TEXAS LAND TRUST COUNCIL

Valuing Economic Benefits of Texas Conservation Lands

January 2019

Produced by:

SIGLO GROUP

EXECUTIVE SUMMARY

This study quantifies the value of lands and conservation easements that have been conserved by or with assistance from the Texas land trust community. Economic values for benefits provided by these conserved lands were calculated using an ecosystem services approach. Specifically, the study assessed the more than 1.6 million acres of open space lands that have been compiled into a statewide conserved lands database by Texas Land Trust Council members and partners as of January 1, 2018. Lands were assessed in terms of the services and subsequent taxpayer savings they provide for water quality, water quantity, flood prevention, and rural economies (via agricultural production and wildlife leases).

To determine the benefits provided and their larger impact, this study examined past and current research and data related to economic benefits achieved through conservation. The study found that the lands put into conservation with the help of Texas land trusts are estimated to provide more than $1 billion in benefits to Texas taxpayers each year. Of this, 47% is attributed to flood prevention and damage reduction, 16% can be attributed to supporting rural economies, and 37% can be attributed to benefits for water quality and quantity. Over the next 30 years, the protection of these services would result in $30.9 billion in taxpayer savings at today's current rates.

It is important to note while the calculations in this report begin to articulate some of the economic values that these lands provide to the state, it is not a comprehensive estimation of the values they contribute. For instance, aesthetic appeal and enhancement of surrounding property values, endangered species habitat, and fish habitat protection where not considered, among many other variables. The study focused on issues that are critically important to Texans and represent where land conservation can have a positive impact on issues effecting water supply, flood mitigation, and food production. The findings represent a great step forward toward recognizing the substantial value that conservation lands bring to the Texas economy.

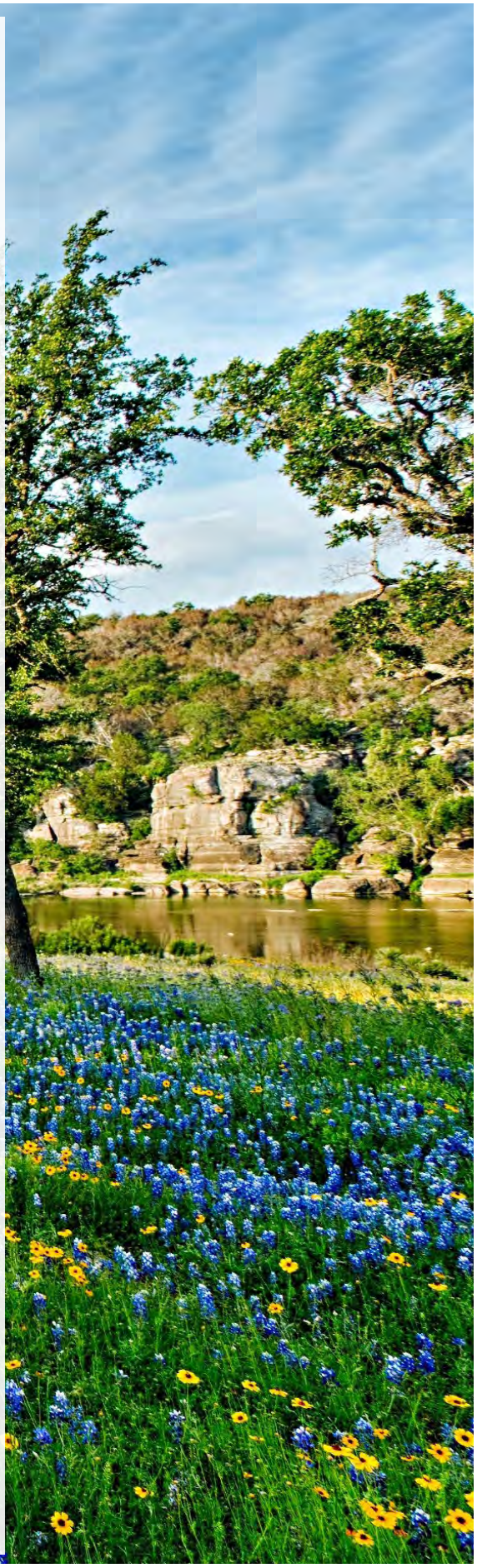


TABLE OF CONTENTS

EXECUTIVE SUMMARY	
BACKGROUND	4
METHODS	6
RESULTS	17
CONCLUSION	18
REFERENCES	19

Cover photo: Conservation easement on a family ranch in Goliad County. Photo courtesy of Guadalupe Blanco River Trust.

Opposite Page Photo: A central Texas conservation easement on the Pedernales River. Photo courtesy of Texas Land Conservancy.

BACKGROUND

This study seeks to better quantify the economic value of lands protected by Texas Land Trust Council members and partners using an ecosystem services approach. Texas land trusts are non-profit organizations that work to conserve Texas' special lands and waters by permanently protecting them from development for the benefit of the people, economy, and wildlife of our state. Land trusts conserve natural areas by negotiating private, voluntary agreements with property owners to leave their land undeveloped or through outright purchases. Land trusts offer nonprofit, voluntary solutions for land conservation.

Ecosystem services are the goods and services provided by the natural environment that sustain, support, and enrich human life (MEA 2005, Issues in Ecology 1997). The bedrock of a functioning community, these services include ecological processes that improve our environment—such as nutrient cycling and habitat for our native species—as well as services that primarily benefit human communities—like the supply of drinking water, water purification, flood mitigation, recreational opportunities, and food production (Issues in Ecology, 1997).

In Texas, open lands help preserve these natural functions and serve as an integral part of Texas heritage. Iconic expanses of prairie, rangeland, forest, marsh and desert have defined our state's history and culture and continue to sustain our economy. The ecosystem services these landscapes provide offer support to our rapidly growing urban communities. Between 2010 and 2016, Texas experienced the nation's largest annual population growth, adding just under half a million new residents on average each year and reaching a population of 28.3 million by the end of 2017 (Texas Land Trends 2014, U.S. Census Bureau).

This continuing trend of massive population growth will have dramatic impacts on our state water supplies, food, and landscapes. In urban areas of high growth—such as Austin, San Antonio, Houston and Dallas—water supplies are already stressed. The loss of working lands and open spaces, which normally help retain water by letting rain infiltrate into the ground and circulate into aquifers, means that these groundwater resources are less able to recharge. Additionally, the land fragmentation that results from development can often be detrimental to agricultural sustainability and profitability (www.texaslandtrends.org). Given that Texas is the third largest agricultural state in the U.S.—accounting for 6% of the country's total agricultural income (USDA 2017)—and is home to a $5.1 billion annual hunting and angling industry, these losses can have wide-reaching impacts on the economy (TPWD 2001) and the livelihoods of millions of Texans.

Through a monetary valuation of the economic benefits that land trust conserved lands provide, the results of this project are intended to more clearly articulate the value of Texas conservation lands and open spaces to decision makers. For example, we demonstrate that conservation easements on privately held lands create many public benefits and that these lands should be preserved intact, like public parks and wildlife management areas. Unfortunately, the very characteristics that make conserved lands suitable to sustain our food, water, and natural resources also make them an easy target for the execution of large-scale infrastructure projects involving eminent domain.

While several studies in Texas have begun to approach an evaluation of ecosystem services (the Texas Comptroller's office examined the economic impact of state parks in 2008 and the Texas A&M Forest Service assessed the regulating and cultural services provided by forest ecosystems in 2013), none have considered the value provided by privately held lands. In fact, 83% of lands in Texas are classified as privately-owned working lands and provide more than 145 million acres of forest, farm, and ranch. By analyzing the value of a large amount of privately and permanently conserved lands, this assessment is meant to prepare TLTC and its partners to articulate the importance of protecting these spaces to decision makers. We hope the tools and data provided here will continue to support future valuations and legislative action.

"We are Texans, working together to conserve the lands we love and the water we depend on."

- Texas Land Trust Council

Land trusts across Texas have helped conserve more than 1.6 million acres as of January 1, 2018. The services provided by these land trust conserved lands could provide more than $21 billion in economic benefits over the next 30 years (at today's current rates).

METHODS

STUDY AREA

Calculations were limited to lands conserved by, and/or with the help of, Texas land trusts, identified via TLTC's Conservation Lands Inventory (as of January 1, 2018). This represents over 1.6 Million acres across the state.

SERVICES CALCULATED

For this study, five key metrics were calculated across three categories. These metrics represent the dollar amount that taxpayers and/or the government save annually, thanks to the permanent conservation of TLTC lands and the benefits and services they provide. The services of each metric are explained briefly below.

CATEGORY 1: Water Resources

Water Quality: As rain falls, natural lands absorb water and remove harmful materials, thereby improving water quality.

Water Quantity: Natural habitats and pervious surfaces help store and slowly release water over time, increasing water quantity in our streams, rivers, reservoirs, and aquifers.

CATEGORY 2: Flood Prevention

Inland Flood Prevention: Conserved inland areas help capture rainfall and slow and soak up floodwaters, thereby decreasing flood damage.

Coastal Flood Prevention: Conserved coastal lands reduce flood damage by slowing and capturing water and reducing surge levels.

CATEGORY 3: Rural Economic Support

Timber, Agriculture, and Ranching Productivity: Lands conserved by land trusts allow landowners to continue contributing to rural economies through timber, agriculture, and ranching, while also protecting habitat.

Wildlife and Hunting Leases: The potential dollar contribution of TLTC lands to rural economies in the form of wildlife and hunting lease industries.

Cypress swamps and marshes like these help filter water, removing impurities and pollutants. Photos courtesy of Texas Land Trust Council and the Texas Land Conservancy.

METRICS 1 and 2: WATER QUALITY & QUANTITY

Water quality and quantity were calculated using the methods outlined in the conservation easement study carried out by the Natural Resource Institute (NRI) at Texas A&M (NRI 2019), and data from the Natural Resource Conservation Service at USDA, the Texas State Water Plan, and Texas Land Trust Council (Table 1, Figure 1). To determine the dollar per acre foot values associated with each region of the state of Texas, regional water management costs from the 2017 Texas State Water Plan were divided by the projected regional water yield. To determine the values associated with water quality and quantity, strategies from the State Water Plan were then categorized as pertaining to either the protection or improvement of water quality, or the protection and generation of water quantity (Table 2). The percent of the value associated with each of these two categories was then multiplied by the cost per acre-foot to determine the cost associated with water quantity and quality, respectively.

In line with NRI methods, rainfall infiltration was estimated using a two-step process. First, average annual rainfall data (PRISM Climate Group 2018) was used to estimate rainfall across TLTC lands. Second, an estimated infiltration rate of 50% was applied to rainfall rates. This rate was derived from a previous study by Arnold & Gibbons (1996), which states that natural ground cover infiltrates at approximately 50%, with 25% shallow infiltration and 25% deep infiltration.

To identify the total estimated value saved by the conservation of TLTC lands, the cost per acre-foot values for quantity and quality were each multiplied by the acreage of current TLTC lands. These values were adjusted from 2017 values to 2018 values using the Bureau of Labor Statistics' Consumer Price Index online inflation calculator (BLS).

Top: The Spring Creek Greenway is the longest connected, urban forested corridor in the nation, conserved in part by a local land trust. Photo courtesy of Bayou Land Conservancy. Bottom: At 710 miles long, the Trinity River is the longest river within a Texas watershed, provideing water for rural and urban communities. Photo courtesy of Trinity River Dallas Facebook Page.

Data Sources

DATA	TYPE	SOURCE	YEAR
Rainfall	raster	NRCS	1981-2010
Infiltration Rate	report	Arnold & Gibbons	1996
Water Mgmt Costs	report	TWDB State Plan	2017
TLTC Lands	.shp	TLTC, Siglo Group	2017

Table 1. Abbreviated data sources for the input data used for water quality and quantity calculations. For full list of data sources, see References on page 19.

Children jumping at Jacob's Well Spring on Cypress Creek, conserved by a local land trust in partnership with Hays County. Photo courtesy of Carl Griffin.

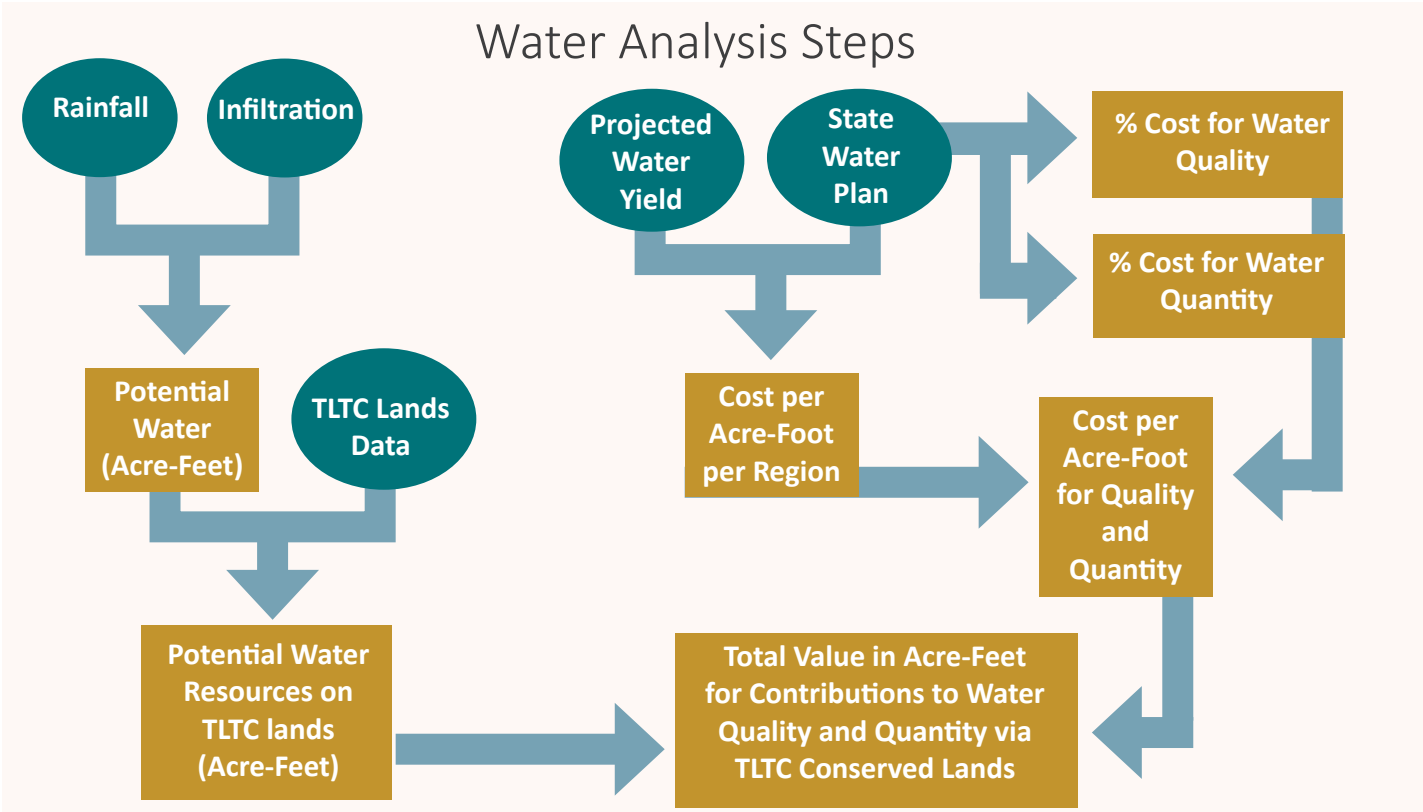


Figure 1. Steps used to determine an estimate of the value of potential acre-feet of water captured, filtered, and stored by TLTC lands annually. Ovals indicate input data, while rectangles indicate calculation results. For full data sources, see Table 1 and References.

This coastal Texas ranch is forever preserved via a conservation easement held by a local Houston-area land trust in partnership with the Texas Farm and Ranch Lands Conservation Program. Photo courtesy of Katy Prairie Conservancy.

Metric	Strategies	% Total Cost	Description
Water Quality	Indirect Reuse	8%	Discharge of waste water into natural water bodies for later use
	Other Direct Reuse	4%	Reuse of non-potable water (e.g. for landscaping)
	Other Conservation	2%	Best management practices for industries (e.g steam-electric, mining)
	Seawater Desalination	1%	Desalination of seawater resources
	Direct Potable Reuse	1%	Treatment of waste water effluent
	Groundwater Desalination	1%	Desalination of groundwater resources
	WATER QUALITY TOTAL:	**18%**	
Water Quantity	Conjunctive Use	1%	Combining surface and ground to optimize benefits
	Aquifer Storage and Recovery	2%	Injection of water into aquifers for storage
	Drought Management	3%	Restrictions on water use (e.g. watering lawns, washing cars)
	Groundwater Wells	7%	Addition of new wells
	Irrigation Conservation	16%	Changes in irrigation methods
	Municiple Conservation	10%	Changes to plumbing, pricing, and audits
	New Major Resevoir	13%	Addition of 26 new, major resevoirs
	Other Surface Water Collection	31%	Removal of infrastructure bottlenecks (e.g. small resevoirs)
	WATER QUANTITY TOTAL:	**82%**	

Table 2. Breakdown of water management tasks associated with water quality and water quantity from the Texas State Water Plan (TWDB 2017). Eighteen percent (18%) of costs were associated with water quality, and approximately 82% were associated with water quantity management.

Halifax Hole on the Blanco River is part of the Halifax Ranch, a private property now conserved in perpetuity through a conservation easement. Photo courtesy of Kenny Braun.

Region	Capital Costs ($)	Total Acre-Feet	$/Acre-foot ($)	$/Acre-foot Quality ONLY ($)	$/Acre-foot Quantity ONLY ($)
A	$ 866,000,000	23,033,333	$ 37.60	$ 6.77	$ 30.83
B	$ 630,000,000	3,283,333	$ 191.88	$ 34.54	$ 157.34
C	$ 23,635,000,000	39,766,667	$ 594.34	$ 106.98	$ 487.36
D	$ 1,241,000,000	13,733,333	$ 90.36	$ 16.27	$ 74.10
E	$ 1,930,000,000	10,066,667	$ 191.72	$ 34.51	$ 157.21
F	$ 1,201,000,000	9,008,333	$ 133.32	$ 24.00	$ 109.32
G	$ 4,321,000,000	25,650,000	$ 168.46	$ 30.32	$ 138.14
H	$ 10,879,000,000	67,491,667	$ 161.19	$ 29.01	$ 132.18
I	$ 2,754,000,000	24,075,000	$ 114.39	$ 20.59	$ 93.80
J	$ 144,000,000	1,091,667	$ 131.91	$ 23.74	$ 108.16
K	$ 3,773,000,000	29,358,333	$ 128.52	$ 23.13	$ 105.38
L	$ 8,076,000,000	19,391,667	$ 416.47	$ 74.96	$ 341.50
M	$ 1,866,000,000	23,475,000	$ 79.49	$ 14.31	$ 65.18
N	$ 510,000,000	4,633,333	$ 110.07	$ 19.81	$ 90.26
O	$ 814,000,000	10,600,000	$ 76.79	$ 13.82	$ 62.97
P	$ 332,000,000	3,133,333	$ 105.96	$ 19.07	$ 86.89

Table 3. Breakdown of the projected capital costs associated with state water management from 2020-2070 in Texas (TWDB 2017). Dollar-per-acre-foot costs for Quality and Quantity were calculated using the percentage breakdowns shown in Table 2. For more information, reference "Publications" on TLTC's website.

METRIC 3:
INLAND FLOOD PREVENTION

Inland flood prevention was calculated in line with the general methods of a recent Texas Forest Service study (Simpson et al. 2013). The study used FIA forestland data alongside National Land Cover Data to determine areas of upland, riparian, and wetland forests, then calculated estimates of dollar per acre values for each of these systems based on their potential to offset inland flood damage and associated costs. In contrast, our study employed the vegetation community data from the Ecological Mapping Systems produced by Texas Parks and Wildlife Department (TPWD 2018). This dataset was chosen as it is highly-specialized, detailed, and continuous across the study area (Table 4).

To calculate the value of TLTC lands for inland flood protection, areas of upland forest, riparian forest, and wetland forest were first extracted from the TPWD EMS dataset. The TPWD EMS dataset lacks forested wetland data for many regions, so the 2011 National Land Cover Data (USGS 2014) "woody wetland" classes were added to the database. This “woody wetland” class was also used in the 2013 TAMU study (Figure 2). Where areas of overlap occurred between the NLCD and TPWD data, only the TPWD data was retained as it is higher resolution and considered more accurate.

2011 National Land Cover Data "developed" areas were then intersected with the upland forest, riparian forest, and wetland forest areas. This allowed for each of the forested area types to be classified as either “urban” or “rural”. The differentiation between urban and rural is important for the valuation of the land—forest in areas with more infrastructure, like urban areas, are more valuable because infrastructure damaged by flooding is costly to repair. All remaining areas that were not forested lands or urban land were classified as “all other vegetation types.” Whether lands are forested or not, all vegetated landcover is valuable for flood protection and is accounted for in this analysis.

These lands were intersected with TLTC land to determine the total acres of each type within TLTC boundaries (Figure 3). For rural riparian forests, rural wetland forests, urban upland forest, urban riparian forest, and urban wetland forests, dollar per acre values from the Texas Forest Service study were applied to calculate the total monetary value for each vegetation type (Simpson et al. 2013, see Table 5). The Texas Forest Service study does not provide dollar per acre values for rural upland forests or other vegetation types, and no other studies in Texas have put forth a reported value. To account for this absence, rural upland forests and all other vegetation types were estimated using a conservative proxy value, based on population density. Given that an estimated 15.3% of Texans live in rural areas as compared to urban areas, the rural upland forest value was proxied by taking 15.3% of the dollar per acre dollar per acre value assigned to urban upland forests by the Texas Forest Service study. For all other vegetation types, a blanket value of 10% the rural upland forest value was applied as a conservative estimate (Table 5, Figure 2).

Once dollar per acre values had been determined for all vegetation types, they were applied to the total calculated acres of each system within the TLTC lands dataset. The resultant number was then adjusted for inflation from 2013 (BLS), the original year of the Texas Forest Service study and thus the dollar per acre values.

Data Sources

DATA	TYPE	SOURCE	YEAR
TPWD EMS	.shp	TPWD	2018
TLTC Lands	.shp	TLTC	2017
$/Acre Values	report	TAMU Texas Forest Service	2013

Table 4. Abbreviated data sources for input data used for water quality and quantity calculations. For full list of data sources, see References.

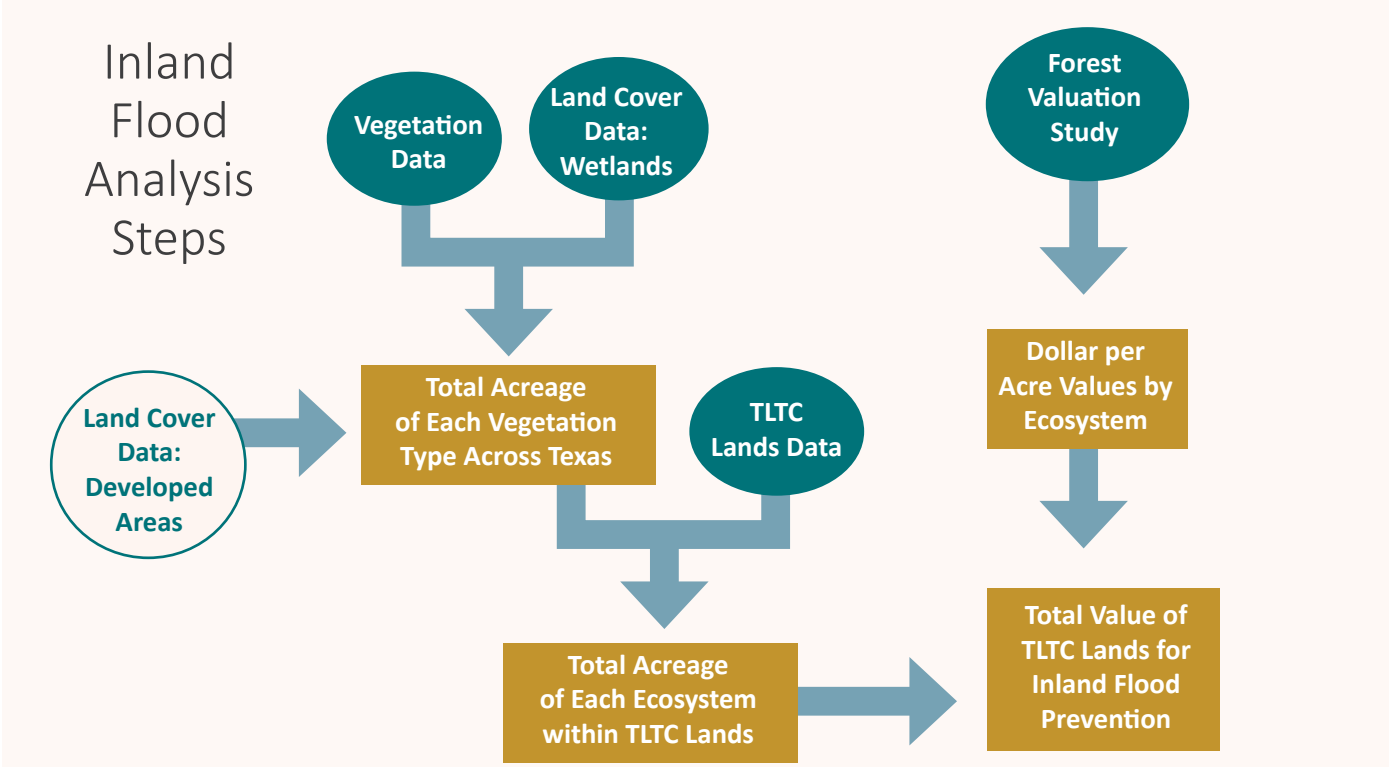


Figure 2. Steps used to determine an estimate of the value of TLTC conserved lands for inland flood prevention and damage mitigation. Ovals indicate input data, while rectangles indicate calculation results. For full data sources, see Table 4 and References.

Land Cover	Water Regulation Value ($/Acre)	Source
Rural Riparian Forests	$ 116.45	TAMU 2013
Rural Wetland Forests	$ 1,758.18	TAMU 2013
Urban Upland Forest	$ 662.96	TAMU 2013
Urban Riparian Forests	$ 779.41	TAMU 2013
Urban Wetland Forests	$ 2,421.14	TAMU 2013
Rural Upland Forest	$ 101.43	N/A (Population Density Proxy)
All Other Vegetation Types	$ 10.14	N/A (10% of Population Density Proxy)

Table 5. Water regulation (flooding) $/acre values for the 7 vegetation classifications used in this study.

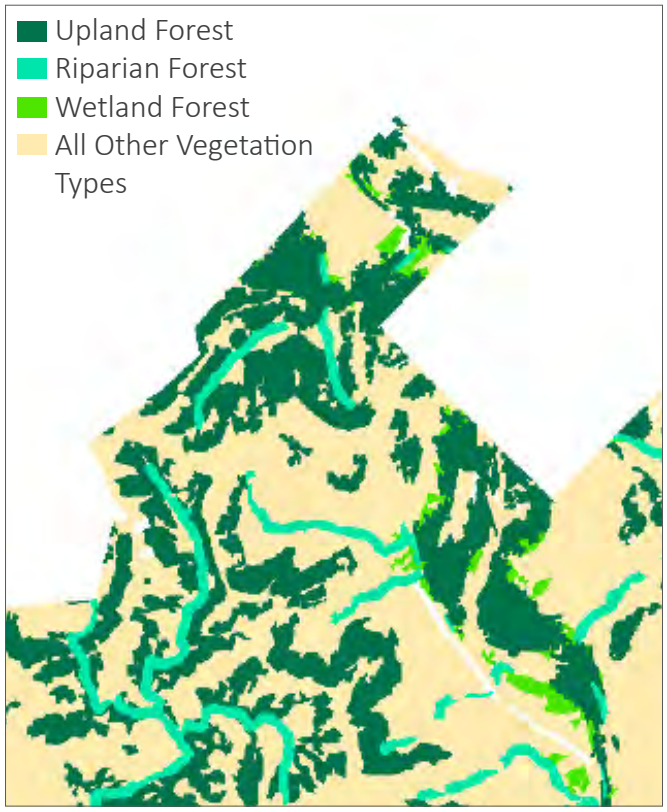


Figure 3. Inland flood-prone ecosystems were isolated from TPWD EMS data and intersected with the boundaries of lands conserved by TLTC.

METRIC 4: COASTAL FLOOD PREVENTION

Coastal flood prevention was calculated using the estimated value of Texas' coastal habitats extracted from a recent study published in Nature Climate Change in 2013 (Arkema et al. 2013). The study estimated that natural coastal habitats protect approximately $2.4 billion of property in Texas. To determine a dollar per acre value, this total value estimate was divided by the calculated total acreage of undeveloped coastal habitat in Texas. Total acreage of coastal habitats was calculated through a three-step process, using data from the Texas Parks and Wildlife Department and TLTC (Table 6).

First, a subset of vegetation systems was isolated from Texas Parks and Wildlife Department's Ecological Mapping Systems data (TPWD 2018, Figure 5 and Table 7). Second, to ensure that the remaining areas were habitat rather than impervious cover—which is incapable of absorbing flood waters—areas marked as "developed" in the National Land Cover Dataset were isolated and removed (Figure 5). This process yielded the remaining total acreage of all undeveloped coastal habitats within Texas. Third and finally, coastal habitats were intersected with existing TLTC lands dataset to determine the acreage of habitat within TLTC lands (Figure 4).

The dollar per acre value was then applied to each acre of TLTC conserved land to determine the total value of coastal flood protection that TLTC lands offer. This value was adjusted for inflation from the 2013 value that was provided by the study in Nature Climate Change (BLS, Arkema et al. 2013).

Data Sources

DATA	TYPE	SOURCE	YEAR
TPWD EMS	shp	TPWD	2018
TLTC Lands	shp	TLTC	2017
$/Acre Values	Report	Nature Climate Change	2013

Table 6. Abbreviated data sources for the input data used for water quality and quantity calculations. For full data sources, see References.

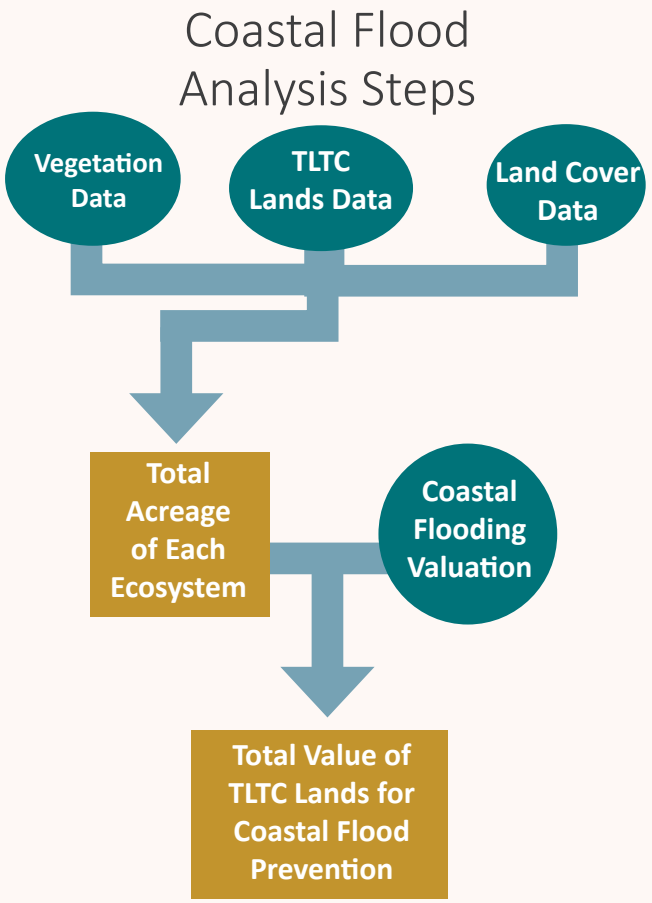


Figure 4. Steps used to determine an estimate of the value of TLTC conserved lands and ecosystems for inland flood prevention and damage mitigation. Ovals indicate input data, while rectangles indicate calculation results. For full data sources, see Table 6 and References.

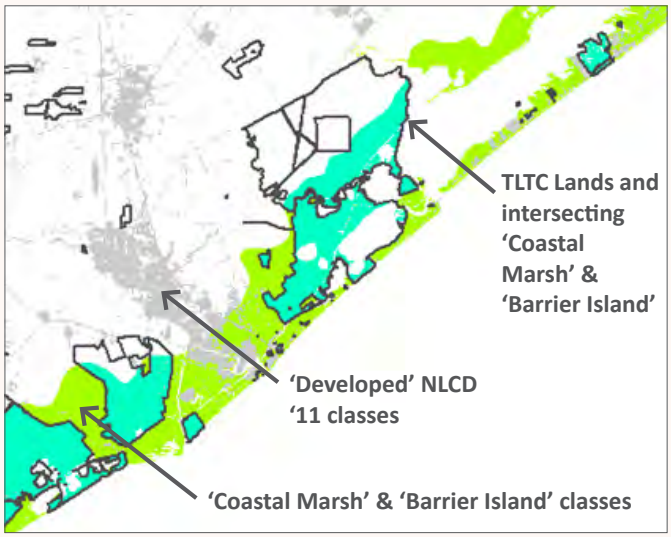


Figure 5. Coastal flood-prone ecosystems were isolated from TPWD EMS data and intersected with the boundaries of lands conserved by TLTC.

Damage from Hurricane Harvey in 2017 cost individual land owners, taxpayers, and the government millions of dollars. Conserved lands help offset these damages by absorbing water and mitigating flood impacts. Photo courtesy of US Army Corps of Engineers.

Metric	TPWD Ecosystems	Counties
Inland Flooding	All classes that contained "forest" as well as "riparian" or "wetland" within the following ecoregions were included: Bastrop Lost Pines, Cross Timbers, Post Oak Savanna, Edwards Plateau, Central Texas, High Plains, Pineywoods, Columbia Bottomlands, Red Roiver, Chenier Plain, South Texas, and Trans-Pecos. Within the Coastal Bend ecoregion these ecosystems were isolated: Hardwood, Mixed, and Live Oak Fores, and Evergreen and Deciduous Shrubland.	Anderson, Angelina, Aransas, Armstrong, Atascosa, Austin, Bandera, Bastrop, Bee, Bell, Bexar, Blanco, Bosque, Bowie, Brazoria, Brewster, Burnet, Caldwell, Calhoun, Callahan, Cameron, Chambers, Cherokee, Collin, Collingsworth, Colorado, Comal, Cooke, Coryell, Crockett, Culberson, Dallas, Delta, Denton, Dimmit, Duval, Ector, Edwards, El Paso, Ellis, Falls, Fayette, Fisher, Fort Bend, Franklin, Frio, Galveston, Gillespie, Goliad, Grayson, Grimes, Guadalupe, Hardin, Harris, Harrison, Hays, Hemphill, Henderson, Hidalgo, Hood, Houston, Hudspeth, Hunt, Jasper, Jeff Davis, Jefferson, Johnson, Kaufman, Kendall, Kerr, Kleberg, Lamar, Lampasas, Lee, Leon, Liberty, Limestone, Live Oak, Llano, Lubbock, Marion, Mason, Matagorda, Maverick, McCulloch, McLennan, Medina, Milam, Mitchell, Montgomery, Moore, Nacogdoches, Newton, Nueces, Oldham, Orange, Palo Pinto, Parker, Pecos, Polk, Presidio, Rains, Randall, Real, Red River, Reeves, Refugio, Robertson, Rusk, Sabine, San Jacinto, San Patricio, Shackelford, Shelby, Smith, Somervell, Starr, Tarrant, Terrell, Titus, Tom Green, Travis, Trinity, Tyler, Uvalde, Val Verde, Victoria, Walker, Waller, Washington, Webb, Wharton, Willacy, Williamson, Wilson, Wise, Wood, Yoakum, Zapata.
Coastal Flooding	Coastal Sand Plain, Floodplains and Low Terraces, Laguna Madre Barrier Islands and Coastal Marshes, Lower Rio Grande Alluvial Floodplain, Lower Rio Grande Valley, Mid-Coast Barrier Islands and Coastal Marshes, Northern Humid Gulf Coastal Prairies, Southern Subhumid Gulf Coastal Prairies, Texas-Louisiana Coastal Marshes.	Aransas, Brazoria, Calhoun, Cameron, Chambers, Galveston, Harris, Jefferson, Kennedy, Kleberg, Matagorda, Nueces, Orange, Refugio, San Patricio, Victoria, Willacy.

Table 7. Ecosystems from the TPWD Ecological Mapping System and counties that were used for Inland Flood and Coastal Flood calculations. Note that counties which are not listed for Inland Flood Prevention did not have any TLTC conserved lands listed, and thus were excluded from the calculations.

METRIC 5: RURAL ECONOMIES

To calculate the impact of TLTC lands on rural economies, methods and data were adopted from the Texas Land Trends study by the Natural Resources Institute (NRI) at Texas A&M University (Table 8, TAMU 2019).

NRI has dollar per acre values that were derived from Texas State Comptroller Data. These values were originally acreage and dollars organized by Independent School Districts (ISD). These ISDs were then aggregated to the county level, and an average dollar value per acre per county was calculated. NRI provided Siglo Group with these dollar-per-acre values, which were then applied to the acres of TLTC lands within each county (TAMU 2019). For TLTC lands that lay across multiple counties, the acreage in each county was split and calculated.

Values were adjusted for inflation (BLS) and totaled to provide the estimated value of TLTC land acreage to the rural economy.

Data Sources

DATA	TYPE	SOURCE	YEAR
TLTC Lands	.shp	TLTC	2017
Texas Land Trends	report	TAMU NRI	2018

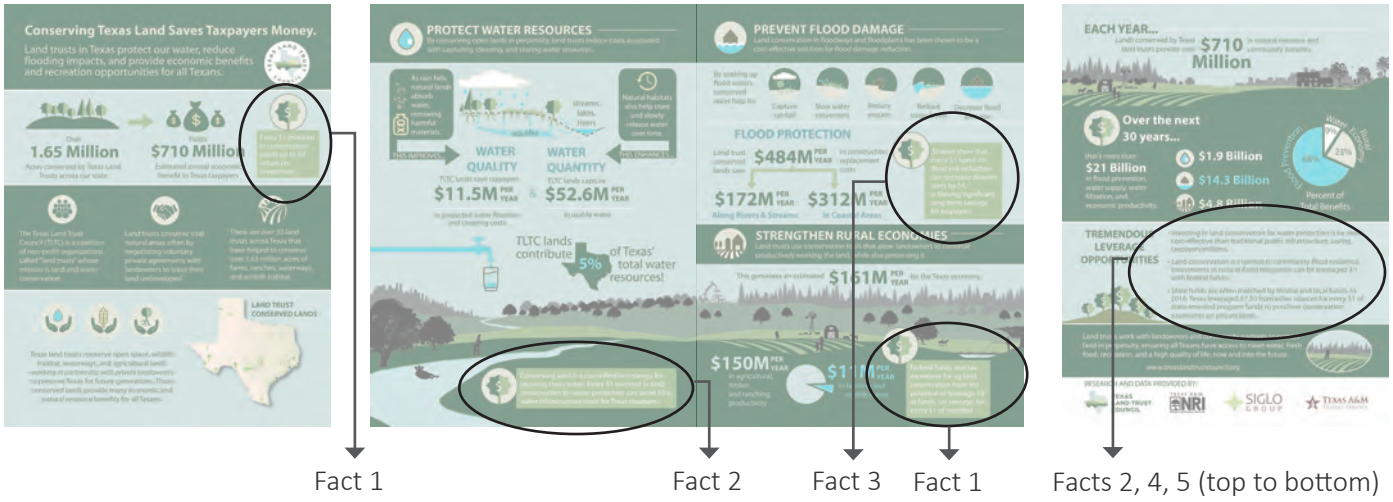
Table 8. Abbreviated data sources for the input data used for water quality and quantity calculations. For full data sources, see References.

Texas is the third largest agricultural state in the U.S. (USDA), home to a $5.1 billion annual hunting and angling industry (TPWD 2001), and is the target destination for more than 1 million people who travel here annually to observe, photograph, or interact with wildlife (TPWD 2001). These industries depend on preserved, open tracts of land to prosper and to provide for Texans and visitors alike. Photos courtesy of Texas Land Trust Council.

LEVERAGE ARGUMENTS & RETURN ON INVESTMENT

Leverage arguments and return on investment calculations are found throughout the infographic. Some of these were generated from literature reviews while others were calculated directly from currently available data. The figure above Table 9 identifies each leverage fact with a number. Facts that are listed twice are given the same number. Table 9 then connects each of these numbers with the leverage argument, its data source, and any calculation procedures that were used.

North Texas prairie conserved by a local land trust. Photo courtesy of Texas Land Trust Council.



FACT	STATEMENT	SOURCE
1	The Farm Bill provides $450 million per year in federal funds for ag lands, and has the potential to leverage $9 in matching funds for every $1 of state investment.	Texas Farm and Ranch Lands Conservation Program (TFRLCP). Note: The $9 figure is the average of all TFRLCP projects to date funded with state funding, after the highest and lowest outliers were removed from the data.
2	Every $1 invested in land conservation can avoid $6 in water infrastructure costs for Texas taxpayers.	Texas A&M Institute of Renewable Natural Resources
3	Every $1 spent on flood risk reduction produces $ in decreased disaster costs.	Multihazard Mitigation Council 2005
4	Investments in natural flood mitigation can be leveraged 3:1 with federal funds.	Small-Lorenz et al. 2016
5	In 2016, Texas leveraged $7.50 from other sources for every $1 of state-invested program funds for the purchase of conservation easements on private lands.	Texas A&M Institute of Renewable Natural Resources

Table 9. Each leverage is identified with a unique number that corresponds to entries in the table.

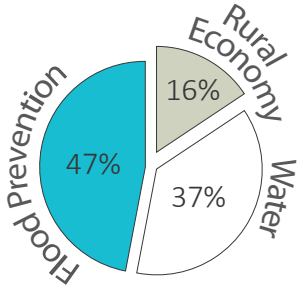
RESULTS

This study found that lands conserved to date by Texas Land Trusts across the state save taxpayers an estimated $1 billion annually. That's nearly $30.9 billion over the course of 30 years.

While the majority of these savings come in the form of flood damage prevention, lands conserved by Texas Land Trusts also boast big implications for water quality, quantity, and rural economic support. Table 10, below, shows numbers for each of the 6 calculated metrics in terms of annual savings, 30-year savings (at current rates) and average savings per-acre. In particular, TLTC lands are estimated to contribute more than $1,500 per acre annually for coastal flood protection.

Across all of these services, TLTC lands likely provide an even larger savings. For instance, in the case of water, conserved land has been shown to be 6 times more cost effective than water infrastructure for processing the same water volume (TAMU IRNR 2016, Table 9). Because our estimates were based on a direct comparison to water infrastructure, investments in TLTC lands could in fact be worth up to 6 times the estimate provided here. Investments in natural flood mitigation are thought to have a similar effect. One recent study found that investments in natural flood mitigation can be leveraged for a 3:1 impact with federal funds (Small-Lorenz et al. 2016). Studies also show that every $1 spent on food risk reduction produces $4 in disaster cost savings, achieving significant long-term benefits for taxpayers (Multihazard Mitigation Council 2005). Additionally, state investments in land conservation are often matched by federal and local funds, such as the Agricultural Land Easement Program at the Natural Resource Conservation Service or with local bond funds, meaning that state investments could go much farther than anticipated. In 2016 alone, Texas leveraged $7.50 for every $1 of state-invested program funds to purchase conservation easements on private lands (Texas Farm and Ranch Lands Conservation Program data, Table 9).

Percent of Total Benefits of TLTC Conservation Lands by Metric (%)



Metric	Annual Savings ($)	30-Year Savings ($)	Acres Evaluated	Average Annual Savings-Per-Acre ($/Acre)
Water Quality	$ 69,345,345.51	$ 2,080,360,335.30	1,642,913	$ 42.21
Water Quantity	$ 315,906,569.44	$ 9,477,197,083.20	1,642,913	$ 192.28
Inland Flooding	$ 171,958,275.00	$ 5,158,748,248.04	1,592,989	$ 107.95
Coastal Flooding	$ 312,254,158.68	$ 9,367,624,760.40	208,079	$ 1,500.65
Timber, Agriculture and Ranching	$ 150,224,496.78	$ 4,506,734,903.46	1,642,913	$ 91.43
Wildlife and Hunting Leases	$ 11,044,019.56	$ 31,320,586.80	1,642,913	$ 6.72
TOTAL	$ 1,030732,863.90	$ 30,921,985,917.11	N/A	N/A

Table 10. Summarized calculated value for each of the 6 metrics.

CONCLUSION

This study sheds light on a part of the immense value Texas Land Trust lands contribute to the Texas economy and its communities. $1 billion is an amazing community benefit when considering the efficiency of the Land Trust model for protecting conservation lands. It is important to remember that the total here only covers water quality, water quantity, flood protection, agriculture production, and hunting economy. These numbers do not include tourism, increasing land values, air quality, biodiversity protection, community health, or numerous other variables affected by conservation land.

It is also important to remember that measuring ecosystem services—the community services provided by the natural environment and in this case conservation lands—is a relatively new practice. While the work here demonstrates that conservation lands have a high value, there is still more to understand about the complex nature of our relationship with the landscape and how to better quantify that value. This recognition makes it clear that the numbers mentioned here are only a small piece of the value conservation lands bring to Texas every day.

Land conservation by private, non-profit land trusts is a cost-effective and efficient way to protect water quality and quantity, mitigate and prevent flood damage, and support the rural economies that provide Texans food, water and wildlife resources. To save taxpayers and the state government money over the long term, it is prudent to invest in the continued purchase and protection of Texas lands, particularly through conservation easements. Additional funding from local and federal sources can elevate state investments in land conservation to new heights and should be sought at all opportunities.

By providing landowners the opportunity to continue living and working sustainably on their lands, land trust conservation efforts offer a unique solution for all those involved. Private working lands in Texas comprise 83% of the state—an extreme majority. By partnering with willing land owners to conserve some of these lands, land trusts provide a service to the community and our natural resources now and into the future.

A conservation easement on the Shield Ranch protects Barton Creek, which flows more than 40 miles from its start in Hays County to Austin's Lady Bird Lake. Photo courtesy of Shield Ranch.

REFERENCES

Arkema, K. K. et al. (2013). *Coastal habitats shield people and property from sea-level rise and storms*. Nature Climate Change, 3(10), 913.

BLS. *Consumer Price Index online inflation calculator.* Bureau of Labor Statistics. Accessed 2018: www.bls.gov/data/inflation_calculator.htm

Glick, P. et al. (2014). *Natural defenses from hurricanes and floods: protecting america's communities and ecosystems in an era of extreme weather.* National Wildlife Federation.

Multihazard Mitigation Council. (2005). *Natural hazard mitigation saves: an independent study to assess the future savings from mitigation activities.* National Institute of Building Sciences, Washington, D.C.

PRISM Climate Group. (2018). *30-Year Normals: Precipitation.* Oregon State University. Accessed 2018: http://prism.oregonstate.edu

Small-Lorenz, S.L., et al. (2016). *Natural defenses in action: harnessing nature to protect our communities.* Washington, DC: National Wildlife Federation.

Simpson, Hughes et al. (2013). *Texas statewide assessment of forest ecosystem services: A comprehensive analysis of regulating and cultural services by Texas' forests* [White paper]. Texas Forest Service. Accessed 2018: https://tfsweb.tamu.edu/uploadedFiles/TFSMain/Data_and_Analysis/Contact_Us(3)/Ecosystem%20Services%20%20TX%20Statewide%20Assessment.pdf.

Texas A&M University Natural Resources Institute (TAMU NRI). (2019). *Texas Land Trends Conservation Easement Report Methodology [*White paper]. Texas A&M Natural Resources Institute. Shared by TAMU NRI with Siglo Group.

Texas A&M University Institute of Renewable Natural Resources (TAMU IRNR). (2016). *Texas Farm and Ranch Lands Conservation Program: Evaluation Report* [White paper]. Texas A&M Institute of Renewable Natural Resources.

Texas Parks and Wildlife Department and Missouri Resource Assessment Partnership. *Texas Ecological Mapping Systems of Texas.* Accessed 2018: http://tpwd.texas.gov/landwater/land /programs/landscape-ecology/ems/

Texas Farm and Ranch Lands Conservation Program (TFRLCP). (2019). Texas Parks and Wildlife Department.

Texas Water Development Board (TWDB). (2017). *Texas State Water Plan*. Accessed 2018: https://2017.texasstatewaterplan.org/statewide.

United States Department of Agriculture (USDA) Economic Research Service. (2017). *Cash receipts by commodity, state ranking, 2017*. Accessed 2018: https://data.ers.usda.gov/reports.aspx?ID=17844

United States Geological Survey. (2016). *National Land Cover Dataset*. Accessed 2018: https://catalog.data.gov/dataset/usgs-national-land-cover-dataset-nlcd-downloadable-data-collection

These calculations and the resulting infographic are intended to support Texas land trusts as they work to demonstrate the value of their lands and the services they provide. For additional information on the methods outlined in this report, contact Siglo Group at info@siglogroup.com. An appendix with supporting information is available in the "Publications" section of TLTC's website.

TEXAS LAND TRUST COUNCIL MEMBER ORGANIZATIONS

Working together to conserve the lands we love and the water we depend on.

www.texaslandtrustcouncil.org

TEXAS LAND TRUST COUNCIL

SIGLO GROUP