The Superconducting Super Collider
Expanding the Role of the Survey Office

by Richard C. Hurst, SR/WA and Marvin A. Shepherd

Richard C. Hurst, is a senior member of the IRWA and past president of Chapter 26. He is currently employed by Universal Field Services as the project manager on the Superconducting Super Collider project.

Marvin A. Shepherd is a registered professional land surveyor for the state of Texas. He is currently employed by Universal Field Services as the survey manager on the Superconducting Super Collider project.

The Superconducting Super Collider (SSC) will be the most advanced particle accelerator in the world. It will provide the United States with the preeminent facility for the study of high energy physics.

Located in Ellis County, Texas, the SSC is constructed within a racetrack-shaped tunnel, 54 miles in circumference and 14 feet in cross section diameter. The required right of way is 1,000 feet wide, an average of 100 feet below ground and approximately 100 feet in vertical dimension.

Within the tunnel, 10,000 superconducting magnets will focus and guide two beams of protons in opposite directions, approaching the speed of light. These beams will be made to collide head-on with the energy of 40 trillion electron volts. The particles emanating from these collisions will be studied and generate basic research information which will help scientists better understand the complexities of the universe.

In May of 1990, Universal Field Services was hired to acquire the 1,360 parcels of land required for the project. The land acquisition program consisted of four different property types:

1. Two administrative campuses consisting of 9,500 acres.
2. Sixteen 50-acre sites around the ring for the construction of magnet delivery shafts, the removal of fill and the construction of cooling ponds.
3. Nine sites for the construction of monitoring wells.
4. Six thousand, three hundred acres of subsurface fee for the construction of the tunnel.
5. The total land area being acquired consisted of 16,700 acres.

Eleven survey consultant firms were employed to perform the boundary surveys and to establish horizontal control on existing monuments.

Project Overview

The greatest challenge Universal faced was to explain the nature of the project and overcome the property owners' concerns about radioactive particles circulating at high speeds beneath their property, and then being brought together in a collision. Questions about ground water contamination, radiation, the impact on the value of their remainders, and how the tunnel construction might impact adjoining land all had to be addressed.

To answer these questions, the role of our survey section was greatly expanded. They were responsible for the traditional tasks of property boundary surveys, monument recovery, parcel staking, providing rights of entry, and scheduling information. In addition, the survey section was also responsible for providing state-of-the-art illustrative material to support all aspects of the land acquisition program, and assist in mediating boundary disputes and related problems with contractors, landowners and survey firms.

Eleven survey consultant firms were employed to perform the boundary surveys and to establish horizontal control on existing monuments.

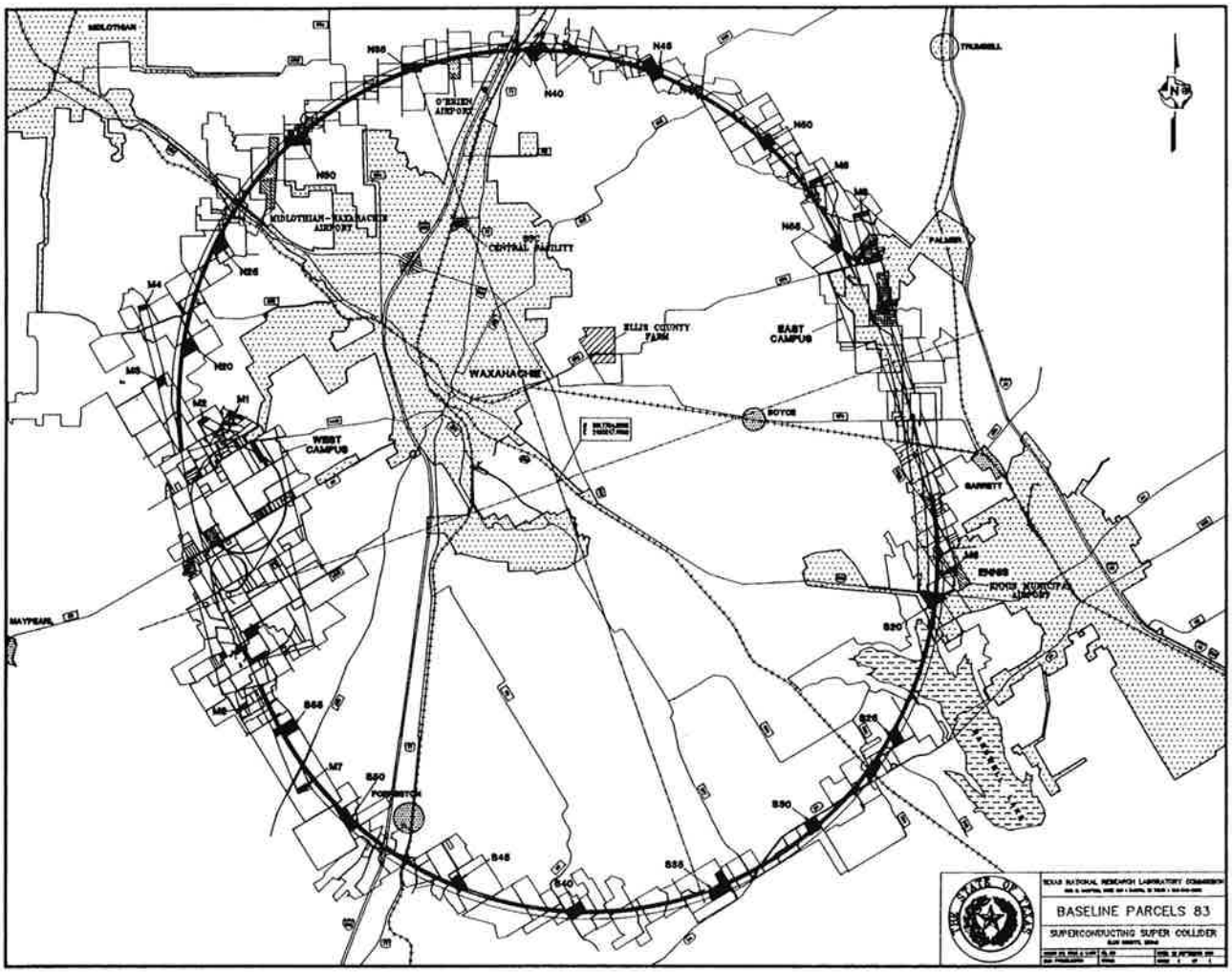
All parcels were referenced to the Texas Coordinate System (NAD 83) from these control monuments developed with the Global Positioning System and furnished to the contractors by Universal. Boundary surveys were performed to meet both state and national standards. Drawings were required to be in AutoCad format and in conformance with national map accuracy standards. Example survey boundary drawings, specifications and special instructions were provided to the survey companies.

The survey drawings included improvements within 200 feet of the proposed taking. Effecting easements were also shown, both visible and of record. All final plats and legal descriptions were certified and submitted with specified supporting data.

AutoCad became the primary tool to develop and provide this information. Supporting software included

Continued on Page 12

FIGURE 1



The Superconducting Super Collider

Continued from Page 11

DCA Coordinate Geometry and Digital Terrain Modeling Package, and the Lewis and Lewis Coordinate Geometry Package. Universal developed in-house software programs for vertical modeling and horizontal/vertical intersections. We also developed in-house programs to process quality assurance checks on all incoming/outgoing plats and descriptions.

Certified boundary plats were required on each parcel. In addition, a surface contour model was developed for the entire project. Three-dimensional horizontal and vertical models of the project ring were made using the location criteria provided by the Superconducting Super Collider Laboratory (SSCL). These models were used in developing three-dimensional intersections required for the completion of a legal description.

General land office original field note and patent maps on the 168 original surveys covered by the project limits were used. These patents were mapped, analyzed and plotted on aerial photography to determine if any state ownership (vacancies) existed, and a complete report of the findings was developed.

This information provided the support for three primary reference sources:

- "All" Drawing: Through the use of the coordinate system each parcel surveyed was inserted as a unique entity into a CADD "All" drawing which became the basis for many project drawings. Universal used this drawing to piece the parcels together like parts of a puzzle into a project base map in NAD 83. Errors, omissions, gaps and overlaps could readily be identified from this drawing.
- Parcel Booklets: These booklets provided a breakdown of the project limits on legal size paper, thereby allowing us to illustrate parcels in a given project area.
- Baseline Parcel Map: This map was continuously updated to show the total taking and parcel parent tract polylines. (see Figure 1)

The information that was developed from these reference sources was tailored for five primary user groups: the appraisers, agents, eminent domain attorneys, project administrators and title.

Appraisers

The appraisers were provided detailed parcel information to help them in performing the appraisal(s). The plat and legal description provided to the appraiser showed and described the whole property acreage and included all adjoining ownerships. Aerial photography covering all appraised areas was provided, and access corridors were defined on existing maps and special exhibits.

Property sketches were prepared illustrating the relationship of the tunnel to the surface. These drawings provided the appraiser with the distance and elevation information that was required to assess damages that might result from the acquisition.

An index of parcel survey and location maps, road maps, ownership maps and subdivision maps were developed to assist the appraisers. Drawings showing the contours of the property, lakes, drainage corridors, access corridors, and flood zones were also made available to the appraisers, as well as comparable sales maps.

Agents

The property sketches were used by the agents to explain to the property owners exactly how the project was affecting their property. The sketches showed the depth and thick-

Continued on Page 14

Figure 2 Subsurface Corridor

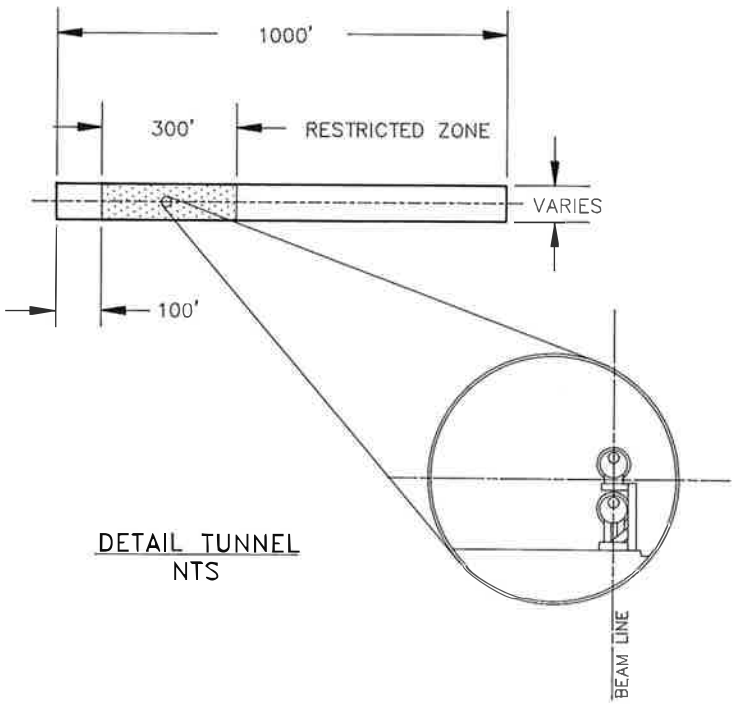
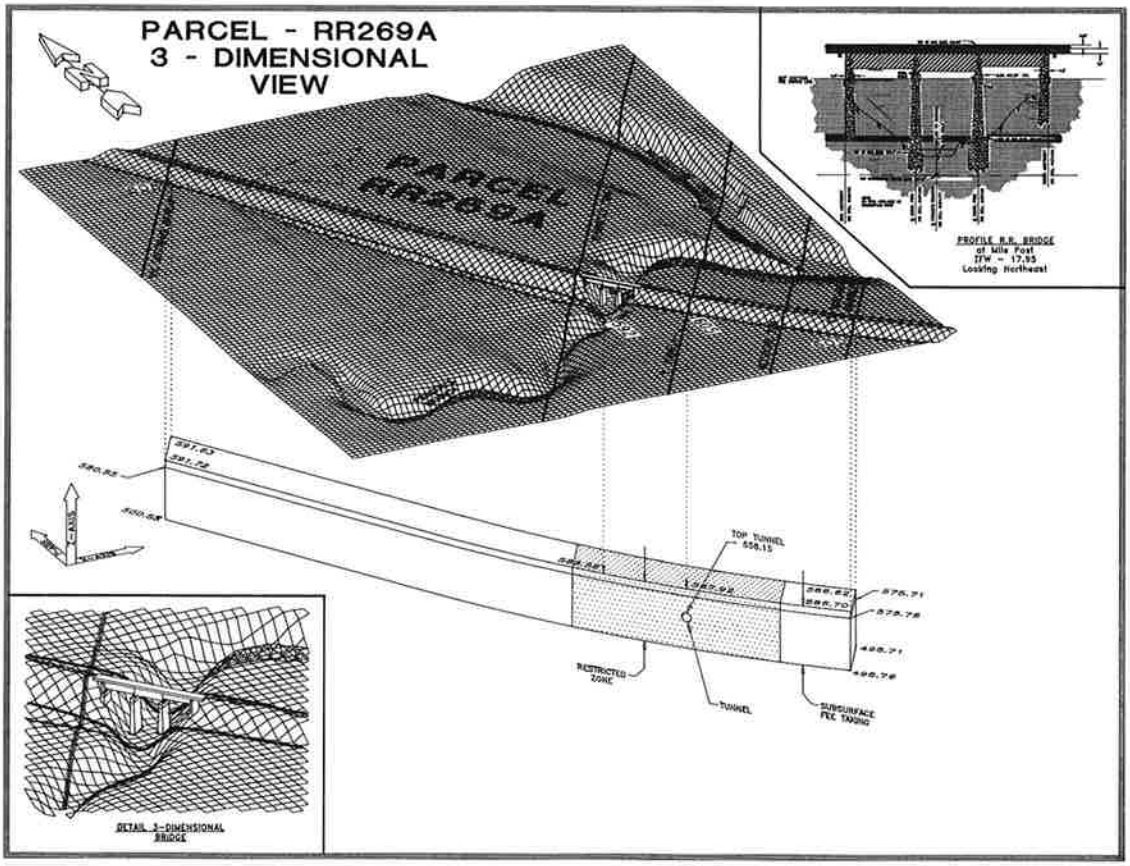


FIGURE 3 SUPERCONDUCTING SUPER COLLIDER



The Superconduction Super Collider

Continued from Page 12

ness of the subsurface taking, and enabled the agents to answer specific questions raised by the property owners. Agents were able to show the location of the tunnel in relation to homes, ponds, other improvements and surface features.

Although the 1,000 foot-wide subsurface right of way was acquired in fee simple, the property owners retained the right to drill water wells through a specified 700-foot wide area. (see Figure 2) A 300-foot restricted zone (150 feet on each side of the centerline of the tunnel) within which no drilling was allowed was established to protect the integrity of the tunnel during and after construction. The CADD drawings were used by the agent to review the deed with the property owner, and illustrate the sections of the deed that applied to the restricted zone and the unrestricted area.

The agents also had access to all project mapping. Special exhibits were developed to assist the agents in explaining both surface and subsurface takings. An elevation sheet was also developed for the agents that indicated the depth and thickness of the subsurface taking.

Eminent Domain Attorneys

A predominant issue in the eminent domain cases was whether the construction of the Super Collider would have a detrimental impact on the remainder property. In an effort to determine any damages, Universal studied all sales located over or near the ring after the public announcement of the SSC's location. The results of these studies show no impact on the market value of the remainder property. Interviews were also conducted with the buyers and sellers, and they reinforced the fact that no damages existed.

CADD drawings were used in court to illustrate the proximity of the sales to the property being acquired. These drawings were tailored to reflect properties of similar highest and

Figure 4 Superconducting Super Collider

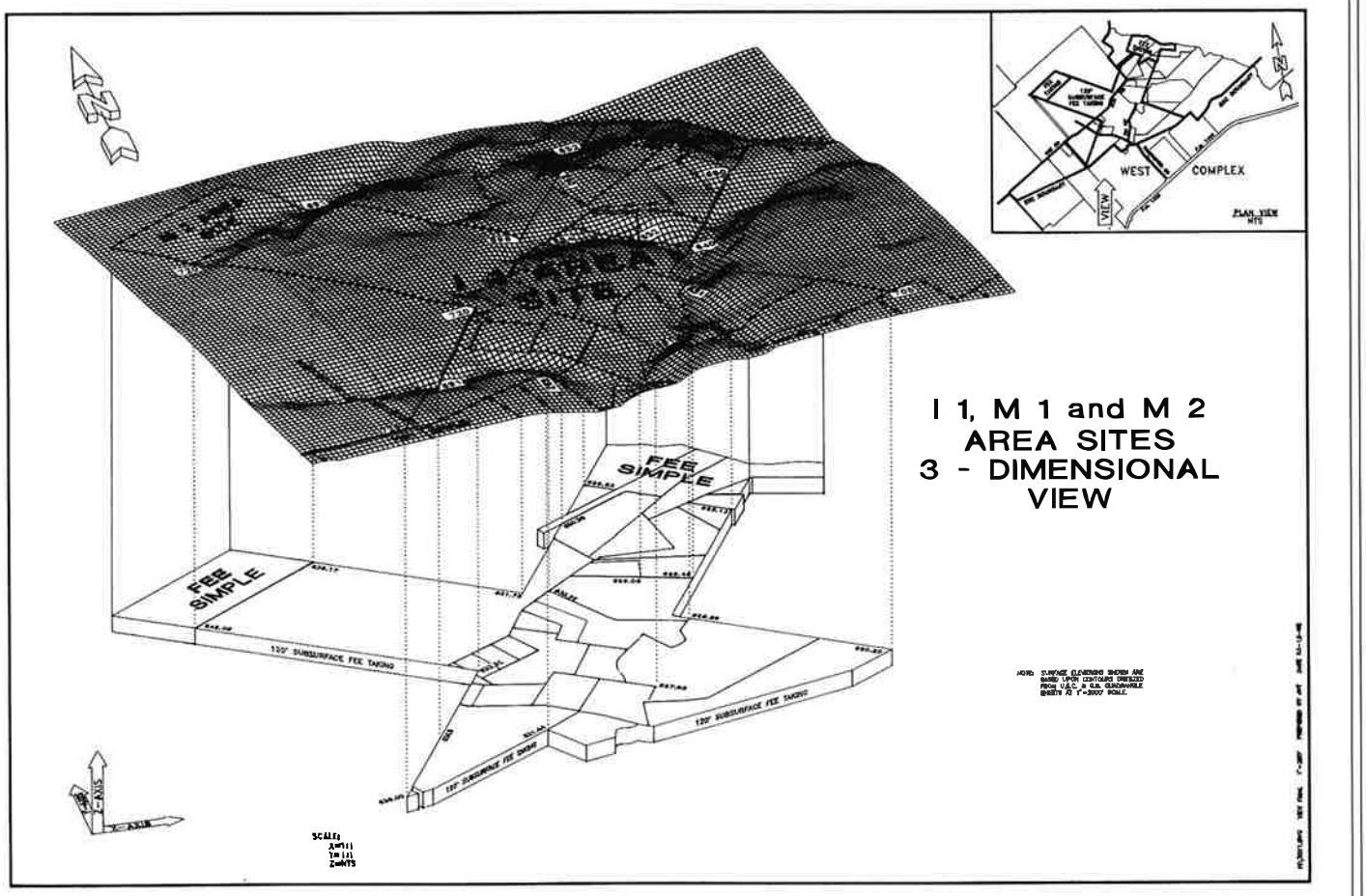
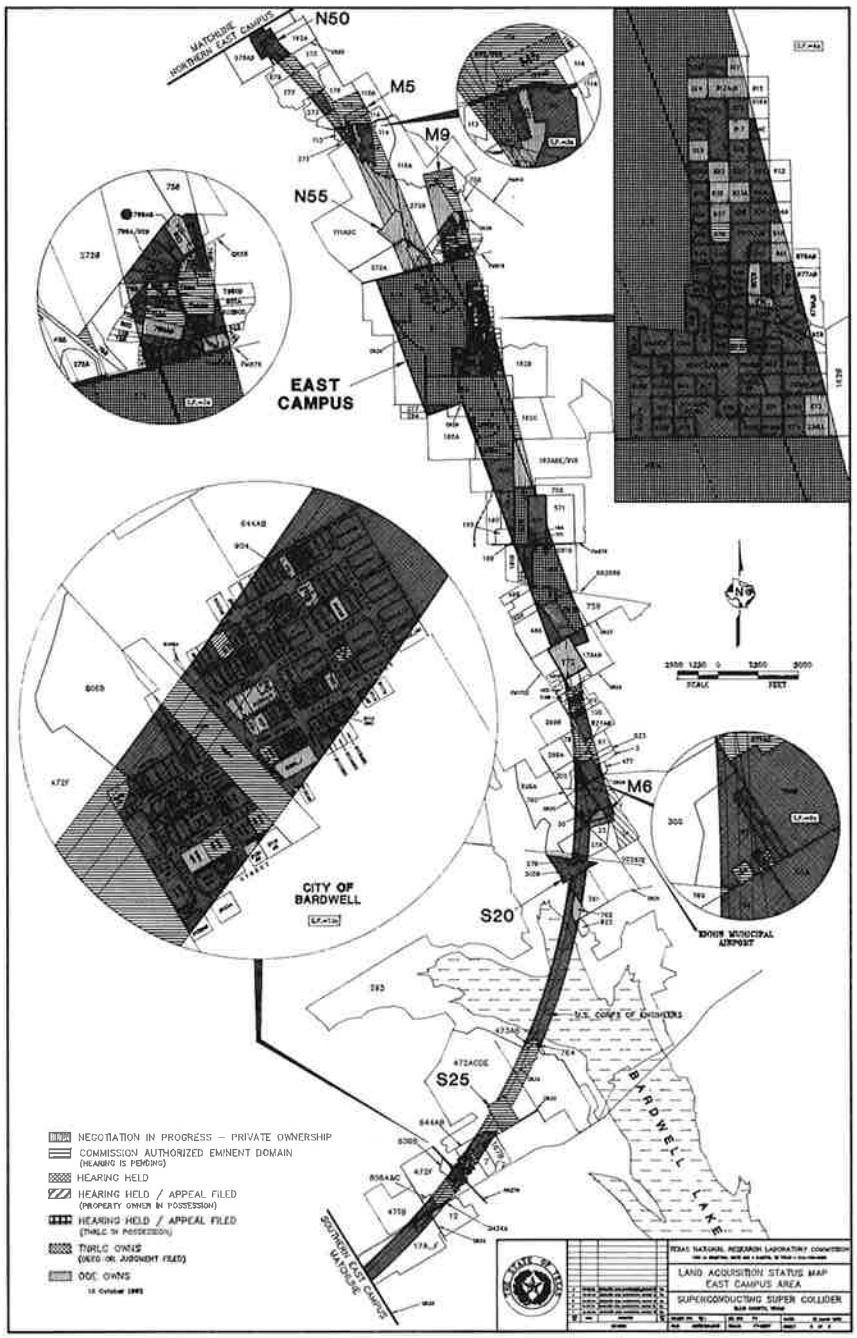


FIGURE 5



best use. Three dimensional CADD drawings were also used to depict the location of the subsurface in relation to the surface. The market value of the subsurface fee being acquired was determined to be nominal. The drawings were very valuable in court for illustrating the relationship of the tunnel to the remainder property to the jury. (see Figures 3 & 4)

ADMINISTRATORS

Status maps were developed to show the monthly status of each parcel being acquired. (see Figures 5 & 6) CADD drawings were also used to show the consistency of appraised values, current and proposed land uses, to illustrate the location of the campus boundary for fencing purposes, and other items that impacted the project.

In defining the requirements for the 16 tunnel access sites located around the ring, it was important to know the configuration and topography of the land and how it could be

Continued on Page 16

The Superconducting Super Collider

Continued from Page 15

accessed in order to determine exactly how many acres needed to be acquired. The property contours and flood plain information provided essential data on where cooling ponds could be located and excavated fill stored.

Construction plans required the purchase of land for utility service areas to distribute power and provide refrigeration to the superconducting magnets. To accommodate the delivery of the 10,000 superconducting magnets, sufficient access and vehicle turning ratio's were required. The design requirements were overlaid onto the parcel sketches to establish the amount of land to be acquired. In certain cases, the owners were allowed to suggest an alternative configuration that diminished the impact to their crops, but still accomplished the objective. In these cases, Universal was able to effect a negotiated settlement which satisfied both the needs of the project and the property owner.

Title

As part of the acquisition program, Universal surveyed and described all the land being acquired. In some cases the results of these surveys showed out parcels, strips and gores that were not covered by a deed. CADD drawings were used to illustrate to the property owner the difference between what was recorded by deed and what the property owner believed he owned. This assisted the agent in explaining how the discrepancy in title was being handled.

Several major real estate lenders held loans on property which was affected by the project. Many requested that the affected parcels be grouped so that they could consolidate the processing of releases, thereby facilitating the closing process. "Blanket" releases were obtained from the affected taxing authorities by providing overlays of the parcels on road maps, school districts, city limits, etc.

Summary

The unique nature of the Superconducting Super Collider project demanded many innovated approaches to traditional survey applications. State-of-the-art computer technology was necessary to manage the integration of surface and subsurface acquisition, and to respond to diverse mapping needs generated from this complex project.

Many technical applications were developed by the survey section. A highly accurate horizontal control network based on the Texas Coordinate System (NAD 83) was the basis for much of the work. The X, Y and Z geodetic coordinates that located the ring and all campus area boundaries were provided by the SSCL. This data was used to develop digital models of the surface and underground takings for the entire project.

Universal used both in-house and consultant staff on the SSC project to provide the surveys and legal descriptions. The majority of the CADD work was performed by in-house staff, which consisted of a survey manager, three staff surveyors, four survey technicians, and a data input operator. The ability of this relatively small section to quickly and accurately respond to the informational needs of a diverse group of users was a key factor in complying with rigorous U. S. Department of Energy schedules, and to complete the land acquisition project in a timely manner. IRWA