Tritium measurements of streamwater draining the Toenepi catchment, a small dairy farming area in Waikato, New Zealand, have shown that the mean transit time of the water varies with the flow rate of the stream. Mean transit times through the catchment are 2–5 years during high baseflow conditions (in winter), becoming older (3–4 decades) as streamflow decreases in summer, and then quite dramatically older during drought conditions, with ages of more than 100 years. The groundwater store supplying baseflow was estimated from the mean transit time and average baseflow to be about 1 m water equivalent over the catchment and 2.3 times total annual streamflow. Nitrate is relatively high at higher flow rates in winter, but is low at times of low flow with old water. This reflects both lower nitrate loading in the catchment several decades ago as compared to current intensive dairy farming, and denitrification processes occurring in the older groundwater. Silica, leached from the aquifer material and accumulating in the water in proportion to contact time, is high at times of low streamflow. There was a good correlation between silica concentration and streamwater age, which potentially allows silica concentrations to be used as a proxy for age when calibrated by tritium measurements. This study shows that tritium dating of stream water is possible with single tritium measurements now that bomb-test tritium has effectively disappeared from hydrological systems in New Zealand.