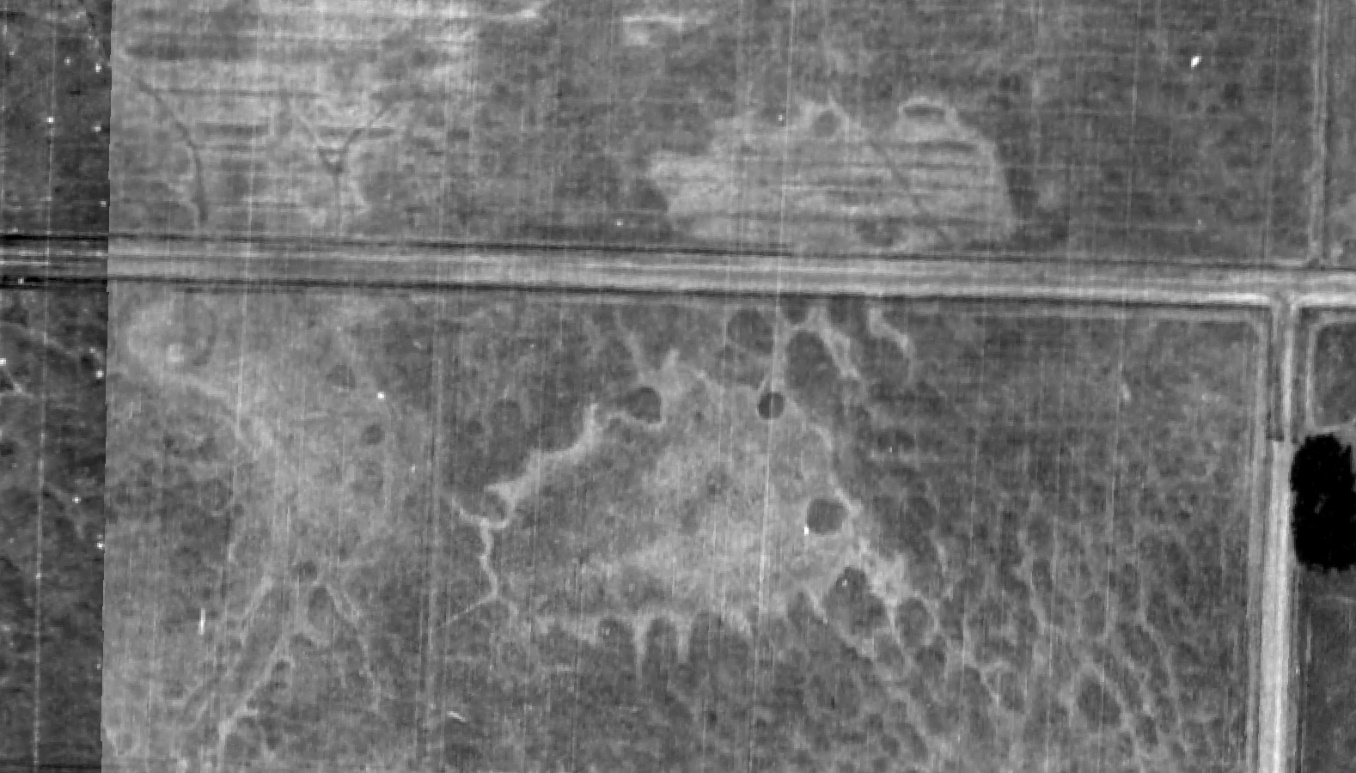


Fig 2. In this historical image, the intermediate pool in the center is surrounded by mima mounds, with a network of smaller pools in depressions around the mounds.

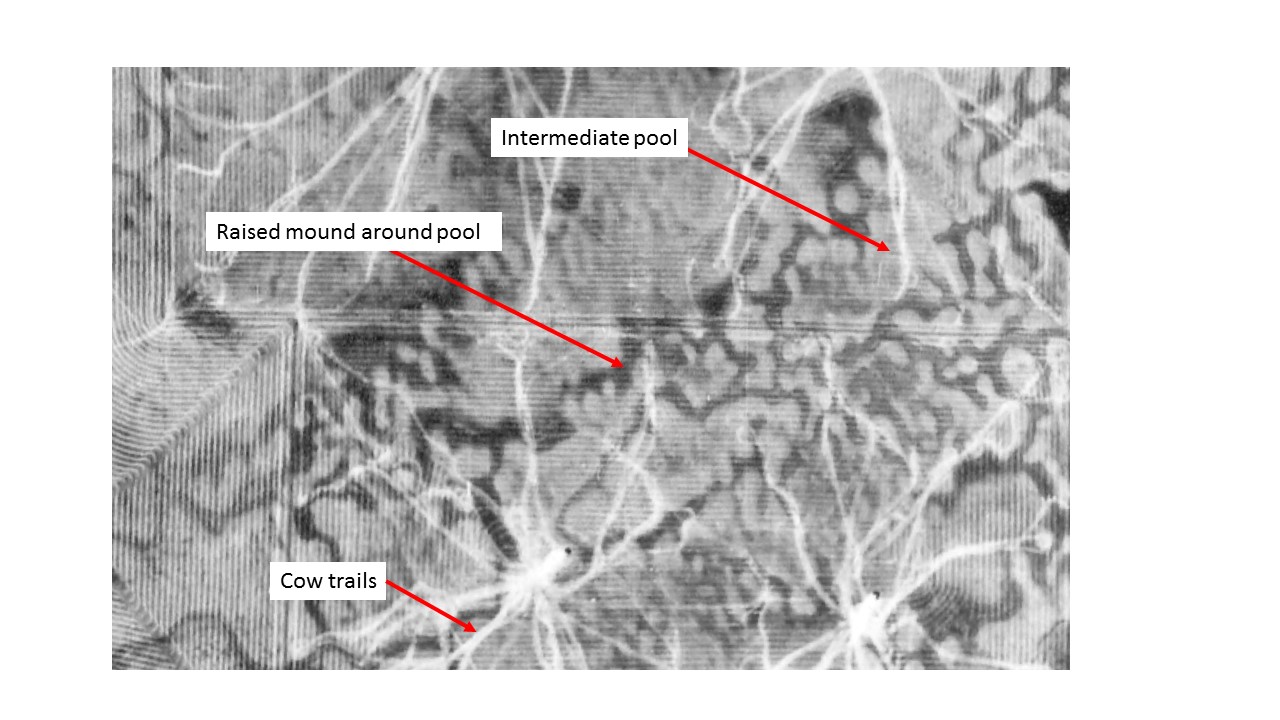


Fig 3. This figure shows the complex topography associated with intermediate pools, as well as the variability in their shape. Intermediate pools are surrounded by a network of raised mounds around the pools.

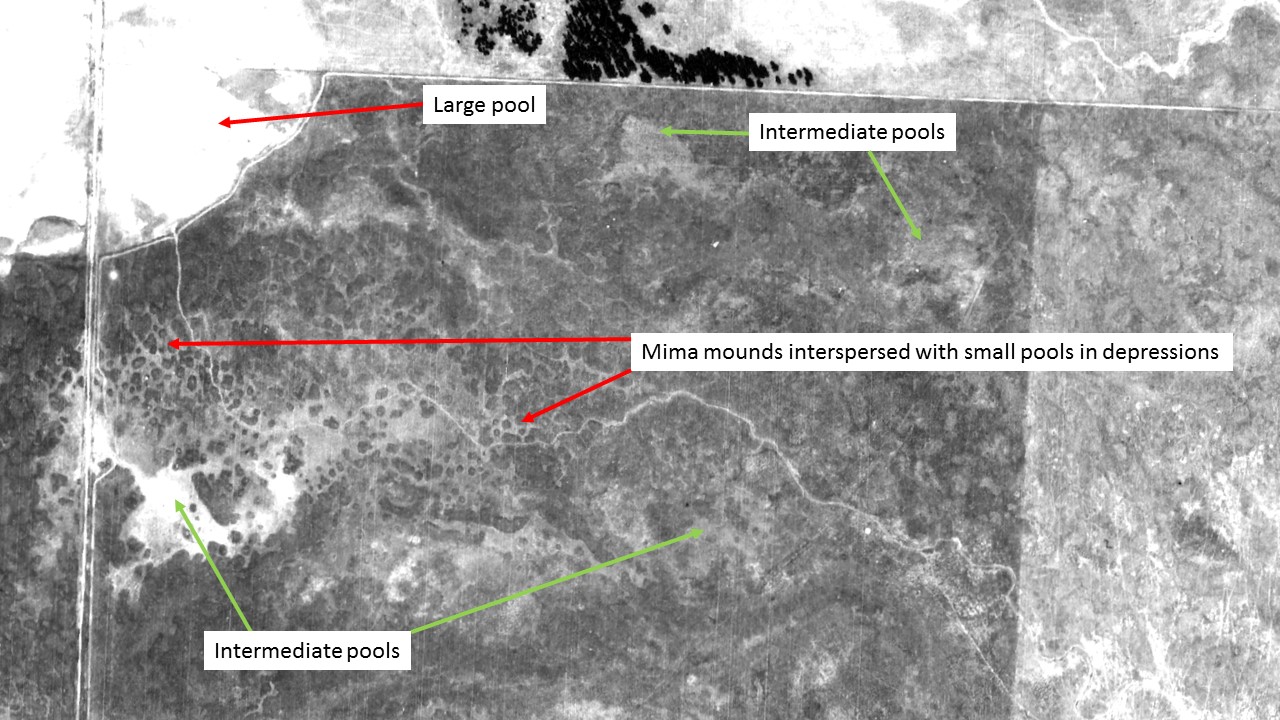


Fig 4. In some places, intermediate and small pools are intermixed. In these areas, some parts of the landscape that are well defined and characterized by a relatively regular distribution of mima mounds, whereas other areas are more complex and mixed with irregularly shaped intermediate and large pools.

1. **Small pools** – These pools occur most often between mima mounds. This landscape is characterized by regularly occurring mima mounds that are fairly similar in size, and usually more or less circular in shape. In this pool type, we calculated the area of the mima mounds, not the depressions between them - the small pools are linked to each other and form the interstitial space between the mounds. The average size of 40 representative mounds is 0.0347 ha (SD 0.027 ha). Their average density on the landscape (from 10 representative areas) is 13.9 mounds/ha (SD 13.93 mounds/ha).

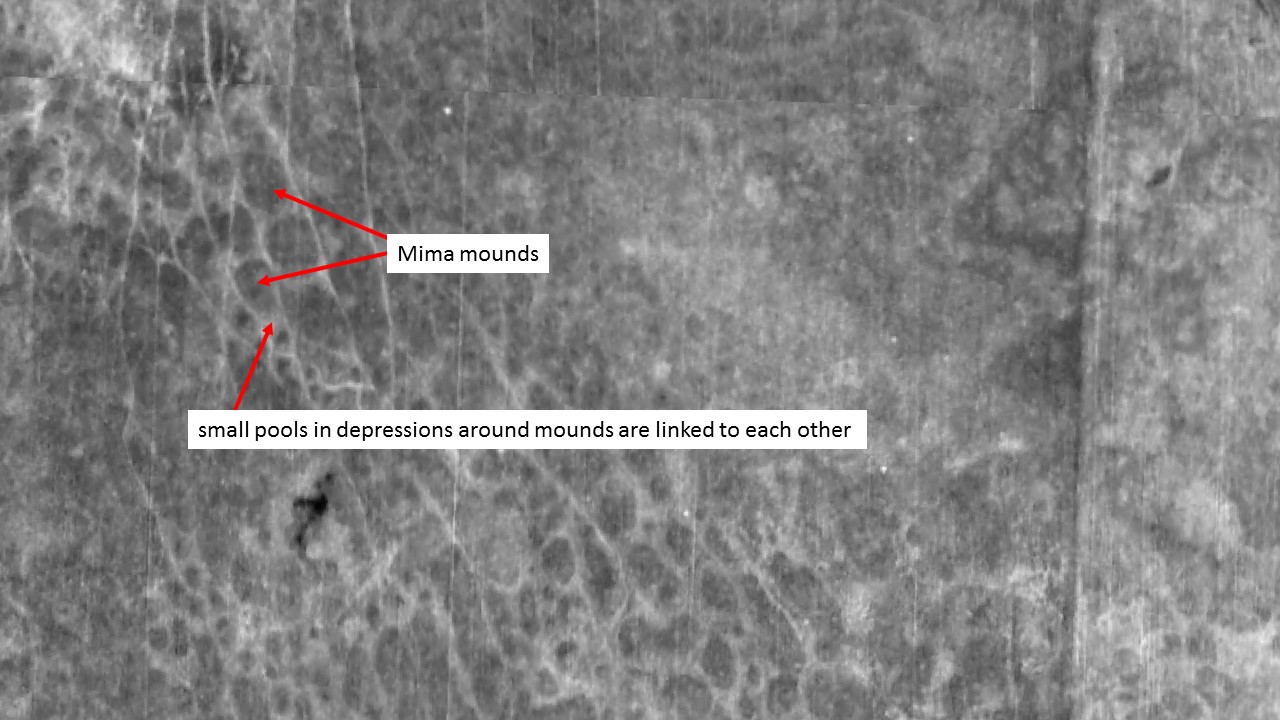


Fig 5. In this historical imagery, you can see the regular formation of mima mounds on the landscape, as well as the small pools that occur in depressions around the mounds. These pools are linked to each other, forming a network around the mounds.

**Locations in Delta**

There are three main areas where there are vernal pools in the delta. We found distinct patterns in each area. The areas and their associated patterns are:

1. West Delta

*Pool type:* Mix of large, intermediate, and small pools with mima mounds

*Matrix habitat type:* Alkali wet meadow

*Notes:* In this area, we found a mixture of large, intermediate and small pools. We didn’t find any conclusive information about what the surrounding matrix should be, but the large pools are alkali, and the historic imagery suggests areas around the large pools with salt build up as well. So, it would probably be safe to assume alkali meadows should form the matrix around the vernal pools.

1. North delta/willow slough area

*Pool type:* Mix of large and intermediate pools, no small pools or mima mounds

*Matrix habitat type:* Alkali wet meadow

*Notes:* In this area, the soil type from the underlying soil map specifically mentions alkali, so we think the matrix in this area should be alkali meadow. In this area, we found mainly pools of intermediate size, and there are several mapped large pools as well. We found less evidence of small pools with hog wallows in this area.

1. East delta Stone lakes area

*Pool type:* Small with mima mounds

*Matrix habitat type:* Grassland possibly mixed with seasonal wet meadow

*Notes:* The soils mapped for the area do not mention alkali, and the adjacent veg types are wet meadow and grassland, with an underlying soil that specifically says it is not alkali. Most of the underlying soil in the vernal pool area is San Juaquin loams which make numerous reference to the hog wallows as a characteristic feature that defines this soil type. We found fewer intermediate pools and no large pools in this area.