REPORT ON THE EFFECTS OF GROUNDWATER WITHDRAWALS ON THE SUSTAINABILITY OF THE SOUTHERN HILLS AQUIFER SYSTEM AND THE WATER SUPPLIES OF PARISHES WITHIN THE REGION DEPENDENT UPON GROUNDWATER RESOURCES

AS REQUESTED BY:
HOUSE CONCURRENT RESOLUTION NO. 115 OF 2016

FEBRUARY 27, 2017

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I. EXECUTIVE SUMMARY

The purpose of this report is to provide an evaluation of the effects of groundwater withdrawals on the sustainability of the Southern Hills Aquifer System and on the water supplies and water levels, including the lowering of the water table, of parishes currently relying on this groundwater source. Such an evaluation requires the creation of useable definitions and delineations, as well as an understanding of the complexities of groundwater hydrology and data collection and assessment. A brief outline is therefore in order.

Scope, Architecture, and Importance of the Southern Hills Aquifer System

The Southern Hills Aquifer System is a formation of aquifers layered one atop the other that stretches across 14,000 square miles in southwest Mississippi and southeast Louisiana. Inside Louisiana's borders, the system reaches west to the Atchafalaya Basin, south to Lake Pontchartrain, and east to the Pearl River, covering all of the Florida Parishes, along with the parishes of West Baton Rouge and Point Coupee. It is a large, prolific resource that supplies, on average, 290 million gallons a day to the ten-parish region identified in this study.[1] Its value to the region lies both in the availability of relatively large amounts of groundwater for beneficial use and the relatively consistent high quality of this groundwater.

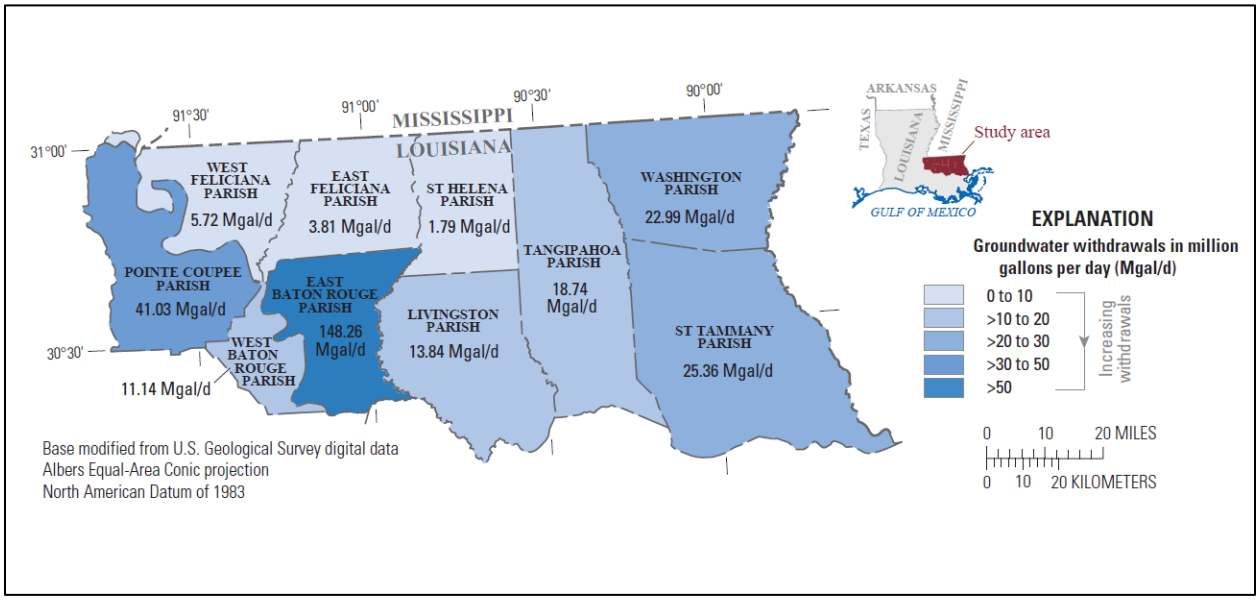


Fig. 1: Location of the 10-parish area overlying the Southern Hills Aquifer System, showing daily average groundwater withdrawals for 2014 (darker shading indicates greater withdrawal amounts). Source: Vincent E. White, *Water Resources of the Southern Hills Regional Aquifer System, Southeastern Louisiana*, USGS, Feb. 2017.

[1] Pointe Coupee, East and West Baton Rouge, East and West Feliciana, St. Helena, Livingston, Tangipahoa, Washington, and St. Tammany Parishes. Water use data compiled by the U.S. Geological Survey (USGS).

In terms of its architecture, the Southern Hills Aquifer System consists of a number of major aquifers (or "sands") ranging from approximately 400-feet to 2800-feet deep (Fig. 2). The USGS classifies these sands into shallow, mid-range, and deep system groupings known respectively as the Chicot Equivalent, Evangeline Equivalent, and Jasper Equivalent (Fig. 2 & 3). Generally speaking, there is some level of communication between aquifers in a system, although by no means consistent due to the highly variable nature of the formations themselves and/or the relative thickness of confining layers separating them. Also, the names of the individual formations vary depending upon regional location within the overlay area. The Mississippi River Alluvial Aquifer—available for use in some of the parishes along the western edge of the region—is excluded from this study because of its depth of less than 400 feet.

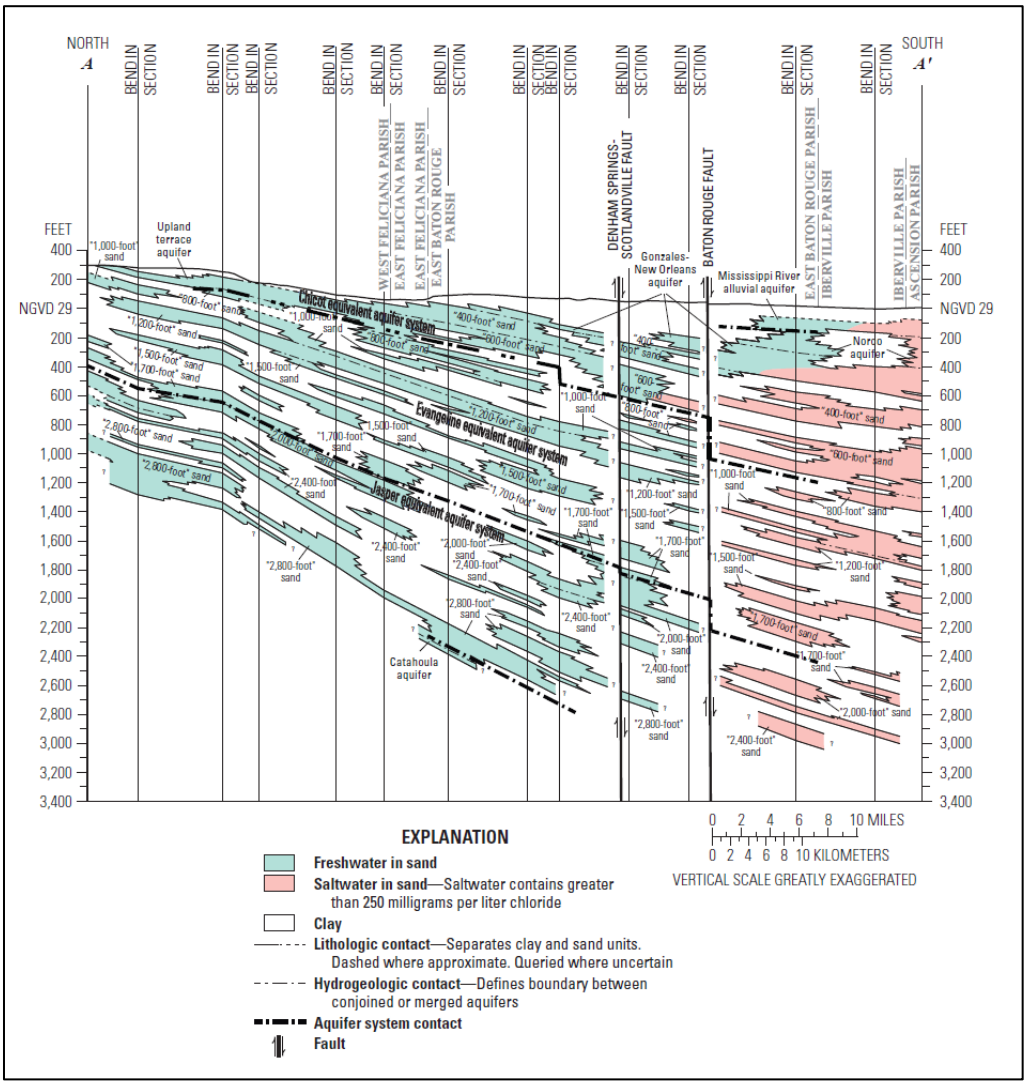


Fig. 2: Generalized north-to-south hydrogeologic section through the western part of the Southern Hills Aquifer System, showing the Chicot, Evangeline, and Jasper Equivalent System classifications and the generalized extent of saltwater in local sands. Source: White, *Southern Hills Regional Aquifer System.*

Aquifer System	Overlying Parishes	Overlying Parishes
	East Baton Rouge East Feliciana Livingston Pointe Coupee St. Helena West Baton Rouge West Feliciana	St. Tammany Tangipahoa Washington
Chicot Equivalent Aquifer System	400-foot sand 600 foot sand	Upland Terrace Upper Pontchatoula
Evangeline Equivalent Aquifer System	800-foot sand 1000-foot sand 1200-foot sand 1500-foot sand 1700-foot sand	Lower Pontchtoula Big Branch Kentwood Abita Covington Slidell
Jasper Equivalent Aquifer System	2000-foot sand 2400-foot sand 2800-foot sand	Tchefuncte Hammond Amite Ramsay Franklin

Fig. 3: USGS classification of aquifers within the Southern Hills Aquifer System. Source: USGS.

The Southern Hills Aquifer System provides fresh groundwater for public supply purposes in the ten parishes of Pointe Coupee, West Baton Rouge, East Baton Rouge, West Feliciana, East Feliciana, Livingston, St. Helena, Tangipahoa, Washington, and St. Tammany (referenced in HCR 115 as those "ten parishes in and surrounding the Capital Area Region"). The system also supplies groundwater in these parishes for industrial purposes—especially in East Baton Rouge—as well as for power generation and agriculture/irrigation needs (Fig. 4). Average system-wide withdrawals have doubled since 1960 (Fig. 5).

Use Category	Volume (Mgal/d)
Public Supply	140.34
Industrial	94.34
Power Generation	9.69
General Irrigation	23.18
Rice Irrigation	3.47
Rural Domestic	12.83
Livestock	0.57
Aquaculture	8.23
Total	**292.65**

Fig. 4: Groundwater withdrawals, 2014, in million gallons per day, by use category in the 10-parish area overlying the Southern Hills Aquifer System. Source: USGS.

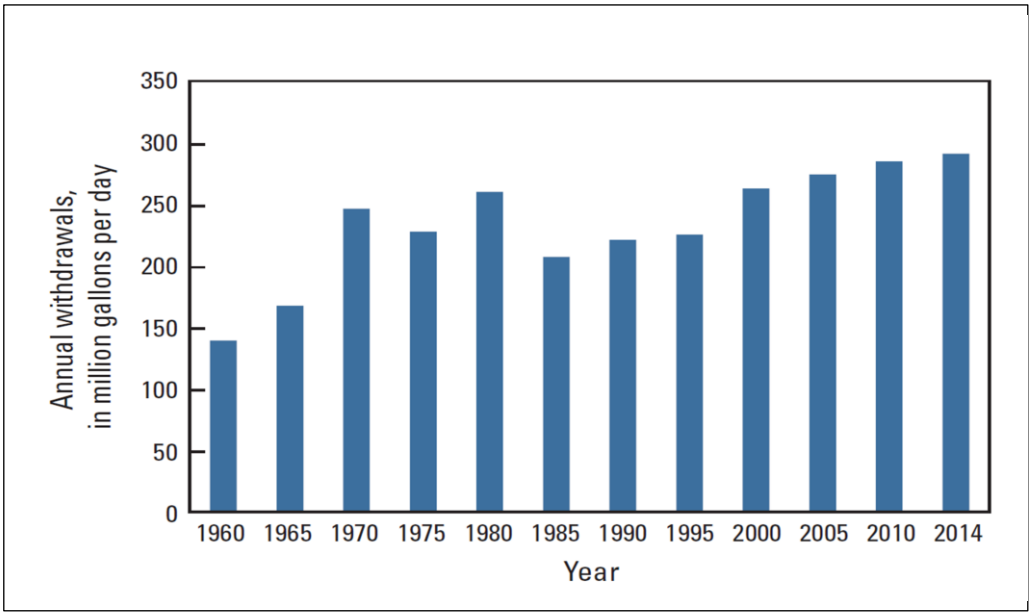


Fig. 5: Average daily groundwater withdrawals from the 10 parishes overlying the Southern Hills Aquifer System, 1960-2014. Source: White, *Southern Hills Regional Aquifer System*.

Definition of Sustainability

In order to gauge sustainability or sustainable use in the region of the Southern Hills Aquifer System, the Office of Conservation must utilize the definition established in state law. Ch. 13-A-1. Water Resources Management, La. R.S. 38:3097.2, states that, "Sustainability means the development and use of ground water in a manner that can be maintained for the present and future time without causing unacceptable environmental, economic, social, or health consequences." The agency also assesses aquifer sustainability as authorized in La. R.S. 38:3097.3.C.(2) and (3) for unacceptable effects such as the movement of saltwater fronts, water level decline, and subsidence of land surface caused by groundwater withdrawal.

The Office of Conservation has established a sustainability timeframe for this report that extends from the present into the near future (five years) based on the reasonable expectation that: 1) assumptions about major groundwater demand factors such as population and economic growth will continue to be refined for accuracy and reliability based on new data; 2) the statewide groundwater resource monitoring network and reporting system will continue to be available for identifying unacceptable longer-term groundwater level and quality trends; and 3) any future unacceptable (non-sustainable) aquifer conditions that may arise will be managed in accordance with the existing governmental and legal framework.

For the purposes of completing the requested study, certain terms used in HCR 115 require further definition as well. The Office of Conservation interprets "water supplies" as encompassing a matrix of groundwater quantity and quality, that is, is there a sufficient amount of groundwater for current and reasonably expected near-future

beneficial use and is this groundwater of sufficient quality for such use. Sufficient quality presumes few or no chloride issues (as represented by chloride and total dissolved solids measurements) as a result of saltwater encroachment caused by water level drawdowns.

"Water levels" can reasonably be assumed to infer volumes, or quantity, of groundwater within an aquifer available for beneficial use. Use of the term "water table" can really only apply to the northern portions of the Florida Parishes within the Southern Hills Aquifer System where the 400- and 600-foot sands outcrop and recharge. In this area, the water level of these unconfined aquifers is nearly interchangeable with the measurement of the water table.

Importance of a Groundwater Monitoring Network

A note on the importance of groundwater resource monitoring is appropriate here as overall management of the Southern Hills Aquifer System is dependent on the maintenance of such a program. The Capital Area Ground Water Conservation Commission has long maintained a monitor well network in its five-parish district. The Department of Transportation and Development (DOTD) also has maintained a statewide monitor well network that includes additional sites in the parishes overlying the Southern Hills Aquifer System. Both of these networks are serviced through agreements with the USGS.

Moreover, in a recently completed four-year project (2012-2016) funded with Federal dollars, the Department of Natural Resources (DNR), in conjunction with the USGS, doubled the number of monitor wells in the DOTD network as part of an effort to provide a baseline for future management activities. Importantly, DNR, with the support of the Louisiana Water Resources Commission and the cooperation of the USGS and DOTD, was able to keep the bulk of this expanded network intact even after the project ended.[2]

It is expected that with current funding levels, the USGS will be able to maintain this network in place going forward and that it will be sufficient for the state's needs. The current network does have the capacity to expand as demand and funding allow so that future developments that may lead to increased groundwater withdrawals, such as, for example, an uptick in energy development in the Tuscaloosa Marine Shale—part of which lies beneath the regional overlay of the Southern Hills Aquifer System—or continued population growth in certain areas, can be monitored effectively for sustainability.

[2] Louisiana Water Resources Commission, *Report on Activities*, Feb. 2017, 10-14.

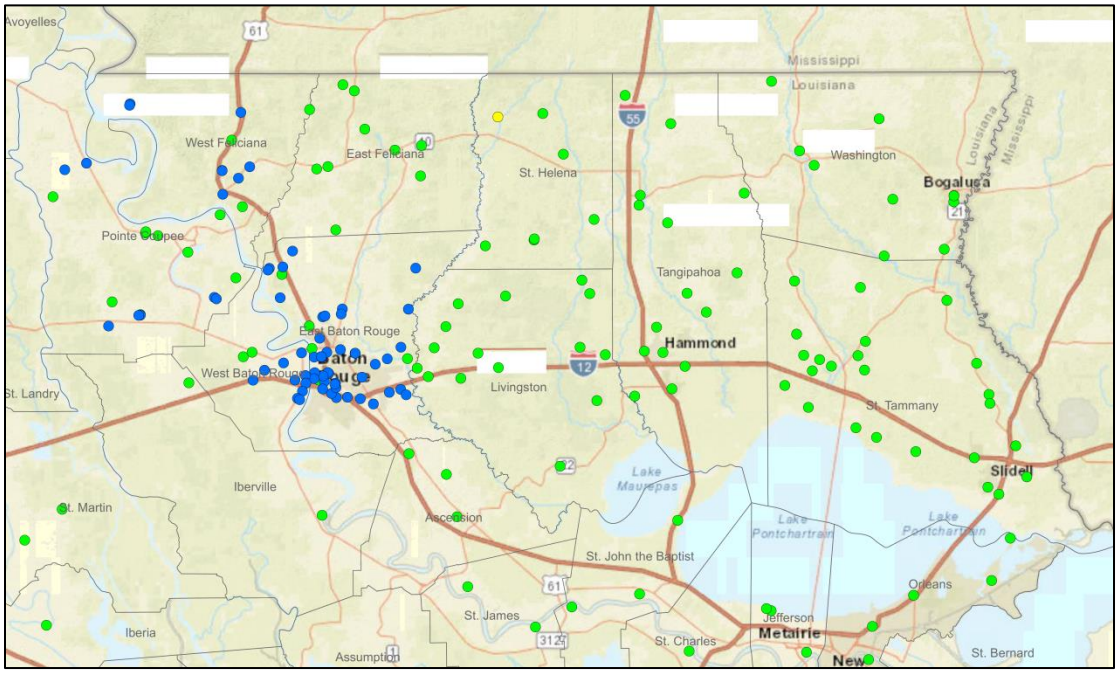


Fig. 6: The groundwater monitor network in the 10-parish area overlying the Southern Hills Aquifer System. Green dots indicate wells monitored by the USGS for DOTD (including wells added through the DNR/USGS expanded monitoring project). Blue dots represent wells monitored by the USGS for the Capital Area Ground Water Conservation Commission. Source: USGS.

Research Prospectus and Summary of Findings

Working within the definitions provided above regarding sustainability and a sustainability timeframe, Office of Conservation staff analyzed groundwater level data, chloride level data, scientific and government reports, and parish groundwater use data collected by the USGS—the latter acquired through the Commissioner of Conservation's statutory authority—to evaluate overall sustainability in the Southern Hills Aquifer System. Individual parish information is provided in Part II of this report. However, a general assessment can be made at this time for the whole system.

Overall, groundwater withdrawals in the 10-parish region overlying the Southern Hills Aquifer System have doubled since first measured and/or estimated in 1960. Consistent with such an increase in use, water level declines inside local aquifers are evident, to a lesser or greater degree, in all sample wells reviewed. Within the more recent timeframe of the past 15 or 20 years, though, groundwater levels appear to have stabilized in many places throughout the region. It is important not to equate these new, mostly static lower levels with unsustainable conditions unless quantity and quality issues factor into the mix. Such issues have not become apparent based on scientific observations in most places within the region except at Baton Rouge, where ongoing saltwater encroachment is well documented.

Therefore, the Office of Conservation finds:

1. **Groundwater withdrawals from the Southern Hills Aquifer system to be substantially sustainable for the near future (the next five years) across the region, with little to no impact on water supplies for those parishes dependent upon groundwater resources; and**

2. **Already reported and acknowledged unacceptable effects on sustainability in East Baton Rouge Parish caused by current and projected groundwater withdrawals in certain sands.**

The scope of the problem in the Baton Rouge area merits special consideration in this section of the report. East Baton Rouge alone consumes over half of the total groundwater pumpage from the Southern Hills Aquifer System and these withdrawals over the past 60 years or more have lowered local aquifer water levels significantly. Moreover, groundwater level declines have been noted in certain aquifers in the parishes of West Baton Rouge and Pointe Coupee that correlate closely to the large withdrawals in the same aquifers in East Baton Rouge. Even more, potentiometric maps completed by the USGS clearly show that the pumpage at Baton Rouge is controlling the directional flow of groundwater in these same aquifers in the region, including in some cases as far away as the Felicianas and Livingston and St. Helena parishes.[3]

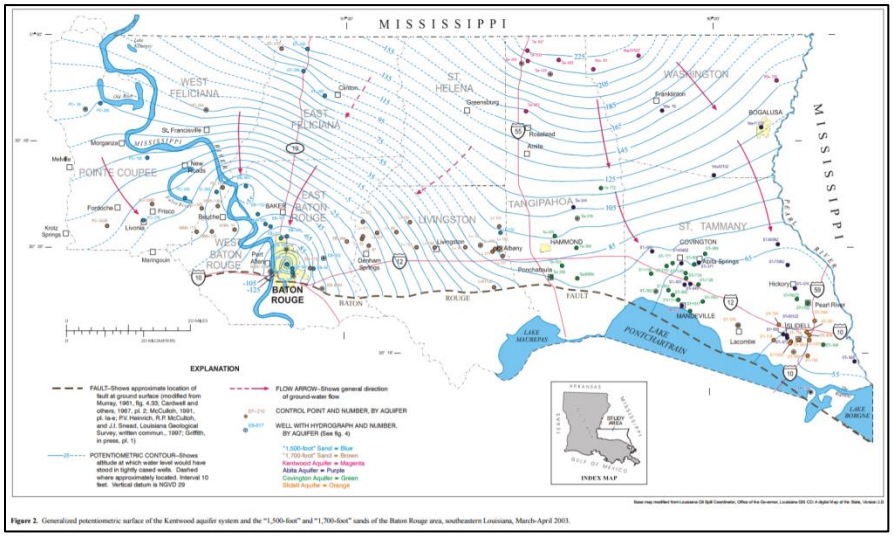


Fig. 7: Groundwater flow in the 1500- and 1700-foot sands of the Southern Hills Aquifer System (Evangeline Equivalent). L.B. Prakken, *Louisiana ground-water map no. 17: Generalized potentiometric surface of the Kentwood aquifer system and the "1500-foot" and "1700-foot" sands of the Baton Rouge area in southeastern La., March-April 2003*, 2004.

[3] See the following USGS reports: J.M. Griffith and J.K. Lovelace, *Louisiana ground-water map no. 15: Potentiometric surface of the "1200-foot" sand of the Baton Rouge area, Louisiana, spring 2001*, 2003; J.M. Griffith and J.K. Lovelace, *Louisiana ground-water map no. 16: Potentiometric surface of the "1500-foot" sand of the Baton Rouge area, Louisiana, spring 2001*, 2003; L.B. Prakken, *Louisiana ground-water map no. 17: Generalized potentiometric surface of the Kentwood aquifer system and the "1500-foot" and "1700-foot" sands of the Baton Rouge area in southeastern Louisiana, March-April 2003*, 2004; R.B. Fendick, Jr., *Louisiana ground-water map no. 22: Generalized potentiometric surface of the Amite aquifer and the "2800-foot" sand of the Baton Rouge area in southeastern Louisiana, June-August 2006*, 2007.

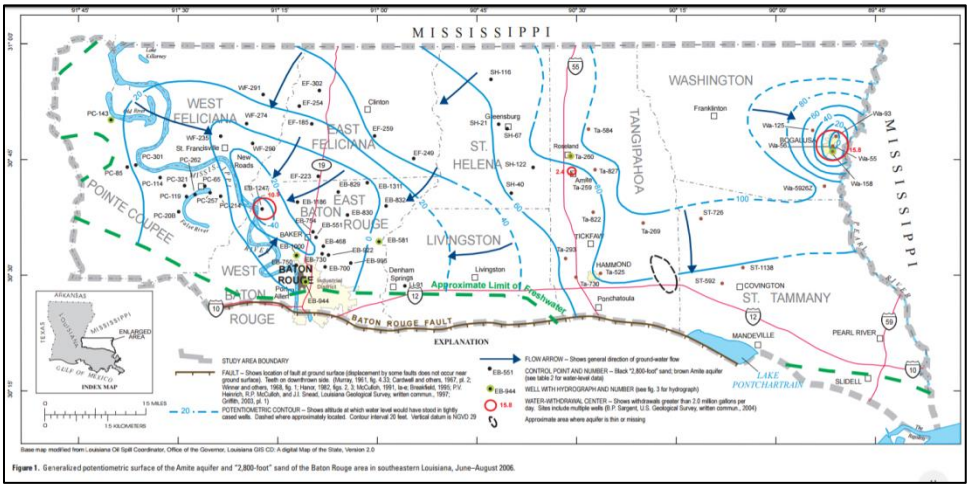


Fig. 8: Groundwater flow in the 2800-foot sand of the Southern Hills Aquifer System (Jasper Equivalent). R.B. Fendick, Jr., *Louisiana ground-water map no. 22: Generalized potentiometric surface of the Amite aquifer and the "2800-foot" sand of the Baton Rouge area in southeastern La., June-August 2006*, 2007.

The more concerning aspect of this heavy groundwater use in East Baton Rouge is the fact that it has pulled saltwater across the Baton Rouge Fault that runs through the parish and across most of southeast Louisiana. Saltwater encroachment has been detected in seven of the 10 sands beneath Baton Rouge, with the saltwater wedges in the 1500- and 2000-foot sands considered the most serious in terms of potential impact upon water supplies.[4]

The Capital Area Ground Water Conservation Commission (CAGWCC)—created by the Legislature in 1974 with front-line management authority of this situation—has adopted aquifer-specific groundwater production limits to slow saltwater encroachment in the 1500- and 2000-foot sands and has contracted with the USGS to model the entire aquifer system at Baton Rouge for management purposes. The CAGWCC also has embraced the "scavenger well" concept as a means to protect groundwater production at vulnerable well fields in the 1500- and 2000-foot sands.[5] In particular, the currently operational 1500-foot "scavenger well" is intended to shield a major public supply production center of the Baton Rouge Water Company located at the Lula Pumping Station.[6] The 2000-foot "scavenger well"—still in planning—is intended to eventually shield an industrial production center (primary) north of the State Capitol along with another public supply center (secondary). While this technology has the potential to protect the viability of groundwater production at these well fields for several decades,

[4] Commissioner of Conservation James H. Welsh to Capital Area Ground Water Conservation Commission, January 14, 2013, specifically, "The 1500 and 2000 foot sands of the Southern Hills aquifer system located in the Baton Rouge area are not being used in a manner that can continue indefinitely without causing unacceptable environmental, economic, social, or health consequences."

[5] CAGWCC, "Plan for Management of the Southern Hills Aquifer System in the Baton Rouge Area, April 8, 2014." See also, Anthony J. Duplechin, "Taking a Logical Approach to Addressing Saltwater Intrusion in Baton Rouge, Louisiana," *Louisiana Civil Engineer*, v. 21, no. 4 (August 2013).

[6] Rhett Moore, Vic Kelson, and Erik Anderson, "Remedial Options for Saltwater Encroachment in the 1500-ft Sand" (Lane Hydro Report), 2011.

as noted in published reports,[7] several more years of observation are required to prove the effectiveness of these assertions.[8] Moreover, it is acknowledged that "scavenger wells" do not halt the continued flow of saltwater into an aquifer but serve only to temporarily remediate encroachment within their immediate capture area.

The most recent published information from the USGS indicates that saltwater continues to encroach into the 1500- and 2000-foot sands further away from the Baton Rouge Fault and towards these respective pumping centers at a rate that threatens to compromise long-term sustainability of the aquifer system in the Baton Rouge area.[9] Yet local groundwater usage appears sustainable in the *near future* (over the next five years) based on current and expected demand, with only minimal projected impacts without any additional management actions other than the ones already taken.

It is expected that the CAGWCC, with its extensive regulatory authority, will continue to evolve its organization and management activities to meet these challenges in an open, transparent, and accountable manner that places the utmost emphasis on protection and conservation of the aquifer system at Baton Rouge for the long-term. Certainly, the Office of Conservation will continue to provide aggressive oversight of the entire system and work in conjunction with the CAGWCC to perfect its management plans.[10]

[7] Dr. Frank T.-C. Tsai, " Scavenger Well Operation Model to Assist BRWC to Identify Cost-Effective Approaches to Stop Saltwater Intrusion toward the BRWC Water Wells in the '1500-ft' Sand of the Baton Rouge Area," 2011.

[8] Baton Rouge Water Company to Office of Conservation email correspondence, 13 September 2016. Specifically, "The hydrologists who originally designed the Scavenger Well Couple had estimated that it would take around five years to reflect any real impact of chloride removal at the Lula Pump Station, due to the transmissivity of the formation and the physical separation. The station was placed on line [in] March of 2014."

[9] See the following USGS reports: J.K. Lovelace, *Chloride concentrations in East and West Baton Rouge, 2004-05*, 2007, and C.E. Heywood, J.M. Griffith, and J.K. Lovelace, *Simulation of groundwater flow in the "1,500-foot" sand and "2000-foot" sand, with scenarios to mitigate saltwater migration in the "2,000-foot" sand of the Baton Rouge area, Louisiana*," 2014.

[10] See Office of Conservation Order No. ENV 2012-GW011, "Order Concerning Management Planning Strategy and Agency Actions to Address Sustainability of the Southern Hills Aquifer System Underlying the City of Baton Rouge and Surrounding Areas," May 23, 2012; Welsh to CAGWCC, January 14, 2013 (cited previously); Commissioner of Conservation James H. Welsh to CAGWCC, November 27, 2013; and through official agency representation on the CAGWCC, Regular Quarterly Minutes of the CAGWCC, 2013 to 2016, available at http://www.cagwcc.com.

II. Review of Regional and Parish Information

Capital Area Ground Water Conservation District

*The following description is adapted from the official informational pamphlet of the Capital Area Ground Water Conservation Commission (CAGWCC).

The Capital Area Ground Water Conservation District (CAGWCD) was created by the Louisiana Legislature in 1974 and includes the parishes of East and West Baton Rouge, East and West Feliciana, and Pointe Coupee. Groundwater resources in the District are administered by the CAGWCD's governing board, the CAGWCC. The Legislature established the CAGWCD and CAGWCC due to concerns about overuse of local groundwater resources that had led to water level declines and saltwater encroachment inside local aquifers, along with potential land subsidence. Today, groundwater continues to meet the needs of more than a half-million people in the CAGWCD, along with those of numerous light businesses, small-scale agricultural operations, and heavy industries.

Members of the CAGWCC are appointed by the Governor and include representatives of various user groups (industry, public supply, and agriculture) in the CAGWCD, local parish governments, and state regulatory agencies, including the Office of Conservation and the Department of Environmental Quality. The CAGWCC issues permits on a case by case basis to individuals or corporate entities wishing to install, or already operating, an individual water well or set of wells within the CAGWCD that pumps more than 50,000 gallons of groundwater on any day during the calendar year. Currently, there are 58 regulated users with permitted water wells within the CAGWCD. These include public supply providers, power generation and industrial facilities, and commercial users.

The CAGWCC has the authority to conduct scientific investigations and research, collect data and make inspections, permit large-volume water wells, undertake special projects and acquire property, set groundwater use priorities and production limits, and assess a uniform groundwater use fee on permitted users to effectively manage local groundwater resources and prevent or limit saltwater encroachment and land subsidence. Fees generated by the groundwater use fee (currently about $600,000 annually) fund the CAGWCC's operations, projects, and investigations. The funds also pay a part-time director and full-time administrative assistant.

East Baton Rouge Parish

Approximately 89% of regulated groundwater use within the CAGWCD is located in East Baton Rouge Parish.[11] The large volume groundwater withdrawals (about 145 million gallons a day presently) that have lowered water levels inside local aquifers and presently control the directional flow of groundwater across much of the Southern Hills Aquifer System also have caused saltwater to encroach into the freshwater sands at Baton Rouge. Groundwater investigations in the 1960s first identified this interface near the Baton Rouge Fault which runs parallel to the Interstate 10 corridor before continuing east-southeast across the Florida Parishes. While water levels have reached a stasis or actually begun to trend upwards in some cases since about 2000, saltwater flow inside the aquifers remains unimpeded. The flow is towards the main centers of pumping activity inside the affected aquifers.

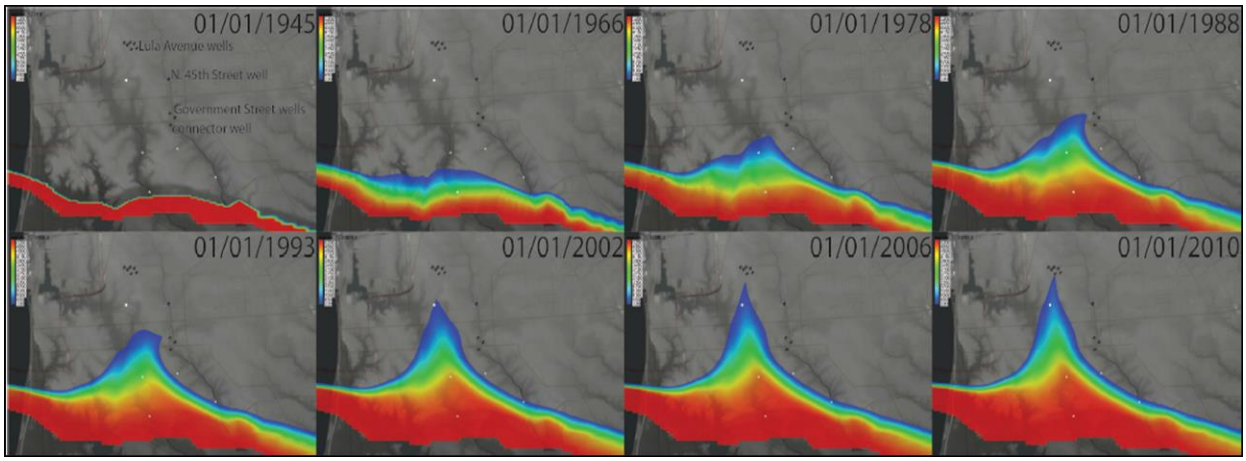


Fig. 9, Saltwater intrusion approach towards Lula Pumping Station in the 1500-foot sand, Baton Rouge, 1945-2010. Dark blue represents a concentration of 250 mg/l, the upper limit of EPA's safe drinking water guideline. Source: Frank T.-C. Tsai, et al., "Feasibility Study of Scavenging Approach to Stop Saltwater Toward Water Wells," 2012.

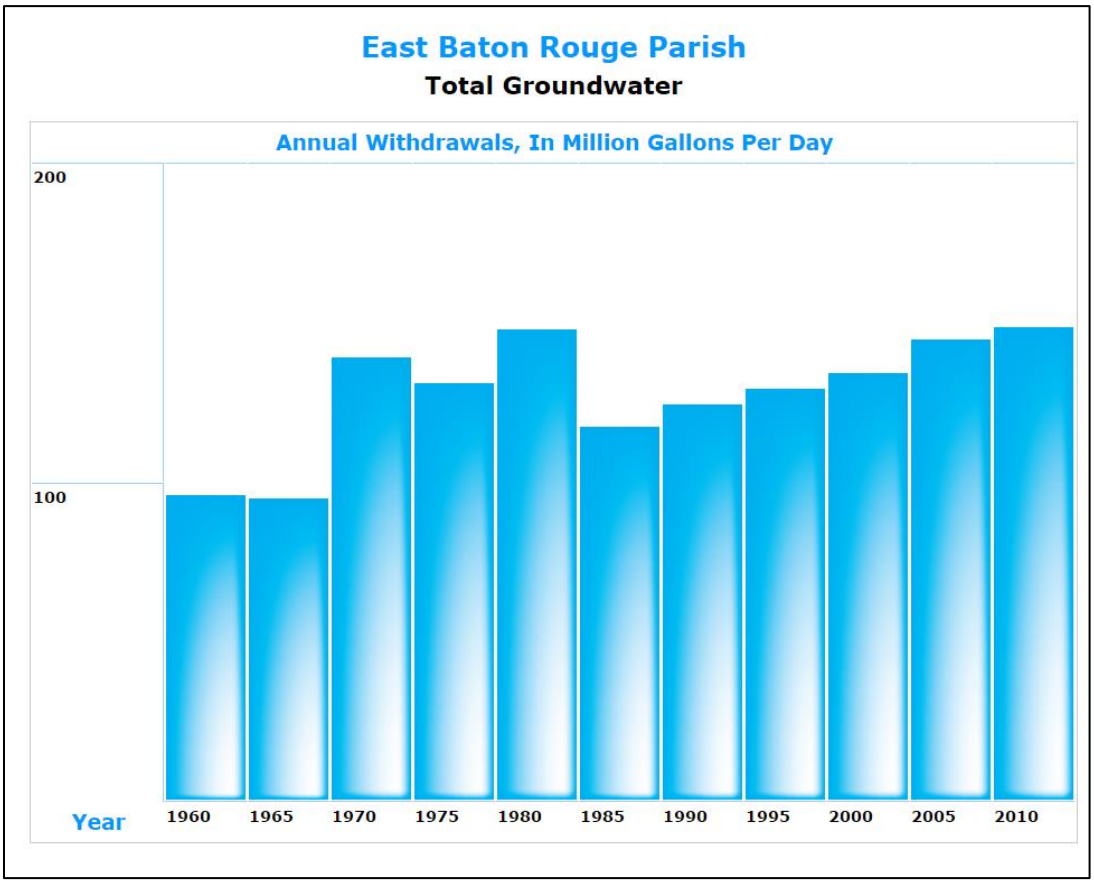
As noted in the Executive Summary, the most immediate threats in terms of impact to water supplies are the saltwater fronts in the 1500- and 2000-foot sands. The CAGWCC has taken action to restrict pumpage in these sands and also to employ "scavenger well" technology. It is important to note, however, that neither of these actions halt or remediate completely the saltwater intrusion, but rather serve to slow the rate of flow and, in the case of the "scavenger wells," remove chlorides from the system before they have reached major production centers. The Baton Rouge Water Company has stated explicitly that the goal of the 1500-foot scavenger well is simply to "reduce the amount of chlorides progressing towards the Company's Lula Pump Station

[11] CAGWCC 2015 Groundwater Report ("Act 790" Report), April 22, 2016.

in order to extend the stations [*sic*] useful life by about fifty years."[12] It is expected that chloride levels will continue to build in front of the scavenger wells since the saltwater flow is unabated. At some point in the *longer-term* future, the build-up of chlorides likely will have the potential to overwhelm the capacity of any scavenger well in-place and/or move around its flanks to compromise the continued viability of the production center.

There are currently no publicly released plans for major groundwater pumpage reductions from the users in East Baton Rouge regulated by the CAGWCC.[13] Therefore, groundwater use at the present level or along a slightly upward trend seems a logical assumption, with all attendant consequences. This being the case, best management practice dictates continued, aggressive, deep contingency planning and reporting to the Legislature by the front-line regulator on alternative source use, employment of all available technologies, movement of water wells, or decommissioning of wells to ensure protection of the aquifer system for continued beneficial use in the long-term.

Figure 10.1: Groundwater Withdrawals, East Baton Rouge Parish, 1960-2010. Source: USGS.



[12] Baton Rouge Water Company to Louisiana Office of Conservation, Sept. 13, 2016.

[13] Commissioner of Conservation James H. Welsh to CAGWCC, Jan. 14, 2013, including summation of responses to groundwater use projections query in Order No. ENV 2012-GW011.

Figure 10.2: Groundwater Withdrawals, by Aquifer System, East Baton Rouge Parish, 2014. Source: USGS.

2014 Aquifer Withdrawals

East Baton Rouge Parish

Aquifer	Withdrawals in Mgal/day
Chicot Equivalent Aquifer System	16.49
Evangeline Equivalent Aquifer System	63.95
Jasper Equivalent Aquifer System	67.76
Mississippi River Alluvial Aquifer	0.06

Samples of Available Groundwater Monitor Well Information, by Aquifer System, East Baton Rouge Parish, 2000-2016

Fig. 10.3: Monitor well in the 400-foot sand, Chicot Equivalent Aquifer System, East Baton Rouge Parish, showing relative stasis and even a slight upward trend in water levels since 2000. Source: USGS.

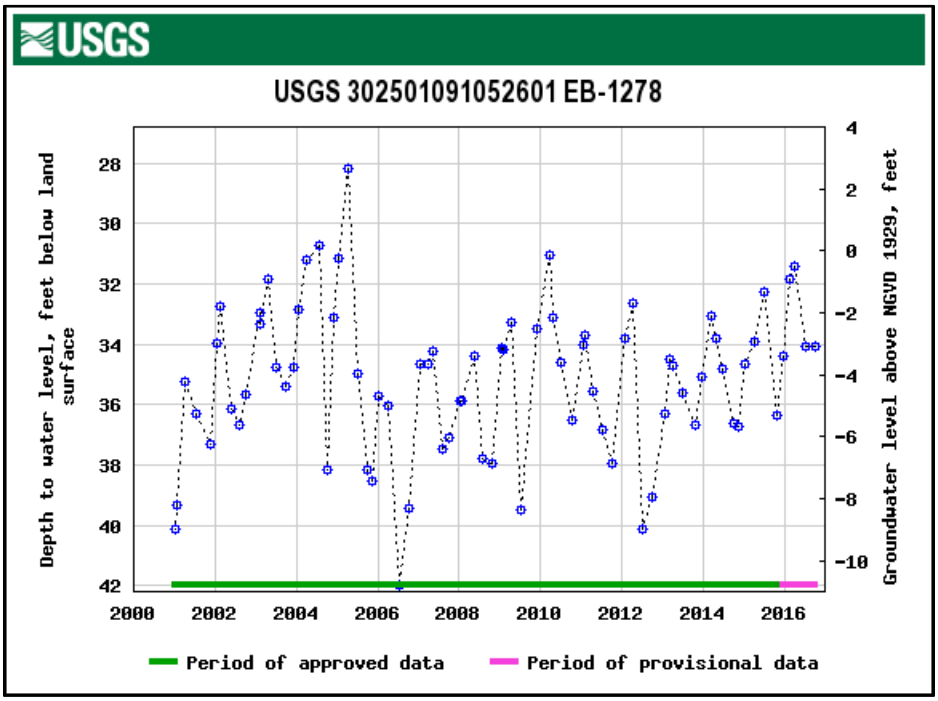


Fig. 10.4: Monitor well in the 600-foot sand, Chicot Equivalent Aquifer System, East Baton Rouge Parish, showing expected declines since 2000, and relative stasis since 2010. Source: USGS.

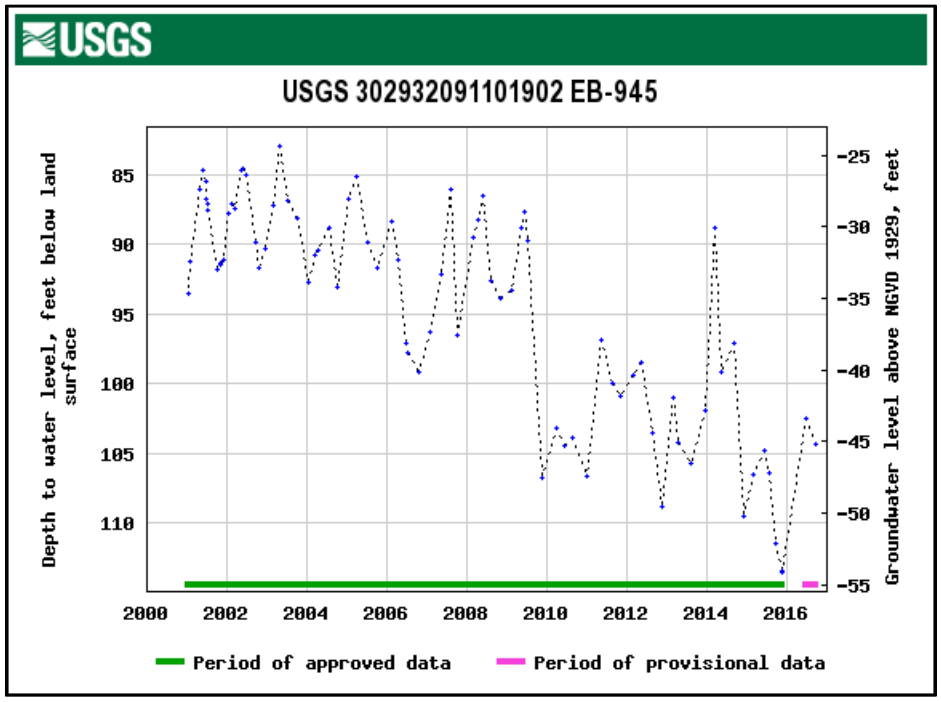


Fig. 10.5: Monitor well in the 800-foot sand, Evangeline Equivalent Aquifer System, East Baton Rouge Parish, showing relative stasis since 2010. Source: USGS.

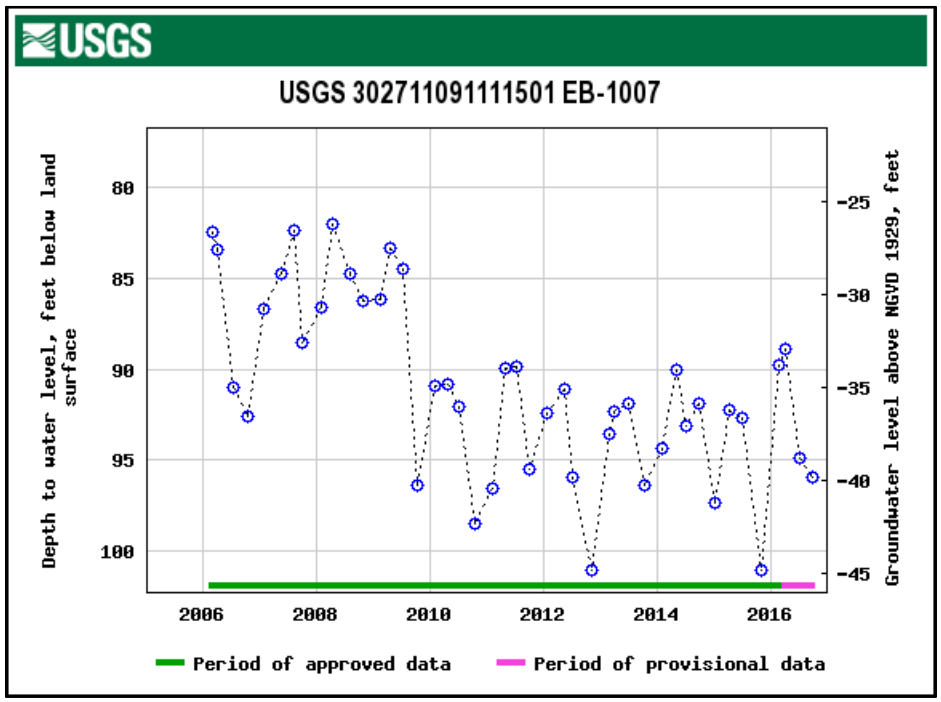


Fig. 10.6: Monitor well in the 1500-foot sand, Evangeline Equivalent Aquifer System, East Baton Rouge Parish, showing upward trend since 2007. Source: USGS.

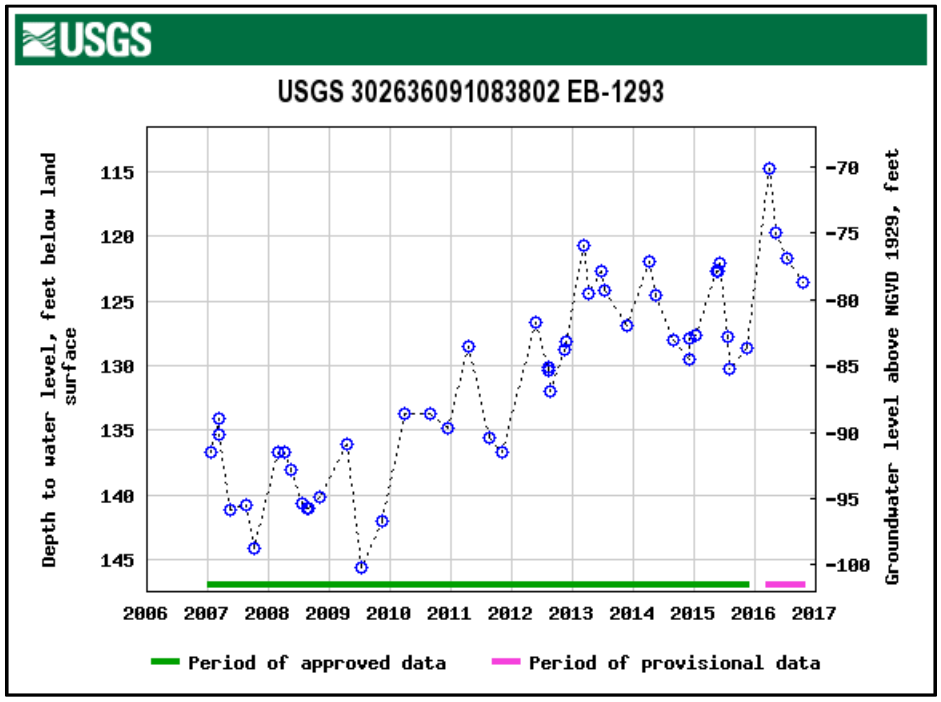


Fig. 10.7: Monitor well in the 1700-foot sand, Evangeline Equivalent Aquifer System, East Baton Rouge Parish, showing slight upward trend over the past two years. Source: USGS.

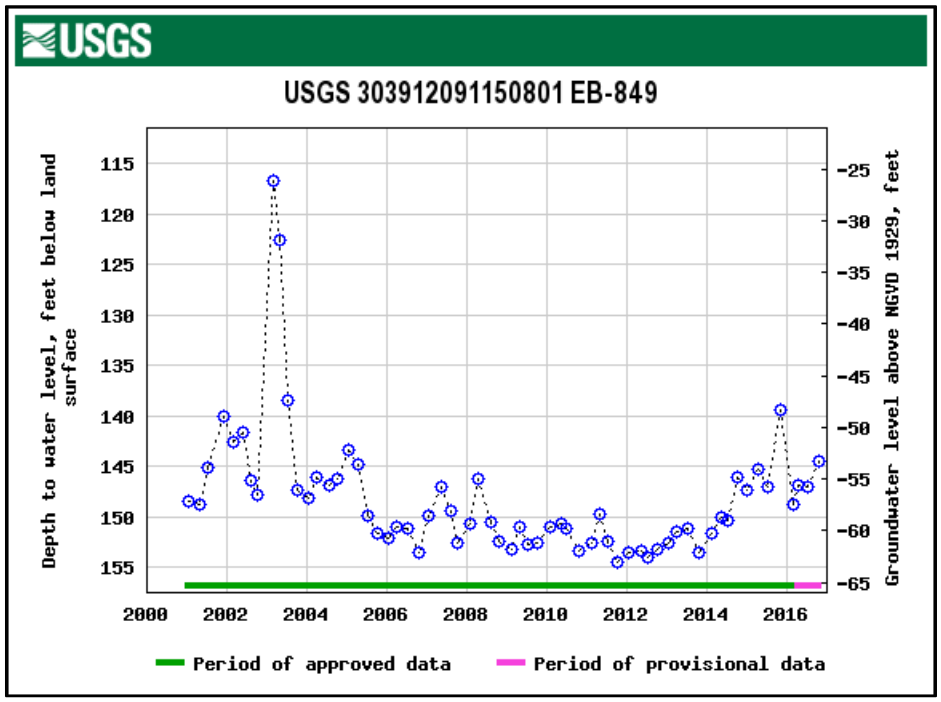


Fig. 10.8: Monitor well in the 2400-foot sand, Jasper Equivalent Aquifer System, East Baton Rouge Parish, showing relative stasis since 2000. Source: USGS.

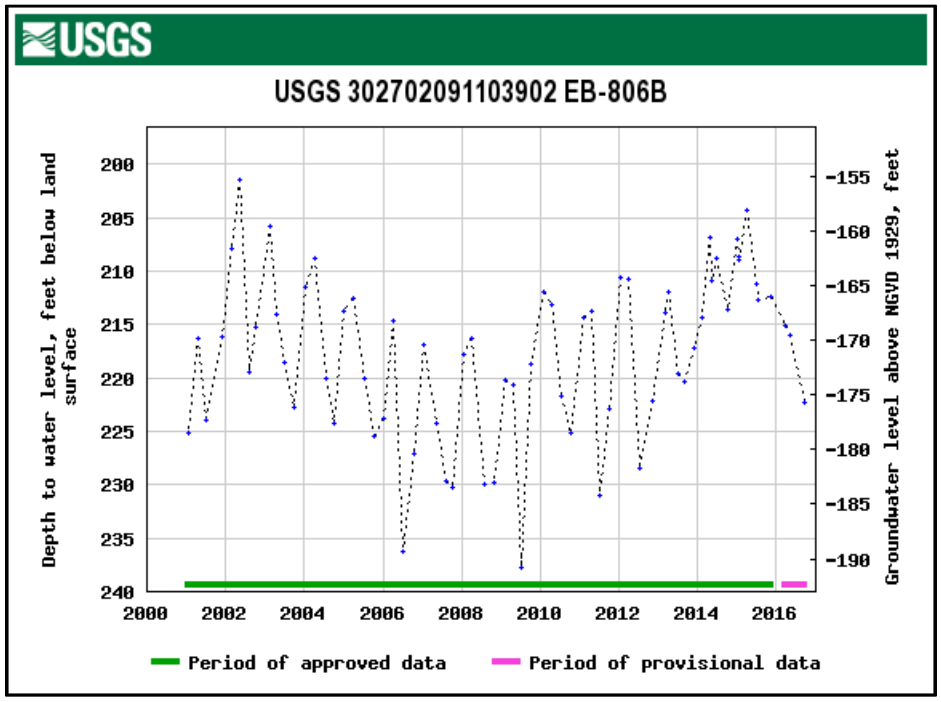
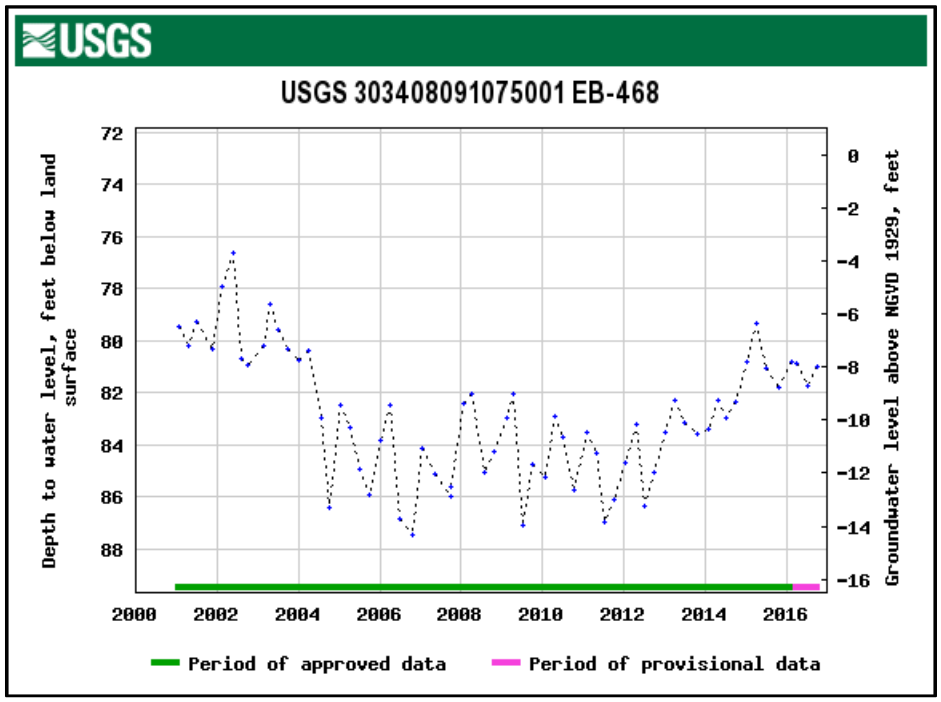


Fig. 10.9: Monitor well in the 2800-foot sand, Jasper Equivalent Aquifer System, East Baton Rouge Parish, showing decline, relative stasis, and upward trend since 2012. Source: USGS.



West Baton Rouge Parish

Groundwater usage in West Baton Rouge Parish has declined by approximately four million gallons per day since 2000, as reflected in Fig. 11.1 and Fig. 11.2. As the population of the parish continues to grow, however, demand for deeper and better quality groundwater resources likely will increase, shifting a larger percentage of the usage from the shallow Mississippi River Alluvial Aquifer utilized primarily in agriculture. As noted previously, there are water level declines noted in some aquifers in West Baton Rouge Parish due to their proximity to heavy pumpage from similar sands in East Baton Rouge. Also, chloride issues have been reported in the 1500-foot sand and 2400-foot sand, and possibly in the 1200-foot sand, according to the USGS. While these situations require close monitoring and potential management action, near future usage remains sustainable.

Figure 11.1: Groundwater Withdrawals, West Baton Rouge Parish, 1960-2010. Source: USGS.

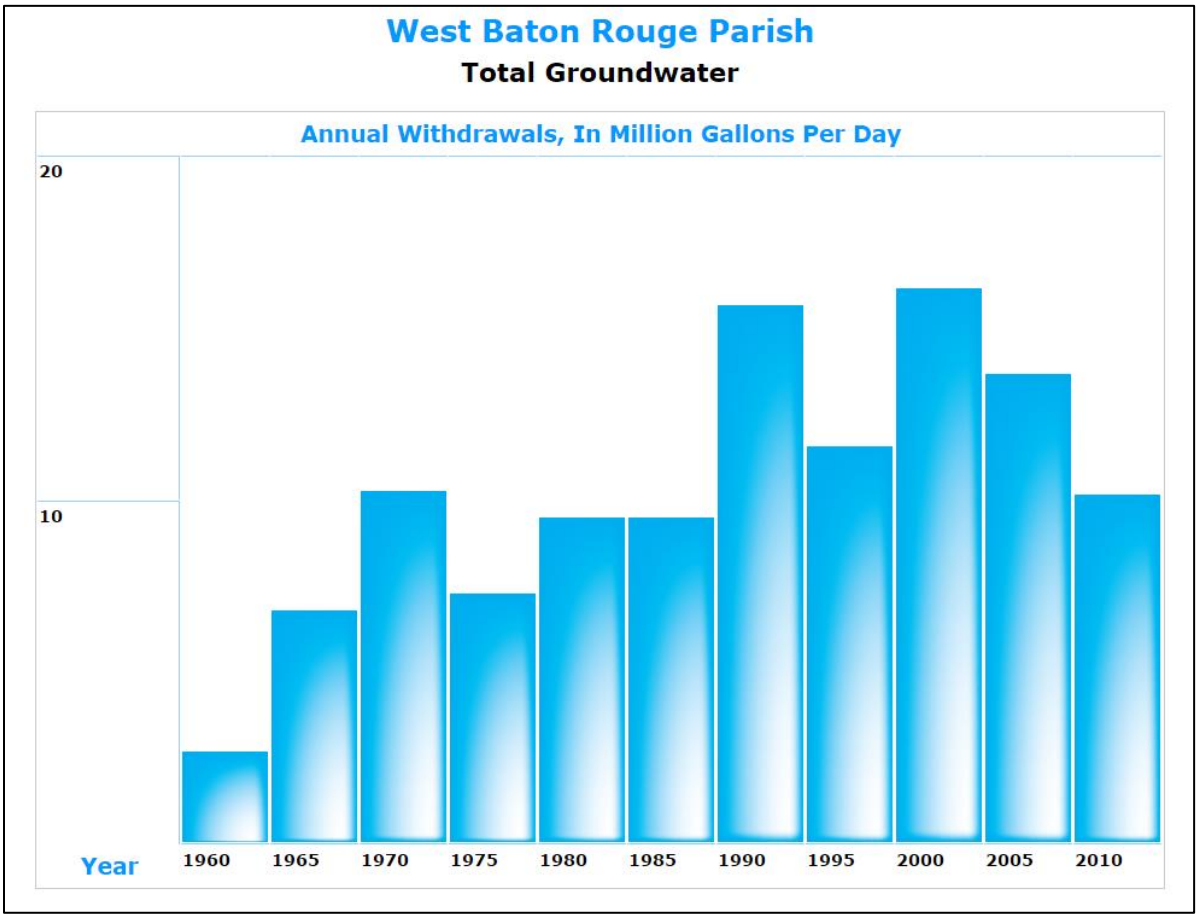


Figure 11.2: Groundwater Withdrawals, by Aquifer System, East Baton Rouge Parish, 2014. Source: USGS.

2014 Aquifer Withdrawals

West Baton Rouge Parish

Aquifer	Withdrawals in Mgal/day
Chicot Equivalent Aquifer System	0.01
Evangeline Equivalent Aquifer System	7.26
Jasper Equivalent Aquifer System	0.00
Mississippi River Alluvial Aquifer	3.87

Samples of Available Groundwater Monitor Well Information, by Aquifer System, West Baton Rouge Parish, 2000-2016

Fig. 11.3: Monitor well in the 400-foot sand, Chicot Equivalent Aquifer System, West Baton Rouge Parish, showing relative stasis since 2001. Source: USGS.

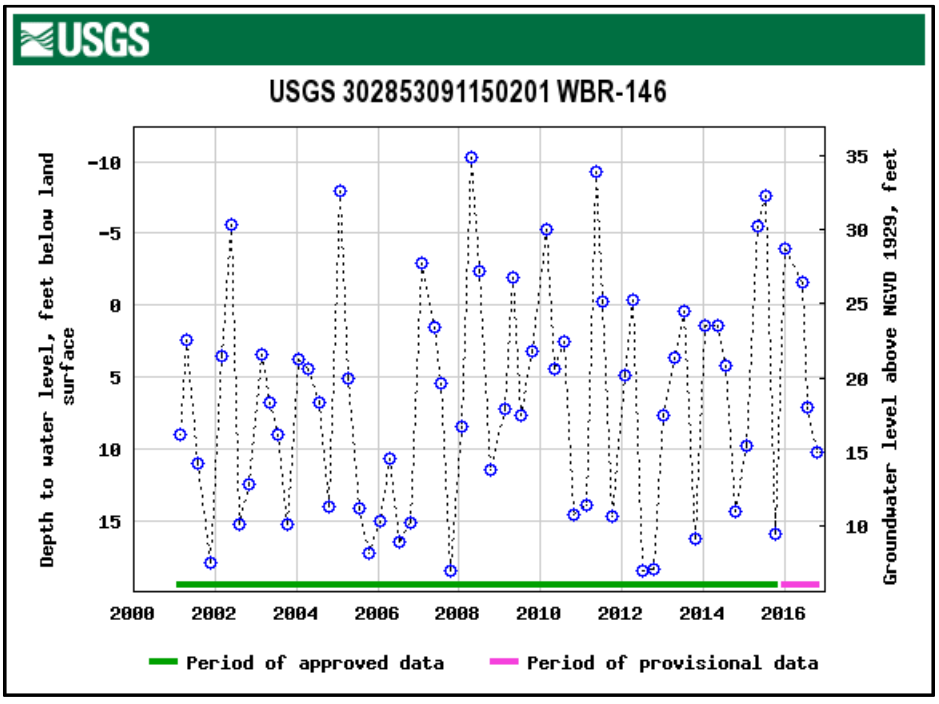


Fig. 11.4: Monitor well in the 600-foot sand, Chicot Equivalent Aquifer System, West Baton Rouge Parish, showing downward trend since early 2000s. Source: USGS.

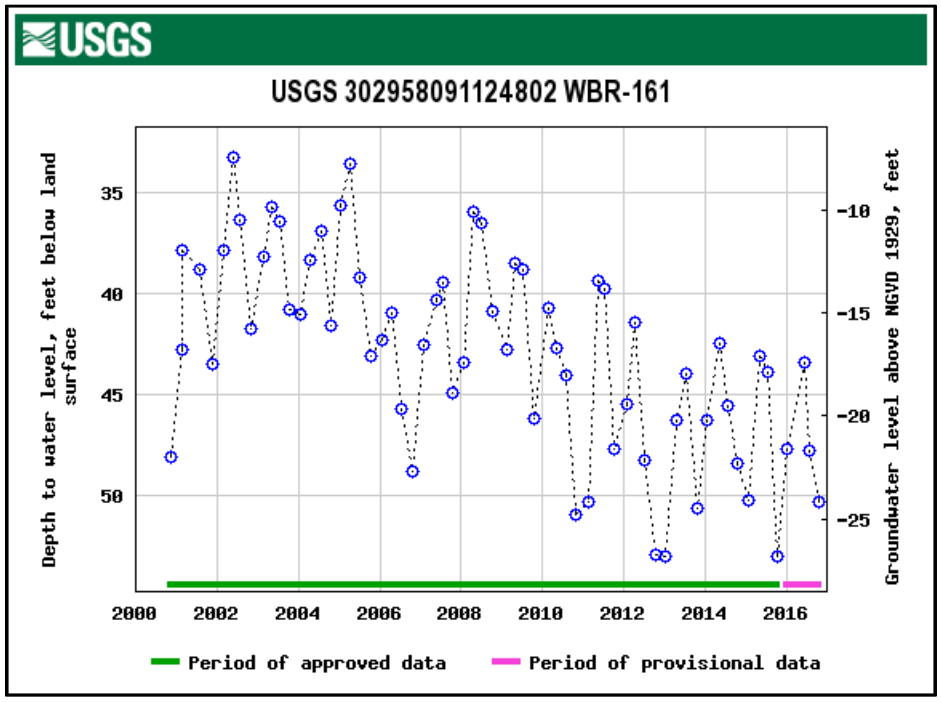


Fig. 11.5: Monitor well in the 1200-foot sand, Evangeline Equivalent Aquifer System, West Baton Rouge Parish, showing downward trend since early 2000s. The Evangeline Equivalent is the most heavily used groundwater resource in West Baton Rouge. Source: USGS.

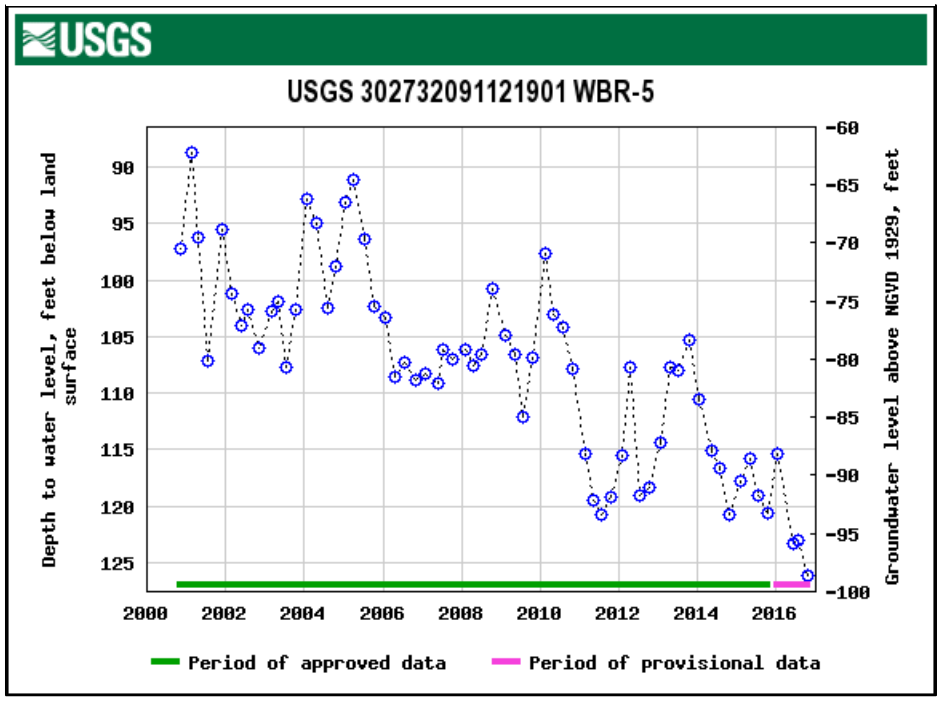


Fig. 11.6: Monitor well in the 1200-foot sand, Evangeline Equivalent Aquifer System, West Baton Rouge Parish, showing downward trend since early 2000s. Source: USGS.

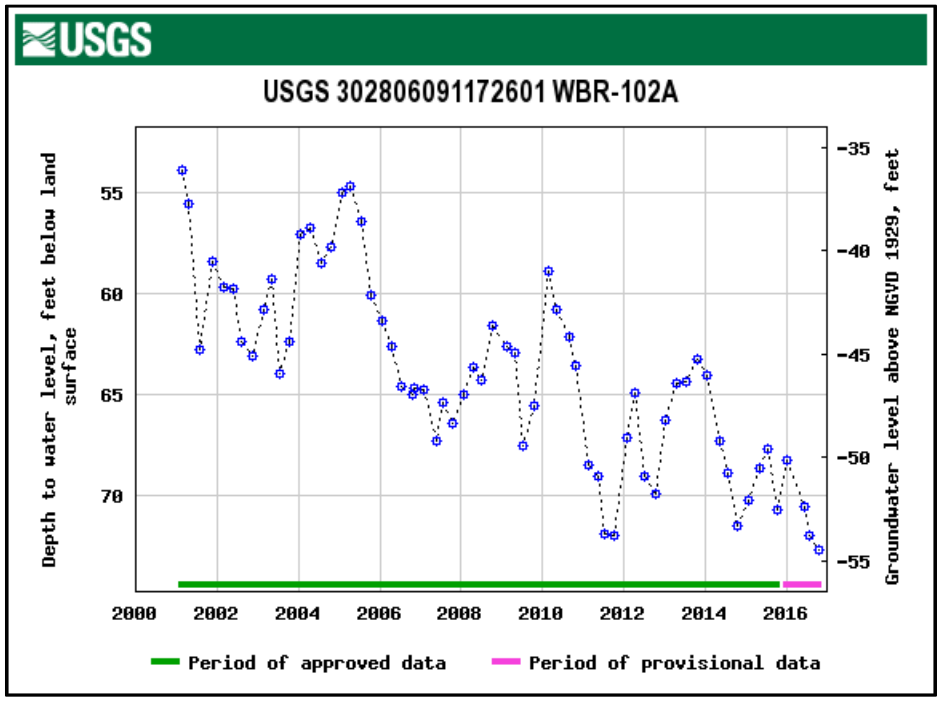


Fig. 11.7: Monitor well in the 1700-foot sand, Evangeline Equivalent Aquifer System, West Baton Rouge Parish, showing steep downward trend since 2012. Source: USGS.

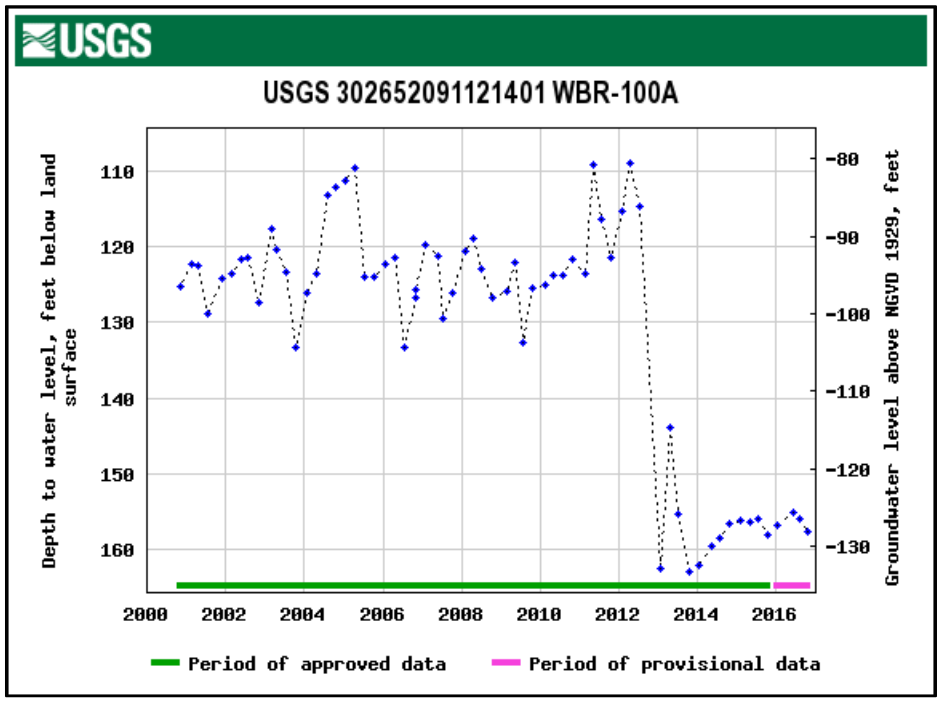


Fig. 11.8: Monitor well in the 2000-foot sand, Jasper Equivalent Aquifer System, West Baton Rouge Parish, showing upward trend since early 2000s. Source: USGS.

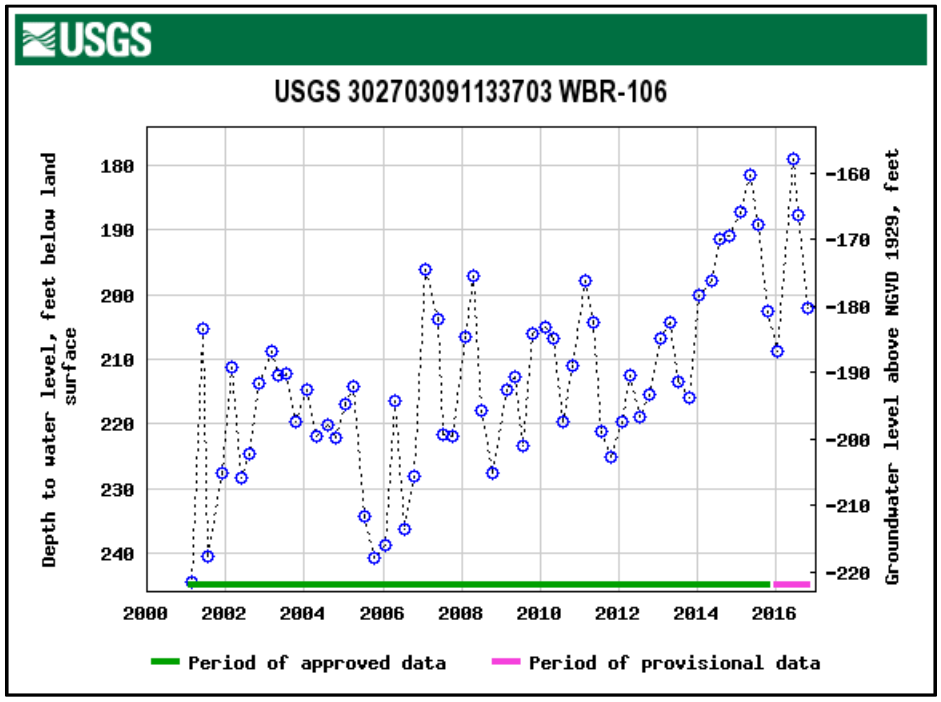
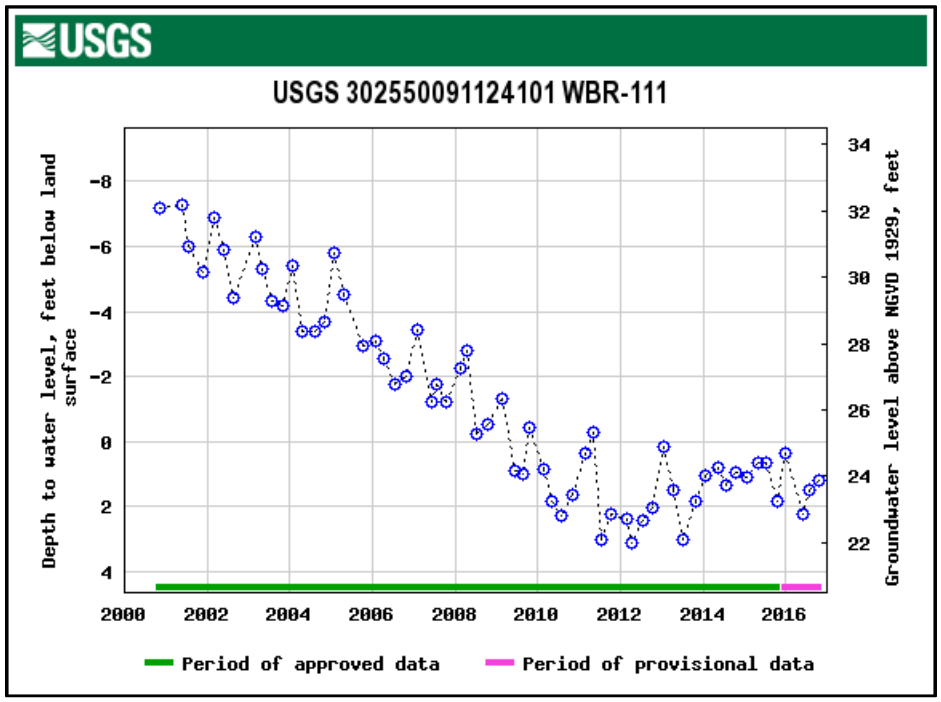


Fig. 11.9: Monitor well in the 2000-foot sand, Jasper Equivalent Aquifer System, West Baton Rouge Parish, showing downward trend since early 2000s but relative stasis since 2012. Source: USGS.



Pointe Coupee Parish

As Fig. 12.1 and Fig. 12.2 indicate, total annual groundwater withdrawals in Pointe Coupee Parish have increased significantly since 1960. The bulk of this usage, however, is for hydroelectric power needs and is drawn from the Mississippi River Alluvial Aquifer, a large, efficiently recharged, but lower quality groundwater resource found at shallow depth and disconnected from the deeper Southern Hills Aquifer System.

Water level declines have been observed in the deeper local aquifers, particularly in the Jasper Equivalent system and to a lesser extent in the Evangeline Equivalent system. The declines are primarily attributable to the pumping regime in East Baton Rouge Parish, that is, the levels are controlled by the rate of pumping in the same aquifers at Baton Rouge. Not unlike in East Baton Rouge, though, water levels in local aquifers in Pointe Coupee appear to have stabilized or even risen slightly since 2010, possibly reflecting the reductions in pumping at Baton Rouge since that time.

Fig 12.1: Groundwater Withdrawals, Pointe Coupee Parish, 1960-2010. Source: USGS

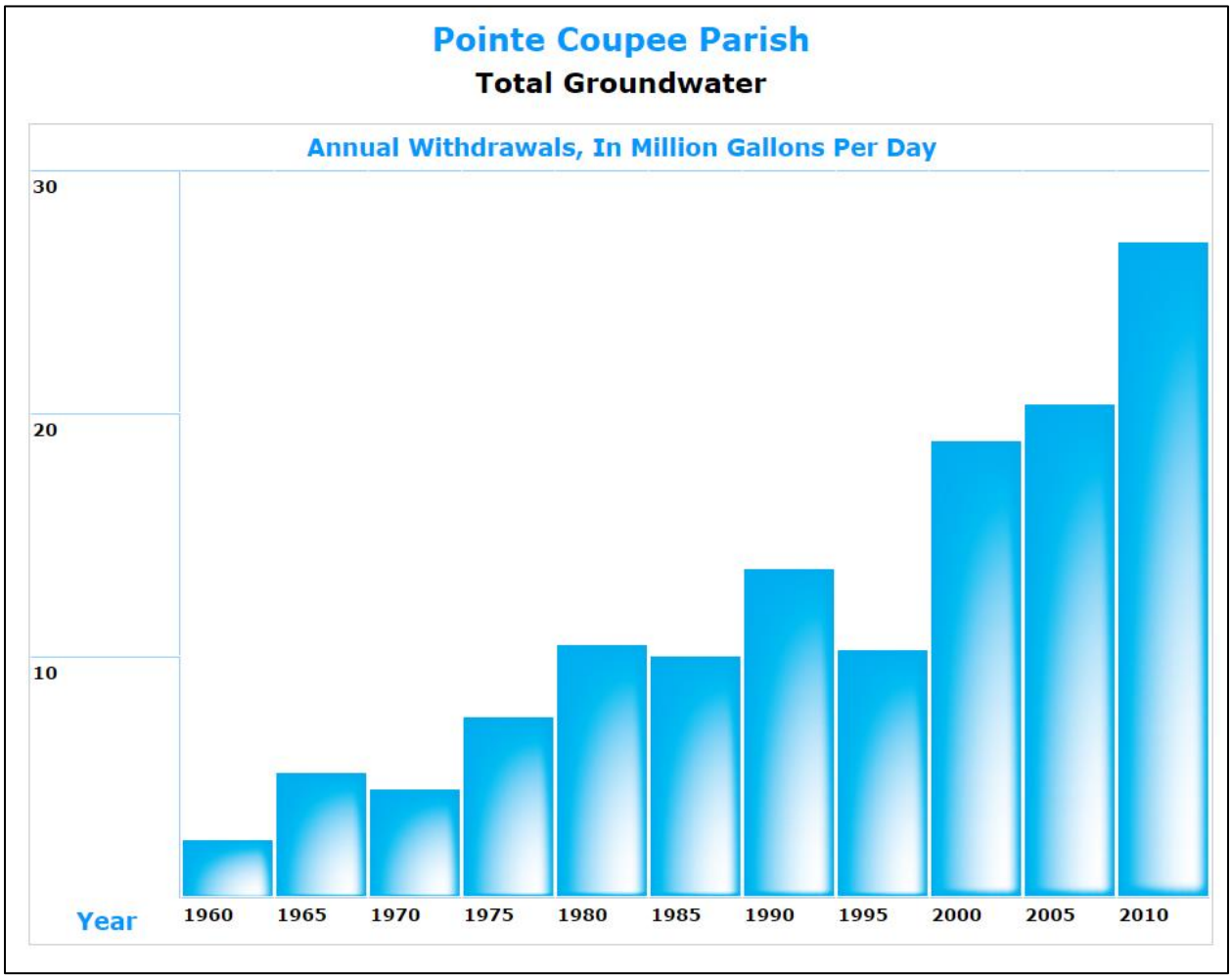


Figure 12.2: Groundwater Withdrawals, by Aquifer System, Pointe Coupee Parish, 2014. Source: USGS.

2014 Aquifer Withdrawals

Pointe Coupee Parish

Aquifer	Withdrawals in Mgal/day
Chicot Equivalent Aquifer System	1.89
Evangeline Equivalent Aquifer System	7.09
Jasper Equivalent Aquifer System	4.00
Mississippi River Alluvial Aquifer	28.05

Samples of Available Groundwater Monitor Well Information, by Aquifer System, Pointe Coupee Parish, 2000-2016

Fig. 12.3: Monitor well in the 1200-foot sand, Evangeline Equivalent Aquifer System, Pointe Coupee Parish, showing slight downward trend since 2001. Source: USGS.

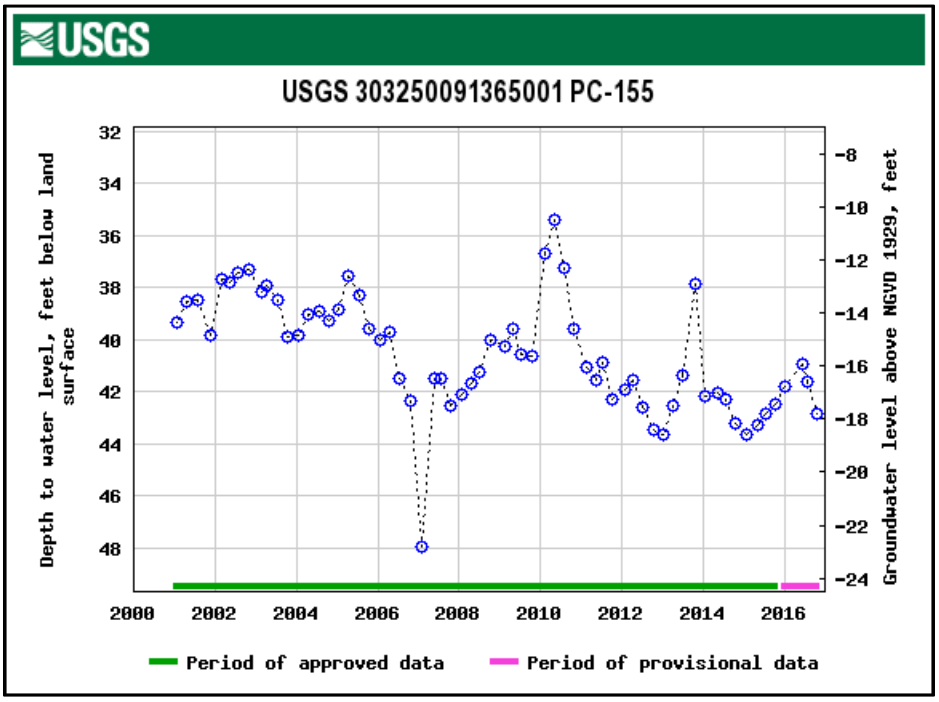


Fig. 12.4: Monitor well in the 1500-foot sand, Evangeline Equivalent Aquifer System, Pointe Coupee Parish, showing relative stability since 2001. Source: USGS.

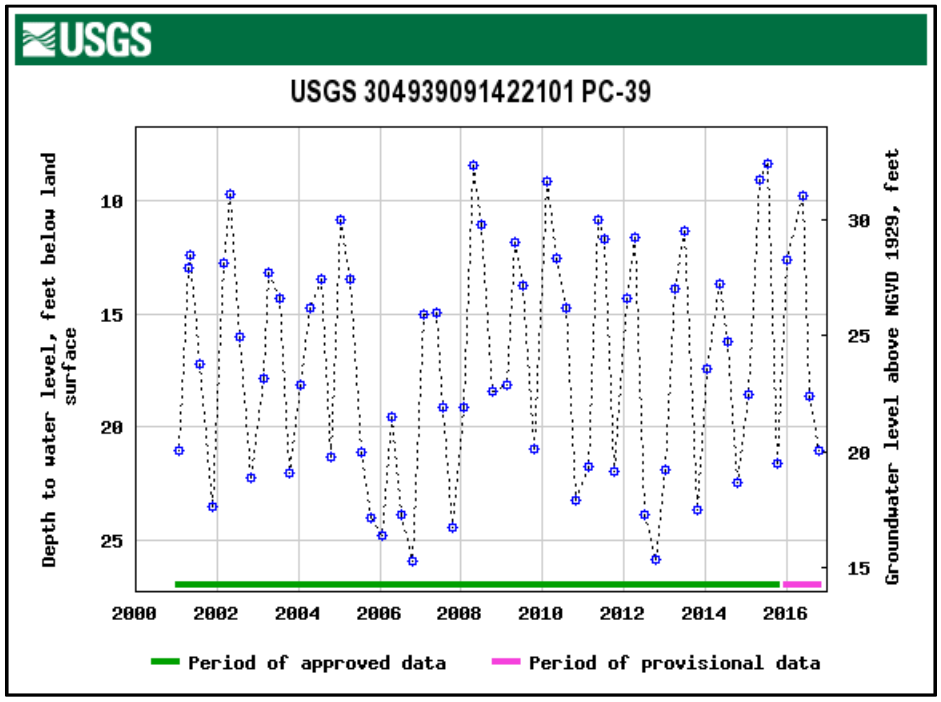


Fig. 12.5: Monitor well in the 2000-foot sand, Jasper Equivalent Aquifer System, Pointe Coupee Parish, showing downward trend since 2001 but upward movement since 2013. Source: USGS.

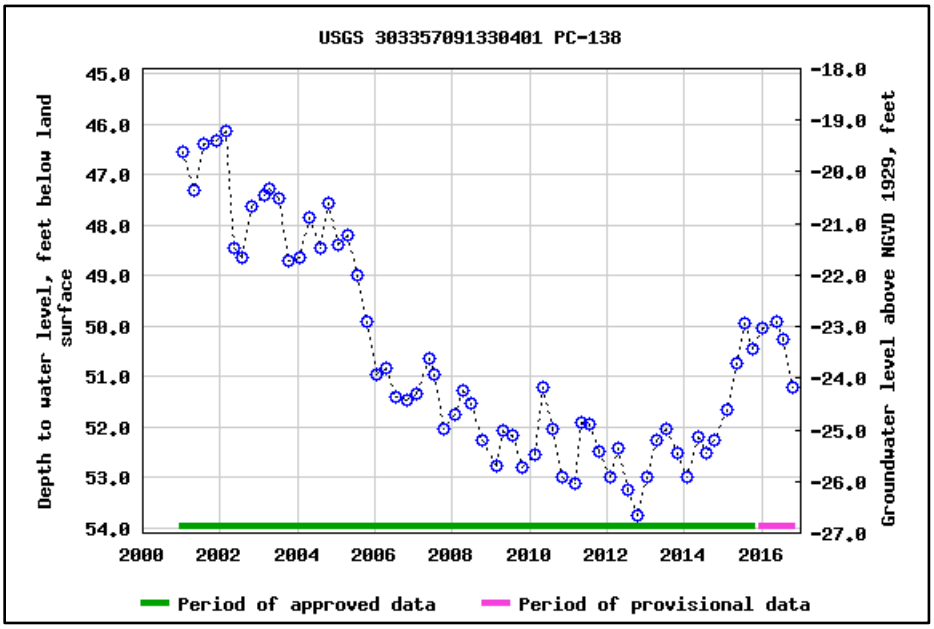
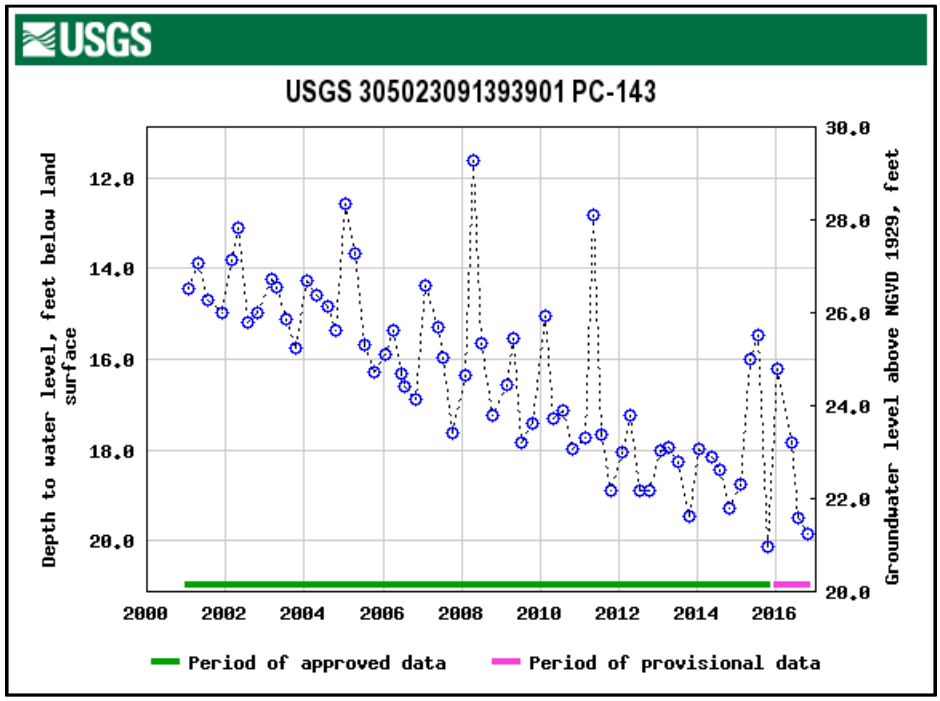


Fig. 12.6: Monitor well in the 2800-foot sand, Jasper Equivalent Aquifer System, Pointe Coupee Parish, showing downward trend since 2001. Source: USGS.



West Feliciana Parish

There are no apparent or reported unacceptable effects for the present and near future on water supplies due to groundwater withdrawals from the Southern Hills Aquifer System in this parish. The volume of groundwater withdrawals has remained relatively static for the past 20 years or more, as illustrated by Fig. 13.1 and Fig. 13.2. The groundwater flow in several local aquifers does appear in part to be controlled by the proximity to the pumping centers inside East Baton Rouge Parish but this has not been noted as an impact on local groundwater sustainability.

Fig 13.1: Groundwater Withdrawals, West Feliciana Parish, 1960-2010. Source: USGS

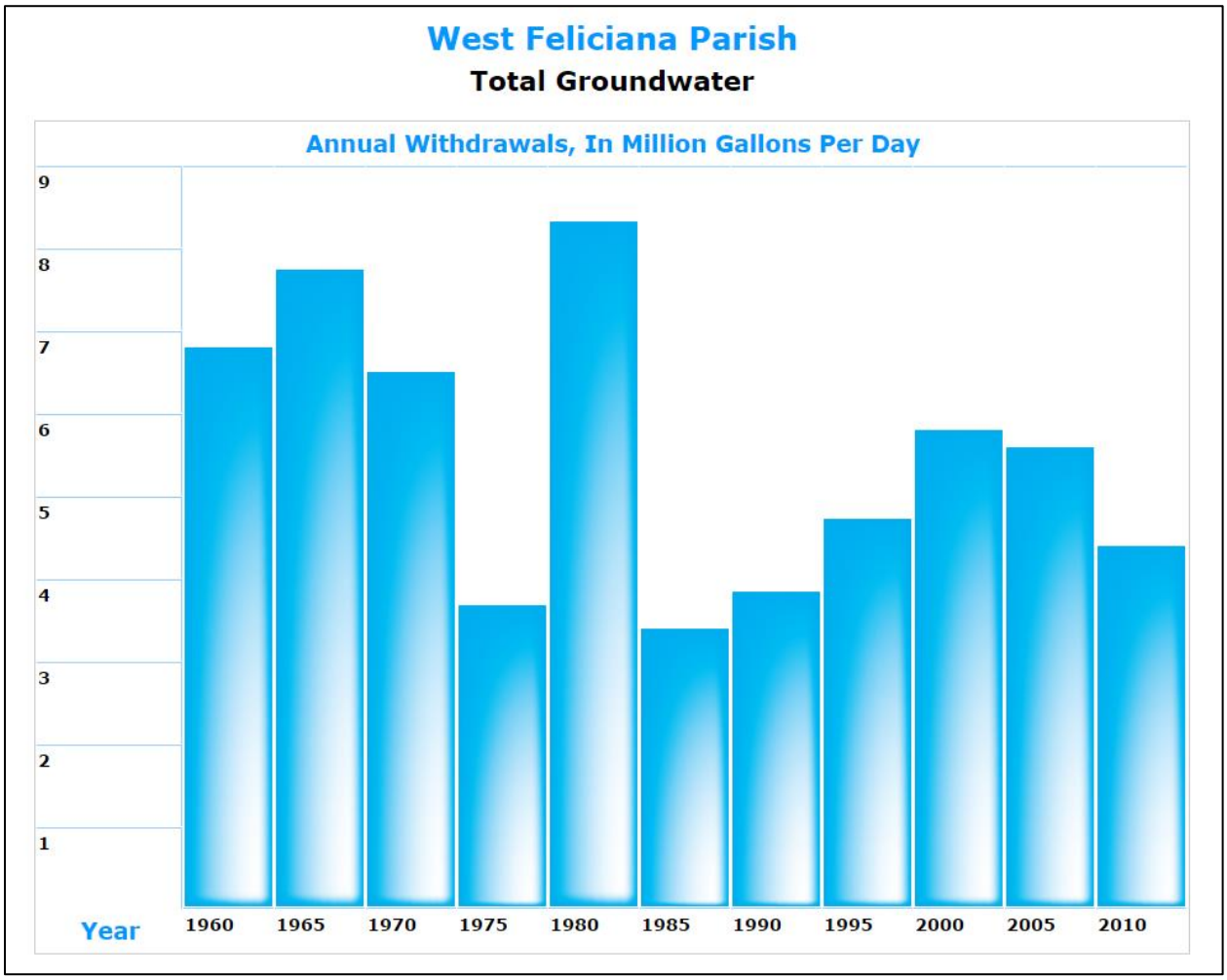


Figure 13.2: Groundwater Withdrawals, by Aquifer System, West Feliciana Parish, 2014. Source: USGS.

2014 Aquifer Withdrawals

West Feliciana Parish

Aquifer	Withdrawals in Mgal/day
Chicot Equivalent Aquifer System	0.73
Evangeline Equivalent Aquifer System	0.02
Jasper Equivalent Aquifer System	4.96
Mississippi River Alluvial Aquifer	0.01

Samples of Available Groundwater Monitor Well Information, by Aquifer System, West Feliciana Parish, 2000-2016

Figure 13.3: Monitor well at 156-foot, in the Upland Terrace Aquifer, West Feliciana Parish showing downward trend and then upward movement since 2012. Because of the outcropping of the aquifer in parts of this parish, this chart might be considered a reflection of change in the water table as well. Source: USGS.

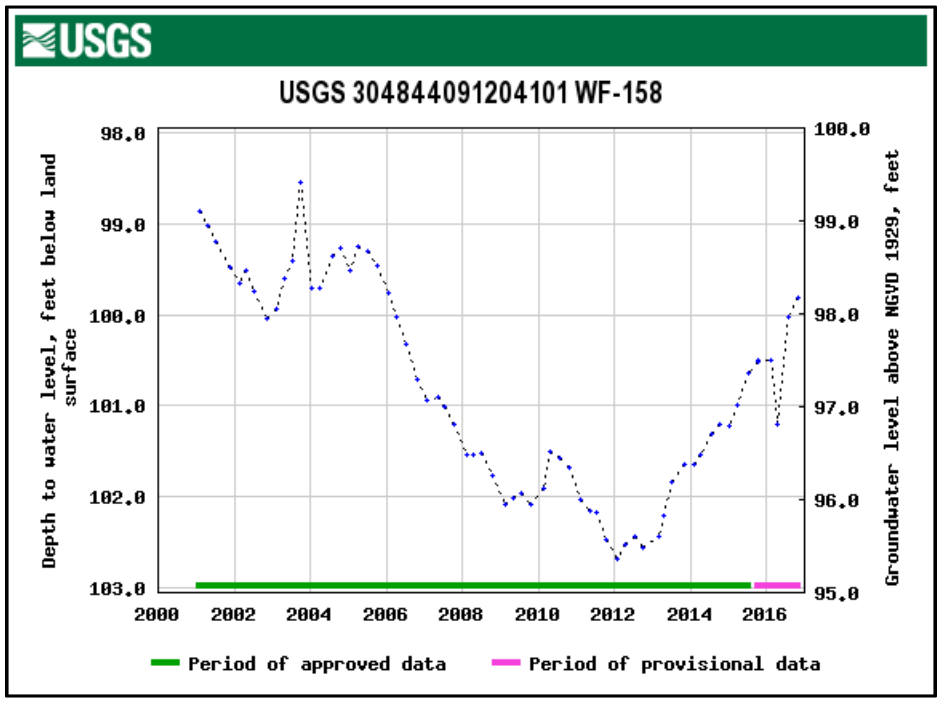


Fig. 13.4: Monitor well in the 1700-foot sand, Evangeline Equivalent Aquifer System, West Feliciana Parish, showing slight downward trend since 2001 and upward trend since 2012. Source: USGS.

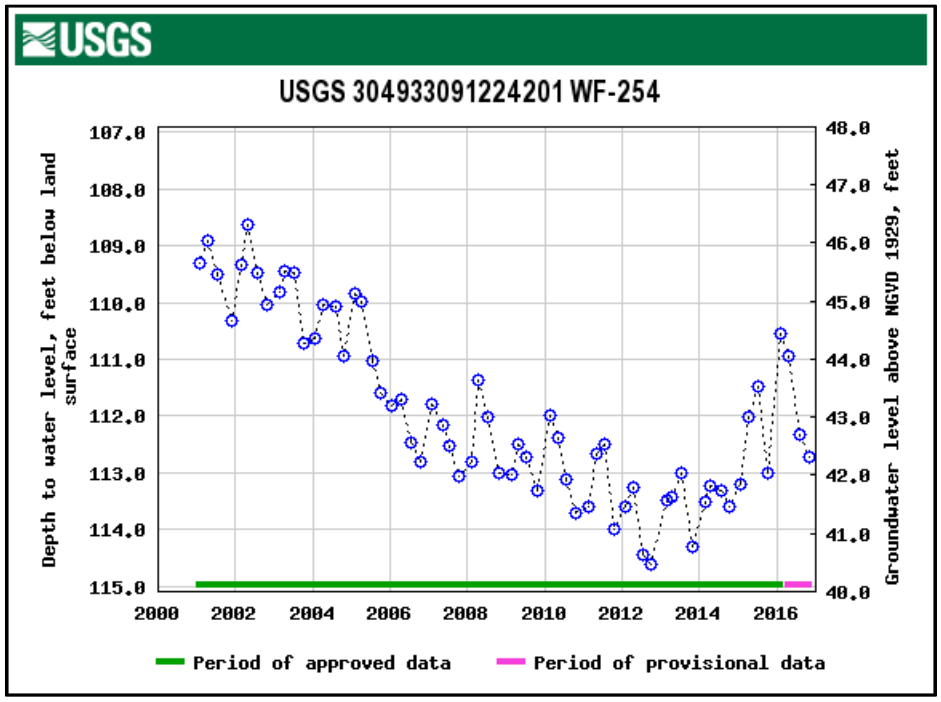


Fig. 13.5: Monitor well in the 2000-foot sand, Jasper Equivalent Aquifer System, West Feliciana Parish, showing slight downward trend since 2001. Source: USGS.

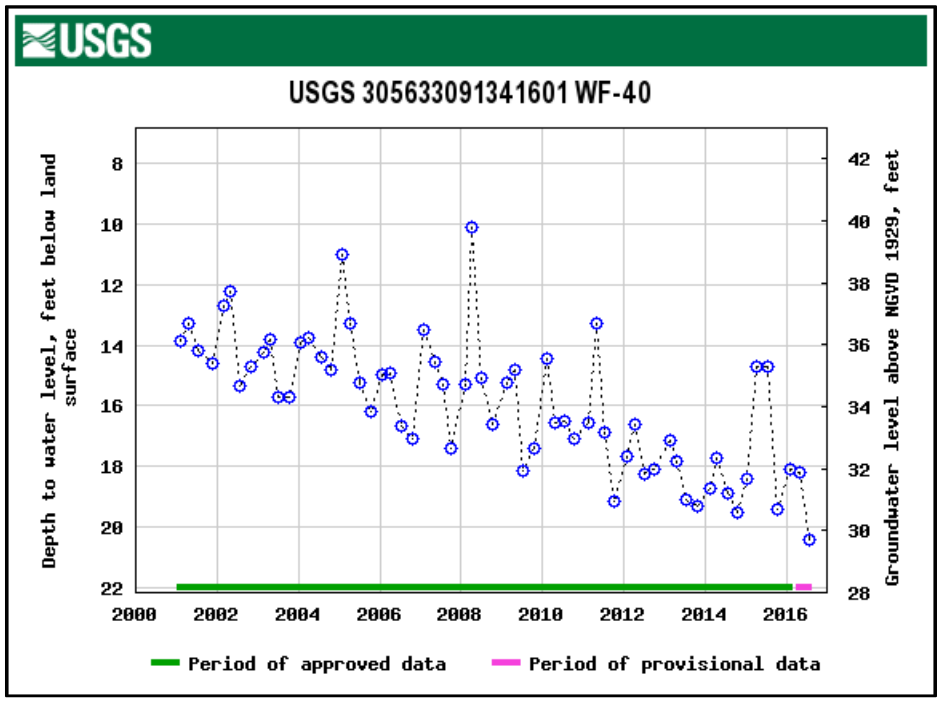
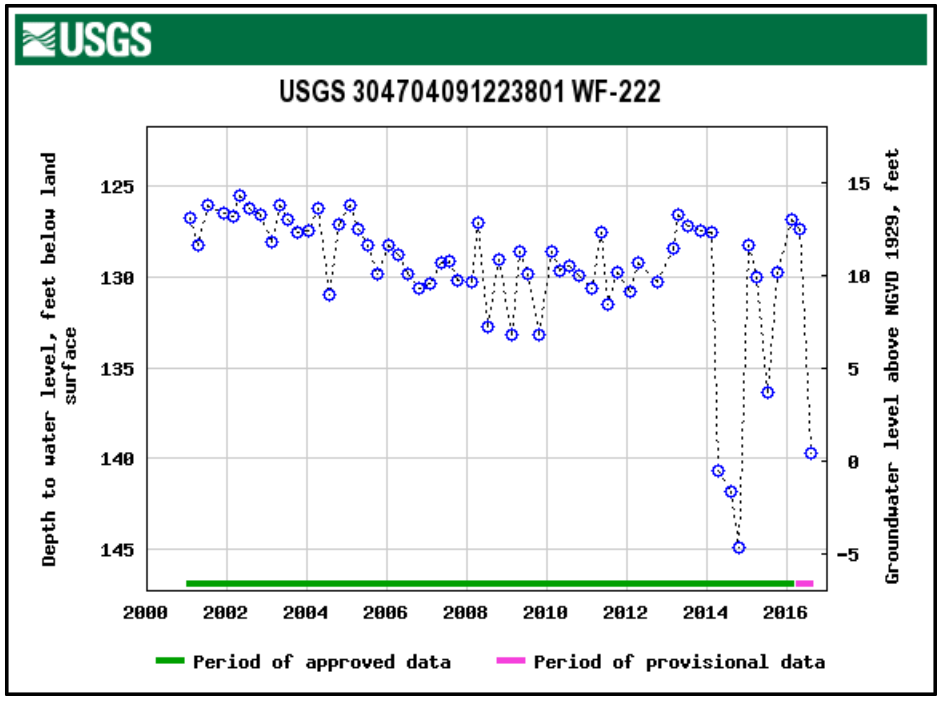


Fig. 13.6: Monitor well in the 2400-foot sand, Jasper Equivalent Aquifer System, West Feliciana Parish, showing relative stasis through first decade of 2000s, followed by drawdown since 2014. Source: USGS.



East Feliciana Parish

There are no apparent or reported unacceptable effects for the present and near future on water supplies due to groundwater withdrawals from the Southern Hills Aquifer System in this parish. The volume of groundwater withdrawals has remained relatively static for the past 20 years, as illustrated by Fig. 14.1 and Fig. 14.2; most of the volume comes from the deeper Jasper Equivalent system. The groundwater flow in several local aquifers does appear in part to be controlled by the proximity to the pumping centers inside East Baton Rouge Parish but this has not been noted as an impact on local groundwater sustainability.

Fig 14.1: Groundwater Withdrawals, East Feliciana Parish, 1960-2010. Source: USGS

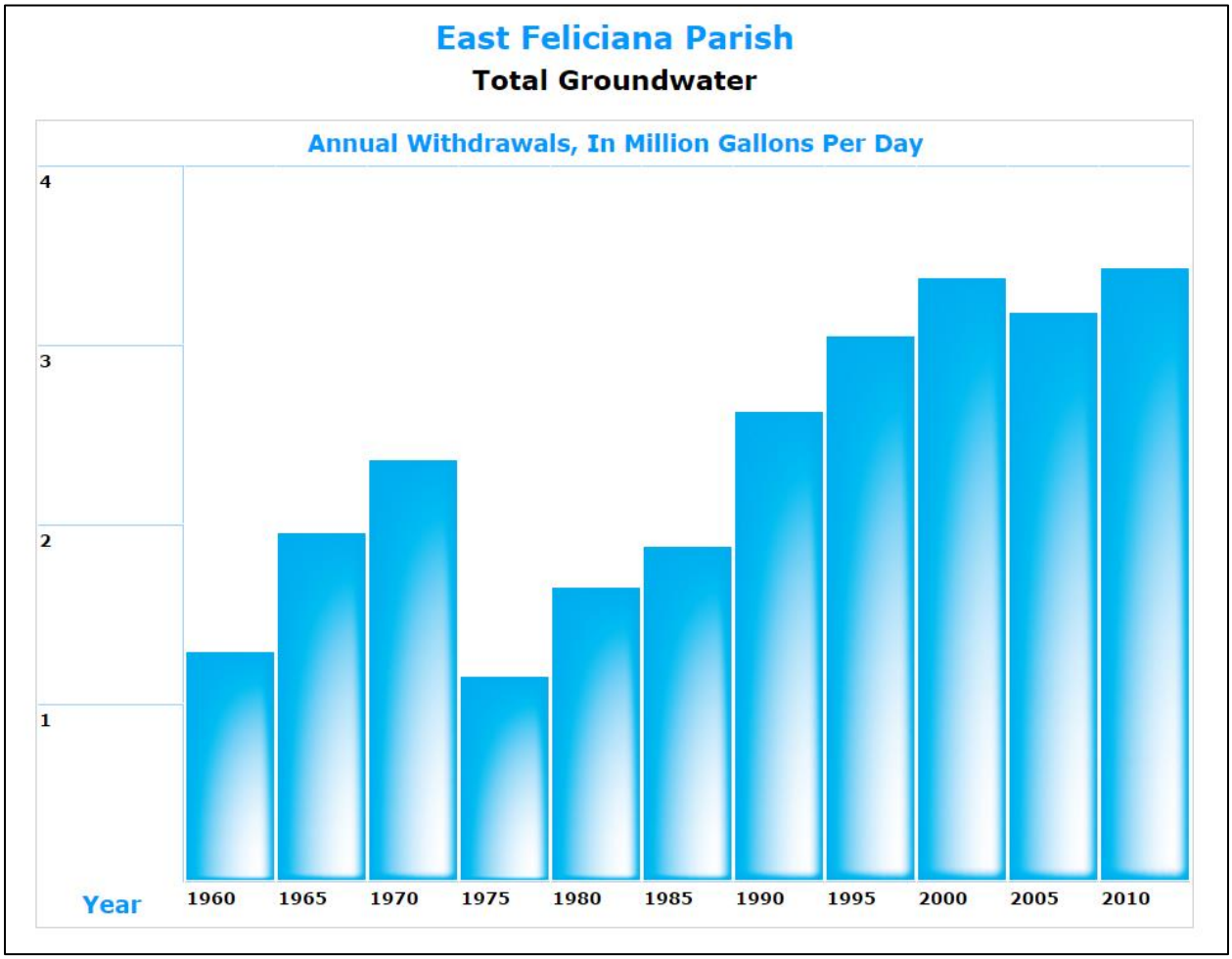


Figure 14.2: Groundwater Withdrawals, by Aquifer System, East Feliciana Parish, 2014. Source: USGS.

2014 Aquifer Withdrawals

East Feliciana Parish

Aquifer	Withdrawals in Mgal/day
Catahoula Aquifer	0.55
Chicot Equivalent Aquifer System	0.44
Evangeline Equivalent Aquifer System	0.34
Jasper Equivalent Aquifer System	2.48

Sample of Available Groundwater Monitor Well Information, by Aquifer System, East Feliciana Parish, 2000-2016

Fig. 14.3: Monitor well in the 1200-foot sand, Evangeline Equivalent Aquifer System, East Feliciana Parish, showing relative stasis over first decade of 2000s and upward trend since 2014. Source: USGS.

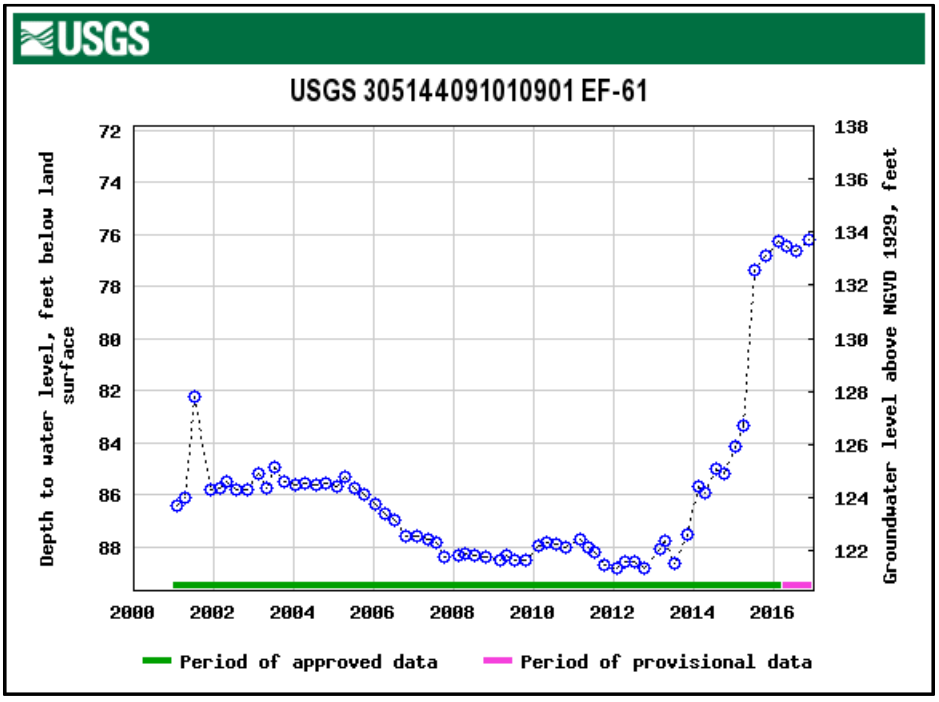
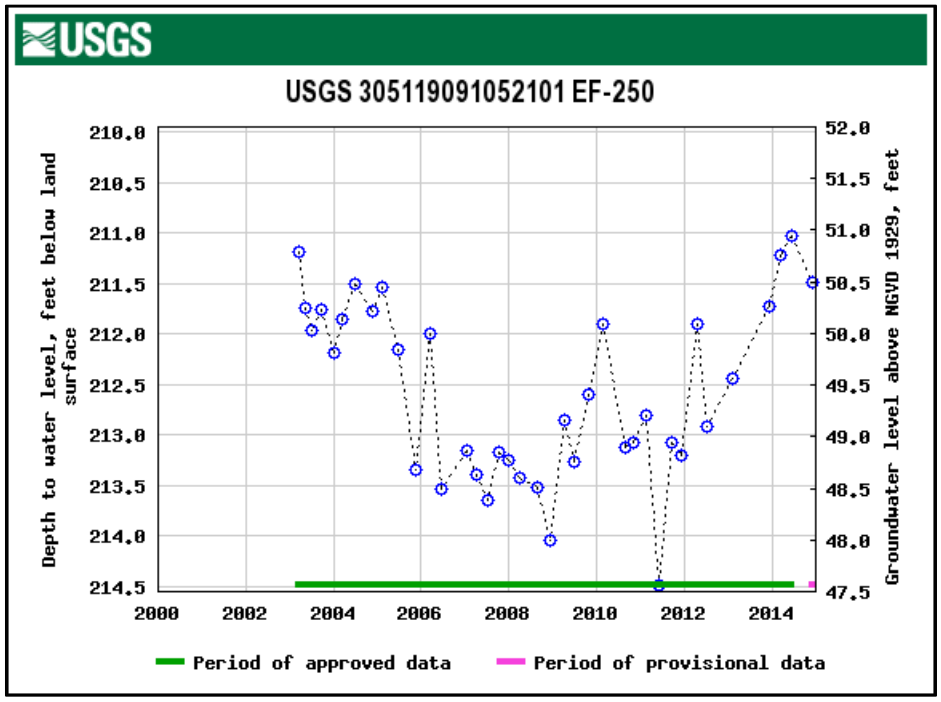


Fig. 14.4: Monitor well in the 2800-foot sand, Jasper Equivalent Aquifer System, East Feliciana Parish, showing relative stasis over the past decade. Source: USGS.



Remaining Parishes in the Southern Hills Overlay

Livingston Parish

There are no apparent or reported unacceptable effects for the present and near future on water supplies due to groundwater withdrawals from the Southern Hills Aquifer System in this parish. Although continued population growth in Livingston Parish has led to increased demand over the last 20 years (see Fig. 15.1 and Fig. 15.2), and likely will lead to more in the future, this does not appear likely to impact local groundwater availability or aquifer system sustainability. As elsewhere in this region, the direction of groundwater flow in the parish primarily is controlled by the proximity to the pumping centers inside East Baton Rouge Parish.

Fig 15.1: Groundwater Withdrawals, Livingston Parish, 1960-2010. Source: USGS

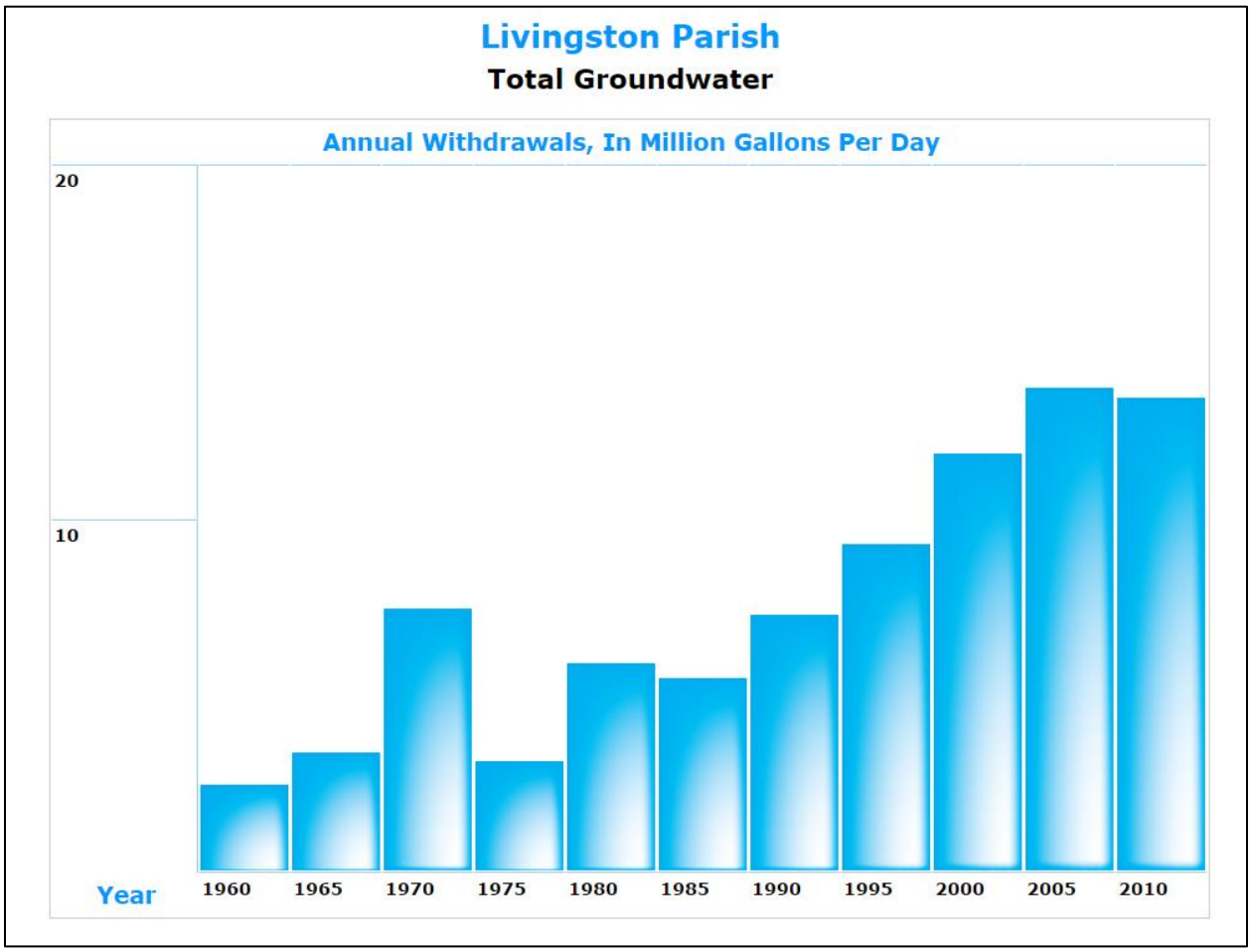


Figure 15.2: Groundwater Withdrawals, by Aquifer System, Livingston Parish, 2014. Source: USGS.

2014 Aquifer Withdrawals

Livingston Parish

Aquifer	Withdrawals in Mgal/day
Chicot Equivalent Aquifer System	2.68
Evangeline Equivalent Aquifer System	5.50
Jasper Equivalent Aquifer System	5.66

Sample of Available Groundwater Monitor Well Information, by Aquifer System, Livingston Parish, 2000-2016

Fig. 15.3: Monitor well in the 400-foot sand, Chicot Equivalent Aquifer System, Livingston Parish, showing relative stasis over the past decade. Source: USGS.

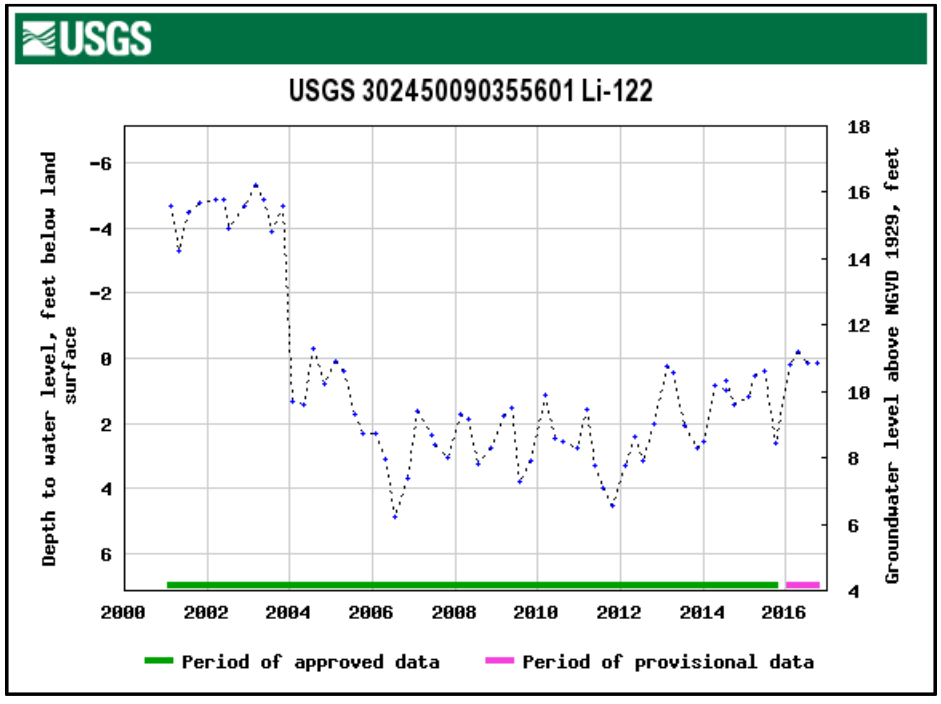


Fig. 15.4: Monitor well in the 400-foot sand, Chicot Equivalent Aquifer System, Livingston Parish, showing water level decline and recovery over the past decade. Source: USGS.

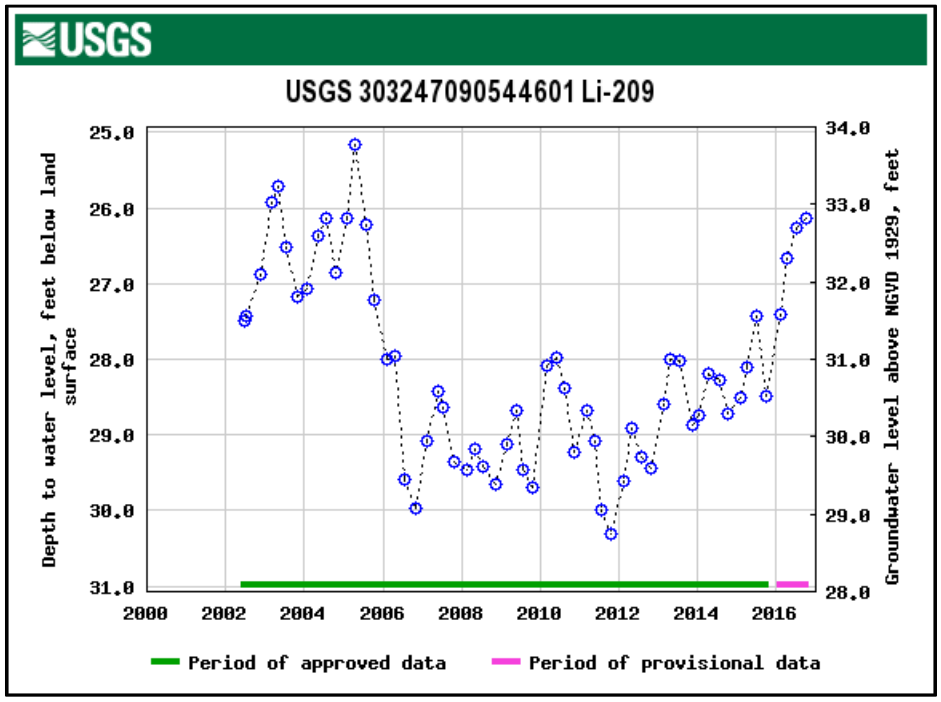


Fig. 15.5: Monitor well in the 1200-foot sand, Evangeline Equivalent Aquifer System, Livingston Parish, showing water level decline and recovery over the past decade. Source: USGS.

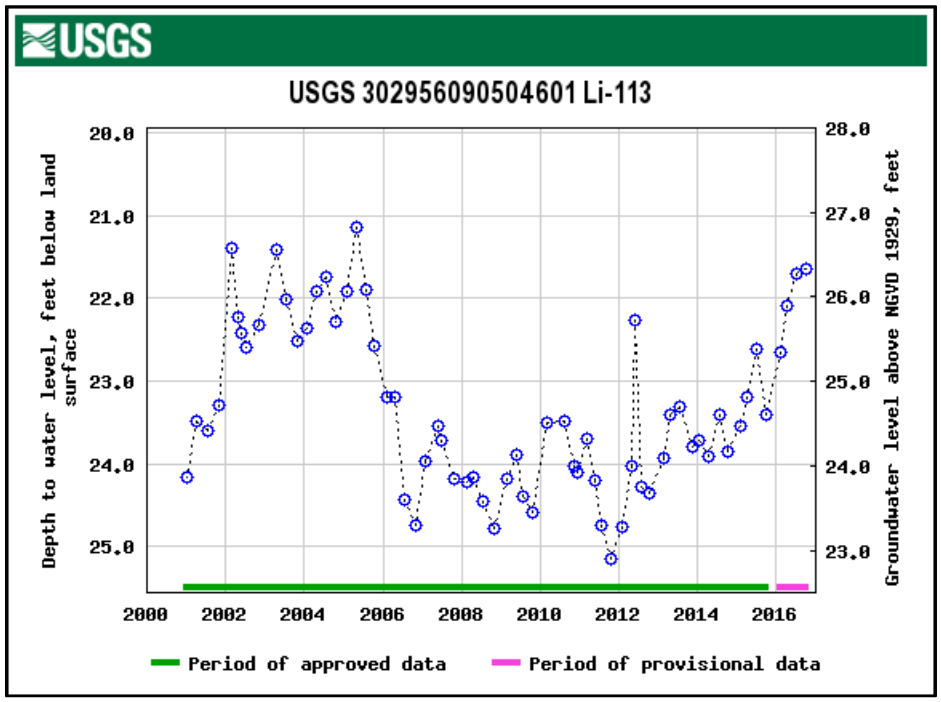


Fig. 15.6: Monitor well in the 1700-foot sand, Evangeline Equivalent Aquifer System, Livingston Parish, showing water level decline and recovery, and decline again, over the past decade. Source: USGS.

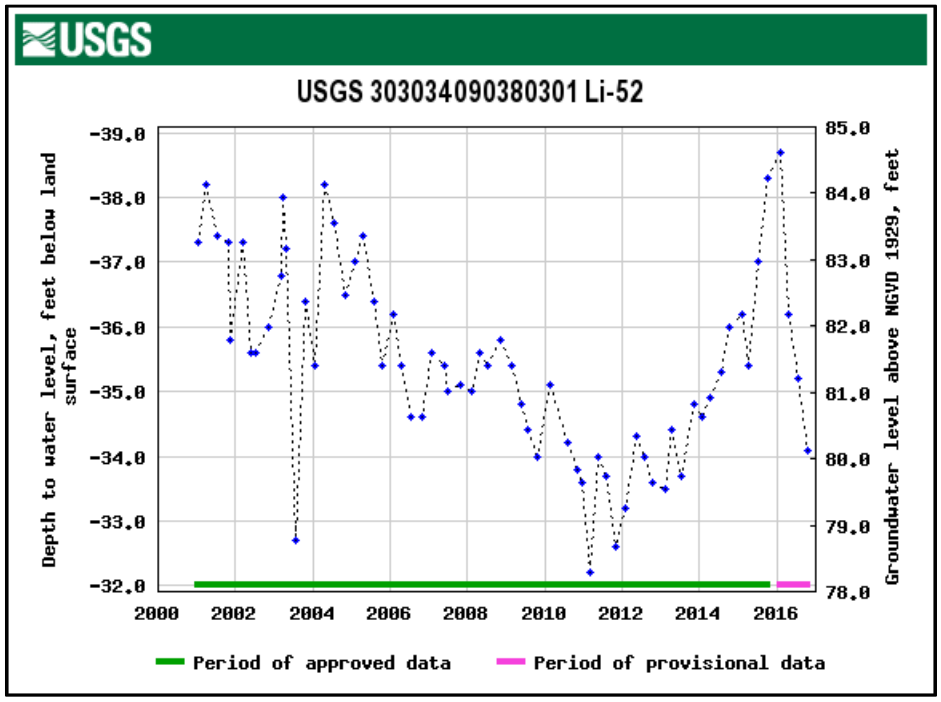
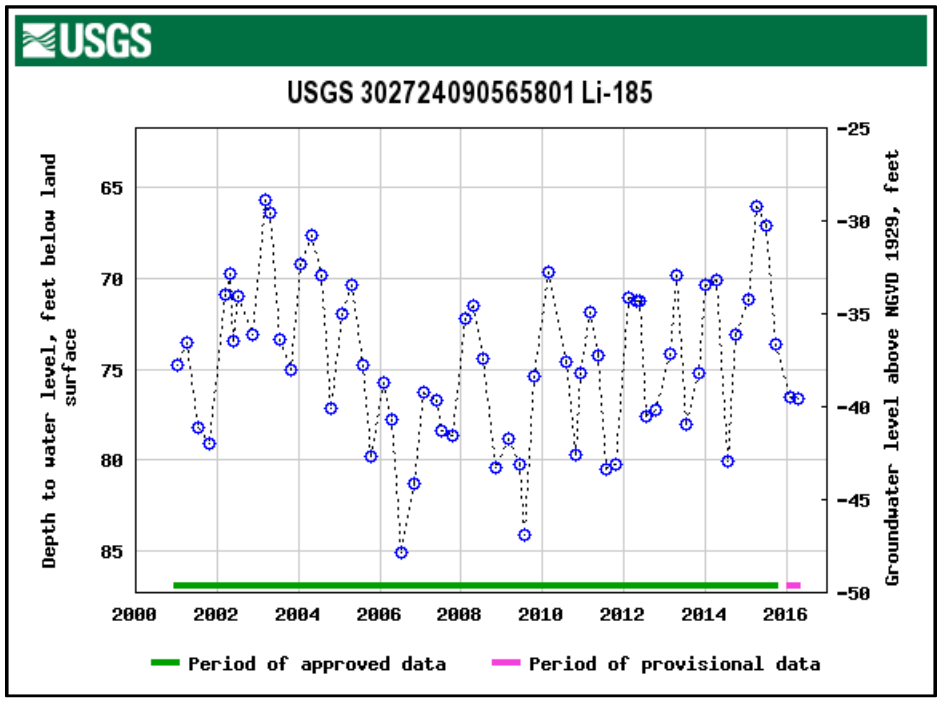


Fig. 15.7: Monitor well in the 2400-foot sand, Jasper Equivalent Aquifer System, Livingston Parish, showing relative stasis in water levels since 2001. Source: USGS.



St. Helena Parish

There are no apparent or reported unacceptable effects for the present and near future on water supplies due to groundwater withdrawals from the Southern Hills Aquifer System in this parish. Groundwater use is minimal, reflecting a small population with little industry and relatively small-scale agricultural and stock raising activity.

Fig 16.1: Groundwater Withdrawals, St. Helena Parish, 1960-2010. Source: USGS

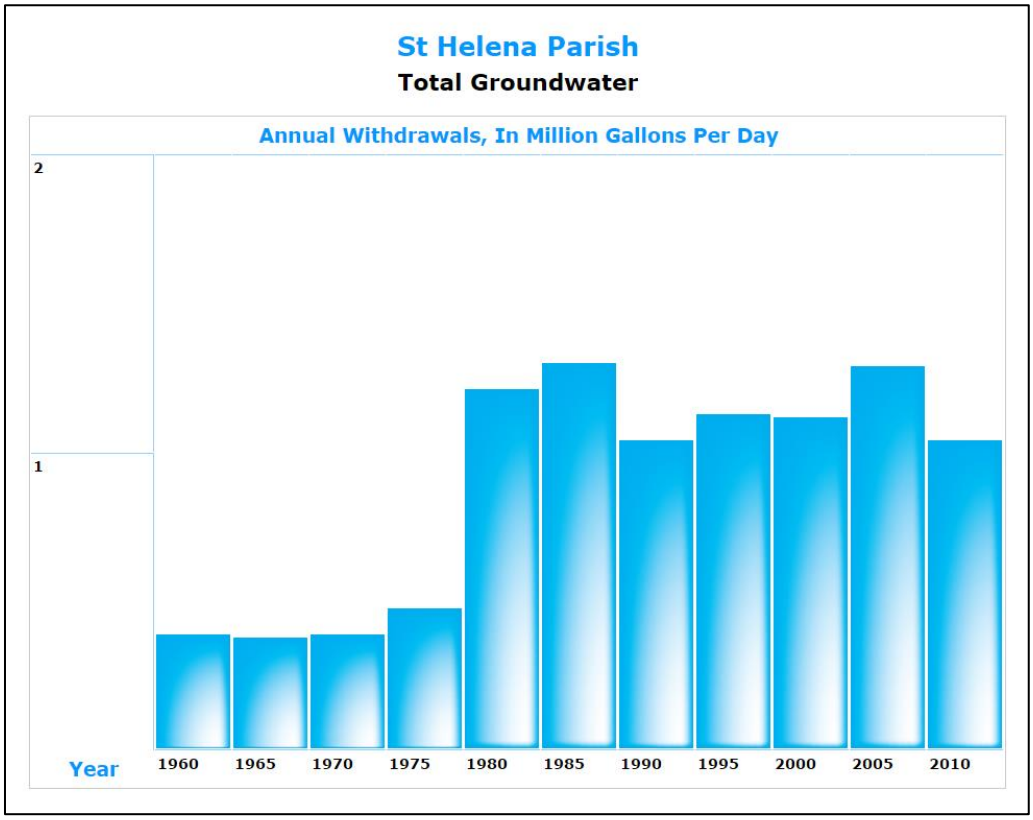


Figure 16.2: Groundwater Withdrawals, by Aquifer System, St. Helena Parish, 2014. Source: USGS.

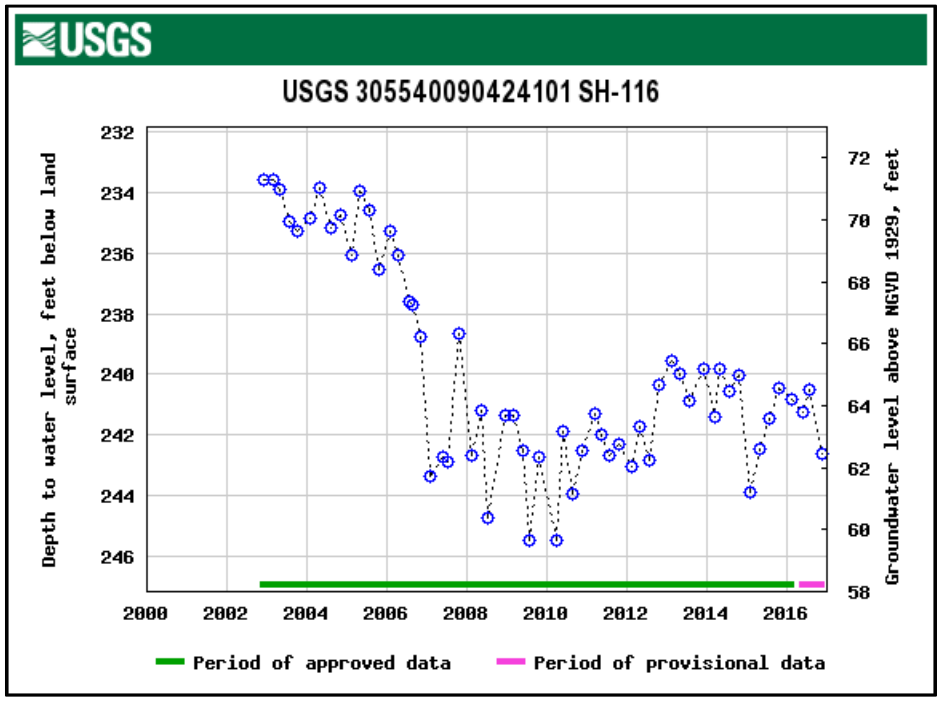
2014 Aquifer Withdrawals

St Helena Parish

Aquifer	Withdrawals in Mgal/day
Chicot Equivalent Aquifer System	1.21
Jasper Equivalent Aquifer System	0.58

Sample of Available Groundwater Monitor Well Information, St. Helena Parish, 2000-2016

Fig. 16.3: Monitor well in the 2800-foot sand, Jasper Equivalent Aquifer System, St. Helena Parish, showing water level decline and relative stasis since 2008. Source: USGS.



Tangipahoa

There are no apparent or reported unacceptable effects for the present and near future on water supplies due to groundwater withdrawals from the Southern Hills Aquifer System in this parish. Although continued population growth in Tangipahoa Parish has led to increased demand over the last 15 years (see Fig. 17.1 and Fig. 17.2), and likely will lead to more in the future, this does not appear to impact local groundwater availability or aquifer system sustainability.

Fig 17.1: Groundwater Withdrawals, Tangipahoa Parish, 1960-2010. Source: USGS.

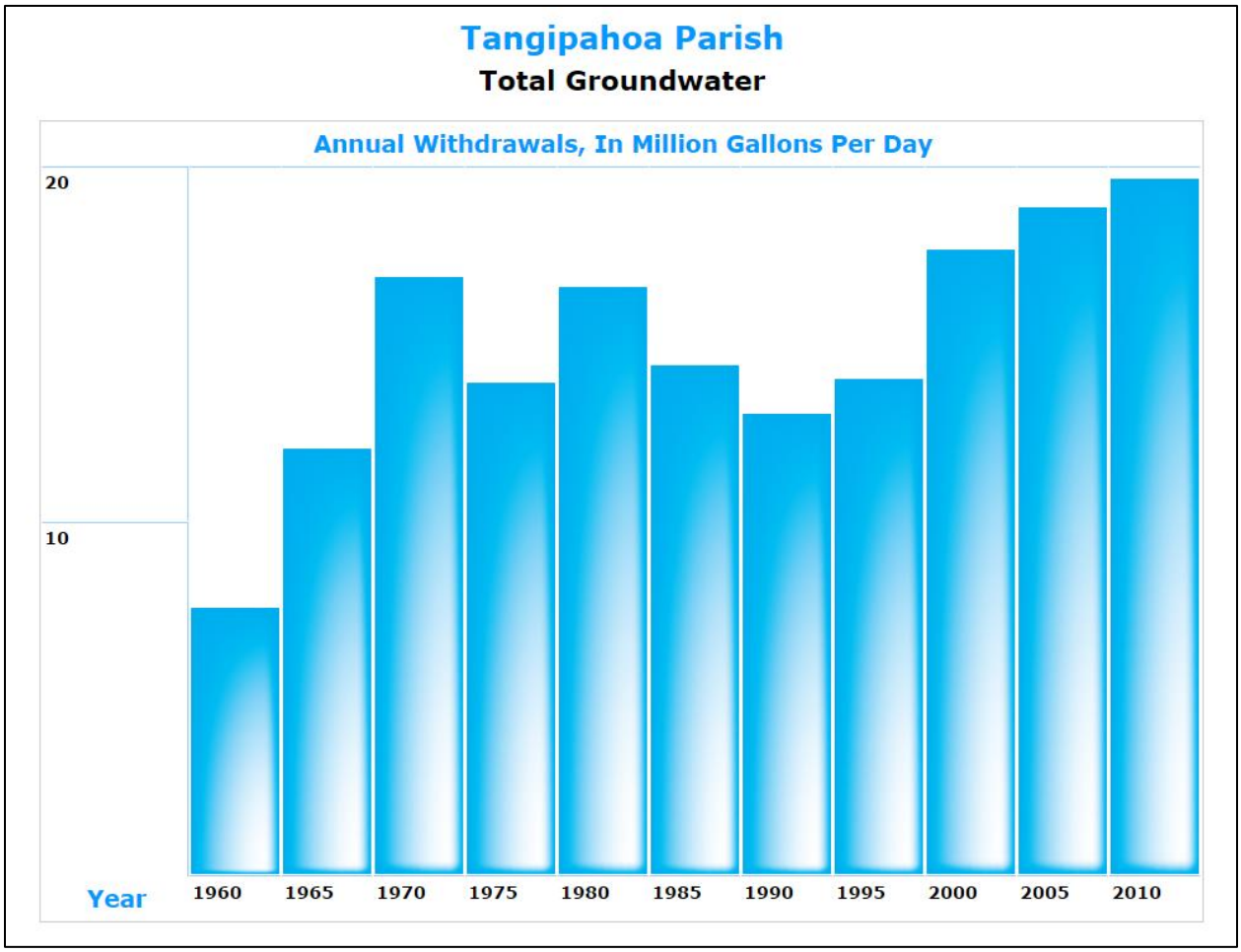


Figure 17.2: Groundwater Withdrawals, by Aquifer System, Tangipahoa Parish, 2014. Source: USGS.

2014 Aquifer Withdrawals

Tangipahoa Parish

Aquifer	Withdrawals in Mgal/day
Chicot Equivalent Aquifer System	4.47
Evangeline Equivalent Aquifer System	3.06
Jasper Equivalent Aquifer System	11.20
Upland Terrace Aquifer	0.01

Sample of Available Groundwater Monitor Well Information, by Aquifer System, Tangipahoa Parish, 2000-2016

Fig. 17.3: Monitor well in the Upland Terrace Aquifer, Chicot Equivalent Aquifer System, Tangipahoa Parish, showing water level increase, drawdown, and rise since 2001. Source: USGS.

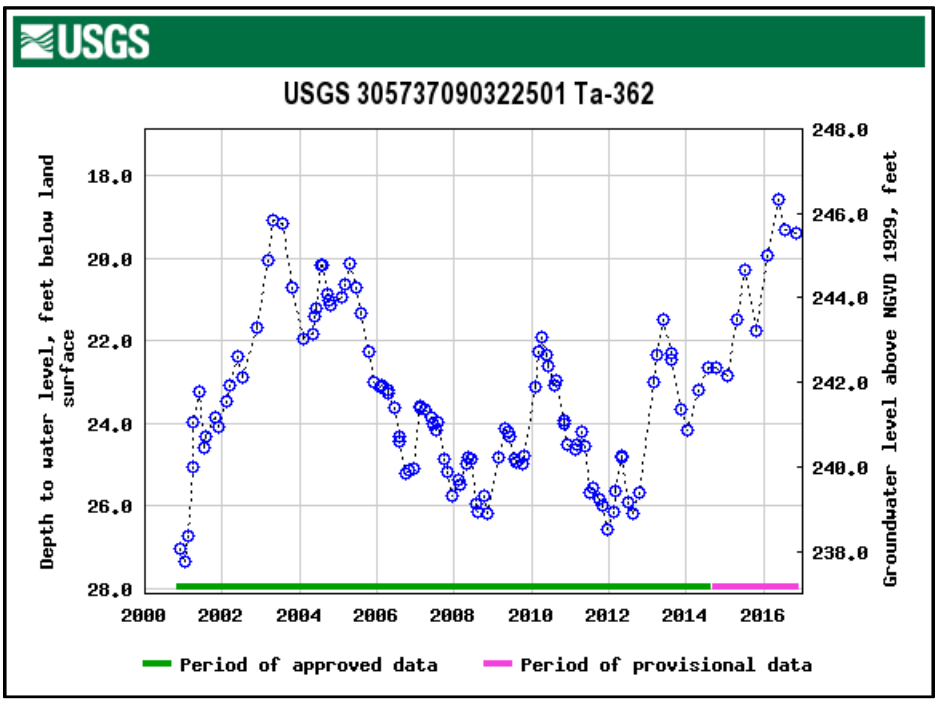


Fig. 17.4: Monitor well in the Covington Aquifer, Evangeline Equivalent Aquifer System, Tangipahoa Parish, showing water level drawdown and rise since 2001. Source: USGS.

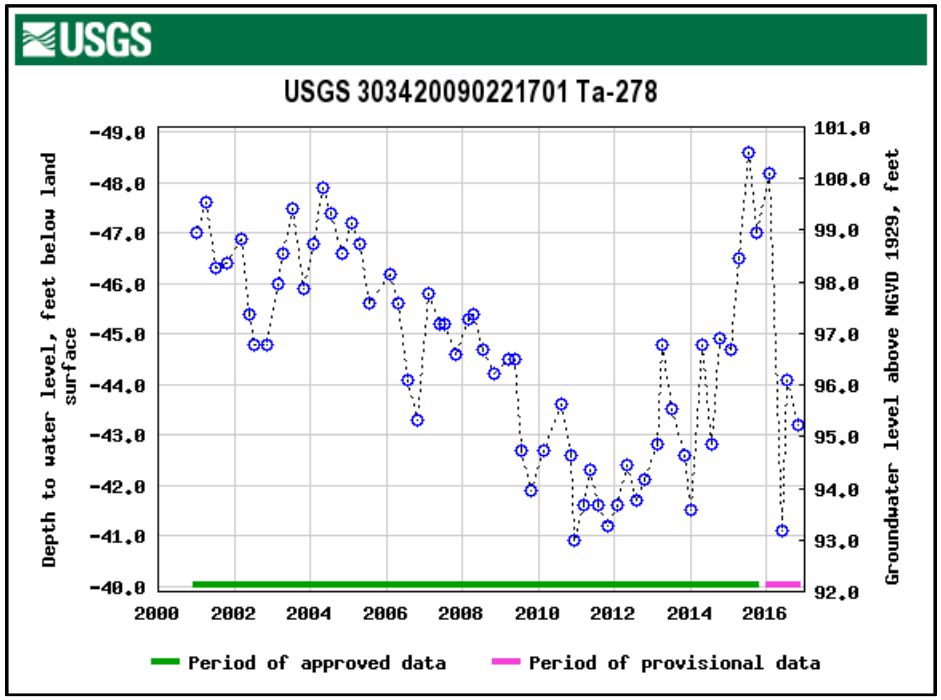


Fig. 17.5: Monitor well in the Covington Aquifer, Evangeline Equivalent Aquifer System, Tangipahoa Parish, showing water level drawdown and relative stasis since 2002. Source: USGS.

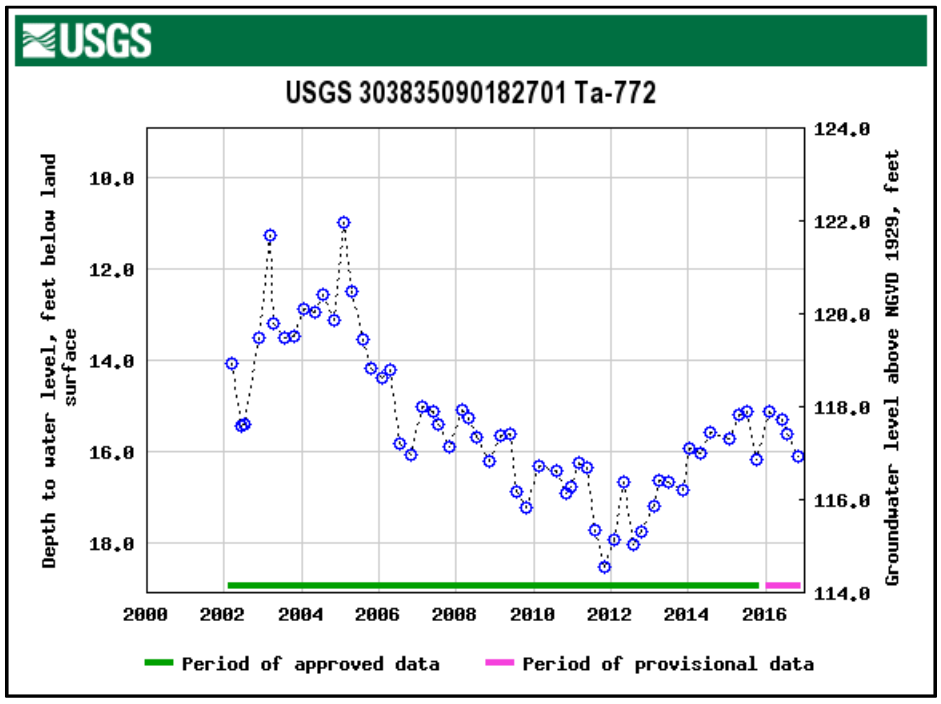


Fig. 17.6: Monitor well in the Amite Aquifer, Jasper Equivalent Aquifer System, Tangipahoa Parish, showing water level drawdown, rise, and relative stasis since 2012. Source: USGS.

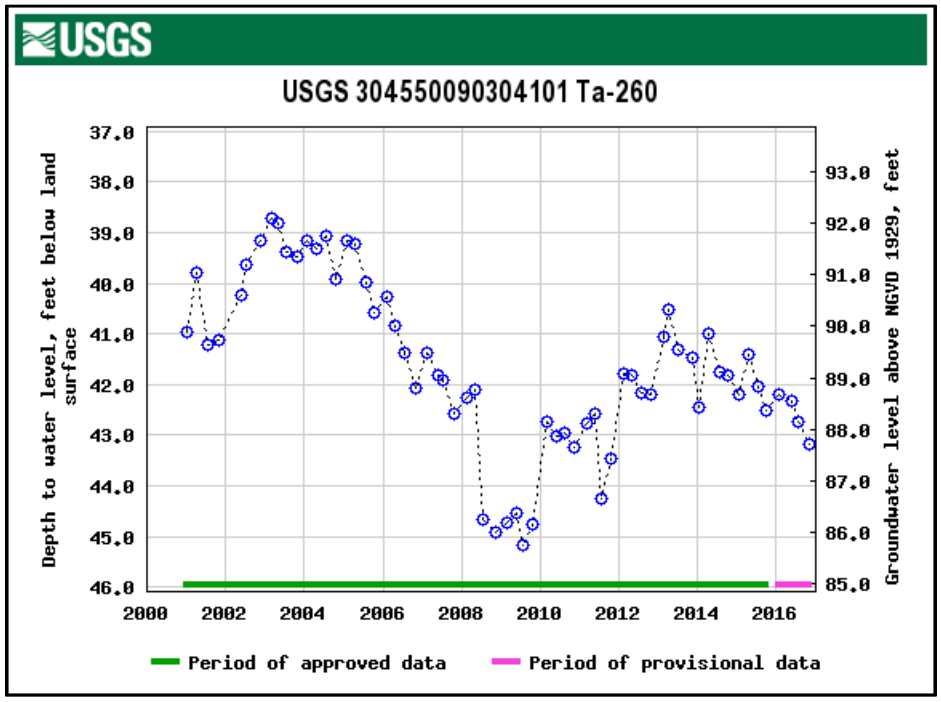
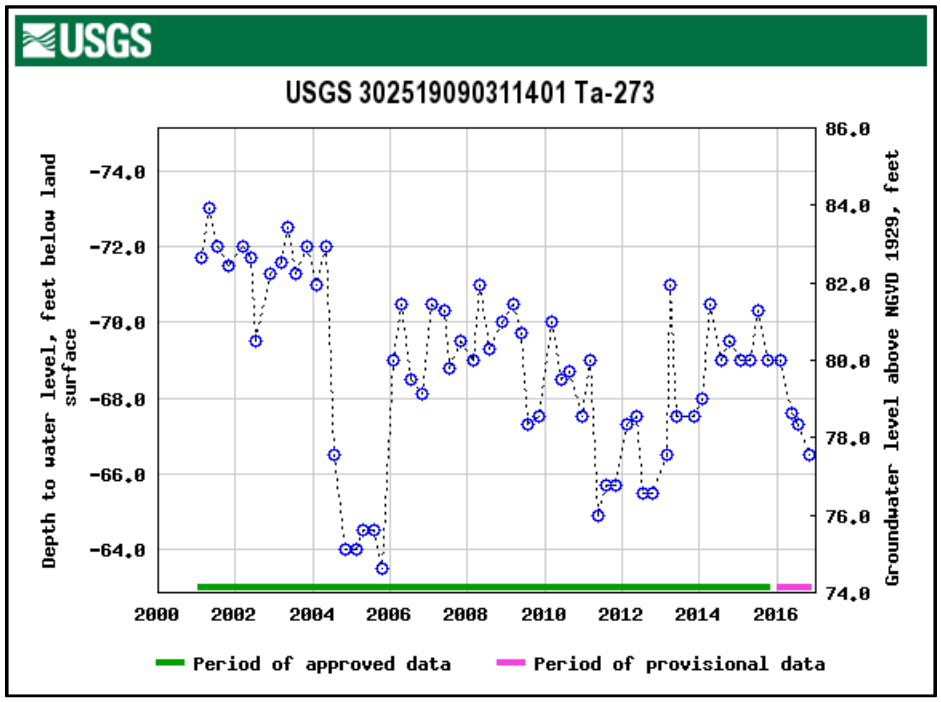


Fig. 17.7: Monitor well in the Tchefuncte Aquifer, Jasper Equivalent Aquifer System, Tangipahoa Parish, showing water level decline, rise, and relative stasis over last decade. Source: USGS.



Washington Parish

The reported volume of groundwater use in Washington Parish has remained fairly consistent over the past five decades due to a sizeable industrial pumpage. The only noted impact on groundwater levels has been in the deeper aquifers of the Jasper Equivalent Aquifer System where a cone of depression is apparent. If managed correctly, it is not a particular threat to the sustainability of groundwater resources in the parish.

Fig 18.1: Groundwater Withdrawals, Washington Parish, 1960-2010. Source: USGS

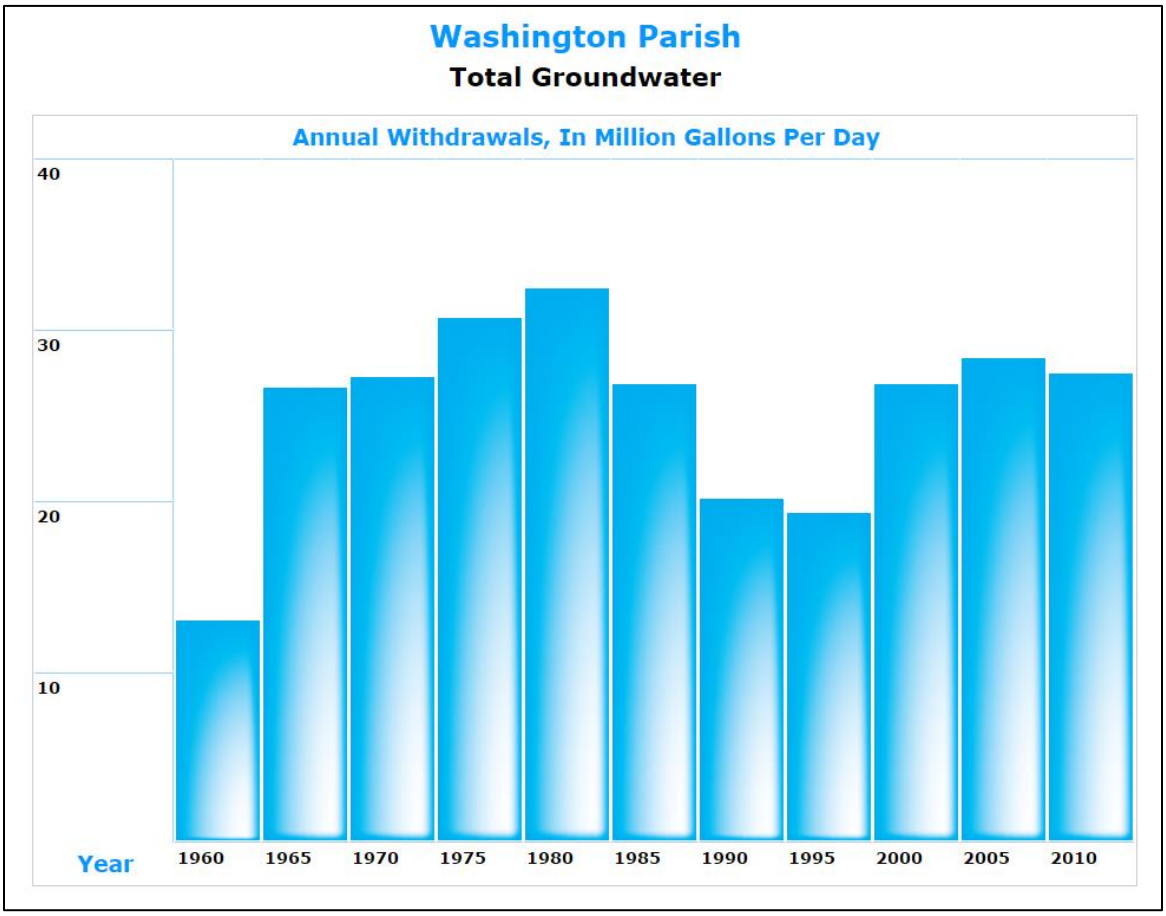


Figure 18.2: Groundwater Withdrawals, by Aquifer System, Washington Parish, 2014. Source: USGS.

2014 Aquifer Withdrawals

Washington Parish

Aquifer	Withdrawals in Mgal/day
Chicot Equivalent Aquifer System	7.66
Evangeline Equivalent Aquifer System	0.15
Jasper Equivalent Aquifer System	15.18
Other	1.25

Sample of Available Groundwater Monitor Well Information, by Aquifer System, Washington Parish, 2000-2016

Fig. 18.3: Monitor well in the Upland Terrace Aquifer, Chicot Equivalent Aquifer System, Washington Parish, showing relative stasis since 2001. Source: USGS.

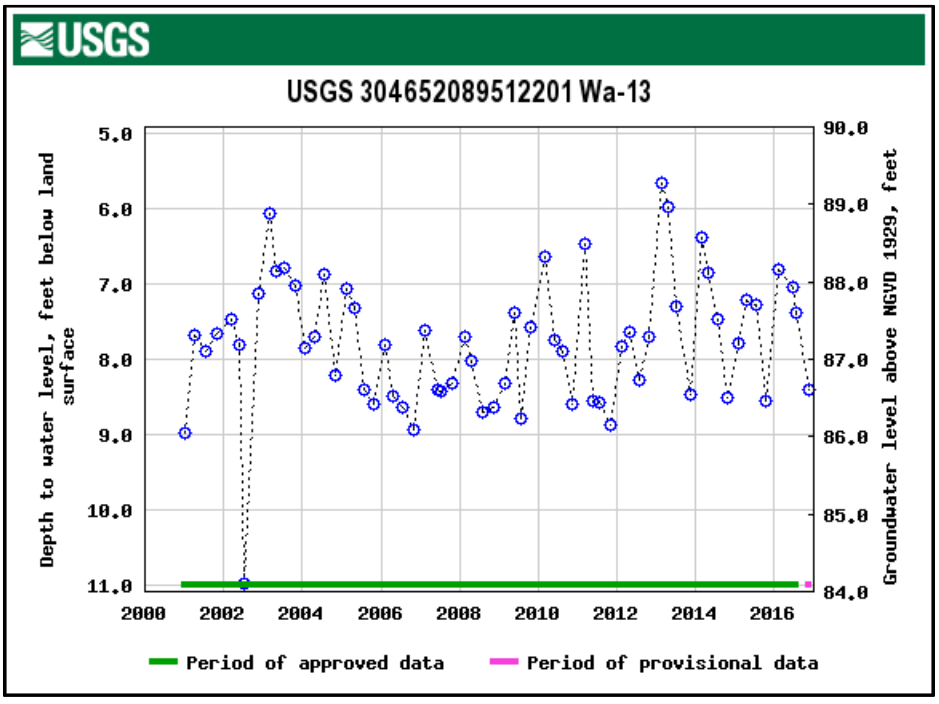


Fig. 18.4: Monitor well in the Lower Ponchatoula, Evangeline Equivalent Aquifer System, Washington Parish, showing water level rise and relative stasis over last decade. Source: USGS.

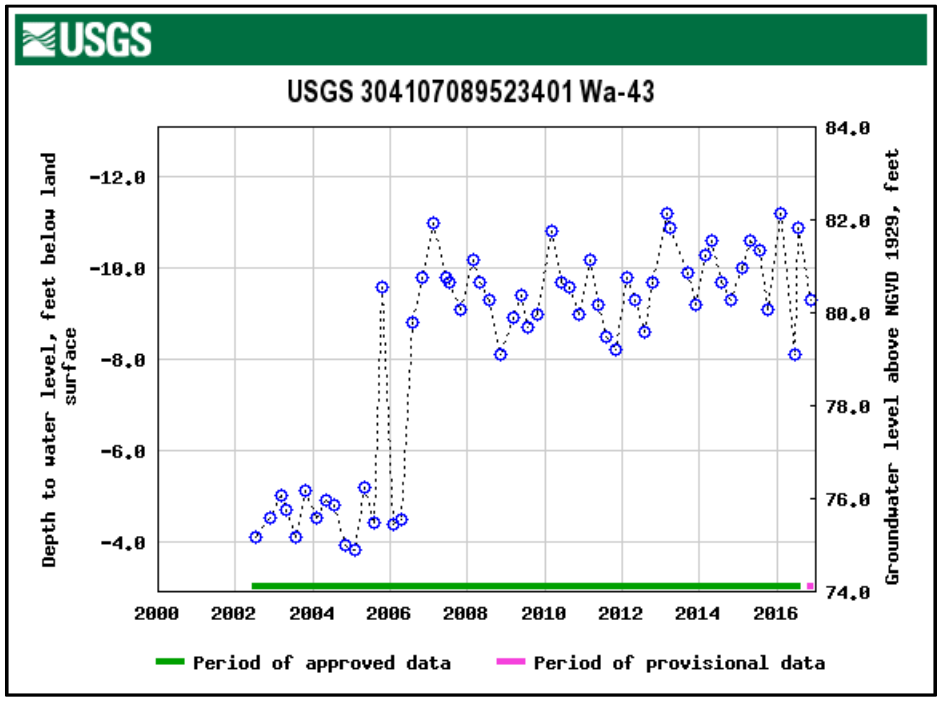
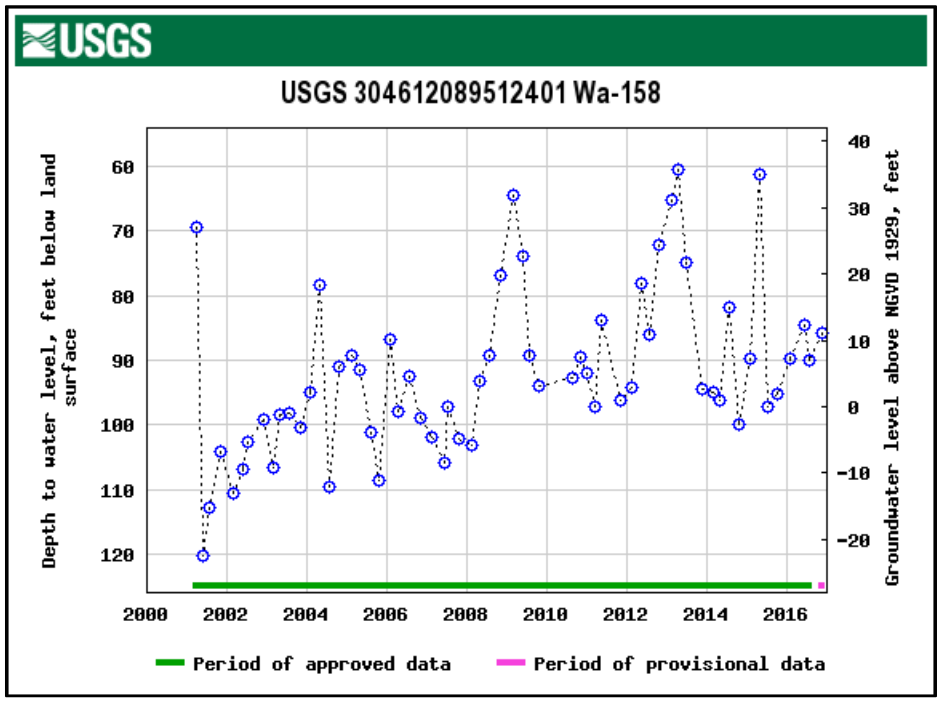


Fig. 18.5: Monitor well in the Amite Aquifer, Jasper Equivalent Aquifer System, Washington Parish, showing water level trending upward since 2001. Source: USGS.



St. Tammany Parish

There are no apparent or reported unacceptable effects for the present and near future on water supplies due to groundwater withdrawals from the Southern Hills Aquifer System in this parish. Elevated chlorides in one area of the southern end of the parish appear to be static. Continued population growth will lead to increased demand but this does not appear likely to impact local groundwater availability or aquifer system sustainability, although such new demand merits increased management attention.

Fig 19.1: Groundwater Withdrawals, St. Tammany Parish, 1960-2010. Source: USGS

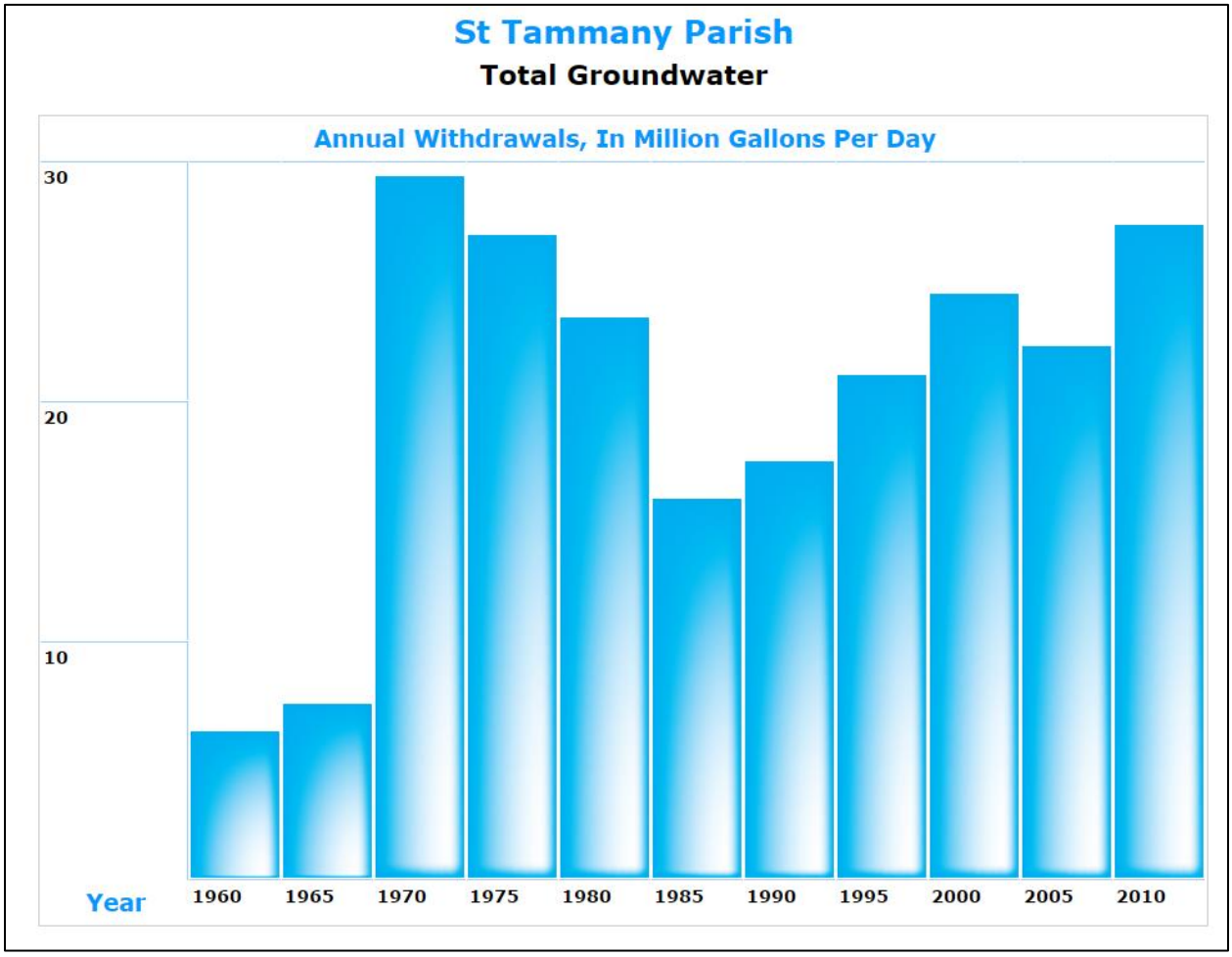


Figure 19.2: Groundwater Withdrawals, by Aquifer System, St. Tammany Parish, 2014. Source: USGS.

2014 Aquifer Withdrawals

St Tammany Parish

Aquifer	Withdrawals in Mgal/day
Chicot Equivalent Aquifer System	5.39
Evangeline Equivalent Aquifer System	12.98
Jasper Equivalent Aquifer System	6.98
Upland Terrace Aquifer	0.01

Sample of Available Groundwater Monitor Well Information, by Aquifer System, St. Tammany Parish, 2000-2016

Fig. 19.3: Monitor well in the Greater New Orleans Aquifer, Chicot Equivalent Aquifer System, St. Tammany Parish, showing water level drawdown and rise. Source: USGS.

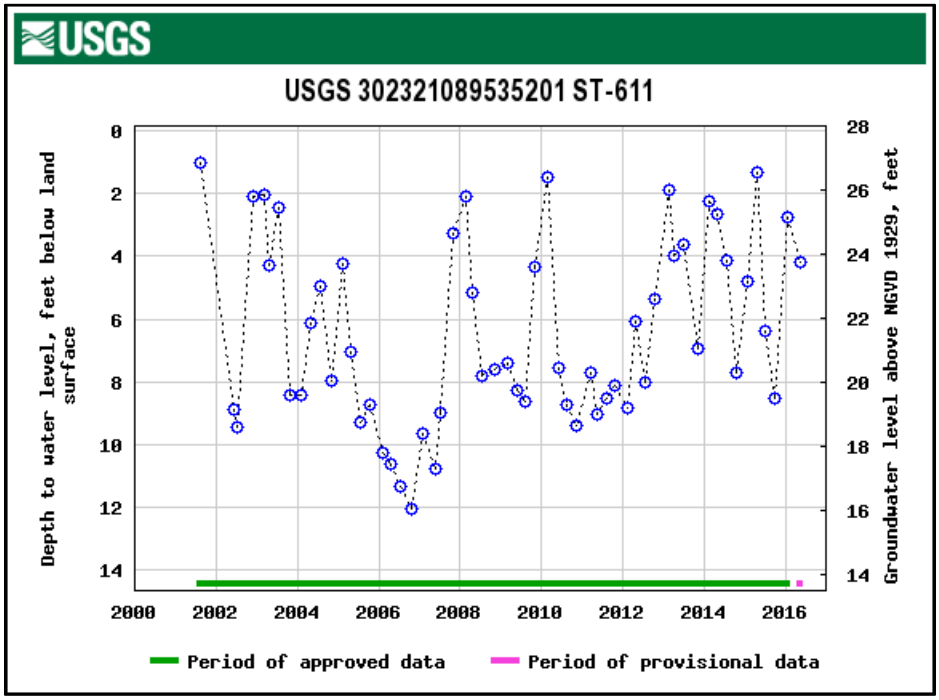


Fig. 19.4: Monitor well in the Upland Terrace Aquifer, Chicot Equivalent Aquifer System, St. Tammany Parish, showing relative stasis in water levels over last decade. Source: USGS.

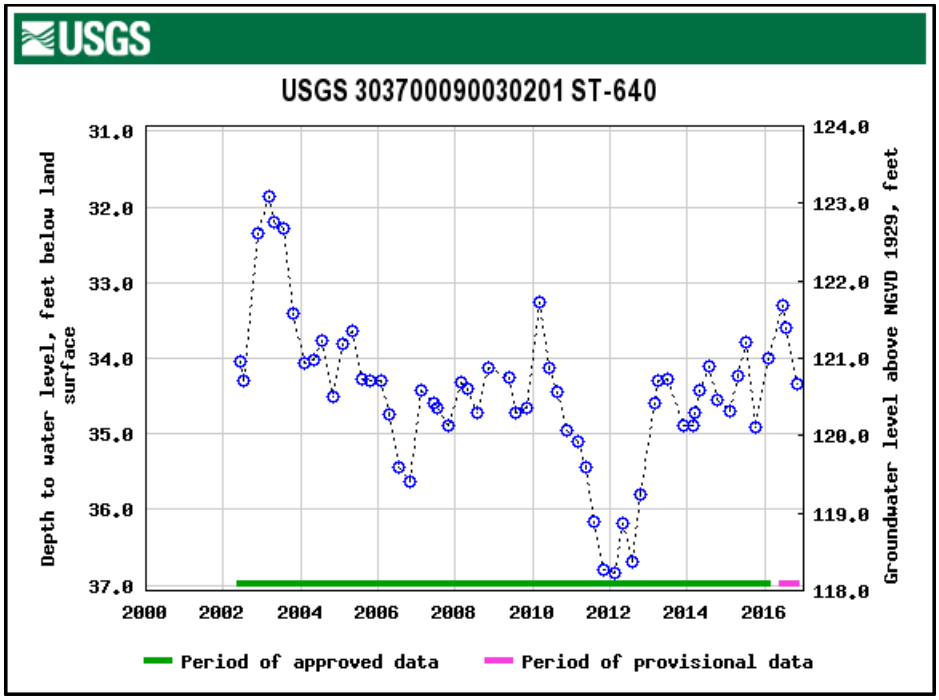


Fig. 19.5: Monitor well in the Big Branch Aquifer, Evangeline Equivalent Aquifer System, St. Tammany Parish, showing relative stasis in water level since 2001. Source: USGS.

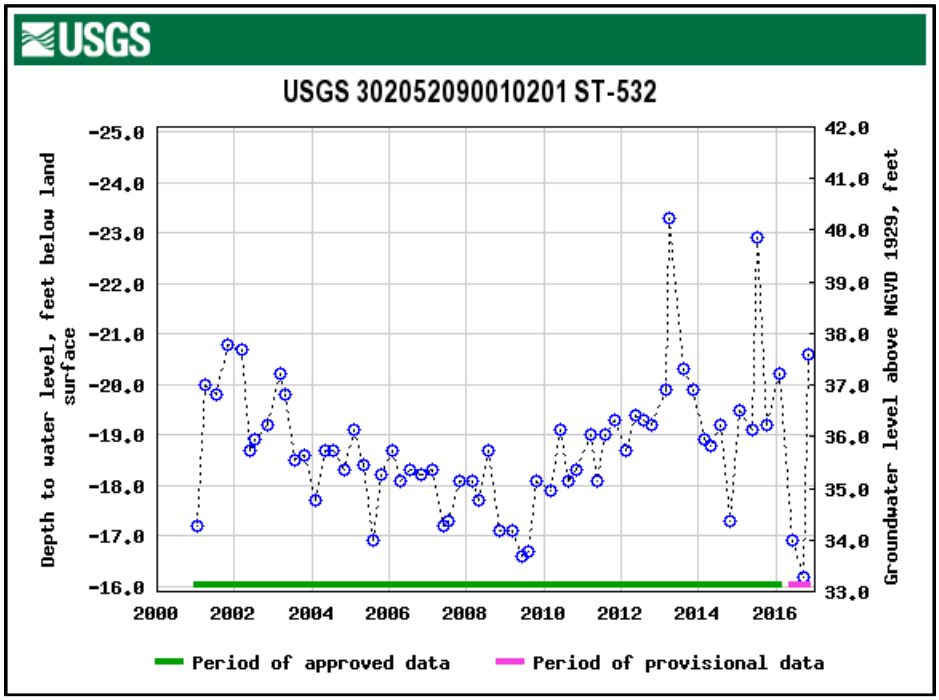


Fig. 19.6: Monitor well in the Lower Ponchatoula Aquifer, Evangeline Equivalent Aquifer System, St. Tammany Parish, showing water level rise over last decade. Source: USGS.

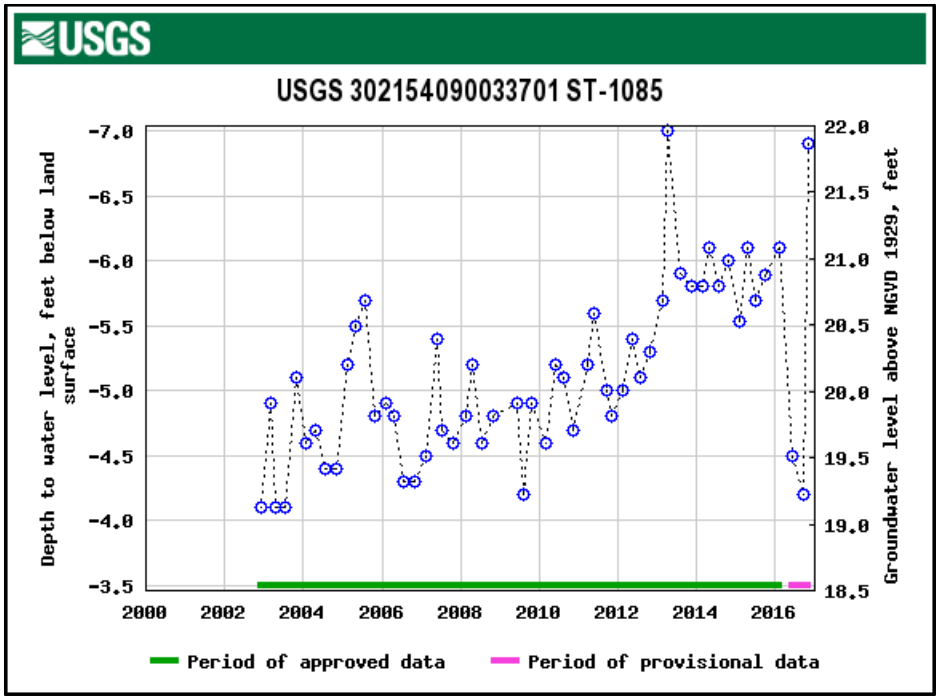


Fig. 19.7: Monitor well in the Lower Ponchatoula Aquifer, Evangeline Equivalent Aquifer System, St. Tammany Parish, showing upward trending water level since 2008. Source: USGS.

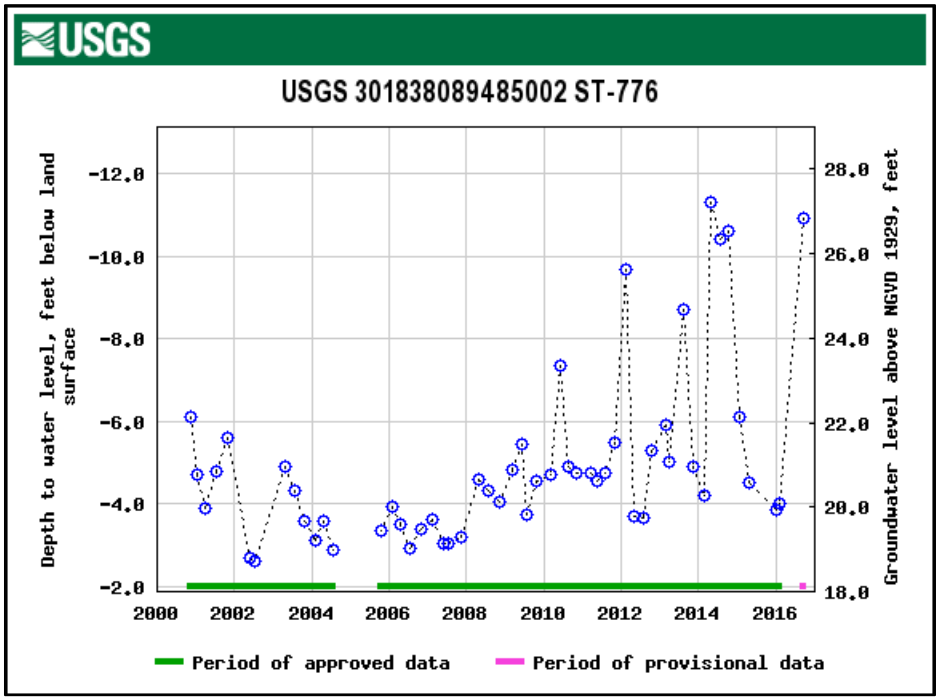
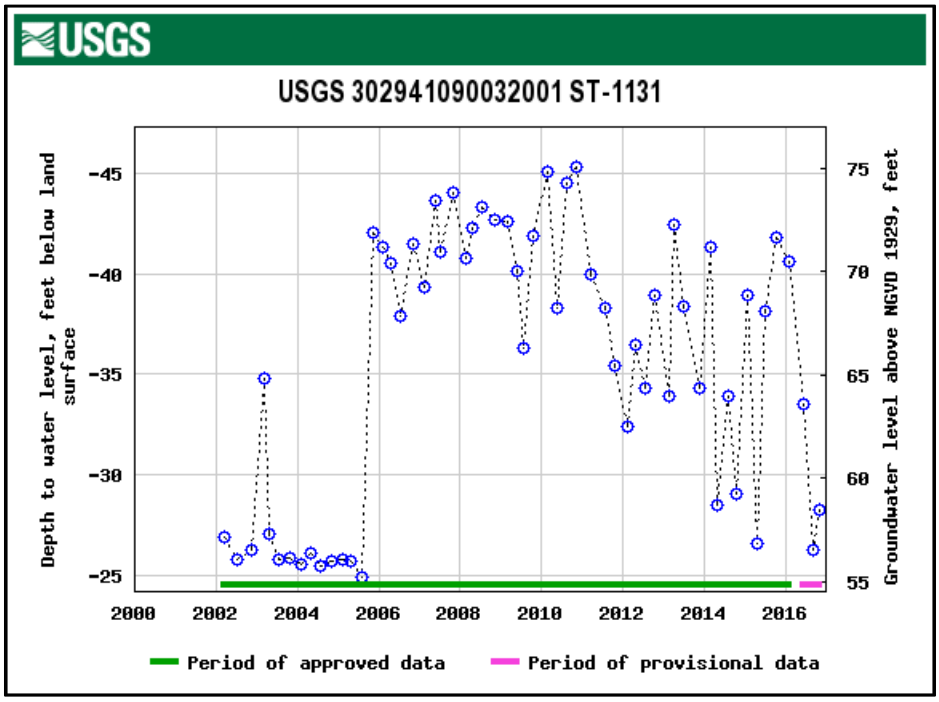


Fig. 19.8: Monitor well in the Tchefuncte Aquifer, Jasper Equivalent Aquifer System, St. Tammany Parish, showing water level rise and downward trend since 2011. Source: USGS.



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