

As earlier stated, once the water production mechanism is understood, an effective strategy can be formulated to control the water production. The flow of water into the well bore can occur through two main paths i.e. flow through a separate path as the hydrocarbons and flow of water with the hydrocarbons (<http://karl.nrcce.wvu.edu/> accessed 25/10/2010). Flow through a separate path from the hydrocarbon often leads to direct competition between the water and the hydrocarbon production. This usually constitutes bad water. Therefore, reducing or controlling this water production would lead to the increase of oil or gas production rate and recovery efficiencies. The second flow path usually constitutes good and sweep water. Therefore, a reduction or control in the production of this water would imply a reduction in the production of the hydrocarbon (Bailey et al 2000). However, no matter the flow path, there are three factors that must be present, namely the source of water, pressure gradient and a favorable relative permeability to water (<http://karl.nrcce.wvu.edu/> accessed 25/10/2010). Pressure gradient: Production of oil and gas from the reservoir can only be achieved by applying a pressure draw-down at the wellbore which creates a pressure gradient within the formation. Production from a fully penetrating and perforated well results in a horizontal pressure gradient in the formation. However, flow from a partially penetrated well will result in not just a horizontal pressure gradient but also a vertical pressure gradient. This will often lead to an undesirable condition. Favorable relative permeability to water: Oil, water and gas mainly flow through the path of least resistance, which is usually the part of the reservoir with higher permeability. For a reservoir with uniform geometry and permeability, flow will be along a simple line into the wellbore but this is not the usual case. With water driven or water flooded reservoirs, this heterogeneity especially in multi-layered cases would result in water channeling through the high permeability streaks. Most reservoirs consist of layers of different permeability, either immediately adjacent to each other or separated by impermeable layers. Layering and associated permeability variations are major causes of channeling in the reservoir. As the water sweeps the higher permeability intervals, permeability to subsequent flow of the water becomes even higher in those intervals and the lower permeability intervals remain unswept. This leads to a premature water breakthrough. Channeling can be further exacerbated by lower water viscosity as compared to that of oil especially during water flooding.