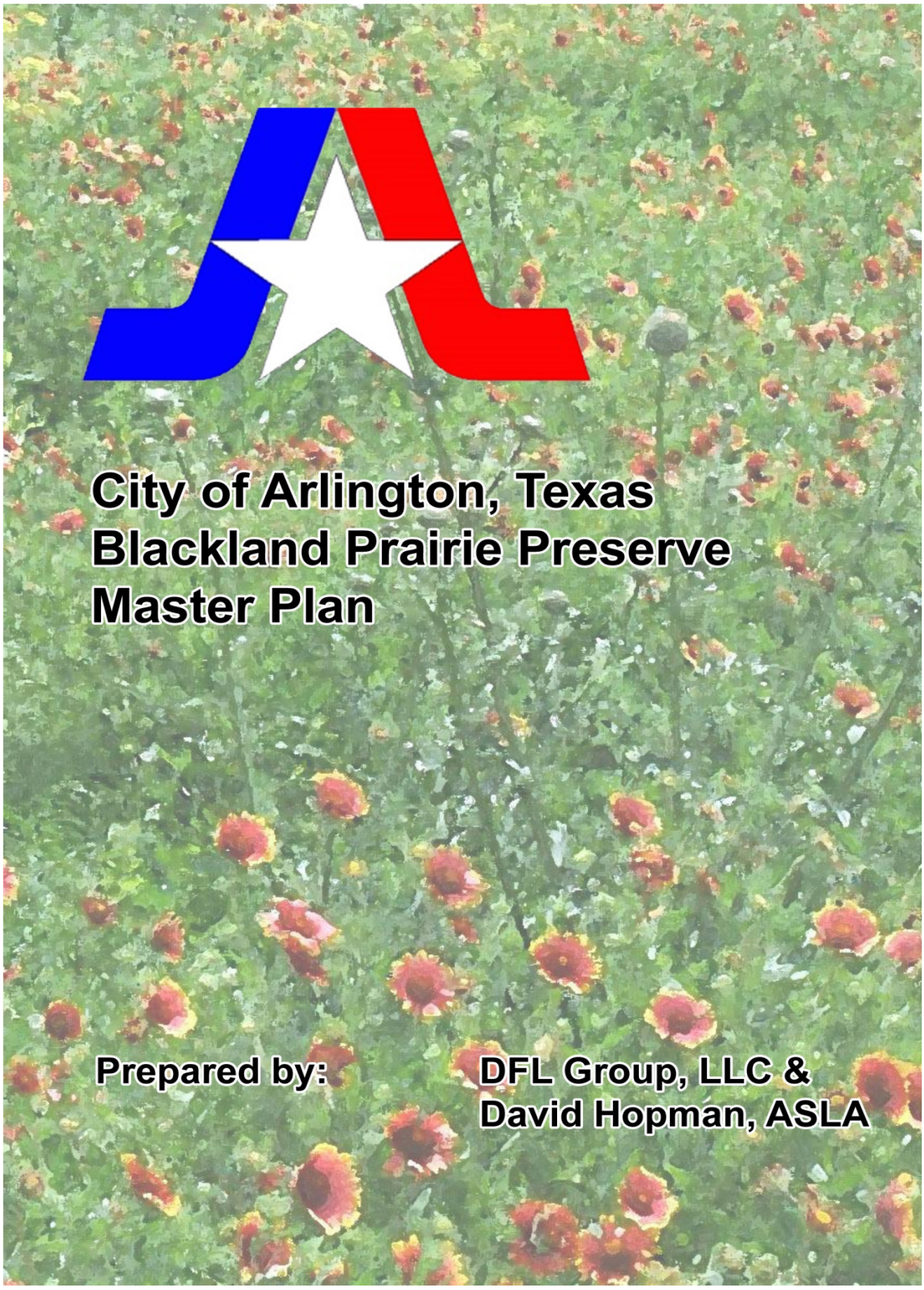

City of Arlington, Texas
Blackland Prairie Preserve
Master Plan
Prepared by:
DFL Group, LLC &
David Hopman, ASLA

FOUNDATION

The City of Arlington acquired the Blackland Prairie site in 1998 after a group of concerned citizens identified its value as possibly the last blackland prairie remnant site in the city. Encouraged by the Arlington Conservation Council, the land was purchased by the city to be held as permanent open space.

In its current condition, the site remains in transition. Efforts by volunteers have helped maintain native prairie grasses on approximately half of the site. The eastern half however, has remained untouched since acquisition. Invasive grasses, woody and herbaceous plants continue to proliferate in this area, leaving relatively few native species.

In 2013, the City secured the services of DFL in association with University of Texas Arlington professor and landscape architect David Hopman to prepare a master plan for the site.

The three major goals of the plan are:

1. To recommend methods to restore the eastern section of the site to a more native condition,
2. To recommend maintenance practices that will preserve the entire site in a native condition to the extent possible, and
3. To provide a graphic framework plan that identifies and locates limited development, including parking, trails, seating, interpretive signage, and a shade structure.

The park's acquisition and preservation meets several goals recognized in the 2004 Parks Recreation and Open Space Master Plan:

- Goal I.3 "Preserve and enhance the City's valuable and sensitive natural resources."
- Goal I.4 "Develop collaborative relationships between the City and other public, nonprofit, and private organizations to promote a more effective parks and recreation system."
- Goal II.B "Installation of drought tolerant and native plants in all new park development. Continue to research new and innovative construction practices and technology. The master plan also initiated a new "Natural Areas" classification. Examples include the SW Nature Preserve, Blackland Prairie Park, Crystal Canyon Natural Area, Village Creek Historical Area, OW Fannin Park, and portions of several other parks.

Open space and parkland preservation has long been an important priority for the City. As far back as the 1980's, staff and citizens acknowledged a parkland shortage. With the passage of several bond programs and aggressive grant efforts, the City's open space inventory expanded

faster than at any time in its history. 2004 also saw a significant new focus for Arlington. For the first time, the City established a "natural area" classification, precluding intensive development of environmentally sensitive park sites. Although not yet designated a natural area, reclassifying the prairie site is clearly an achievable goal. This is an extremely important objective since Texas Parks and Wildlife reports that less than 1% of Texas original prairie land remains today.

The City of Arlington envisions this park as a place for passive recreation. While many cities discourage use and even fence prairie sites, parks officials see this site as an opportunity for citizens to visit, walk, and enjoy its benefits. A stroll through a site like this surrounded by nature provides immeasurable emotional and psychological benefits to urban residents.

The site's location also offers a unique opportunity for the City and School District to work together to provide an outdoor classroom. Bowie High School is located just a short walk to the southeast. With the addition of strategically placed trails and interpretive signage, students will be exposed to an ecosystem that has largely been lost to development. Instruction will expand the public's appreciation of not only this site, but also native prairies in general.

Mitigating the negative ecological and environmental impacts of development are perhaps the most underappreciated benefits of the prairie. Although the relatively small size of the site limits animal population to birds and small mammals, the park is a welcome refuge for an abundance of wildlife. Texas Parks and Wildlife suggests the site will probably be home to various squirrels, non-venomous snakes, cottontail rabbits, quail, dove, possum and mice. A much larger variety of birds have been noted, including:

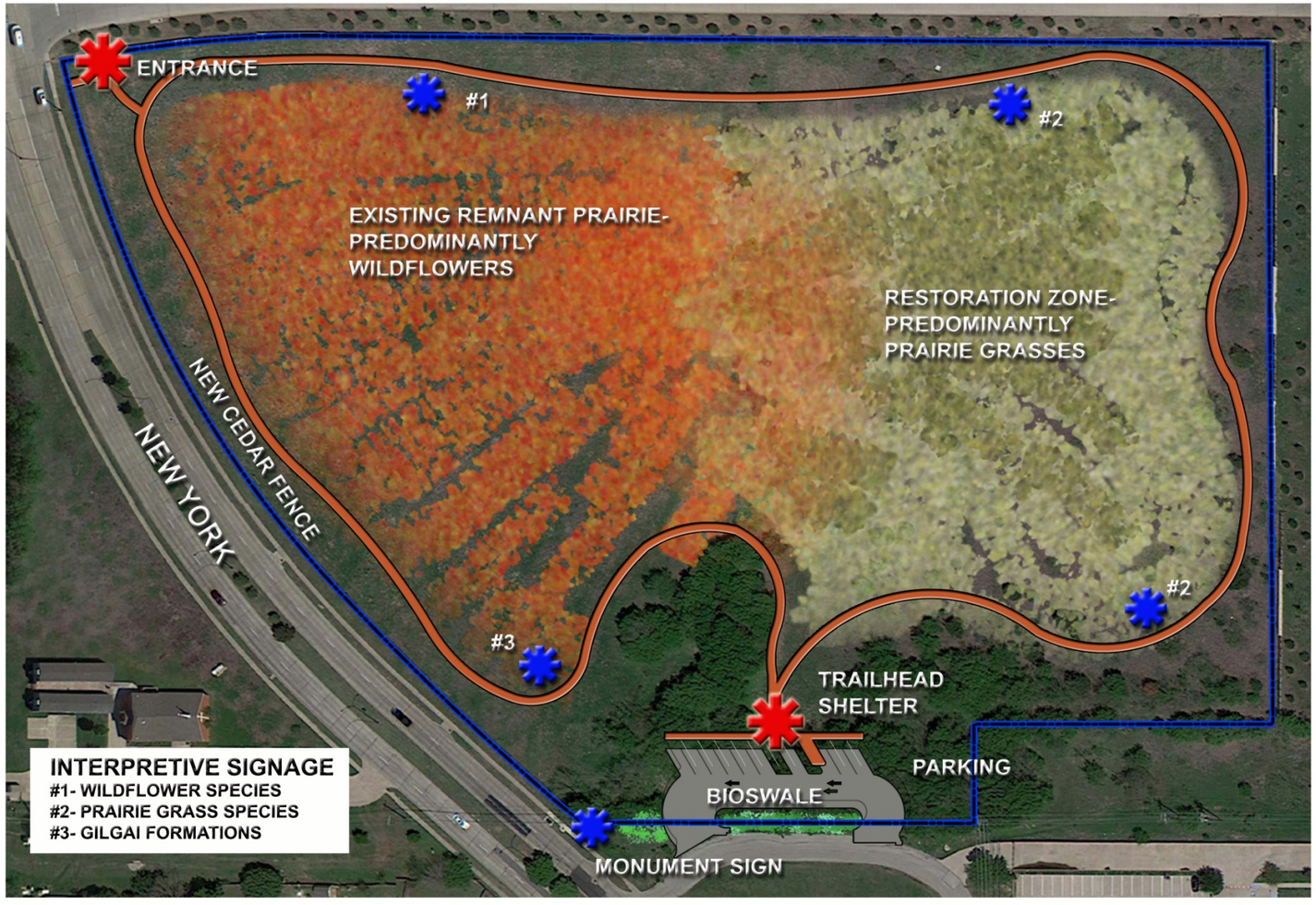
- American kestrel
- Red-tailed hawk
- Northern harrier
- Painted bunting
- Savannah sparrow
- Northern cardinal
- Scissor-tailed flycatcher
- Eastern meadowlark
- Loggerhead shrike
- Western kingbird[1]

The benefits of improved water and air quality provided from undeveloped open space have also been well documented. Only heavily forested areas are landscapes that promote more rainwater infiltration than native grasslands. Water absorption reduces erosion and flooding potential, and

- [1] Jan Miller, Arlington Conservation Council, 2012Miller, Arlington Conservation Council, 2013

helps recharge groundwater. The comparison to forests is also apt when considering air quality improvements and “urban heat island” reduction. Large tracts of native grassland add oxygen to the air and reduce reflective heat in highly developed areas.

This plan will provide the Arlington Parks Department an outline to develop and manage the site in the future. Although current management practices have kept part of the site in an acceptable condition, these efforts must be expanded as soon as possible. Furthermore, the longer the eastern parcel remains untouched, the more difficult it will be to restore. Lastly, when funds are available a limited amount of development should be implemented.



PARKING LOT LIGHTS TO BE DARK SKY FRIENDLY.

PARKING LOT GATES TO BE PROVIDED IF DETERMINED NECESSARY.

WILDLIFE CULVERTS TO BE PLACED AT GRADE ALONG NORTH AND EAST WALLS.

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CONCEPTUAL MASTER PLAN

DFL Group, LLC
PARKS + OPEN SPACE PLANNING - LANDSCAPE ARCHITECTURE
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BLACKLAND PRAIRIE
NATURE PRESERVE
ARLINGTON, TEXAS

SITE HISTORY

People began settling the area between 9,000 and 5,000 years ago. [2]. The earliest documented inhabitants were the Native American Caddo Indians. The Texas State Historical Association reports that by the year 900, the Caddos enjoyed a "complex and socially ranked society." Their major source of food was maize, beans, and squash, as well as native plants like Maygrass, Amaranth, Chenopods, and Sunflowers. Although they were primarily an agriculturally based society, the Caddos also hunted deer, bear, and bison for meat and hides. When Texas was admitted as a state in 1845, most Caddos were relocated to reservations farther west. Within twenty years, records indicate that all of the remaining Caddo tribes of Texas were living on reservations in Oklahoma.

The notion that prairie sites were untouched by man prior to the arrival of Europeans is incorrect. In fact, tribes like the Caddos periodically burned native vegetation for a variety of reasons. Among the most common were game relocation and crop management. As a result then, prairies were largely a disturbance maintained ecosystem, with trees remaining predominantly along creeks and rivers. It is probably safe to say then, that by the 1840's when Arlington was settled by Caucasions, the site was different in appearance than before the Caddos arrived. In all probability, settlers were greeted by a tall grass prairie that naturally established after Caddo farming ceased. The rich prairie soils were attractive to farmers, and southeast Arlington became a prosperous cotton-based community. Fortunately, it appears that only the eastern half of the project site was ever cultivated. Cotton farming fell off by the 1930's but aerial photos indicate that the land was still farmed into the 1970's, when the major agricultural product shifted to hay and cattle.

Southeast Arlington experienced rapid residential construction throughout the 1990's. Farmland surrounding the site was nearly entirely developed by the end of that decade. Except for the realignment of New York Avenue, the prairie site remained undeveloped. In 1998, the City of Arlington, encouraged by the Arlington Conservation Council, acquired the park site. It is believed to be the last blackland prairie remnant site left in the city. Except for perimeter fencing, it remains undeveloped.

[2] Francaviglia, Richard, *The Cast Iron Forest*, The University of Texas Press, 2000

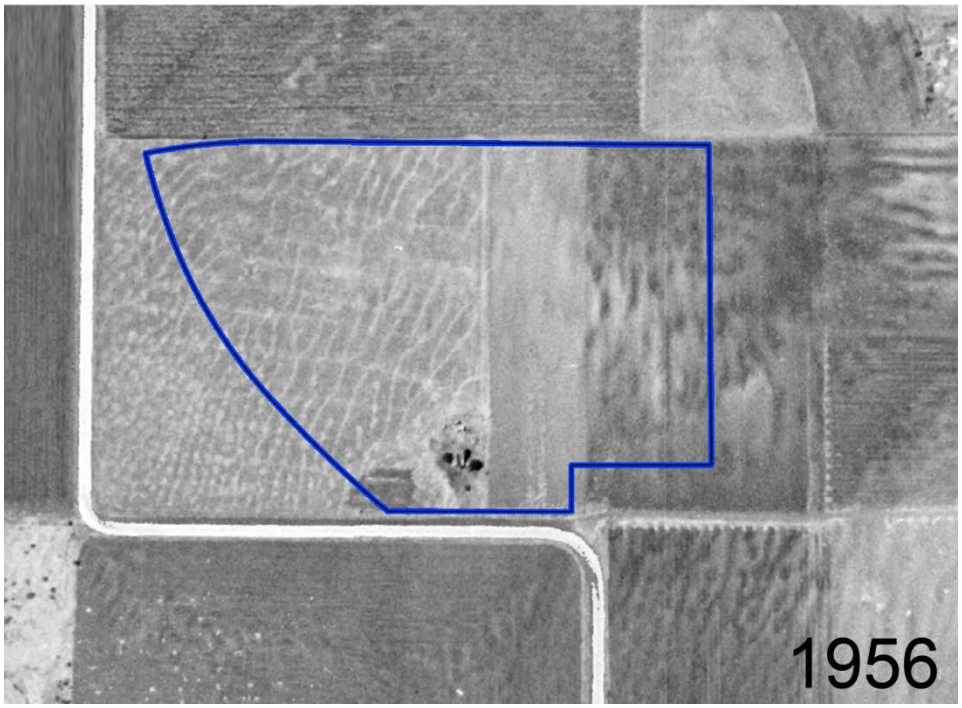

Figure 1: Aerial photo clearly identifies preserved linear gilgai. Note original alignment of New York Avenue and farm structures.

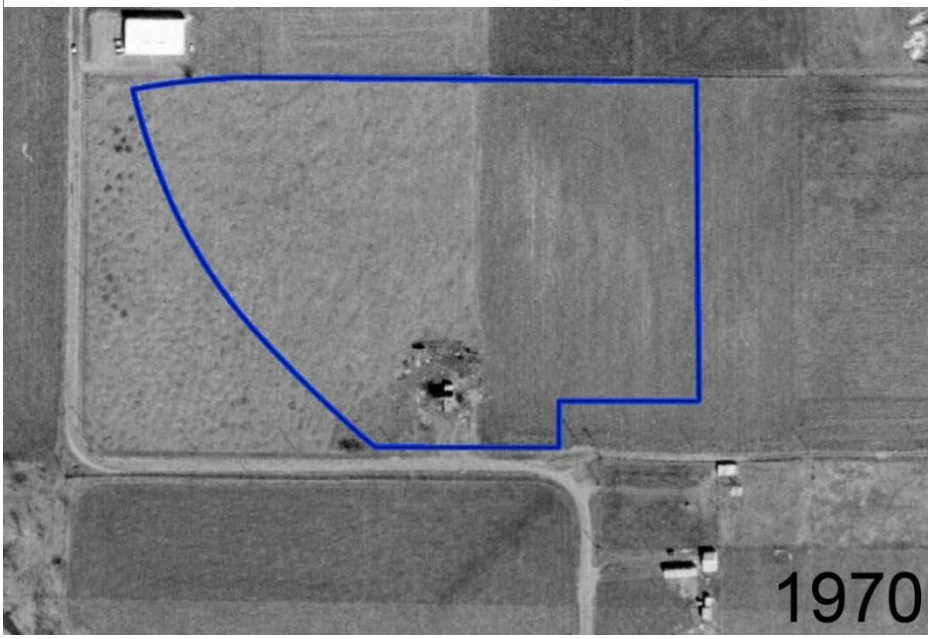

Figure 2: No significant changes occurred during the 1960's. Off-site buildings begin to appear and heavy cultivation is evident on eastern portion of site.

Figure 3: Farming activity appears to have declined or eliminated entirely. Woody plants begin to encroach.

Figure 4: New York Avenue is realigned, isolating a number of circular gigai. Although this part of the site is lost to development, Arlington acquires the area outlined.

SOILS ANALYSIS

The United States Department of Agriculture has identified two predominant soils on the Blackland Prairie site: Heiden and Navo. Both types are predominantly deep clay soils with a slope of less than 3%. The western half of the site is classified as Heiden Clay and the eastern half is Navo Clay Loam. Both are suited for agricultural use including pastureland and cropland.

Heiden Clay

Heiden clay, a gently sloping clayey soil located in upland areas is found on the western half of the site. It has a depth of about 60 inches with underlying yellowish/grayish shaly clay. Permeability is very slow and water retention is high. It is highly expansive and is moderately alkaline. These characteristics make the soil difficult to plow during weather extremes.

Navo Clay Loam

Navo clay loam has a depth of about 12 inches with a subsoil of brownish clay to 72 inches. This soil type has a lower percentage of clay than Heiden and is therefore less alkaline, more permeable and less expansive. Although still difficult to plow, it is an easier soil to work as cropland. This might explain why the eastern half of the site was clearly disturbed by cultivation and no longer contains the more natural topography and indigenous plant material found to the west.

The boundary between Navo and Heiden Clay is nearly identical to the edge of the current maintained prairie, suggesting that early farmers may have found Heiden most suitable for pastureland and more difficult to cultivate.

Tarrant County, Texas

33—Heiden clay, 1 to 3 percent slopes

Map Unit Setting

Landscape: Plains
Elevation: 400 to 1,000 feet
Mean annual precipitation: 28 to 42 inches
Mean annual air temperature: 64 to 70 degrees F
Frost-free period: 225 to 275 days

Map Unit Composition

Heiden and similar soils: 100 percent

Description of Heiden

Setting

Landform: Ridges, plains
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve
Microfeatures of landform position: Linear gilgai, linear gilgai
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Parent material: Clayey residuum weathered from clayey shale of eagleford shale or taylor marl

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 55 percent
Gypsum, maximum content: 5 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 12.0
Available water capacity: Moderate (about 9.0 inches)

Interpretive groups

Farmland classification: All areas are prime farmland
Land capability (nonirrigated): 2e
Hydrologic Soil Group: D
Ecological site: Blackland 28-40" PZ (R086AY196TX)

Typical profile

0 to 12 inches: Clay
12 to 64 inches: Clay
64 to 72 inches: Clay

Figure 5: Natural Resource Conservation Service soil descriptions

Map Unit Description: Navo clay loam, 1 to 3 percent slopes–Tarrant County, Texas

Tarrant County, Texas

50—Navo clay loam, 1 to 3 percent slopes

Map Unit Setting
Landscape: Plains
Elevation: 490 to 520 feet
Mean annual precipitation: 30 to 34 inches
Mean annual air temperature: 64 to 66 degrees F
Frost-free period: 225 to 235 days

Map Unit Composition
Navo and similar soils: 100 percent

Description of Navo

Setting
Landform: Ridges
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Loamy residuum weathered from sandstone and shale of the woodbine formation

Properties and qualities
Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Available water capacity: High (about 9.2 inches)

Interpretive groups
Farmland classification: Not prime farmland
Land capability (nonirrigated): 3e
Hydrologic Soil Group: D
Ecological site: Claypan Prairie 28-40" PZ (R086AY200TX)

Typical profile
0 to 6 inches: Clay loam
6 to 72 inches: Clay

Data Source Information

Soil Survey Area: Tarrant County, Texas
Survey Area Data: Version 8, Sep 21, 2012

Figure 6: Natural Resource Conservation Service soil descriptions

SOILS MAP

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BLACKLAND PRAIRIE PARK
ARLINGTON, TEXAS

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TOPOGRAPHY

The site is fairly level with an approximate 20 foot fall over 600 feet from the northeast to southwest, about a 3% slope. Runoff from the site enters the storm drainage system along New York Avenue, eventually discharging into a concrete channel farther west. The map on page 14 illustrates the site's topography at 2-foot contour intervals. Although it represents the park's general topography, this level of mapping does not adequately record some critical landforms.

A slight ridge line runs north/south almost approximately midway through the site. It seems to correspond with the break between the undisturbed portion and the previously plowed half of the site. This disturbance may in fact have been the result of farming activity.

Significant micro-topographic features are clearly evident in the park's southwest quadrant. These linear gilgai are not apparent on the topographic survey, but they are clearly visible on the ground and on aerial photos dating back to 1956. Although both circular and linear gilgai are natural prairie formations, they are sometimes referred to as "hogwallows." They were not formed by animal activity, but were created by the repeated swelling and shrinking of clay type soils (Diggs, *1999).* When undisturbed, the soil cracks caused by the drying of these expansive soils silted in, and subsequent swelling forced soil upward around the edges. This depression then began to hold water for extended periods, further accentuating the shrink/swell process. These ephemeral pools remain at a higher moisture level than surrounding ridges, resulting in a different variety of native plant material than normally found on higher ground. For instance, it is common to see Eastern Gamagrass and Spikerush in the depressions of the gilgai while the dryer upper areas prefer species like Sideoats Grama and Little Bluestem.[3]

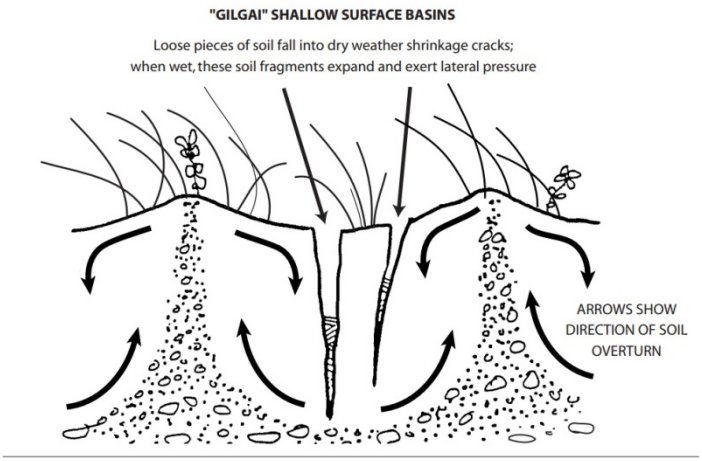

Figure 7: Mechanism of Gilgai (from Diggs, `1999)

[3] Clymer Meadow Preserve & Parkhill Prairie", Clay Carrington, 05/19/13

Farmers considered gilgai to be a hindrance to crop cultivation and they were often filled to improve drainage. Their existence on the site indicates that the western half of the property was only used for domestic grazing purposes.

Figure 8: Gilgai at Clymer Meadow in early spring

Figure 9: Circular gilgai after winter rain

TOPOGRAPHY

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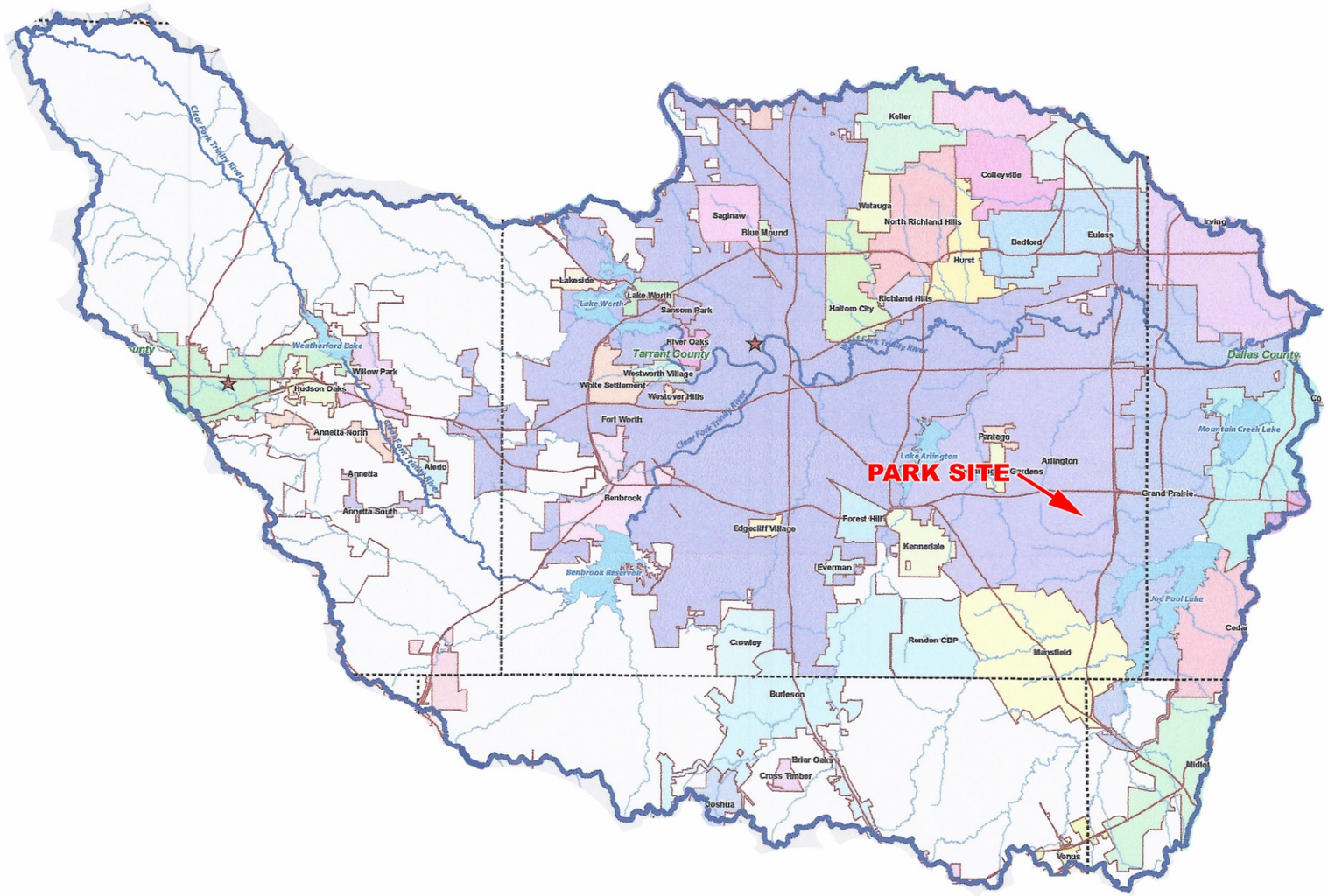
HYDROLOGY

The Blackland Prairie site is located in the Lower West Fork Trinity sub-basin. This watershed encompasses nearly all of Tarrant County, as well as portions of Dallas, Johnson, and Parker Counties. The park is situated north of Fish Creek in the Fish Creek Sub-Watershed in south Arlington. It drains to the southwest into a channelized tributary of Fish Creek. This sub-watershed is generally located along the I-20 corridor, north of Joe Pool Lake. Fish Creek flows east into the Mountain Creek Lake/Mountain Creek Lake Watershed and ultimately into the sub-basin of the West Fork of the Trinity.



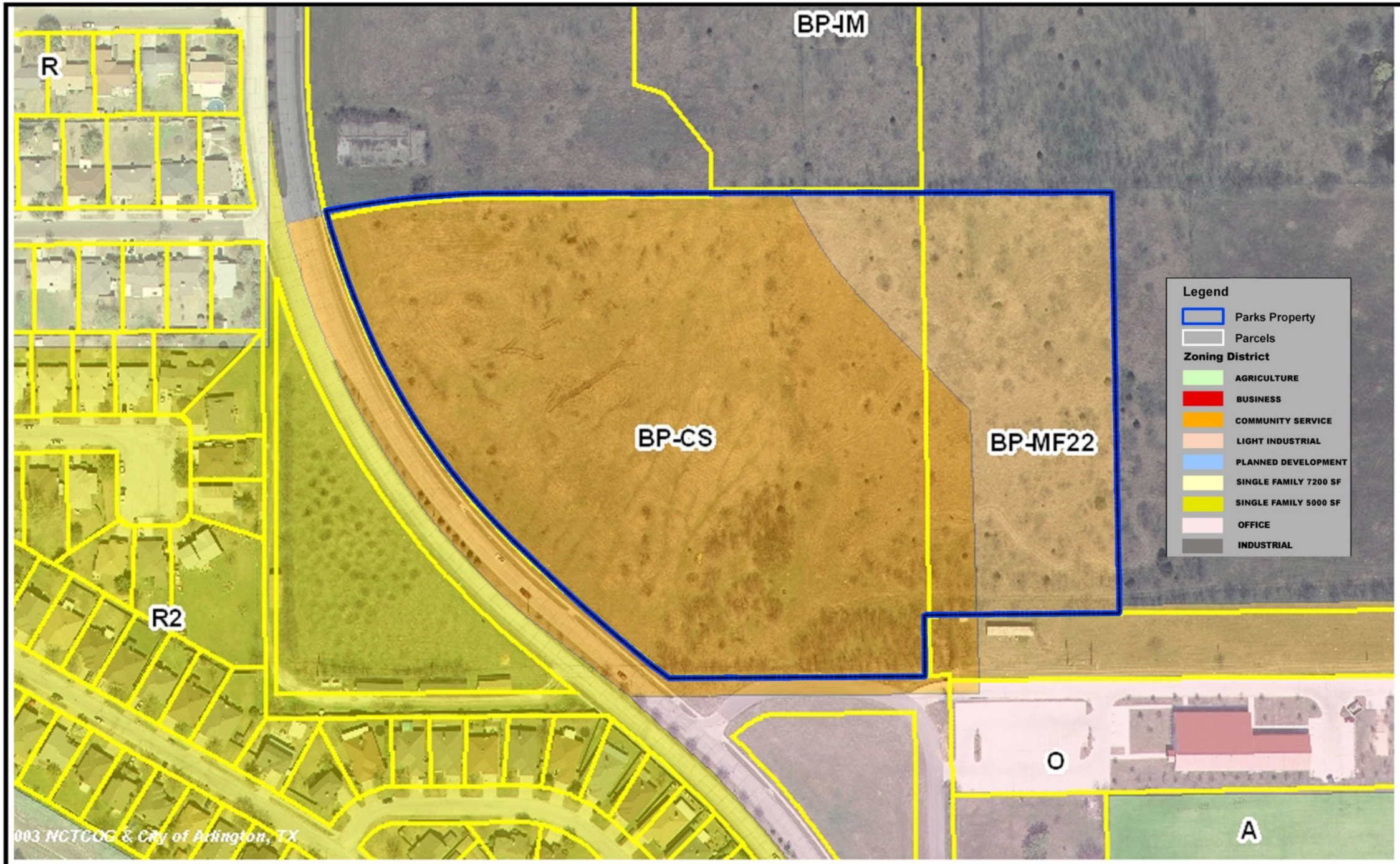
LOWER WEST FORK TRINITY WATERSHED

REGIONAL LAND USE

With the exception of the floodplain of Fish Creek and its tributaries, The Blackland Prairie site is one of the larger open space parcels remaining in southeast Arlington. Although undeveloped land does remain along the I-20 and SH 360 corridors, those properties will eventually be used for commercial development.

Located east of New York Avenue, a major north/south arterial, property surrounding the prairie site is nearly fully developed. West of New York is a dense single family subdivision. Immediately north of the park is a fully developed business complex. Its nearly 100% impermeable surface has been completely cleared of plant material. Property to the east is undeveloped, but platted. At some point, it will become an extension of the adjacent business development. Saint Andrew's Church lies directly to the south of the park.

Bowie High School is located approximately ½ mile to the southeast of the park. Its proximity to the school provides Arlington with a unique opportunity to use the site as an outdoor classroom. It is critical that Arlington's residents become aware of the historic, cultural, and environmental value of native prairies, particularly as we observe similar opportunities for acquisition lost to development.



200 100 0 200 400 Feet

Blackland Prairie Site

4907 New York Ave. - 9.87 Acres

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BLACKLAND PRAIRIE PARK
ARLINGTON, TEXAS

RESTORATION

Introduction

The Blackland Prairie Park site contains two parcels at very different stages of evolution. The west side is already on a good historic trajectory. The soil, hydrology, plants, and landforms are much closer to historic, pre-settlement conditions than the east side. However, the management of the western portion (see figure 26) has been and will continue to effect the balance of vegetation. Therefore, it is important to experiment with historic disturbance regimes and carefully monitor the results.

A goal should be set as a benchmark against which to measure the success of the ongoing management of the west side of the park. The plant palette of The Clymer Meadow (a 1400 acre preserve located near Celeste, Texas) is the nearest analogous site with a long track record of successful prairie management. The extensive and well documented biota of the Clymer Meadow can be a benchmark against which the success of management practices can be measured. Comparing the documented plants from both sites will indicate opportunities for the introduction of species into Blackland Prairie Park.

The eastern portion of the site (figure 14) is in much greater need of efforts that will set the site back onto a more historically appropriate trajectory. The parcel may never achieve the goals for the west side since modern environmental conditions and constraints will inevitably change the evolution of the site. However, a testing of disturbance regimes for the east side can be benchmarked against The Parkhill Preserve in Collin County, a site that has been undergoing prairie restoration since the 1980s. Parkhill was seeded 25 years ago with the complete range of species from the nearby Clymer meadow and currently contains over 200 documented species of prairie plants. Parkhill, like the eastern portion of Blackland Prairie Park, had been both farmed and grazed and does not yet contain the flora defining features of Gilgae. Therefore, it is a good corollary for efforts at restoration on the Eastern part of Blackland Prairie Park. Appendix 3 lists the flora identified on the site between 2006 and 2010 by Jim Varnum.

Historic changes in the Texas Environment

Prairies are the product of continuous and ever changing series of disturbances. Texas is a non-temperate climate zone where the “normative condition” is that there is no “normative condition”. The diverse biota of the historic prairies adapted over millennia to cyclic and uneven disturbances by drought, flood, fire, wind, insects, and grazing by large herbivores. In recent years, an additional element has been added with the advent of rising temperatures. Figure 10 shows the gradual rise in temperature of North Texas since record keeping began in 1895. Note that both diurnal high temperatures and evening temperatures have been increasing to the point that the

climate in the DFW area is now approximately where Waco was 75 years ago and where Austin was at the beginning of the 20th century. The high temperature is slightly warmer while the low temperature has increased almost 3-1/2 degrees.

As the area continues to develop, both the "urban heat island effect" and a more generalized warming trend will continue to be an influence on the development of the Blackland Prairie Park. Therefore, obtaining plants from prairies south of the DFW area with similar soils, is a good strategy to build in resilience to rising temperatures. The plants (phenotype) will possess a genetic predisposition toward a greater tolerance for both heat and drought, even though they may be the same variety and species.

Rainfall patterns have not changed from historical norms as can been seen in figures 11 & 12. However, as the area warms, evapotranspiration increases and the effect is a general drying trend.

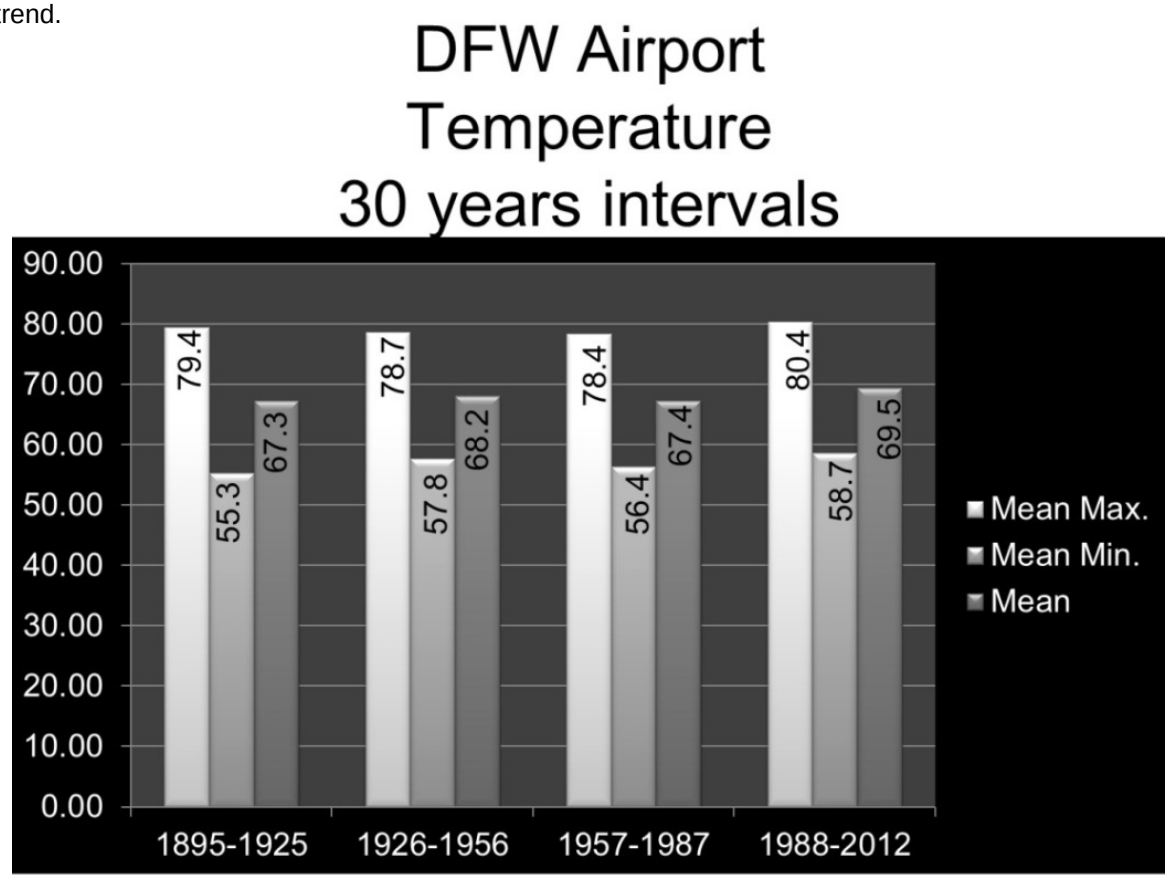

Figure 10

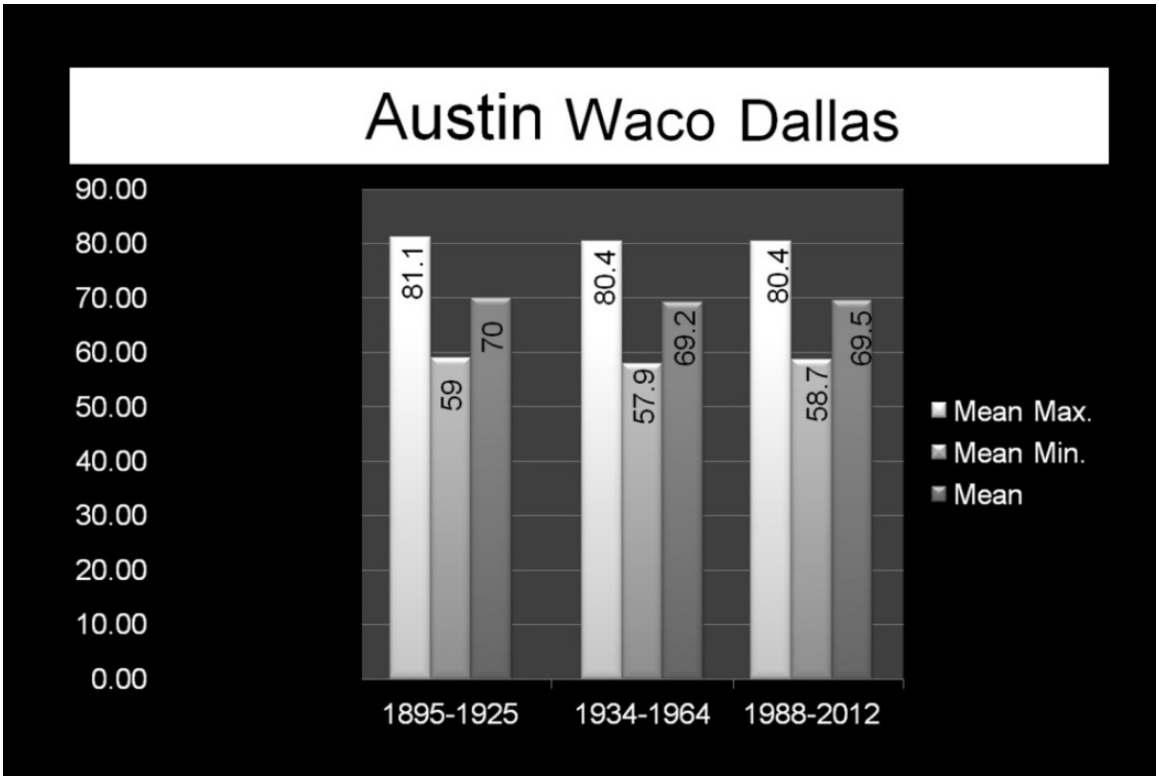

Figure 11 - temperature comparison over time for Austin, Waco, & Dallas

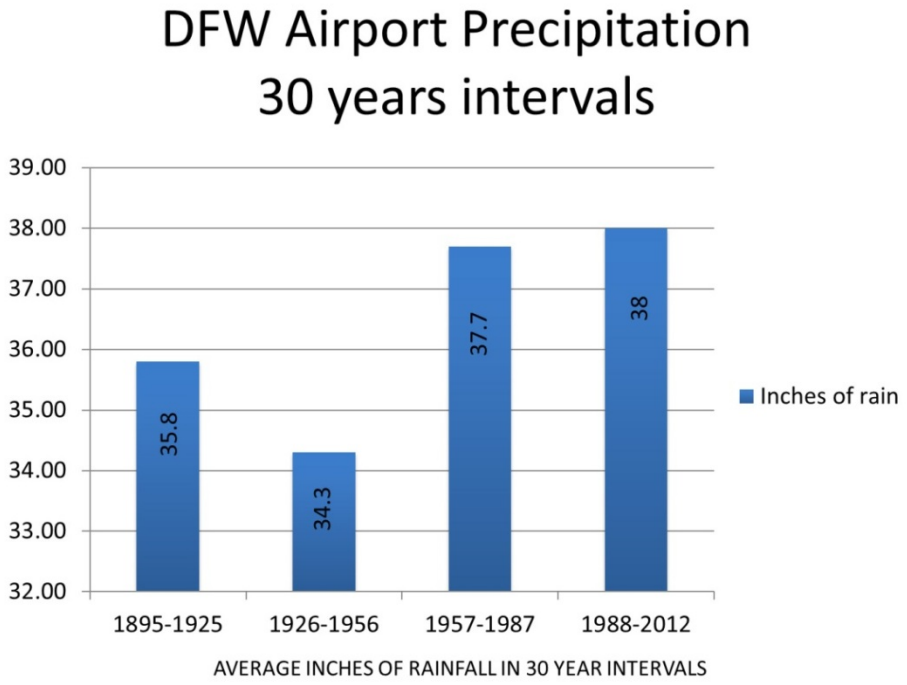

Figure 12-rainfall comparison of DFW in 30 year intervals

Removal of Invasive Species

All areas of Blackland Prairie Park have invasive species that are either not native to blackland prairies or are not appropriate for a healthy prairie ecosystem. Removing unwanted species and maintaining their absence will require regular interventions and careful documentation of the successes and failures of methods used.

The Eastern portion of the site is the most problematic and may be in need of a complete reconstruction as opposed to a restoration that manages existing flora to recreate a healthy prairie ecosystem. The first step should be to immediately remove the stands of junipers and hardwoods that have invaded in the absence of disturbance. Removing trees will also discourage nesting of birds that bring in exotic plants and trees that are undesirable for this type of ecosystem. Some of the trees will aggressively sucker when they are cut down, such as Mesquite (*Prosopis glandularis)* and the hackberries (*Celtis laevigata).* These trees can be treated with a hormone, such as *Garlon,* in order to abate their reoccurrence. Other trees will not sucker and can be removed by simply cutting them down very close to the ground. The most prominent example of this group is the Eastern Red Cedar (*Juniperus virginiana).*

Another way to help keep out undesirable plants is to create a buffer zone around the park of reasonably tall native grassland plants. By removing trees along New York Avenue, and where possible on the other three sides of the park, a biological buffer will be created that will help trap wind born and water born seeds before they enter Blackland Prairie Park. It will also keep birds from roosting on the immediate edges of the park. The fences are not as problematic for birds as they are fairly open and are typically patrolled regularly by hawks. The areas immediately adjacent to the wooded area in the SW portion of the site should be maintained on a regular basis to keep the trees from spreading into the park. Selective removal of trees from this area can leave a few shady areas for the pavilion and parking and also help keep the trees from spreading into the prairie.

The most difficult problem with invasive plants will be removal of unwanted exotic grasses and forbs. The eastern parcel of Blackland Prairie Park has a high percentage of very well adapted exotic undesirable species such as KR Bluestem (*Bothriochloa ischaemum).* According to the Ladybird Johnson Wildflower Center, the most effective way to remove this very tough and adapted plant is to till (or burn) the land during the early summer when the plant is growing actively but has not yet flowered[4].

[4] Simmons M.T., Windhager S., Power P., Lott J., Lyons R.K. & Schwope C. (2007) Selective and non-selective control of invasive plants: the short-term effects of growing-season prescribed fire, herbicide, and mowing in two Texas prairies. *Restoration Ecology*, 15, 662-669

Figure 13: View to north illustrating transition from prairie to unmaintained grassland. Note encroachment of cedar and other hardwoods

Figure 14-Looking east at emerging trees

This will both kill mature plants and cause the seed-bank of KR in the soil to sprout, at which point the area can be lightly tilled again to a depth of about 2 inches. The process can be repeated several times, with or without using a glyphosate, in order to eliminate most of the vegetation from the site. Simmonds et al. recommend multiple applications of a strong Glyphosate dilution for the removal of KR Bluestem. This technique should be tested at Blackland Prairie Park. Other studies on removal of KR Bluestem show that spot treatments with chemicals are not always effective and that a complete reconstruction of the prairie may be the most effective solution to remove this and other exotic invasive species. A complete guide to step by step prairie restoration is beyond the scope of this report. However, resources may be found in the bibliography that can be used as a detailed guide to the process[5].

The Eastern portion of Blackland Prairie Park can be heavily reseeded with a complete mix of prairie seed harvested from the Clymer Meadow. Ideally, the seeds will have been harvested once in June to obtain spring flowering plants, and again in September to gather fall flowering species. The goal should be a mosaic planting that is more in keeping the historical plant distribution of Texas prairies. Some existing prairie remnants are grass dominated, some forbs dominated, and some contain mixed patches of both grasses and forbs in a variety of combinations. Since the western portion of the site, the area most visible to casual observers on New York Avenue, already contains a rich diversity of forbs, it makes sense to develop a mosaic by reconstructing a healthy grass dominated zone in at least a portion of the more degraded eastern side[6].

Figure 15: KR Bluestem

The western portion of Blackland Prairie Park also has invasive exotic species. However, they are not as dominant and are more easily controlled by spot removal/treatment and by management techniques such as mowing and grazing. A brief discussion of the viability of various management techniques on the control of exotic invasive plants follows, as the advantages and disadvantages of these alternatives are discussed below.

[5] *The Tallgrass Restoration Handbook* by Cornelia Mutel and Stephen Packard, Island Press, 2005.

[6] See http://images.library.wisc.edu/EcoNatRes/EFacs/NAPC/NAPC12/reference/econatres.napc12.pschramm2.pdf p. 171

Possible Management Techniques for the Maintenance and Restoration of Blackland Prairie Park

The literature on management techniques for prairies is rife with mixed results, opinions, and anecdotal evidence. Even prairie managers with decades of experience have fundamental disagreements on best practices. Therefore, the site might be considered as a study area for at least the first decade of active management as a park and natural area. By carefully measuring the changes in biota caused by a variety of disturbance regimes, a long term methodology that is best for the goals of the city and the site conditions can be developed.

Surface prairie biomass must be removed in order to maintain a healthy prairie ecosystem. In the absence of removal, the surface plants will start to oxidize, rather than breaking down as they would in the soil, and the prairie will slowly smother and thin out. In the North Texas area, historic pre-settlement prairies were either burned or eaten by large herbivores every two to three years. This removal of vegetation occurred in a random mosaic pattern that allowed a portion of the flora and fauna to remain intact during each disturbance. The goal of the management for Blackland Prairie Park should be to replicate this pattern of disturbance in the most effective way possible. There are a number of techniques that can studied to remove the vegetation on a cyclic basis:

1. Burning
2. Haying
3. Mowing
4. Short term/high intensity grazing

Burning

Regular burning is generally considered the best option for maintaining a prairie as it most closely imitates natural development. However, one objection to burning is that small prairie remnants have few places for insects and small mammals to escape from a fire and, therefore, their populations may be threatened. An option that bears monitoring is currently being developed by the city of Flower Mound for The Flower Mound Prairie. It is a steel box approximately 20 feet long with a chimney that will be taken to the prairie in Flower Mound and used to burn small sections, while entirely containing the fire inside the box. There are many questions about this approach related to both its safety and efficacy at removing both trees and the buildup of vegetation. If the method proves successful, The City of Arlington may be able to borrow or rent the box and experiment on a portion of the Blackland Prairie Park site as an alternative to open burning.

Haying

Haying has been used for many years in North Texas as an agricultural practice. A side benefit of this practice has been to preserve large tracts of land as prairie while also keeping them economically productive. The over 1,000 acre Meador Prairie near St. Jo, Texas is a good example[7]. The owners of the prairie, Bill Tom Meador and his sister Lucie Ann Martin are amenable to visits and discussing their operation and can be a valuable resource for all the details of this type of management if it is selected for testing or as the preferred management technique.

Haying is generally done in mid-summer—just as the mid-season grasses are sending up their flower stalks—in order to maximize the quality of the product for livestock. The cut grass is allowed to dry, wind-rowed, baled and removed. Mid-summer haying will favor spring and early summer-blooming flowers since the late summer and early fall species are cut before they produce viable seeds. Haying in mid to late summer will provide higher yields but the quality of the hay will be less and the plants will be weakened and will not have time to recover before winter. However, like all management techniques, there may be some disruption of ground-nesting birds and pollinators. Haying on a two or three year cycle helps prevent this from changing the species mix as much. The results would have to be studied to see final results[8].

For the purposes of Haying, cutting heights of 4 to 7 inches is recommended in order to leave enough stubble for recovery and to avoid bare ground. The removal of the biomass does not affect the soil excessively as most of it is underground in the rhizophere. The Kansas biological survey recommends resting up to 30% of a field every year in order to provide refuge for wildlife. Resting also provides a seed bank for species whose seed production is interrupted by the haying. See figure 16 for a suggested rotation cycle of Haying and burning. The burn cycle can be replaced with either mowing or mob grazing, both of which are explained below.

Mowing

The most ecologically healthy portions of Blackland Prairie Park, primarily on the west side, are currently maintained by mowing. Mowing is commonly used for several purposes:

1. To control annual and biennial weeds in the first two years after seeding
2. Controlling cool season grasses and weeds as an alternative to burning
3. preventing invasion by trees and shrubs, and

[7] http://www.countryworldnews.com/news-archives/ETX/2004/et0701grasslands.php
[8] See http://www.theprairieenthusiasts.org/chapter/smoke/PrairieHayMeadows-web.pdf , http://www.prairienursery.com/store/images/ManagementOfPrairieMeadows(1).pdf , http://www.iowaprairienetwork.org/mgmt/mgmtguide.shtml

4. reducing biomass that would otherwise smother emergent seedlings and plants

Mowing can best be accomplished at Blackland Prairie Park with a heavy duty riding lawn mower. It is important that the mower be designed for mulching and that it contain an anti-scalp roller (typically used in golf courses) to prevent cutting into the Gilgai edges. The shredded biomass left over after the mowings will still be an impediment to small seedlings and to the warming of the soil in spring, but not to the extent that a single courser mowing would be. Mowing will also lead to a gradual buildup of the soil O-horizon or detritusphere—the relatively undecomposed litter just above the soil level. Burning will remove the biomass as will the alternative of mob grazing discussed below.

As more knowledge is gained by prairie maintenance crews, a good alternative is to use a heavy duty line trimmer on specific problem areas. For example, the south portion of the site near the entrance is currently heavily infested with Hedge Parsley also called Begger's Ticks (*Torilis arvensis*). This cool season invasive exotic annual species can be controlled with a line trimmer just as it is beginning to flower in late May or early June. By trimming at various heights, the plant can be set back without cutting down other more desirable under laying plants. The line trimmer will lay the plant flat and spread the biomass without clumping.

The timing of mowing is critical and is determined by the goals set for the procedure and for the site. For example both fire and mowing in early spring should be avoided since it has been shown to promote the growth of KR Bluestem—one of the worst invaders in the eastern portion of Blackland Prairie Park[9]. Simmons et al demonstrate that mowing in mid growing season also has a very minimal effect on KR Bluestem, especially during wet years or in wet areas (such as the lower portions of the gilgai at Blackland Prairie Park). Therefore, mowing should be considered more of a tool for general prairie health with the effect on specific species subject to study. The recommendation is made to mimic historic disturbance regimes as closely as possible in order to favor native species that have adapted to these disturbances over millennia. These disturbances include mid-season fire. Therefore testing the idea of mid-season disturbance by mowing in mid-season should be studied at Blackland Prairie Park. Figure 31 in Appendix 2 shows a proposed mowing schedule created by Neil Diboll that is specifically applicable for a full prairie reconstruction such as on the East side of Blackland Prairie Park.

[9] see Simmons, 2007

.

Figure 17-typical haying operation

Short Duration/High Intensity Grazing (Mob Grazing)

Historically, one of the most significant factors effecting the development of prairies in the United States was the immense mass migration of millions of Buffalo. These herds were so large that it sometimes took over 6 weeks for the constantly moving animals to pass a particular location.

"The four main herds in Texas migrated from northern Montana and entered Texas between the 99th and 101st meridians on established trails. The main buffalo trails in Texas were east of the Trans-Pecos and Llano Estacado and west of the Western Cross Timbers. At the height of the buffalo population in Texas these trails could be several miles wide. The buffalo usually did not range farther than the Concho River valley, but during certain seasons they migrated as far east and south as the Gulf Coastal Plains."[10]

Many studies have shown the value of mob grazing in maintaining the ecology and productivity of both prairies and rangeland. The most prominent proponent of using herbivores as a management tool is Alan Savory[11]. He has shown in his research and consulting experience the fallacy of the belief that animals can only harm by overgrazing:

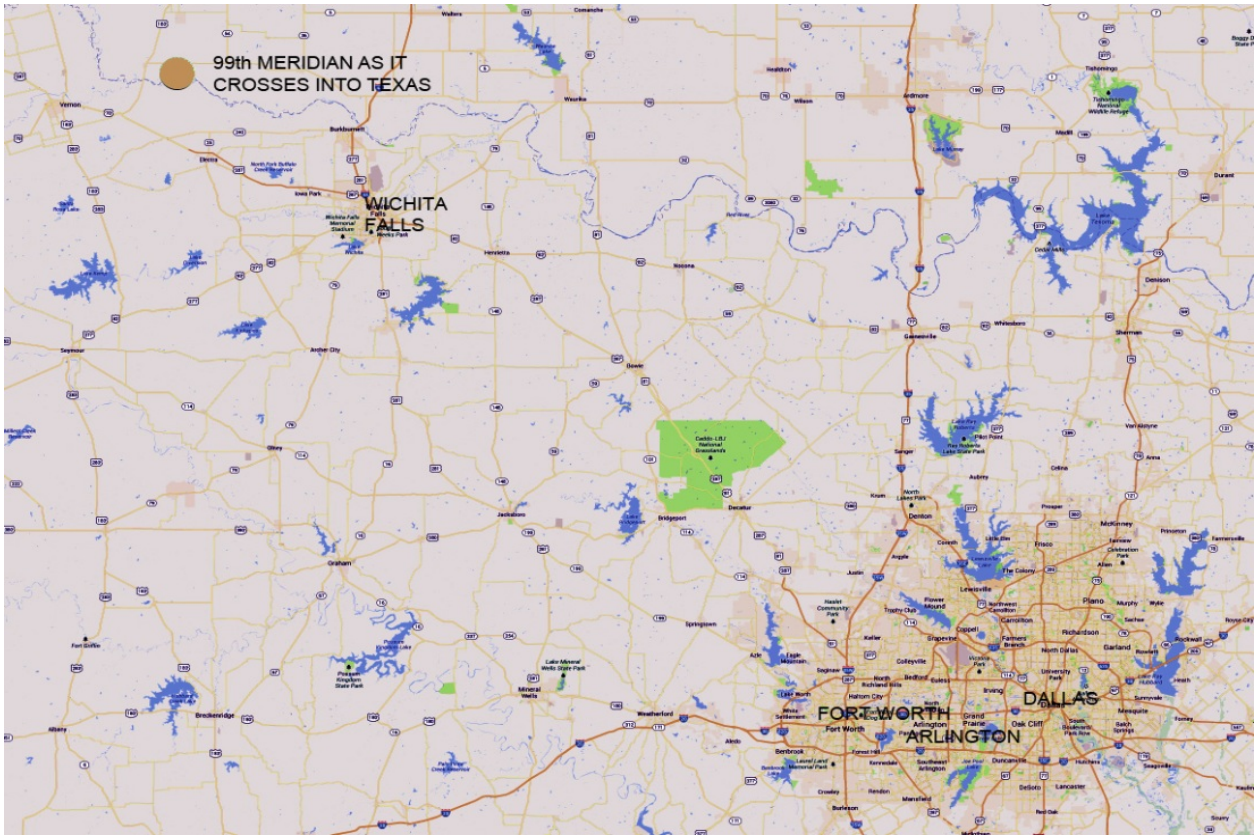

Figure 18: 99th meridian at Red River

[10] http://www.tshaonline.org/handbook/online/articles/tcb02

[11] See : http://www.ted.com/talks/allan_savory_how_to_green_the_world_s_deserts_and_reverse_climate_change.html

"Periodic high animal impact, together with grazing, but not overgrazing, could remove old material, invigorate existing plants without exposing soil [as by burning], create conditions for new plants to establish, and move the biological community away from noxious weeds or woody plants. Low animal impact for prolonged time, or partial rest, as much observation and research data have shown, does not do so but rather causes such situations."[12]

Savory and others have shown that the value of mob grazing is not just in the removal of vegetation as by other means such as fire and mowing. There is also great value to the health of prairies in the other activities associated with grazing such as defecating, urinating, salivating, and even trampling. The challenge, then, is to create a viable system of short term/high intensity grazing that will be practical in a metropolitan context. Buffalo are in some ways ideal but they are difficult to obtain in sufficient numbers, require much larger sites, and can be dangerous without a very expensive fencing system that will move them through the site. They are also selective browsers, as are cattle and horses, and will not remove some of the most unwanted vegetation such as small shrubs and suckering trees. Cattle could be more easily obtained but also have several drawbacks. They also need a very sturdy fence, and their hooves are flat rather than pointed like a buffalo's. Flat hooves compact the soil and do not accomplish the mixing of plant materials and soil that is a valuable part of mob grazing by Buffalo. Sheep are easier to control but are also selective feeders and are known for pulling up the plants they eat causing damage to desirable vegetation.

The best candidate for mob grazing in a metropolitan area is the Goat. Goats are known to eat almost anything although they do have preferences. Blackmore (1999) conducted a more than seven year study on using Goats to control woody vegetation. [13] Her results show a number of key findings relative to Blackland Prairie Preserve:

1. Goats prefer smaller trees and shrubs less than 6 feet tall which they either kill or seriously set back,
2. Goats prefer some plants (such as the invasive Japanese Honeysuckle) early in the season and trees when they are fully leafed out.
3. Goats will eat both woody and herbaceous vegetation.
4. Goat droppings inspected had very few seeds which will help prevent the transfer of Alien species into the park.

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[12] Savory, 1999. P.237

[13] See: Mary Blackmore: *Dairy Goats as Tools for Controlling Woody Vegetation on Prairie Remnants*, Proceedings of the 16th National Prairie Conference: http://digital.library.wisc.edu/1711.dl/EcoNatRes.NAPC16

Another advantage of Goats is the structure of their hooves which mimics the hooves of Buffalo at a much smaller and less threatening scale (see figures 21 and 22). Goat hooves, like Buffalo hooves push knocked down vegetation into the ground, thereby promoting the decomposition of the liter and the enhancement of soil biota.

The use of Goats for ecological restoration is slowly gaining acceptance. A conversation with Phillip Quast, program director for the Native Prairie Association of Texas (NPAT), revealed that NPAT is very amenable to the concept. Others, such as Neil Diboll, have expressed reservations about using Goats because they "tend to eat everything in sight". However, this is precisely what makes them attractive for removal of built up biomass as they will not aggressively select out desirable vegetation and, instead, will start with undesirable trees and shrubs and in short order eat almost everything.

The time needed for eating down to the shortest observed length possible will vary and will require study. Blackmoore's trials were on two sites and showed that with a stocking rate of 13 to 30 goats per acre, the grazing will only take five days per year or so. The rate can easily be tested by obtaining two or three goats, enclosing them in a small area, and seeing how long it takes them to clear the land.

The biggest question about the use of Goats is the practical viability of the concept. First, a heard must be rented for a short period of time at a reasonable cost. Mr. Quast stated that there is currently a herd of Goats being bred and assembled for the specific purpose of prairie restoration in San Marcus, Texas. Many other herds are active in North Texas for both milk and meat production. Assuming that a herd can be obtained on a short term basis for a week or two every two or three years, the next issue is containment. There are currently two relatively inexpensive methods to containing a small herd and moving them through Blackland Prairie Preserve as they consume and/or knock down all the vegetation. First, it is possible to equip the animals with dog shock collars and create an "invisible fence" the same way that many home owners do. Second, a solar powered Premier electric net fencing system can be used. This system is very cost effective, and basically runs on a car battery that is recharged with a solar cell (see figure20). The fence is inexpensive, easy to move, visually unobtrusive, and creates very little disturbance to the prairie[14]. Plants that are known to be eaten by goats include highly preferred species such as Blackberry, Green Briar, Sumac, Winged Elm, Poison Ivy, and Ironweed; moderately preferred species such as Post Oak, Multiflora Rose, Sunflower, Ragweed, Hickory, Hawthorn, Tall Thistle and Eastern Red Cedar, and many others[15]. Hart summarizes the benefits of Goats as Follows:

[14] http://www.leopold.iastate.edu/sites/default/files/GoatGrazingcasestudy.pdf

[15] Hart, S.P. 2001. ***Recent Perspectives in Using Goats for Vegetation Management in the USA***. Journal of Dairy. Science 84 (E. Suppl):E170-E176 http://www.uky.edu/Ag/AnimalSciences/goats/pubs/s.hart%20overview%20veg.%20management.pdf

1. Goats have a tremendous diet diversity, are resistant to many plant toxins and anti-nutritive factors that prevent other herbivores from eating them,
2. Goats are a productive way to manage vegetation since they produce a saleable product,
3. Goats help restore cycling of plant nutrients sequestered by woody species, and
4. Goats preferentially consume seeding stems, thereby reducing the spread of weed species by seed.

Hart concludes his study by stating that "in most cases, Goats are the most cost-effective, non-toxic, nonpolluting solution available[16].

The Fort Worth Star Telegram recently featured an article on goat grazing at the San Francisco Airport[17]. The goats were used to clear a long 20 foot wide firebreak. The principle advantage of the goats cited was their ability to reduce the vegetation without disturbing several endangered species. Similarly, goats can be used at Blackland Prairie Preserve to safely remove biomass in a relatively small area where local native insects, herpetofauna, ground nesting birds, etc. will have less room to escape from more drastic mechanical methods or burning than they would on a larger prairie preserve such as the Clymer Meadow.

Figure 19: Nubian goats eating brush

Figure 20: Electric fencing so flexible you can walk on it

[16] Hart, 2001.

[17] http://www.star-telegram.com/2013/07/05/4983681/goats-invade-airport-to-prevent.html

Figure 21: Buffalo hoof

Figure 22: Goat hoof

RECOMMENDATIONS

The description of the four options for managing the buildup of biomass in Blackland Prairie Preserve above shows the complexity of the issue. It is not possible to definitively recommend any single method, especially since burning is probably not an option. Therefore, the best course of action for the management of Blackland Prairie Preserve may be to experiment with two or three of the most viable options for an extended period of time and carefully note the methods used and their impact as it relates to the goals for the natural area.

The two strongest candidates for trials are short mowing and mob grazing with Goats. Mowing is easier to accomplish as it is already a normative part of land maintenance in a suburban context. However, mob grazing more closely mimics a disturbance that has been part of the development of prairies for millennia, and may be the best alternative to burning for the long term health of the Blackland Prairie Preserve ecosystem. Although not technically a component of this document, Appendix 2 discusses the possibility of creating a study site that measures the results of the various management techniques.

Trail Development

The trail system at Blackland Prairie Preserve is the critical element that will allow the park to be used both by the neighborhood for recreation and enjoyment, and by all the people of the City of Arlington for environmental education. The site is currently very inhospitable to users—especially children and toddlers. Many people do not understand that a prairie is a habitat for chiggers and fire ants, in addition to the beautiful plants. Both can be dangerous and can ruin the prairie experience.

At the same time, the trail should not be visually obtrusive and should have minimal effect on the hydrology and temperature of the park. The proposed master plan shows a connection both to the existing neighborhood and to the parking lot and future pavilion. It encourages residents to take advantage all of the magnificent prairie amenities. Figure 24 shows how the new trail could be located on the top of the Gilgai ridges, thereby permitting year-round use, especially during the spring months when the prairie is usually wettest and wildflowers are at their peak.

The trail should be both highly permeable and have a high solar reflective index (SRI) in order to prevent heat buildup. A number of trail surface materials meet these criteria. One material is decomposed granite, with a polymer binder, which must be specified so that it has the maximum possible amount of permeability. Another newer material is recycled crushed glass mixed with a small amount of decomposed granite and a polymer. Figure 25 shows this material being installed at The Green at College Park on the UT-Arlington campus where it has been in place for over two years. Although the UTA version contains a dye that makes the material reddish brown, the Blackland Prairie trail should be as light colored as possible to keep the pavement from absorbing too much heat from the sun. One of the advantages of the glass pavement is that it is very inert and stable, and is a very difficult media for plants to root in.

A third option is a plank and beam deck made out of a composite, non-biodegradable artificial wood material. The deck would have to be set very low and could be filled with crushed aggregate between the beams in order to allow equipment to drive over it. The big advantages of the deck system are that it will always be dry as it is slightly above grade, the deck can “flex” more with the movement of the soil as it expands and contracts, it can be physically relocated in small sections if the gilgai shift (thereby maintaining accessibility standards), and it will be highly durable if designed and installed properly. The main disadvantage is that the initial cost of materials and installation will be higher.

Figure 24: Proposed trail weaving through wet gilgai

Figure 25: Installation of *Filter Pave* at the Green at College Park on the UTA Campus

Figure 26: Looking West early June, 2013

Figure 27: Looking West July 27, 2013

Figure 28: Looking West October 10, 2013

Figure 29: Looking North at the transition between East and West sides: October 10, 2013

Figure 30: Looking East, October 10, 2013

APPENDIX 1

PLANTS OF BLACKLAND PRAIRIE PRESERVE

List provided by Jim Varnum as of May 24, 2013: jevarnum@aol.com
Flora from BRIT survey 6-5-13 added 7-13: edited by David Hopman 7-13: dhopman@uta.edu

Scientific Name	Common Name	Plant	Family
Acacia angustissima var. hirta	Prairie acacia	Forb	Fabaceae
Acalypha ostryifolia	Hop-hornbeam copperleaf	Forb	Euphorbiaceae
Achillea millefolium	Yarrow	Forb	Asteraceae
Agalinis heterophylla	Prairie agalinis	Forb	Scrophulariaceae
Amaranthus palmeri - 8/6/09	Carelessweed	Forb	Amaranthaceae
Ambrosia psilostachya	Western ragweed	Forb	Asteraceae
Ambrosia trifida var. texana	Giant ragweed	Forb	Asteraceae
Amphiachyris dracunculoides (OLD Gutierrezia dracunculoides)	Broomweed	Forb	Asteraceae
Andropogon gerardii subsp. gerardii.	Big bluestem	Grass	Poaceae
Andropogon glomeratus	Bushy bluedtem	Grass	Poaceae
Anemone berlandieri	Anemone, Windflower	Forb	Ranunculaceae
Arnoglossum plantagineum	Indian plantain	Forb	Asteraceae
Artemisia ludoviciana subsp. mexicana	Mexican sagebrush	Forb	Asteraceae
Asclepias verticillata - new 9/10/12	Whorled milkweed	Forb	Asclepiadaceae
Asclepias viridiflora	Wand milkweed	Forb	Asclepiadaceae
Asclepias viridis	Green milkweed	Forb	Asclepiadaceae
Astragalus crassicarpus var. ?	Ground plum	Forb	Fabaceae
Bifora americana	Prairie bishop's weed	Forb	Apiaceae
Bothriochloa ischaemum var. songarica	King Ranch bluestem	Grass	Poaceae
Bothriochloa laguroides subsp. torreyana	Silver bluestem	Grass	Poaceae
Bouteloua curtipendula var. =	Side oats grama	Grass	Poaceae
Brickellia eupatorioides var. ???	False boneset	Forb	Asteraceae
Brickellia eupatorioides var. texana = Kuhnia	Texas False Boneset	Forb	Asteraceae
Bromus japonicus	Japanese brome	Grass	Poaceae
Carex meadii	Dewey Mead's Sedge	Sedge	Cyperaceae
Carex reniformis	kidneyshape sedge	Sedge	Cyperaceae
Carex tetrastachys (identified at SWNP by RO and RJT)	Four-angled caric sedge	Mono	Cyperaceae
Carya illinoinensis	Pecan	Tree	Juglandaceae
Castilleja purpurea var. purpurea	Purple paintbrush	Forb	Scrophulariaceae

Celtis laevigata var. ?	Hackberry, Sugarberry	Tree	Ulmaceae
Centaurea americana	American basketflower	Forb	Asteraceae
Cercis canadensis	Eastern redbud	Forb	Fabaceae
Chaerophyllum tainturieri	Chervil	Forb	Apiaceae
Chamaesyce nutans	Eyebane	Forb	Euphorbiaceae
Chamaesyce sp.	Tropical euphorbia	Forb	Euphorbiaceae
Cirsium texanum	Texas thistle	Forb	Asteraceae
Convolvulus arvensis	Bindweed	Vine	Convolvulaceae
Convolvulus equitans	Texas bindweed	Vine	Convolvulaceae
Convolvulus equitans = hermannioides/incanus	Texas bindweed	Forb	Convolvulaceae
Conyza canadensis var. =	Horseweed	Forb	Asteraceae
Cooperia drummondii - 8/4/09	Rain lily	Mono	Liliaceae
Crepis pulchra	Smallflower Hawksbeard	Forb	Asteraceae
Croton monanthogynus	Prairie tea	Forb	Euphorbiaceae
Cuscuta sp.	? dodder (orange spaghetti)	Forb	Cuscutaceae
Cynodon dactylon	Bermuda grass	Grass	Poaceae
Cyperus esculentus	Yellow nut-grass	Sedge	Cyperaceae
Dalea purpurea var. purpurea = Petalostemon	Purple or Violet prairie clover	Forb	Fabaceae
Dalea sp.	? Prairie clover	Forb	Fabaceae
Delphinium carolinianum subsp. virescens	Prairie larkspur	Forb	Ranunculaceae
Dracopis amplexicaulis	Clasping-leaf coneflower	Forb	Asteraceae
Dyschoriste linearis	Snakeherb	Forb	Acanthaceae
ELEOCHARIS SP.		Sedge	Cyperaceae
Elymus canadensis var. canadensis	Canada wild rye	Grass	Poaceae
Elymus sp.	? Wildrye	Grass	Poaceae
Engelmannia peristenia	Engelmann's daisy, Cut-leaf daisy	Forb	Asteraceae
Erigeron strigosus var. =	Prairie fleabane	Forb	Asteraceae
Erodium cicutarium	Pin clover, Filaree	Forb	Geraniaceae
Eupatorium serotinum	Lateflowering thoroughwort, White boneset, Late boneset, Late-flowering boneset	Grass	Asteraceae
Euphorbia bicolor	Snow-on-the prairie	Forb	Euphorbiaceae
Euphorbia spathulata	Weak spurge	Forb	Euphorbiaceae
Eustoma exaltatum subsp. russellianum (OLD Eustoma russellianum)	Bluebells	Forb	Gentianaceae
Gaillardia pulchella	Firewheel, Indian blanket	Forb	Asteraceae
Galium aparine	Bedstraw, Cleavers	Forb	Rubiaceae
GAURA LONGIFOLIA???			
Gaura parviflora (NEW Gaura mollis)	Lizard-tail gaura	Forb	Onagraceae
Gaura suffulta	Kisses	Forb	Onagraceae
Glandularia bipinnatifida	Prairie verbena	Forb	Verbenaceae
Gleditsia triacanthos	Honey locust	Tree	Fabaceae
Grindelia papposa	Saw-leaf daisy	Forb	Asteraceae

Hedyotis nigricans	Bluets	Forb	Rubiaceae
Helianthus annuus	Texas sunflower	Forb	Asteraceae
Helianthus maximiliani	Maximilian sunflower	Forb	Asteraceae
Hordeum pusillum = Critesion	Little barley	Grass	Poaceae
Hymenopappus scabiosaeus var. corymbosus	Wooly-white, Old plainsman	Forb	Asteraceae
Hypericum hypericoides ssp. multicaule = Ascyrum	St. Andrew's cross	Forb	Hypericaceae
Ilex vomitoria	Yaupon Holly	Tree	Aquifoliaceae
Ipomoea cordatotriloba var. ?	Morning-glory	Vine	Convolvulaceae
Iva angustifolia	Narrowleaf marshelder, Narrow-leaf Sumpweed	Forb	Asteraceae
Iva annua	Marsh-elder, Sumpweed	Forb	Asteraceae
Juniperus virginiana	Eastern red cedar	Tree	Cupressaceae
Krameria lanceolata	Trailing rhatany	Forb	Krameriaceae
Lactuca canadensis	Wild lettuce	Forb	Asteraceae
Lactuca serriola	Prickly lettuce	Forb	Asteraceae
Lathyrus hirsutus	Singletary pea	Forb	Fabaceae
Lepidium virginicum	Pepper grass	Forb	Brassicaceae
Lesquerella gracilis subsp. =	Cloth-of-gold	Forb	Brassicaceae
Liatris mucronata	Gayfeather	Forb	Asteraceae
Limnodea arkansana	Ozark grass, Ozarkgrass	Grass	Poaceae
Lindheimera texana	Texas yellow star	Forb	Asteraceae
Lithospermum incisum	Fringed puccoon	Forb	Boraginaceae
Lolium perenne subsp. =	Perennial rye grass	Grass	Poaceae
Lolium perenne subsp. italicum (awned)	Italian rye grass	Grass	Poaceae
Lolium temulentum var. temulentum	Darnel ryegrass	Grass	Poaceae
LONICERA JAPONICA 3/9/2011	Japanese Honeysuckle		Caprifoliaceae
Lupinus texensis	Texas bluebonnet	Forb	Fabaceae
Lythrum alataum var. lanceolatum	Lance-leaf loosestrife	Forb	Lythraceae
Matelea biflora	Two-flowered milkvine	Forb	Asclepiadaceae
Medicago minima	Bur clover	Forb	Fabaceae
Medicago sativa	Alfalfa	Forb	Fabaceae
Mimosa roemeriana	Roemer’s sensitive vine	Forb	Fabaceae
Mirabilis linearis	Four o’clock	Forb	Nyctaginaceae
Monarda citriodora	Lemon mint	Forb	Lamiaceae
Nassella leucotricha	Winter grass, Spear grass	Grass	Poaceae
Nemastylis geminiflora	Prairie celestial	Mono	Iridaceae
Nothoscordum bivalve	Crow poison, False garlic	Mono	Liliaceae / Alliaceae
Oenothera speciosa	Showy evening-primrose, Buttercup	Forb	Onagraceae
Opuntia engelmannii var. lindheimeri	Prickly-pear cactus	Forb	Cactaceae
Opuntia humifusa = compressa	Devil's-tongue, Prickly pear	Forb	Cactaceae
Oxalis stricta	Oxalis, Yellow wood-sorrel	Forb	Oxalidaceae
Packera obovata = Senecio	Senecio, Spring Groundsel	Forb	Asteraceae

Packera plattensis	Prairie groundsel	Forb	Asteraceae
Parietaria pensylvanica var. =	Pennsylvania pellitory	Forb	Urticaceae
Pediomelum linearifolium	Slim-leaf scurf-pea	Forb	Fabaceae
Petrorhagia dubia	Childing pink	Forb	Caryophyllaceae
Phalaris sp.	? canary grass	Grass	Poaceae
Physalis cinerascens	Ground-cherry	Forb	Solanaceae
Plantago virginica	Pale-seed plantain	Forb	Plantaginaceae
Poa arachnifera (ID by JM)	Texas blue grass	Grass	Poaceae
POLYGONUM SP. (SOUTH END GILGAI)	? smartweed	Forb	Polygonaceae
Polytaenia nuttallii	Nuttall's prairie parsley, Wild dill, Prairie parsnip	Forb	Apiaceae
Polytaenia nuttallii	Prairie parsley	Forb	Apiaceae
Prosopis glandulosa	Honey mesquite	Tree	Fabaceae
Psoralidium tenuiflorum	Slimflower scurfpea, Scurfy pea	Forb	Fabaceae
Pyrrhopappus pauciflorus	Texas dandelion	Forb	Asteraceae
RORIPPA ??? 3/9/11, 3/28/11			
Rubus trivialis	Southern dewberry	Forb	Rosaceae
Rumex crispus	Curly dock	Forb	Polygonaceae
Salvia azurea var. grandiflora	Texas giant sage	Forb	Lamiaceae
Salvia farinacea	Mealy blue sage	Forb	lamiaceae
Sapindus saponaria	Western soapberry	Tree	Sapindaceae
Schizachyrium scoparium	Little bluestem grass	Grass	Poaceae
Scutellaria parvula var. parvula (CHECK in SPRING 2008)	Small skullcap	Forb	Lamiaceae
Setaria parviflora	Knot-root bristlegrass	Grass	Poaceae
Sherardia arvensis	Field madder	Forb	Rubiaceae
Sideroxylon lanuginosum subsp. oblongifolium	Woolly-bucket bumelia, Chittamwood	Tree	Sapotaceae
Silene antirrhina	Sleepy silene, Sleepy catchfly	Forb	Caryophyllaceae
Silphium radula	Rough-stem rosinweed	Forb	Asteraceae
Sisyrinchium langloisii (OLD Sisyrinchium pruinosum)	Blue-eyed grass	Mono	Iridaceae
Small tree, red stems, ovate leaves with red veins, serrate		Tree	Rosaceae
Smilax bona-nox	Catbrier	Vine	Smilaceae
Solanum dimidiatum	Horse-nettle	Forb	Solanaceae
Solanum elaeagnifolium	Sliver-leaf nightshade, Trompillo	Forb	Solanaceae
Solidago canadensis var. ???	Common goldenrod	Forb	Asteraceae
Solidago gigantea	Giant Goldenrod	Forb	Asteraceae
Solidago missouriensis var. fasciculata = glaberrima	Missouri Goldenrod	Forb	Asteraceae
Sonchus asper	Sow thistle (early)	Forb	Asteraceae
Sorghastrum nutans	Yellow Indian grass	Grass	Poaceae
Sorghum halepense	Johnson grass	Grass	Poaceae

Spermolepis inermis	Red River scaleseed, Spreading Scaleseed	Forb	Apiaceae
Spiranthes cernua	N32° 39.995' W97° 04.648' 3/28 no rosette: Nodding lady's tresses, Ladies' tresses, Nodding ladies' tresses orchid	Mono	Orchidaceae
Symphyotrichum divaricatum (OLD Aster subulatus var. ligulatus)	Fall aster	Forb	Asteraceae
Symphyotrichum ericoides var. = (OLD Aster ericoides)	Heath aster	Forb	Asteraceae
Torilis arvensis	Hedge parsley, Beggar's lice	Forb	Apiaceae
Toxicodendron radicans	Poison ivy	All	Anacardiaceae
Tradescantia ohiensis	Ohio spiderwort	Mono	Commelinaceae
Tragia sp.	? Noseburn	Forb	Euphorbiaceae
Triodanis perfoliata (OLD T.perfoliata var. =)	Venus' looking glass	Forb	Campanulaceae
Ulmus americana ???	American elm	Tree	Ulmaceae
Ulmus crassifolia	Cedar elm	Tree	Ulmaceae
Ulmus rubra ???	Slippery elm	Tree	Ulmaceae
Valerianella radiata	Beaked cornsalad	Forb	Valerianaceae
Verbena halei	Texas vervain	Forb	Verbenaceae
Vernonia baldwinii	Western ironweed	Forb	Asteraceae
Vicia sativa subsp. sativa	Common vetch	Forb	Fabaceae
Zanthoxylum clava-herculis	Hercules'-club, Prickly ash, Toothache tree	Tree	Rutaceae

APPENDIX 2

EXPERIMENTAL DESIGN

For the purposes of studying the impacts of various management techniques, the site should be divided into two main areas. The eastern portion will be a complete prairie reconstruction and will need to follow a regular mowing schedule, in lieu of burning, in order to get off to a good start and to prevent early encroachment by annual weeds. After the first three seasons, the east parcel can either be set up similarly to the western portion, or information from the trials on the west side can be used to inform a long term management plan for the East site.

The western portion of the site can test mowing, grazing, and (possibly) haying on a more established ecosystem. Three replicates of each treatment will give more accurate results. For example, treatments could include:

A. Spring mowing only
B. Spring and mid-season mowing with additional “spot treatments” with a line trimmer and/or herbicides
C. Spring grazing
D. Spring and mid-season grazing with additional “spot treatments” with a line trimmer and/or herbicides

One diagonal transect in each of the 6-18 study areas (depending on how many replicates and management methodologies are chosen) can be used to track the impact of treatments on the vegetation (see figure 30) for three replicates of the six treatments listed above). The transects should be documented at least twice per year in order to cover both spring and fall species. Late spring and Early Fall will yield more predictable results. Point intercept readings can then be taken on living material at 1m intervals in order to monitor results. All treatments should be applied to the Western portion of the site in staggered two to three year intervals so that only ½ to 1/3 of the site is disturbed in any given year. The effects of the various treatments will be relatively subtle to the average observer and will not break the park up into the grid shown above or diminish the quality of the prairie experience. Encroaching trees can be noted and mechanically removed in years with no disturbance. A qualified research entity should be retained to document the progress of Blackland Prairie Preserve and to make recommendations for future maintenance of the park as the research progresses. Qualified local entities include The University of Texas at Arlington and The Botanical Research Institute of Texas in Fort Worth.

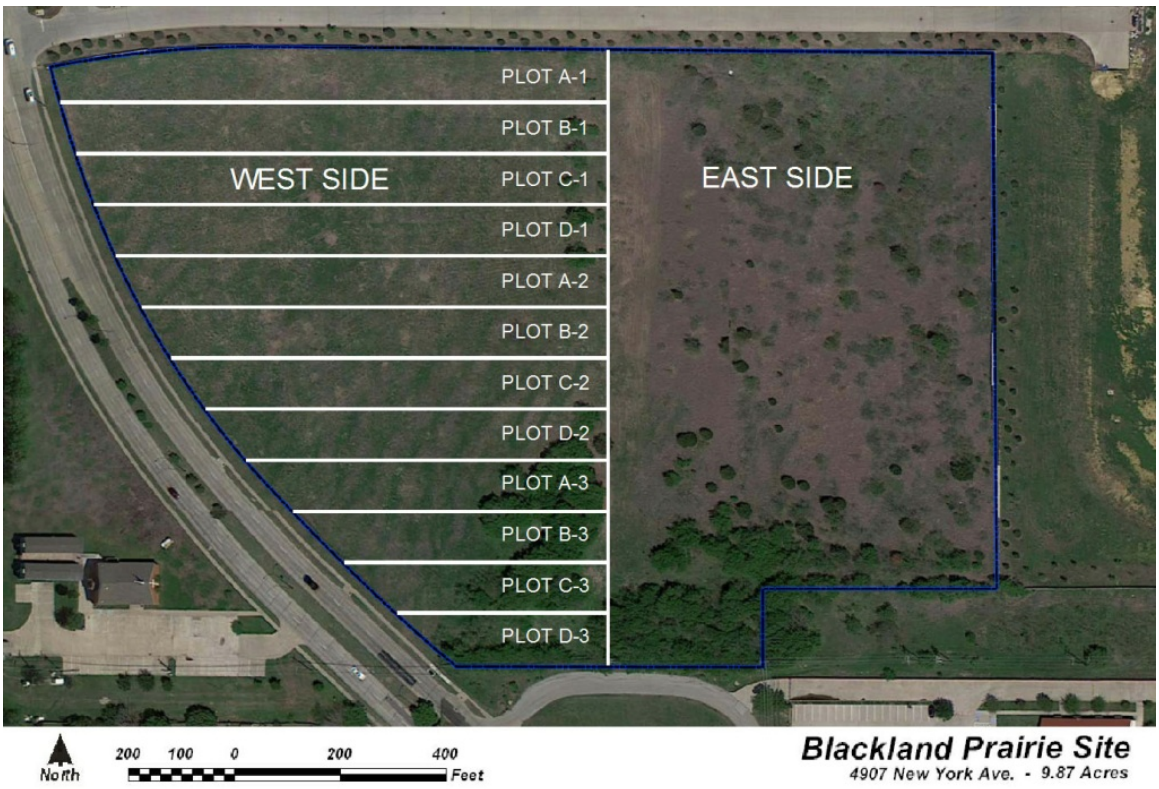

Figure 31-study plots for understanding implications of maintenance practices over time

The diagram below shows a potential rotation dividing a prairie into thirds; it could as easily be divided into smaller parcels, meaning a longer rotation, depending on the economic impact of resting a portion.

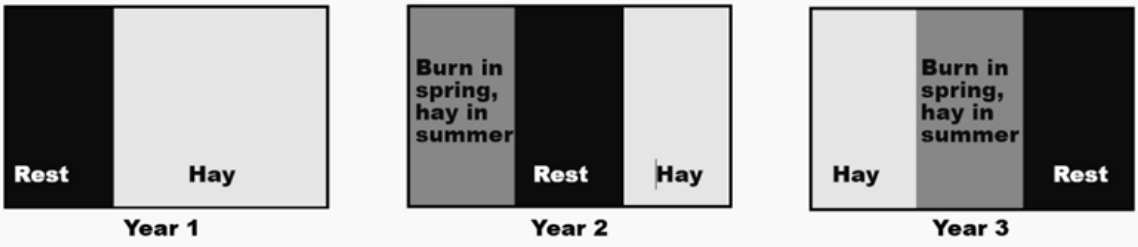

Figure 32: Haying schedule

APPENDIX 3: Plants of Parkhill Preserve

List courtesy of Jim Varnum: Plant List from visits between 2006 and 2010.
Plants are listed in the order of BRIT's Flora (by Family). jevarnum@aol.

No.	Scientific Name	Common Name	Plant	Family
1.	Juniperus virginiana	Eastern red cedar	Tree	Cupressaceae
2.	Ruellia humilis	Low ruellia, Wild petunia	Forb	Acanthaceae
3.	Alternanthera philoxeroides	Alligator-weed	Aqua	Amaranthaceae
4.	Rhus glabra	Smooth sumac	Tree	Anacardiaceae
5.	Toxicodendron radicans	Poison ivy	All	Anacardiaceae
6.	Bifora americana	Prairie bishop's weed	Forb	Apiaceae
7.	Bowlesia incana	Hoary bowlesia	Forb	Apiaceae
8.	Chaerophyllum tainturieri	Chervil	Forb	Apiaceae
9.	Daucus carota	Wild carrot	Forb	Apiaceae
10.	Eryngium leavenworthii	Eryngo	Forb	Apiaceae
11.	Eryngium yuccifolium	Rattlesnake master	Forb	Apiaceae
12.	Polytaenia nuttallii	Prairie parsley	Forb	Apiaceae
13.	Torilis arvensis	Hedge parsley, Beggar's	Forb	Apiaceae
14.	Torilis nodosa	Knotted hedge parsley	Forb	Apiaceae
15.	Ilex decidua	Possumhaw holly	Tree	Aquifoliaceae
16.	Asclepias viridis	Green milkweed	Forb	Asclepiadaceae
17.	Matelea biflora	Two-flowered milkvine	Forb	Asclepiadaceae
18.	Achillea millefolium (JQ A.	Yarrow	Forb	Asteraceae
19.	Ambrosia psilostachya	Western ragweed	Forb	Asteraceae
20.	Ambrosia trifida var. texana	Giant ragweed	Forb	Asteraceae
21.	Arnoglossum plantagineum	Indian plantain	Forb	Asteraceae
22.	Artemesia ludoviciana	Mexican Sagebrush	Forb	Asteraceae
23.	Aster ericoides (NEW	Heath aster	Forb	Asteraceae
24.	Aster praealtus (NEW	Willow-leaf aster	Forb	Asteraceae
25.	Aster subulatus var. ligulatus	Fall aster	Forb	Asteraceae
26.	Brickellia eupatorioides var.	False boneset, Prairie	Forb	Asteraceae
27.	Carduus nutans subsp.	Nodding thistle	Forb	Asteraceae
28.	Centaurea americana	American basketflower	Forb	Asteraceae
29.	Cirsium texanum	Texas thistle	Forb	Asteraceae
30.	Cirsium sp. Large rosette		Forb	Asteraceae
31.	Coreopsis tinctoria	Plains coreopsis	Forb	Asteraceae
32.	CREPIS PULCHRA, was	Showy hawk's-beard	Forb	Asteraceae
33.	Dracopis amplexicaulis	Clasping-leaf coneflower	Forb	Asteraceae
34.	Echinacea angustifolia	Purple prairie coneflower	Forb	Asteraceae
35.	Eclipta prostrate	Pieplant	Forb	Asteracear
36.	Engelmannia peristenia	Engelmann's daisy, Cut-	Forb	Asteraceae
37.	Erigeron philadelphicus	Philadelphia fleabane	Forb	Asteraceae
38.	Erigeron strigosis var. =	Prairie fleabane	Forb	Asteraceae
39.	Evax prolifera	Big-head evax	Forb	Asteraceae
40.	Gaillardia pulchella	Firewheel, Indian blanket	Forb	Asteraceae

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No.	Scientific Name	Common Name	Plant	Family
41.	Grindelia sp. (wide spaced		Forb	Asteraceae
42.	Gutierrezia dracunculoides	Broomweed	Forb	Asteraceae
43.	Helianthus annuus	Texas sunflower	Forb	Asteraceae
44.	Helianthus maximiliani	Maximilian sunflower	Forb	Asteraceae
45.	Hymenopappus scabiosaeus	Woolly-white, Old	Forb	Asteraceae
46.	Iva annua	Marsh-elder, Sumpweed	Forb	Asteraceae
47.	Krigia sp.		Forb	Asteraceae
48.	Lactuca serriola	Prickly lettuce	Forb	Asteraceae
49.	Liatris mucronata	Gayfeather	Forb	Asteraceae
50.	Lindheimera texana	Texas yellow star	Forb	Asteraceae
51.	Packera plattensis	Prairie groundsel	Forb	Asteraceae
52.	Packera tampicana	Great plains ragwort	Forb	Asteraceae
53.	Pluchea odorata	Camphorweed	Forb	Asteraceae
54.	Pyrrhopappus carolinianus	Carolina false dandelion	Forb	Asteraceae
55.	Pyrrhopappus pauciflorus	Texas dandelion	Forb	Asteraceae
56.	Ratibida columnifera	Mexican hat	Forb	Asteraceae
57.	Silphium laciniatum	Yellow compass plant	Forb	Asteraceae
58.	Silphium radula	Rough-stem rosinweed	Forb	Asteraceae
59.	Solidago canadensis var. ?	Common goldenrod	Forb	Asteraceae
60.	Solidago rigida	Rough goldenrod	Forb	Asteraceae
61.	Sonchus asper	Sow thistle (early)	Forb	Asteraceae
62.	Sonchus oleraceus	Sow thistle (late)	Forb	Asteraceae
63.	Thelesperma filifolium var. =	Greenthreads	Forb	Asteraceae
64.	Vernonia baldwinii (JQ ssp.	Western ironweed	Forb	Asteraceae
65.	Xanthium strumarium var.	Cocklebur	Forb	Asteraceae
66.	Buglossoides arvensis	Buglossoides, NCN	Forb	Boraginaceae
67.	Heliotropium tenellum	Pasture heliotrope	Forb	Boraginaceae
68.	Lithospermum incisum	Fringed puccoon	Forb	Boraginaceae
69.	Myosotis macrosperma	Spring forget-me-not	Forb	Boraginaceae
70.	Capsella bursa-pastoris	Shepherd's purse	Forb	Brassicaceae
71.	Draba cuneifolia	Wedge-leaf draba	Forb	Brassicaceae
72.	Lepidium austrinum	Southern pepper grass	Forb	Brassicaceae
73.	Lepidium virginicum	Pepper grass	Forb	Brassicaceae
74.	Lesquerella gracilis subsp. =	Cloth-of-gold	Forb	Brassicaceae
75.	Myagrum perfoliatum	NCN, Myagrum	Forb	Brassicaceae
76.	Rapistrum rugosum	NCN	Forb	Brassicaceae
77.	Opuntia engelmannii var.	Prickly-pear cactus	Forb	Cactaceae
78.	Triodanis perfoliata var.	Venus' looking glass	Forb	Campanulaceae
79.	Lonicera albiflora	Western white	Shru	Caprifoliaceae
80.	Symphoricarpos orbiculatus	Coralberry	Shru	Caprifoliaceae

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No.	Scientific Name	Common Name	Plant	Family
81.	Arenaria serpyllifolia	Thyme-leaf sandwort	Forb	Caryophyllaceae
82.	Stellaria media (JQ var. m.)	Chickweed	Forb	Caryophyllaceae
83.	Cornus drummondii	Rough-leaf dogwood	Tree	Cornaceae
84.	Convolvulus arvensis	Bindweed	Vine	Convolvulaceae
85.	Cuscuta sp.	dodder	Forb	Cuscutaceae
86.	Scabiosa atropurpurea	Pincushion plant	Forb	Dipsaceae
87.	Chamaesyce maculata	Spotted spurge	Forb	Euphorbiaceae
88.				
89.	Croton monanthogynus	Prairie tea	Forb	Euphorbiaceae
90.	Euphorbia bicolor	Snow-on-the prairie	Forb	Euphorbiaceae
91.	Euphorbia spathulata	Weak spurge	Forb	Euphorbiaceae
92.	Tragia sp.		Forb	Euphorbiaceae
93.	Acacia angustissima var	Prairie acacia	Forb	Fabaceae
94.	Amorpha fruticosa	False indigo	Tree	Fabaceae
95.	Astragalus crassicarpus var.	Ground plum	Forb	Fabaceae
96.	Astragalus nuttallianus var.	Small-flower milk-vetch	Forb	Fabaceae
97.	Cercis canadensis var.	Eastern redbud	Tree	Fabaceae
98.	Chamaecrista fasciculate	Partridge pea	Forb	Fabaceae
99.	Dalea compacta var.	Showy prairie clover	Forb	Fabaceae
100.	Dalea multiflora	White prairie clover	Forb	Fabaceae
101.	Desmanthus illinoensis	Illinois bundleflower	Forb	Fabaceae
102.	Desmodium tweedyi	Tweedy's tick trefoil	Forb	Fabaceae
103.	Gleditsia triacanthos	Honey locust	Tree	Fabaceae
104.	Lathyrus hirsutus	Singletary Pea	Forb	Fabaceae
105.	Medicago minima	Bur clover	Forb	Fabaceae
106.	Medicago orbicularis	Button clover	Forb	Fabaceae
107.	Melilotus albus. BRIT has	White sweet clover	Forb	Fabaceae
108.	Melilotus officinalis	Yellow sweet clover	Forb	Fabaceae
109.	Mimosa roemeriana	Roemer's sensitive vine	Forb	Fabaceae
110.	Neptunia lutea	Yellow puff	Vine	Fabaceae
111.	Sophora affinis	Eve's necklace	Tree	Fabaceae
112.	Vicia sativa subsp. sativa	Common vetch	Forb	Fabaceae
113.	Q M			
114.	Quercus shumardii	Shumard red oak	Tree	Fagaceae
115.	Eustoma russellianum (NEW	Bluebells	Forb	Gentianaceae
116.				
117.	Erodium cicutarium	Pin clover, Filaree	Forb	Geraniaceae
118.	Geranium carolianum	Carolina geranium	Forb	Geraniaceae
119.	Geranium dissectum	NCN	Forb	Geraniaceae
120.	Nemophila phacelioides	Baby blue-eyes	Forb	Hydrophyllaceae

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No.	Scientific Name	Common Name	Plant	Family
121.	Lamium amplexicaule	Henbit	Forb	Lamiaceae
122.	Monarda citriodora	Lemon mint	Forb	Lamiaceae
123.	Salvia azurea var.	Texas giant sage	Forb	Lamiaceae
124.	Salvia farinacea (JQ S. f.	Mealy blue sage	Forb	Lamiaceae
125.	Scutellaria drummondii var.	Skullcap	Forb	Lamiaceae
126.	Teucrium canadense	American germander	Forb	Lamiaceae
127.	Linum rigidum var. berlindieri	Stiff-stem (yellow) flax	Forb	Linaceae
128.	Lythrum alataum var.	Lance-leaf loosestrife	Forb	Lythraceae
129.	Callirhoe alcaeoides	Plains winecup	Forb	Malvaceae
130.	Cocculus carolinus	Carolina snailseed	Vine	Menispermaceae
131.	Maclura pomifera	Osage orange, Horse	Tree	Moraceae
132.	Morus rubra	Red mulberry	Tree	Moraceae
133.	Mirabilis sp.		Forb	Nyctaginaceae
134.	Fraxinus pennsylvanica	Green ash	Tree	Oleaceae
135.	Fraxinus texensis	Texas white ash	Tree	Oleaceae
136.	LIGUSTRUM 5 VEINS	5/30		
137.	LIGUSTRUM 7+ VEINS	5/30		
138.	Calylophus berlandieri	Sundrops, Square-bud	Forb	Onagraceae
139.	Gaura parviflora (NEW	**Lizard-tail gaura**	**Forb**	**Onagraceae**
140.	Gaura suffulta	Kisses	Forb	Onagraceae
141.	Ludwigia peploides	**Water-primrose**	**Aqu**	**Onagraceae**
142.	Oenothera speciosa	Showy evening-primrose,	Forb	Onagraceae
143.	Oxalis stricta	Oxalis, Yellow wood-	Forb	Oxalidaceae
144.	Passiflora lutea	Yellow passion-flower	Vine	Passifloraceae
145.	Plantago rhodosperma	Red-seed plantain	Forb	Plantaginaceae
146.	Phlox pilosa subsp. pilosa	Prairie phlox	Forb	Polemoniaceae
147.	Eriogonium longifolium	Long-leaf buckwheat	Forb	Polygonaceae
148.	Polygonum hydropiperoides	Swamp smartweed	Forb	Polygonaceae
149.	Rumex crispus	Curly dock	Forb	Polygonaceae
150.	Rumex pulcher	Fiddle dock	Forb	Polygonaceae
151.	Claytonia virginica	Spring beauty	Forb	Portulacaceae
152.	Anemone berlandieri	Anemone, Windflower	Forb	Ranunculaceae
153.	Clematis pitcheri	Leather-flower	Vine	Ranunculaceae
154.	Delphinium carolinianum	Prairie larkspur	Forb	Ranunculaceae
155.	Ranunculus fascicularis	Tufted buttercup	Forb	Ranunculaceae
156.	Crataegus sp. Small oval	32º-16.621', 96º-17.764'	Tree	Rosaceae
157.	Geum canadense var.	White avens, Geum	Forb	Rosaceae
158.	Prunus mexicana	Mexican plum	Tree	Rosaceae
159.	Prunus rivularis	Escarpment plum	Tree	Rosaceae
160.	Rosa foliolosa	White prairie rose	Shru	Rosaceae

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No.	Scientific Name	Common Name	Plant	Family
161.	Rosa setigera var.	Prairie rose	Shru	Rosaceae
162.	Rubus trivialis	Southern dewberry	Forb	Rosaceae
163.	Galium aparine	Bedstraw, Cleavers	Forb	Rubiaceae
164.	Galium tinctorum	Dye bedstraw, Stiff marsh	Forb	Rubiaceae
165.	Hedyotis nigricans	Bluets	Forb	Rubiaceae
166.	Houstonia pusilla	Small bluets, Houstonia	Forb	Rubiaceae
167.	Sherardia arvensis	Field madder	Forb	Rubiaceae
168.	Zanthoxylum clava-herculis	Hercules'-club, Prickly	Tree	Rutaceae
169.	Populus deltoides subsp. =	Eastern cottonwood	Tree	Salicaceae
170.	Salix nigra	Black willow	Tree	Salicaceae
171.	Cardiospermum	Balloon vine	Vine	Sapindaceae
172.	Sapindus saponaria var.	Western soapberry	Tree	Sapindaceae
173.	Sideroxylon lanuginosum	Woolly-bucket bumelia,	Tree	Sapotaceae
174.	Agalinis heterophylla	Prairie agalinis	Frob	Scrophulariaceae
175.	Castilleja indivisa	Texas paintbrush	Forb	Scrophulariaceae
176.	Castilleja purpurea var.	Lemon paintbrush	Forb	Scrophulariaceae
177.	Castilleja purpurea var.	Purple paintbrush	Forb	Scrophulariaceae
178.	Penstemon cobaea	Foxglove	Forb	Scrophulariaceae
179.	Veronica persica	Persian speedwell	Forb	Scrophulariaceae
180.	Physalis cinerascens	Ground-cherry	Forb	Solanaceae
181.	Physalis sp. OVATE		Forb	Solanaceae
182.	Physalis sp., with Dana, 4/28		Forb	Solanaceae
183.	Celtis laevigata var. =	Hackberry, Sugarberry	Tree	Ulmaceae
184.	Ulmus americana	American elm	Tree	Ulmaceae
185.	Ulmus crassifolia	Cedar elm	Tree	Ulmaceae
186.	Parietaria pensylvanica var.	**Pennsylvania pellitory**	**Forb**	**Urticaceae**
187.	Valerianella amarella	Hairy cornsalad	Forb	Valerianaceae
188.	Glandularia bipinnatifida	Prairie verbena	Forb	Verbenaceae
189.	Lippia lanceolata (NEW	Lance-leaf frogfruit	Forb	Verbenaceae
190.	Parthenocissus quinquefolia	Virginia creeper	Vine	Vitaceae
191.	Echinodorus berteroi	Erect burhead	Mon	Alismataceae
192.	Tradescantia ohiensis	Ohio spiderwort	Mon	Commelinaceae
193.	Carex crus-corvi	**Crow-foot caric sedge**	**Mon**	**Cyperaceae**
194.	Carex microdonta	Small-tooth caric sedge	Sedg	Cyperaceae
195.	Cyperus sp., 3-4 small		Sedg	Cyperaceae
196.	CYPERUS ESC…, 5/30/08		Sedg	Cyperaceae
197.	Eleocharis quadrangulata	Square-stem spike-rush	Sedg	Cyperaceae
198.	Scirpus pendulus	a bulrush	Sedg	Cyperaceae
199.	Nemastylis geminiflora	Prairie celestial	Mon	Iridaceae
200.	Sisyrinchium pruinosum	Blue-eyed grass	Mon	Iridaceae

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201.	Allium canadense var.	Canada wild onion	Mon	Liliaceae /
202.	Juncus marginats	Grass-leaf rush	Mon	Juncaceae
203.	Juncus torreyi	Torrey's rush	Mon	Juncaceae
204.	Allium sp. collected by CC	? wild onion	Mon	Liliaceae /
205.	Allium canadensis var.	Canada wild onion	Mon	Liliaceae /
206.	Camassia scilloides	Wild hyacinth	Mon	Liliaceae /
207.	Nothoscordum bivalve	Crow poison, False garlic	Mon	Liliaceae /
208.	Spiranthes cernua	Ladies tresses	Mon	Orchidaceae
209.	Atistida sp.	? three-awn (long awns)	Gras	Poaceae
210.	Andropogon gerardii subsp.	Big bluestem	Gras	Poaceae
211.	Bothriochloa ischaemum	King Ranch bluestem	Gras	Poaceae
212.	Bothriochloa laguroides	Silver bluestem	Grass	Poaceae
213.	Bouteloua curtipendula var.	Side oats grama	Gras	Poaceae
214.	Bouteloua rigidiseta	**Texas grama**	**Gras**	**Poaceae**
215.	Buchloe dactyloides	Buffalo grass	Gras	Poaceae
216.	Cynodon dactylon	Bermuda grass	Grass	Poaceae
217.	Elymus canadensis	Canada wildrye	Gras	Poaceae
218.	Elymus virginicus	Virginia wildrye	Gras	Poaceae
219.	Echinochloa muricata var. =	a barnyard grass, NCN	Gras	Poaceae
220.	Eriochloa sericea	Texas cupgrass	Gras	Poaceae
221.	Festuca arundinacea (NEW	Tall fescue	Gras	Poaceae
222.	Hordeum pusillum	Little barley	Gras	Poaceae
223.	Lolium perenne var.			
224.	Lolium perenne subsp. =	Perennial rye grass	Gras	Poaceae
225.	Nassella leucotricha	Winter grass, Spear	Gras	Poaceae
226.	Panicum capillare	Witchgrass	Gras	Poaceae
227.	Panicum virgatum	Switchgrass	Gras	Poaceae
228.	Paspalum dilitatum	**Dallis grass**	**Gras**	**Poaceae**
229.	Phalaris caroliniana	Carolina canarygrass	Gras	Poaceae
230.	Schizachyrium scoparium	Little bluestem grass	Gras	Poaceae
231.	Setaria parviflora	**Knot-root bristlegrass**	**Gras**	**Poaceae**
232.	Sorghastrum nutans	Indian grass	Gras	Poaceae
233.	Sorghum halepense	Johnson grass	Gras	Poaceae
234.	Tridens albescens	White tridens	Gras	Poaceae
235.	Tripsacum dactyloides	Eastern gamma grass	Gras	Poaceae
236.	Zea mays	Corn	Gras	Poaceae
237.	Potamogeton nodosus	**Long-leaf pondweed**	**Aqu**	**Potamogetonac**
238.	Smilax bona-nox	Catbrier	Vine	Smilacaceae
239.	Typha domingensis	Narrow-leaf cat-tail	Aqua	Typhaceae

Selected Resources

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