

A Comprehensive Geodatabase

of the Freeman Center

by

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LIST OF ABBREVIATIONS

Abbreviation	Description
GPS	Global Positioning System
GIS	Geographic Information Science
ArcGIS	Program that Manipulates Geographic Data
PDOP	Position Dilution of Precession
KMZ	Zipped Keyhole Markup Language File
NAIP	National Agriculture Imagery Program
SBAS	Satellite Bases Augmentation Systems
MXD	File type used in ArcGIS
GEO XH 2008-3000	Global Position System Receiver
Trimble GeoXT	Global Position System Receiver
Trimble GeoXH	Global Position System Receiver
Trimble Juno 3	Global Position System Receiver
IH	Interstate Highway

I. INTRODUCTION

Freeman Center has become one of the most popular places to conduct research at Texas State University, over the past decades. Every semester, graduate research, undergraduate projects, and other ranch activities utilize the Freeman Center. With many students and researchers in need of an accurate and compressive Geographic Information Systems (GIS) dataset, this project uses data collected from multiple undergraduate projects to compile and organize a geodatabase of Freeman Center. This paper will first go through a brief background of the Freeman Center. Second, the geography of the site will be described in detail. Third, data collected within each pasture described with regard to how the GEO 4324/5234 groups collected and processed their data. Lastly, procedures related to data manipulation and integration to compile the completed geodatabase will be described. This geodatabase will be available to all students and researchers who wish to conduct research at the Freeman Center.

The resulting geodatabase will make research projects more efficient and accurate by providing consistent geospatial data for Freeman Center. Since the geodatabase is organized, updating the data will be more efficient and straightforward in the future.

Purpose of Research

In the Fall semesters of 2014 and 2015, eight groups were assigned to create a baseline GIS dataset for Freeman Center. Each of the groups were given a specific pasture for which to collect data. Although each group was given specific parameters on how to gather and store Global Positioning Systems (GPS) data, not all groups followed the same protocol for data collection and storage. These inconsistencies between data set collection and storage created complications when attempting to merge the datasets.

The objective of this directed research project is to assemble a comprehensive geodatabase of features and imagery corresponding to Freeman Center.

A complete dataset of the Freeman Center is an asset that will benefit University departments conducting research at the facility. For example, the Biology department conducts multiple ongoing research projects at the facility would benefit from a complete GIS database. This will help streamline research for those not privy to geospatial science by allowing them to conduct GIS work from an existing database to assist with their research.

Once a geodatabase has been created, it gives users the ability to update and improve specific aspects of the geodatabase. A geodatabase should not be treated as a static entity because the Freeman Center is in a constant state of change. Updating and maintaining a successful geodatabase will mitigate requests for specific geospatial layers that researchers request from Freeman Center personnel.

II. SITE AND SITUATION

Background

Freeman Center is a large tract of land consisting of 3,485 acres donated by Harold M. Freeman to Texas State University in 1981, and a lease agreement of 667 acres located southeast section of the property totaling in 4152 acres. Located several miles west of Texas State University, the property provides students with the opportunity for hands-on learning and on-site research. Acquired by the Freeman brothers in the 1940s, the land functioned primarily as a working cattle ranch and hunting area. However, Harold M. Freeman stated that Freeman Center “is to be used by Texas State University for farm, ranch, game management, educational, and experimental purposes,” Texas State University has taken the opportunity to expand research opportunities at the facility. For example, the Biology Department conducts numerous wildlife studies; the Criminal Justice Department has a unique on-site facility that conducts research on human decomposition and forensic anthropology; Agriculture established and maintains the Sustainable Farm; Geography conducts field work related to mapping and environmental science; and the Center provides subject matter for the Fine Arts department. Texas State has operated and maintained the Freeman Center with the priority of education and research.

Site Description

Freeman Center is located on the edge of the Balcones Escarpment, a sub region on the Edwards Plateau (Jandle 2016). The Center is located 7.2 miles northwest of San Marcos, Texas (29.937378 -98.009938). Historically, the area was used for ranching and agricultural purposes. Today, the Freeman Center is divided into thirteen separate

pastures for cattle rotation (Jandle 2016). The Freeman Center is primarily underlain by limestone from the Fredericksburg Group, with a mixture of alluvium and colluvium in stream flood areas. This geologic stratigraphy and lithology creates the unique Hill Country vegetation types at the Freeman Center which include: riparian woodland, Ashe juniper-live oak forest, live oak savannah, live oak woodland and mesquite savannah (Baccus et al. 2000). Elevation ranges from 670 to 847 feet above sea level with a terrain that is dominated by rolling hills. Average annual high temperature is 79.6 degrees Fahrenheit, and the average yearly low temperature is 57.3 degrees Fahrenheit (Dixon 2000). Precipitation in the region is moderate with an average yearly rainfall of 35.75 inches (Dixon 2000). The geology is predominantly karst terrain which has created a large aquifer that provides water for Hays County.

Agriculture and Vegetation

The Freeman Center is centered in a biological crossroads of three major biomes of North America: grasslands, desert, and temperate forest. Much of the Edwards Plateau is dominated by grasslands with prairie grasses and live oak trees. Periodic grazing of the lands, frequent wildfires, and migratory herds of animals has predominated in this area (Barnes et al. 2000). Chronic overgrazing of livestock, in the present day, has become one of the central issues facing areas of the Edward's Plateau. Due to the frequent overgrazing, wildfire hazards, and the introduction of invasive species, much of the native woody plants and native grasses have been dramatically reduced (Barnes et al. 2000).

According to a vegetation study conducted in 2000, over 300 vascular plant species consisting of 70 different families have been identified on the Freeman Center

(Barnes et al. 2000). The grass family contains the highest amount of diversity (Barnes et al. 2000). No endangered plant species have been located on the property, although there are several uncommon species such as the Texas mulberry, devils shoe-string, and dwarf palmetto. Invasive species include Johnson grass and King Ranch bluestem (Fowler 1988). Over 30 woody species of plants have been identified at the Center. The most common include cedar elm (*Ulmus crassifolia*), Texas persimmon (*Diospyros texana*), plateau live oak (*Quercus fusiformis*), Spanish oak (*Quercus falcata*), honey mesquite (*Prosopis glandulosa*, and Texas mountain laurel (*Dermatophyllum secundiflorum*) (Barnes et al. 2000). Freeman Center's vegetation is characteristic of the Edwards Plateau which contains savannahs and woody vegetation clusters. Woody vegetation is prevalent in the Comfort rock soils, while the Rumble Comfort soils support the grassland savannah areas (Barnes et al. 2000).

Ranching has been, and is currently the predominant agricultural practice at Freeman Center. Since the procurement of Freeman Center, the scale of ranching has been greatly reduced (Barnes et al. 2000). Overgrazing has reduced native grasses and allowed woody vegetation such as Ashe juniper occupy a greater percentage of grasslands (Barnes et al. 2000). Historically, livestock have been the predominate grazers; however, due to the decrease in the number of livestock, the white-tail deer populations have increased. The exact extent of their influence on the vegetation is not well known (Barnes et al. 2000). Further studies are needed to understand the extent of over grazing by the white-tail deer (*Odocoileus virginianus*) population.

Climate

Freeman Center is subjected to a variety of weather conditions typical of a humid sub-tropical climatic zone. Droughts are not uncommon within the region which can result in negative influences on vegetation and animal communities. Climate data at Freeman Center have only been recorded since 1998 (Dixon 2000). Observations in surrounding areas are used to extrapolate climate phenomenon at Freeman Center (Dixon 2000). Temperature data pertaining to Freeman Center has an annual mean of 60 degrees Fahrenheit, with summer highs in the nineties and winter lows in the forties (Dixon 2000). For much of the year, the temperature is skewed to more elevated temperatures with over 100 days exceeding ninety degrees Fahrenheit (Dixon 2000). Periodic drought and floods are prevalent within the region, with precipitation throughout the year. Although, higher levels of precipitation have been recorded in the fall months. Winds prevail from the Gulf of Mexico creating high relative humidity, but can be usurped by northern polar fronts in the winter as well as continental tropical air from the Sonoran Desert in the summer (Earl and Kimmel 1995). The summer is dominated by clear skies and high amounts of solar radiation, while the winter months see an increase in humidity creating cloudier conditions (Dixon 2000)

Two hazardous weather conditions are consistent to the region, flash flooding and tornadoes. Rainfall can exceed 30 inches in less than 24 hours during major precipitation events (Slade and Persky 1999). These dramatic storms have the potential to produce world record rainfall rates with some past storm damages exceeding 100 million dollars (Slade and Persky 1999). Tornadoes are also a byproduct of these storms, but are generally weak and only registering F0 or F1 on the Enhanced Fujita Scale (Dixon 2000).

Biology

Amphibian and reptile diversity is low when compared to the surrounding area due to land management, climate, and invasive species. Thirty species were observed during surveys conducted in 1946 (cite). Currently twenty-three species were observed during a nine-year survey. Traditional pressures of land management practices and climate have influenced amphibian and reptile populations. Fire ants are a new pressure attributed with largely affecting current reptile and amphibian populations. A combination of land management practices, climate, and invasive species has decreased the amphibian and reptile population at the Freeman Center (Rose 2000).

Amphibians and reptiles have significant populations in the Texas Hill Country region, but the Freeman Center is limited in biodiversity due to a deficiency of an aquatic environment (Rose 2000). The Freeman Center has typical characteristics that affect the ranch lands throughout the region: overgrazing, topsoil erosion, and fire ant (*Solenopsis invicta*) infestation (Rose 2000). These three characteristics have adversely influenced populations of invertebrates in the area.

Amphibian populations are poorly represented at the Freeman Center. Salamanders are absent due to the lack of aquatic environments. Hays County is home to eighteen frog and five toad species; however, only one is truly represent in significant numbers at the Freeman Center, the green tree frog (*Hyla cinereal*). Other frog and toad species have been observed but not in significant numbers to support a substantial population (Rose 2000). Extended periods of drought will negatively affect populations of amphibians.

Reptilian diversity is only a minute fraction of what is represented in Hays

County. Two of the eleven turtles that inhabit the region are found at the Freeman Center. The red eared slider (*Trachemys scripta*) and the western box turtle (*Terrapene ornate*) generally inhabit the area in and around cattle tanks. Of the sixteen native lizards, two have been identified at the Freeman Center, keeled earless lizard and the slender glass lizard. Common habitat for these species is in the fallen debris of oak motts. The most common snake species is the Texas rat snake found in oak motts. Many one-time sightings of other species have been documented, but does not support the concept of a large population, the species include: bull snake (*Pituophis catenifer*), western patch nose snake (*Salvadora hexalepis*), flathead snake (*Tantilla gracilis*), copperhead (*Agkistrodon contortrix*), Texas corral snake (*Micrurus tener*), and diamond back rattle snake (*Crotalus adamanteus*), but are typically only observed as solitary individuals. (Rose 2000).

Until the acquisition by the Texas State University, the Freeman Center was a working ranch operation. The ranchers exhibited intense ranching approaches which over time created harsh effects on the native species. Smaller mammalian species are susceptible to intense grazing practices and suffer from habitat destruction (Baccus et al. 2000). When a population reduction occurs in small mammalian species, larger predators are affected by this population reduction causing a downward spiral in overall species diversity (Baccus et al. 2000). A systematic study on vertebrates has not been conducted at the Freeman Center, wildlife that do occupy the area can be confirmed through subjective sightings (Baccus et al. 2000). A list of verified mammal inhabitants includes 26 species: Virginia Opossum (*Virginia opossum*), Cave Myotis (*Myotis velifer*), Eastern Pipistrelle (*Pipistrellus subflavus*), Eastern Red Bat (*Lasiurus borealis*), Hoary Bat (*Lasiurus cinereus*), Brazilian Free-Tailed Bat (*Tadarida brasiliensis*), Nine-Banded

Armadillo (*Dasybus novemcinctus*), Eastern Cottontail (*Sylvilagus floridanus*), Black-tailed Jack Rabbit (*Lepus californicus*), Rock squirrel (*Otospermophilus variegatus*), Eastern Fox Squirrel (*Sciurus niger*), Fulvous Harvest Mouse (*Reithrodontomys fulvescens*), White-ankled Mouse (*Peromyscus pectoralis*), Northern Pygmy Mouse (*Baiomys taylori*), Hispid Cotton Rat (*Sigmodon hispidus*), Coyote (*Canis latrans*), Red Fox (*Vulpes vulpes*), Common Gray Fox (*Urocyon cinereoargenteus*), Ringtail (*bassariscus astutus*), Raccoon (*Procyon lotor*), Striped Skunk (*Mephitis mephitis*), Common Hognose Skunk (*Conepatus mesoleucus*), Mountain Lion (*Puma concolor*), Bobcat (*Lynx rufus*), Feral Hog (*Sus scrofa*), and White-tailed Deer (*Odocoileus virginianus*). (Baccus et al. 2000).

Geology

The Freeman Center is situated on the Balcones Fault Zone a sub-region between Edwards Plateau to the west and the Gulf Coast plains to the east. The Fredericksburg Group contains the Edwards Limestone formation, which runs beneath the Freeman Center. The faults within the formation control the water output for greater Hays County. The thickness of the Edwards limestone formation ranges from 350 to 400 feet, and consist of a honeycomb structure due to dissolved shell material (DeCook 1963).

The Fredericksburg group consist of Walnut Clay, Comanche Peak Limestone and Edwards limestone. Both the walnut clay and Comanche peak limestone are erosional stratigraphic features than prove challenging to map. The dominant feature within this group is the Edwards limestone, which is thick bedded and dolomitic. The formation is only visible near Sink Creek, Blanco River, and Onion Creek (DeCook 1963)

Intersecting, faults and joints create channels for groundwater to surface. The Balcones Fault Zone begins west of Waco, Texas and roughly follows Interstate Highway (IH) 35 south to just north of San Antonio where to the fault boundary diverts to the west. A great number of minor faults are prevalent in the region between San Marcos, Texas to Wimberley, Texas (DeCook 1963).

Eight soil series have been identified at the Freeman Center; Anhalt, Comfort Eckrant, Krum Medlin, Orif, Rumble, and Tarpley. All soils except Orif are predominately composed of clay (Carson 2000), while the rest are comprised of a stony matrix. These high clay content soils are less permeable and exhibit a higher moisture carrying capacity. However, these ranch soils with a high clay content are lacking moisture storage due to lack of soil volume and depth (Carson 2000). Smectite is the predominate mineral in the Freeman Center clay soils. Smectite can dramatically change in volume in the presence of moisture making it unstable for structures; however, it does contain a large carrying capacity for nutrients. Much of the soils found at the Freeman Center are well suited for ranching (Carson 2000). The Freeman center consist of over 90% rumble and comfort soils (Barnes et al. 2000).

III. GPS DATA COLLECTION AND DATA INTERGRATION

Laguna Pasture

GPS data for the Laguna pasture were collected by four students using both Trimble GeoXT and Trimble Juno 3 GPS units. All features were post processed in Pathfinder Office using base stations: CORS, San Marcos (TXSM), Texas; Texas Department of Transportation Austin; and CORS, Johnson City (TXJC), TEXAS. Positional accuracy of three meters or less was accomplished via post processing.

Data were organized in ArcGIS 10.1 and projected in NAD 1983 2011 Texas State Plane South Central FIPS 4204FtUS into a single geodatabase and separated into individual feature classes by type. Collected point data included birdhouses, blinds, drinkers, feeders, gates, pump-house, trail camera, weather monitoring station, wells, and windmills. Line features represented pasture, fences, power lines, and roads. Polygon features consisted of structures and water features. The geodatabase was organized and did not require any alteration when merging with the other geodatabases.

North Crawford Pasture

The North Crawford group utilized Trimble GeoXT Trimble GeoXH and Juno GPS units with the goal of 1 meter precision for collected features. Point features included deer blinds, game feeders, drinkers, gates, wells, wind mills, weather station and stock feeder. Line features were comprised of creeks, fence, roads, and waterlines. The singular polygon feature collected was open areas. A combination of post processed code and post processed carrier float were used to differentially correct the features using Pathfinder Office. Water lines and grazeable areas were digitized due to weather restrictions described in the report.

The geodatabase did not require any major modification; the North Crawford geodatabase was created with individual features classes that represented each collected feature. One minor modification included changing multiple feature class names to allow the merge tool to function properly. A file geodatabase was created in ArcGIS 10.1 and projected in NAD 1983 2011 State Plane Texas South Central FIPS 4204FtUS for all the collected features.

Front, Fernando, and Turkey Pastures

These three pastures were collected by a group consisting of four individuals using GeoXT and Trimble Juno 3 GPS units. Point features collected consisted of feeder, drinker, well, pump, gate, structures, and deer blinds. Line features included roads, trail, creek, and utilities. Polygon features were comprised of waterbodies and buildings. It is important to note that the Freeman Center manager specified that structures were to be collected in point format instead of polygon format.

The data were imported into a single geodatabase and projected in NAD 1983 2011 State Plane Texas South Central FIPS 4204FtUS. The geodatabase did not require modification for the merge. The group's collection parameters included a) minimum accuracy of 10 feet, b) 30 positions collected for points and vertices, and c) a maximum PDOP of 6.0. Differential correction in Pathfinder Office to achieve the group's accuracy goals used base stations Texas (ITRF00(1997)-Derived from IGS08 (NEW)) and CORS, San Marcos (TXSM).

Data editing was conducted for the fence features in Front, Fernando, and Turkey to fill in missing segments. Due to dense vegetation canopy, stream data were digitized for the three pastures as well. Google Earth KMZ data were used to verify locations for

digitization of stream features. ArcGIS 10.1 was used to aggregate the GPS data in the file geodatabase.

Posey and Triangle Pastures

Data for these two pastures were collected by a group of four individuals. The group set accuracy parameters of 3-meter precision, a minimum of 30 positions collected for point features and a maximum PDOP of 6.0. Point features included blinds, feeders, wells, drinkers, and gates. Line features consisted of roads, fences, and trails. Structures represented the only polygon collected in the area. Data were collected using a Trimble GeoXT 2005 series.

GPS data were post processed using Pathfinder Office and the CORS, San Marcos (TXSM) base station. Multiple features were digitized due to the group's time restraints. Digitized features included grazeable land, polygons, fences, roads, streams and drinkers. Digitized features were referenced with 2012 National Agriculture Imagery Program imagery and Google Earth KMZ files. A combined use of the imagery assisted the group in creating features that were unattainable due to limited access and time. ArcGIS 10.1 was used to create a geodatabase that contained feature classes within the Posey and Triangle pastures. The geodatabase did not require any modification and merged properly.

TDN Pasture

Using Trimble GeoXT and Juno 3 GPS units, a group of four individuals collected data for the TDN pasture. The group set accuracy requirements of 3 meters, 30 positions averaged for each feature, and a maximum PDOP of 6. Point data consisted of feeders, blinds, and miscellaneous. Polyline data included gates, fences, and roads. A

single polygon feature for a structure was collected. Gates were incorrectly collected as polylines, which required recollection with a Trimble GeoXT of the entire feature class for gates in 2016. A miscellaneous feature class contained data that lacked comment or was a feature that did not pertain to any category. This feature class was omitted from the final product.

The data were differentially corrected but the group did not document which base stations were used. Data collected for road and fences was inconsistent and did not meet the group's accuracy parameters, which resulted in the group digitizing both road and fence features. The group did not document the source of imagery they used to digitizing features. A geodatabase was created in ArcGIS 10.1 and data were projected to NAD 1983 2011 State Plane Texas South Central FIPS 4204FtUS.

South Crawford Pasture

This group did not provide a field report for their collected data. Information was assembled through evaluating 2015 50cm NAIP imagery and information from the groups attribute table. A Geo XT 2005 unit was used to collect: windmills, fences, wells, feeders, drinkers, gates, and structures. Each of the features was well within the 5 meters of error after post processing. The group digitized features that were not collected via GPS. The digitized features included: water features, roads, drinkers, blinds, feeders, and object wells. There is no way of knowing what imagery the digitized data was referenced from. Through the use of ground control points and 2015 50cm NAIP imagery, I was able to verify the integrity of the digitized data.

The fence line to the north was redundantly collected, the duplicate collected from this group was of substandard accuracy, and therefore, was deleted. The South Crawford

group did organize the data dictionary by feature which allowed for an unhampered merge.

Crow's Nest East Pasture

Crow's Nest East group set vertical and horizontal accuracies at 3 meters of error and collected data using GeoXT 2005 and Juno series 3 GPS receivers. All collected data were post processed using the Texas Department of Transportation CORS base station, with the exception of the solar panel, which was real time SBAS corrected.

The group organized their data dictionary into three separate vector categories: point, line and polygon. The Crow's Nest East group used the comment section to specify the name of each feature. Each vector category was broken down into separate feature classes which represented the name of the object collected. Fence data were collected as a polygon which was transformed in to line data for the compiled database. The solar panel was collected as a polygon and transformed in to point data for the completed geodatabase.

Editing consisted of modifying the fence line data. Although the group stated in the report that the fence data fell within the 3 meters of error parameters; after reviewing, the fence data did not fall within the 3 meters of error that was required. To complete the dataset, the decision was made to digitize the fence line using the 2015 NAIP imagery.

Crow's Nest West Pasture

The Crow's Nest West group did not provide a report. Information about the data collected was provided through information gathered in the attribute table. The group's geodatabase was organized by feature names and did not require any modification when merging with the other geodatabases.

The students used Juno Series 3 and GEO XH 2008-3000 receivers to collect data. All data were post processed, but the base station wasn't specified. The group did meet the required accuracy for all collected data and organized the collected data in a way which was easy to interpret and merge. The students neglected to collect all data with a GPS, digitized features included: major streams, minor streams, and power lines. When importing the features into the Freeman Center database, power lines were transformed from point to line data and the inner fence was transformed from a polygon to line.

IV. RESULTS AND DISCUSSION

Although the database is a comprehensive representation of the Freeman Center, there are some inconsistencies that should be identified for future modification.

The greatest inconsistency between the data collected by the students is the fence line data. It is a patchwork of digitized and collected data. Two issues that affect the fence data include poor data collection and inaccessibility of the fence line. Improved collection practices, such as collecting individual, static vertices along the fence line, would remedy fence line data collection. Additionally, Structures were collected both as polygons and point features. A more comprehensive collection of all the structures, in a polygon format, would make for a more comprehensive and accurate geodatabase.

Each group followed similar organizational formats. Geodatabases were broken down into each individual feature. Crow's Nest East Pasture group did not follow this format and collected data by feature type rather than individual features and labeled the feature type in the comment section. Point, line, and polygon sections collected by Crow's Nest East Pasture group had to be exported from the attribute table and labeled by feature name. Several features were not identified in the comment section and required an on-site evaluation to determine what feature was collected. Another inconsistency was that the TDN group incorrectly collected the gate features as poly-lines, requiring a recollection so all gates at the Freeman Center are point features.

The entire Freeman geodatabase was created from these students' projects, giving an overall perspective of the entire site. A comprehensive map provides an additional tool to assist with day-to-day operation at the facility (Figure 1). Researchers, faculty, or staff that are not familiar with Freeman Center have a visual tool that can assist them. Other

thematic maps can be created from the data on the Freeman Center geodatabase such as the location of all hunting related objects, agriculture objects, and roads and fences to access a desired pasture efficiently (Figures 2, 3, and 4).

The geodatabase allows the Texas State Geography Department to provide a complete geospatial compilation of Freeman Center to reduce the amount of stress involved with providing GIS data to other University departments. Texas State departments that are utilizing the geodatabase do not have to concern themselves with collecting or processing data to obtain basic spatial information about the Center, thus saving time for both faculty, researchers, and students.

The Freeman Center is organized into a geodatabase categorized by features. The imagery folder contains NAIP imagery from 2004, 2005, 2008, 2010, 2012, 2014, and 2015. This imagery has been clipped to the boundary of Freeman Center. A total of four maps were created: complete comprehensive maps of all the features, agriculture, hunting, and roads maps were saved in the geodatabase in MXD format.

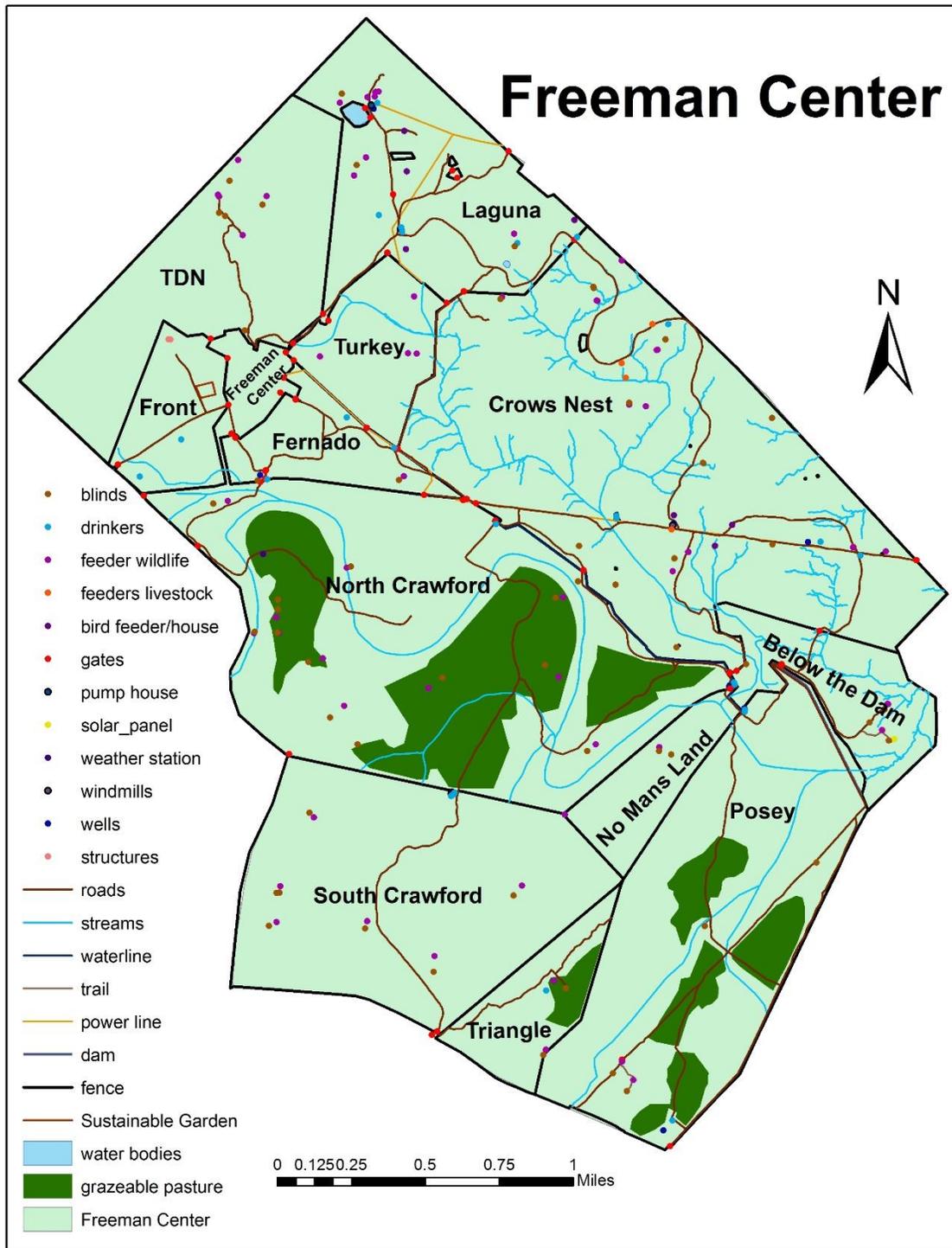


Figure 1: The entire database of Freeman Center.

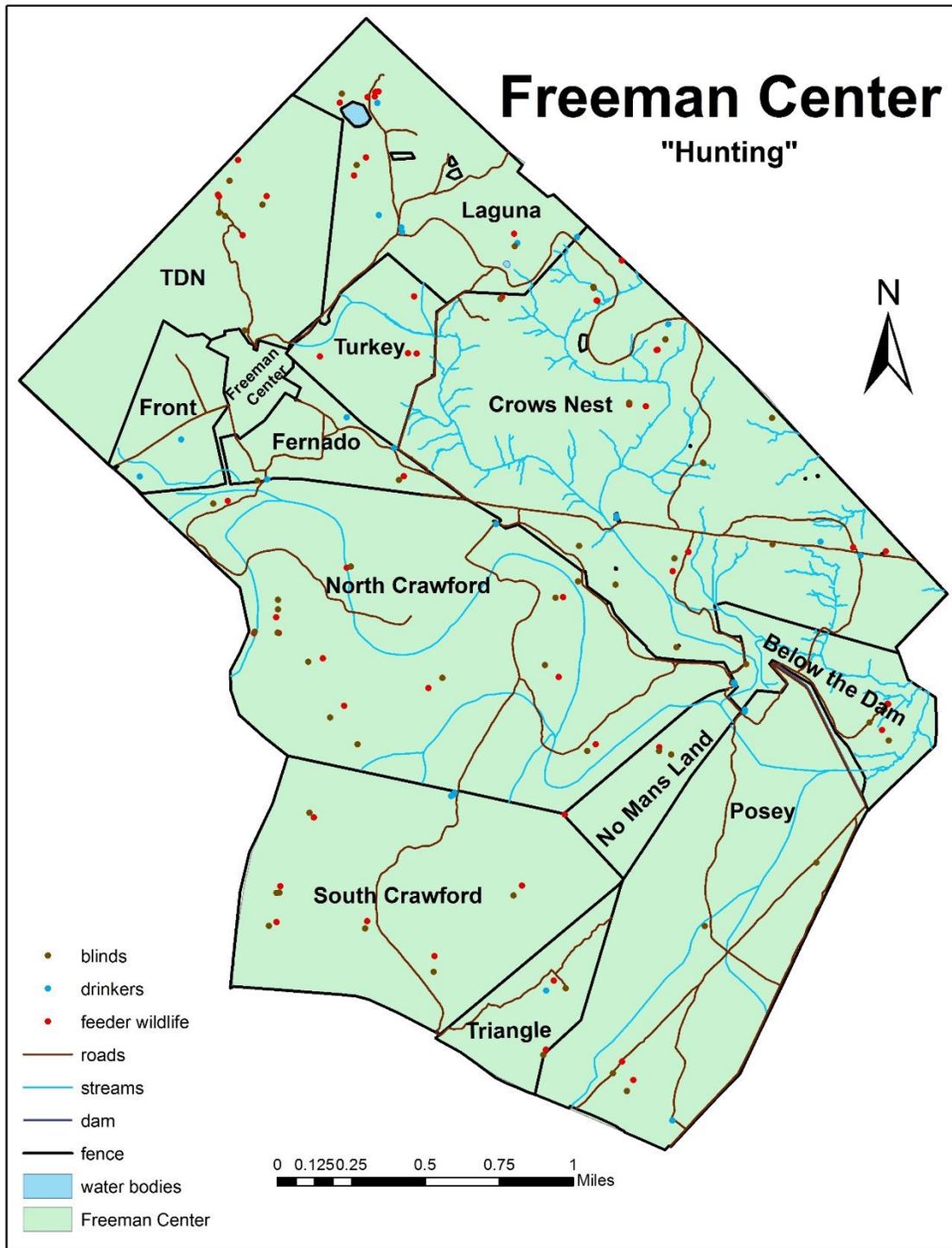


Figure 2: Hunting Objects at Freeman Center.

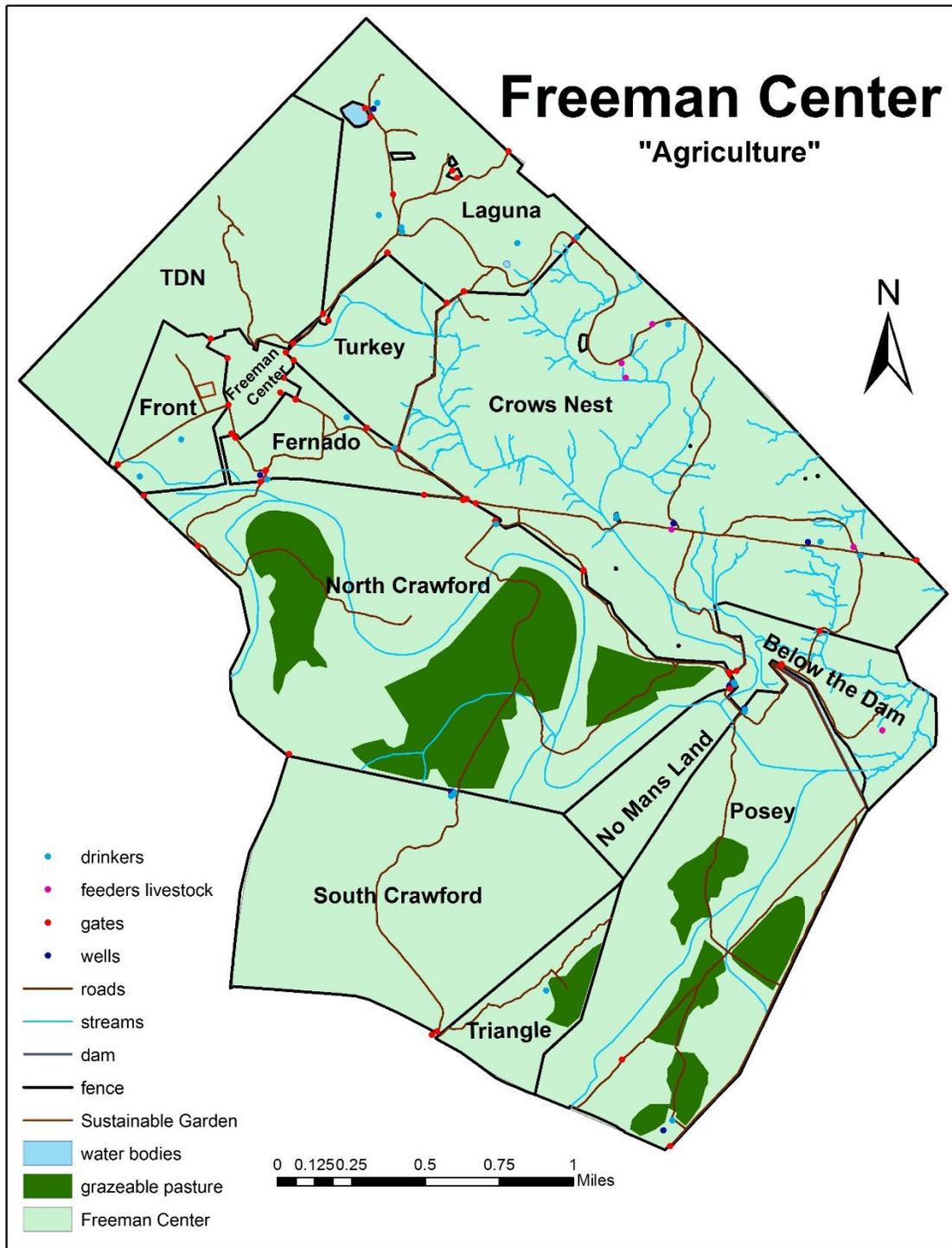


Figure 3: Agriculture objects at Freeman Center.

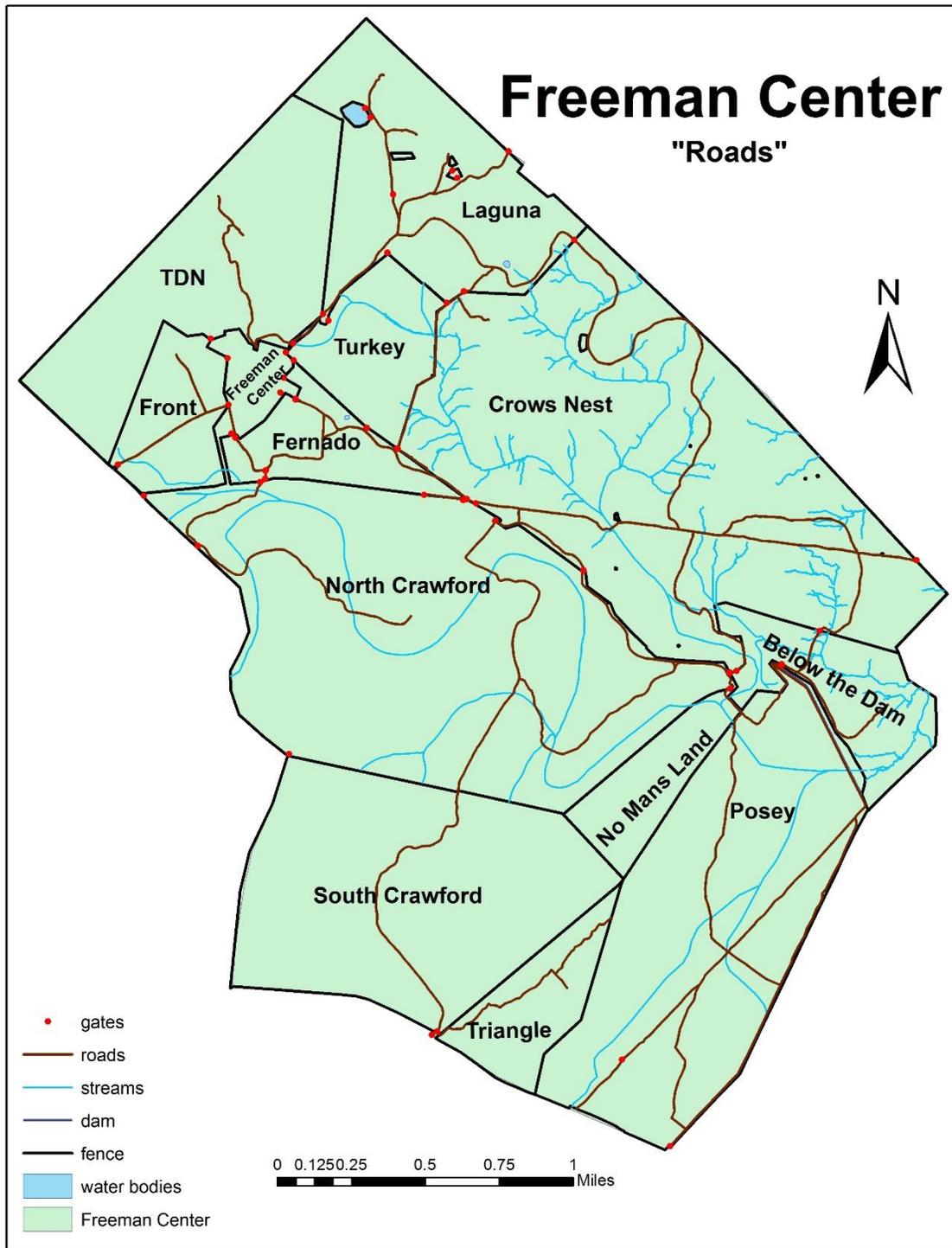


Figure 4: Roads and Fences at Freeman Center.

V. LIMITATIONS AND CONCLUSION

A geodatabase is an ever-evolving resource that requires a continuous enhancement to maintain integrity. As features and objects located at Freeman Center transform, so should the geodatabase. The database allows for a complete visual interpretation of the faculty, and if it is not properly maintained, it will gradually lose integrity and become scientifically inconsequential.

Data collection quality varied between each group and some groups relied heavily on digitization to fill the void of missing data. Collecting quality GPS data in rough terrain is challenging for experienced GPS technicians. Posey triangle groups chose to digitize fence data. This created an inconsistency in the data set where the fence data consists of a patchwork of a GPS and digitized data.

South Crawford and Crow's Nest West groups did not provide a field report. I can surmise the intentions of the groups through analyzing the attribute table, but reasoning for these decisions is not apparent.

The assimilation of the Freeman Center database is a step forward into providing a comprehensive geospatial tool for Texas State University.

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