

# Groundwater in Texas: Case Studies of Effective Management

Hays Trinity Groundwater Conservation District

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# Introduction

Groundwater is critical to Texas' ecology and economy. It is the primary source of water for agriculture, rural landowners, and communities in Texas, providing approximately 60% of the 16.1 million acre-feet of water used in the state annually. Groundwater also supports rivers, streams, and springs in Texas, providing an estimated 30% of surface flows. During drought, virtually all of the naturally flowing water in rivers originates from groundwater.

Groundwater conservation districts (GCDs) are the only entities in Texas with the primary responsibility for managing groundwater resources. GCDs utilize science to manage groundwater in a balanced, proactive and effective way. This is no easy task, and what effective management looks like is different for different GCDs as they are managing unique hydrogeological conditions and varying uses across Texas, through individually unique enabling legislation.

This series of case studies will describe how different GCDs across the state are proactively managing groundwater to protect both the long-term viability of groundwater resources and landowners' private property rights in groundwater.

In this first case study, we discuss the work that the Hays Trinity Groundwater Conservation District (GCD) is doing to protect groundwater wells and springflow within its jurisdiction. The iconic Jacob's Well spring, the second-largest underwater cave in Texas, and Cypress Creek, an important tourist attraction that generates tens of millions of dollars of revenue for Hays County, are located within the district's jurisdiction.<sup>1</sup> To better protect these treasured water resources and in some cases even prevent springs and rural wells from drying up completely, the district embarked on a multi-faceted and interconnected process that included stakeholder engagement, improving science and data, and management tools such as drought curtailments.

## CASE STUDY

# Hays Trinity Groundwater Conservation District

### CHALLENGES FACED



**Declining groundwater levels**



**Declining river baseflows and springflows**

*Decreasing baseflows in the Blanco River and flows in Jacob's Well and Pleasant Valley springs threatened due to combined effects of drought and groundwater pumping*



**Increasing number of domestic drinking water wells going dry**

### PREDOMINANT WATER USERS



**Public water supply utilities**



**Domestic drinking water wells**



**Recreation/  
Tourism**



**Environment**

### TOOLS USED TO ACHIEVE MANAGEMENT GOALS

#### Regulatory

- ▶ Creation of a groundwater management zone with prohibition on new operating permits in the Middle Trinity Aquifer.
- ▶ Drought curtailments triggered by reduced springflow, based on actual historic production.
- ▶ New permit in management zone restricted to upper and lower Trinity.

#### Science and data

- ▶ Scientific technical committee formed and completed study of springshed.
- ▶ An extensive monitoring well network tracks localized trends and informs drought declarations.
- ▶ Regional Recharge Zone formed for additional 5-year monitoring and study.

#### Community engagement

- ▶ Stakeholder engagement committee created to reach agreement on management tools and strategies.

### LESSONS LEARNED

- ▶ A rigorous, scientific study of hydrogeology is a valuable foundation for developing strategies to address threats to groundwater.
- ▶ After developing a science-based understanding of hydrogeology, stakeholder engagement is crucial to creating consensus around strategies such as curtailments triggered by drought.
- ▶ In addition to sound science and stakeholder engagement, a sustainable source of funding is vital to proactively manage limited groundwater resources.

## Background and governance

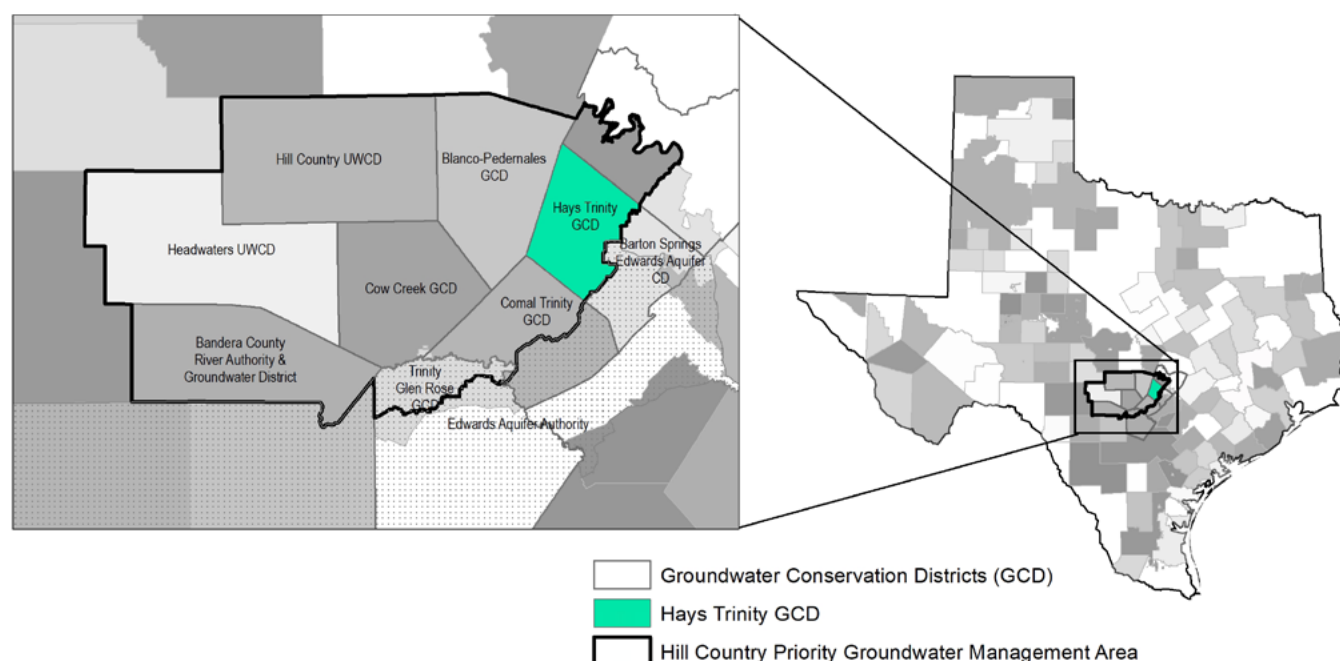
In 1990, the Texas Commission on Environmental Quality (TCEQ) determined that the Trinity Aquifer in the Texas Hill Country was suffering severe groundwater declines and that as a result, demand for groundwater in the region would exceed availability within the next 50 years. Consequently, TCEQ created the Hill Country Priority Groundwater Management Area (PGMA) and recommended that the Legislature create groundwater conservation districts in the PGMA to manage and conserve groundwater resources.

The Legislature subsequently created Hays Trinity GCD in 2001 and voters in Hays County confirmed the district in 2003. The district encompasses the western half of Hays County, a rapidly growing area of Central Texas.

FIGURE 1

### Hays Trinity Groundwater Conservation District administrative boundaries

#### Hill Country Priority Groundwater Management Area Groundwater Conservation Districts



Source: Wimberley Valley Watershed Association

## Powers and funding mechanisms

Under state law, all GCDs must “protect property rights, balance the conservation and development of groundwater to meet the needs of this state, and use the best available science in the conservation and development of groundwater.”<sup>2</sup> The Hays Trinity GCD has established a goal of sustainable management of the Trinity Aquifer, including a reasonable balance between groundwater supply for the community and maintaining base flow contribution to streams that preserve a sound ecological environment.<sup>3</sup>

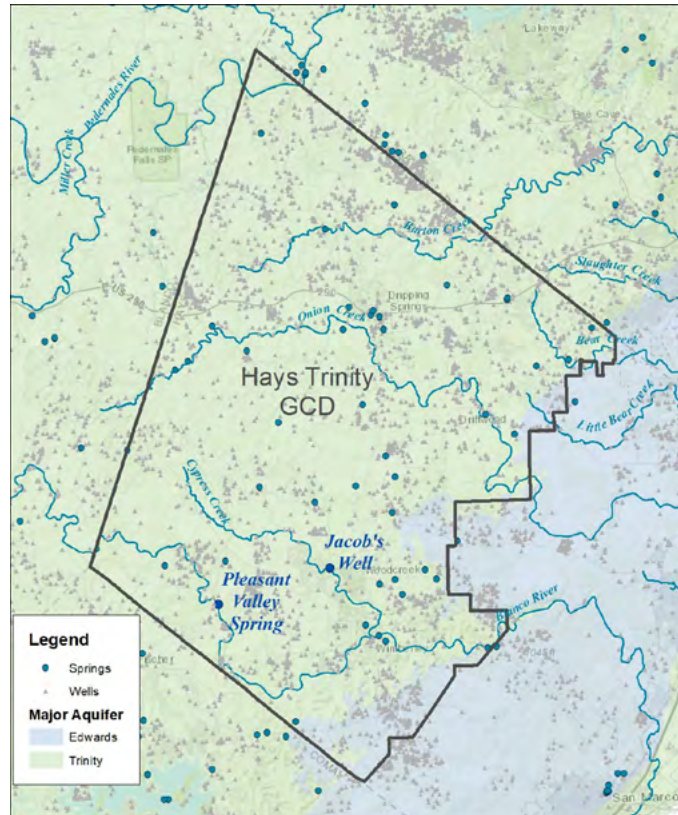
Hays Trinity has inadequate funding to carry out its statutory responsibilities. Currently, the district’s only viable sources of revenue are new well construction fees, permit renewal application fees, and service connection fees. The Hays Trinity GCD’s enabling legislation prohibits it from assessing production fees on permittees or from assessing an ad valorem property tax, two common funding mechanisms that other groundwater districts in Texas utilize.

## Groundwater resources within the jurisdiction

The Hays Trinity GCD has jurisdiction over the Trinity Aquifer in Western Hays County. Approximately, 46,000 rural residents within the district rely on private or public water supply wells withdrawing groundwater from the Trinity Aquifer for drinking water.<sup>4</sup> Springs from the Trinity Aquifer are important to sustaining creeks and rivers in the district's jurisdiction.

FIGURE 2

## Wells and springs in the Hays Trinity Groundwater Conservation District



Source: Wimberley Valley Watershed Association

Pleasant Valley Spring is a massive spring located in the riverbed of the Blanco River, a tributary to the Guadalupe River. It is the largest documented Trinity Aquifer spring in the Hill Country. During severe drought, Pleasant Valley Spring, along with Jacob's Well, become the sole contributors of baseflow to the Blanco River.

Jacob's Well spring is the second-largest underwater cave in Texas and the sole source of water for Cypress Creek, a tributary to the Blanco River. Cypress Creek flows through the city of Wimberley, where the popular swimming destination Blue Hole and shop-lined town square are located. In 2010, it was estimated that Cypress Creek helped to bring approximately \$65 million in tourism and hospitality revenue to Hays County.<sup>5</sup> Jacob's Well itself is a popular tourist destination, generating almost \$200,000 in park fee revenues to Hays County in 2019.

A federally funded watershed protection plan for Cypress Creek was established in 2014 to protect the water quality of Cypress Creek. The plan specifically recommends preservation of springflow from Jacob's Well at a rate of six cubic feet per second to maintain dissolved oxygen levels and water quality in the creek.

The district utilizes an extensive monitoring well network to track localized trends and inform drought declarations. Groundwater levels in wells and flow at springs reflect the amount of groundwater stored in the Trinity — with higher water levels and springflow measured during wet periods and lower water levels and low to no springflow during droughts. During the record-setting drought of 2011, a large numbers of wells went dry in the district.

Artesian pressure is the pressure in an aquifer that exists when water is trapped between confining rock layers. Increased groundwater pumping reduces artesian pressure in the Trinity Aquifer, which in turn causes declines in rural drinking water wells, springs, and the creeks and rivers they sustain. Decreasing baseflows in the Blanco River over the past few decades suggest that flow from Pleasant Valley Spring is threatened due to the combined effects of drought and groundwater pumping.<sup>6</sup> Jacob's Well has continuously flowed throughout recorded history, including during the drought of the 1950s, until 2000. Since 2000, it has stopped flowing seven times.<sup>7</sup>

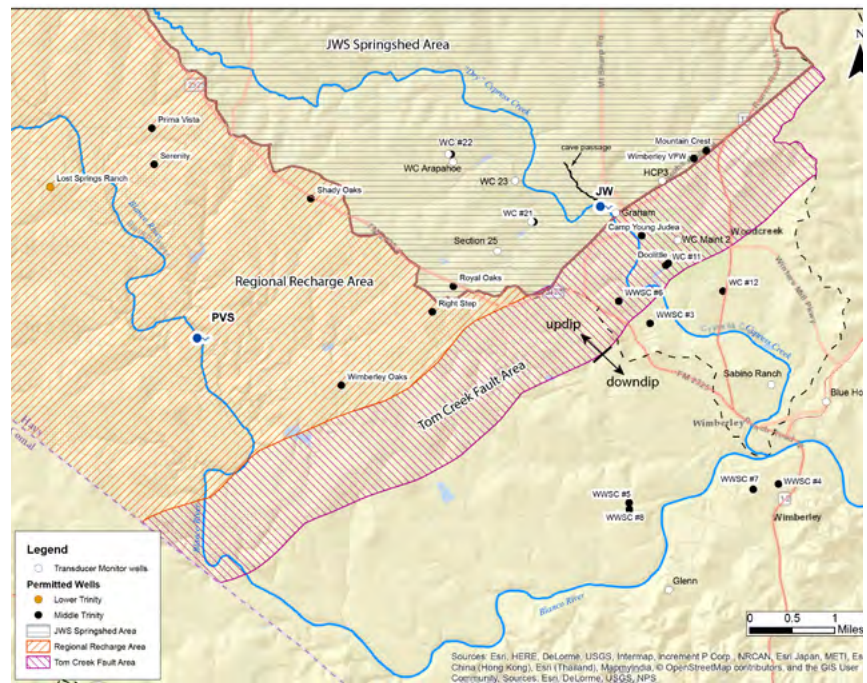
## Tools used to protect wells and springs

### Science and stakeholder driven

To better understand how decreasing groundwater levels in the Trinity Aquifer impact wells and springflow from Jacob's Well and to inform future policy, the district formed a scientific technical committee of groundwater scientists in 2018. The district requested that the committee delineate the springshed for Jacob's Well — the area that contributes flow to the spring. The scientific technical committee was composed of technical staff at the groundwater district, the Edwards Aquifer Authority, the Barton Springs Edwards Aquifer Conservation District, and the Meadows Center for Water and the Environment.

FIGURE 3

### Tom Creek fault zone and permitted wells



Source: Hays Trinity Groundwater Conservation District



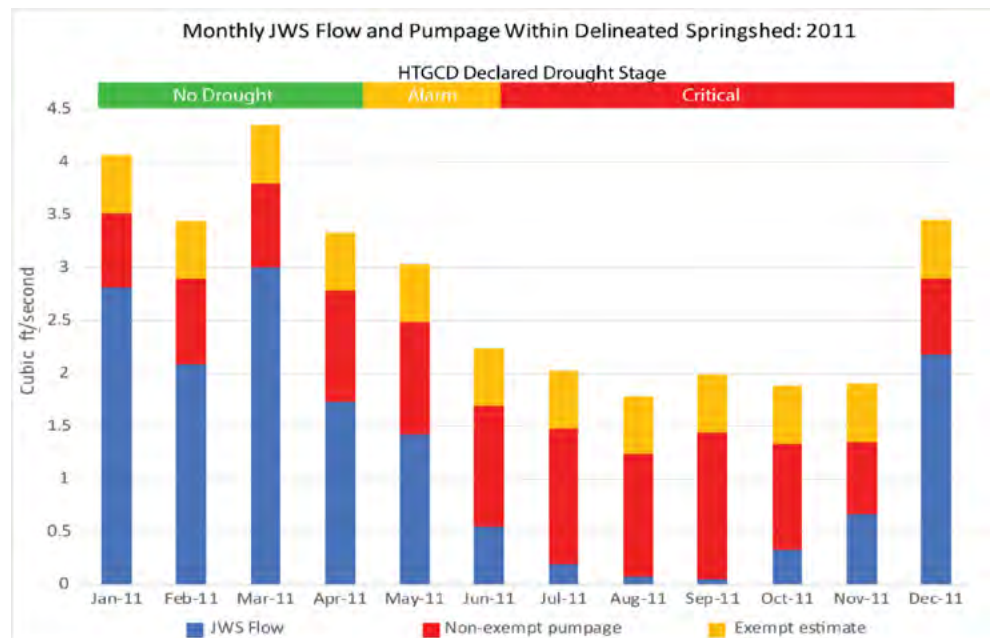
In July 2019, the scientific technical committee completed the evaluation, determining that flow to Jacob's Well is primarily constrained within the Dry Cypress Creek watershed and recommended that the Hays Trinity GCD create a groundwater management zone to more effectively manage groundwater within this area.<sup>8</sup> Under state law, GCDs may utilize groundwater management zones as a tool to manage groundwater in a hydrogeologically unique area.<sup>9</sup>

The study revealed differences in groundwater levels and recharge rates on either side of the Tom Creek Fault, a fault running from the northeast to the southwest downgradient of Jacob's Well. In this karst geology, the Tom Creek fault acts as a partial barrier to groundwater flowing from the northwest to the southeast, with Jacob's Well acting as a "relief valve" for water pressure building up in the aquifer. An important finding from the study is that although groundwater levels upgradient of the Tom Creek fault recharge quickly after rainfall events, groundwater pumping from water supply wells upgradient of the fault directly impacts springflow from Jacob's Well. In other words, pumping from the water-supply wells causes a reduction in flow at Jacob's Well and Cypress Creek, and during drought when recharge is not occurring, the impacts are more pronounced.

On the downgradient side of the Tom Creek fault, the study found that aquifer characteristics are different. The aquifer is much deeper and does not recharge quickly after rainfall events, and consequently, groundwater monitoring wells indicate a continual decline in water levels, between 3-11 feet per year. Additionally, water level trends indicate that the public water supply wells downgradient of the fault are likely not in direct communication with Jacob's Well. These findings could help inform future water management strategies in the area and underscore how a "one-size-fits-all" approach to groundwater management is not necessarily the most effective approach.

FIGURE 4

## Groundwater pumping and impacts to Jacob's Well



Source: Hays Trinity Groundwater Conservation District

The scientific technical committee concluded that reduction in pumping during drought periods from current levels of pumping will result in increased springflows. As a result, the committee recommended that in addition to establishing a groundwater management zone in the springshed of Jacob's well, the groundwater conservation district implement drought curtailments and a prohibition on new operating permits within the management zone. The committee also recommended that the district establish a second management zone, the Regional Recharge Zone, where additional studies are needed. Finally, the committee recommended that alternative water supply strategies, such as aquifer storage and recovery, should be explored to offset public water supply and reduce the demand on groundwater in the springshed of Jacob's Well.

The district recognizes the importance of public involvement and support for policy decisions. To determine the level of public support for a groundwater management zone, the groundwater conservation district formed a stakeholder task force.<sup>10</sup> The task force consisted of a wide variety of representatives, including from Hays County commissioners, well owners, water supply corporations, business owners and developers. The task force met once a month from October 2018 through January 2019 and twice a month from January 2019 through June 2019, for a total of more than fifteen meetings. The meetings were professionally facilitated and lasted an average of 2 hours each for a total of over 30 hours of analysis and discussion.

The task force adopted three guiding principles:

1. Delivering practical solutions that achieve measurable results while developing trust and respect by really listening to all members.
2. Agreeing that Jacob's Well and Cypress Creek flowing permanently is of central importance to all in Wimberley Valley and is a core ideal of this effort.
3. The economic health of the Wimberley Valley and our property values depend on clean, healthy water and aquifers. Sustainability of our water sources is essential and our goal is to protect the health of those systems.

At the conclusion of this process, the task force made consensus decisions on the scientific technical committee's recommendations, which were crafted into rules and approved by the Hays Trinity GCD Board on March 5, 2020.<sup>11</sup>

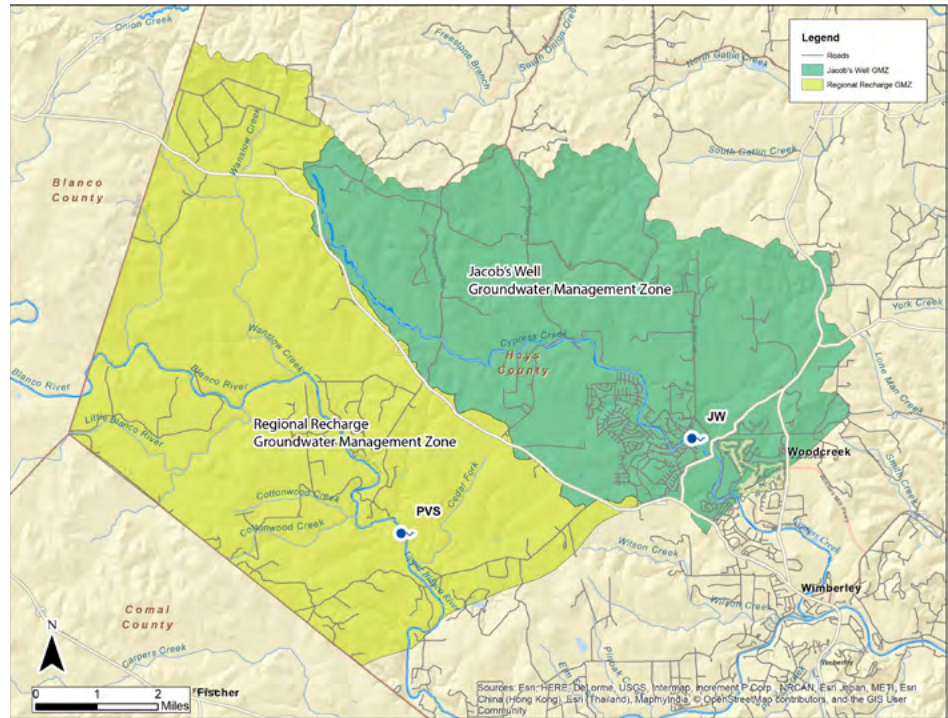
### **Jacob's Well Groundwater Management Zone**

The rules create the Jacob's Well Groundwater Management Zone (GMZ), a 39-square-mile area that encompasses the dry Cypress Creek Watershed<sup>12</sup>. To protect groundwater levels, as recommended by the stakeholder task force, the rules prohibit new permits over two acre-feet from the Middle Trinity Aquifer in the groundwater management zone but allow for the Hays-Trinity GCD Board to grant a waiver to this prohibition under certain circumstances. The Lower Trinity Aquifer remains available for permitting and exempt wells are not subject to the new rules in the Jacob's Well GMZ. The rules designate cutback triggers based on Jacob's Well springflow. When flow from Jacob's Well averages six cubic feet or less during any 10-day period, the district board declares the appropriate drought stage, and permittees must reduce groundwater pumping according to the curtailment percentage designated in the rules.



FIGURE 5

## Jacob's Well Groundwater Management Zone and Regional Recharge Zone boundaries



Map Credit: Hays Trinity Groundwater Conservation District

Furthermore, the rules create the Regional Recharge Study Zone, to the west of the Jacob's Well GMZ which encompasses Pleasant Valley Spring, where the district, along with technical partners, will monitor recharge, discharge, springflow, water quality, and aquifer levels for a five-year period.<sup>13</sup> As part of this study, the Hays Trinity GCD is participating in the development of an integrated groundwater and surface water numerical model for the Blanco River and Onion Creek watersheds that will provide a greater understanding of how groundwater pumping is impacting surface water and wells in the area.



*"I believe the intent of the Jacob's Well Groundwater Management Zone is not only to protect the flow of Cypress Creek, but also to protect the resources and property of the citizens that reside in the Wimberley Valley. For this reason, your rules should provide safeguards to over pumping in this area in order to protect all of those that currently rely on this resource and those who plan on using this resource responsibly in the future."*

— Lon Shell, Hays County Commissioner

## Effective management in the future

The Hays Trinity GCD has relied on sound science and stakeholder input to develop policy and management tools to protect the unique groundwater resources within its jurisdiction. This benefits all landowners and groundwater users within the district. The Hays Trinity GCD Board has recognized, however, that moving forward, to proactively manage the limited groundwater resources within its jurisdiction, it is vital for the district to secure a sustainable source of future funding and plan for future management. As a result, the board has recently initiated a stakeholder process to discuss amendments to its enabling legislation to provide additional sources of funding so that the district can continue to effectively manage groundwater in the future.

## Endnotes

- 1 Understanding Hill Country Water Resources Assessment of The Economic Contribution of Cypress Creek To The Economy of Wimberley, Phase II Final Report. 2013. M. Miller, et al. Texas State University.
- 2 Tex. Water Code§ 36.0015.
- 3 Hays Trinity Groundwater Conservation District Management Plan, available at: [http://haysgroundwater.com/files/Rules/2016\\_ManagementPlanApprovedv2.pdf](http://haysgroundwater.com/files/Rules/2016_ManagementPlanApprovedv2.pdf).
- 4 Hays Trinity Groundwater Conservation District, 2020, file: HTGCD Estimated Residents on Groundwater.xlsx.
- 5 Understanding Hill Country Water Resources Assessment of The Economic Contribution of Cypress Creek To The Economy of Wimberley, Phase II Final Report. 2013. M. Miller, et al. Texas State University.
- 6 Pleasant Valley Spring: A Newly Documented Karst Spring of the Texas Hill Country Trinity Aquifer, available at: [https://bseacd.org/uploads/Hunt\\_etal\\_2013.pdf](https://bseacd.org/uploads/Hunt_etal_2013.pdf).
- 7 Gary, M.O., Hunt, B.B., Smith, B.A., Watson, J.A., and Wierman, D.A., 2019, Evaluation for the Development of a Jacob's Well Groundwater Management Zone Hays County, Texas. Technical Report prepared for the Hays Trinity Groundwater Conservation District, Hays County, Texas. Meadows Center for Water and the Environment, Texas State University at San Marcos, TX. Report: 2019-05. July 2019, 58 p. available at: <https://gato-docs.its.txstate.edu/jcr:15e1d5ca-395e-4233-9ae7-c7769d20b407> (page 12).
- 8 Id.
- 9 Tex. Water Code§ 36.116(d).
- 10 See [Facilitator's Report: Jacob's Well Springflow Stakeholder Task Force – Final Recommendations, July 2019 Memorandum](#).
- 11 See Rule 15 and Rule 16, [http://haysgroundwater.com/files/Rules/2020\\_Rules\\_04062020.pdf](http://haysgroundwater.com/files/Rules/2020_Rules_04062020.pdf).
- 12 See HTGCD Rule 15.
- 13 See HTGCD Rule 16.

## Acknowledgements

*Thank you to the Hays Trinity Groundwater Conservation District and the Wimberley Valley Watershed Association for their contribution to this case study.*