Influence of gisontone veins on the Birds Nest aquifer:

Gisontone (a solidified carbonate) occurs in veins ranging in thickness from a couple inches to tens of feet and originates in the rich ilite shale beds of the upper Green River Formation, continuing up to the surface, cross-cutting the Birds Nest aquifer. Questions remain as to how these veins might affect groundwater movement through the Birds Nest aquifer, could they act as barriers to flow or could they create vertical and/or horizontal pathways for water transmission.

- **Evidence for barrier:** Near the basin’s depocenter, several areas exist that intersect the entire Saltine zone. Most of these areas (e.g., S1,T3-5) show significant saline mineral dissolution. In this location, the basin has begun disposing saline water into the Birds Nest in this area. However, there is one well (Clark State 1) that sits very slightly to the north, which shows no signs of saline mineral dissolution. This is explained by the behavior of a gisontone vein. With the beds dipping to the north and the veins dipping to the northeast, water within the Birds Nest has dissolved the saline minerals to the south of the vein, but the gisontone vein acts to stop water from reaching the area on its northern side, creating a zone of dissolution. It is presumed that similar areas of the saline mineral dissolution occur throughout the Birds Nest aquifer, but it is difficult to quantify these areas without core samples.

- **Gisontone mine tour; evidence for both transmission and barrier:** The gisontone vein is a highly fractured type of gisontone which easily transmitted water through the vein. The second mine contains a type of gisontone vein that was very solid and transmitted no water. These observations suggest that gisontone veins could act as both barriers or conduits for water depending on the type of gisontone in the vein. However, gisontone type at depth is impossible to identify in the absence of an actual mine.

### Birds Nest aquifer water chemistry:

Chemistry of Birds Nest water (mostly acquired by Anadarko) in the north (averaging ~10,000 mg/L TDS and as high as 100,000 mg/L TDS) is distinct from that in the south (averaging ~10,000 mg/L TDS and down to near 100 mg/L TDS). This abrupt change in water chemistry is most likely due to the differing amounts of saline mineral dissolution in the two areas. The northern area may have been flushed more, whereas saline minerals in the southern area are still actively dissolving. This transition is important because produced saline water can only be disposed into the aquifer when the water is currently ~10,000 mg/L TDS and above (only north of the red line). In some areas, like near Anadarko’s disposal wells, it seems that the presence of gisontone has had an influence on the shape of the 10,000 mg/L TDS line. The gisontone veins could be acting as barriers, creating underground channels of groundwater flow (see discussion to left).

### Regional cross sections through the Birds Nest aquifer:

Regional cross sections were constructed to help define the areal extent of the Birds Nest aquifer. The areas shaded in blue represent the presence of large saline nodules/beds one or two zones, the dissolution of which causes the porosity and permeability for potential large-scale saline water disposal.