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Land Surface Subsidence Caused by Groundwater Withdrawal in Southeastern Louisiana

In the past, water levels in the Baton Rouge area were generally above land surface and flowing wells were common. Since the 1950s, ground water withdrawals in East Baton Rouge parish for industrial and public supply uses have averaged approximately 100 million gallons per day. Long-term declines in water levels of approximately 0.3 m/yr. are evident in all of the major aquifers. As water levels decrease in major aquifers in response to pumping, water drains from interbedded clay confining layers. The weight of overlying sediments causes clays to compact. Most of the subsidence in the Baton Rouge area is believed to be the result of clay compaction. In this study, I construct a numerical model of one-dimensional compaction of clay confining layers due to vertical leakage of pore water into adjacent aquifers. Computed total subsidence from 1940 to 1975 is approximately 0.42 m, in good agreement with land surface subsidence estimated from releveling data. Computed total subsidence projected out to 2010 ranges from 0.669 to 0.765 m depending on the extent of water level decline after 2001. Model total subsidence rate increased from 1940 to 1969 reaching a peak of 0.018 m/yr. Model subsidence rate declined from 1970 to 1986 in response to decreased groundwater withdrawal by industry, reaching a minimum of 0.005 m/yr. Predicted subsidence rate has increased steadily since 1986 as groundwater use has increased and should reach rates equivalent to the maximum subsidence rate of 1969 by approximately 2007 if water levels in major aquifers continue to decline. Thick clay confining layers between the major aquifers in Southeastern Louisiana have a high potential for additional compaction and land surface subsidence. Subsidence over the next 50 years will continue as thick confining layers approach hydrologic equilibrium even if water levels in major aquifers remain at 2001 levels. Future land surface subsidence will accelerate, perhaps dramatically, if water levels continue to decline and irreversible clay compaction begins.