The Hershey Ranch

Resilient Ranch Plan

A Story of Conservation and Agriculture

Taken in front of the Hershey Ranch House (May 23, 2023). Photo: Cody Brown, NCAT

This publication is based upon work that is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under award number 2020- 38640-31521 through the Southern Sustainable Agriculture Research and Education program under subaward number SPDP22-09. USDA is an equal opportunity employer and service provider. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Prepared by the National Center for Appropriate Technology and Carbon Cycle Institute

Authors:

Cody R. Brown
Carbon Farm Planner – Texas
National Center for Appropriate Technology
codyb@ncat.org / (432) 661–2215

Elise Haschke, MS
Climate Program Manager
National Center for Appropriate Technology
eliseh@ncat.org

Lynette Niebrugge
Carbon Cycle Institute
lniebrugge@carboncycle.org

Jeff Creque, PhD
Carbon Cycle Institute
jcreque@carboncycle.org

Andrew Sansom
Acting Landowner
andrewsansom@txstate.edu

Garrett Kunz
Ranch Manager
g.hunz@icloud.com

NCAT ATTRA
SUSTAINABLE AGRICULTURE

SARE
Sustainable Agriculture
Research & Education

Carbon Cycle Institute

The Meadows Foundation
Serving the People of Texas

Table of Contents

I. WHAT IS RESILIENT FARM AND RANCH PLANNING

In response to the rapid pace of global climate change, the National Center for Appropriate Technology (NCAT) is engaging agricultural producers in conservation and resilience planning that is rooted in the soil carbon cycle. Through a process known as Resilient Farm and Ranch Planning, NCAT is supporting Texas producers' ability to achieve their goals while simultaneously enhancing interdependent agroecosystem dynamics. We offer tailored planning and implementation technical assistance to boost the carbon cycle as the principle energy pathway driving agricultural productivity, as well as safeguarding critical resources such as water and soil health, increasing wildlife habitat and biodiversity, and building resilience to changing climate conditions. With nearly 250,000 farms and ranches covering nearly 130 million acres, Texas agriculture is poised to be a leader in climate forward conservation.

Resilient Farm and Ranch Planning (Resilient Planning) adheres to the Carbon Farm Planning framework developed by the Carbon Cycle Institute (CCI). CCI advances the carbon cycle as the fundamental process underlying land management and agricultural conservation in our efforts to mitigate and adapt to the global climate crisis. Greenhouse gas mitigation strategies that lessen the severity of extreme weather paired with adaptation strategies that prepare for anticipated climate changes ultimately give rise to resilience, defined as the ability to rebound from disruptive events.

> Carbon has been absent from discussion of elements essential to agriculture and the management of working lands; yet carbon is the basis for all agricultural production.

Largely taken for granted, carbon has been absent from discussion of elements essential to agriculture and the management of working lands; yet carbon is the basis for all agricultural production. Carbon enters the farm system from the atmosphere through the process of plant photosynthesis, which uses the energy of sunlight to capture carbon dioxide (CO_2) from the air and combine it with water and nutrients from the soil to produce the sugars, cellulose and lignin of harvestable crops. In addition to food, fiber, fuel and flora, carbon can also be beneficially stored long-term (decades to centuries or more) in soils and woody vegetation through a process known as terrestrial carbon sequestration (figure 2).

While the importance of carbon to soil health and fertility has long been understood, its significance has begun to be increasingly recognized in recent years. Today, managing for increased soil organic matter (SOM), which is about 50% carbon, is the core of the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) healthy soils program.

This planning process emphasizes conservation practices that increase the rate of photosynthetically-driven transfer of solar energy and atmospheric CO_2 into plant productivity, perennial cover, woody biomass and/or healthy soil organic matter (SOM). Increasing carbon capture and storage on agricultural working lands also helps to slow rising levels of carbon dioxide and other atmospheric greenhouse gases (GHGs) that are warming the planet and contributing to climate destabilization and uncertainty. Agroecosystems with enhanced carbon energy pathways are positively correlated with a variety of ecological benefits, including but not limited to:

- Soil water holding capacity and hydrological function;
- Pollinator and wildlife biodiversity;

- Soil microbial activity and fertility;
- Resilience to drought and flood; and
- Improved agricultural productivity.

The planning process is based upon the USDA NRCS nine-step conservation planning process and elevates agricultural carbon depletion as the resource concern of overriding importance. The planning team, in collaboration with producers, identifies a tailored suite of NRCS Conservation Practice Standards proven to enhance the rate of carbon accrual in agricultural systems. The conservation practices included in any individual Resilient Farm and Ranch Plan uphold and advance the five principles of soil health: keep the soil covered, minimize soil disturbance, maintain continual living root, enhance plant diversity, and integrate animals.

Texas has a vast array of ecosystems from brittle arid western desert to southern great plains and grasslands to non-brittle eastern forests. NCAT's national knowledge and database will contribute greatly to being able to create unique Resilient Farm and Ranch Plans for all types of ecoregions.

It is important to note that this framework is not tied to the carbon credit marketplace and does not result in the issuance or verification of salable carbon credits.

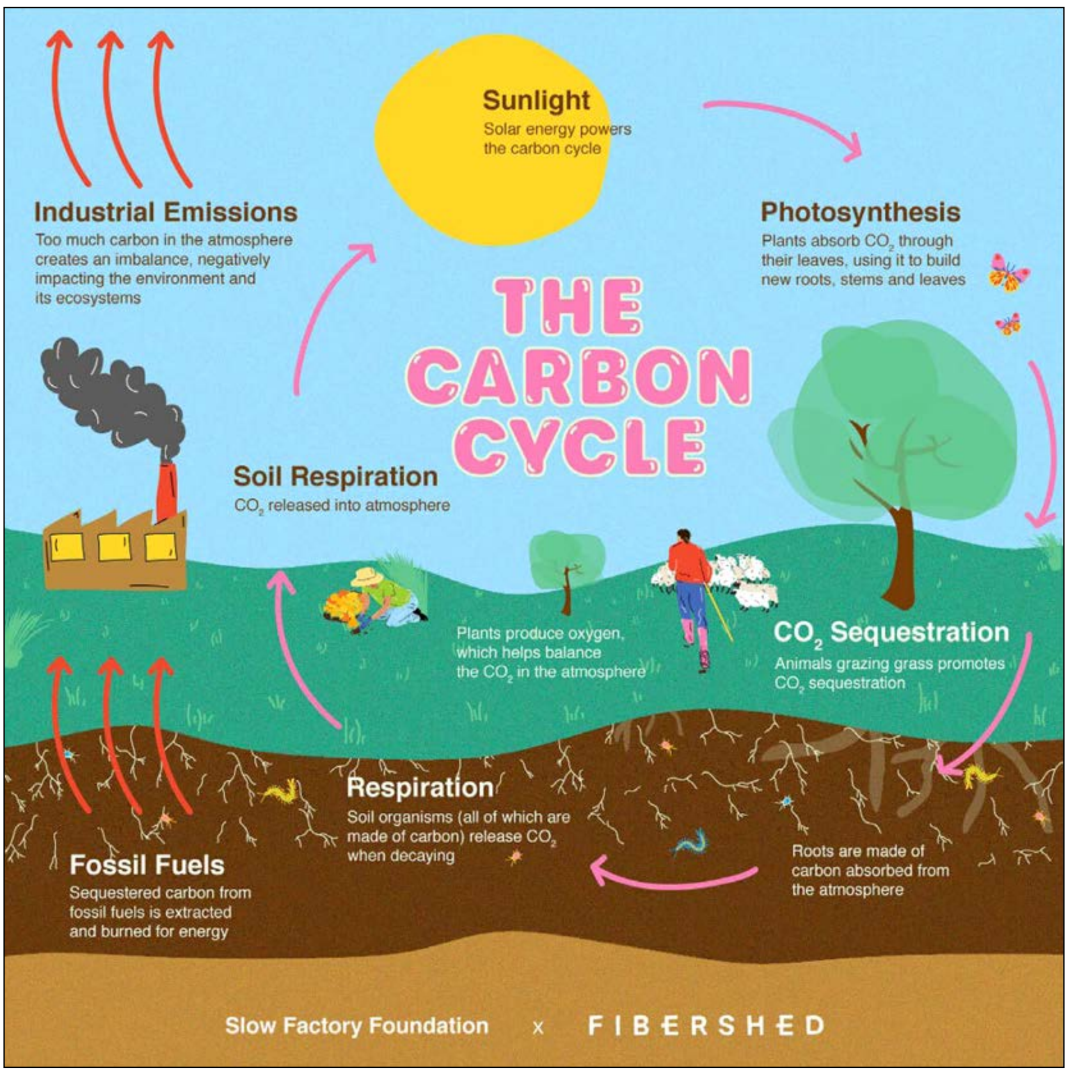


Figure 2. The Carbon Cycle Credit: Fibershed

Carbon as the Keystone

All farming is dependent on carbon because all agricultural production depends on plant photosynthesis to turn solar energy and atmospheric CO_2 into plant material. Carbon entering the farm system from the atmosphere can end up in several locations: the harvested portion of the crop, the SOM through root exudates, grassland vegetation, herbaceous and woody perennials (trees, shrubs, vines, orchards, etc.), and "waste" materials such as compost or manure.

On-farm and ranch carbon in all its forms contains energy that originated as the solar energy used by plants to make carbohydrates from atmospheric CO_2, water, and soil nutrients. The carbon in plants and SOM can thus be understood as the embodied solar energy that drives agricultural processes, including the essential ecological processes that predispose soil to greater water holding capacity and nutrient availability for the growing crop. ***Consequently, Resilient Planning places carbon at the center of the planning process and views carbon as the single most important element, upon which all other on-farm processes depend*** *(figure 3).*

While all farming is completely dependent upon carbon, the various farming practices, and the different farm systems, can lead to variable amounts of on-farm carbon capture and storage. ***The Resilient Planning process differs from other approaches to land use planning by focusing on increasing the capacity of the agricultural land to accrue and store carbon*** *(figure 4).*

Extractive farming methods have become engrained in farming cultures across the globe. We are witnessing loss of natural wildlife habitats, depletion of surface and reservoir waters, increased loss of topsoil and decreasing amounts of nutrients found in our food supply. Agricultural working lands are integral to human civilization and wield extreme power in determining the future of our society. Increasing the education and adoption of climate-beneficial farming practices and mitigating extractive practices will be integral in building resilience to a changing climate.

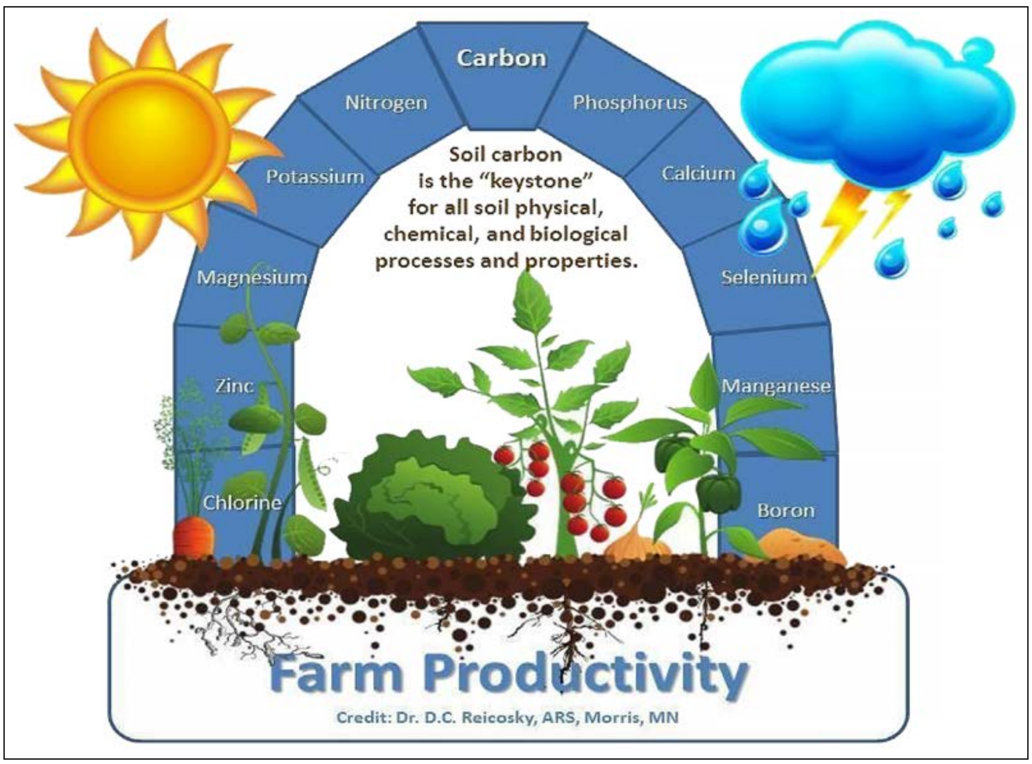


Figure 3. Carbon as the Keystone element to Working Land Productivity and Resilience

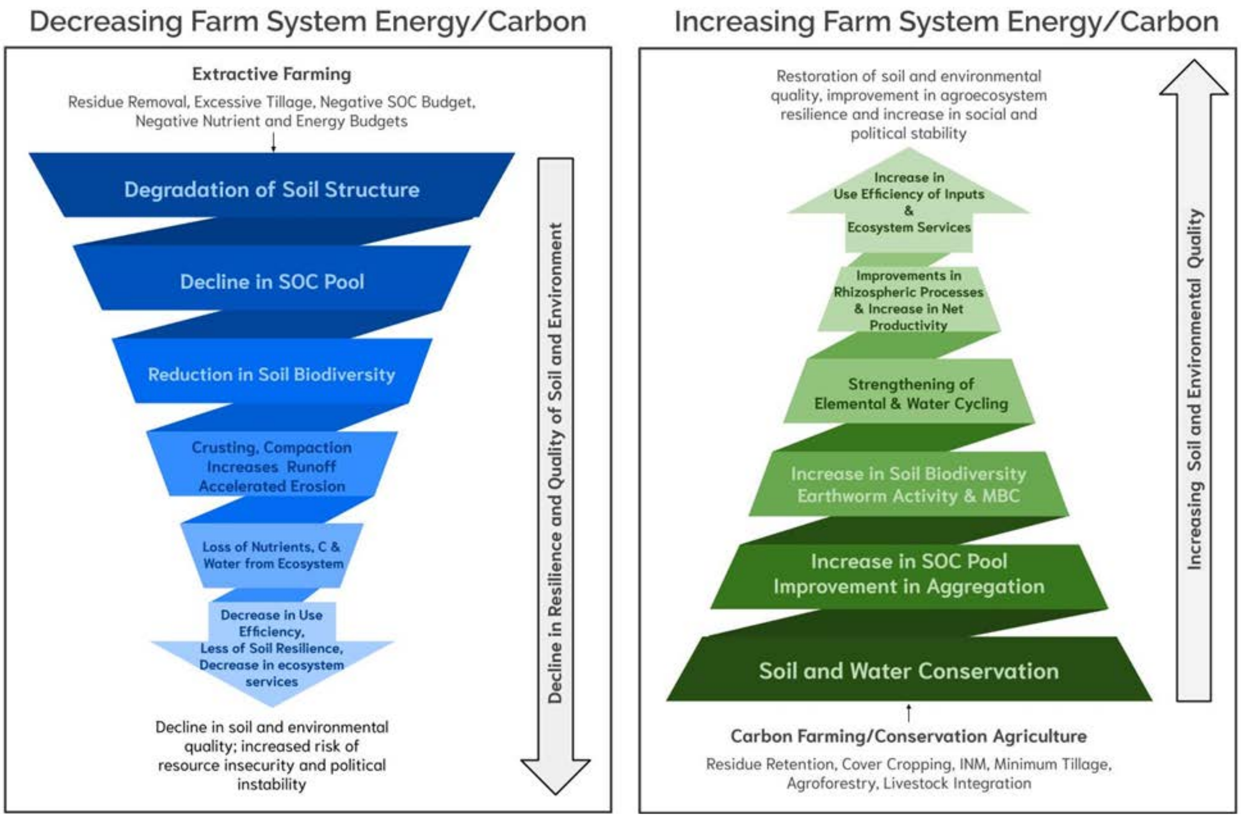


Figure 4. The virtuous carbon cycle. Diagram: CarbonCycleInstitute

The Planning Process

Resilient Planning upholds the conservation planning principles of Carbon Farm Planning, which are similar to the NRCS Conservation Planning process, beginning with producer goals and an overall inventory of natural resource conditions on the farm or ranch. Akin to Carbon Farm Planning, Resilient Planning focuses on identifying opportunities for drawing more atmospheric CO_2 into the farm system and reducing greenhouse gas emissions. This is a creative and collaborative process! It considers the whole farm or ranch property as a tapestry of interdependent systems and considers every square inch of possibility to boost the carbon cycle.

Maps of the property and fields are developed to account for existing infrastructure and natural resources, and to lay out the design of potential conservation practices. The USDA COMET-Planner tool is used to generate an estimated greenhouse gas benefit of each proposed practice in tons of carbon dioxide equivalent (CO_2e) as 1) avoided emissions or 2) atmospheric CO_2 sequestration.

Finally, practices are prioritized based on the needs and goals of the farm or ranch, choosing high carbonbenefit practices wherever possible. Funding mechanisms are identified, such as USDA-NRCS programs, other federal and state programs, and private funding. Projects are implemented as funding, technical assistance and farm scheduling allows. The Plan is a living document that is evaluated and adapted as needed to meet changing farm objectives and environmental conditions, using the fully implemented plan scenario as a goal or point of reference.

Additional information about Carbon Farming can be found online at: marincarbonproject.org and carboncycle.org.

Additional information about NCAT's Climate Solutions can be found on line at: NCAT Climate Solutions and NCAT Soil for Water.

II. INTRODUCTION TO THE HERSHEY RANCH

A panorama taken from the highest point on the ranch (May 23, 2023). Photo: Cody Brown, NCAT

Ranch Background

Hershey Ranch is a 1,565 acre spread of land just outside the town of Stonewall in the rolling hills of Central Texas. The property was originally acquired with a Spanish Land Grant prior to the Civil War. In 1857, a Scottish cotton trader names James Bannerman acquired the property and began cultivating cotton to ship back to mills overseas. During the 1960's and up into the 70's this use of the land continued until 1975 when the property was bought by Jacob and Terese (Terry) Hershey of Houston, TX to be used as a weekend retreat. Terry Hershey and her beloved friend Lady Bird Johnson spent large amounts of time enjoying this ranch over the next decades and the seed of preservation for the natural landscape was planted.

Andrew Sansom was introduced to Terry Hershey by way of Texas Parks and Wildlife Department (TPWD) when then Governor of Texas, Ann Richards, appointed Terry to work under Andy, the Executive Director of the TPWD at the time. Terry and Andy's relationship grew over the years as Andy mentored Terry as she moved from being a steward of urban park land to being a steward of Texas' land and wildlife. As the relationship continued to grow roots, Terry offered the old 1857 stone house as a writing retreat for Andy and Nona (Andy's wife) as he completed his first two books in the early 1990's. It would seem to be meeting an old friend for the first time for Andy and the Hershey Ranch, as he would come to inherit a Life Estate in Hershey Ranch in 2011 per Terry Hershey's will (who eventually passed after her 94th birthday in 2017); Andy will essentially own the ranch until his death or until he is no longer able to take care of it. Then the ranch will return to the Jacob and Terese Hershey Foundation.

Andy, being the conservationist that he is, immediately became engaged in wildlife preservation and youth community outreach to teach the importance of natural landscapes and wildlife. In 2003 Andy advised Terry to put the land under a conservation easement with the NRCS – this would prove to just be the beginning of the land conservation efforts. The Hershey Ranch has been focused on land and wildlife conservation for the better part of two decades but "upp'd the ante" in 2017 when Andy took up full-time residency at the ranch and the preservation of its beauty became the focus. The Hershey Ranch has worked and continues to work with conservation agencies to accomplish the following: (Covered in detail later)

- restored all but 2 of the 5 degraded cotton fields to native prairie (NRCS)
- completed a prescribed burn on 800 acres (NRCS)
- transect monitoring Soil for Water (NCAT)

- 2 youth hunts and 1 women exclusive deer hunt / year (TPWD)
- clearing cedar (whole ranch completed) and restoring internal fencing (NRCS)
- stream restoration with Parks and U.S. Fish and Wildlife (funded through Guadalupe Bass Endangered Species)
- NRCS easement on the dam
- wildlife biology screening (Romy Swanson)
  - deer counts annually
  - 4 bird counts annually
  - 2 site reptile collection points
  - 2 site insect collection points
  - applies for annual MRB permits

HISTORICAL MANAGEMENT

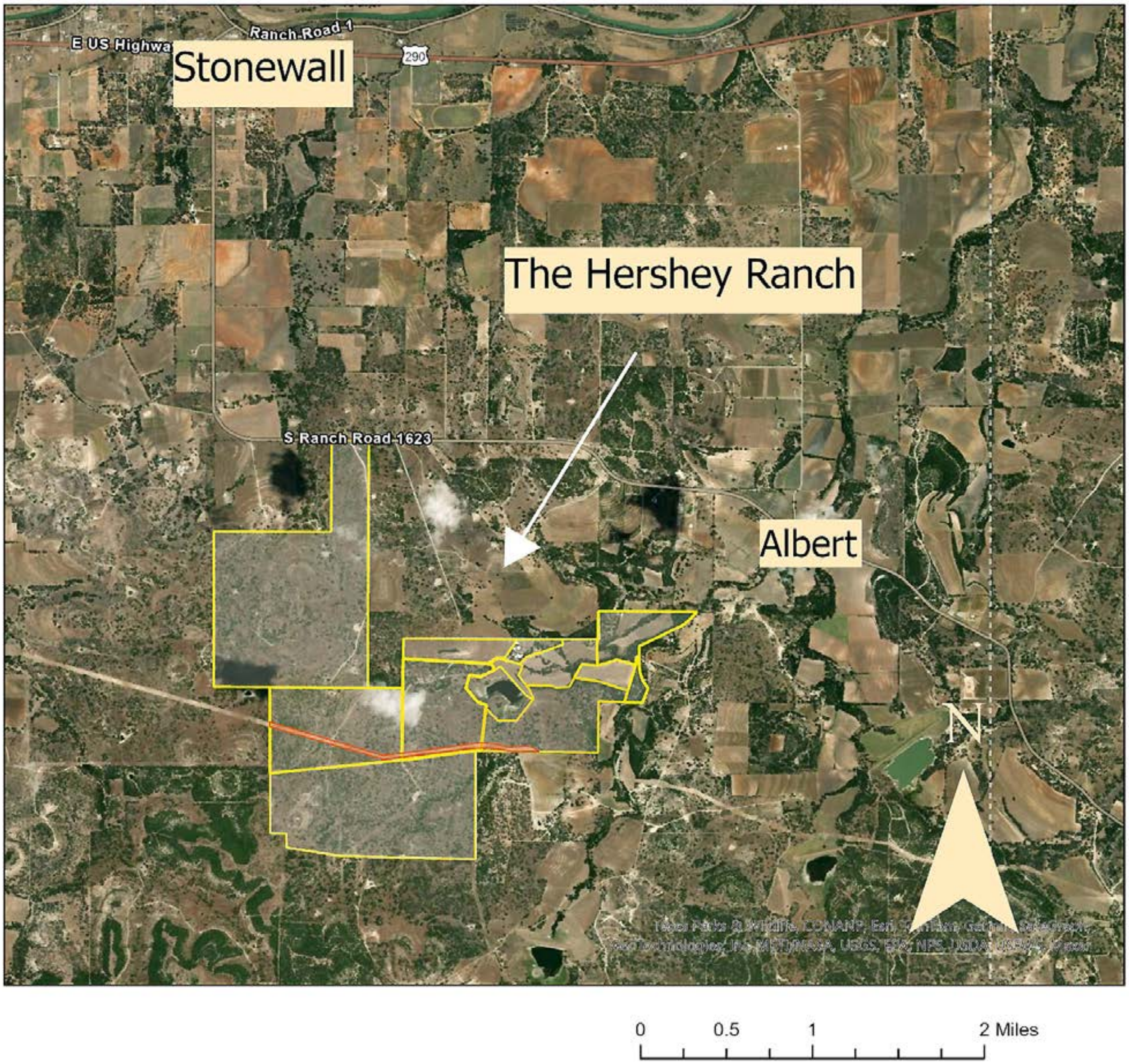
The history prior to the 1970's acquisition of the ranch by the Hershey family was the conventional, extractive method of cotton farming. This method of farming would generally deploy practices including: annual tilling/ploughing, the use of agrichemical fertilizers, insecticides and herbicides, monocropping, and likely the lack of cover cropping leading to bare soils. As discussed in the introduction, practices such as these have depleted the health of soils across the globe and increased the demand for climate-beneficial carbon farming methods. The only prior evidence of animal production was sheep in the late 1960's by a separate rancher (unknown name). The ranch found a period of rest for 40+ years from the Hershey family's purchase of the property until 2017 when Andy began a renaissance of regeneration, rejuvenation and future resiliency.

> The Hershey Ranch is one of the largest pieces of contiguous land in Gillespie county; making it imperative to preserve, conserve and instill resilience on the Hershey Ranch.

CURRENT MANAGEMENT

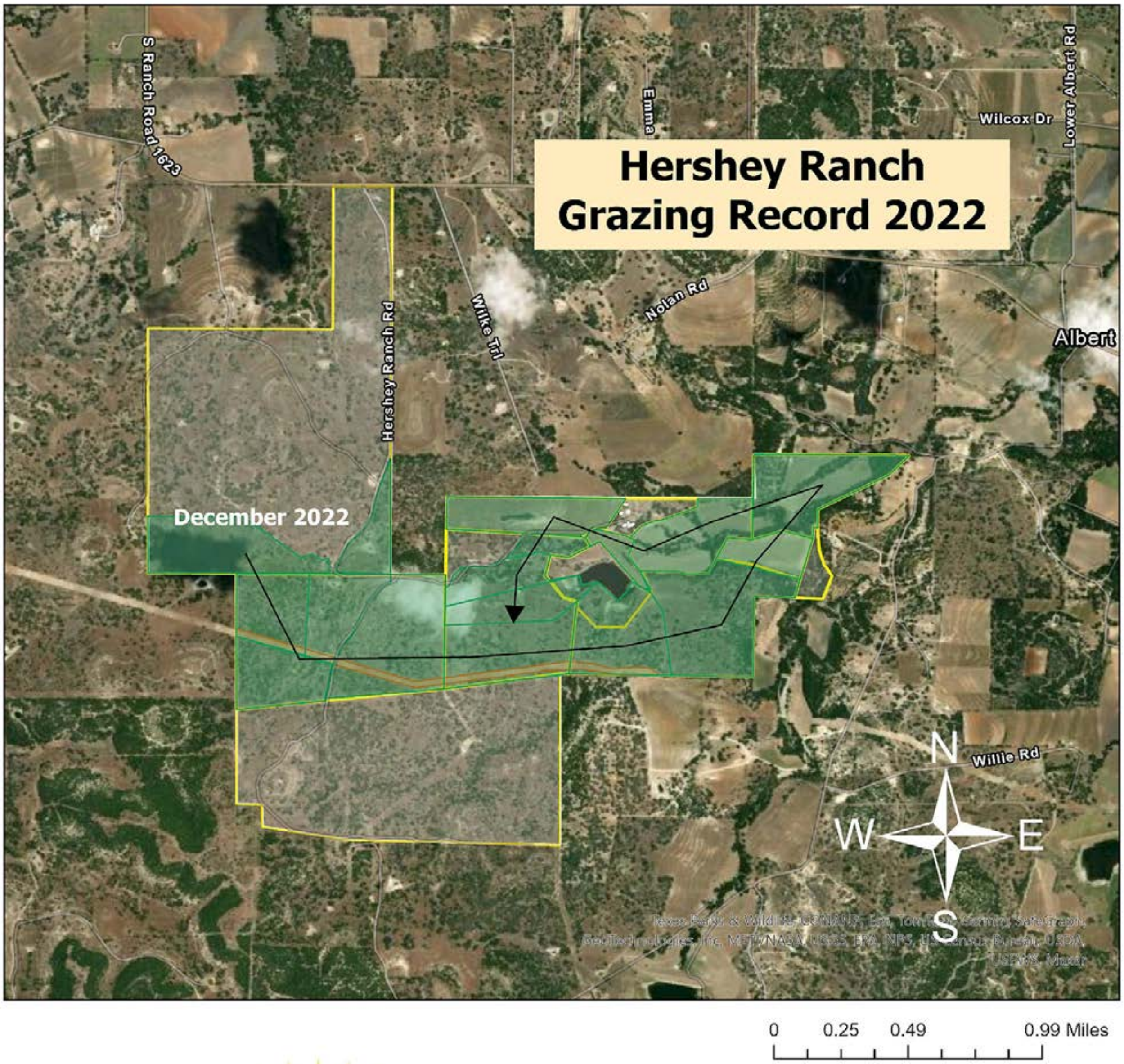
As mentioned above, Andy has initiated many conservation projects across the ranch and over the course of time Andy met a rancher by the name of Garrett Kunz. Their relationship grew over the years after a myriad of conversation revolving around conservation and proper animal grazing management as a tool for land conservation and regeneration. Garrett eventually became the ranch manager and first introduced 27 cow-calf pairs on the property in December of 2021 (still running the same amount).

Garrett utilizes the regenerative grazing practice he refers to as "adaptive grazing" via a solar powered portable electric fence energizer and miles of poly string electric line. Garrett weaves across the landscape establishing paddocks that are adapted to the herd's needs of biomass forage for grazing, water and shelter from the summer sun. The herd is moved often, only staying in one paddock for a few days to one week max. This is done to prevent overgrazing, increase manure patty count per square foot, and increase non-selective grazing behavior that is critical to the success of native forage species. However, in the hot summer months when the rain tends to stop and the small natural ponds dry up, the ranch, Garrett, and the herd all feel the effects. Mind you, the house is also dependent on rain water for plumbing. Garrett usually has to truck in 1,000 gallons of water at a time daily, sometimes twice a day, in the extreme summer heat of August. This is labor intensive, expensive, and not ideal for the herd, but it keeps them alive. However, this restricted access to water limits where and when Garrett can move the herd and hinders the positive impact the herd could have on the ranch. The carbon sequestration potential of removing this limitation is huge, as we will address later.The following map displays where Garrett has grazed since he's been on the property and what is still left to graze. Garrett would like greater access to water to graze the right place at the right time and to promote the growth of warm season grasses, which help the ranch hold water and cover the soil in the hottest summer months.



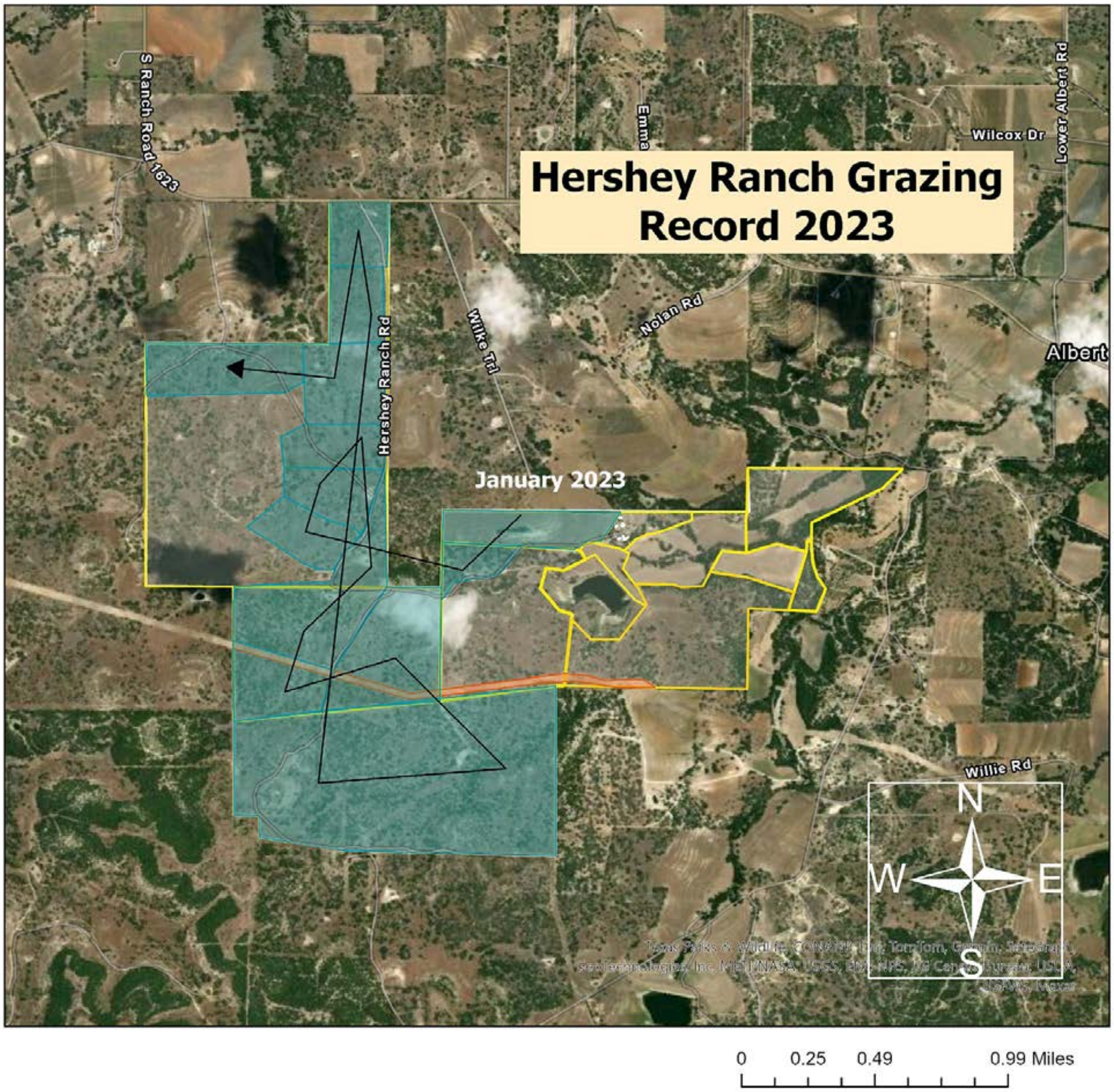
NATIONAL CENTER FOR APPROPRIATE TECHNOLOGY

SARE Sustainable Agriculture Research & Education



NCAT NATIONAL CENTER FOR APPROPRIATE TECHNOLOGY

SARE Sustainable Agriculture Research & Education


Hershey Ranch Grazing
Record 2023
January 2023
S Ranch Road 1623
Hershey Ranch Rd
Wilke Trl
Nolan Rd
Emma
Wilcox Dr
Lower Albert Rd
Albert
Willie Rd
N
W
E
S
0
0.25
0.49
0.99 Miles

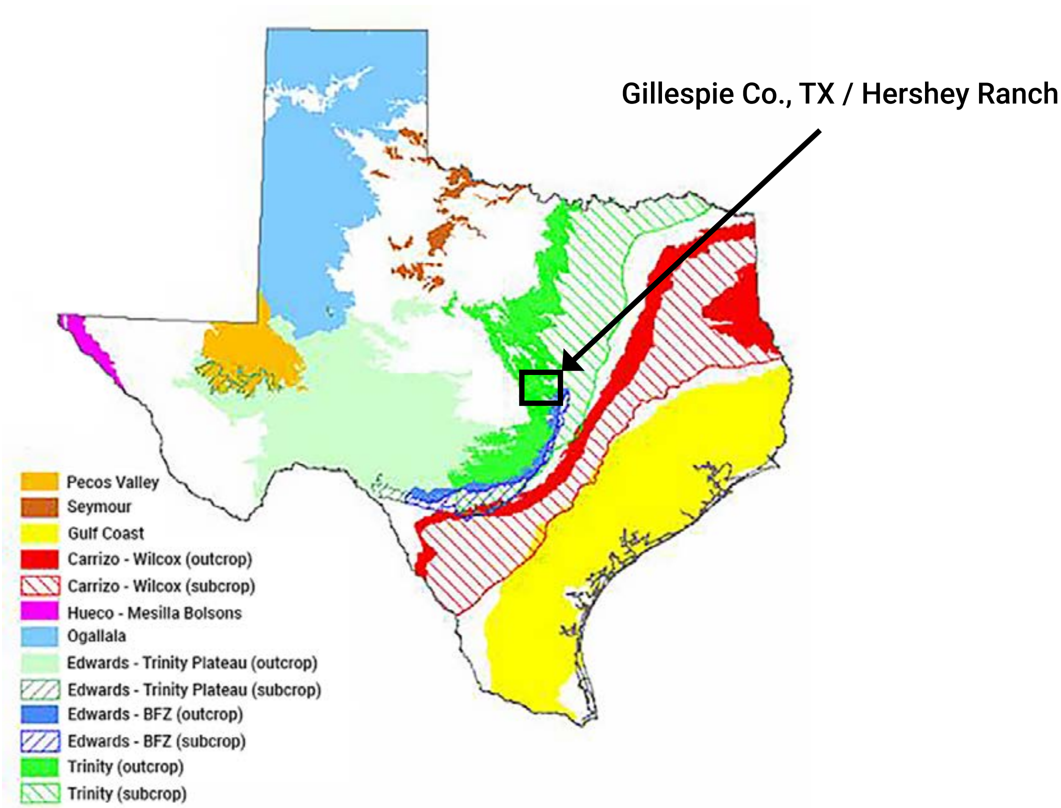
Goals and Objectives

1. Andy said simply, "The land". Andy and Garrett alike see the ranch as a "living, breathing organism" and seek to treat it this way. All the tools being utilized – cattle grazing, cedar removal, and prescribed fire – are for the sole benefit of the land and wildlife. They use agriculture production as a tool to restore the land and create suitable habitats for native flora and fauna.
2. Education. Andy wants the ranch to not only continue to be an education hub for youth, ranchers, and outdoors enthusiasts alike, but to strengthen the tools through which they can provide enriching educational experiences, such as with a Resilient Ranch Plan.
3. Long-term conservation. Andy and Garrett alike see the importance of a Resilient Ranch Plan in helping guarantee that the property will always be managed with these conservation goals at the forefront of decision making – long past the both of them.

Environmental Conditions

WATERSHED AND HYDROLOGY CONSIDERATIONS

The Hershey Ranch is perched on the southern side of the of the North Grape Creek – Pedernales River watershed, which encompasses approximately 421 square miles between Gillespie county, TX and Blanco county, TX. The sub watershed that is encompassing Hershey Ranch is known as the Williams Creek – Pedernales River with an estimated size of 49 square miles. This area is a part of the Colorado River Basin sub basin of the Pedernales. These watershed formations feed the Edwards Aquifer (major), the Hensel (Middle Trinity) Aquifer, Ellenburger Aquifer and Hickory Aquifer (deepest).



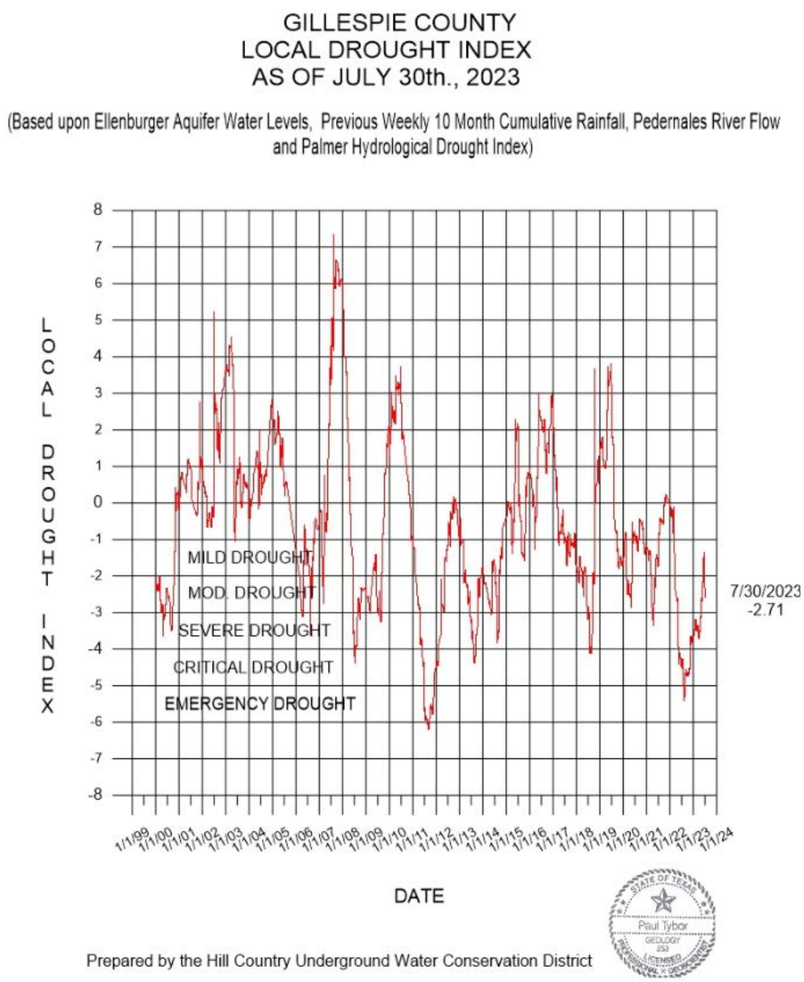
Major aquifers in Texas by location. Photo: Texas Water Development Board (TWDB)

The Cretaceous age Edwards aquifer within Gillespie County is comprised of limestone and dolomite that is an extension of the Edwards Plateau into Gillespie county from the west. Yields from the Edwards are generally low (10-20 gpm) and it is used primarily for rural domestic and livestock demands. Recharge is from local precipitation which occurs on the outcrop.

The Hensel outcrops in the Pedernales River Valley, but it is in the subsurface where the Edwards Plateau is present. Yields from the Hensel are generally 10 to 20 gpm and used for rural domestic and livestock demands. Some drip irrigation occurs from the Hensel for peaches and vegetables. It is recharged from local precipitation on its outcrop and through the overlying units where it is in the subsurface.

In some areas significant cavity development has occurred within the Ellenburger resulting in it being able to produce very large amounts of groundwater (>500 gpm) in some locations. It is utilized extensively by the City of Fredericksburg and many peach and grape growers in Gillespie County. Recharge to the Ellenburger is mainly through the overlying Hensel.

The Edwards Aquifer is home to over 15 endangered species and serves as a main water supply for 2 million people (Sharp and Banner, 1997). It is essential for life in central Texas. Water conservation and contaminant transport regulation have become an essential part of protecting our aquifer. Trinity-Edwards Plateau Aquifer covers all or part of over 20 counties from Gillespie to the trans-Pecos region of west Texas. Together, they are the primary water source for most of the Hill Country. Most users in northern Bexar, Bandera, Kendall, Comal, and Kerr counties get their water from the Trinity. Unlike the Edwards, the Trinity Aquifer recharges very slowly. Only 4-5% of water that falls as rain over the area ends up recharging the Aquifer, and water also

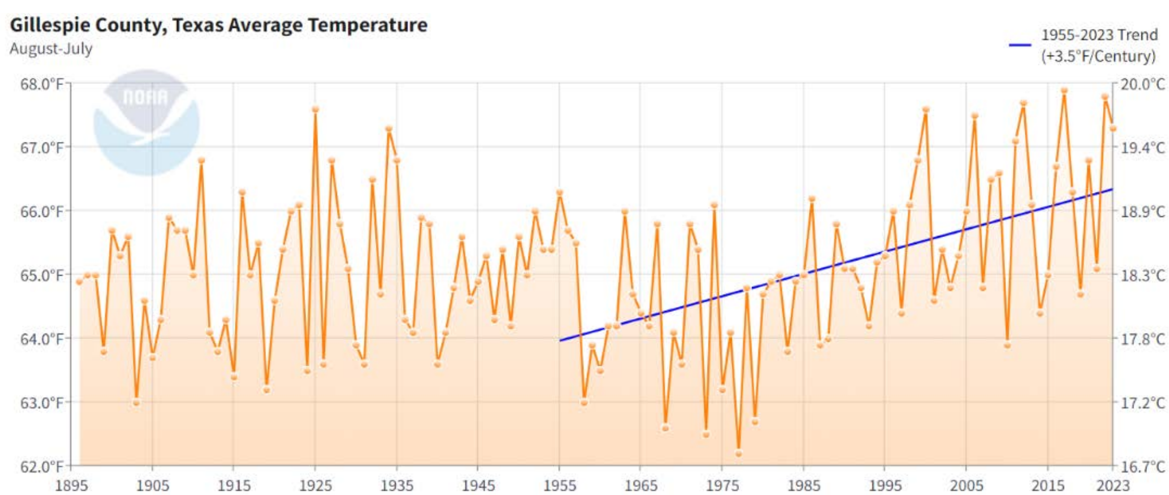


moves through the Trinity much more slowly than through the Edwards. In 1990, the Texas Natural Resource Conservation Commission designated the Trinity region to be a Priority Groundwater Management Area (PGMA), defined as an area where a critical water shortage is occurring or can be expected to occur in the next 25 years. (Gregg Eckhart Edwards Aquifer)

The Pedernales River is a tributary of the Colorado River, approximately 106 miles long, west of Austin, TX. The Pedernales drains an area of the Edwards Plateau, flowing west to east across the Hill Country west of Austin. The Pedernales River is the primary river flowing through the North Grape Creek / Williams Creek Pedernales watershed that encompasses the Hershey Ranch. Williams Creek is the tributary if the Pedernales River that weaves through the NE corner of the property. Rapid growth and urbanization throughout Travis County is pushing higher quantities of water and sediment into the Colorado River through increased impervious cover and disturbed surfaces. Excessive amounts of dirt often wash into the river from landscapes that have recently lost their native vegetation and natural cover. (Texas Rivers.org)

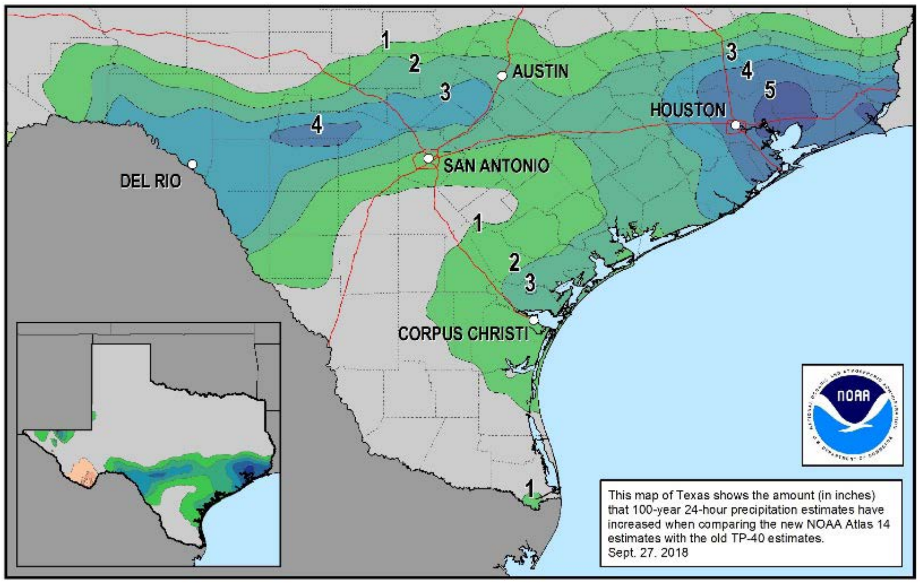
CLIMATE

The Hershey Ranch, along with the rest of Gillespie county – and largely the state, has been experiencing climate trends that put a glaring focus on water scarcity and rising temperatures. As mentioned above, not only are the aquifers experiencing unprecedented water demands from development, but they are also experiencing less rainfall. When the rain does come it comes in the form of flash floods, exposing depleted soil water holding capacities and puddling from frequent tillage compaction. This is not mention the amount of pollutants that flow through the water shed from storm water runoff from construction sites, municipal waste facilities, farm fertilizers and animal feeding operations.



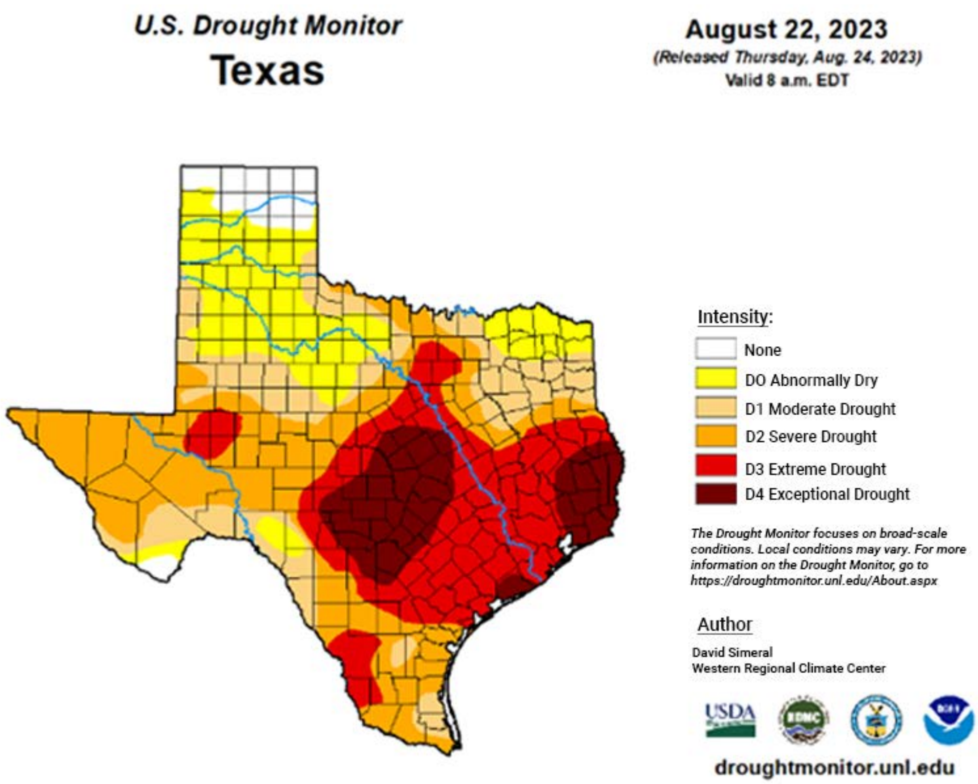
National Oceanic and Atmospheric Administration (noaa.gov)

A study conducted by NOAA in 2018 led to the revision of Texas's flood data for 100yr flooding events total rainfall over a 24hr period. The southern half of the state from 31 degree N down was revised to show the risk increase from previous datasets; with Gillespie county reflecting a 2-3" increase in rainfall impact during a 100yr flood event. Such increases in total rainfall during a flooding event can cause significant land management problems for the Hershey Ranch as they are challenged with undulating terrain with varying landscapes. PRIME THE PUMP HERE - impacts and why its here – rain catchment CFP will make recommendations.



National Oceanic and Atmospheric Administration (noaa.gov)

In an article written by the Texas Comptroller, "2022 is the 11th driest year in the past 128 years and is the worst drought since 2011. Between Aug. 9 and Aug. 15 of this year, about 68 percent of Texas was in extreme drought conditions and nearly 30 percent was in exceptional drought conditions, according to the U.S. Drought Monitor" (Texas Comptroller, 2023). The U.S. Department of Agriculture (USDA) estimated the agriculture industry suffered losses between $11.1 billion and $15.5 billion (in 2021 dollars) during this drought. Total costs to Texas and other impacted states approached a staggering $73 billion, and an estimated 271 Texans lost their lives, according to the National Oceanic and Atmospheric Administration (NOAA, 2023)(Texas Comptroller, 2023). The most frightening thing about these trends is that 2023 broke all of the drought, heat and rainfall records set in 2022.



VEGETATION

Plant life in combination with topography, geology, soils, rainfall patterns, animal population, seasonal temperatures, and land use by man determines the ability of the land to support populations of native, migratory, and introduced wildlife species. A general knowledge and understanding of plants and their function in wildlife habitat is fundamental to understanding the land and animals that live here.

Grass species found in Northcentral Texas may be classified as annual or perennial and cool season or warm season. Including: little bluestem (*Schizachyrium scoparium,* warm season perennial), big bluestem *(Andropogon gerardi,* warm season perennial), indiangrass *(Sorghastrum nutans,* warm season perennial), switchgrass *(Panicum virgatum,* warm season perennial) Texas wintergrass *(Nassella leucoticha,* cool season perennial). Grasses are important food items for many wildlife species and provide nesting habitat for others. Ground cover provided by grasses reduces soil erosion and provides cover for wildlife. Many native perennial grass species have been replaced by annual species due to long-term land abuse and overgrazing by livestock.

A general knowledge and understanding of plants and their function in wildlife habitat is fundamental to understanding the land and animals that live here.

Grasslands and prairies that once supported perennial native grasses such as little bluestem, Indiangrass, and switchgrass now support non-native annual brome species or perennial cool season species such as Texas wintergrass. Grasses such as little bluestem, Indiangrass, sideoats grama *(Bouteloua curtipendula),* buffalograss *(Bouteloua dactyloides),* and Texas wintergrass *(Nassella leucoticha)* are examples of native perennial grasses. If not overgrazed, perennial grasses provide cover for many wildlife species and nesting habitat for ground nesting birds. In our initial field visit to the Hershey Ranch we celebrated with Garrett the sighting of a beautiful stand of native (but now rare) eastern gamagrass *(Tripsacum dactloides)* on the edge of creek that has been under riparian restoration since 2017.

Photo: Cody Brown, NCAT

Forbs, also called weeds or wildflowers, forbs may be classified as annual or perennial and warm season or cool season. Common forbs found in Northcentral Texas are bluebonnets (cool season annual), native sunflowers (warm season annual), Engelmanndaisy (cool season perennial), and Maximillian sunflower (warm season perennial). Forage and seeds provided by forbs are important food item in the diets of many wildlife species. Forbs provide cover and protection from predators. Examples of native annual forb species include annual native sunflower, partridge pea, coreopsis, croton species, and broomweed. Seeds produced by annual forbs are an important food source for many species of birds and small mammals. Annual plants provide habitat for insects that are important in the diets of many wildlife species. Ground cover provided by annual plants also helps reduce soil erosion.

Trees are perennial woody plants with a main stem or trunk usually growing over 10' tall and with multiple branches from some point above the ground. Examples: cedar elm, Texas ash, post oak, cottonwood, pecan, and willow. Trees proved forage for browsing wildlife species, nesting and roosting sites for birds, cover, and food from seed, nuts, and fruits. Deciduous - woody non-evergreen plants that do not retain their leaves during the winter months. During winter months, however, deciduous woodlands often lack sufficient browse, food, or cover to support high populations of white-tailed deer or other wildlife species. Examples: post oak, blackjack oak, Texas oak, elbowbush, flame-leaf sumac, blackhaw, and hawthorn. Non-deciduous-woody evergreen plants that retain their green leaves throughout the year. Non-deciduous woody plants provide year-round cover for many wildlife species. Most non-deciduous woody species have low palatability as browse for white-tailed deer. Their value on the landscape as cover for a wide variety of other wildlife species is important. Examples: live oak, blueberry juniper, and agarita.

Much of Northcentral Texas in the Blackland Prairie, Fort Worth Prairie, Rolling Plains, Edwards Plateau, and Lampasas Cut Plain was historically native prairies or savannahs. Native prairies areas were also present within the East and West Cross Timbers. Few native prairie sites remain today although there are extensive grasslands on many private ranches in the northern portion of the Fort Worth Prairie and on ranches locations in the Lampasas Cut Plain, West Cross Timbers, Edwards Plateau, and Rolling Plains.

Texas Parks and Wildlife reports 27 species of plants in Gillespie county. that are endangered – 19 of these species are endemic to Gillespie county. A full list of all Gillespie county endangered species can be found in the appendix. It is of high importance to highlight that the Hershey Ranch is one of the largest pieces of contiguous land in Gillespie county; making it imperative to preserve, conserve and instill resilience on the Hershey Ranch.

WILDLIFE

As discussed previously, wildlife and the health of the land are of utmost importance; as is reflected in the conservation work Andy has been working towards prior to this Carbon Farm Plan. The Gillespie county endangered species list includes: 4 amphibian, 12 bird, 3 fish, 2 insect, 16 mammal, 4 mollusk and 7 reptile species – 22.9% of which being endemic to Gillespie county. A full list of all Gillespie county endangered species can be found in the appendix. It is of high importance to highlight that the Hershey Ranch is one of the largest pieces of contiguous land in Gillespie county; making it imperative to preserve, conserve and instill resilience on the Hershey Ranch. Romy does the deer surveys, hunts, bird watcher and counts.

Photo: Cody Brown, NCAT

III. ECOLOGICAL SITES AND SOILS

Ecological Sites

According to TPWD and SSURGO, The Hershey Ranch encompasses a multitude of ecological sites, but they can largely be broken down into three main categories: savanna grassland, flood plain herbaceous vegetation and oak/ hardwood woodlands.

EDWARDS PLATEAU: SAVANNA GRASSLANDS

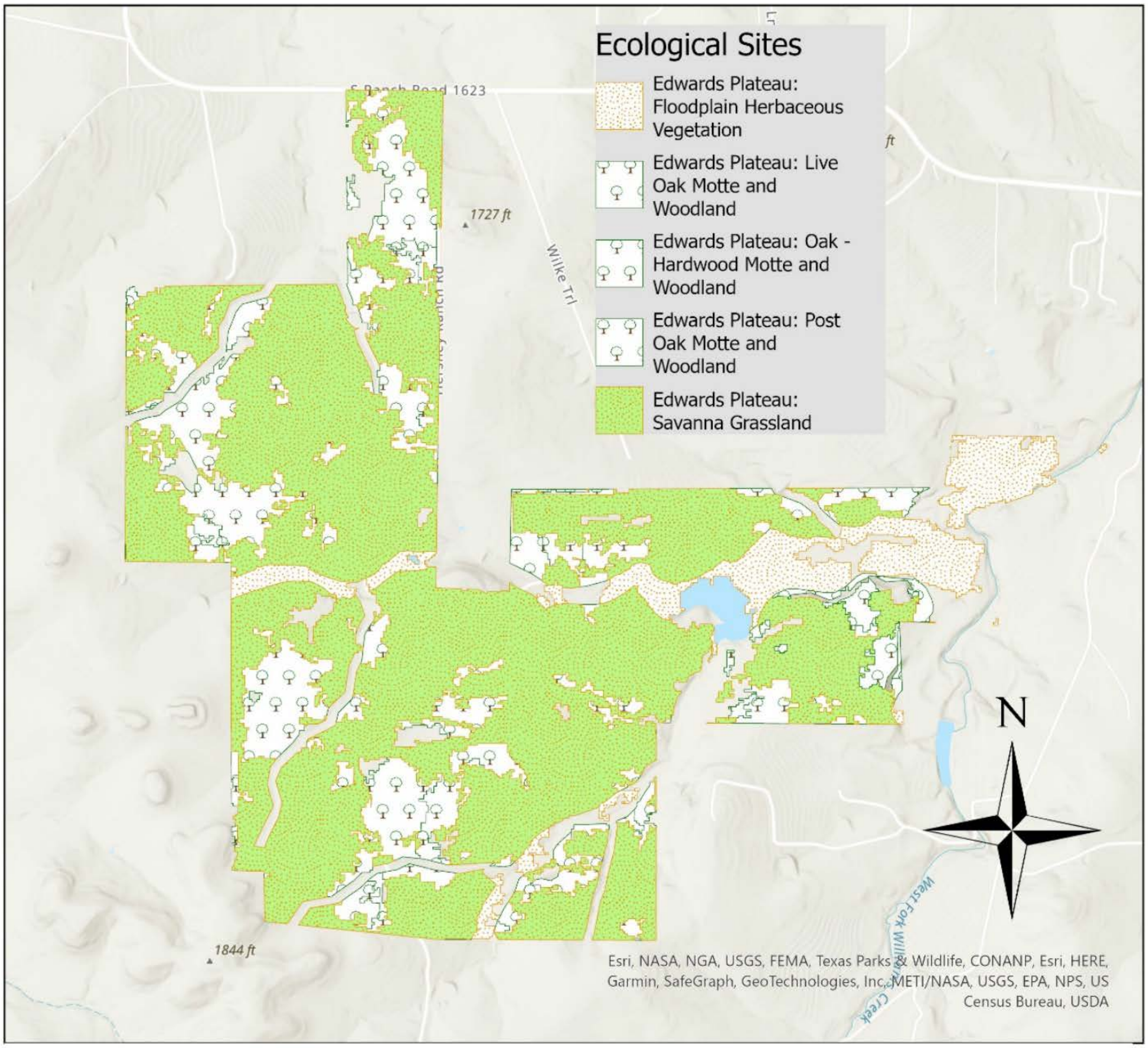
(TPWD + https://edit.jornada.nmsu.edu/catalogs)

Uplands of the Edwards Plateau are frequently described as a mosaic of woodlands, shrublands, and grasslands. Areas with reduced woody cover may occupy sites of considerable size, depending on the land use history, management, and fire history. While these sites have sometimes been referred to as prairies, they are more appropriately considered a part of the savanna mosaic.

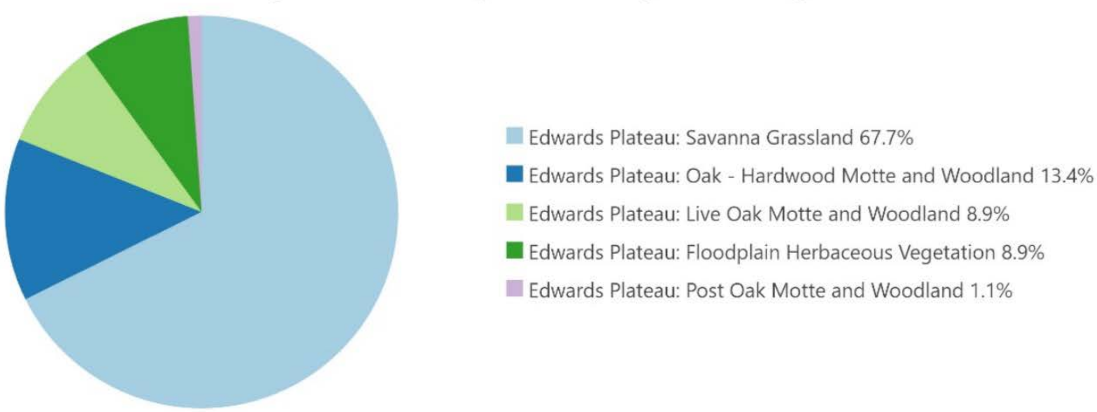
Grasslands in areas transitioning to regions with a prairie matrix (such as the northwestern transitions to shortgrass prairie, northern transitions to mixedgrass prairie, and northeastern and eastern transitions to tallgrass prairie), may closely resemble and be difficult to distinguish from these prairie types. *Schizachyrium scoparium* (little bluestem), *Aristida purpurea* (purple threeawn), *Nassella leucotricha* (Texas wintergrass), and *Bouteloua curtipendula* (sideoats grama) are common dominants on these sites, but *Bothriochloa ischaemum var. songarica* (King Ranch bluestem) and/or *Cynodon dactylon* (bermudagrass) frequently dominate or are significant components. Numerous other grass species, including *Aristida spp.* (threeawn), *Bothriochloa barbinodis* (cane bluestem), *Bothriochloa laguroides ssp. torreyana* (silver bluestem), *Sorghastrum nutans* (Indiangrass), *Bouteloua hirsuta var. pectinata* (tall grama), *Bouteloua trifida* (red grama), *Bouteloua rigidiseta* (Texas grama), *Bouteloua hirsuta* (hairy grama), *Erioneuron pilosum* (fluffgrass), *Hilaria belangeri* (curly mesquite), and many others may be present or dominate these sites.

Open, gentle slopes underlain by Glen Rose Limestone often maintain grasslands that are often dominated by *Bouteloua pectinata* (tall grama) and *Muhlenbergia reverchonii* (seep muhly). Sites under heavy, continuous

Photo: Cody Brown, NCAT



Hershey Ranch Ecological Sites by Percentage



grazing, or sites with thin or xeric soils tend to be dominated by shortgrass species such as *Bouteloua dactyloides* (buffalograss), *Hilaria belangeri* (curly mesquite), or *Erioneuron pilosum* (fluffgrass). Numerous forb species are also present in the herbaceous layer. Woody cover constitutes less than 25% of the canopy and is made up of various species including, but not limited to, *Prosopis glandulosa* (mesquite), *Juniperus ashei* (Ashe juniper), *Mahonia trifoliolata* (agarito), *Quercus sinuata var. breviloba* (white shin oak), *Quercus fusiformis* (plateau live oak), *Diospyros texana* (Texas persimmon), *Ziziphus obtusifolia* (lotebush), and/or *Sophora secundiflora* (Texas mountain-laurel).

EDWARDS PLATEAU: FLOODPLAIN HERBACEOUS VEGETATION

Grasslands on floodplains, often dominated by *Cynodon dactylon* (Bermuda grass) and/or *Bothriochloa ischaemum var. songarica* (King Ranch bluestem). Native species that may be present, common, or dominant include *Panicum virgatum* (switchgrass), *Andropogon glomeratus* (bushy bluestem), *Elymus virginicus* (Virgina wildrye), *Nassella leucotricha* (Texas wintergrass), *Hordeum pusillum* (little barley), *Tripsacum dactyloides* (eastern gamagrass), *Muhlenbergia lindheimeri* (Lindheimer muhly), *Chasmanthium latifolium* (creekoats). Scattered *Prosopis glandulosa* (mesquite), *Quercus fusiformis* (plateau live oak), *Celtis laevigata* (sugar hackberry), or other overstory species may be present.

EDWARDS PLATEAU: OAK HARDWOOD AND WOODLANDS

Rolling to level topography, often on plateau tops, but also on gentle slopes; This upland system forms the matrix vegetation type of the Edwards Plateau. It is typified by a mosaic of evergreen oak and juniper forests, woodlands and savannas over shallow soils of rolling uplands and adjacent upper slopes within the Edwards Plateau and some adjacent ecoregions where limestone is present. Significant open areas dominated by grasses may resemble prairies, and such open occurrences may grade into prairie types to the west (shortgrass prairie), northwest (Central mixedgrass), north (Southeastern Great Plains tallgrass), and east (Blackland).

Species such as *Quercus fusiformis* (plateau live oak) or *Juniperus ashei* (Ashe juniper) often dominate the canopy of this system. Other canopy species may include *Quercus buckleyi* (Texas oak), *Quercus laceyi* (Lacey oak, in the southwestern part of the Edwards Plateau), *Ulmus crassifolia* (cedar elm), *Fraxinus texensis* (Texas ash), *Quercus sinuata var. breviloba* (white shin oak), and *Quercus vaseyana* (Vasey shin oak) (especially in the western part of the region). *Pinus remota* (paper-shell pinyon) and *Juniperus pinchotii* (redberry juniper) may dominate or be a component of the canopy to the southwest and west of the region.

Photo: Cody Brown, NCAT

The shrub layer may be fairly well-developed, containing overstory species, as well as species such as *Diospyros texana* (Texas persimmon), *Mahonia trifoliolata* (agarito), *Sophora secundiflora* (Texas mountain-laurel), *Prosopis glandulosa* (honey mesquite), *Opuntia engelmannii var. lindheimeri* (Lindheimer pricklypear), and *Cylindropuntia leptocaulis* (tasajillo). Many uplands have mottes of *Quercus fusiformis* (plateau live oak) punctuating a generally grass dominated landscape, forming what has been referred to as a motte-savanna.

The understory can contain various graminoid species, including *Schizachyrium scoparium* (little bluestem), *Bouteloua curtipendula* (sideoats grama), *Bothriochloa barbinodis* (cane bluestem), *Bothriochloa laguroides ssp. torreyana* (silver bluestem), *Nassella leucotricha* (Texas wintergrass), *Sorghastrum nutans* (Indiangrass), *Hilaria belangeri* (curlymesquite), *Bouteloua dactyloides* (buffalograss), *Andropogon gerardii* (big bluestem), *Bouteloua hirsuta* (hairy grama), *Bouteloua rigidiseta* (Texas grama), *Muhlenbergia reverchonii* (seep muhly), *Muhlenbergia lindheimeri* (Lindheimer muhly), *Aristida purpurea* (purple threeawn), and/or *Carex planostachys* (cedar sedge).

The composition of the grassland component is driven by grazing, fire, and climate. Shortgrass species such as *Bouteloua dactyloides* (buffalograss) and *Hilaria belangeri* (curlymesquite) are favored under heavy continuous grazing and/or dry climate (to the west), while mid- and tallgrasses are favored under more mesic conditions, more well-developed soils, and well-managed grazing. The herbaceous stratum is often dominated by non-native grass species, especially *Bothriochloa ischaemum var. songarica* (King Ranch bluestem). Some disturbed areas on hard-bedded limestone of the western plateau are now dominated by mesquite woodland. Natural mesquite woodlands are believed to have occurred on the deeper soils of adjacent riparian systems. Generally, loams, clay loams, or clays, often with limestone parent material apparent. Low Stony Hill, Adobe, Clay Loam, and Shallow Ecological Sites are commonly associated with this system.

Photo: Cody Brown, NCAT

Endangered Species and Concerns of Ecological sites

(Habitat Management - TPWD, texas.gov)

The Edwards Plateau Limestone Savanna and Woodland ecological site lists the plant *Tridens buckleyanus* (Buckley's flufflgrass) as an "at-risk" species. Other species and/or animals that are reported for the ecological system are: Nine-banded Armadillo *(Dasypus novemcinctus),* Texas Deermouse *(Peromyscus attwateri),* Lacey's White-ankled Mouse *(Peromyscus laceianus),* Texas Spiny Lizard *(Sceloporus olivaceus)* and the Gray Fox *(Urocyon cinereoargenteus).*

> Climatic conditions in the Hill Country, and their highly variable nature, undoubtedly contribute to alterations of the landscape.

The appearance of Hill Country rangelands is very different today compared to 150 years ago. The grasslands, which were dotted with an occasional live oak motte, are no more. Midgrass and tallgrass communities have been replaced with shortgrass communities (where grasses persist). Grasslands were replaced by parklands and woodlands. Ashe juniper has spread from the steep draws and canyons and exploited the uplands. Replacement of many deciduous trees (e.g., Spanish oak, madrone, Lacey oak) is nonexistent, and the species will die (locally) with the parent trees.

Climatic conditions in the Hill Country, and their highly variable nature, undoubtedly contribute to alterations of the landscape. While several factors contribute to long-term and large-scale landscape changes, recent changes in the appearance of the Hill Country are primarily a result of two factors: (1) overgrazing/ over-browsing by domestic livestock and wild herbivores, and (2) fire suppression. Since the "Golden Period," many rangelands have been overstocked with sheep, goats, and cattle. More recently, white-tailed deer and exotic ungulates have increased to numbers far surpassing the rangeland's carrying capacity. Overstocking rangelands with livestock is largely a result of our naivete of the widely fluctuating patterns of climatic conditions in the Hill Country.

> *"...The figure for the average annual rainfall at Fredericksburg in Gillespie County, 27.5 inches, means very little when only 11 inches fall in one year and 41 inches the very next, as happened in 1956 and 1957. In the nineteenth century, two of the four census years used, 1859 and 1879, were marred by severe drought. The wet years served only to convince the inhabitants that the dry ones were exceptional strokes of bad fortune, while in fact they were part of the normal course of climatic events, to be expected in such a transition zone."* –Terry Jordan 1966 (Jordan, T. G. 1966. German seed in Texas soil: immigrant farmers in nineteenth-century Texas. University of Texas Press, Austin, Texas, USA.)

A single-species approach to wildlife management also has led to large-scale landscape changes in the Hill Country. The expansion of Ashe juniper has had a tremendous impact on the ecosystem, causing a decrease in plant species diversity and an increase in soil erosion. Cedar brakes lose a significant amount of precipitation through transpiration and overland flow, leaving much less water for aquifer recharge. While overgrazing and fire suppression have contributed to cedar invasion of upland sites, subsequent protection of Ashe juniper (for endangered wildlife) has compounded the problem. As the groundwater resources are being depleted, associated fauna is threatened.

The key to managing natural resources is to use a holistic approach, where all tools are applied to develop and maintain healthy ecosystems. Single species deserve less attention, while the system in which they thrive requires more. Knowing how that system functions, and applying the techniques with which that system developed (e.g., moderate cattle grazing, prescribed burning, hunting) is imperative for its continued existence.

Soils

(Web Soil Survey, usda.gov)

The Hershey Ranch contains a multitude of soils types across is 1,565 acres; 12 different soils, but three major soil types comprise 73% of the ranch's soil composition. The soils of the site vary from very shallow clays to shallow clay loams with pockets and crevices of deeper soils. Productivity of the site varies with these fluctuations and decreases with precipitation from east to west. Moisture holding capacity is relatively limited and often limits productivity. Long-term droughts, occurring three to four times per century, may cause shifts in vegetation by causing woody plant mortality.

The largest soil type composition found on the ranch is *Purves soils (PuC)*, comprising about 35% of the total acres (547.4 acres); found in congruence with the Edwards Plateau: savanna grassland ecological sites across the ranch. The surface layer is dark grayish-brown, calcareous loam about 6 to 9 inches thick. Texture modifiers such as gravel and cobbles compose up to 40 percent on the surface and it is estimated to have roughly 4% organic matter. According to the NRCS/USDA soil report the *Purves (PuC)* soils across the Hershey Ranch has a pH around 7.1 and an available water holding capacity (AWC) of 0.16 cm/cm; meaning that for every square foot (939.03 cm) of soil it can hold 150.24 cm (4.9 in) of water. However, the very undulating nature of the Hershey ranch it is susceptible to sheet and rill erosion (0.15 of 0.69 rating [21st percentile]), which hinders the ability of the soil to capture and hold water as well as flatter terrains.

Purves soils (PuC), clay loam, undulating		
Description		
Setting	**Typical Profile**	**Properties and Qualities**
Landform: Plains Down-slope shape: Convex Across-slope shape: Linear Parent material: Residuum weathered from limestone	H1 - 0 to 11 inches: clay H2 - 11 to 14 inches: very cobbly clay loam H3 - 14 to 19 inches: bedrock	Slope: 2 to 8 percent Depth to restrictive feature: 8 to 20 inches to lithic bedrock Drainage class: Well drained Runoff class: Very high Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Calcium carbonate, maximum content: 45 percent Available water supply, 0 to 60 inches: Very low (about 2.1 inches)

Doss (DoC) soils are 19% of the total acres (302.3 acres) on the ranch, making it the second largest soil type on Hershey Ranch; a silty clay with 1 to 5 percent slopes and it is also found in the Edwards Plateau: savanna grasslands ecological site. The surface layer is dark grayish-brown, calcareous loam about 6 to 9 inches thick. Texture modifiers such as gravel and cobbles compose up to 40 percent on the surface and it is estimated to have roughly 2% organic matter. According to the NRCS/USDA soil report the *Doss (DoC) soils* across the Hershey Ranch has a pH around 8.2 and AWC of 0.14 cm/cm (a slight decrease from *(PuC).* The Shallow ecological site consists of nearly level to gently sloping soils on uplands. Slope ranges from 0 to 8 percent. This site is usually found on stream terraces, alluvial fans, hills, ridges, divides, and foot slopes. The elevation ranges from 899 feet to 2,500 feet above sea level. This soil is nearly level to gently sloping uplands and much of the site could be used for rangeland due to the shallow soils.

Doss soils (DoC), silty clay, 1 to 5 % slopes		
Description		
Setting	**Typical Profile**	**Properties and Qualities**
Landform: Plains Down-slope shape: Convex Across-slope shape: Linear Parent material: Residuum weathered from limestone	H1 - 0 to 11 inches: clay loam H2 - 11 to 14 inches: very cobbly clay loam H3 - 14 to 19 inches: bedrock	Slope: 2 to 8 percent Depth to restrictive feature: 8 to 20 inches to lithic bedrock Drainage class: Well drained Runoff class: Very high Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Calcium carbonate, maximum content: 45 percent Available water supply, 0 to 60 inches: Very low (about 2.1 inches)

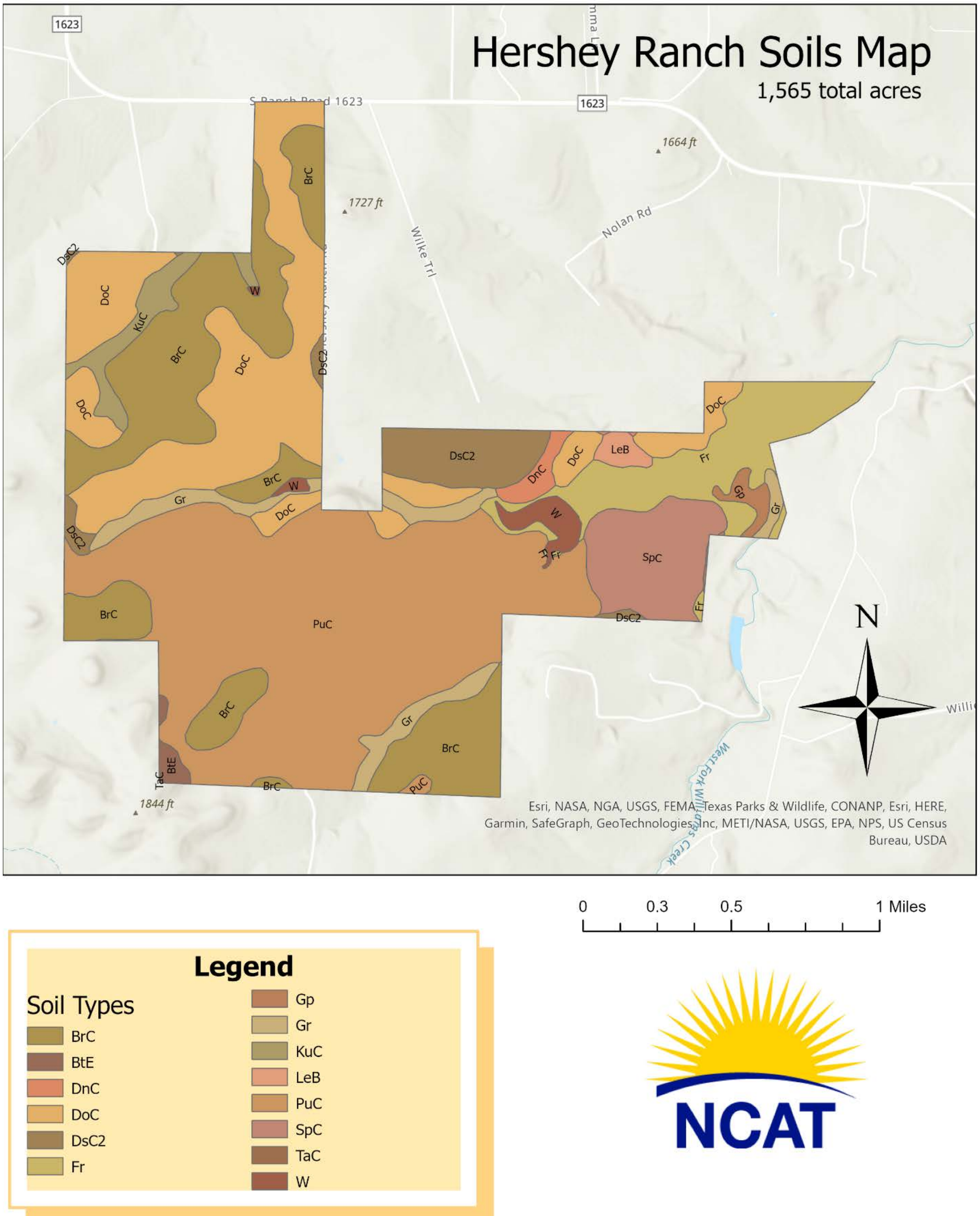
Brackett (BrC) soils are about 18% of the total acres (284.6 total acres) at Hershey Ranch and are primarily found within the Edwards Plateau: oak, hardwood and motte woodland ecological sites. These sites are found on shallow calcareous gravelly loams and gravelly clay loams over limestone or chalky marl on undulating to hilly uplands. In the landscape, it may be in narrow bands on steep slopes, on foot slopes below steeper soils, on small, isolated hills within areas of deeper soils in surrounding valleys, or along narrow ridges. Areas range up to 300 acres in size but are mostly about 150 acres or less. Slopes are complex and vary from 2 to 20 percent. Runoff is low to high, and the potential erosion is moderate to high. The elevation ranges from 351 to 2,451 feet. Geological and accelerated erosion has removed most of the surface layer between the deeply cut drainage ways. Due to their high lime content and little organic matter, the forage production on some soils in the site is limited, less palatable and lower in essential minerals than that of surrounding sites.

Brackett (BrC) soils, 1 to 8% slopes		
Description		
Setting	**Typical Profile**	**Properties and Qualities**
Landform: Ridges Down-slope shape: Convex Across-slope shape: Linear Parent material: Residuum weathered from limestone	A - 0 to 7 inches: loam Bk - 7 to 14 inches: loam Cr - 14 to 60 inches: bedrock	Slope: 1 to 8 percent Depth to restrictive feature: 10 to 20 inches to paralithic bedrock Drainage class: Well drained Runoff class: Low Depth to water table: More than 80 inches Calcium carbonate, maximum content: 90 percent Available water supply, 0 to 60 inches: Very low (about 1.7 inches)

The last soil type worth mentioning in this report is known as the *Oakalla (Fr) soils* – about 8.2% of the remaining acreage (128 total acres). These soils are found in the Edwards Plateau: floodplain herbaceous vegetation ecological site. Remember back to the Hershey Ranch profile and the discussion of the conventional cotton farmer; all of the old cotton fields (roughly 110 acres) working to be restored back to native prairie were located within this floodplain ecological site / soil type. These soils are typically well drained and have high water holding capacity, sometimes receiving overflow from adjacent sites and from flooding creeks and rivers. These sites generally flood once every two years for periods of four hours to less than 48 hours. These soils may be underlain with material comprised of 65 to 90 percent rounded alluvial gravels, cobbles, and stones at depths of 12 to greater than 80 inches.

The site produces high yields of palatable and nutritious forage. The deep soils with high organic matter stored a large amount of water for plant growth. The production of the tall grasses kept soil erosion to a minimum. During flood events, these grasses would bend over and protect the soils much the same as shingles protect the roof of a house. Flooding of this site would bring in new soil and nutrients from the upslope watershed. Flooding could also re-work the channel depending upon severity. Severe droughts increase this vulnerability.

Oakalla (Fr) soils, silty clay loam, 0 to 2 % slopes, occaisonal flooding		
Description		
Setting	**Typical Profile**	**Properties and Qualities**
Landform: Flood plains Down-slope shape: Linear Across-slope shape: Concave Parent material: Loamy alluvium derived from limestone	Ap - 0 to 8 inches: silty clay loam Ak - 8 to 23 inches: silty clay loam Bk1 - 23 to 53 inches: silty clay loam Bk2 - 53 to 80 inches: silty clay loam	Slope: 0 to 2 percent Depth to restrictive feature: More than 80 inches Drainage class: Well drained Runoff class: Low Depth to water table: More than 80 inches Frequency of flooding: Occasional Calcium carbonate, maximum content: 60 percent Available water supply, 0 to 60 inches: Moderate (about 8.8 inches)



Hershey Ranch Soils Map
1,565 total acres
1623
S Ranch Road 1623
1664 ft
1727 ft
1844 ft
Nolan Rd
Wilke Trl
West Fork Williams Creek
N
Esri, NASA, NGA, USGS, FEMA, Texas Parks & Wildlife, CONANP, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA
BrC
DoC
KuC
DsC2
W
Gr
PuC
BtE
TaC
DnC
LeB
Fr
Gp
SpC
0
0.3
0.5
1 Miles
Legend
Soil Types
BrC
BtE
DnC
DoC
DsC2
Fr
Gp
Gr
KuC
LeB
PuC
SpC
TaC
W

IV. RESOURCE CONCERNS

Soil

The Hershey Ranch encompasses a multitude of soil types across various topographies with a multitude of soil resource concerns.

As previously discussed, soil erosion and water holding capacity are major concerns on the Hershey Ranch. The floodplain soils (old cotton fields) are currently eroding down the slope towards the creek as a result of previous cotton growing practices. We address this with practice suggestions in the next section that build contours and slows the flow of water across the landscape to help increase infiltration.

There are many areas across the ranch where it is evident water flows and previously pooled, but instead of being absorbed and stored it is "running" off the ranch and into the creek. The idea is to revitalize those waterways with living roots to help decrease soil erosion and build organic matter.

A lot of great work has been done along the riparian corridors on the Hershey Ranch including cedar removal utilizing the "chop and drop" method as to create micro bird nurseries. There are still some areas of bank erosion concern along parts of the riparian corridor that need to be addressed by incorporating some more living roots to slow down the flow of rain water and seeding in native grasses to help with bank structure and water retention.

Water

Water is the main resource concern on the ranch. In particular, the limited water access is restricting the ability to regeneratively graze and positively impact the entirety of the ecosystem. We have seen a positive impact and response wherever Garrett has been able to graze the cattle. However, this has only been an estimated 30-40% of total grazable land.

It is a goal of the ranch to install a solar water pump and irrigation line so that the cattle can be moved to all areas of the ranch; not only allowing for more rest time between grazes, but also a more widespread impact across the ranch. The irrigation pipeline map can be found in the appendix for a visual aid.

Another suggestion made for the Hershey Ranch concerning water capture is "critical area plantings". These areas are highlighted as important pieces of the ranch's topography because it is apparent that water flows along these areas and could potentially be revitalized to hold and carry water across the ranch naturally.

In efforts to help slow erosion and increase water infiltration on the old cotton fields, a suggestion is made to establish trees and shrubs along contours (berms and swales).

Animal

As mentioned in the opening paragraphs discussing the ecological sites, there are many endangered species that are present on the ranch – some of them being endemic to Gilespie County.

V. RANCH SYSTEMS MANAGEMENT

The Hershey Ranch has experienced a cornucopia of ecological systems and evolutions over the course of its existence: large scale cotton production, small sheep operation, long periods of rest and now resilient rejuvenation. As the property functions now, it would be best described as a beacon of conservation; forging relationships around natural habitats and seeking to empower and educate youth about the importance of wilderness and agriculture. The Hershey Ranch utilizes the cattle herd to rejuvenate native forage biomass and increase the "soil sponge" as Garrett refers to it – this is a prime example of how agricultural practices can enhance landscapes rather than degrade them.

As the property functions now, it would be best described as a beacon of conservation; forging relationships around natural habitats and seeking to empower and educate youth about the importance of wilderness and agriculture.

Resilient Ranching Practices

SOIL HEALTH PRACTICES

Native Prairie Pasture Restoration Fields (121 acres)

- Conservation Cover (CPS 327) Convert Non-Irrigated Cropland to Permanent Unfertilized Grass/ Legume Cover
  - This practice has been carried out with help of the NRCS – relevant paperwork can be found in the appendix with species utilized. This practice did include a light till before broadcasting seed was completed.
- Residue and Tillage Management (CPS 329) Intensive Till to Reduced Till on Non-Irrigated Cropland
  - In one of our meetings, Andy expressed that it was important to him that the NRCS contract be updated to reflect a "no-till" initiative when doing cover crop or conservation plantings. The use of a no-till seed drill would be feasible for these fields. Working with Warren Day on this now 04/24.

Soil Health Carbon Beneficial Practices Description and Quantifications				
Conservation Practice Standard	**Practice Extent & Description**	**Total acres**	**Annual GHG Benefit (Mg CO2e)**	**20-year Benefit (Mg Co2e)**
Conservation Cover (CPS 327) Convert Non-Irrigated Cropland to Permanent Unfertilized Grass/ Legume Cover	old cotton fields being restored to native prairie habitat	121	108	2,160
Residue and Tillage Management (CPS 329) Intensive Till to Reduced Till on Non-Irrigated Cropland	old cotton fields being restored to native prairie habitat	121	21	420
Totals	**8 practices**	**123.8 acres**	**240 annually**	**4,800 20-yr total**

GRAZING AND PASTURE PRACTICES

Adaptive/ Regenerative Grazing (1472 acres)

- Prescribed Grazing (CPS 528) Grazing Management to Improve Rangeland or Non-Irrigated Pasture Condition

Grazing and Pasture Carbon Beneficial Practices Description and Quantifications				
Conservation Practice Standard	**Practice Extent & Description**	**Total acres**	**Annual GHG Benefit (Mg CO_2e)**	**20-year Benefit (Mg Co_2e)**
Prescribed Grazing (CPS 528) Grazing Management to Improve Rangeland or Non-Irrigated Pasture Condition	All available acreage for grazing	1,472	112	2,240

AGROFORESTRY PRACTICES

Critical Area Planting (267.4 acres)

- Critical Area Planting (CPS 342) Restore Highly Disturbed Areas by Planting Permanent Vegetative Cover
  - These areas have been identified as highly susceptible to erosion, or old water ways that have been eroded due to lack of living roots. This practice suggests broadcasting native forbs and grasses along these areas and bale grazing the cattle herd across the areas. The cattle manure, urine and stomping effect combined with the hays ability to retain water and provide shade from the sun will help increase germination and establishment.

Riparian Restoration (75.15 acres)

- Riparian restoration (CPS 391) Restore Degraded Riparian Areas by Planting Woody Plants
  - The riparian area around the creek has been tended to quite a bit, and all of the cedar has been removed and left in place as bird shelter. Some of the other riparian areas identified across the ranch have had less attention, and some even now seem to be riparian areas of the past. These areas need grass and forbs seeded along the embankments to help prevent further erosion. Some of the areas where cedar was the predominant species need to be replanted with native tree varieties to help reestablish the ecosystem.

Hedgerow Planting (27.3 acres)

- Hedgerow Planting (CPS 422) Replace a Strip of Cropland with 1 Row of Woody Plants
  - This practice is to be implemented in the old cotton fields that are being converted into native prairies. It is quite evident from the satellite images that severe rill erosion has occurred across these fields in the direction of the creek. This practice suggests establishing woody hedgerow corridors on contour with the erosion with berms and swales. This will not only act as a wildlife corridor, but also help slow down the flow of water in order to help increase infiltration into the soil before it runs to the creek.

Agroforestry Carbon Beneficial Practices Description and Quantifications				
Conservation Practice Standard	**Practice Extent & Description**	**Total acres**	**Annual GHG Benefit (Mg CO_2e)**	**20-year Benefit (Mg Co_2e)**
Critical Area Planting (CPS 342) Restore Highly Disturbed Areas by Planting Permanent Vegetative Cover	roadways and water spillways, highly eroded areas, areas for water capture	267.4	507	10,140

Riparian restoration (CPS 391) Restore Degraded Riparian Areas by Planting Woody Plants	Along West Fork Willams Creek, around the pond and secondary creeks/ dry beds	75.15	165	3,300
Hedgerow Planting (CPS 422) Replace a Strip of Cropland with 1 Row of Woody Plants	Within the old cotton fields flood plain areas being restored	27.3	172	3,440
Totals	**3 practices**	**369.85 total acres**	**844 metric tons annually**	**13,910 metric tons 20 years**

Total Carbon Beneficial Practices Description and Quantifications

Conservation Practice Standard	**Practice Extent & Description**	**Total acres**	**Annual GHG Benefit ($Mg\ CO_2e$)**	**20-year Benefit ($Mg\ Co_2e$)**
Conservation Cover (CPS 327) Convert Non-Irrigated Cropland to Permanent Unfertilized Grass/ Legume Cover	old cotton fields being restored to native prairie habitat	121	108	2,160
Residue and Tillage Management (CPS 329) Intensive Till to Reduced Till on Non-Irrigated Cropland	old cotton fields being restored to native prairie habitat	121	21	420
Cover Crops (CPS 340) Add Legume Seasonal Cover Crop (with 50% Fertilizer N Reduction) to No-Till Non- Irrigated Cropland	old cotton fields being restored to native prairie habitat	121	10	200
Multiple Conservation Practices – Intensive Till to No Till or Strip Till (CPS 329) + Add Legume Cover Crop (CPS 340) + Replace Synthetic N Fert w/ Compost (CN25) (CPS 590) on Non-Irrigated Croplands	old cotton fields being restored to native prairie habitat	121	101	2,020
Conservation Cover (CPS 327) – Pollinator Habitat Plantings	surrounding the ranch house	2.8	–	–
Soil Carbon Amendment (CPS 336)	old cotton fields being restored to native prairie habitat	121	–	–
Prescribed Grazing (CPS 528) Grazing Management to Improve Rangeland or Non-Irrigated Pasture Condition	All available acreage for adaptive/ regenerative grazing	1,472	112	2,240
Critical Area Planting (CPS 342) Restore Highly Disturbed Areas by Planting Permanent Vegetative Cover	roadways and water spillways, highly eroded areas, areas for water capture	267.4	507	10,140

Riparian restoration (CPS 391) Restore Degraded Riparian Areas by Planting Woody Plants	Along West Fork Willams Creek, around the pond and secondary creeks/ dry beds	75.15	165	3,300
Hedgerow Planting (CPS 422) Replace a Strip of Cropland with 1 Row of Woody Plants	Within the old cotton fields flood plain areas being restored	27.3	172	3,440
Totals				
Conservation Practice Standards	**Practice Extent & Description**	**Total acres**	**Annual GHG Benefit (Mg CO_2e)**	**20-year Benefit (Mg Co_2e)**
10 practice categories	**43 total practices**	**2,570.65**	**1,196**	**23,920**

It is important to note that although drilling a water well, installing irrigation pipeline and solar pump are supporting practices that do not directly have a GHG sequestration impact (why they are not quantified); they are still important features of the Hershey Ranch and will go a long ways in instilling resilience across the ranch.

Andy has made it clear that we do not want the water well and pipeline to be the greatest part about the plan, thus focus has been given to the ecosystem and health of the land. You can find the plans for water well and pipeline installation plans in the appendix.

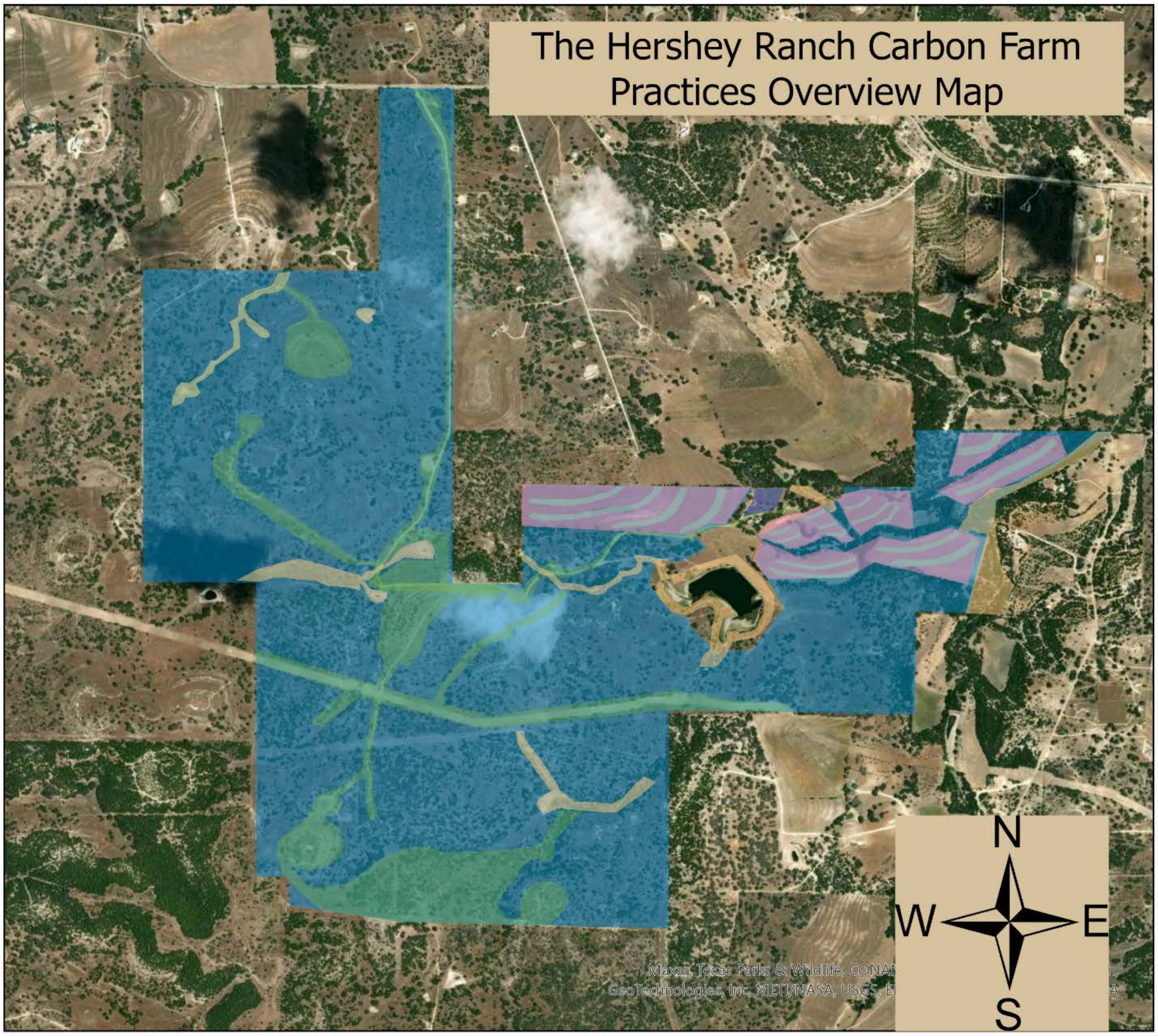
Soil Water Holding Capacity

This section is to estimate additional water storage capacity (WHC) associated with soil carbon increases on a working landscape resulting from the implementation of the practices proposed in the CFP. NRCS suggests that a 1% increase in soil organic matter (SOM) results in an increase in soil WHC of approximately 1-acre inch, or 27,152 gallons of increased soil water storage capacity per acre. A 1% increase in SOM represents roughly 20,000 pounds (10 short tons) of organic matter or 5 short tons of organic carbon.

This is largely the goal of Garrett bringing cattle onto the property, to help increase the "soil sponge" by utilizing grazing as tool to promote root growth, suppression of non-native species and increase biodiversity; which in turn increases the soil's ability to hold water, support microbial life and increase ecosystem services across the landscape.

> A living root not only provides above ground biomass, but it also provides root exudates that feed the microbial population, turning over bio-available nutrients and increasing organic matter within the soil.

The majority of the "Critical Area Plantings" and "Riparian Area Plantings" that are included in the suggested practice sections are intended to get a living root re-established along these areas of either high erodibility or areas that were once natural waterways, and seasonal streams. A living root not only provides above ground biomass, but it also provides root exudates that feed the microbial population, turning over bio-available nutrients and increasing organic matter within the soil. The increased root depth, enhanced microbial populations and added organic matter are all factors of soil health that increase the soils' water holding capacity.



0 0.31 0.62 1.24 Miles

Agroforestry NRCS practices

- Critical Area Planting (7)
- Riparian Restoration (7)
- Riparian Restoration (1)
- Riparian Restoration (1)
- Pollinator Habitat (1)
- Hedgerow Planting (18)

Soil Health NRCS practices

- Native Prairie Restoration (4)
- Native Prairie Restoration (2)
- Pollinator Planting (1)

Grazing and Pasture NRCS practices

- Adaptive Grazing Potential

NCAT

By building out a WHC table one can demonstrate to producers the potential for increasing on farm soil water storage capacity through soil carbon enhancement. Figure 10 shows estimated additional WHC associated with practices in Table 5: Carbon Beneficial Practices & Quantification. These estimates are over a 20-year time horizon since it takes time for conservation practices to build SOM and TOC.

As you take a look at the WHC Table for the Hershey Ranch shown below you'll notice that if all the suggested practices were implemented it would increase the Hershey Ranch's WHC capacity by 58.75 acre feet over 20 years. Now, let's be realistic and breakdown these numbers a little bit. The suggested "Critical Area Planting (CPS 342)" practice implementation across 267.4 acres would have the greatest impact on the ranch's water holding capacity; 25.33 acre feet increase in water holding capacity. The "Prescribed Grazing (CPS 528)" and cattle have the second largest impact with a potential increase of 11.19 acre feet. Tending to areas of high susceptibility by converting to permanent cover by using the cattle to bale graze and help germinate should be of high priority.

Carbon Farm Practices (use dropdown)	Mg CO_2e 20 yr	Mg SOC	Soil Factor	Mg SOM	Mg SOM/ AI	Acre Inches (AI)	Acre Feet (AF)
Conservation Cover (CPS 327)	2160.00	588.56	1.00	1,177.11	9.09	129.48	10.79
Conventional Tillage to No-Till (CPS 329)	420.00	114.44	1.00	228.88	9.09	25.18	2.10
Cover Crops (CPS 340)	200.00	54.50	1.00	108.99	9.09	11.99	1.00
Prescribed Grazing (CPS 528)	2,240.00	610.35	1.00	1,220.71	9.09	134.28	11.19
Critical Area Planting (CPS 342)	10,140.00	2762.94	0.50	2,762.94	9.09	303.92	25.33
Riparian Restoration	3,300.00	899.18	0.50	899.18	9.09	98.91	8.24
Blank	100.00	27.25	0.00	0.00	9.09	0.00	0.00
Blank	100.00	27.25	0.00	0.00	9.09	0.00	0.00
Blank	100.00	27.25	0.00	0.00	9.09	0.00	0.00
Blank	100.00	27.25	0.00	0.00	9.09	0.00	0.00
Blank	100.00	27.25	0.00	0.00	9.09	0.00	0.00
Blank	100.00	27.25	0.20	10.90	9.09	1.20	0.10
TOTAL	**19,060.00**	**5,193.46**		**6,408.72**		**704.96**	**58.75**

Conclusion and Discussion

Andy Sansom has really trailblazed the conservation efforts at the Hershey Ranch by working with the NRCS, TPWD, Romy Swanson, Youth of Gillespie county and Garret Kunz (cattle manager).

With chop and drop of the cedar in the riparian areas the ranch has seen flowing water return to the West Fork Williams Creek. As of May 2024 all off the old cotton fields have been seeded for conversion to native grass prairies and planted utilizing a no-till seed drill. Access to water and timely grazing of cattle will really help establish these native prairies.

Without access to water supply, Garrett has been able to graze an estimated 30-40% of the total area he would like to cover in a year to help promote native grass growth. Regardless, his annual impact with his cattle herd is an estimated 30-40 metric tons of CO_2 annually sequestered with an annual increase of 6" in soil WHC across the ranch.

The critical area plantings that are planned are set to have the greatest long-term impact on the ranch by re-rooting and revitalizing highly erodible areas across the ranch. We plan to utilize the practice known as "bale grazing" over a conservation cover seed mix in hopes of increasing the germination percentages. This practice has been well studied across arid landscapes by the Quivira Coalition out of New Mexico. With a 20 year, 25 acre foot increase in available WHC, by adopting critical area plantings practice the Hershey Ranch could see an annual increase of 1.25 acre feet annual increase in available WHC.

VI. SUMMARY

The Hershey Ranch represents the largest piece of contiguous land in Gillespie county, making it imperative to plan for the long-term conservation of the Hershey Ranch. It is vital to consciously manage the Hershey Ranch for the benefit of the land and utilize the ranch as a teaching tool for peer- to peer learning events as it is truly a piece of land to cherish in the Texas Hill Country and a powerful educational tool that displays the intersection of agriculture and conservation and how they can work together.

The Hershey Ranch Plan works towards the Hershey Ranch's overarching goals of:

1) Andy said simply, "the land". Andy and Garrett alike see the ranch as a "living, breathing organism" and seek to treat it this way. All the tools being utilized: cattle grazing, cedar removal and prescribed fire are for the sole benefit of the land and wildlife. They are using agriculture production as a tool to restore the land and create suitable habitats for native flora and fauna.

2) Education. Andy wants the ranch to not only continue to be an education hub for the youth, ranchers and outdoors enthusiasts alike; but to strengthen the tools which they can do that through – a Resilient Ranch Plan.

3) Long-term conservation. Andy and Garrett alike see the importance of a Carbon Farm Plan in helping guarantee that the property will always be managed with these conservation goals at the forefront of decision making – long past the both of them.

Project Implementation Timeline

Conservation Practice	Location and Extent	CO2e Benefit	Associated Benefits							Date	Funding Source
Carbon Beneficial Practice and or NRCS Conservation Practice Standard & Associated Number	*Identify Location (see CFP Map) & Monitoring Photo Points*	*Calculated Using: COMET-Planner, etc.*	*Soil Health*	*Water Quality*	*Water Quantity*	*Wildlife Enhancement*	*Plant Community*	*Air Quality*	*Producer Economics*	*Planned, Implemented, Completed &/or Maintained*	
Resilient Ranch Plan	Hershey Ranch	Comet-Planner	X	X	X	X	X	X	X	Completed March 2024	SSARE & Meadows Foundation
Riparian Restoration (CPS 391)	along West Fork Creek	Comet-Planner		X	X	X	X	X		Completed May 2023	many organizations
Conservation Cover (CPS 327) + No-Till	old cotton fields	2580 Mg Co2e	X	X	X	X	X	X	X	Completed May 2024	CIC NRCS
Prescribed Grazing (CPS 528)	Ranch-wide	2240 Mg Co2e	X	X	X	X	X	X	X	Started 2021 - ongoing	
Livestock Pipeline and Solar Pump (CPS 516/533)	Ranch-wide	Prescribed Grazing Supporting Practice		X	X	X	X		X	Well drilling being scheduled spring 2025	NRCS help cost-share pipeline/ Garret and Andy work out well drill
Critical Area Planting (CPS 342)	Ranch-wide	10,140 Mg Co2e	X	X	X	X	X	X	X	Start Fall 2024 on front 510ac	NCAT+ Cody donate hay
Hedregrow Planting (CPS 422)	old cotton fields	3,440 Mg Co2e	X	X	X	X	X	X	X	Fall / Winter TBD	TBD, Treefolk, Working Trees, Symbiosis
		©CarbonCycleInstitute									

Monitoring

The Hershey Ranch has been affiliated with Soil for Water for a number of years where annual monitoring has been conducted every October – set to end 2024. NCAT will continue to offer technical assistance to the Hershey Ranch with any practice implementation and/ or agricultural related questions and concerns. The Hershey Ranch is very active with their county NRCS representative Warren Dey, and they continuously monitor the status of prescribed burns, native prairie restoration and cedar control.