SSCL-SR-1232

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November 1993
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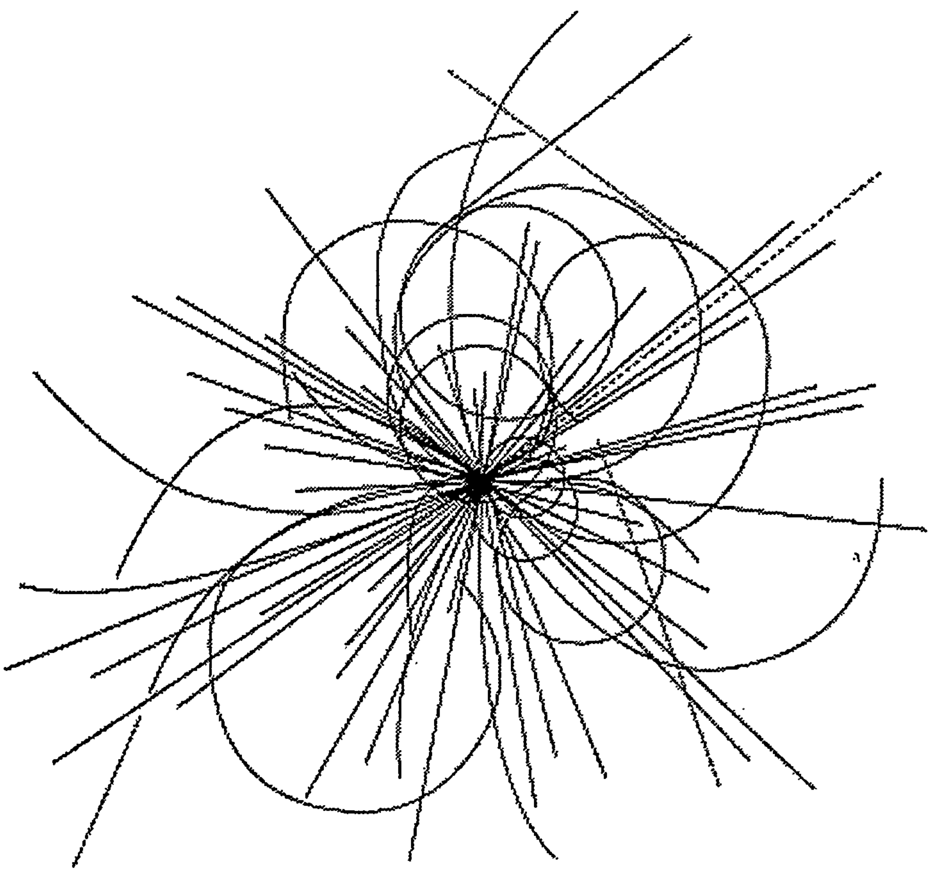
Planning Group of the
Directorate and
Conventional Construction
Division

Technical Site Information



Superconducting Super Collider Laboratory

SSCL-SR-1232

Technical Site Information

Planning Group of the Directorate and
Conventional Construction Division

Superconducting Super Collider Laboratory*
2550 Beckleymeade Ave.
Dallas, TX 75237

November 1993

*Operated by the Universities Research Association, Inc., for the U.S. Department of Energy under Contract No. DE-AC35-89ER40486.

PREFACE

Work on the Technical Site Information (TSI) document began in the spring of 1993 at the request of the U.S. Department of Energy. An earlier plan prepared in 1992 was considered out of date and in need of revision because the applicable DOE Order had since been modified. Current specifications called for a TSI that would include a description of the facilities and infrastructure to be constructed during the project phase of the SSC Laboratory. Originally, subsequent chapters of the document were to cover the ten-year period following initial operation of the experimental program. Cancellation of the project in October 1993, however, made any such discussion moot, and the TSI presented here is limited to a description of the facilities that were to have been provided within the baseline funds called for in the intial program.

To prepare the TSI and guide its development, a Working Group was formed consisting of individuals from several divisions of the Laboratory and from DOE and the Texas National Research Laboratory Commission. The members of the Working Group were George Belcheff, Greg Bush, Tom Elioff, John Garland, Pete Jacobs, Oscar Orban, Aubie Oslin, Willy Poon, Wayne Reber, Dan Reich, Bob Sims, Shelly Sipes, Tim Toohig, and Jeff Western.

The report was prepared by Oscar Orban with the special assistance of Willy Poon and Shelly Sipes based on contributions from all members of the Working Group. In addition, technical and administrative support was provided by Elbert Banzon, David DeSanto, Karen Earley, Michelle Neumann, and Shirley Watson.

This is one of the final reports to be issued by the SSC Laboratory. It is dedicated to all those within and without the Laboratory who believed in the validity of the Super Collider concept and worked so hard to achieve it before support was withdrawn.

James R. Sanford
Working Group Chair
November 17, 1993

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Introduction

This document presents the technical site information for the Superconducting Super Collider project. The Ellis County, Texas site was selected by the Department of Energy in 1989. After assembling the initial staff at temporary facilities in Dallas, the SSC Laboratory began site-specific design work. The resulting design for the SSC accelerators, experimental areas, and laboratory facilities were described in the *Site-Specific Conceptual Design Report* of July 1990. Since then, design specifications for the technical components and conventional facilities have been formulated. In fact, a very significant amount of surface and underground construction has been initiated and many buildings have been completed. Testing of prototypes for most technical components is advanced. The construction phase of the SSC project is approximately 20% complete.

At this time, it is appropriate to capture the conventional design work which has taken place since 1990. This documents records regional and physical information used in site studies, summarizes the site studies for conventional facilities, and presents site layouts for buildings and utilities as they would have been at the end of the construction project. As such, this documents summarizes and complements the work of many groups in the SSC laboratory, the Texas National Research Laboratory Commission (TNRLC), and several subcontractors to the SSC project. The document contains extensive references to their work contained in other drafts and final reports. In particular, it borrows heavily from the *Site Development Plan* (released in draft form in January, 1992) which has, to date, guided aspects of site development.

A main purpose of this document is to guide the future development of the West and East Complexes and of the remote sites. These areas are based on a view of the SSC Laboratory as an evolving research facility that has upgrade potentials inherent in its initial design. It is recognized that any considerations of expansion beyond the SSC initial capabilities are tentative. Construction beyond the current SSC project will depend on technical and funding considerations that will be current ten years from now. However, as the SSC technical systems and facilities have a projected operational life longer than twenty-five years, it is realistic to plan for the upgrades, to reserve areas for expansion, and to ensure current construction and land usage are consistent with these upgrades.

This document also complies with the DOE's objectives for site planning. However, the DOE's order as written applies directly to improvements of existing sites. Because of the scale of the initial construction for the SSC project (over many undeveloped sites and over many long years), the DOE objectives have been applied to fit the SSC situation. The document will concentrate on the West and East Complexes and treat other sites (N, and S) by single representatives rather than in detail. Also, a twenty year planning window has been divided into two parts—existing programs and future programs. Existing programs include only the current SSC project and those other programs with identified funding sources. Future programs include all other programs. Instead of detailing existing site conditions, this report takes the existing plans for the SSC project as the base from which to project the construction needs of future programs. A table in Appendix I relates the sections of this document to the outline suggested in the DOE order.

The first chapter contains information on the SSC site region: socioeconomic data on surrounding communities, utilities services near the project sites, and physical characteristics of the region. The second chapter briefly discusses the gross requirements for the construction phase of the SSC project. It then summarizes the studies and decisions that lead to the facilities and utilities layouts shown in the third chapter. The third chapter closes with a discussion of site development issues such as site security and environmental mitigation.

Chapter three describes the sites at the end of the SSC project's construction phase. These sites form the planning base for future development. Chapter four discusses the possible technical upgrades to the accelerators and estimates the extra personnel, facilities, and utility demands the upgrades would require. The chapter also considers which of the upgrades may be built in the first ten years of laboratory operations. Chapter five presents the Master Plan, the site layouts at the end of the twenty-year planning period (2013).

The sixth and final chapter summarizes the construction plan for the next five years (1994–1999) as defined by the SSC Laboratory's current baseline.

This document is a member of a group of documents defining the site development objectives. After delimiting the development zones and the preservation zones, this document does not address the uses and management of the preservation zones. Further information on these zones is contained in the *Land Use Management Plan* (to be released). Also, while this document addresses some environmental issues related to facilities siting, a separate Environment, Safety & Health document defines the five-year effort required for site monitoring and compliance.

1.0 REGIONAL CONDITIONS

This chapter provides background information on the SSC project region. The first section describes the site selection process and the determination of the site boundaries. The second section reviews regional social and economic information previously collected to assess the project's impact on the region. The last three sections summarize the ordinances and regulations affecting site development, the infrastructure serving the region, and the geography and climate of the region.

1.1 History of the Site

In July 1983, the High Energy Physics Advisory Panel recommended to the U.S. Department of Energy (DOE) the consideration of a multi-TeV high-luminosity proton-proton collider. After initial feasibility studies, the DOE decided to proceed with a conceptual design of the Superconducting Super Collider (SSC) project.

1.1.1 The Site Selection Process

After reviewing the *SSC Conceptual Design Report*[1] (March 1986), the DOE recommended the project to the Reagan Administration, which approved the project for submission to Congress in January 1987. In February 1987, the Secretary of Energy announced a site selection process to assure an open and fair site competition. The DOE issued its *Invitation for Site Proposals for the SSC*[2] (ISP) in April 1987, and received 43 site proposals by the cutoff date, September 2, 1987. Of these, seven sites did not meet all the basic qualifications and one site was withdrawn from consideration by its sponsors. For the remaining 35, a joint committee of the National Academies of Science and Engineering provided an independent evaluation of the proposal's information which resulted in the announcement of an un-ranked Best Qualified List (BQL) of sites in January 1988.

The DOE's SSC Site Task Force then reviewed all available information on the BQL sites, visited the sites for formal presentations and review, and presented follow-up questions to the sites' sponsors. After reviewing the supplemental data, including that assembled for the Environmental Impact Statement (EIS), the Site Task Force evaluated the sites based on the criteria and sub-criteria given in the Invitation for Site Proposals and each criterion was assigned a rating of "outstanding," "good," "satisfactory," "poor," or "unsatisfactory". The main criteria were Geology (especially stability and constructibility), Regional Resources (including local support), Environment (minimal impact and flexibility to mitigate), Setting (land acquisition issues), Regional Conditions (climate and physical characteristics), and Utilities (proximity, capacity, and cost). The sub-criteria and the ratings for the Ellis County site are given in Table 1.1.1-1.

A major factor working in the site's favor was the site geology, the Austin Chalk and Taylor Marl formations, which have well-known, excellent tunneling characteristics. Other factors included the efficient regional transportation network and the established high-technology industrial base supported by a large, highly skilled work force. The Dallas/Ft. Worth region also offered high-quality colleges and universities, affordable housing, and advanced medical facilities. Also significant was the strong institutional support the State of Texas provided the project through the Texas National Research Laboratory Commission (TNRLC).

The Task Force also discussed and refined the life-cycle cost analyses developed for each of the Best Qualified List sites. The Task Force presented its findings in the *SSC Site Evaluations*[3] (November 1988). In addition, the DOE oversaw preparation of a *Final Environmental Impact Statement*[4] (December 1988) for each of the BQL sites. Based on the evaluations and the EIS analysis, the DOE selected the Ellis County site proposed by the State of Texas and published its Record of Decision in January 1989. In March of 1989, the DOE's Maintenance and Operations contractor began to develop the SSC Laboratory in temporary facilities near the site. Figure 1.1.1-1 shows the Ellis County site and the surrounding region.

Table 1.1.1–1. Site Selection Criteria and Ellis County Site Ratings.

Criteria	Texas Ellis County Rating
Geology and Tunneling	Outstanding
Geologic Suitability	Outstanding
Operational Stability	Good
Operational Efficiency	Good
Construction Risk	Outstanding
Regional Resources	Outstanding
Community Resources	Outstanding
Accessibility	Outstanding
Industrial Base	Outstanding
Institutional Support	Outstanding
Environment	Outstanding
Environmental Impact	Outstanding
Compliance with Requirements	Good
Ability to Mitigate	Good
Setting	Outstanding
Real Estate	Outstanding
Flexibility	Good
Natural and Man-made Features	Good
Regional Conditions	Good
Vibrations and Noise	Good
Climate	Outstanding
Utilities	Good
Electricity	Good
Water	Good
Other Utilities	Good

Source: DOE/ER–0392, SSC Site Evaluations, Nov., 1988

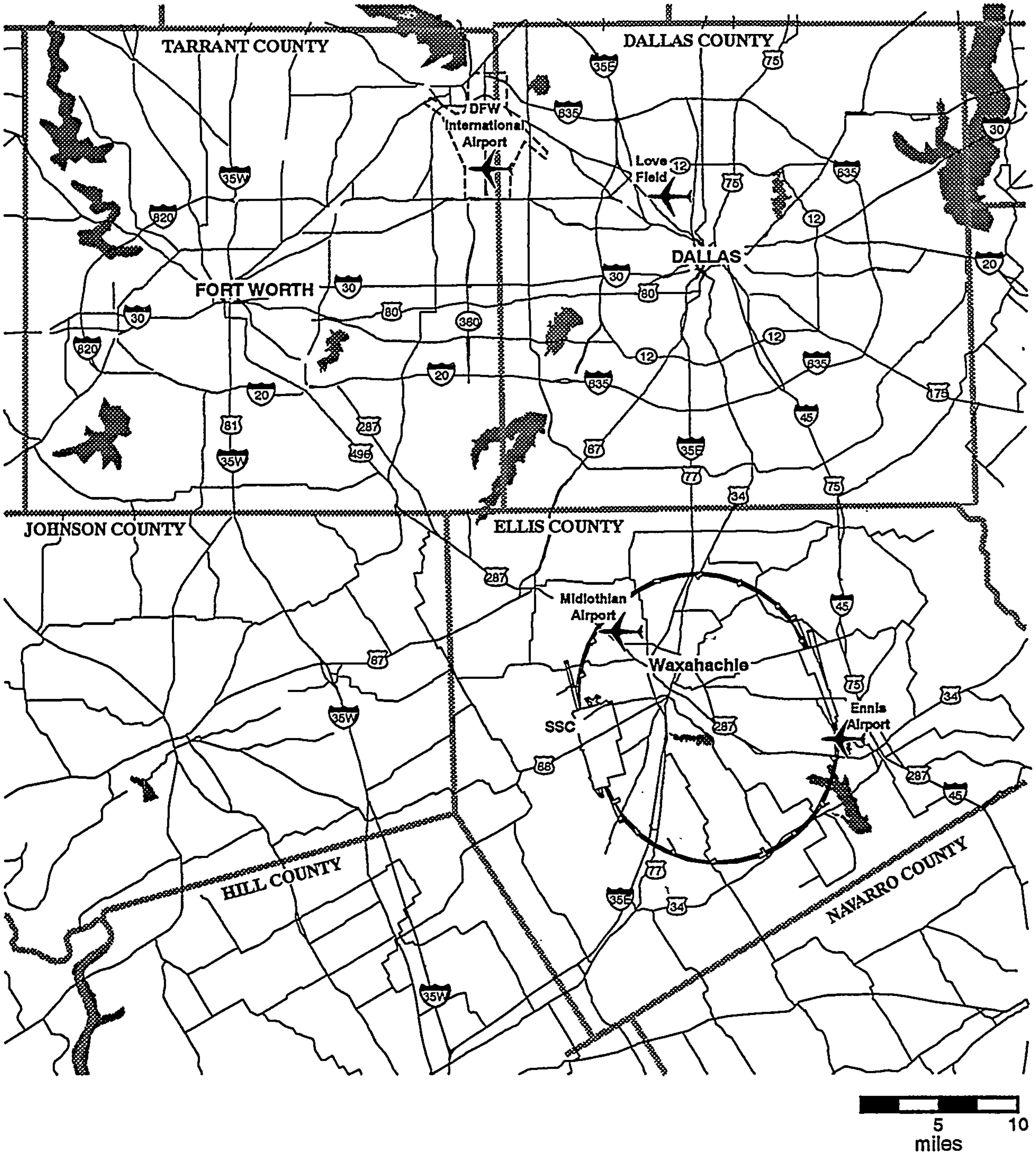

Figure 1.1.1-1. SSC Project Site Region.

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1.1.2 Footprint Description

The collider is housed in a 54-mile, oval tunnel divided into four sections-the North and South Arcs and the West and East Clusters. Because of the great length of the collider tunnel, two types of land will be purchased-fee simple and stratified fee. Fee simple purchases involve a transfer of land title and rights to the US DOE. Stratified fee purchases provide a 'right-of-way' for the tunnel to pass underneath lands that required no construction on the surface. By requesting stratified fee lands in the arcs, the Laboratory reduced the project's impacts (such as relocations) on the region.

The collider is supported by surface facilities in the West Complex and the East Complex and at eighteen Service Areas around the collider arcs. The West Complex, the largest site, contains the injectors (used to accelerate the particle beams to 2 TeV), the collider West Utility Straight (used to inject, accelerate, and dump the beams), and interaction regions (used to cross the beams at interaction points). The East Complex contains a utility straight and interaction regions. The Service Areas around the arcs house cryogenic and conventional facilities for cooling the collider magnets and providing necessary services such as tunnel ventilation. For safety reasons, the project also requires fee simple Monitoring Areas near the West and East Complexes. These areas are shown in Figure 1.1.2-1.

1.1.3 Determination of the SSC Footprint

During the site selection process, it was understood that Texas's proposed location for the collider ring and the boundaries of the associated surface areas were subject to adjustment by the DOE and the SSC Laboratory. One of the first major tasks of the new laboratory was to fix the site boundaries so that land acquisition could proceed. The technical arguments behind the siting of the collider are explained in the *Footprint Characterization Document*[5] (June 1990). Technical changes in the collider and the injector were incorporated into the footprint. An extensive geotechnical survey was undertaken by the Laboratory to supplement the exploratory survey done by the State of Texas for its proposal. New borings better defined the interface between the Austin Chalk and Eagle Ford Shale formations on the west side of the ring. Based on preliminary information, the Laboratory adjusted Texas's proposed ring location and defined new surface boundaries for the West and East Complexes in *Computer Aided Design of the Digital Footprint*[6] (March 1990). The report also suggested new boundaries for the Collider Service areas.

The Service Area boundaries were used for further site studies. The Laboratory and its Architect-Engineer/Construction Manager (A-E/CM) studied the physical features of the proposed Service Area sites. The North (N) arc and South (S) arc sites were considered for impediments to construction such as flood plains and utility easements. As a result of this study, several of the N & S site boundaries were adjusted. This study, the *Service Site Adequacy Study, Phase I*[7] (March 1991), is considered more fully in section 2.4. The final N & S boundaries are shown in Figure 1.1.2-1, the SSC Footprint.

The Laboratory waited for the completion of the geotechnical survey before it finalized the precise tunnel elevation. The Laboratory requested its A-E/CM subcontractor, to compare several tunnel elevations which would reduce the length of tunnel running through the Eagle Ford Shale formation (a less desirable rock). The A-E/CM considered geotechnical data, shielding and safety criteria, and costs before making its recommendation in the *Collider Tunnel Elevation Study Report*[8] (October 1991). The elevation change raised the collider in its western half and lowered it on its eastern half. The raising of the ring maintained the criterion of 30 ft of cover everywhere, but necessitated the purchase of more fee simple land near five creek crossings. The new elevation did not affect other fee simple land boundaries.

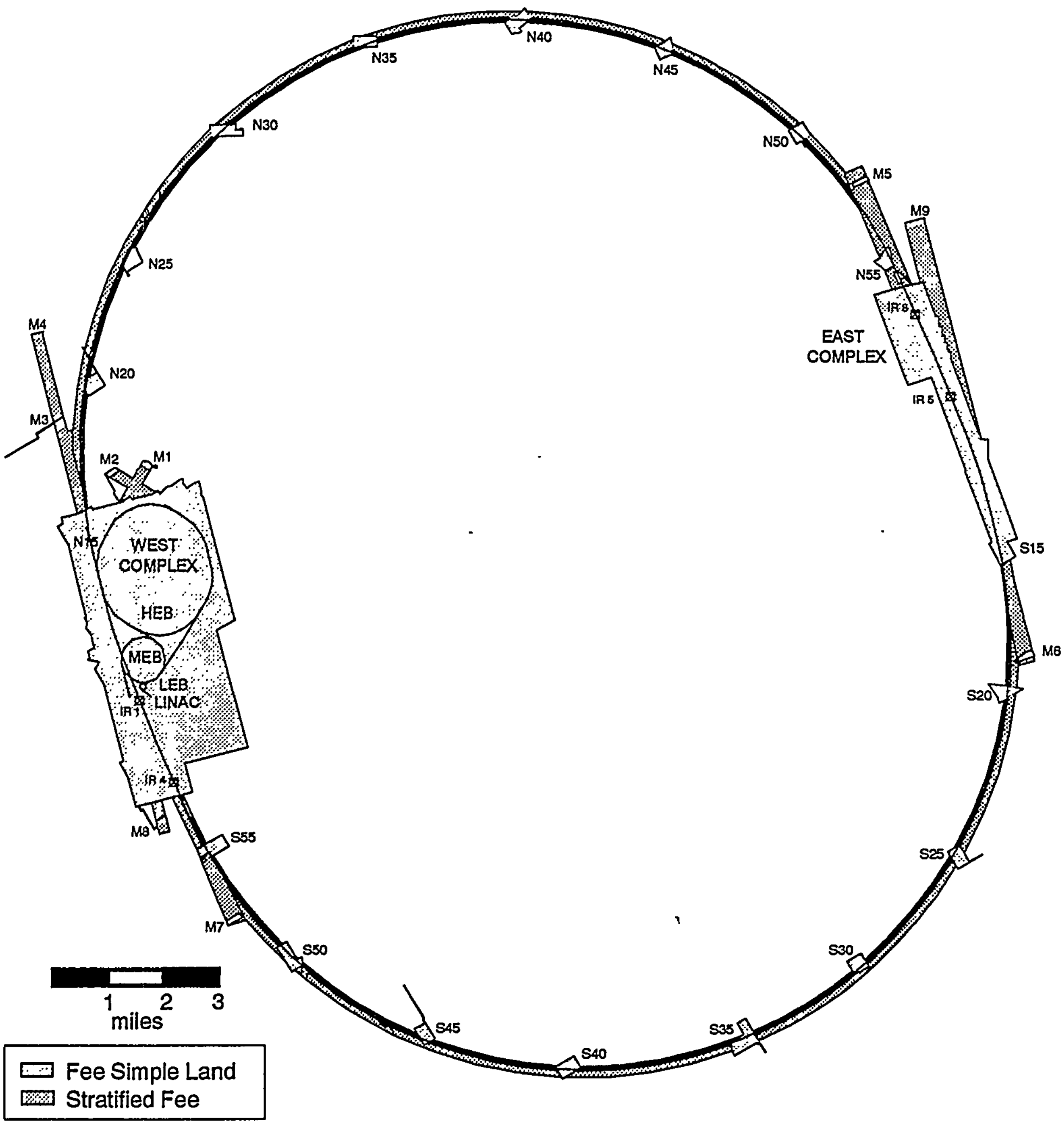

Figure 1.1.2-1. The SSC Footprint.

1.1.4 Land Acquisition and Project Construction

Following the determination of the land requirements by the Laboratory, it transmitted to TNRLC the coordinates of land plots needed for the construction of the accelerators and research facilities. The land requirements for the West and East Complexes were transmitted in the *Computer Aided Design of the Digital Footprint* (March 1990). After the tunnel elevation was finalized and the N & S sites were evaluated, the finalized fee simple boundaries and the finalized stratified fee boundaries were transmitted in the *SSC Real Properties Requirements Volume I* [9] (December 1991). Based on these coordinates, staff members of the TNRLC determined the location and extent of the specific parcels of land to be acquired. The acres of land required are given in Table 1.1.4-1. The table shows the acreage originally requested and the acreage required after all modifications and studies were complete. The acquisition of land began in 1990 and was largely completed by 1993.

Table 1.1.4-1. SSC Land Requirements.

Functional Area	Invitation for Site Proposals (acres)	SSC Revised Requirements (acres)
Fee Simple		
West Complex	5,510	7,520
East Complex	1,980	1,921
Service Areas and Access Points	200	984
Monitoring Sites		163
Creek Crossings		40
Subtotal	7,690	10,628
Stratified Fee		
Tunnel 1000 ft.	3,750	4,235
Muon Absorption	4,390	1,887
Subtotal	8,140	6,122
Total	15,830	16,750

Source: SSCL-SR-1041 (Rev. 1), Footprint Characterization Document, June 1992.
SSCL-SR-1049 (Rev. 2), SSC Real Property Requirements, Vol. I, Dec. 17, 1991.

In the EIS, the DOE committed to preparing a *Final Supplemental Environmental Impact Statement*[10] (SEIS) (December 1990). This document assessed the effects of technical and siting changes and updated the information in the initial EIS. Among the major changes addressed were the change of collider injection energy and an increase in the number and size of the collider service areas. Other differences from the EIS arose from additional site-specific data gathered on the defined site and the application of more sophisticated analysis. The DOE issued the draft SEIS in August 1990, and held public hearings in mid-September. The DOE issued the final SEIS in December 1990, and published its related Record of Decision to proceed with construction in February 1991.

1.2 Regional Overview

The SSC site is located within Ellis County, approximately 25 miles south of Dallas and 35 miles southeast of Ft. Worth. The site is accessible from the Dallas-Ft. Worth metropolitan area (the metroplex) via interstate highways I-35E and I-45. The metroplex includes communities ranging from the large cities of Dallas and Ft. Worth to smaller cities and towns. The outlying areas are predominantly rural. Previous Figure 1.1.1-1 shows the four-county region around the site.

The SSC ring encircles the city of Waxahachie, the Ellis County seat, and is bordered by the municipality of Ennis on the southeast, the community of Maypearl on the southwest, and the town of Red Oak on the northern edge of the ring. Other surrounding communities include Italy, Midlothian, Ovilla, Ferris, and Palmer. Figure 1.2-1 displays Ellis County, its cities and towns, and its independent school districts (ISDs), which form a tax base for support of public schools.

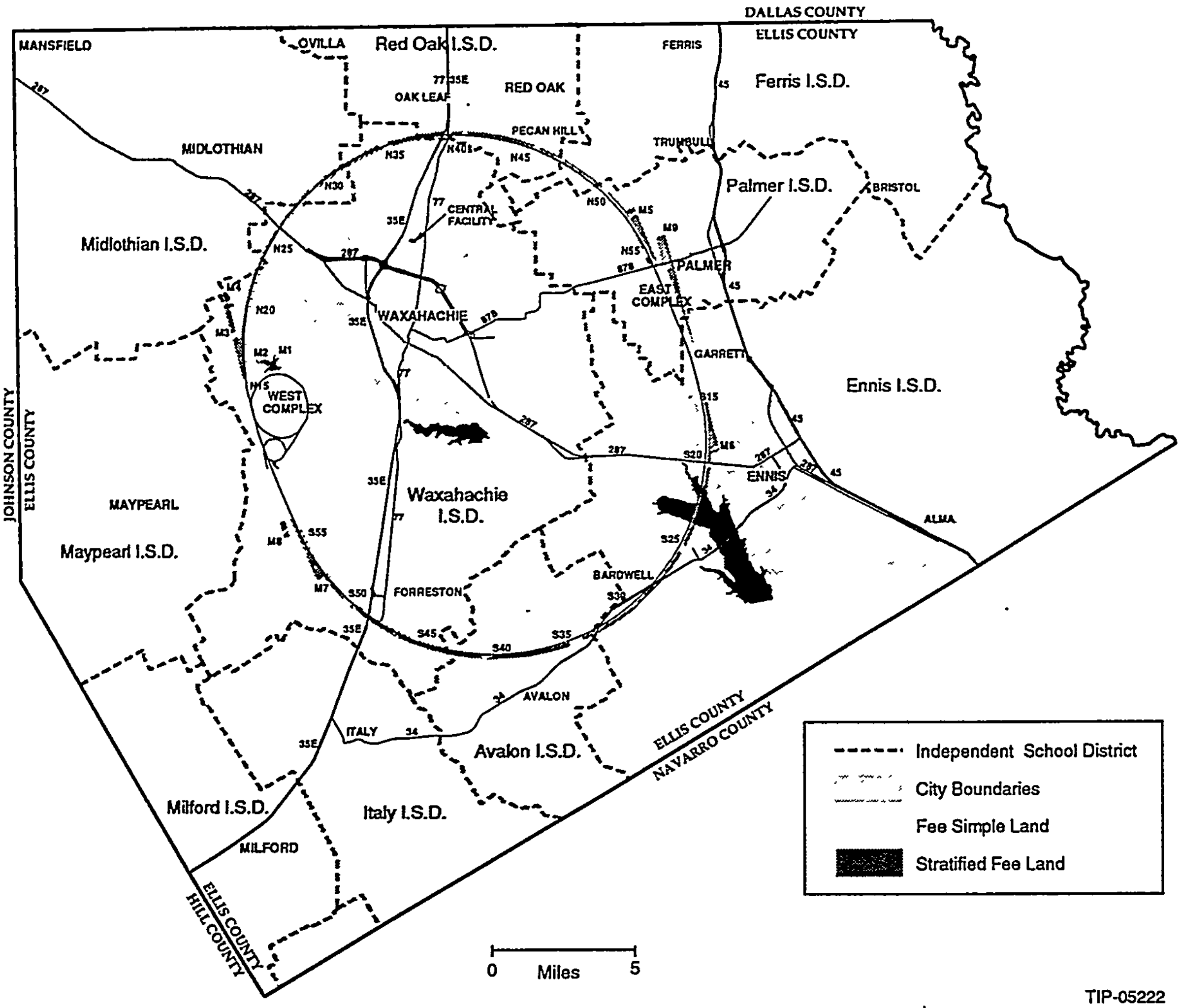

Figure 1.2-1. Ellis County.

The social and physical characteristics of Ellis County have been extensively documented in the several volumes of the *Land Use and Infrastructure Plan*[11] (June 1991). The SEIS and its supporting documents analyzed the effects of the SSC project on the communities near the project site. This section considers potential influences of the surrounding communities and residents on the SSC site development.

1.2.1 Demographic Features

The first two columns of Table 1.2.1-1 show the populations of Dallas and Ellis counties in 1980 and 1990. The third column shows the distribution of project-related 'in-migrants' as recorded in the *Socioeconomic Monitoring Report*[12] (August 1992). The 'in-migrants' count includes the employees (and their families) of both the SSC Laboratory and its A-E/CM contractor. The last column shows that for most communities, the 'in-migration' is a negligible increment to their 1990 population. Even in those communities most directly affected (influx greater than 3%), the survey found no significant increase in demand for services. This implies that the communities can smoothly incorporate the in-migrants and indeed have welcomed SSC workers and their families.

Table 1.2.1-1. Demographic Estimates and Projections of Surrounding Communities.

	Total Population		SSC Effect In-migration by 1992	Percentage of SSC In-migration to Total Population in 1990
	1980	1990		
Dallas County				
Cedar Hill	6,849	19,976	402	2.0%
De Soto	15,538	30,544	1,415	4.6%
Duncanville	27,781	35,748	399	1.1%
Lancaster	14,807	22,117	194	0.9%
Rest of Dallas County	1,491,574	1,744,425	2,395	0.1%
Ellis County				
Ennis	12,110	13,883	34	0.2%
Ferris	2,228	2,212		0.0%
Italy	1,306	1,699		0.0%
Midlothian	3,219	5,141	120	2.3%
Palmer	1,187	1,659		0.0%
Red Oak	1,882	3,124	170	5.4%
Waxahachie	14,624	18,168	646	3.6%
Rest of Ellis County	23,190	39,281	104	0.3%
Total	1,616,295	1,937,977	5,879	0.3%

Source: Socioeconomic Monitoring Report.

1.2.2 Community Attitudes

Comments received from area residents are documented in the volumes of the Final SEIS. To characterize the diverse responses, assessors grouped the residents into four general categories: town residents; farm operators; rural, non-farm residents; and urban/ suburban residents. In general, most residents accept and welcome the SSC for the development it brings, but they would like to ensure that the development does not erase the unique character of their communities and way of life. This sentiment is expressed particularly strongly by the long-term county residents.

An important element of the way of life the county residents wish to preserve is the local autonomy enjoyed throughout Texas. A vocal group of residents has opposed the formal adoption of a county zoning plan which they perceived as an imposition from the outside. The plan was designed to coordinate and aid the economic development of the county and was to be approved and implemented by the Ellis County Commissioners Court. While the plan was not approved by the court, it still may guide the county-wide development.

1.2.3 Labor Supply

A major financial and manufacturing center, the Dallas-Ft. Worth metroplex has a skilled work force. High-technology employers have attracted a labor pool consisting of many technical and other specialized personnel. High-tech industries include aerospace, communications, electronics, and semiconductors. The presence of a large, highly skilled work force has allowed the SSC Laboratory to hire most technicians and engineers from the local labor market and thus achieve the rapid ramp-up the project needed in its early stage.

1.2.4 Materials Availability

Because of the high-technology industrial base in the D/FW region, vendors had already created the distribution networks of commercial materials and equipment needed in a project like the SSC. Such needs range from copiers and micro-computers for offices to electronic instruments and machine tools for shops. The large number of regional and national construction companies in the Dallas-Ft. Worth area provided a source for materials and equipment needed in the civil construction of the SSC project. That equipment which is singular to the SSC project and manufactured elsewhere (for example, the superconducting magnets) can readily be shipped to the site because of the excellent regional transportation network.

1.2.5 Housing and Accommodations

Based on data from the North Central Texas Council of Governments, the SEIS concluded that the housing demand created by the SSC project in-migration could be absorbed by available units and ongoing development. A related concern is the availability of short-term accommodations near the site. There are 260 rooms available in Ellis county-154 in Waxahachie, 68 in Ennis, and 45 in Midlothian. Also, there is no facility in the county that could accommodate a mid-size conference of 500 people. This indicates the need to develop facilities on or near the SSC site that could house short-term visitors and support a mid-size conference.

Houses and other structures near the SSC sites were identified to model the effects of noise emanating from the SSC sites. The noise study and its conclusions are described under 'Noise Impact' later in the section.

1.2.6 Schools

The independent school districts serving Ellis County are shown in Figure 1.2-1. The SEIS concluded that all districts have sufficient classroom capacity to accommodate the growth created by the SSC project, but Waxahachie, Red Oak, and Midlothian would have to slightly increase instructional staff to maintain their current student-to-teacher ratios. The *Socioeconomic Monitoring Report*, found that through 1992 the enrollment of SSC-related students was about 20% below the enrollment estimated in the SEIS. The survey also assessed the impact of the SSC project on the tax base used to fund the schools. In most cases, the survey found a net loss of funds in early years and projected a net gain after 1995. The largest unexpected loss from the local tax base was due to the purchase of a warehouse that was converted to the SSC Central Facility.

1.2.7 Emergency Services

The SEIS concluded that the Dallas and Tarrant county municipalities could absorb the extra demand on their police, fire, and health services, but that the Ellis county municipalities may need to hire extra personnel to maintain 1990 service levels. The monitoring survey found that, at this time, there is no correlation between the SSC in-migration and the fluctuations in service requests. The SSC Laboratory itself will have an impact on local services. The Laboratory's emergency service personnel will cooperate with county and municipal sources in emergencies on the project sites. However, due to the special training and materiel required for tunnel emergencies, only project personnel will enter the tunnels during emergencies.

Figure 1.2.7-1 shows that four Ellis county cities (Midlothian, Red Oak, Waxahachie, and Ennis) have their own 911 emergency districts. All other areas are covered by a dispatch center run by the County Sheriff's Office, which coordinates response among the various police and fire departments. Figure 1.2.7-2 shows the Fire Protection Districts throughout the county and the locations of fire stations. Figure 1.2.7-3 shows the medical response regions. Only Midlothian and Ennis maintain their own paramedic response units within their fire departments. The rest of the county is covered under a contract with the East Texas Medical Ambulance Service. The two hospitals shown in the figure are Baylor-Waxahachie and Baylor-Ennis.

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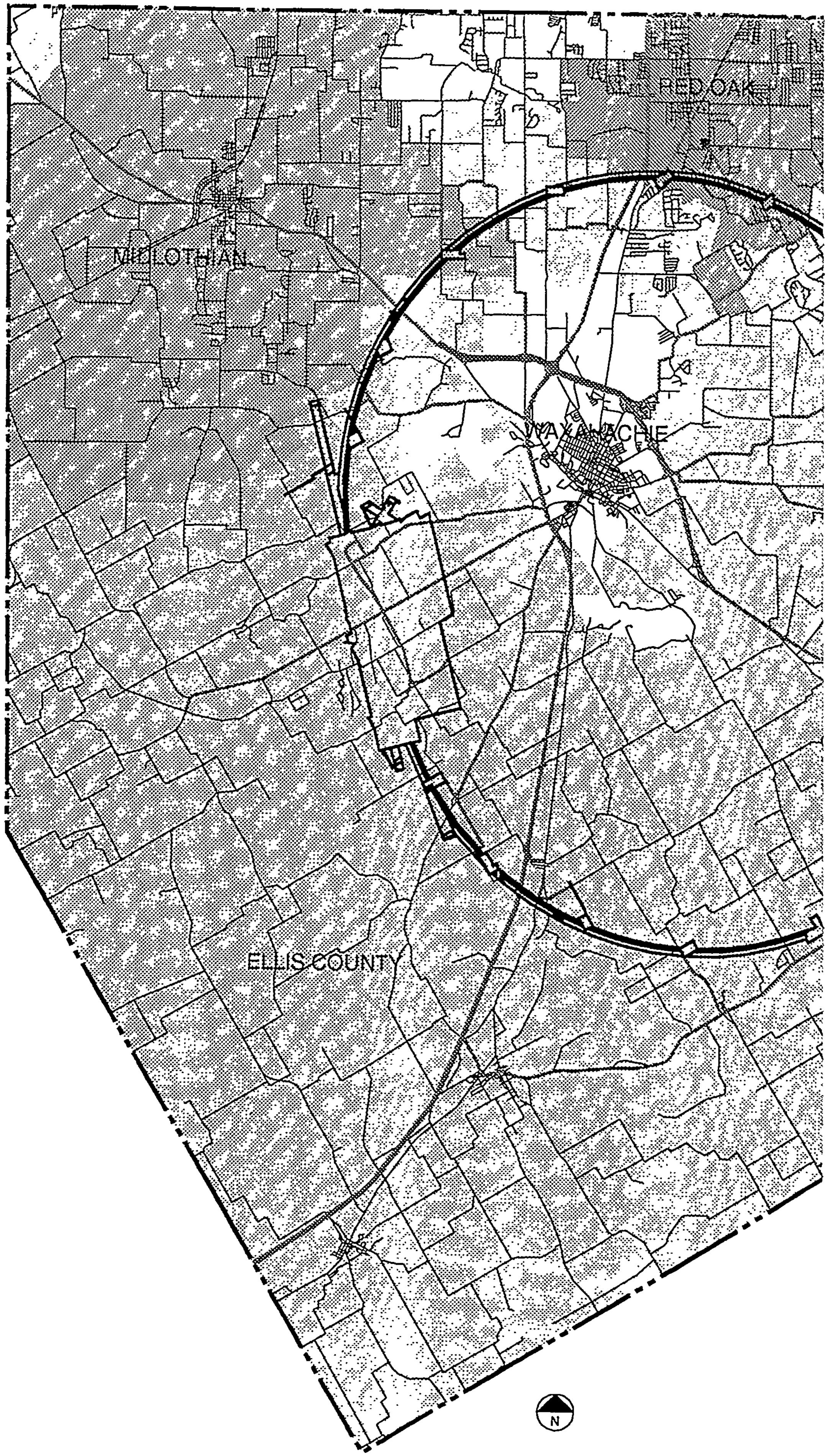

RED OAK
MIDLOTHIAN
WAXAHACHIE
ELLIS COUNTY
N

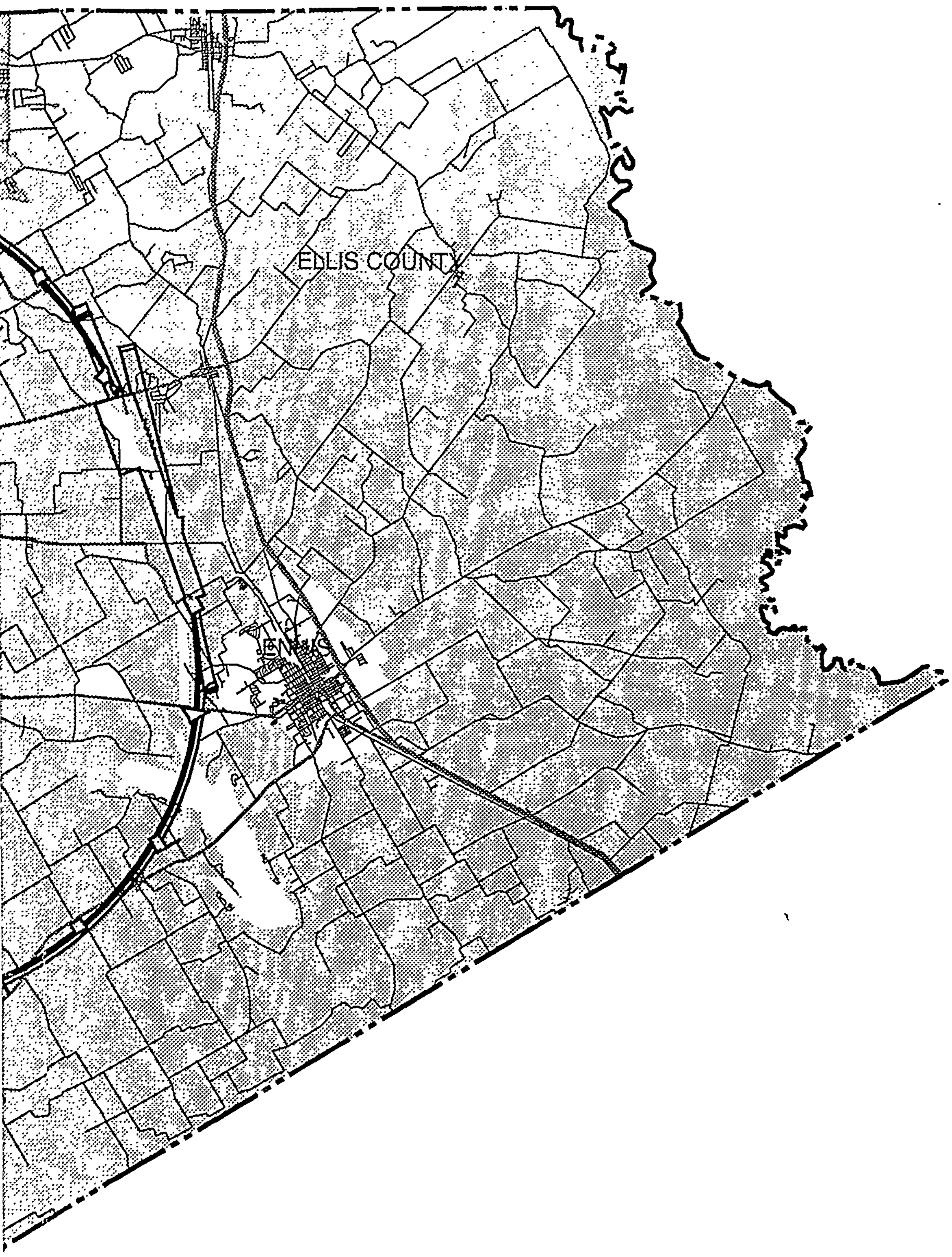

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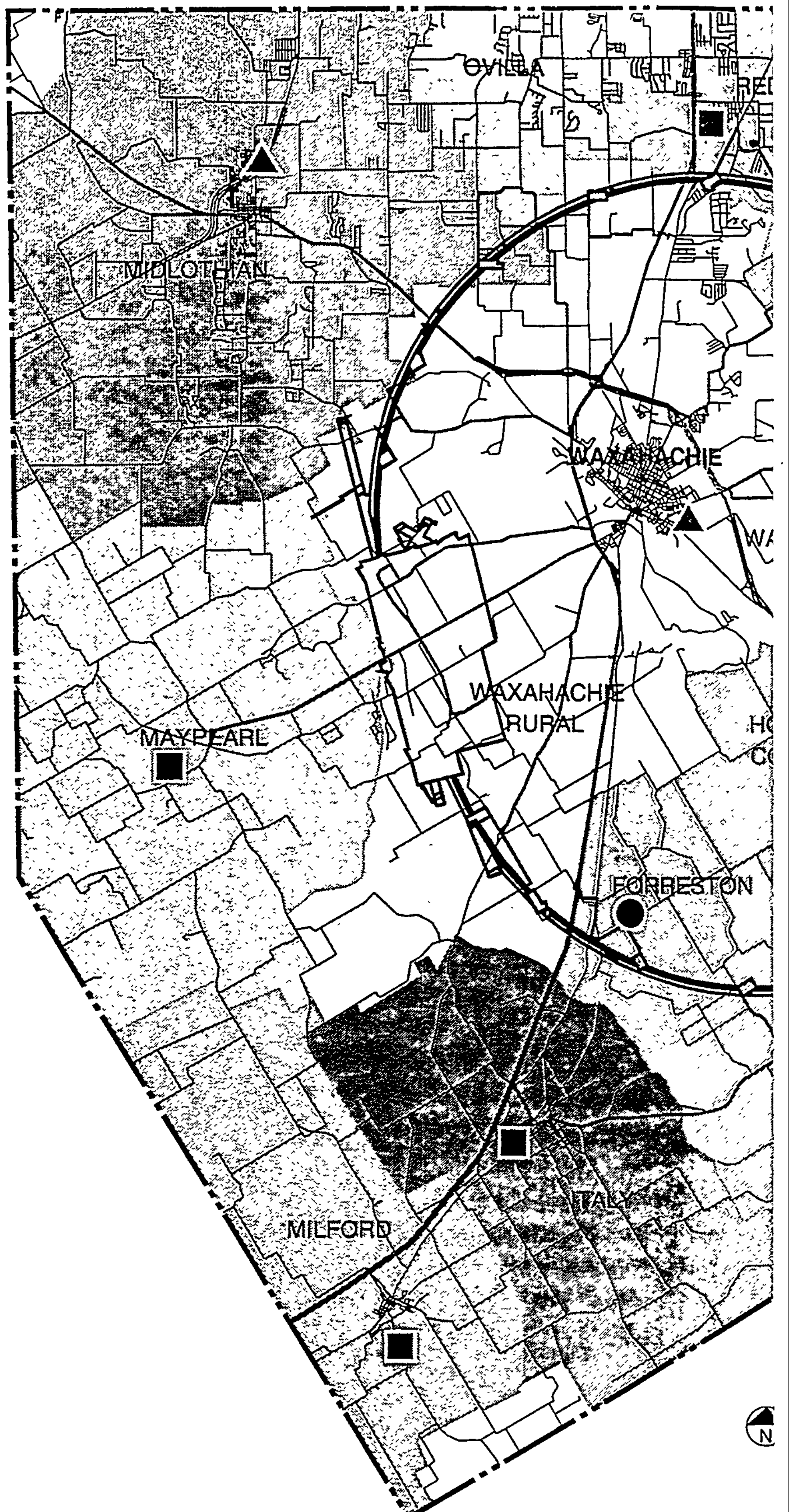
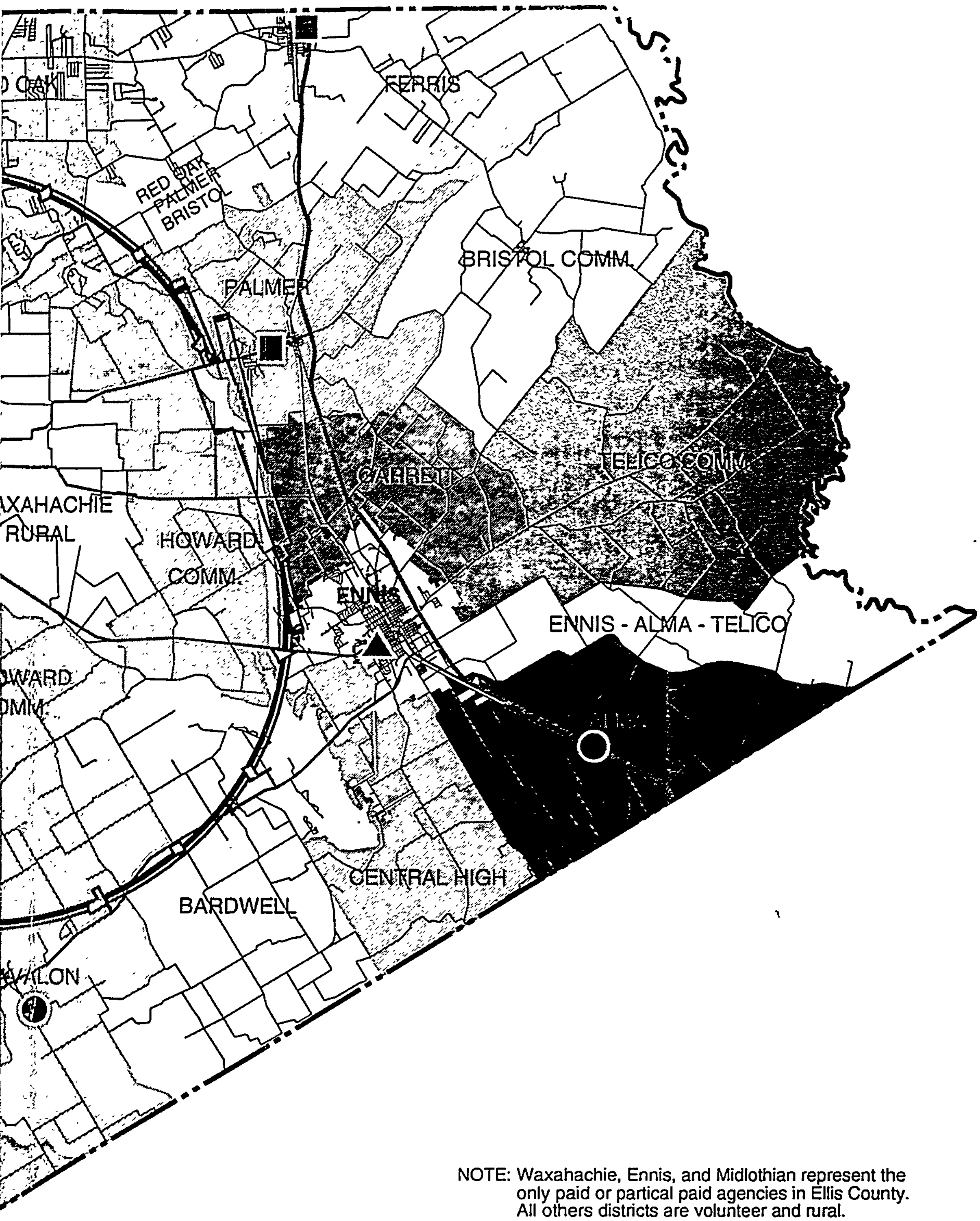
Figure 1.2.7-1. Ellis County 911 Regions.



OVILLA
MIDLOTHIAN
WAXAHACHIE
WAXAHACHIE
RURAL
MAYPEARL
FORRESTON
ITALY
MILFORD
N



NOTE: Waxahachie, Ennis, and Midlothian represent the only paid or partical paid agencies in Ellis County. All others districts are volunteer and rural.

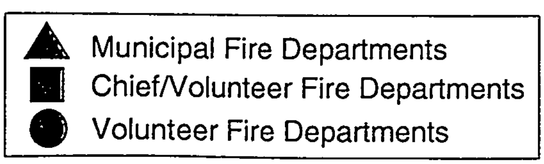


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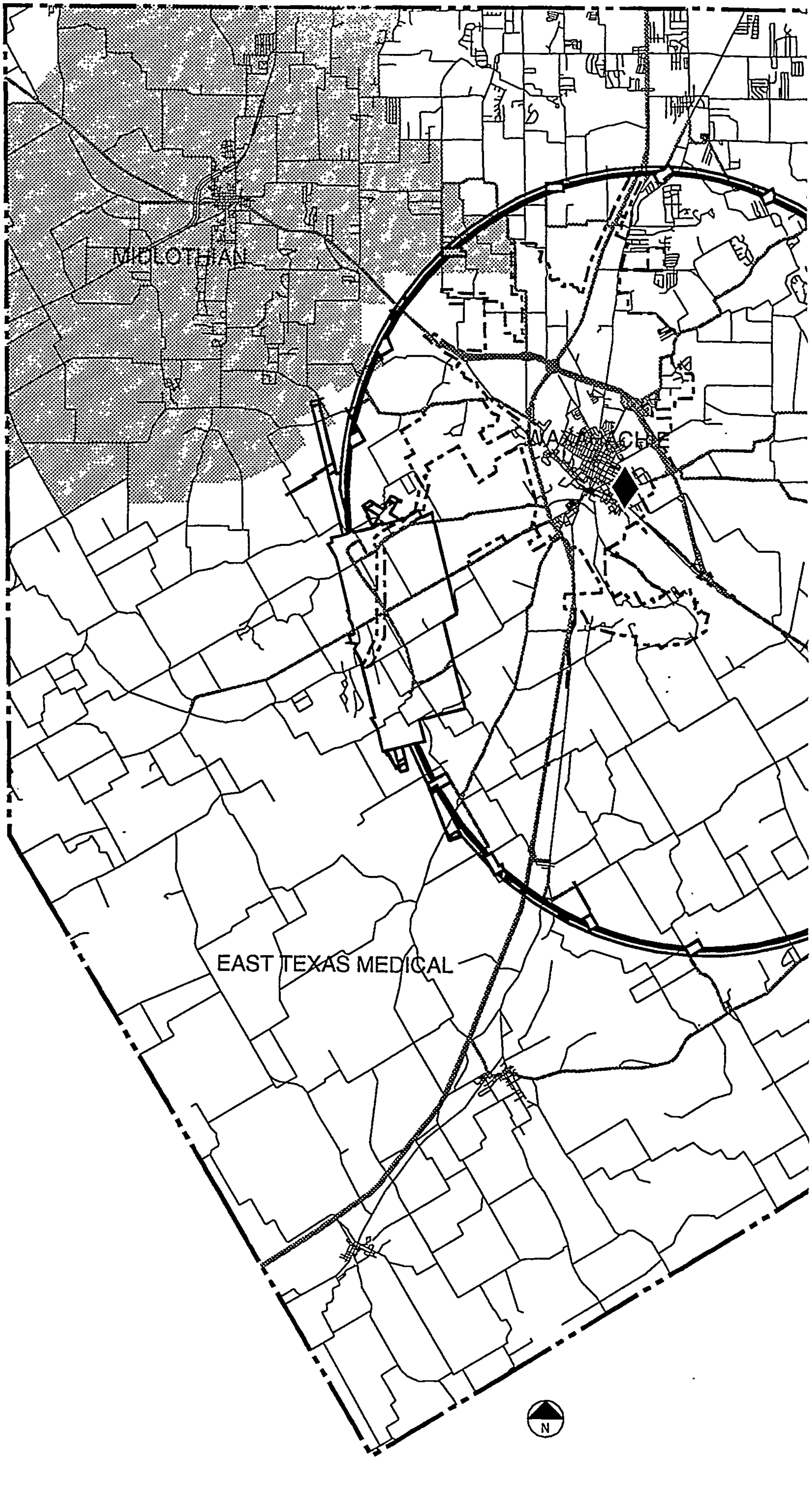
Figure 1.2.7-2. Ellis County Fire Protection Districts.



MIDLOTHIAN
WAXAHACHIE
EAST TEXAS MEDICAL
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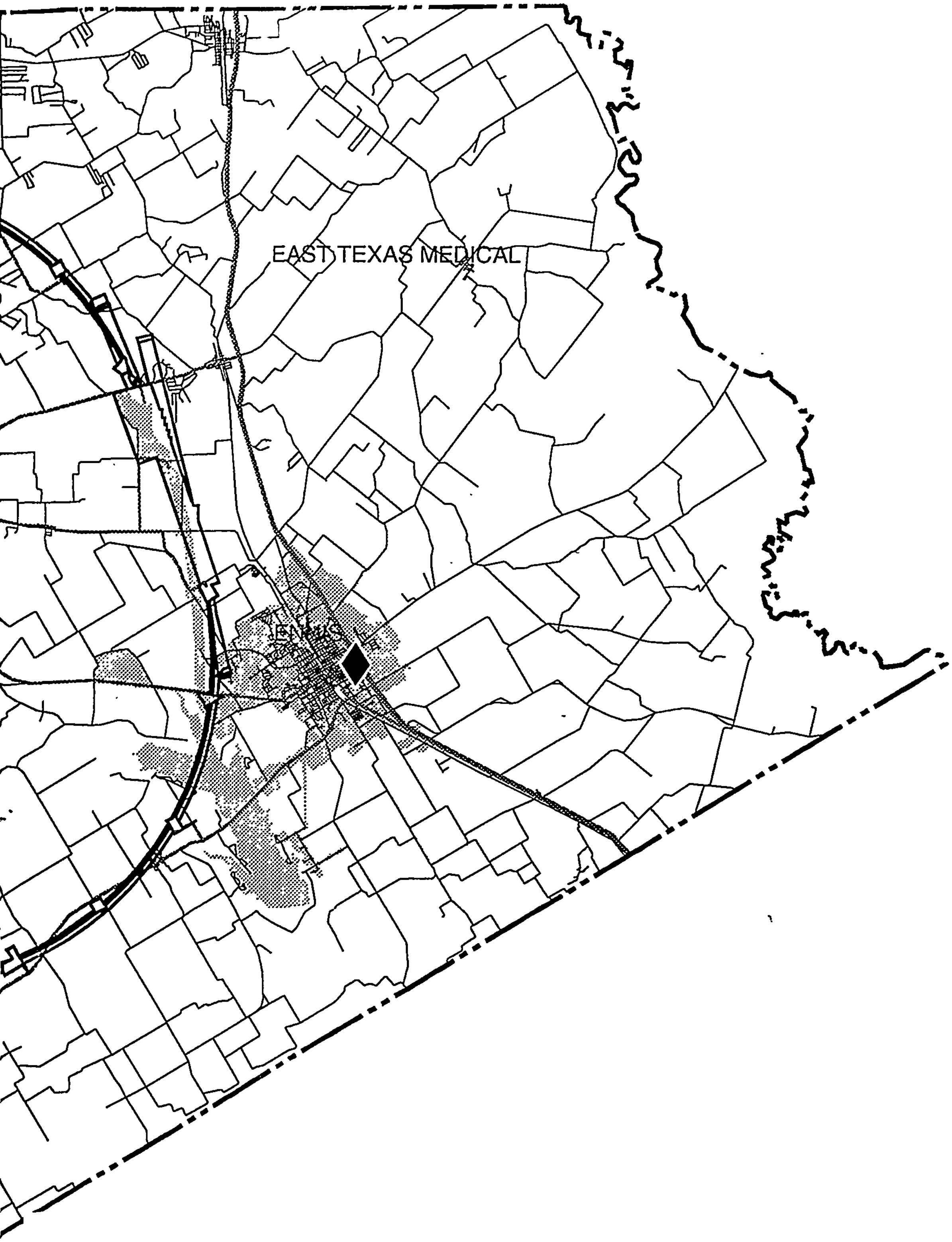


NOTE: EMR for Ennis and Midlothian are exclusive to the city's fire department.
All other medical agencies within the city limits are RUN TRANSPORT ONLY.

TIP-05191

Hospital Location

Figure 1.2.7-3. Ellis County Medical Response Regions.

1.3 Regional Conditions

1.3.1 Population Densities

In locating the footprint for the project, sites away from communities and residences were preferred and efforts were made to minimize the number of people displaced from their residences. In a total of 10,625 fee simple acres, the revised SSC footprint decreased the total number of relocations required from 226 to 195, including houses, trailers, and businesses. Land parcels surrounding the SSC sites are similarly low density.

1.3.2 Zoning & Ordinances

County

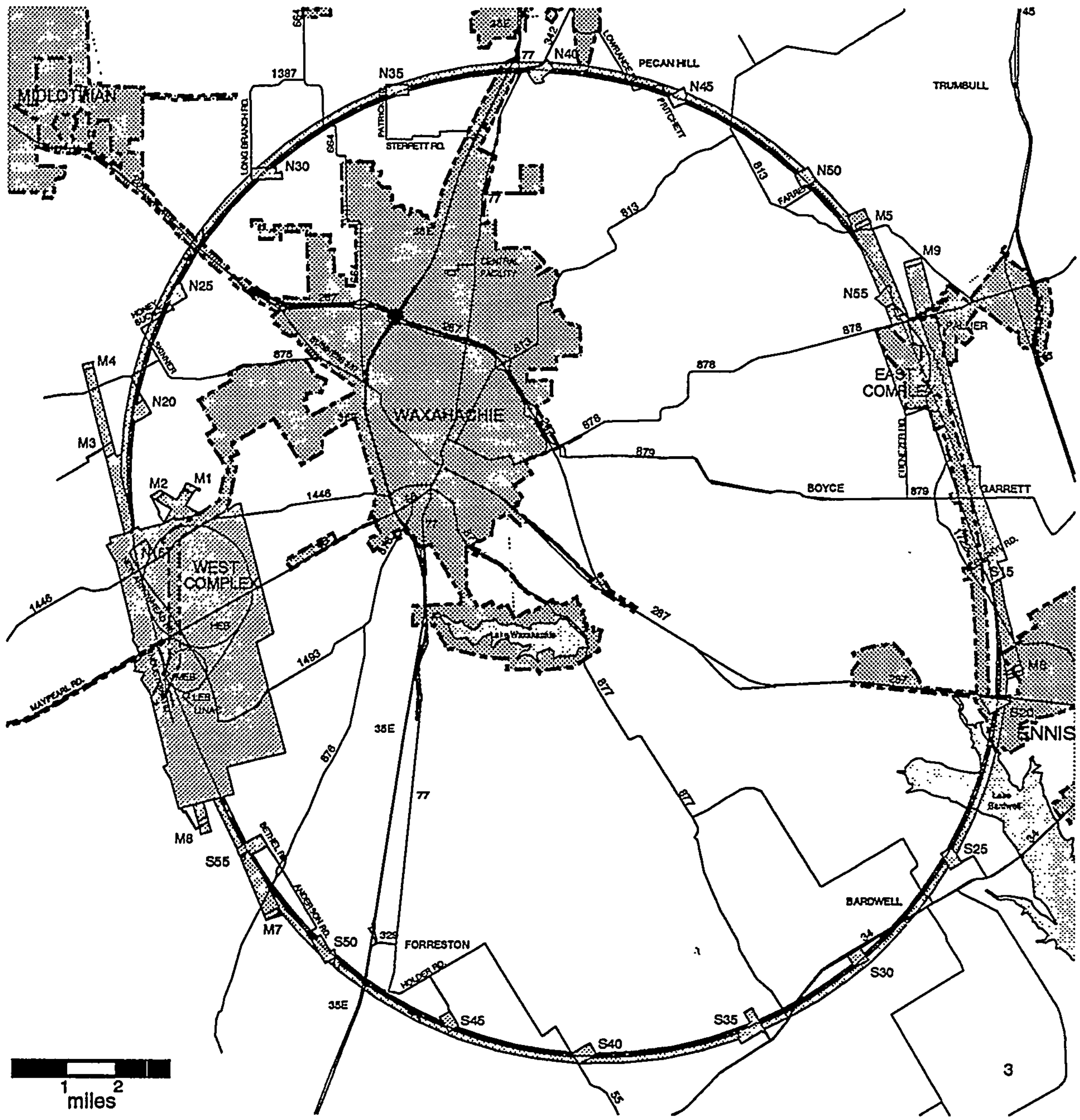
Texas law provides for county regulation in areas not within city limits or its extraterritorial jurisdiction. In 1989, the Texas legislature authorized the Ellis County Commissioners Court to zone the use of land within 10 miles of the SSC project area. As mentioned previously, the Ellis County zoning and regulation plans have been not been formally adopted, but may provide guidance to county planners. The county is affiliated with the North Central Texas Council of Governments, which predicts D/FW regional growth and anticipates infrastructure and service needs. Also, the county is divided into special districts covering various services region as noted above under Emergency Services (Section 1.2.7).

Ellis County participates in the National Flood Insurance Program and regulates development in the 100-year flood plains. Projects that erect a structure or involve substantial excavation must submit an application to the Department of Public Works. If the project is not in a flood plain, the county issues an exemption. If it is, the county may issue a construction permit if it believes the project will not adversely affect the water surface of a runoff event with a recurrence of 100 years.

Municipal

Six Ellis County cities have comprehensive land use plans: Waxahachie, Ennis, Palmer, Bardwell, Midlothian, and Red Oak. Since announcement of the SSC land requirements, the city of Ennis has incorporated some lands on the East Complex, and the city of Waxahachie has incorporated land connecting to the West Complex. This allows the cities to provide services to the complexes. Additionally, the N40 site is within the extraterritorial jurisdiction of Red Oak, the N55 site is within the jurisdiction of Palmer, and the S20 site is within the jurisdiction of Ennis. Other sites are on un-incorporated land. Figure 1.3.2-1. shows the municipal limits in relation to project sites.

There are no known constraints to construction resulting from present jurisdictional boundaries on or around the project. All SSC facilities will meet or exceed all local codes and standards in effect in the municipalities. The SSC Laboratory is filing building permits with the cities of Waxahachie and Ennis and is making building plans available to police and fire departments.



TIP-05194

Figure 1.3.2-1. City Limits and Project Sites.

1.3.3 Land Use

The low population density near the sites is reflected in the Ellis County land use, largely farming and ranching. The major categories of land use are shown in Table 1.3.3-1. The acreages are the 1990 land use as given in the *Land Use and Infrastructure Plan.* The table shows that about 80% of the land in the county is devoted to agriculture and grazing. The effect of purchasing the fee simple lands for the SSC project is minimal in these large categories. The West Complex contained about 2,300 acres of farm land and about 5,200 acres of ranch land. The East Complex contained about 400 acres of farm land and 1,400 acres of ranch land. In addition, both areas contained rural residences and contain riparian woodland.

Table 1.3.3–1. Ellis County Land Use Summary.

Classification	Acres	Percentage
Agriculture	188,700	31%
Pasture/Ranch Land	161,600	27%
Grassland	129,800	21%
Forested Land	61,300	10%
Urban	29,400	5%
Scrub/Shrub	24,700	4%
Water	6,200	1%
Wetland	5,300	< 1%
Others	2,400	< 1%
Totals	609,400	100%

Source: Land Use and Infrastructure Plan, Phase 1.

Urban growth in Ellis County is guided by proximity to the interstate highway system. Northern Ellis County is being transformed into Dallas suburbs with housing subdivisions being developed in predominantly rural areas. In the southern part of the county and extending south beyond county borders, land uses remain rural. Agricultural trends in Ellis County are progressing toward larger farms and fewer full-time farmers. The SEIS has concluded:

> "The west and east [complexes] are situated in roughly the northern half of the county, which is being progressively urbanized as development moves south from Dallas. Therefore, the project is in keeping with other types of major Dallas-Ft. Worth Metroplex developments. Seen in this context, the SSC project would not appear to be a foreign element as it would be if it had been located farther to the south in the decidedly rural portion of the county. As development occurs, it will likely be difficult to distinguish project-related indirect impacts from the impacts from other major economic developments in the region." (pg 9–48, SEIS, Dec. 1990)

1.3.4 Development Issues

The following paragraphs summarize development impacts addressed in the *Final Supplemental Environmental Impact Statement* relevant to site planning. Based on the SEIS, the DOE developed its *Mitigation Action Plan*[13] (March 1991) which is a plan to implement the commitments made in the SEIS. For several issues mentioned below, the *Mitigation Action Plan* gives more detail on the techniques used to moderate the project's impacts.

Wetlands Protection

From U.S. Fish and Wildlife Service wetland inventory maps, the SEIS concluded that wetlands are not a dominant feature of the site and occur on sites primarily as riparian areas along streams. Large reservoirs in the area also have some associated wetlands. It is DOE policy to avoid impacts on wetlands to the maximum extent possible. At those sites where avoiding wetlands is not practical, mitigation will require the creation of new wetlands or enhancement of existing ones. Ponds and their surroundings will be designed to provide sufficient wetlands to meet or exceed the 150% replacement standard for impacted wetlands. Replacement wetlands will provide equal value and function for the impacted wetlands.

Farmland Protection

Based on information from the U.S. DOE, the U.S. Department of Agriculture, Soil Conservation Service evaluated the effects of the project on Ellis County farmland. After quantifying the reduction in farmland caused by the project and assessing the quality of the farmland, the SCS found that the SSC Laboratory requires "a minimal level of consideration for protection," (SEIS p. 4–45) because of the abundance of 'prime' and 'important' farmland throughout the county.

Air Quality Standards

The SEIS evaluated the potential impacts on air quality from SSC construction and related industrial and population growth. Because of the regions topography and wind patterns, air emissions tend to be diluted over a large area. It concluded that construction and construction-related impacts will be temporary and minor, and it only recommended mitigative actions to decrease the amount of fugitive dust. Again, during operation, the SSC will emit only small quantities of air pollutants, making the SSC's contribution to acid rain insignificant and therefore resulting in negligible impact on soils and vegetation.

Noise Impacts

As background for the SEIS, ambient noise levels were measured and compared with noise levels anticipated during both construction and operation phases on the West Complex and for worst-case example Service Areas (N45 for construction and N30 for operations). From its modeling, the SEIS concluded that during both phases, the potential noise impacts from the extreme cases considered can be mitigated through the use of current, practical technology at the source and barriers along the noise path. Noise control measures will need to be adapted for the specific sites.

Preservation of Historical & Archaeological Sites

Historic preservation will be an important consideration for the SSC project. Direct adverse effects (damage or destruction) to significant historic structures and sites will be avoided by design modifications, where possible. When this is not feasible, structures will be moved or, if this is not possible, site surveys will document historic structures and archaeological remains. The SEIS proposes that the DOE, in consultation with the Texas Historical Commission, develop a worker education program to instruct workers on the proper reporting and care of any sites discovered during construction.

Other Regulations

Many federal permits, licenses, and other entitlements may be required in the different phases of the SSC project. The SSC Laboratory will comply with applicable federal statutes as well as state and local programs and laws with regard to environmental protection, land management, and other requirements. Other development issues, such as flood plain management, will be discussed elsewhere in this report, while still others are more related to environmental protection and land management. Refer to Chapter 5 of the SEIS for a complete review of federal laws and regulations and the *Regulatory Compliance Plan for the SSC*[14] (February 1988) for a review of relevant state laws.

1.4 Regional Infrastructure

1.4.1 Transportation

Major Road Networks

Ellis County is traversed by major regional highways between Dallas, Houston, and Austin. Presently in good condition, several of these highways are scheduled for further improvements. Interstate 45 passes through Ennis and crosses the county in a north-south direction connecting Dallas to Houston. The improvements will include reconstruction and widening from a four-lane to a six-lane highway. Interstate 35E, connecting Dallas to Austin, passes through the western edge of Waxahachie. Anticipated improvements over the next few years include widening from four to six lanes between Interstate 20 and Parkerville Road and upgrading of the FM 66 intersection. A proposed by-pass to the south of Waxahachie will connect US 66 and US 287.

US 287 runs southeast through Midlothian and Waxahachie to Ennis. A proposed extension of a north-south freeway in the mid-cities area, State Highway 360 (see Figure 1.1.1-1), will be built during this decade. The extension will be a four-lane freeway connecting to US 287. It will provide a direct route from Ellis County to the DFW airport. US 67, a highway that passes from Dallas in a southwest direction through Midlothian, is to become a four-lane freeway between Dallas and Midlothian.

In addition to regional highways, the county is interlaced with an extensive network of Farm-to-Market (FM) roads, which follow farm property boundaries. The roads are typically two lane, undivided, and constructed with 80–120-foot right-of-ways. These will be maintained or up-graded to provide access to the SSC sites. They are discussed in section 3.4.1. Figure 1.3.2-1 shows the existing road network near the site. Figure 1.4.1-1 shows the regional Integrated Master Transportation Plan developed by the TNRLC to serve the needs of both Ellis County residents and the SSC project. Table 1.4.1-1 describes upgrades to the major regional roads.

Major Airports

The SSC site is located 45 minutes from Dallas-Ft. Worth International Airport (DFW). DFW is the second largest scheduled air service facility in the world. DFW benefits from a mid-continent location that is almost equidistant from New York, Toronto, Los Angeles, and Mexico City. All major North American metropolitan areas may be reached from DFW in less than four hours. DFW is currently used by 25 major airlines including three foreign carriers. Daily arrivals and departures average about 2,000 per day and delays due to traffic loads are infrequent.

The region's second major airport, Love Field, is located 10 minutes north of downtown Dallas. Complementing the international operations at DFW, Love Field serves regional traffic to cities in Texas and neighboring states. Love Field is approximately 35 minutes from the site. The airport closest to the site, the Midlothian-Waxahachie Airport, opened in the spring of 1993. It is a General Utility airport with a runway length of 4,200 ft. The two major airports are shown in Figure 1.1.1-1.

Railroads

The SSC site is served by four major railroads. The Missouri-Kansas-Texas main line crosses the site from north to south and connects Dallas to Austin and San Antonio. The Burlington Northern main line crosses the site north to southeast, connecting Dallas to Houston. A Southern Pacific line connects Ft. Worth to Ennis, crossing the SSC site from northwest to east, and a Southern Pacific line passes east of the site, from Ferris to Ennis and on to Corsicana. Finally, a Santa Fe branch line passes northwest of the site and connects Dallas to the Santa Fe east-west main line at Brownwood, approximately 130 miles to the southwest.

Off-loading facilities are located at Midlothian and Ennis. Santa Fe has a large depot at Midlothian and offers a holding capacity of 10 to 12 cars and ample room for machinery such as cranes. Southern Pacific also operates a depot in Midlothian and is able to serve 5 cars. Another Southern Pacific depot, located in Ennis, is able to serve 10 cars.

Major Seaport

The closest deep seaport is in Houston, Texas, approximately 200 miles to the southeast along I-45. That proximity, together with the well-developed transportation systems from Houston to the site area, may make sea transport viable for some SSC materials, particularly large detector components.

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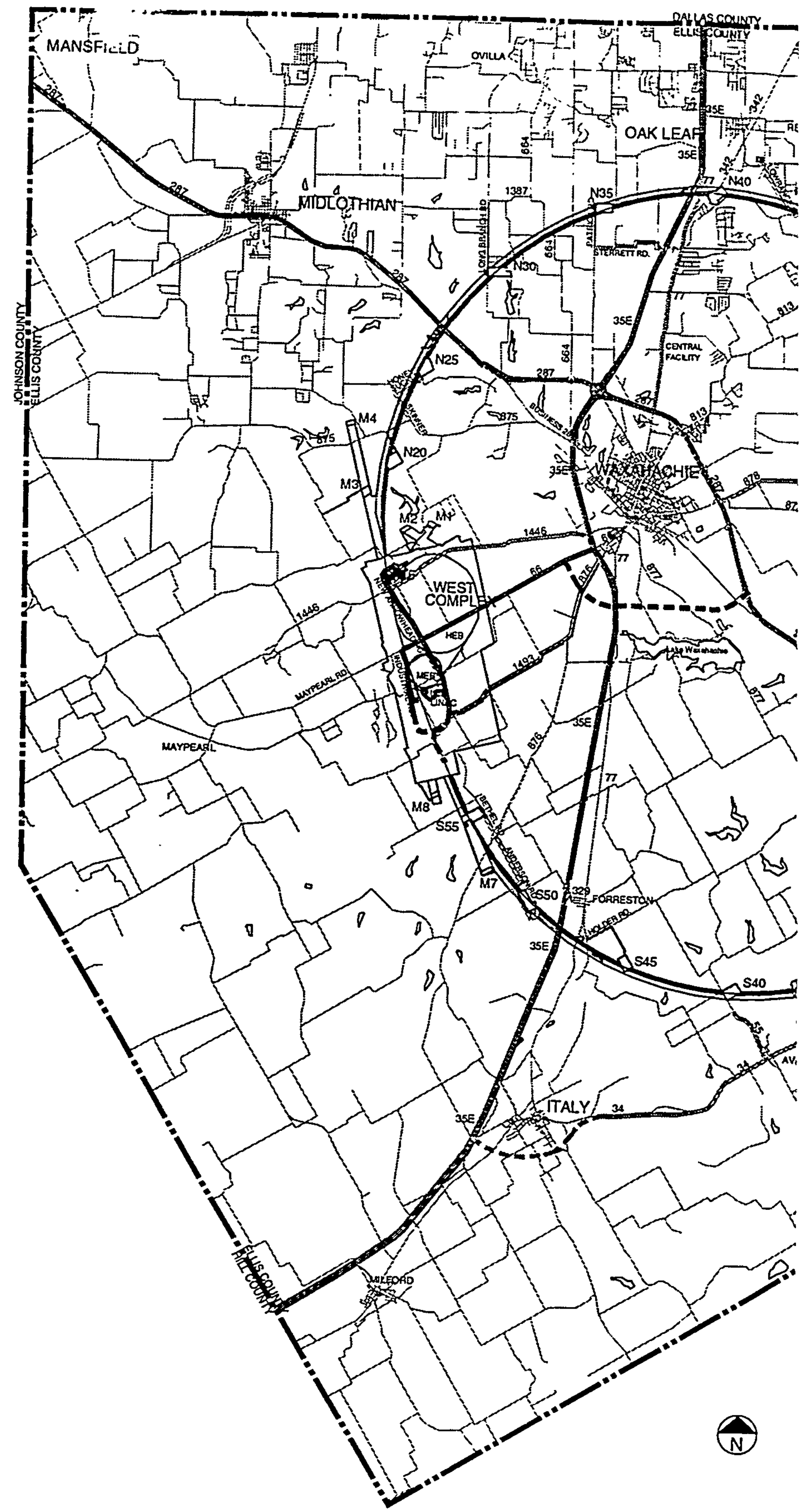
DALLAS COUNTY
ELLIS COUNTY
MANSFIELD
OVILLA
OAK LEAF
MIDLOTHIAN
JOHNSON COUNTY
ELLIS COUNTY
N40
N35
N30
N25
N20
M4
M3
M2
STERRETT RD.
CENTRAL FACILITY
WAXAHACHIE
WEST COMPLEX
MAYPEARL RD
MAYPEARL
M8
S55
M7
S50
FORRESTON
HOLDER RD.
S45
S40
ITALY
MILFORD
ELLIS COUNTY
HILL COUNTY
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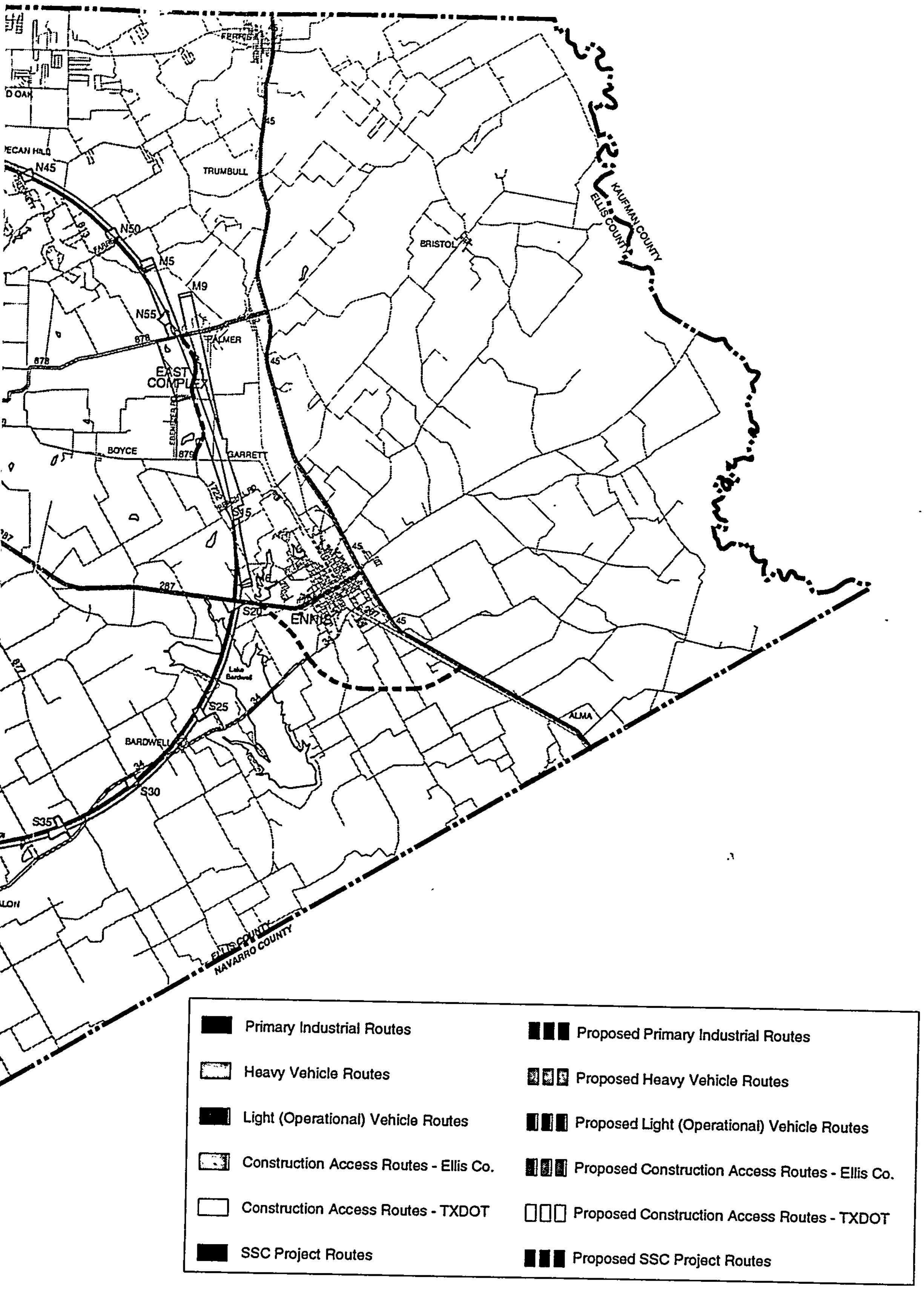

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Figure 1.4.1-1. Road Network in Ellis County.

Table 1.4.1-1. Regional Roads Improvements.

Road Name	Segment	Length (mile)	Action
Waxahachie By-pass (Spur 394)	FM 66 to IH 35E to US 287	4.2	Construct New Roadway
Ennis Bypass	IH 45 to US 287	2.3	Construct New Roadway
SH 34 (Italy Bypass)	IH 35E to Exist. SH 34	2.9	Construct New Roadway
FM 55 (to site S40)	SH 34 to Circle Road	1.9	Upgrade and Replace Structures
SH 360	IH 20 to US 287	11.5	Construct New Roadway

1.4.2 Utilities

Electrical

Ellis and adjacent counties are supplied with electrical power by the Texas Utilities Electric Company (TU Electric). TU Electric has a service territory encompassing much of the northern half of Texas. In 1988, total sales for the TU Electric system were 80.7 billion kilowatt hours (kWh), an increase of 3.8 percent over 1987. During the year's peak demand, the net capability of the system was 20,000 Megawatts (MW), with a reserve margin of 15.2 percent. The Comanche Peak nuclear power plant added a second unit with a capacity of 1,150 MW in 1993. Three coal-fired units, each with a capacity of 750 MW, are scheduled to begin construction soon. In addition to TU Electric, Hill County, Navarro County, and Johnson County Electric Cooperatives also supply portions of Ellis County. These cooperatives buy their electricity from Brazos Electric Cooperative.

The vendor(s) for electrical power has not been selected yet, but, transmission of power to the Complexes is expected along TU Electric transmission lines. This assumption is based on their system capacity and proximate transmission lines. Figure 1.4.2-1 shows the proposed transmission to the West and East Complexes. The West Complex substation will be fed from an existing 345 kV transmission line (Venus to Big Brown line) which runs near the southwest corner of the West Complex. The East Complex sub-station will be fed from a new 345 kV transmission line (Watermill to Limestone line) scheduled to be in service by the end of 1994. The line traverses the county roughly south-north in the area between Waxahachie and Ennis.

Natural Gas

Valero Gas Company and Lone Star Gas Company are the primary natural gas companies servicing the site area. Valero Gas Company had sales that reached 356 billion cubic ft. in 1988, up 25 percent over the previous year. Valero purchases gas from suppliers and has adequate reserves, 3 trillion cubic ft., to meet future demands. Valero operates a 36-in. pipeline that traverses the project area from east to west near the southern end of the West Complex. Lone Star had sales of 325 billion cubic ft. in 1988 and has natural gas reserves of 2.8 trillion cubic ft. Several of its high-pressure transmission lines traverse the project area, including a 30-in. line that extends southwest-northeast and runs near the north end of East Complex and a 30-in. line that runs southeast-northwest to the east of the West Complex. As shown in Figure 1.4.2-2, the vendor for natural gas is assumed to be Lone Star Gas. This assumption is based on the proximity of transmission lines to both complexes.

Communications

Southwestern Bell Telephone Company is the basic provider of communication services in the project area and is the service company for the western portion of the project area. The company serves the towns of Waxahachie, Midlothian, Red Oak, and Ennis with digital switch service and is scheduled to provide this service to Italy. Southwestern Bell has installed a fiber-optic connection from Dallas to San Antonio that follows the alignment of I-35E. The Laboratory's Operation Center will be at the Main Campus on the West

Complex. This center will contain the telecommunications gateways linking the Laboratory to the outside communication lines. As shown in Figure 1.4.2-3, an underground service cable would be installed in the right-of-way along FM 66 from the Southwestern Bell fiber-optic trunk line to the communications center on the West Complex.

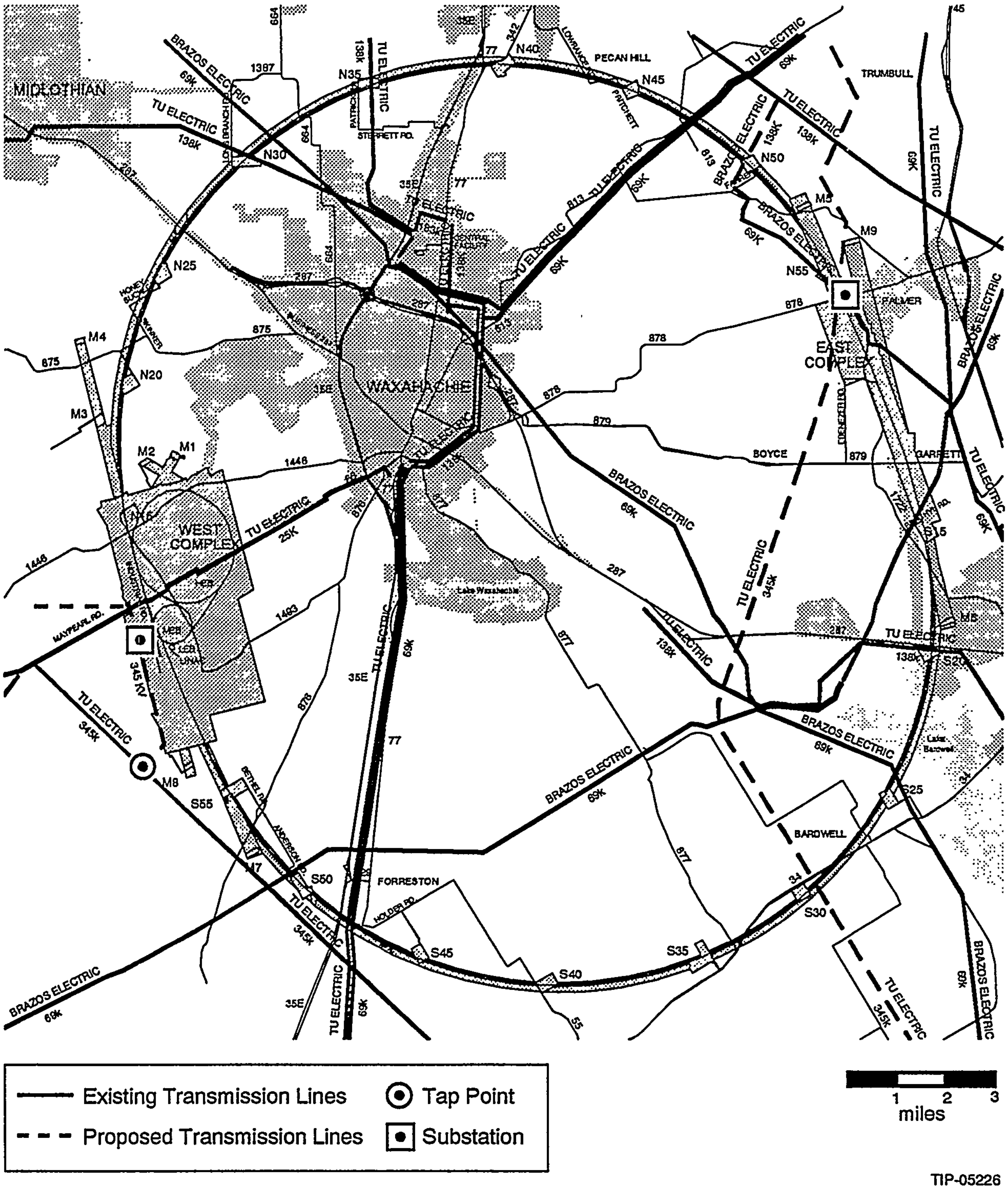


Figure 1.4.2-1. Electrical Transmission Lines in the Vicinity of the SSC.

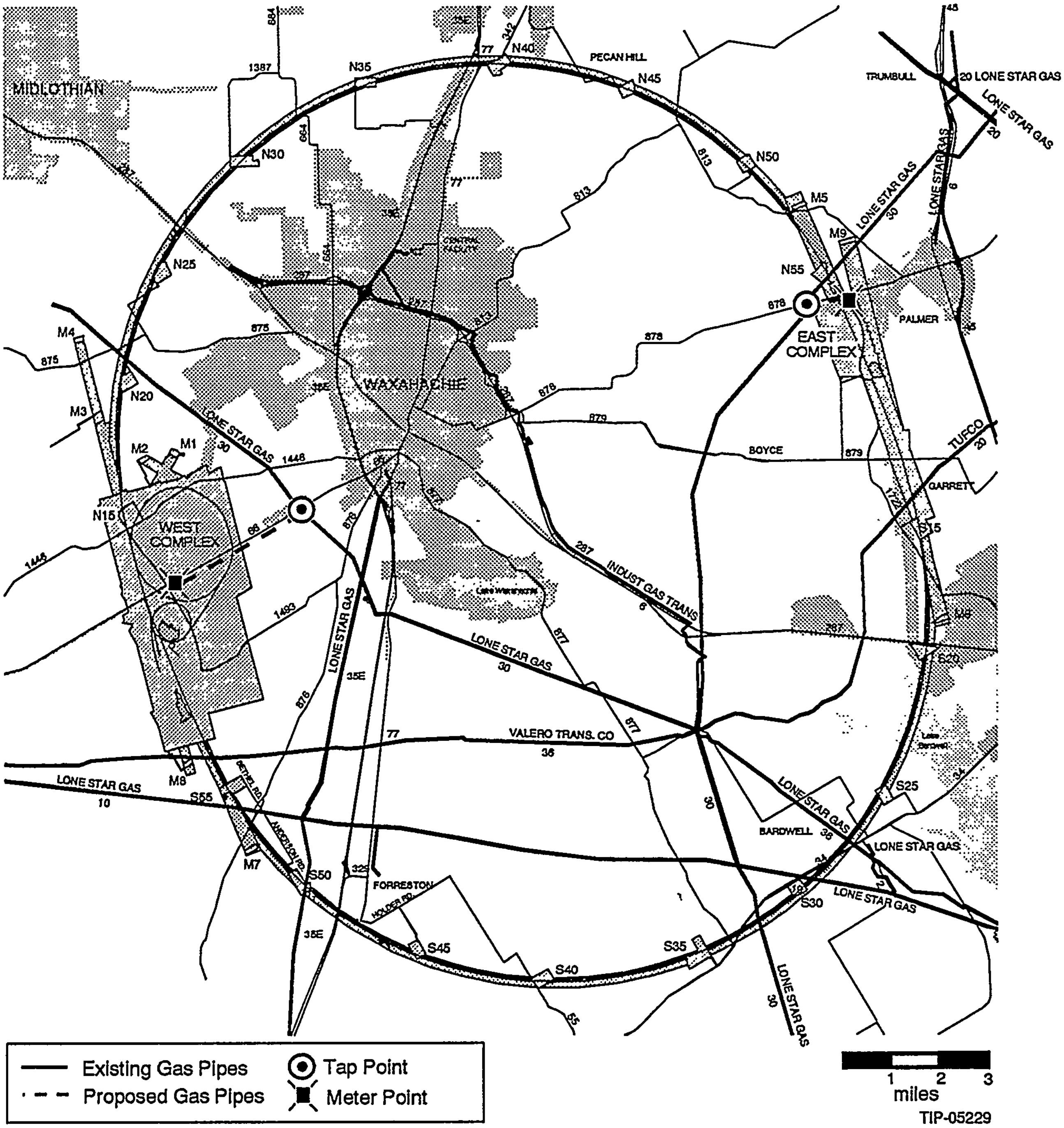


Figure 1.4.2-2. Natural Gas Transmission Lines in the Vicinity of the SSC.

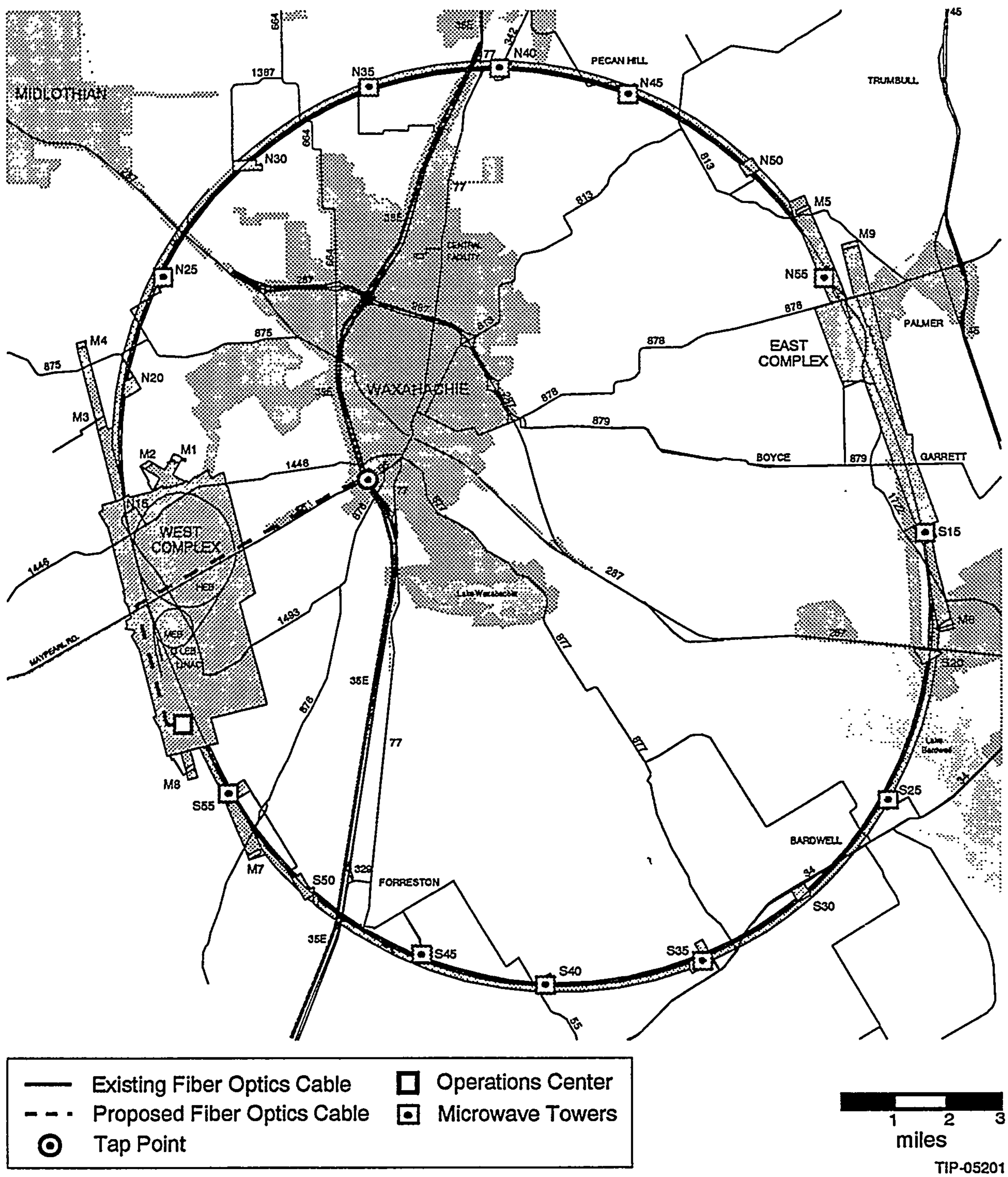


Figure 1.4.2-3. Communications Trunk Lines to the SSC Site.

Water

Presently, the region satisfies its water demands from both groundwater and surface supplies. As discussed under Hydrology (section 1.5.3), the regional demand for ground water has severely lowered the water tables of the local aquifers. For this reason, the SSC project decided to use surface water to supply its needs.

Two major water supply reservoirs exist in the site area. Lake Waxahachie is a 13,500 acre-foot capacity reservoir near the ring's center, three miles south of Waxahachie. Bardwell Lake is a 54,900 acre-foot capacity reservoir on Waxahachie Creek, approximately three miles southwest of Ennis. Both Ennis and Waxahachie use this lake as a municipal water supply. The regional wholesaler of surface water, the Trinity River Authority, maintains 72″ and 90″ pipes for the transport of raw water.

Figure 1.4.2-4 shows the proposed regional raw water lines that would use the 90″ pipe and Lake Bardwell to supply the needs of the SSC project. On the East Complex, the 90″ line will be tapped as it crosses the site. For the West Complex, raw water will be pumped from a proposed regional line that will supply Lake Waxahachie. The options considered in developing this system are discussed in section 2.4.2, under 'Water (Raw and Potable) Transmission.'

The proposed 12″ potable water lines connecting to the East and West Complexes are shown in Figure 1.4.2-5. The lines will deliver water from the Ennis and Waxahachie municipal water supplies respectively. The options considered in developing this system are also discussed in section 2.4.2.

Wastewater

Current plans developed with TNRLC and the local municipalities propose that the East Complex's sewer line discharge into the City of Palmer's sewer system and the West Complex's sewer line be routed to the City of Waxahachie's sewer system. Palmer's sewage treatment plant has a permitted maximum flow rate of .14 MGD. Waxahachie's sewerage treatment plant has a permitted maximum flow rate of 4.4 MGD. Figure 1.4.2-6 shows the proposed lines for these connections. The options considered in developing this system are discussed in section 2.4.2, under 'Wastewater Systems.'

1.5 Regional Physical Characteristics

1.5.1 Topography

The region is located at the northwestern margin of the Gulf Coastal Plain on the eastern slope of the Austin Chalk surface called the White Rock prairie. The site is characterized by sub-mature-to-mature erosion sloping toward the southeast. The eroded surface contains low, west-facing escarpments separated by prairies. Most of the area has a relatively flat to slightly rolling prairie surface and grading to rolling prairie at a few incised drainages. The area's highest elevation is 840 ft. mean sea level at the crest of the White Rock escarpment. The lowest occurs at 360 ft. mean sea level, where the Waxahachie and Onion creeks drain to the southeast.

The site is traversed by the tributaries and main stems of Red Oak, Waxahachie, Onion, and Chambers creeks, all of which flow southeast to join the Trinity River. Waxahachie Creek, the largest drainage, is incised 80–120 ft. below the prairie surface. Please see Section 2.0 for maps of the West and East Complex topology.

Figure 1.4.2-4. Proposed Raw Water Lines to the SSC Sites.

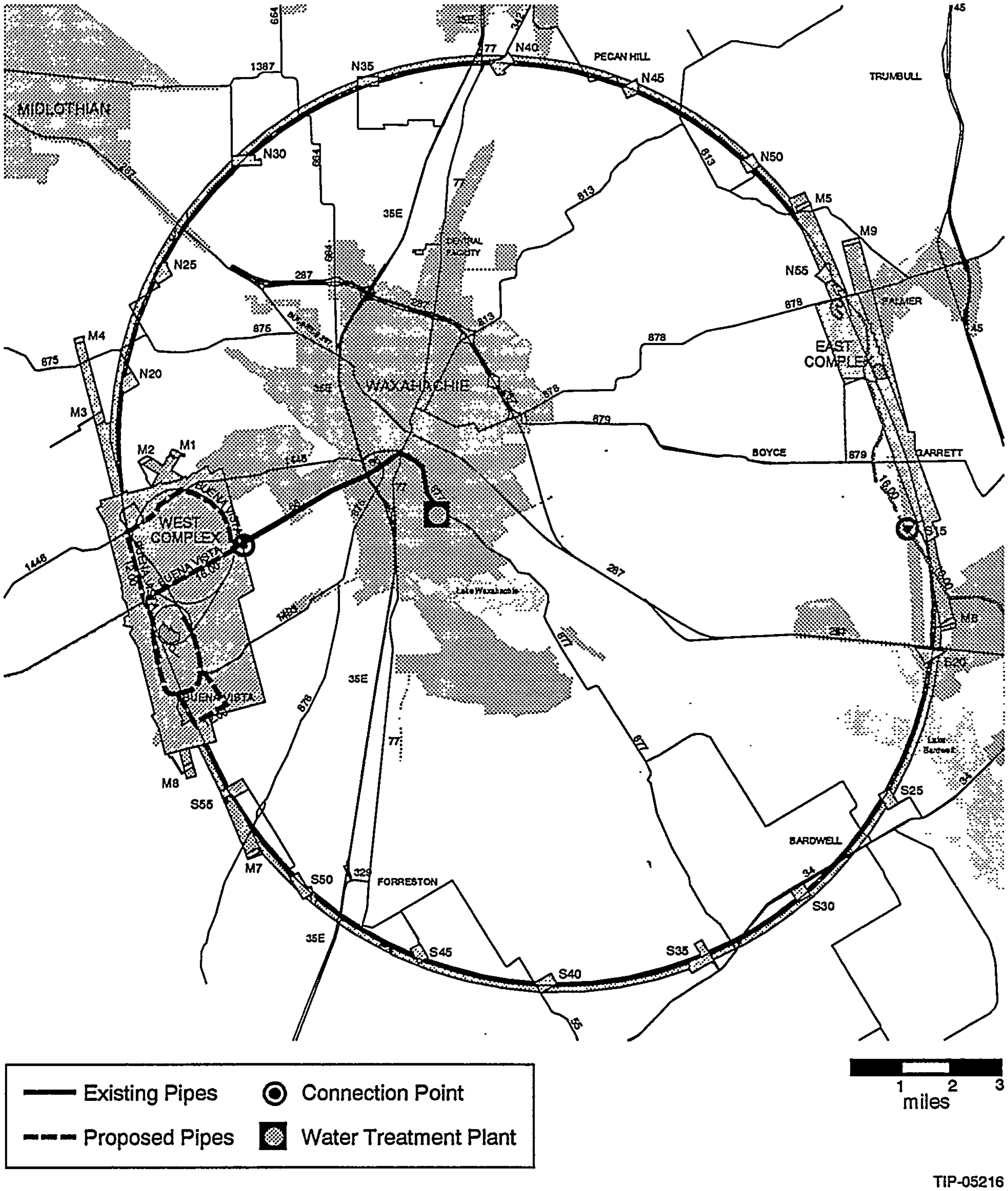


Figure 1.4.2-5. Proposed Potable Water Lines to the SSC Sites.

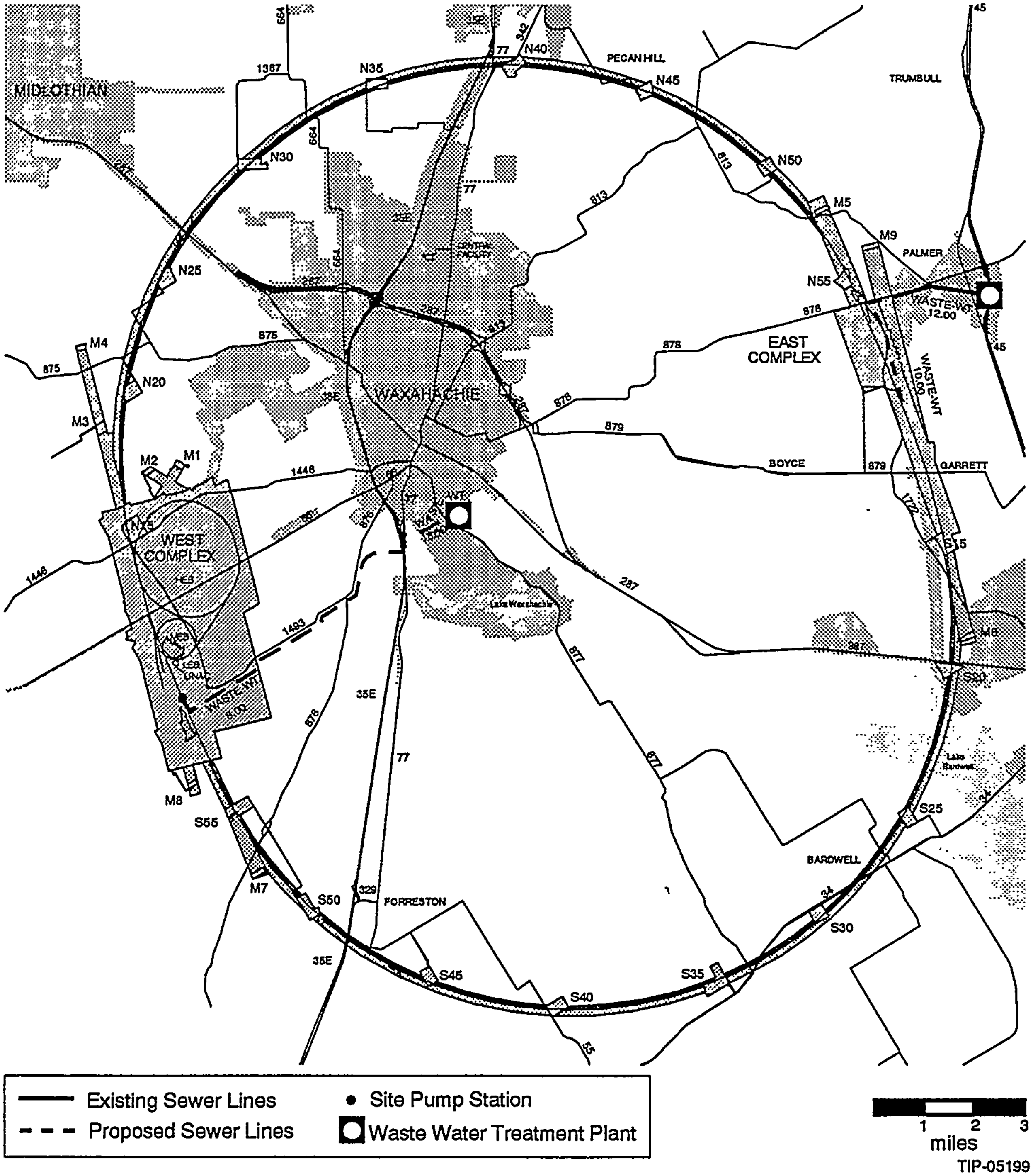


Figure 1.4.2-6. Proposed Sewer Lines from the SSC Sites.

1.5.2 Geology

Sub-surface Formations

North-central Texas is underlain by a series of sedimentary rocks that slope southeastward toward the Gulf of Mexico. The gulf series includes the Taylor, Austin, Eagle Ford, and Woodbine groups which crop out at the SSC site. Tunneling for the Ring will occur in the Eagle Ford Shale, Austin Chalk, and Taylor Marl groups. These groups are covered locally by Quaternary terrace deposits and by recent alluvium.

The Eagle Ford group is divided into two units in the Dallas-Ft. Worth area. Only the upper unit, called Eagle Ford Shale (EFS), is relevant to the site. The EFS consists of a dark-gray-to-black, calcareous to non-calcareous shale with high shrink-swell potential. Overlaying the EFS is the Austin group, or Austin Chalk (AC), which is a stronger, more stable rock than the EFS. The calcium carbonate content of the chalk averages about 85 percent. Thickness ranges from less than 300 ft. in southern Ellis County to about 500 ft. in northern Ellis County. Taylor Marl (TM) is the traditional name for the Ozan formation, which overlies the Austin group. TM is generally a calcareous claystone with interbedded chalk. The maximum thickness of the unit in the site area is about 500 ft. Of these three formation, the Austin Chalk has the best tunneling and stability characteristics, while the Taylor Marl has the next best. Figure 1.5.2-1 shows the site geology as determined from borings around the collider ring.

Fault Locations and Seismology Risks

The region is in the Balcones Fault zone. Maximum displacement on individual faults in the project area is about 100 ft., and fault planes usually dip at about 70 degrees. It is probable that there are fewer fractures in this area than in the same rock units to the south since the entire Balcones Fault system terminates in the Dallas area. At the SSC site, the last indication of Balcones fault movement was approximately 11 million years ago. The major faults revealed by site investigation are shown in Figure 1.5.2-1.

The site region belongs to the seismic zone with the lowest seismicity potential in the United States. Following the ASCE and FEMA code requirements for this zone, all structures are designed to resist earthquake damage that result from accelerations of 0.05g. Historical records indicate that during the operating life of the SSC, both surface and subsurface structures will experience geologic forces below this 0.05g minimum set by the current codes governing engineering design.

1.5.3 Hydrology

Aquifers and Water Tables

Ellis County derives most groundwater from two major aquifers, the Woodbine group and the Lower Trinity formations. The Woodbine is the shallowest major aquifer in the region. Under the SSC site, the 1976 Woodbine water levels ranged from 250 ft. to 400 ft. below ground level. This places it well below the tunnel elevation.

Groundwater usage is an important regional issue. In north-central Texas, usage has caused significant decline in the groundwater levels of the Lower Trinity formations. Rates of decline of about 20 ft. per year are reported between Dallas and Tarrant Counties. Unlike the Trinity Group, the Woodbine aquifer is not overdeveloped and still serves as an important source of groundwater. The Woodbine aquifer declined about 100 ft. county-wide over the period 1955 to 1976. The rate of decline for both aquifers has slowed since local communities began converting to surface water sources. However, to preserve future groundwater supplies for the rural residents, the SSC project has decided to purchase surface water for its needs.

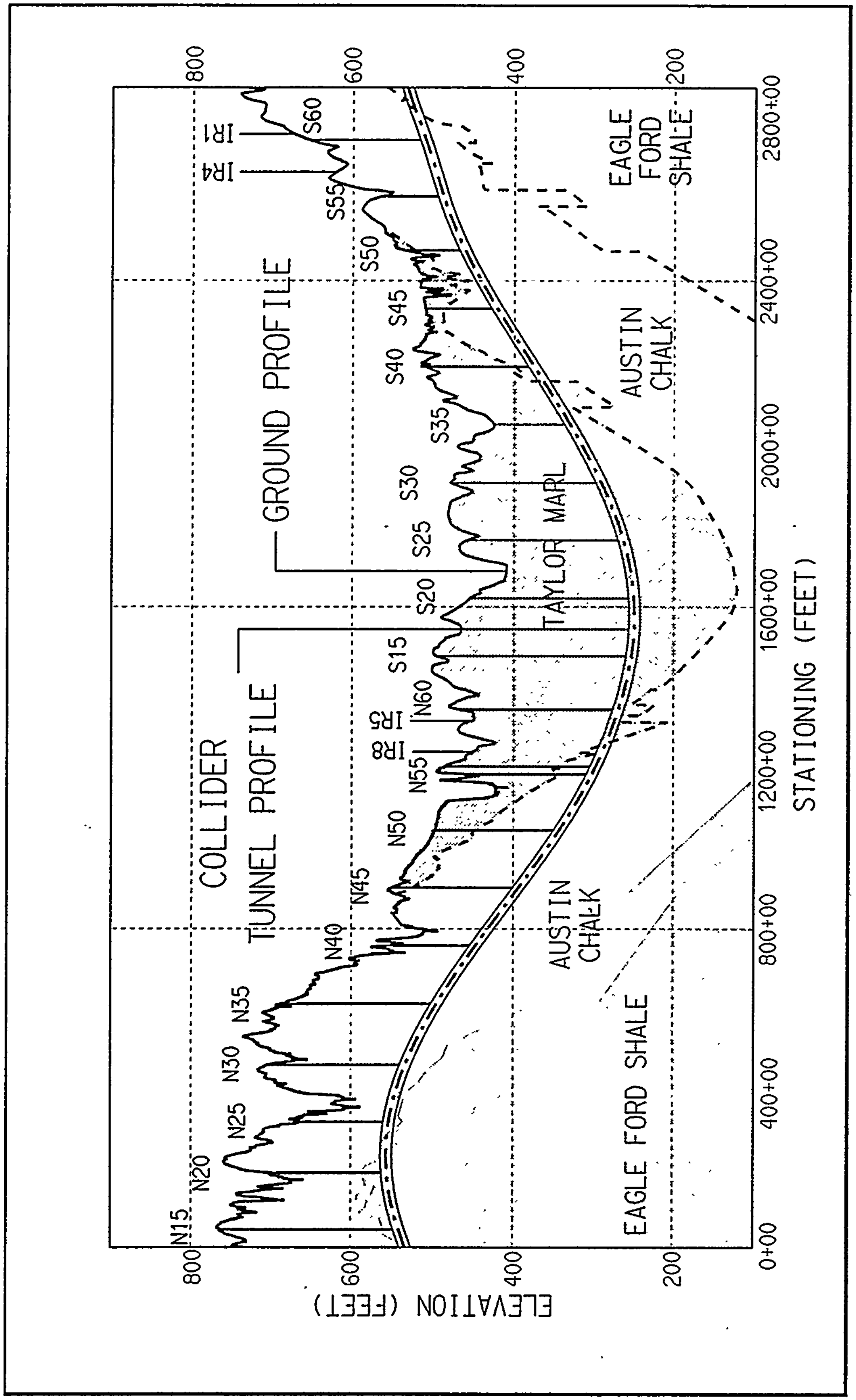


Figure 1.5.2-1. Geologic Profile for the Collider Ring.

Watersheds and Flood Plains

The SSC site lies totally within the Trinity River Basin. The three major watersheds near the project are Red Oak Creek, Waxahachie Creek, and Chambers Creek. General direction of creek flow is easterly or southeasterly. Figure 1.5.3-1 shows the major creeks draining the site area.

Flooding has been a problem in both the Chambers Creek and Red Oak Creek watersheds. In 1987, the Soil Conservation Service completed construction of 72 flood control structures in Ellis County. The system has a combined storage capacity of more than 85,000 acre-ft. Most of these 72 structures were located in the Chambers Creek watershed. However, due to rapid changes in land use (from agricultural to urban) in the Red Oak watershed, flood control structures can no longer be installed as planned. Because of this inability to install additional flood control structures and because of the extreme variation of stream flow, there is an increased possibility of flash-flooding in the Red Oak Creek watershed. The flood prone areas on the West and East Complexes are given in section 2.3.

1.5.4 Ecological Areas

Soils

The soils in the site region have developed from three base materials: the chalk from the Austin formation, the marl from the Taylor formation, and alluvial deposits in flood plains along creeks. Figure 1.5.4-1 shows the general soils associations in Ellis County. An association is a group of soils geographically related in a repeating pattern of soils, relief, and drainage. Associations are named for their major soils components, but they contain other minor soils types. The map shows the project site covered largely by the Eddy-Stephens, Austin-Houston, and Houston-Black soil associations, but, in a detailed view, many other soil types occur on the SSC sites. Detailed information is contained in the *Environmental Information Document,*[15] Vol. 3 (March 1988) produced by TNRLC. Detailed soils maps of the West and East Complexes are contained in the *Land Use Management Plan* (to be released).

Vegetation and Forested Areas

The SSC site is located in the Blackland Prairie ecological area of Texas and is characterized by elm and hackberry parks/woods, croplands, and other native and introduced grasses. The only large tract of prairie remnant in the area is the Kachina Prairie in Ennis and is not on project lands. The dominant type of land cover in the project vicinity is agricultural.

The region is not heavily forested. Of the area one-half mile on either side of the boundaries of the ring and outside its sites, less than 2 percent is wooded (not including scrub). These wooded areas are mostly riparian woodlands that occur along streams and rivers crossing the site. Because of their importance as water sources and their diversity, these areas merit special attention.

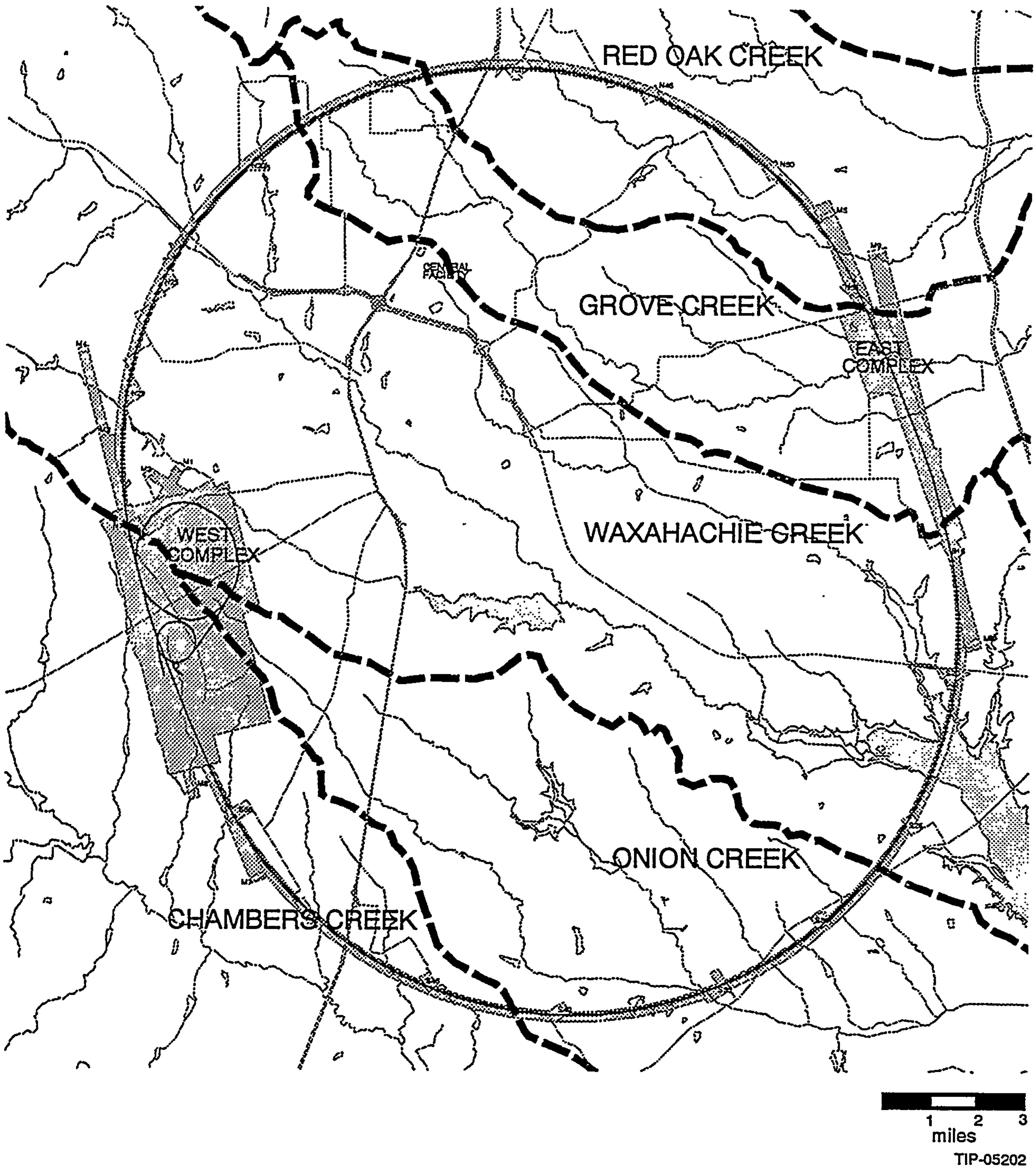
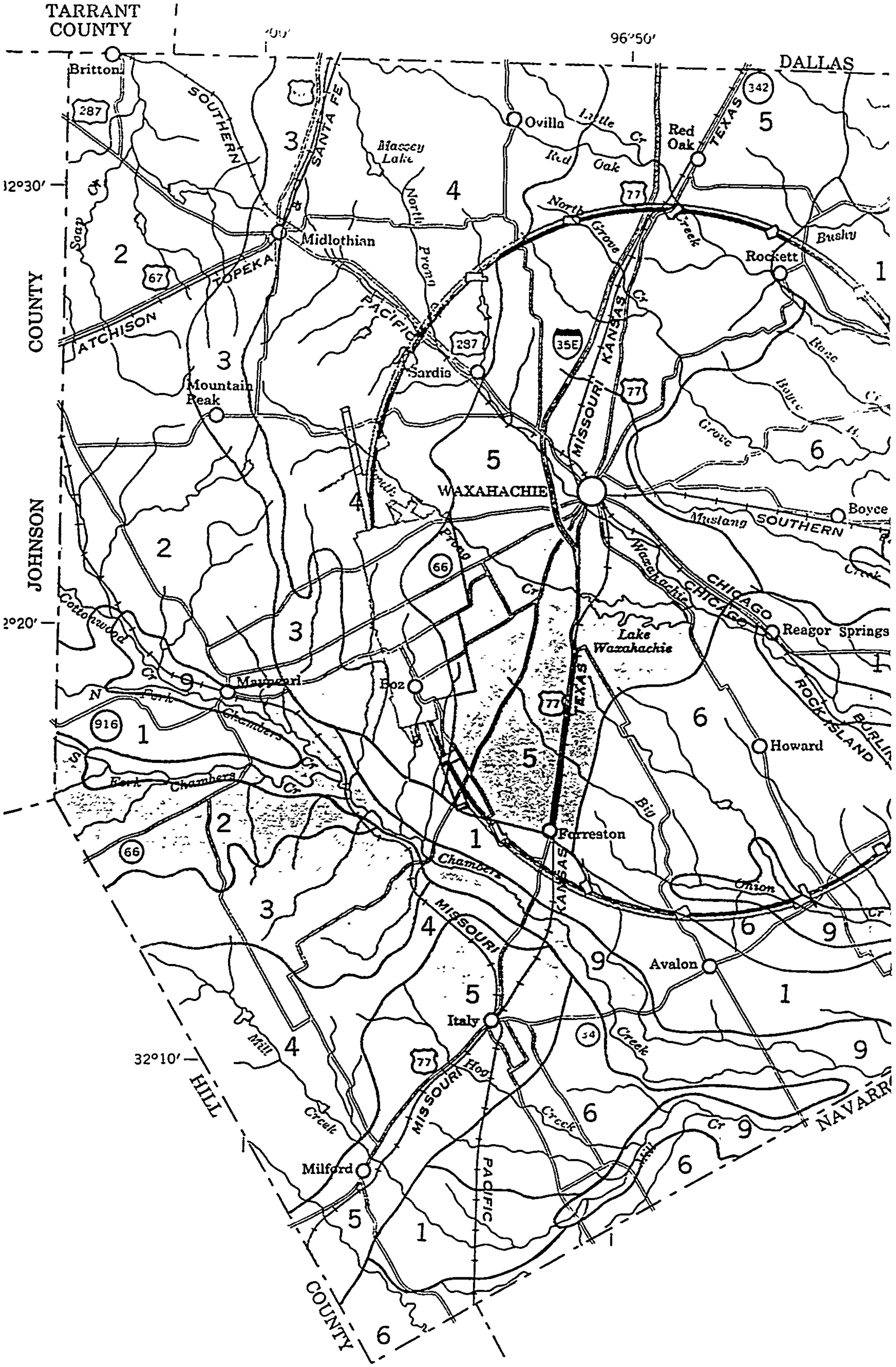
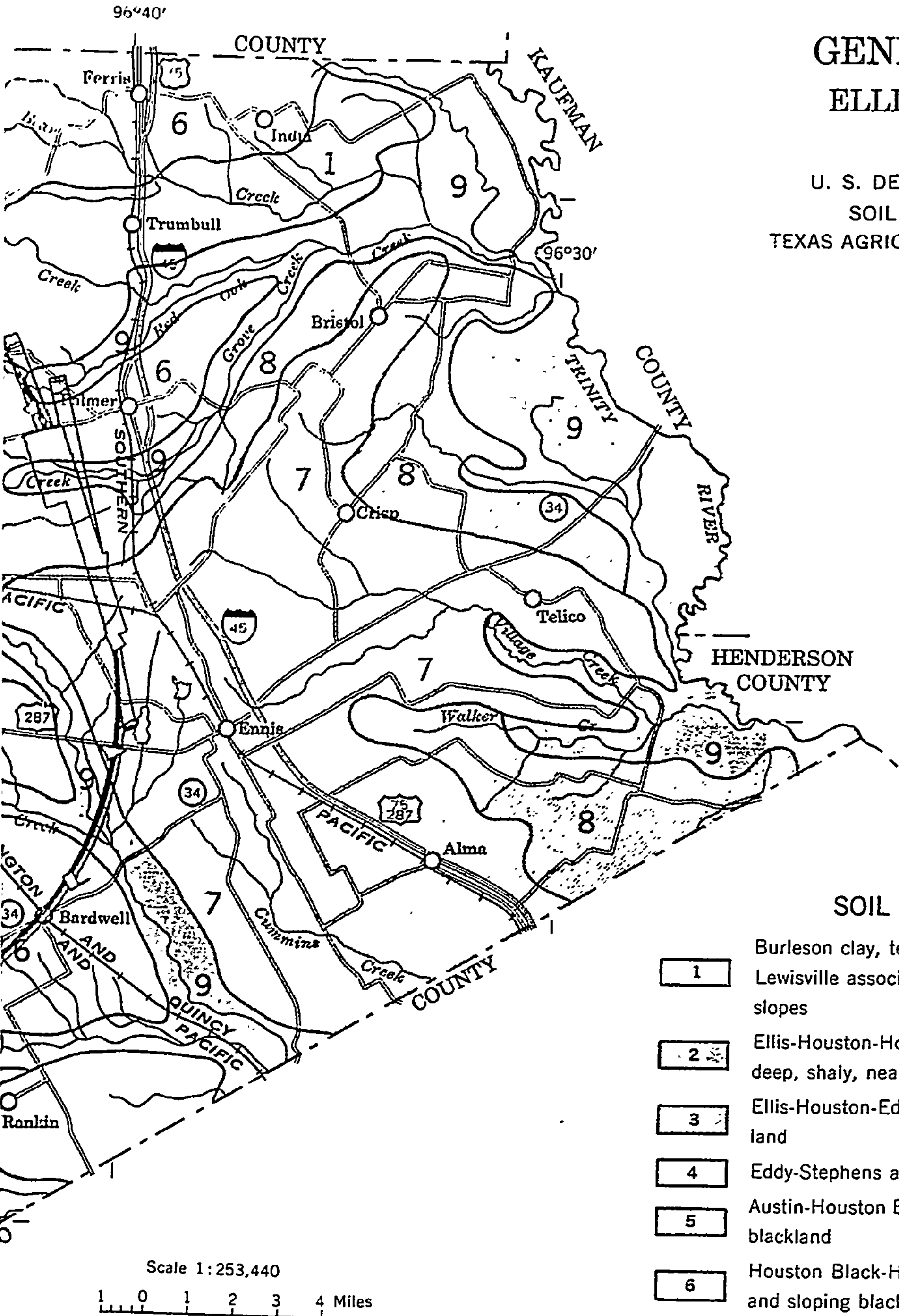


Figure 1.5.3-1. Watersheds in the Vicinity of the SSC Sites.


TARRANT COUNTY
DALLAS
JOHNSON COUNTY
HILL COUNTY
NAVARRO
96°50′
32°30′
32°20′
32°10′
Britton
Ovilla
Red Oak
Midlothian
Rockett
Sardis
Mountain Peak
WAXAHACHIE
Boyce
Reagor Springs
Maypearl
Boz
Lake Waxahachie
Howard
Forreston
Avalon
Italy
Milford
ATCHISON
TOPEKA
SANTA FE
SOUTHERN
PACIFIC
MISSOURI
KANSAS
TEXAS
CHICAGO
ROCK ISLAND
Massey Lake
North Prong
Red Oak Cr
North Grove Creek
Waxahachie
Mustang
Chambers Cr
Mill Creek
Hog Creek
Onion Cr

GENERAL SOIL MAP
ELLIS COUNTY, TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEXAS AGRICULTURAL EXPERIMENT STATION



SOIL ASSOCIATIONS

1	Burleson clay, terrace-Houston Black clay, terrace-Lewisville association: Level blackland and valley slopes
2	Ellis-Houston-Houston Black association: Moderately deep, shaly, nearly level to rolling blackland
3	Ellis-Houston-Eddy association: Shaly and whiterock land
4	Eddy-Stephens association: Whiterock land
5	Austin-Houston Black association: Gently sloping blackland
6	Houston Black-Houston association: Gently sloping and sloping blackland
7	Wilson-Crockett association: Gently sloping grayland
8	Houston-Sumter association: Rolling blackland
9	Trinity-Frio association: Nearly level bottom land

May 1963

Figure 1.5.4-1. General Soils Map.

1.5.5 Climate and Weather

The climate of the Dallas-Ft. Worth region is classified as continental. Because of the effect of the Gulf of Mexico, winters tend to be relatively mild and humid, with daytime temperatures rarely dropping below freezing. However, sudden drops in temperature occur occasionally as a result of "northers" and remain low as polar air masses dominate for a time. During summer, the prevailing winds from the south provide moist, tropical air. When westerly to northerly winds occur in summer, skies are generally fair and the air is hotter and drier.

Normal Weather

Average monthly temperatures in Ellis County are moderate and range from 44° F in January to 86° F in July. The DFW area's record high was 113°F in July 1980 and the record low was 4° F in January 1964. Table 1.5.5-1 shows the high, low, and average monthly temperatures. The estimated annual average humidity is 67%, with variations during one 24-hour period of about 30%.

TABLE 1.5.5-1. ELLIS COUNTY ANNUAL TEMPERATURE AND RAINFALL SUMMARY.

Month	Temperature Fahrenheit*			Precipitation Inches*
	High	Low	Average	Average
January	54	34	44	2
February	59	38	48	2
March	67	45	56	3
April	77	55	66	4
May	84	63	74	5
June	93	71	82	3
July	98	75	86	2
August	97	74	86	2
September	90	68	79	3
October	80	56	68	3
November	66	45	56	3
December	58	37	48	2

* **Rounded to the nearest digit.**

Monthly averages for precipitation are presented in Table 1.5.5-1. Precipitation in the form of rain occurs most often at night and usually rains last for only one or two days. Much of the annual precipitation is the result of brief, heavy rainfall from squall-line thunderstorm activity that occurs mainly in spring. The table shows April through June to be the wettest period, while January and July/August are the driest. Most winter precipitation is in the form of rain; snow and sleet occur rarely from December through March.

The prevailing winds in Ellis County are from the south and are quite moderate. The average of monthly wind speeds is 10.8 miles per hour (mph), ranging from 9 mph in August to 13 mph in March. Figure 1.5.5-1 is a wind rosette showing that the wind is from the south or south-southeast over 30% of the time.

Severe Weather

As mentioned above, the greatest frequency of thunderstorms occur along squall lines in April, May, and June. Thunderstorms occur on the long-term average of about 45 days each year in the D/FW area. Windstorms associated with the thunderstorms can be severe. The fastest recorded wind speed was 77 mph, recorded in the month of July. The region's tornado activity coincides with the thunderstorm season of April through June; these three months account for 60% of the total occurrences. The mean annual frequency in the site region (a region of 4,023 square miles) is 2.05. Most reported tornadoes have a path length less than 10 miles, a path width less than 180 yards, and a maximum speed less than 160 mph. The tornado recurrence interval for striking a point is 570 years.

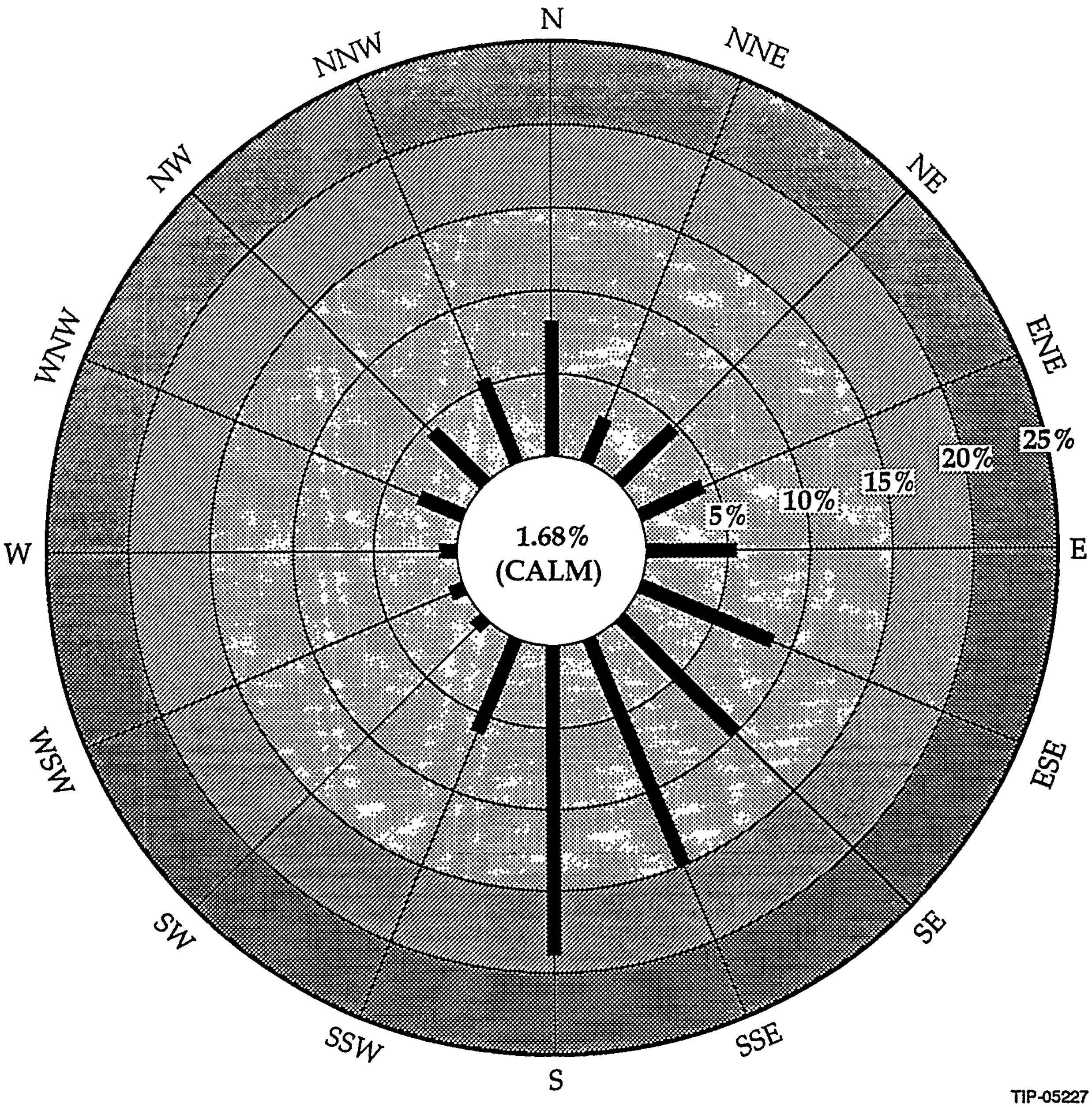


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Figure 1.5.5-1. Wind Rosette.

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2.0 SSC LABORATORY EXISTING PROGRAMS

This chapter presents the Laboratory's current programs and describes the requirements needed to fulfill the programs. It presents some physical characteristics of the West and East Complex sites, with special attention to flood plains. The fourth section of the chapter summarizes site development studies done to locate facilities and determine utilities layouts. The chapter ends by briefly describing the existing laboratory sites and construction sites. The considerations of this chapter lead to the site zoning, facility layouts, and utility layouts given in the next chapter.

2.1 Mission and Programs

The SSC Laboratory has two primary missions-to create a premier international laboratory for high energy physics by early in the next century and to become a major center for science education now and in the future. The high energy physics mission requires the design and construction of the 20-TeV by 20-TeV collider, experimental areas for detecting the results of the proton-proton collisions, and associated research and development facilities.

From its inception, the Laboratory has sought to realize its second mission of serving the public as a resource for science education. The excitement and challenge of the SSC's scientific and engineering programs should be shared with the general public, who provide support for it. It is a responsibility of the Laboratory to provide exhibits, descriptive material, and opportunities for visitors to view the workings of the accelerator and research facilities.

2.1.1 High Energy Physics Programs

The current understanding of subnuclear particles and processes began to emerge three decades ago. It is now recognized that the extraordinary number of previously assumed elementary particles are composites of a small number of basic objects. The Standard Model is the working theory that explains these basic objects (quarks and leptons) and some of their interactions. However, the model is incomplete; it assumes a 'mass-generating' field for which no direct evidence has been found. The simplest model for this field requires the existence of one more particle beyond the known particles-the Higgs particle. The probability of creating a Higgs particle in an existing accelerator is practically zero. The energy level of the SSC interactions was chosen to ensure that the Higgs particle (or whatever phenomena explains mass) will manifest itself at the SSC. The search for the Higgs particle will be the main objective of the SSC High Energy Physics Program, but other investigations will figure prominently. These include a search for the top quark (if not found before SSC operations begin) and an exploration of extensions to the Standard Model, such as Supersymmetry and Technicolor.

Accelerator Program

Some twenty years ago, technological advances made possible colliding beam machines that provide the most effective means to create high energy interactions. Experience with the design, construction, and operation of these machines, especially the Tevatron collider at Fermilab, provides the base from which to build toward the SSC. In the SSC tunnel, oppositely-directed clusters of protons, each with an energy of 20 TeV, will be caused to collide almost head-on, creating a total of 40 TeV of energy in each proton-proton collision. Since the probability of interaction is relatively low, the beams are recirculated repetitively for many hours without significant attenuation. Thus, the SSC is constructed as a pair of storage rings capable of holding tightly confined proton beams on closed paths for a day or more without replenishment. The rings cross at interaction regions where the collision reactions take place and where detectors detect and measure the reaction products for physics study. As the protons collide, their constituents interact at the 1 TeV energy level, the predicted upper bound on the mass of the Higgs particle.

Experimental Program

Detectors are complex technical systems designed to detect particles emitted from beam interactions, to select interactions of interest, and to record associated data from the detector. Individual detectors differ in size and complexity and employ a great variety of technologies. For planning purposes, they can be broadly categorized into four size groups-large, medium, small, and very small. The large detectors are generic detectors that can capture a broad spectrum of particle interactions. The medium size detectors will perform searches for a more restricted range of signals. The small and very small detectors are designed to detect specific interactions. In general, the large and medium detectors are designed to be used over many years through improvements and upgrades that enhance their capabilities and performance. The small and very small detectors will take data for only a short time (from six months to two years) and then be replaced by other detectors. During the initial program, the SSC Laboratory will select and support the fabrication and installation of two large detectors and two other detectors, whose size is yet to be determined.

Support Programs

To ensure that the technical programs are pursued efficiently and in compliance with regulations, the Laboratory mission requires substantial support programs. Those programs of interest here include environmental programs (such as site monitoring and waste handling), safety programs and emergency response, and a land management program.

2.1.2 Education Program

The SSC Laboratory is the first national laboratory to cite an education program of national and international scope as one of its primary goals. To achieve this challenging goal, the Laboratory is developing a broad variety of educational programs reaching out to local and national interest groups as well as interested foreign countries. The Laboratory is considering various options to fulfill this mission. These option include distance-learning mechanisms, educational software, national teacher workshops, and (eventually) a fully equipped Education Center. It is expected that programs and workshops ranging in length from one day to several weeks will be offered at the Center. In addition, continuing education and training facilities for staff and visitors will be provided on-site.

2.1.3 Other Programs

An inviting visitors program can be expected to benefit the SSC Laboratory and the field of high energy physics. The visitors' program would accommodate two distinct groups: professionals and the general public. Professionals would visit the Laboratory to attend conferences and workshops on HEP, accelerator physics, or related engineering disciplines. The Laboratory has a management philosophy of openness and neighborliness: a proactive visitors program for the general public would be consistent with that philosophy. An open and positive visitors program in which the work of high energy physicists is presented accurately and attractively would help to dispel some of the public concern associated with research into the atom. Communicating the role that high energy physics and accelerators play in answering questions about the origins of the universe will be a central message of the Laboratory.

The Laboratory's openness also extends to researchers in other fields. As at other DOE laboratories, the operation of an intense particle beam has attracted the interest of medical researchers. A teaching hospital, the University of Texas Medical School at Southwest Medical Center, has proposed the use of proton beams from the Linac for cancer therapy. The medical uses of the proton beam are the treatment of cancer by secondary radiation and the production of radioisotopes needed for diagnostic imaging. If approved, the Southwest Medical Center would fund and operate a Proton Therapy Facility using Linac bunches diverted when they are not needed for filling the Low Energy Booster.

2.2 Description of Requirements

2.2.1 Staff

During the initial phase, the design, fabrication, and contract oversight functions drive the staffing needs for the Laboratory. As installation of each accelerator is complete, some laboratory staff will be dedicated to pre-operations and commissioning of the accelerators. Table 2.2.1-1 gives staffing counts by division through FY2002, including staff for pre-operations.Figure 2.2.1-1 shows the SSC Laboratory's Organization Chart.

The Laboratory Director is responsible for Laboratory operations and for all Laboratory policies and procedures. In consultation with independent advisory panels, the Director and the Director's Office ensure that the project fulfills its scientific, technical, and educational goals. The General Manager, who reports to the Director, oversees support activities and the Technical Services and Administrative Services Divisions.

The Project Manager oversees the Accelerator Systems, Magnet Systems, and Conventional Construction Divisions as well as the Project Management Office. He is responsible for the design, construction, and commissioning of the accelerators and test beams. The Accelerator Systems Division is responsible for the design and fabrication of all technical systems except the superconducting magnets. The major responsibilities of the Magnet Systems Division are the design of the specialized superconducting magnets and the oversight of magnet production by industrial subcontractors. The Conventional Construction Division directs the work of the Laboratory's Architect-Engineer/ Construction Manager (A-E/CM) subcontractor, who is responsible for design and construction of the tunnels and infrastructure needed to house and support the accelerators and detectors.

The Physics Research Division reports to the Director. It oversees the Laboratory's physics program and coordinates the detector program fabrication and assembly. The Physics division also assists detector collaborations by providing engineering support and research support.

Table 2.2.1–1. Population Projection by Division During Construction Phase.

	Office Personnel			Non-Office Personnel		
Organization	Current	Peak	Start Operation	Current	Peak	Start Operation
Administrative Division	262	233	194			
Accelerator Systems Division	466	350	189	145	100	40
Conventional Construction Division	63	56	10			
Directorate Division	63	64	63	1		
Project Management Office	191	291	384	6	15	15
General Manager Office	147	120	110	23	10	10
Laboratory Technical Services Div.	289	324	308	124	193	187
Magnet Systems Division	309	233	125	61	35	20
Physics Research Division	304	600	669	30	50	51
Sub-Total	2,094	2,271	2,052	390	403	323
Others						
Guest Scientists	139	585	576			
Consultants & Contract Employees	114	17	17			
Students and Teachers	106	105	105			
DOE & Auditors (GAO and IG)	107	107	107			
Sub-Total Others	466	814	805			
Grand Total	2,560	3,085	2,857	390	403	323

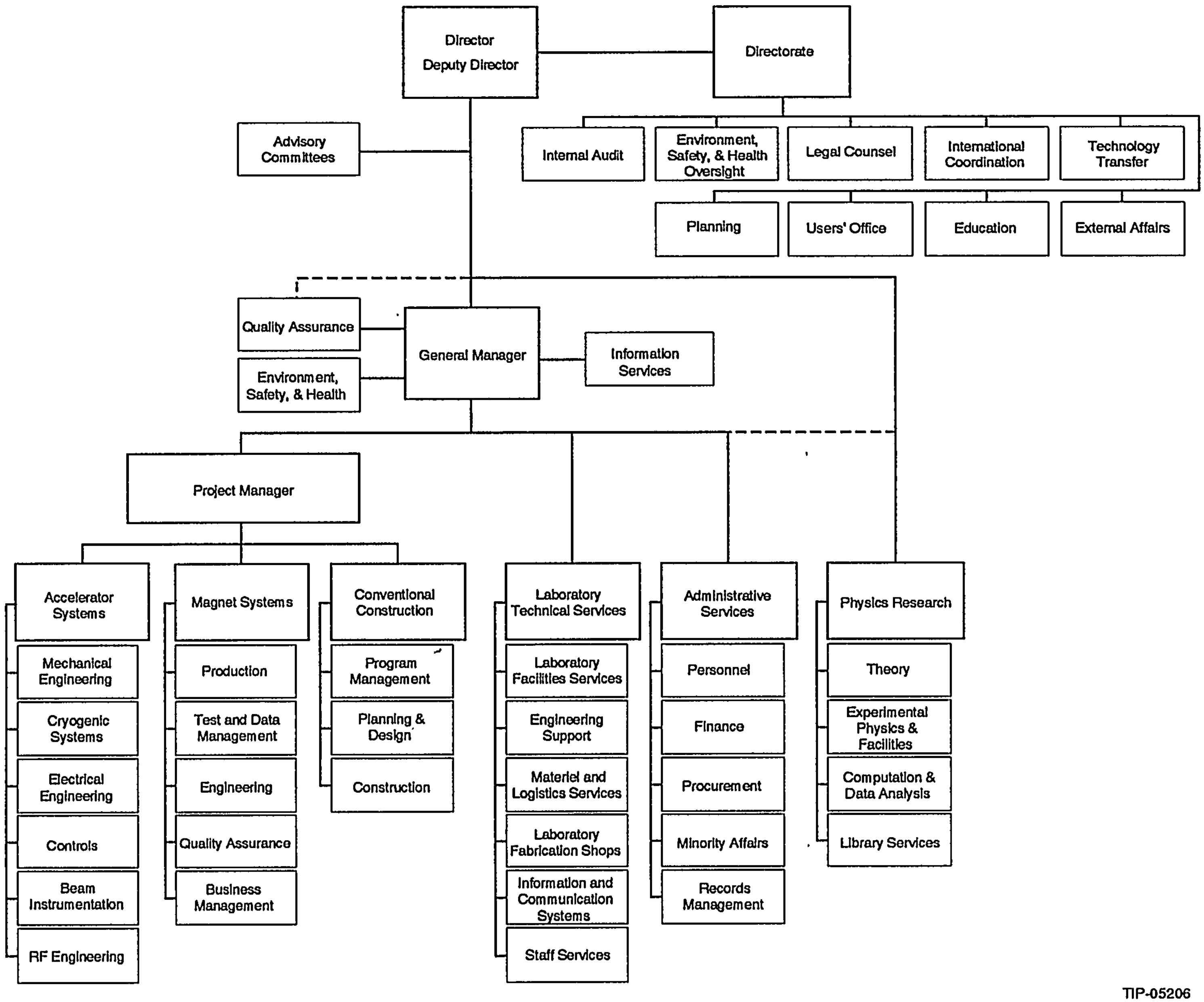

Figure 2.2.1-1 SSCL Organization Chart.

2.2.2 Technical Systems

To meet the goals of the high energy physics program, the Laboratory staff has designed an accelerator complex that consists of four injectors and the collider. Briefly, the accelerator chain is composed of a linear accelerator, two resistive magnet accelerators (the Low Energy Booster [LEB] and the Medium Energy Booster [MEB]), and two superconducting magnet accelerators (the High Energy Booster [HEB] and the Collider). Table 2.2.2-1 gives the energy range and the lengths for each machine.

Table 2.2.2–1. Parameters for the Collider and Injection Accelerators.

	Energy	Circumference or Length (km)
Collider	20 TeV	87.12
HEB	2 TeV	10.89
MEB	200 GeV	3.96
LEB	11.1 GeV	0.57
LINAC	0.6 GeV	0.35

For purposes of the site development, the accelerators are best described at the system level. Briefly, all five accelerators have radio frequency (rf) systems to accelerate the beams and pulsed magnets to inject or eject beams. The four synchrotrons have lattice magnets that bend and focus the beam around a closed path. The HEB and Collider also require cryogenics systems to cool their superconducting magnets to near zero K. All these systems require separate power supplies, cooling water connections, controls, and communications links. Each accelerator also has an associated beam dump that can absorb the proton beams when needed. A detailed description of technical equipment and components required for the accelerator systems is available in other documents. The baseline technical design is given in the SCDR, section 4.2. More recent designs are contained in the documentation of the preliminary and critical design reviews.

The initial experimental program assumes four detectors at four interaction points around the ring. To date, two large detector proposals (the Solenoidal Detector Collaboration [SDC] and the Gammas, Electrons, and Muons [GEM] proposals) have been selected for fabrication and installation. Consideration of the facilities for the two other detectors will be based on model detectors used in conceptual design. This is acceptable for planning purposes, because while the specific choice of detector directly influences the underground halls, the required surface facilities will be similar for detectors in the same size category. Table 2.2.2-2 gives the type and size of the four detectors.

Table 2.2.2–2. Experimental Facilities for the Initial Research Program.

Detector	Location	Detector Dimension/ Volume (cu.m.)	Detector Weight* (ton)
Solenoidal Detector Collaboration (SDC)	IR8	21.8x21.8x40	35,000
Gammas, Electrons, Muons (GEM)	IR5	21.8x21.8x36	11,000
Detector 1	IR1	5000	N/A
Detector 2	IR4	< 5000	N/A

*** Includes weight of support structure.**

The detector components and systems driving the utilities needs are the large magnets that bend the paths of charged particles for momentum identification and the electronics that read, select, and record events. In addition, the large detectors will require refrigeration plants to cool cryogenic magnets or liquid-argon calorimetry. Complete descriptions of the SDC and GEM components and systems are given in the Technical Proposals submitted by the collaborations (SDC — April 1992; GEM — April 1993). Descriptions of the other detector models are given in the SCDR, section 5.4.

2.2.3 Facilities

The collider facilities consist of the 54-mile tunnel, shafts, and associated services supporting the main accelerator ring. Surface facilities are located at the 18 service areas around the ring and at the rf, kicker magnet, and beam dump shafts in the West utility straight. The service buildings will be required to house power supplies, electronics, and refrigeration plants. The injector facilities include surface and subsurface enclosures, tunnels, and associated electrical and mechanical systems supporting the injectors. The test beam facilities include a tunnel from the MEB to near the surface, service buildings for the magnets enclosures below ground, a target hall, a utility building, and a calibration hall with three test stands. A detailed description of these facilities may be found in the facility Design Requirements documents for each machine.

The experimental facilities are those surface and underground structures and associated support systems situated in the four initial detector areas-two on the east side and two on the west side of the Collider Ring. Industrial buildings will be required for on-site assembly of detector components fabricated elsewhere and shipped to the site. Some office and laboratory space will be required at the Interaction Region (IR) areas to accommodate the collaborators who will oversee the detector installation. Utility buildings will provide controlled environments for power, cooling water, cryogenics, compressed air, and vacuum equipment. The design requirements for the conventional facilities supporting the large detectors are contained in the *SDC Experimental Facilities User Requirements* [1](SEFUR, February 1993) and the *GEM Experimental Facilities User Requirements*[2] (GEFUR, February 1993). A discussion of experimental facility requirements for other detectors is given in sections 5.4.7 and 5.4.8 of the SCDR and programmatic descriptions of the surface facilities are given in section 6.2.5.

A campus provides offices, meeting rooms, an auditorium, services for personnel, and light laboratory space for component and electronics development. Heavy works buildings are dedicated laboratories for the fabrication and testing of technical systems. The 'environmental health' facilities handle and temporarily store hazardous waste and low-level radioactive components. The support facilities are emergency stations, warehouses, grounds maintenance buildings, and fabrication shops.

Of the other programs, a firm funding source has been identified for only the Proton Therapy Facility. A complete conceptual design for the multi-level facility is contained in *Proton Therapy at the SSC*[3] (April 1992). The floor level will house the diagnostic imaging equipment, patient preparation rooms, and offices for physicians and technicians. The first level down will contain magnet power supplies and mechanical and electrical systems. The second level down will contain two direct treatment stations and a target room for production of isotopes.

2.2.4 Infrastructure

The SSC sites are distributed throughout a semi-rural area. The project requires the up-grade or construction of roads to access some N & S sites and to link technical areas on the West and East complexes. Off-site, existing dirt roads will be widened and paved and existing bridges will be replaced to allow construction equipment access to the remote N & S sites. Roads to magnet delivery shafts at N40, S25, and S40 must support 50-ft. trailer rigs weighing roughly 15 tons. Roads serving the large detector halls must support the regular delivery of components weighing from 100 tons up to 450 tons. Construction of by-passes around municipalities could significantly reduce the travel time between the West and East complexes and route heavy traffic away from city centers. Some existing roads running from Interstates to the West and East complexes will be up-graded. On the complexes, construction of new roads will provide north/south links between the technical areas.

The electrical power required for the technical and conventional facilities is estimated to demand an average load of 176 MW during collider operations. Several special requirements are imposed on the electrical distribution system because of the technical components. Because of harmonics generated by ramping the magnets, the LEB, MEB, and HEB power distribution lines will require filters to prevent buildup of excessive current peaks. Uninterruptable power supplies are needed for supervisory control and data acquisition systems in the central operations center. Electrical power will be used for climate control at remote sites, while natural gas will be used for heating and dehumidification at the facilities on the Complexes. Table 2.2.4-1 shows the peak utility demands.

Table 2.2.4–1. Operational Utility Requirements for SSCL Systems.

Service Area	Electrical (MW)	Gas (MCF/H)	Cooling Water (MGD)	Potable Water (MGD)
West Complex				
Linac	2.2	1.2	inc. MEB	0.01
LEB	10.4	4.1	inc. MEB	n/a
MEB	23.2	5.5	2.6	n/a
Test Beams	2.8	4.6	inc. MEB	0.01
HEB	15.6	n/a	1.7	n/a
Collider RF	8.0	n/a		n/a
Collider – West Ring	36.0	n/a	below	n/a
N15 Facilities	9.1	8.8		0.08
Campus	7.4	17.9	0.7	0.13
Exp. Facilities (IRs 1&4)	6.6	11.7	1.5	0.08
Support Bldgs.	.2	1.0		.04
Irrigation				0.21
East Complex				
Collider – East Ring	36.0	n/a	below	0.08
Exp. Facilities (IRs 5&8)	19.8	14.4	1.3	0.06
Support Bldgs.	.1	1.0		.03
Irrigation				0.04
Collider	above	n/a	4.3	n/a
Total	177.4	80.2	13.6	0.75

Italics = Allowance for areas in conceptual design.

Electric demands from March 1993 ACPR Load List.

Gas from Infrastructure Working Group & SCDR.

Water from Freese & Nichols "SSC Water Supply Report".

Site-wide communications systems are required to monitor and control the technical systems and conventional facilities from a central operations center. Operation of the injectors and collider requires precision global timing, beam correction controls, a personnel safety interlock system, and a quench protection system. Conventional facilities and utilities will require site-wide facilities controls, supervisory controls for the utilities, and fire alarm systems. Other communication needs include a local area network, telephones for voice, and a cable television system for video.

Water is required for cooling electrical equipment and the oil coolers for the helium and nitrogen compressors. Untreated (raw) water is needed for the primary side of heat exchangers, and filtered water is needed for generation of low conductivity water (LCW) and industrial cooling water (ICW). Cooling water and cooling water plants will be required at various points on the West and East Complexes and on the N & S '5' sites. Potable water will be required at the West and East Complex sites with permanent populations. Water will also be required for irrigation of the landscape at the West and East Complexes. Another demand on the water system is set by the required water flow for fire fighting; on the complexes, the system must be able to provide 2,000 gallons per minute for a two hour period.

Three types of wastewater will be produced by operations at the SSC facilities. Industrial wastewater will be generated from the operation of the closed-loop LCW and ICW systems and the chilled water systems. Wastewater from the closed LCW systems will be treated off-site; wastewater from the ICW and chilled water systems will be discharged to evaporation ponds. Sanitary sewage will be generated at the facilities on the West and East Complexes. For planning purposes, it was assumed that sewage flows will equal the demand for potable water. Finally, storm water run-off will be captured by site drainage systems and routed through detention ponds.

2.3 Physical Characteristics of the Sites

2.3.1 West Complex

Physical characteristics of the West Complex site are indicated in the two site diagrams that follow. Figure 2.3.1-1 shows the topography of the West Complex. The large, central areas of the West Complex have slopes of less than 5 percent. Only along the creeks near the edges of the West Complex are slopes steeper than 10 percent found. Most of the central area is composed of soils suitable for pond and bank construction. This central portion of the site is typified by Austin chalk and Houston black clay interspersed with various soils such as Stephen silty clay.

As part of the required pre-construction site surveys, the A-E/CM performed hydrologic modeling to determine the 100- and 500-year flood plains of the creeks draining the West Complex area. They modeled the Onion Creek, the South Prong Creek, and the Baker Branch (for the S55 site), the Great House Branch, and the unnamed branch of Chambers Creek. The details were presented in *Hydrology Report of Existing Conditions for the West Campus*[4] (August 1991). Figure 2.3.1-2 shows the flood prone areas in the vicinity of the West Complex. Development potential on the West Complex is not significantly affected by the flood prone areas, which breach the site at its northeast, west, and south boundaries.

West Complex development is not affected by heavy vegetation, due to previous agriculture and pasture/range land uses. The most significant habitats are the riparian woodlands, particularly in the northeast corner of the complex and along the southern portion of the unnamed branch of Chambers Creek. Vegetation will be protected and augmented during site development for aesthetic and wildlife enhancement. If significant vegetation along the creeks is lost due to pond construction, the Laboratory plans to re-plant the edge of the ponds.

2.3.2 East Complex

Figure 2.3.2-1 shows the elevation changes on the East Complex. Much of the East Complex land has less than 5 percent slope, but around the creeks, the land is more steeply inclined, with 5 to 10 percent and greater slopes. Soils near the creeks are judged unsuitable for pond and embankment construction, but elsewhere the soils are more suitable. These areas of suitable soil are characterized by Austin chalk, Houston Black clay, and soils such as Stephen silty clay.

The most pertinent physical features of the East Complex are the watercourses that divided the complex into three parts. The Bone Branch and Grove Creeks run near the northern end of the complex and Cottonwood Creek cuts through the middle of the complex. As part of the required pre-construction site surveys, the A-E/CM performed hydrologic modeling to determine the 100- and 500-year flood plains of these creeks and Red Oak Creek (for the M5 and M9 sites) and Wolf Branch Creek (for the S15 site). The details were presented in *East Complex Hydrologic Engineering Report*[5] (November 1992). The report concluded that flood plains did not impact the IR5 and IR8 areas, but that they did impact the M9 and S15 sites. Figure 2.3.2-2 indicates flood prone areas on the East Complex.

Because of previous pasture land and range land uses, East Complex development will not be affected by heavy vegetation. Concentrations of existing trees and other vegetation occur near the watercourses as part of riparian habitats.

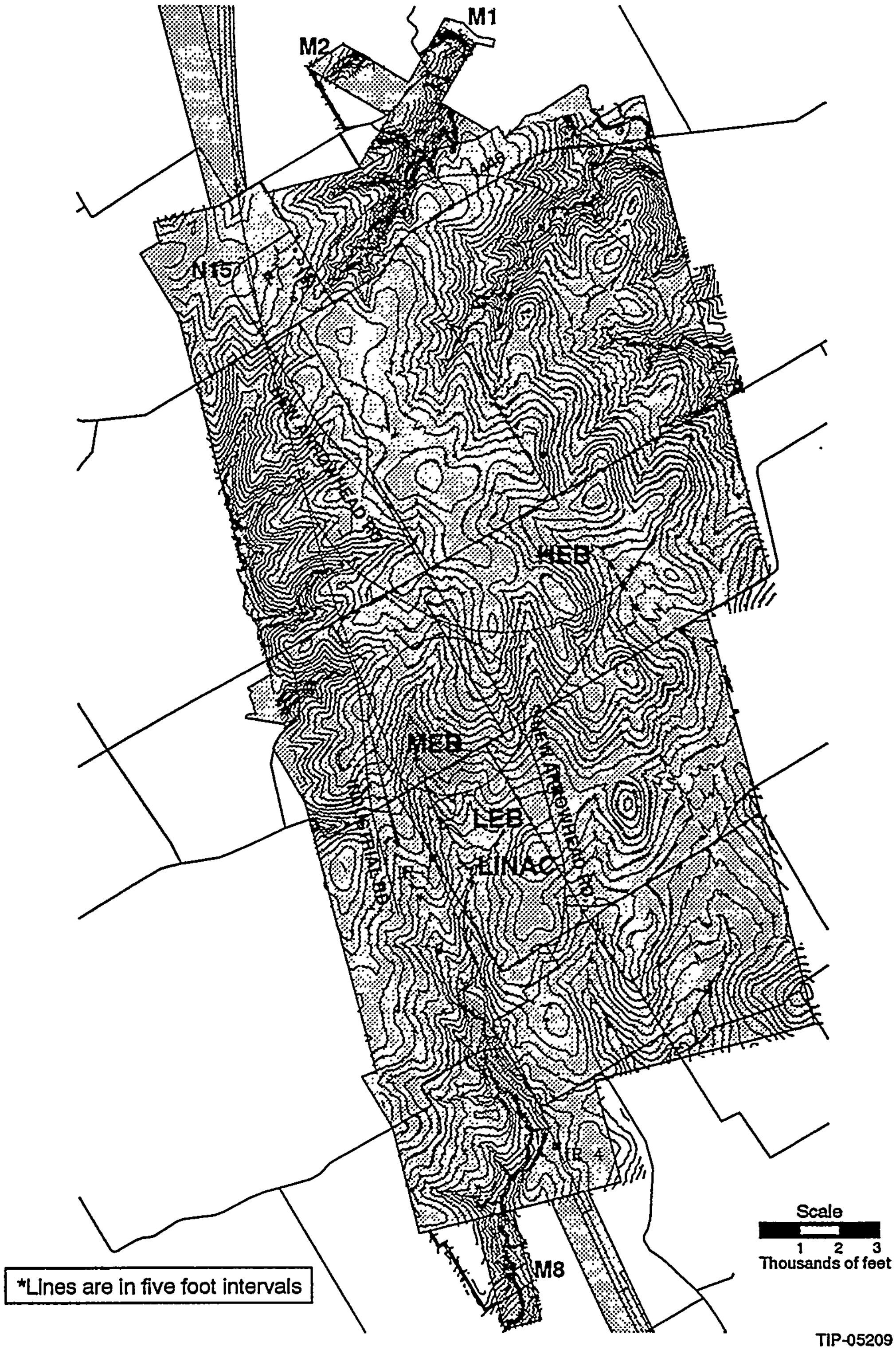

Figure 2.3.1-1. West Complex Topography.

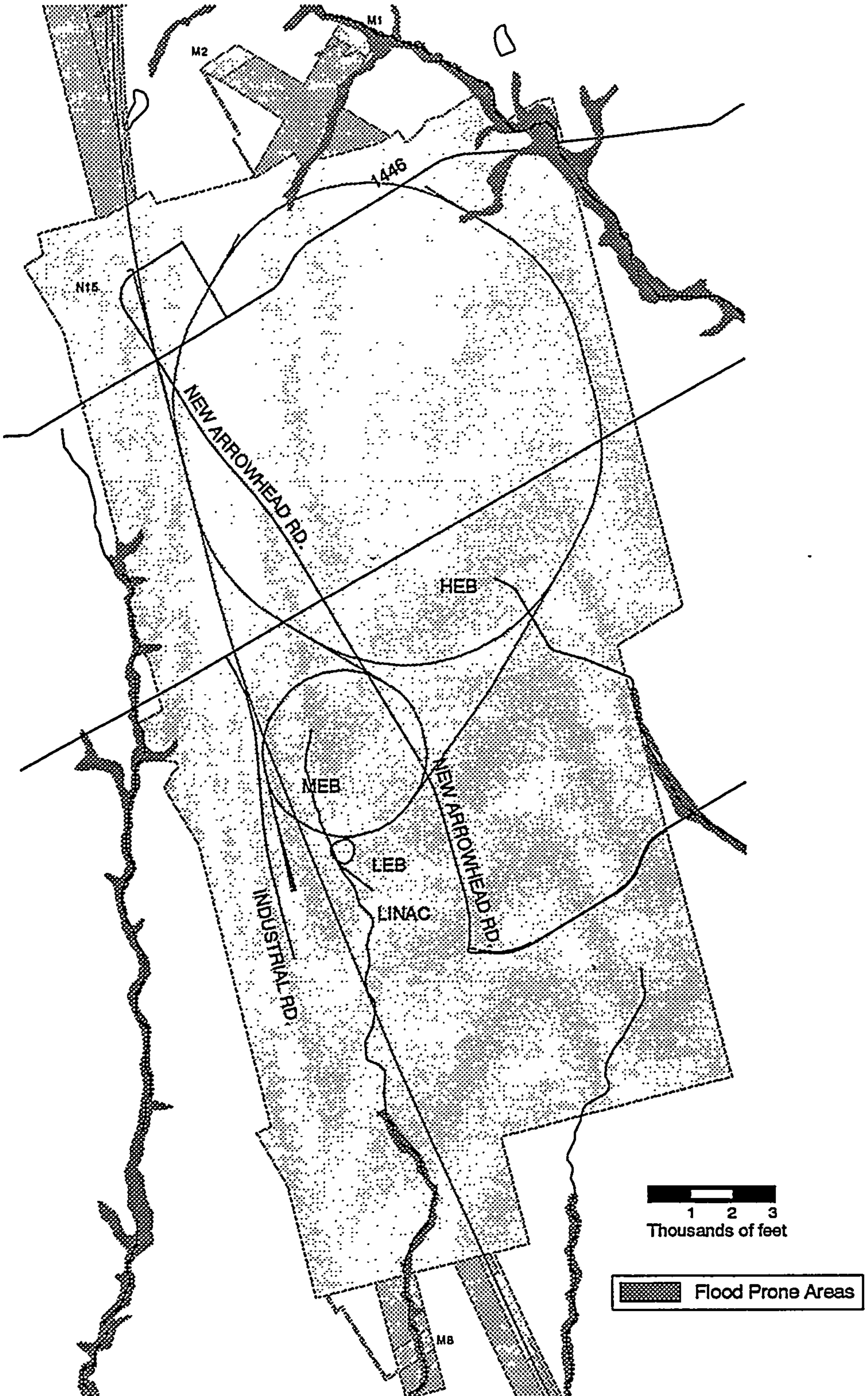

Figure 2.3.1-2. West Complex Flood Prone Areas.

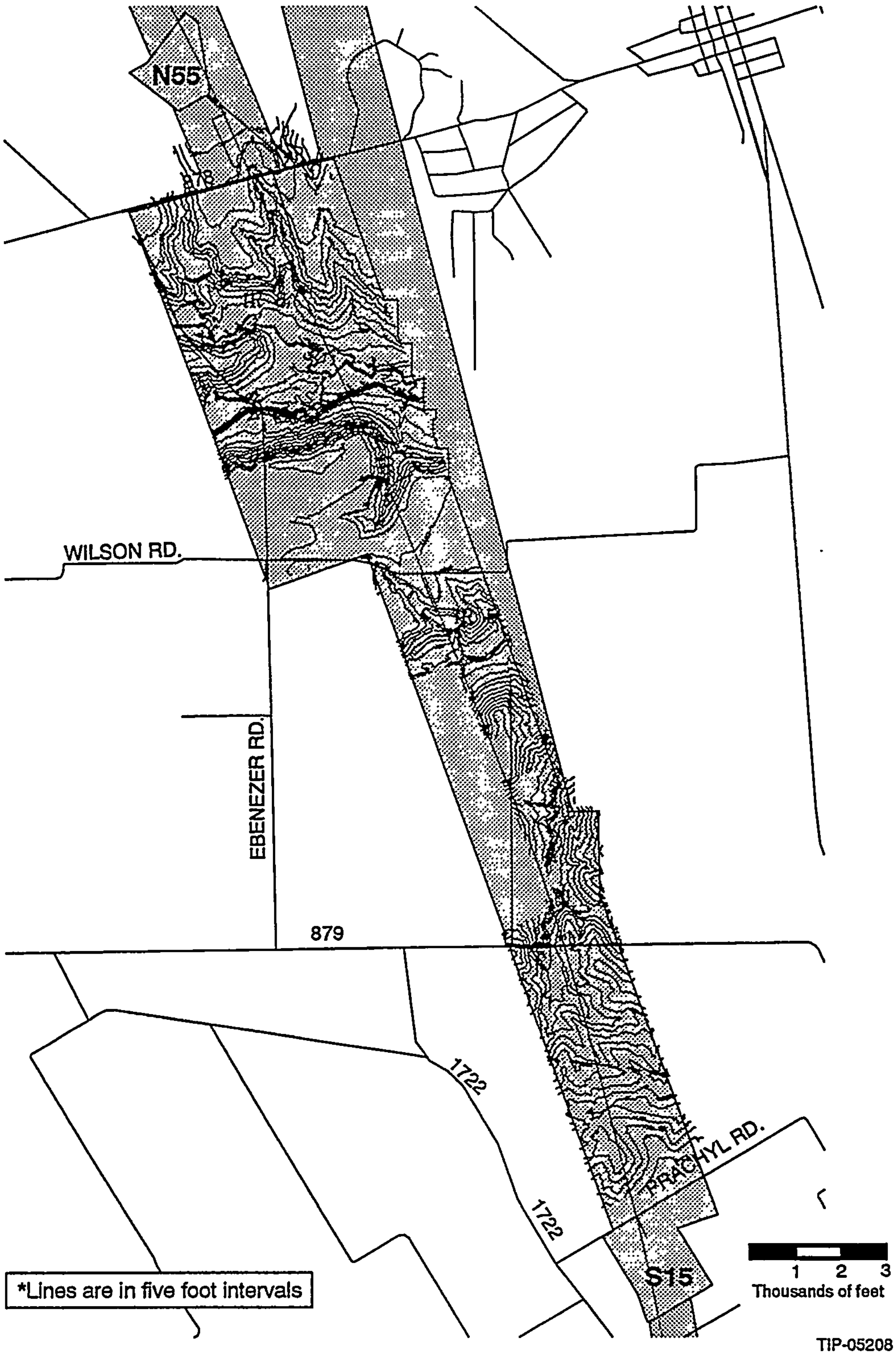

Figure 2.3.2-1. East Complex Topography.

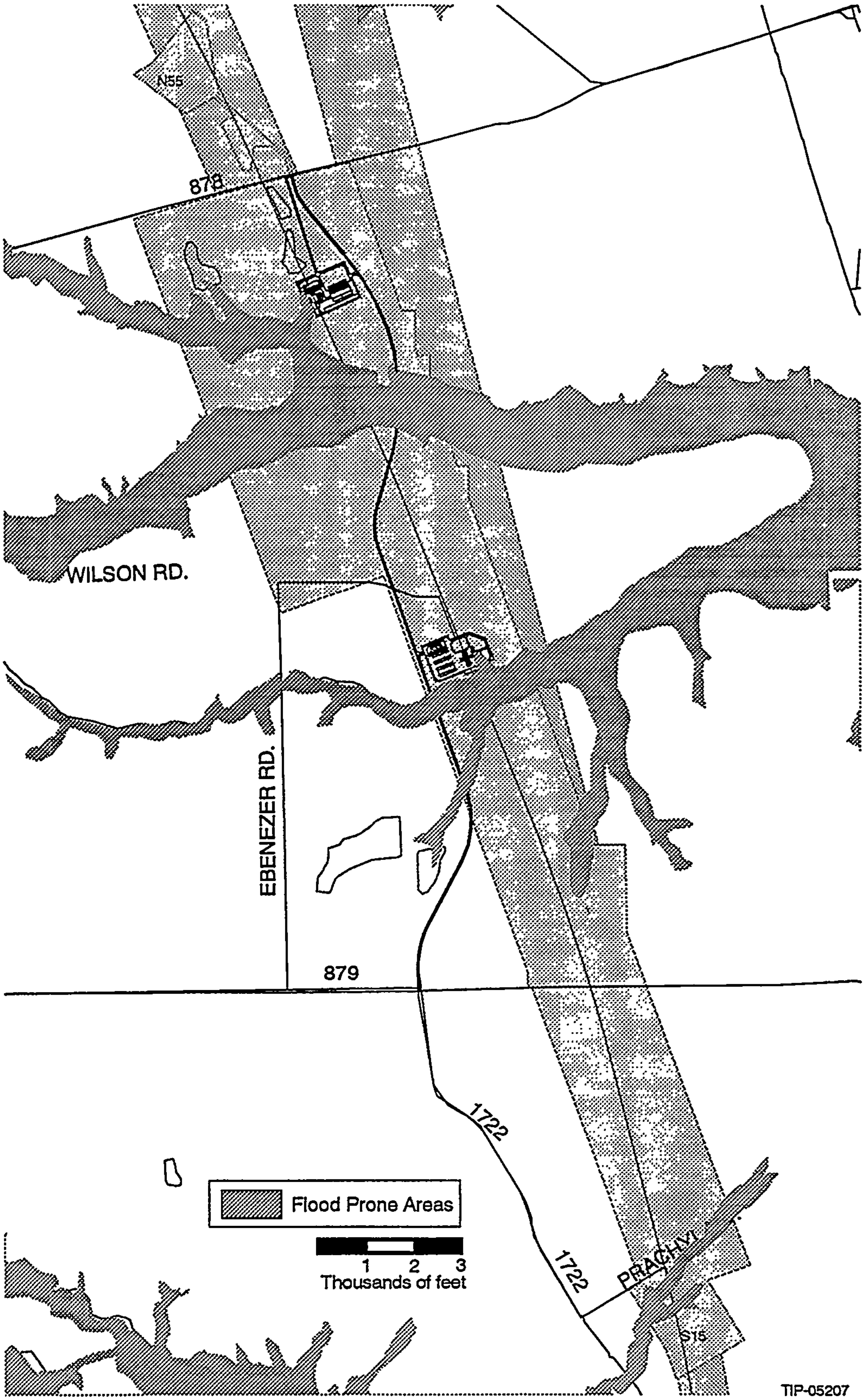

Figure 2.3.2-2. East Complex Flood Prone Areas.

2.3.3 N, S, and M Sites

The A-E/CM, working with Laboratory and TNRLC staff, prepared site analysis diagrams of the physical characteristics for each of the N and S sites. In-depth investigations were conducted for each site relative to slopes, soils, vegetation, watershed/flood plain, noise receptors, access, utilities, and development potential. These diagrams became the basis for the *Service Site Adequacy Study*[6] prepared in 1990/1991 and released in March 1991.

Slopes were categorized as 0–5 percent, 5–10 percent, and greater than 10 percent. The planning assumption was made that slopes greater than 10 percent would require an engineered design solution; slopes 0–5 percent and 5–10 percent would require a minimal engineering response. Soil analyses included a type designation, percentage of site coverage, and a pond and embankment construction suitability rating. Vegetation was mapped to predict the potential impact of construction on existing habitats.

Watershed/flood plain data were based on local drainage systems and Federal Emergency Management Administration (FEMA) maps of flood-prone areas. Areas located in flood plains are subject to careful permitting requirements. For each service area, noise receptors (houses and other structures) between 600 ft. and 1000 ft. from each shaft location were identified. The report discussed the passive or active noise mitigation techniques necessary to maintain existing rural noise levels near each site. Potential impacts on adjacent land uses were also investigated and rated as low, minimal, or moderate.

Near the complexes, there are small sites used for monitoring purposes, the M sites. They are located past the ends of muon vectors projected from the interaction points and the beam absorbers. They are required to sample the condition of the underground environment before and during operation of the accelerators and detectors. Construction on these areas will typically be limited to the drilling of small-bore shafts for the installation of monitoring detectors. Construction access routes to these sites were planned and right-of-way purchased when the monitoring sites boundaries were set.

2.4 Site Development Studies

The first part of this section summarizes the siting studies done for the facilities required for the existing programs. When no formal studies were done, the rationale for siting the facilities is given. The site maps and specific information on the facilities are given in chapter 3, 'SSC Project Site Plans.' The second part of this section summarizes the utilities studies done to determine transmission and primary on-site utility distributions. The utility layouts are given in chapter 3.

2.4.1 Siting of Facilities

Technical Facilities — Collider

After fixing the collider ring elevation (as described in section 1.1.2), the SSC Laboratory and its A-E/CM sub-contractor made a site assessment of the proposed service areas around the North and South arcs. The service areas were initially determined by projecting the collider's half-sector shafts to the surface and requesting 50 developable acres around the point. The TNRLC responded to this request with proposed service area boundaries. These areas were the initial lands to be assessed. A project team investigated each proposed site with regard to slope (topography), soil types, vegetation, watersheds and flood plains, near-by noise receptors, site access, and utility easements. Their criteria were discussed above under section 2.3.3. Their assumptions and the details of their investigation were presented in the *Service Site Adequacy Study.* As a result of the study, five service shafts were moved to more desirable locations. These areas were N25, N30, S20, S35 and S55. Also, four other sites had their boundaries modified to ensure the sites contained 50 developable acres. A sample refrigeration site and a sample ventilation site are shown in section 3.2.3.

Technical Facilities — Injector

The original Texas site proposal placed the injectors on the West Complex, and the laboratory maintained that configuration. The geometries of the injectors and the transfer lines are the primary drivers in the siting of their facilities. As the lattice design developed, significant changes affected the geometries. As mentioned under 'History', the increased energies for the HEB, MEB and LEB resulted in a near doubling of their circumferences. The final design change affecting the geometry occurred in April 1991, when the number of straight sections in the LEB was reduced from six to three, causing a shift in the LEB and the Linac.

The bases for setting the injector elevations were primarily site geology, cost, and safety considerations. The beam lies in a single plane through the Linac, the LEB, and the MEB and then is either directed down to the HEB plane or to the test beam switchyard. The elevation of the injectors near the surface, the Linac, LEB and MEB, was set after a cost study was performed. Under direction from the Laboratory, its A-E/CM developed cost estimates for four elevations. The study considered the amount of material excavated from the trench, the height of the embankments needed for shielding, and MEB shaft depths. The study also factored in the environmental issues involved in a potential stream relocation. The A-E/CM presented its study in the *Linac, LEB, and MEB Elevation Study*[7] (May 1991). The final construction design placed the three machines on a plane slightly sloping with the site topography.

As the design of the HEB to collider transfer line is complicated, the Laboratory fixed the HEB elevation at about 50 ft. above the collider elevation. So, the final collider elevation adjustment also set the HEB elevation. The adopted collider elevation had the added benefit of raising the HEB entirely out of the Eagle Ford Shale and into the Austin Chalk. Later, the service facilities for the HEB were sited by the same method used for siting the collider service areas. The proposed HEB shaft locations were projected to the surface and the areas surrounding the shafts were analyzed for topography, soil, and streams. This resulted in the relocation of one shaft (H40) away from a creek.

Experimental Facilities — Test Beams

The test beams line was sited so that it would be tangent to the MEB and HEB rings. In the future, this would allow test beams to be extracted from the HEB and routed to the test beam switchyard with minimal manipulations. The slope of the test beam plane was set by safety considerations. The paths of the muon vectors projecting from the targets and the test stands were calculated, and the test beams were angled so that the muon vectors will remain below ground for their entire length.

Experimental Facilities — Interaction Regions

As mentioned above, the Laboratory and its Physics Advisory Committee has selected two large detectors for fabrication and installation. To track particles to the detector design precisions, the detector collaborations have requested stringent alignment requirements. Because of the enormous weight of the detectors, the alignment requirements dictated special attention to the long-term stability of the hall floors and their underlying rock. Under the direction of the Laboratory, the A-E/CM conducted a series of studies comparing the West and East Interaction Region (IR) locations. *Experimental Facilities Interaction Region Study Phases A-D*[8–11] (January 1991, September 1991, October 1991, February 1992).

The studies evaluated the site geology (rock properties and seepage evaluation), modeled site-specific halls and foundations, and ran simulations of long-term deformations based on the geology and models. They also compared costs for two construction options (cut & cover vs. cavern) at the four IR sites. The studies were done in tandem with the tunnel elevation study and assumed that the recommended tunnel elevation would be adopted. Even after the tunnel elevation adjustment, the floors of the large detector halls on the West side were near the Austin Chalk and Eagle Ford Shale interface. The studies concluded that the foundations at East IRs would provide better long-term stability, but the costs of constructing the halls on the East side would be greater than constructing them on the West side. It was decided to shift the large detectors to the East because of the over-riding importance of stable hall foundations. The SDC detector and support facilities were shifted from IR1 to IR8 and the GEM detector and support facilities were shifted from IR4 to IR5.

This shift greatly benefitted to the large detectors, but the other detectors will also have suitable foundations. Each detector is designed around the collider beam line. The distance from the beamline to the hall floor is set by the size of the detector. With a medium or small detector placed at a West IR, the required hall floor will be at a shallower depth than a hall for the SDC or GEM detector. This leaves a thicker layer of Austin Chalk between the hall floor and the Eagle Ford Shale. This thicker layer should provide a stable support for the smaller, less massive detectors.

Technical Facilities — Campus

As described under 'Existing Conditions' (section 2.5), Laboratory staff are currently working at several sites. Despite this development, the Laboratory's goal has remained to locate most personnel at a single site in a campus setting. The SSC Laboratory directed the work of a site planner/architect subcontractor, who proposed a site for the campus and prepared an integrated conceptual design of the campus. Their work was presented in the *Main Campus Development Plan*[12] (May 1993).

Four alternative sites were considered for the campus. Because of the shift of the large detector halls to the East Complex, a site on a bluff between the IR5 and IR8 was proposed. Three sites on the West Complex were considered-one within the MEB ring, one to the southeast of the Linac, and one between the IR1 and IR4 sites. The sites were evaluated on the basis of proximity to technical areas, site access, site adequacy (for baseline and future development), and site climate and environment. The four locations were discussed with laboratory staff, detector collaboration members, and DOE personnel. The location between the IR1 and IR4 sites, the 'Boz' site, was selected for further planning.

The campus on the Boz site is envisioned to lie on the edge of a cooling pond, which would serve the campus, IR1, and IR4. The further planning considered pond configurations, water level, facilities layout, and construction phasing. The integrated design included access and parking, footpaths, landscaping, climate control, and energy efficiency. For project function, the campus plan includes an operations center, administrative and laboratory space, a library, and a cafeteria. The design also integrates an auditorium, conference rooms, an education center, and accommodations for visitors (both short- and long-term).

Technical Facilities — Heavy Works Buildings

Both the MTL and the ASST facilities require cryogenics service. The SSC Laboratory is also planning a closed-loop cryogenics test, in which several cells of magnets would be tested in a tunnel sector. These factors caused the magnet laboratories and the ASST to be sited near the N15 refrigeration service area. This proximity would allow the ASST and MTL to use the cryogenics services of the N15 tunnel sector, which would not require the full capacity of the refrigeration plant for several years. However, by procuring and running a full-size refrigeration plant early, staff would gain experience they could apply to specification and procurement of the remaining refrigeration plants. So the MDL, the MTL, the ASST enclosure and shops, a compressor building for the refrigeration plant, and required utilities were located at the N15 area. A magnet warehouse for storage of industrially produced magnets will also be constructed in the N15 area.

Support Facilities — Emergency Facilities

The siting of the emergency facilities is driven by response time to calls. This implies that the facilities must be located with immediate access to main roads and near to population centers. There will be two emergency stations providing fire and paramedic services. The one on the West Complex is sited along Industrial Rd. near its intersection with FM 66. The one on the East Complex is sited northeast of the IR8 area, on the east side of the Connector Road. These place the emergency facilities on the main on-site north/south roads, with quick access to east/west roads running from the sites, and next to necessary utilities. In addition to the two stations, space for an Emergency Operations Center, providing security and dispatch services, and a Medical Office will be available on the Main Campus.

During operations, personnel will be concentrated on the West and East Complexes, so only the two stations will be needed. As the SSCL staff is currently located at several sites, two temporary Medical Offices have been established: one at Stoneridge and one at the Central Facility. Also, during construction the Laboratory has taken the responsibility of providing paramedic services for construction crews. As the construction crews work on all sites, three temporary emergency response trailers will be established at N25, N40 and S40. Similar trailers are already in place on the East Complex (at the IR8 area) and on the West Complex (at the Injector area).

Support Facilities — Hazardous Waste Storage

The SSC Laboratory has allocated funds for the construction of two hazardous waste storage facilities-one for the West Complex and one for the East Complex. Currently, the Laboratory is producing only small quantities of hazardous waste, consisting largely of acids, solvents, paint, and toner. The Laboratory has adapted an interim solution to store these small quantities. It has purchased and installed Temporary Storage sheds at each of the operational sites. To date, the Temporary Storage Areas (TSAs) have been created at the Stoneridge Facility, the Central Facility, and the N15 area. Three more are proposed for the Injector area, the IR5 area, and the IR8 area. This solution has been adapted to let the Laboratory avoid the complications of shipping hazardous materials. Under current conditions, it is the most cost effective solution because the TSAs are not being filled rapidly and so shipping is infrequent.

However, the *SEIS* has estimated that during operations, the Laboratory will generate roughly 10,000 gallons (about 40,500 kgs) of hazardous waste per year. This will have to be compared with the capacity of the TSAs and the costs of shipping to determine if larger central storage facilities become reasonable. This determination must also consider the costs of permitting required to operate an on-site, long-term storage facility. Regulations state that once waste has been shipped over public roads, it has to be delivered to a facility with a Resource Conservation Recovery Act Part B Storage Facility Permit.

Support Facilities — Radioactive Materials Handling and Storage

The SSC Laboratory has also allocated funds for the construction of four radioactive material facilities-two on the West Complex and two on the East Complex. At a radioactive material handling facility, radioactive waste is separated from other wastes and radioactive sources are stored. At a low-level radioactive material storage facility, usable materials (such as magnets) that have become radioactive are stored until they become inert again and can be reused. These facilities have currently not been sited and, by regulation, require rigorous site study before a location is selected. Among the criteria the sites must satisfy are that the facilities must be more than 1000 ft. from the site boundaries and must not be within a 500-year flood plain.

Other Facilities

The only facility outside the project that has a confirmed source of funding is the Proton Therapy Facility. It is sited to use beam from the Linac without interfering with Laboratory operations. This facility has been sited to the west of the Linac-LEB transfer line, about 200 ft. from the point of its beam extraction.

2.4.2 Infrastructure

Electrical

Under the direction of the Laboratory, the project A-E/CM assembled an Electrical Task Force to consider the options for primary site distribution. The Task Forces suggestions were documented in the *Electrical System Review: Design Concept Re-evaluation*[13] (June 1993). The task force considered the following trade-offs: buried cable v. overhead power lines and a single substation v. distributed substations. In the single substation option, major transformers would be located at the main substation and distribution would occur at two voltages, 69 kV and 12.47 kV. In the distributed substations option, the main substation would transform the power to 69 kV, primary distribution would occur at 69 kV, and each site would have a substation. The task force considered system adequacy, costs, system reliability, and environmental factors such as visual impact. The task force put forward several cost improvements and recommended an option using overhead cable and distributed substations. The project's A-E/CM confirmed the adequacy of the recommended concept by running load flows and short circuit analyses. The Laboratory has chosen this option with overhead 69 kV primary distribution to distributed site substations. The visual impact can be reduced by confining the primary distribution to defined utility corridors.

Natural Gas

Per existing DOE requirements, the Laboratory selected the most efficient fuel for its heating needs. The Laboratory's Conventional Construction Division provided the A-E/CM with heating loads for the West Complex facilities and tasked the A-E/CM to perform a life-cycle cost analysis of feasible heating fuels. They presented their finding in the *West Complex Project Fuel Analysis*[14] (September 1991). Using rates from several vendors, the A-E/CM performed a cost analysis of four fuel types-electricity, natural gas, propane gas, and heating oil. The system cost models included all necessary equipment costs, site distribution costs (for natural gas only), maintenance costs, and utility costs for a twenty-five year period. The study concluded that a distributed natural gas system was the most economical fuel source for all the Complex facilities but the HEB facilities. Because of the HEB's large circumference and limited needs, the initial costs for installation of the distribution piping is not repaid with the long-term operational savings. Presently, the Laboratory is planning to heat the HEB facilities electrically. The propane gas system currently serving the N15 area will be converted to burn natural gas.

Communications

All accelerators, detectors, facilities, and utilities will be monitored and controlled from the Operations Center at the Main Campus. All site controls and communications lines must link to the Operations Center. The Laboratory Telecommunications Infrastructure Task Force considered two options to provide a communications link between the West and East Complexes. The first option would route all communication through the collider tunnel. The second option would route communications needed for control of the arcs and the service areas through the tunnel and provide a cross-ring communications link between the Operations Center and the East Complex routed along FM 66 and FM 878. They considered technical benefits, cost and schedule impacts, and risks to system interruption. The Laboratory decided that the cross-ring routing did not provide the technical benefits necessary to justify the added costs. All communications between sites will be routed through the tunnel.

Water (Raw and Potable) Transmission

The TNRLC, which will provide water for the SSC site, has commissioned several studies of water systems to serve the SSC project. A comprehensive report prepared by a subcontractor to TNRLC summarized previous reports and analyzed several options to provide the SSC project with its water needs. They presented their findings to TNRLC in the *Water and Wastewater Feasibility Study for the SSC*[15] (June 1992). Taking as a starting point the demands determined by the Conventional Construction Division, the subcontractor analyzed several options for the regional transmission and on-site primary distribution of both raw and potable water.

On the regional level, it considered two transmission systems-a system with only potable water to serve all needs and a system with raw and potable piping. The various raw water sources considered were one or two taps on the TCWCID pipeline, ground water, and water from Lake Bardwell. The potable water sources considered were the City of Waxahachie, the City of Ennis, Rockett Service Utility District, and a new regional treatment plant. The report reached the following regional conclusions: 1) two piping systems, one raw and one potable, should deliver water to the complexes; 2) one treatment plant, the existing City of Waxahachie plant, should provide potable water to both complexes; and 3) raw water from two taps on the TCWCID pipeline should supply raw water to both complexes and most service areas, with raw water from Lake Bardwell supplying the S25 and S35 sites.

On-site, for the East Complex, this subcontractor considered the option of providing fire and irrigation water from the raw water system or providing it from the potable water system. Another report, *Water Transmission Study: SSC West Complex Areas*[16] *(May 1992)*, by another subcontractor had analyzed the same option for the West Complex. Both reports recommended that the potable water system should serve the irrigation and fire suppression needs, while the raw water system should only provide make-up water for the cooling ponds.

The above reports based their analyses on hydrological, environmental, and cost models. The use of well water at the N & S refrigeration sites was dismissed because of the drain its use would have caused an already low water table. Most recommendations were adopted by TNRLC and the SSC Laboratory except for the source of the potable water. The City of Waxahachie will provide potable water to the West Complex. However, after further negotiations, the City of Ennis has agreed to provide potable water for the East Complex at a more competitive rate. These regional solutions were shown in Figure 1.4.2-4 for raw water transmission and Figure 1.4.2-5 for potable water transmission to the sites.

Wastewater Systems

The TNRLC has agreed to provide funding for the sewer service from project facilities. The above mentioned TNRLC contractors also made recommendations for handling sewage in their *Water and Wastewater Feasibility Study for the SSC.* For the West Complex, they studied the following options: constructing a new on-site treatment plant, constructing a new regional treatment plant, and pumping the sewage to the existing plant owned by the City of Waxahachie. For the East Complex facilities, they considered four options: a new on-site plant, a new regional plant, and the use of one of two existing treatment plants (Ennis's or Palmer's).

Based on facility information from the Conventional Construction Division, the contractor modeled wastewater systems for the various options and prepared life-cycle cost estimates based on their models. They also created basic schedules for construction of the systems. They found that, because of permitting requirements, construction of new facilities required almost twice the time needed to construct lines to existing facilities. Cost estimates also favored connecting to existing municipal wastewater plants and sharing the cost of upgrading the existing sewer lines and plants to handle increased flow.

The report recommended contracting with the City of Waxahachie to accept West Complex wastewater and with the City of Palmer to accept East Complex wastewater. These recommendations were adopted and are shown in Figure 1.4.2-6.

Stormwater System

Regulating the rate of stormwater run-off from developed areas was considered as an adjunct to the design of cooling water ponds. Under the instructions of the Conventional Construction Division, the project's A-E/CM prepared a study of options which provide the facilities cooling water needs. The results of the study were reported in *The Stormwater Detention Cooling Pond Study*[17] (September 1991). It concluded that, for developed areas where the site topography is suitable, on-stream ponds are the best alternative for stormwater detention. The MEB and Campus ponds will be used to regulate the run-off from the injector, the test beam, IR1, and Campus areas. Stormwater from smaller areas, such as IR4, 5, and 8, will drain to nearby stream channels.

2.5 Existing Conditions

2.5.1 Laboratory Sites

Because of the schedule for the magnet industrialization program and the Accelerator Systems String Test (ASST), on-site surface construction began with the magnet laboratories and the ASST facilities. Early construction and equipping of the Magnet Development Laboratory (MDL) and the Magnet Test Laboratory (MTL) provided the Laboratory with the facilities to produce prototype magnets, study the assembly process, and test the magnets produced by its industrial subcontractors. The ASST Facility was required to meet an early technical milestone-the test of a half-cell of collider magnets. This test required a 660-ft, enclosure that simulates the interior of the collider tunnel. To handle additional personnel and storage needs, about 30 trailers have been located at the N15 area and a pre-existing home, the "Gray's House," is being used for office space. A temporary storage area (TSA) for storage of hazardous wastes has been built to serve the N15 area.

The N15 area's utilities are provided by interim systems. Hill County Electric Cooperative has run a 25-kV line to the N15 area along the western edge of the West Complex. Propane gas provides the facilities heating needs. Buena Vista-Bethel Water District provides the facilities with water, and a on-site treatment plant processes the wastewater. Southwestern Bell provides telephone service through pre-existing lines.

Off-site, the SSC Laboratory is leasing office and warehouse space. The SSC initially leased office space at the Stoneridge Office park. As the laboratory staff grew, more space was leased at various locations. Project managers saw the growing necessity of consolidating technical staff and planning for the anticipated staff growth needed to meet the baseline schedule. At the SSC Laboratory's urging, the DOE requested the State of Texas to purchase the Central Facility (CF) for SSC Laboratory use. Currently, the CF contains offices for technical and administrative personnel and laboratory space for the Accelerator Systems Division and the Laboratory Technical Services Division. In effect, the CF performs the function of some project facilities discussed in the *SCDR*-the accelerator systems shops, fabrication shops, and a warehouse. A TSA for storage of hazardous wastes has been located at the CF to store the shop wastes.

The SSC Laboratory continues to lease space in Dallas and DeSoto at the Stoneridge site, Eagle Park, the Provident Bank building, and the Redbird Industrial Park. The Stoneridge site is mostly office space but includes some laboratory space, such as the Magnet Evaluation Lab and the Texas Test Rig. A TSA for storage of hazardous wastes has been located at the Stoneridge office park to store the wastes from the laboratories. The other facilities are exclusively office space. Table 2.5.1-1 gives a listing of space utilization current in May, 1993; Table 2.5.1-2 lists the trailers and their locations, also current in May, 1993.

Table 2.5.1–1. Current Space Utilization for Facilities.

Facility	Areas in Square Feet			
	Admin./Lab	Industrial	Service	Total
Stoneridge	193,639	44,692	5,724	244,055
West Complex	57,923	140,221	5,550	203,694
East Complex	0	0	0	0
Central Facility	281,711	169,890	104,236	555,837
Redbird, Other	83,138	0	0	83,138
Parkerville Warehouse	0	0	40,000	40,000
Total Available	616,411	354,803	155,510	1,126,724

Table 2.5.1–2. Current Temporary Space Utilization.

Site	# of Trailers	# of Work & Storage Trailers	Sq. Ft.
N-15			
Admin./Lab	22		25,208
Industrial		2	640
Service		7	848
Total – N-15	22	9	26,696
Injector			
Admin./Lab	5		7,040
Industrial			
Service		1	96
Total – Injector	5	1	7,136
Other West Complex			
Admin./Lab			
Industrial			
Service		2	192
Total – West Campus	0	2	192
East Complex			
Admin./Lab	1		320
Industrial			
Service		2	640
Total – East Campus	1	2	960
Total Temporary Space	27	13	34,984

2.5.2 Construction Sites

Active construction sites on the West Complex are the N15 area and the Injector area. Construction of a magnet warehouse at the N15 area will begin in 1994. Construction of the Linac facilities is nearing completion, and construction of the LEB and the MEB facilities continues. On the East Complex, the IR5 and IR8 areas have been graded, and construction continues on the IR8 assembly building. In 1994, construction of the IR5 assembly buildings and excavation of both the IR5 and IR8 halls will commence. The entire North of the collider tunnel and the tunnel sectors between S40 and S55 are under construction. Temporary power and water will be required during construction at all sites. To serve the construction sites, emergency response trailers are in place on the East Complex (at the IR8 area) and on the West Complex (at the Injector area).

REFERENCES

1. *Solenoidal Detector Collaboration (SDC) Experimental Facilities User Requirements (SEFUR)*, SCT-000001, Revision F, February 10, 1993.

2. *Gamma Electron Muon Detector Collaboration (GEM) Experimental Facilities User Requirements (GEFUR)*, GCT-000001, Revision C, February 3, 1993.

3. *Proton Therapy at the SSC*, April 1992, SSC Laboratory for University of Texas Southwestern Medical Center.

4. M. N. Ghafar, *Hydrology Report of Existing Conditions for the West Campus*, Doc. No. CPB-000824, August 15, 1991, The PB/MK Team.

5. *East Complex Hydrologic Engineering Report*, Doc. No. CPB-100223, November 5, 1992, The PB/MK Team.

6. *Service Site Adequacy Study Phase 1 Draft*, Doc. No. CPB-000564, March 29, 1991, The PB/MK Team.

7. *Linac, LEB, and MEB Elevation Study*, Doc. No. CPB-000544, May 1991, The PB/MK Team.

8. *Experimental Facilities Interaction Region Study Phase A Report*, Doc., January 1991, The PB/MK Team.

9. *Experimental Facilities Interaction Region Study Phase B*, Doc. No. CPB-000885, September 1991, The PB/MK Team.

10. *Experimental Facilities Interaction Region Study Phase C-3*, Doc. No. CPB-000911, November 8, 1991, The PB/MK Team.

11. *Experimental Facilities Interaction Region Study Phase D*, Doc. No. CP-100041, February 26, 1992, The PB/MK Team.

12. *Main Campus Development Plan*, Doc. No. Y1100029, Rev. A, May 31, 1993, Moshe Safdie and Associates Inc.

13. *Electrical System Review — Design Concept Re-Evaluation Final Report*, Doc. No. CPB-100341, June 14, 1993, The PB/MK Team.

14. *West Complex Project Fuel Analysis*, Doc. No. CPB-000523, September 6, 1991, The PB/MK Team.

15. *Water and Wastewater Feasibility Study for the SSC Draft*, Doc. No. 920272, June 1992, Espey, Huston & Association, Ins. for TNRLC.

16. G. D. Nelson, *Water Transmission Study: SSC West Complex Areas*, May 1992, Black & Veatch for TNRLC.

17. *The Stormwater Detention Cooling Pond Study*, Doc. No. CPB-000892, September 30, 1991, The PB/MK Team.

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3.0 SSC PROJECT SITE PLANS

3.1 Land Use — Site Zoning

The boundaries of the West Complex, the East Complex and the service areas around the ring have been configured to accommodate technical, experimental, and support facilities needed for constructing and operating the SSC Laboratory. All together, approximately 10,000 acres of fee simple land have been put at the disposal of the Department of Energy by the State of Texas. The West Complex contains 7,520 acres, the East encompasses 1,921 acres, and the 18 distributed service areas total 984 acres. The diagrams and tables for the West and East Complexes reflect the siting evaluations that have been summarized in the previous chapter. These have led to zoning of the land to determine the best use of the site, with allowance for further developments.

The West and East complexes have been divided into five zones: technical, experimental, support, open, and technical reserve. The 'technical' zones are those areas where the accelerators, their facilities, and supporting infrastructure (such as substations and cooling ponds) have been located. Similarly, the 'experimental' zones are drawn to encompass the detectors, their surface facilities, and supporting infrastructure. 'Support' zones contain the utility corridors that provide services to technical and experimental areas. 'Open' zones are set aside to preserve pre-existing riparian habitat and to minimize any construction in flood plains. 'Technical Reserve' areas have no currently specified technical uses but were purchased to allow for facilities upgrades. During the construction phase of the SSC project, most of the 'Technical Reserve' lands are available for lease or habitat restoration. If restored, the land would become an 'open' area. Survey monuments and monitoring bore holes may be located within 'technical reserve' or 'open' zones. Access to these sites must be maintained if project lands are leased.

3.1.1 West Complex Zones

The West Complex has been zoned to reflect the current site layouts and to allow future expansions. Technical zones on the West Complex include the injector area (with the Linac, LEB, MEB, and some HEB facilities), the HEB surface areas, and the Collider Utility Straight area. Other technical zones are the Main Campus and the N15 area. Experimental areas are the IR1 (including the Test Beams) and IR4 areas. The support zone is essentially along the utility corridor on the western edge of the complex. The support zone may also include the West emergency facility and radioactive waste handling/storage facilities. Open zones include a recreation area at the northeast corner of the Complex and a riparian woodland to the south of the Campus. Two large technical reserve zones exist on the West Complex. In the long run, an electron synchrotron may be built in the southern technical reserve zone. In the short run, a wetland mitigation pond is planned for a small portion of it. The zoning map for the West Complex is shown in Figure 3.1.1-1, and the areas of the zones are given in Table 3.1.1-1.

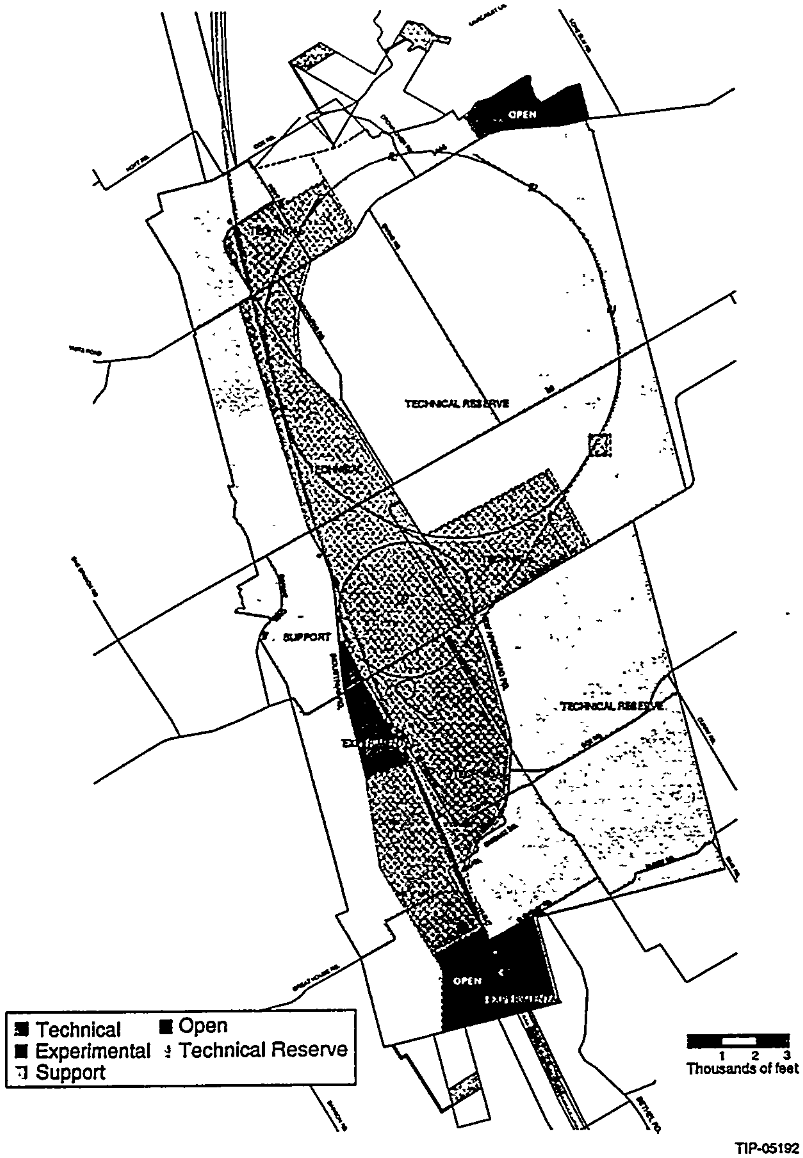


Figure 3.1.1-1. Zoning Map for West Complex.

Table 3.1.1-1. West Complex Zones.

Type	Acres
Technical	1,907
Experimental	214
Support	1,251
Open Space	189
Technical Reserve	3,960
Total	7,520

3.1.2 East Complex Zones

The East Complex has only one technical zone, the S15 areas. (If the S10 shaft is included in the construction phase, it will be a ventilation/egress shaft. One acre around the shaft will be redesignated a technical zone.) The major activities in the East occur in the experimental zones, the IR5, and IR8 areas. One support area provides a location for the East emergency service facility. Open areas include the flood plains of the Grove Creek and Bone Branch Creek and a wetlands mitigation pond to be built in the flood plain. There are also several technical reserve zones. In the long run, the southernmost technical reserve zone might be developed for additional experimental facilities using internal or external beams at low intensity. The technical reserve zone along Wilson Rd. may be developed with an East Campus to accommodate a greater population of experimenters. The zoning map for the East Complex is shown in Figure 3.1.2-1, and the zones and their acreage are given in Table 3.1.2-1.

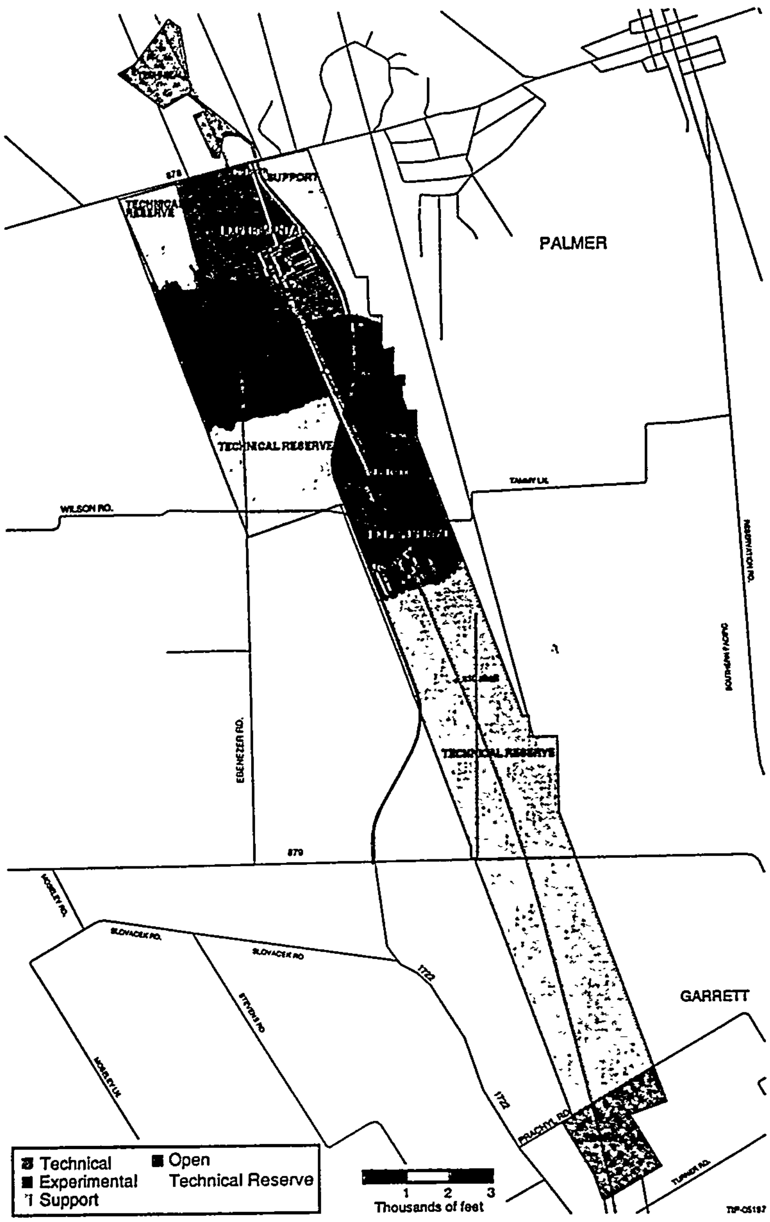


Figure 3.1.2-1. Zoning Map for East Complex.

Table 3.1.2–1. East Complex Zones.

Type	Acres
Technical	97
Experimental	372
Support	78
Open Space	411
Technical Reserve	963
Total	1,921

3.1.3 N, S, and M Sites

Around the collider ring, at 5.2-mile intervals, are found the services area sites that have been acquired to provide services to the collider technical systems. Of the 18 service areas, about half are fully developed (with refrigeration plants) as part of the initial construction program. The ones with refrigeration plants are designated by odd numbers-N15, N25, N35, N45, and N55 on the north arc and S15, S25, S35, S45, and S55 on the south. The intermediate service sites have minor facilities, consisting primarily of an emergency exit from the tunnel and ventilation systems. These intermediate service areas could be further developed in a future upgrade of the collider ring. They are designated by even numbers-N20, N30, N40, and N50 on the north arc with S20, S30, S40, and S50 around the south arc. Through the end of construction, all collider service areas will be designated technical areas. Reserving the entire site for project uses allows maximum flexibility for construction laydown, temporary spoils piles, and location of cooling ponds on these small sites. Table 3.1.3-1 gives data on the expected spoils at each site. The zoning of each site for long-term use will occur before construction is complete. The SSC Laboratory has received several suggestions for land use at several of the sites. Portions of the sites may be re-zoned for other uses.

TABLE 3.1.3-1. SERVICES AREA SITES.

Site Number	Site Gross Area (acres)	Site Features
N10	n/a	Ventilation Shaft
N15	n/a	Refrigeration & Service Bldgs, Magnet Shaft, Personnel Shaft
N20	62	Ventilation Shaft
N25	61	Refrigeration & Service Bldgs, Personnel Shaft
N30	65	Ventilation Shaft
N35	51	Refrigeration & Service Bldgs, Personnel Shaft
N40	66	Ventilation Shaft, Magnet Shaft
N45	48	Refrigeration & Service Bldgs, Personnel Shaft
N50	50	Ventilation Shaft
N55	67	Refrigeration & Service Bldgs, Magnet Shaft, Personnel Shaft
S10	n/a	Ventilation Shaft
S15	n/a	Refrigeration & Service Bldgs, Personnel Shaft
S20	58	Ventilation Shaft
S25	55	Refrigeration & Service Bldgs, Magnet Shaft, Personnel Shaft
S30	50	Ventilation Shaft
S35	104	Refrigeration & Service Bldgs, Personnel Shaft
S40	57	Ventilation Shaft, Magnet Shaft
S45	50	Refrigeration & Service Bldgs, Personnel Shaft
S50	68	Ventilation Shaft
S55	74	Refrigeration & Service Bldgs, Personnel Shaft
Total	986	

There are a few small sites around the collider ring that are used for monitoring purposes (the M sites). They are located beyond the end of muon vectors projected from the interaction points or the beam absorbers. Construction on these areas will typically be limited to the drilling of small-bore shafts for the installation of monitoring detectors. These sites are designated technical zones.

3.2 Facilities Layout

Summary information for the SSC facilities located on the West Complex, East Complex, and Collider Ring Service Areas is contained in this section. Approximately 63 percent of the facilities are located on the West Complex. About 17 percent of the facility needs will be accommodated by the Central Facility and 11 percent at the East Complex. The facilities shown in this section are the foundation for the future development at the Laboratory. The initial program focuses upon the essential elements of the project and economizes with regard to site or infrastructure development.

3.2.1 West Complex

The plans for the West Complex include concentrated facilities development on the West North (WN), West Central (WC), and West South (WS) sites. Each site has an area with a specific function: the N15 area contains facilities for magnet programs, the central contains facilities for the accelerator and experimental programs, and the south site contains the campus. Some of the baseline functions previously designated for the West Complex have been moved to the Central Facility.

Roadway improvements are a integral aspect of the development of the West Complex. Separate roads have been planned for user and industrial access. The transportation system provides a heavy-industrial service corridor developed along the western portion of the Complex. The Industrial Rd. will carry the traffic of heavy equipment necessary for both IR1 and laboratories at the Main Campus. This separates the industrial traffic from New Arrowhead Rd. which provides a passenger link from the N15 area through to the Main Campus. Existing and planned roads are shown in Figure 3.1.1-1.

West North (WN) Site

The WN site is approached along FM 1446 from I-35E. Within the WN site are found the N15 Service Area, some HEB service areas, and facilities for the Collider West Utility Straight. The N15 area contains the magnet development and system facilities along with cryogenic support services. The facilities at these areas are shown in Figures 3.2.1-1 and 3.2.1-2, and their designation, type, and square footage are listed in Table 3.2.1-1.

West Central (WC) Site

The WC site is best approached along FM 66 from I-35E. The WC site contains the LINAC, LEB, MEB, several HEB facilities, the Test Beams, Interaction Region 1, the West Main Substation, and support facilities. The surface facilities at these areas are shown in Figures 3.2.1-3 and 3.2.1-4 and their designation, type, and square footage are listed in Table 3.2.1-2. Internal access roads are also shown for the LEB, MEB, and Test Beam facilities.

West South (WS) Site

The WS site is best approached along FM 1493 from I-35E. The WS site contains the Main Campus and Interaction Region 4. The surface facilities at these areas are shown in Figures 3.2.1-5 and 3.2.1-6, and their designation, type, and square footage are listed in Table 3.2.1-3. The access roads to the Campus are also shown in more detail. Plans for the campus provide for approximately 500,000 gsf of facilities. The Project goal is to maintain the campus layout as design by Moshe Safdie and Associates, but to reduce initial development plans to meet baseline budgets. The resulting Phase 1 campus is shown in Figure 3.2.1-7. This represents only a portion of the scientific elements of the campus. It includes the operations center, offices, laboratory space, and a cafeteria. It is these facilities which are listed in Table 3.2.1-3.

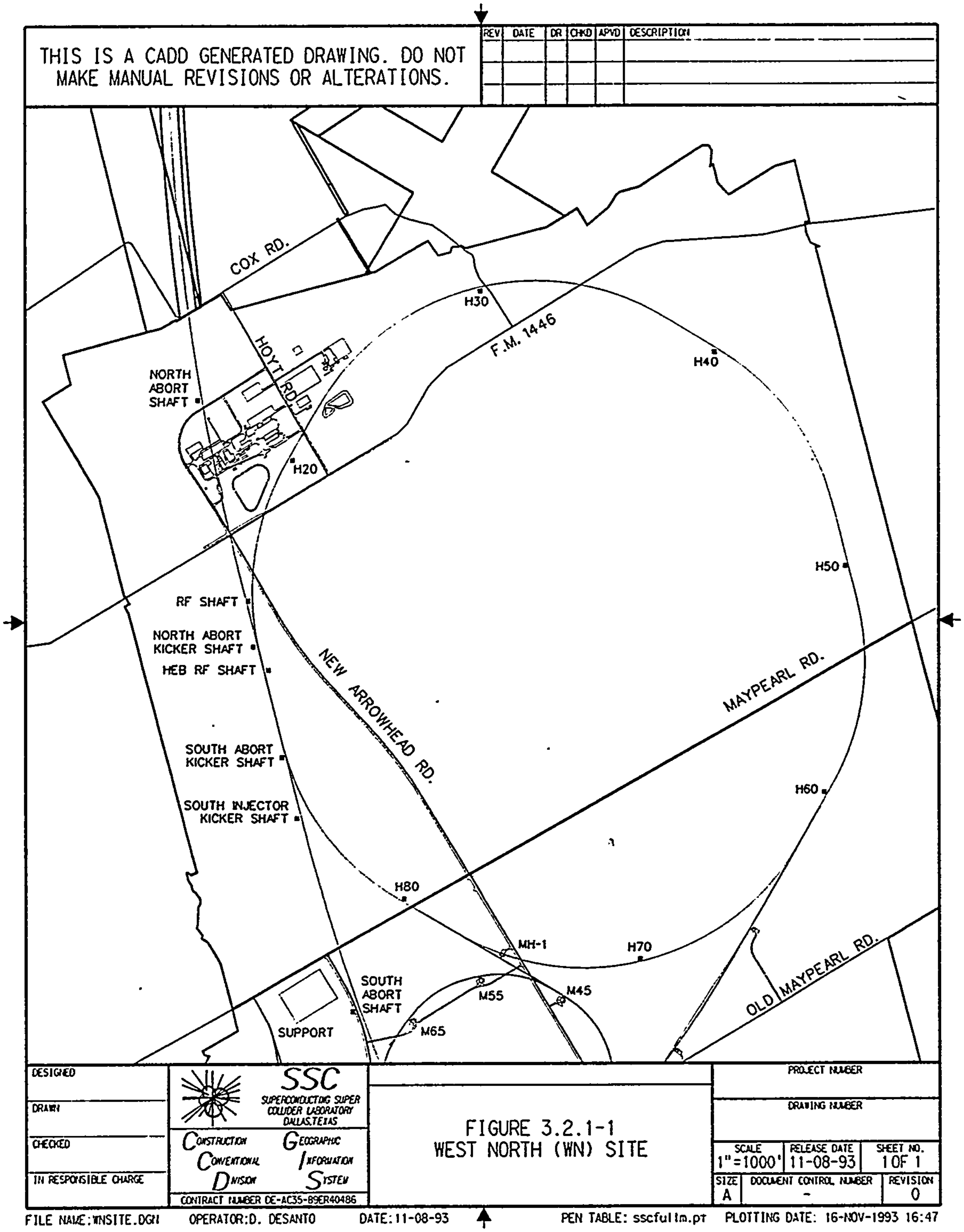
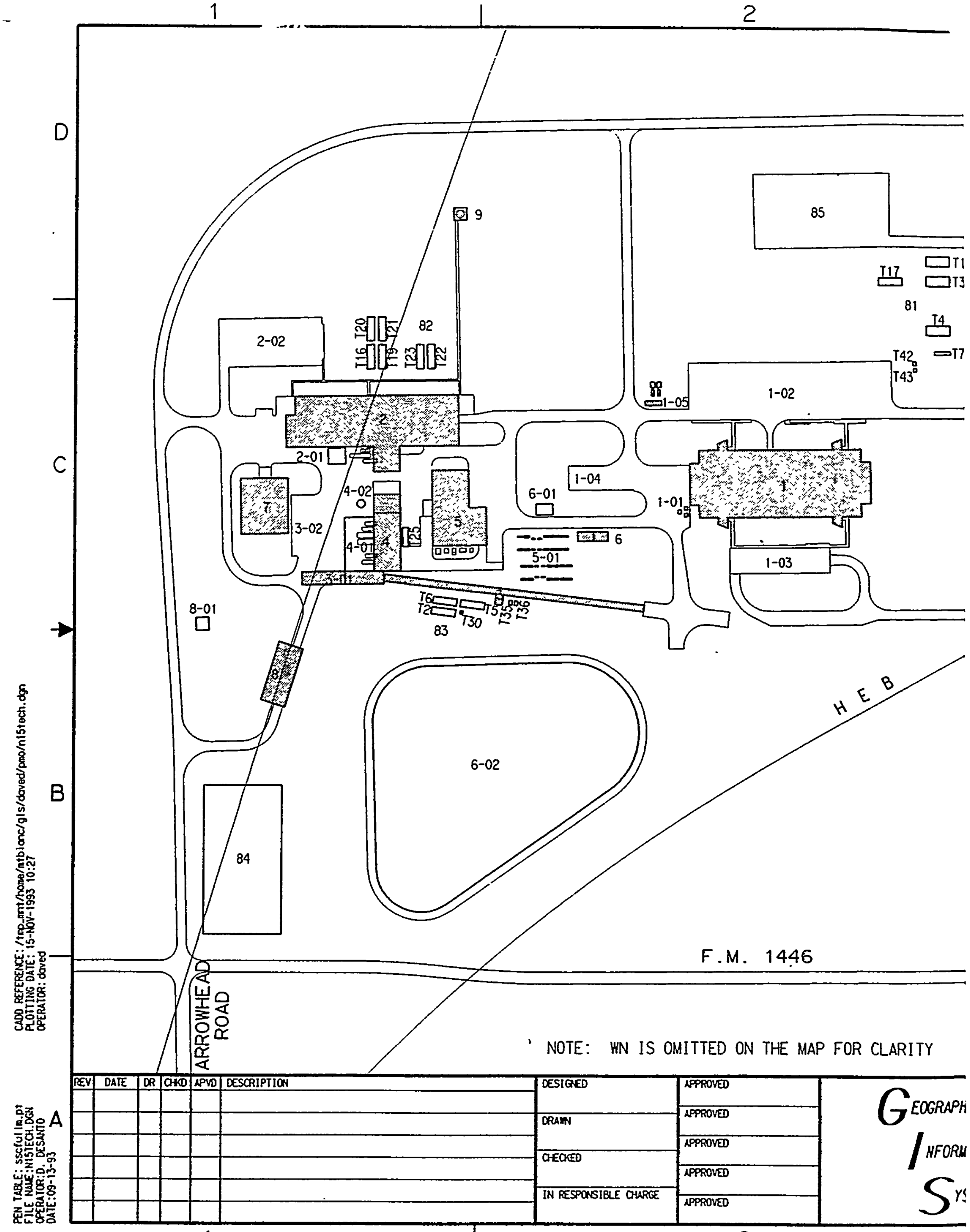


Figure 3.2.1-1. West North (WN) Site.



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F.M. 1446
ARROWHEAD ROAD
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OPERATOR: D. DESANTO
DATE: 09-13-93

SSC SUPERCONDUCTING SUPER COLLIDER LABORATORY DALLAS, TEXAS	N15 TECHNICAL AREA	PROJECT NUMBER
CONTRACT NUMBER DE-AC35-89ER40486		DRAWING NUMBER

SCALE	RELEASE DATE	SHEET NO.
1"=300'	09-13-93	2 OF 2

SIZE	DOCUMENT CONTROL NUMBER	REVISION
B	Y00-00066	0

Figure 3.2.1-2. N15 Technical Area.

Table 3.2.1–1. West North (WN) Site Facilities.

Site Number	Facility	Building Type	Population	Sq. Ft.
Technical Area				
WN–1	Magnet Development Lab	Industrial	148	101,000
WN–2	Magnet Test Lab	Industrial	15	61,000
WN–3	ASST Enclosure	Industrial		21,100
WN–4	ASST Refrigeration & Electrical Power	Industrial		17,000
WN–5	N15 Technical Area Compressor Bldg.	Service		21,094
WN–6	Low Conductivity Water Plant	Service		936
WN–7	N15 Technical Area Electrical Substation	Service		12,656
WN–8	N15 Magnet Delivery Shaft Bldg.	Service		13,700
WN–9	N15 Personnel Shaft Bldg.	Service		463
WN–10	ASST Headquarters – Gray's House	Service	10	5,625
WN–11	Sewage Treatment Plant	Service		580
N/A	HEB RF Service Bldg.	Service		5,700
N/A	HEB H20 Shaft Service Bldg.	Service		17,000
N/A	HEB H30 Shaft Service Bldg.	Service		200
N/A	HEB H40 Shaft Service Bldg.	Service		1,875
N/A	HEB H50 Shaft Service Bldg.	Service		200
N/A	HEB H80 Shaft Service Bldg.	Service		3,125
N/A	Collider Abort Kicker N Headhouse	Service		1,800
N/A	Collider Abort Kicker S Headhouse	Service		1,800
N/A	Collider Abort N Shaft Headhouse	Service		450
N/A	Collider S Injection Kicker Headhouse	Service		2,000
N/A	Collider RF Service Bldg.	Service		5,000
Total			173	294,304

N/A = Not assigned.

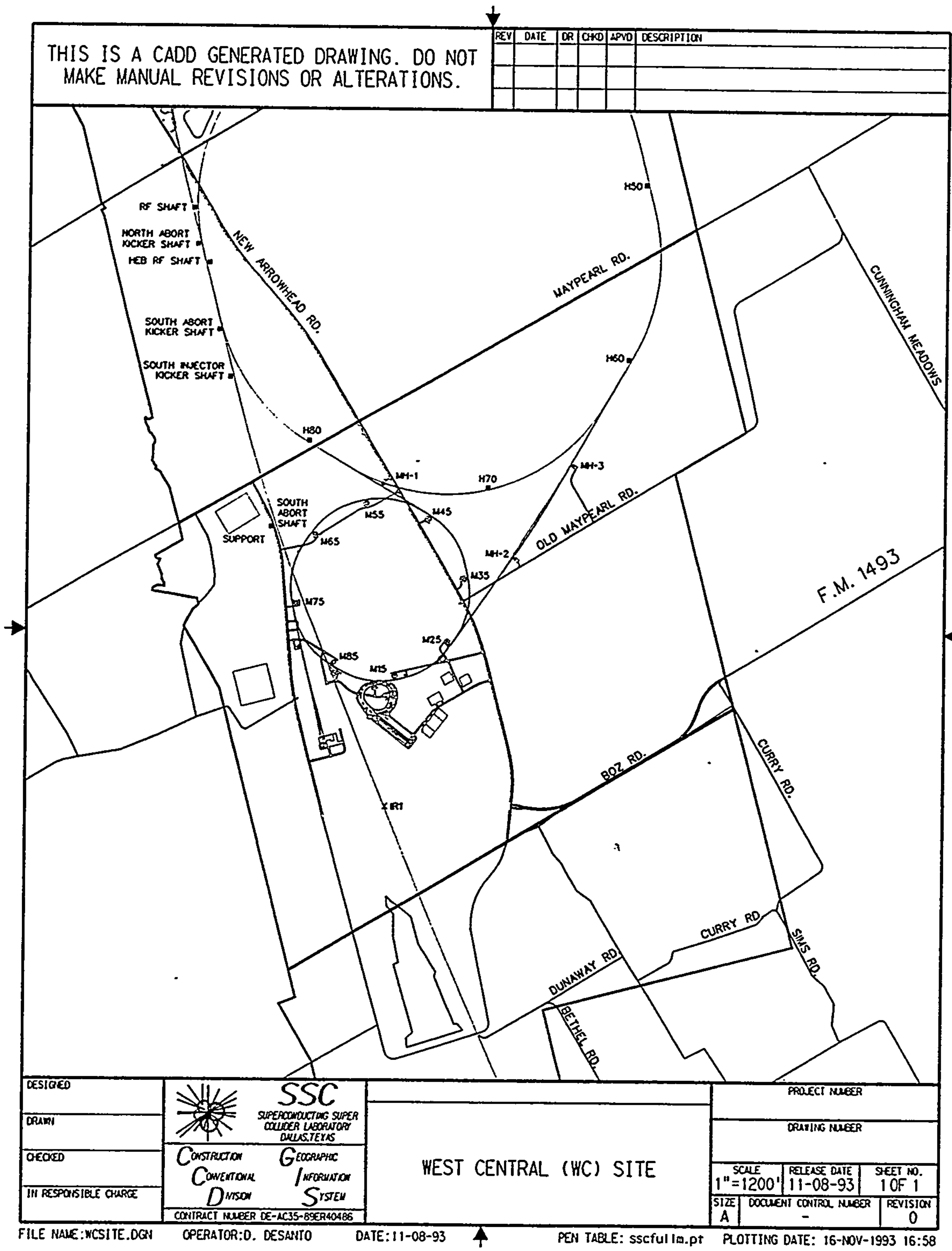
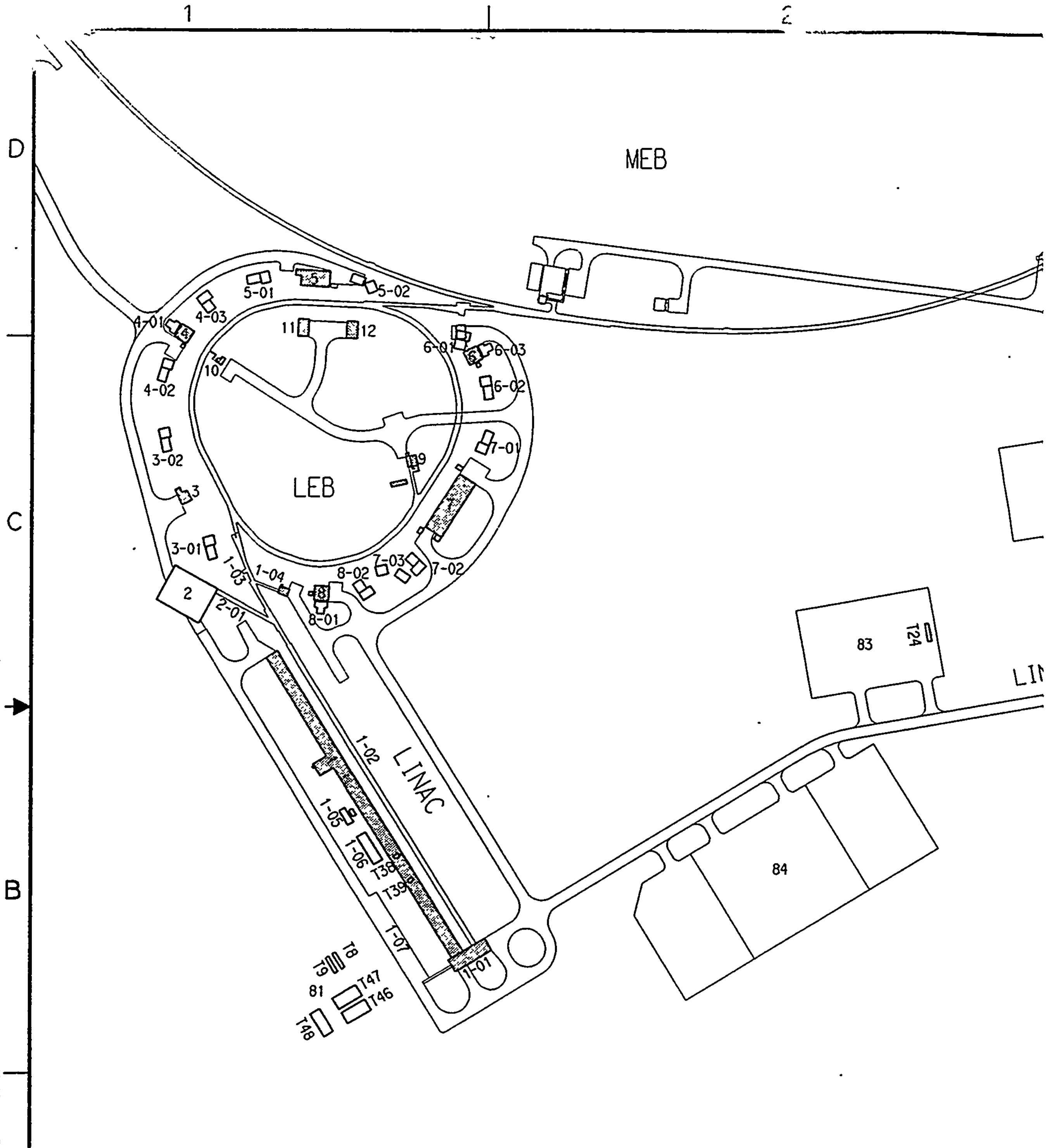


Figure 3.2.1-3. West Central (WC) Site.



NOTE: WC IS OMITTED ON MAP FOR CLARITY

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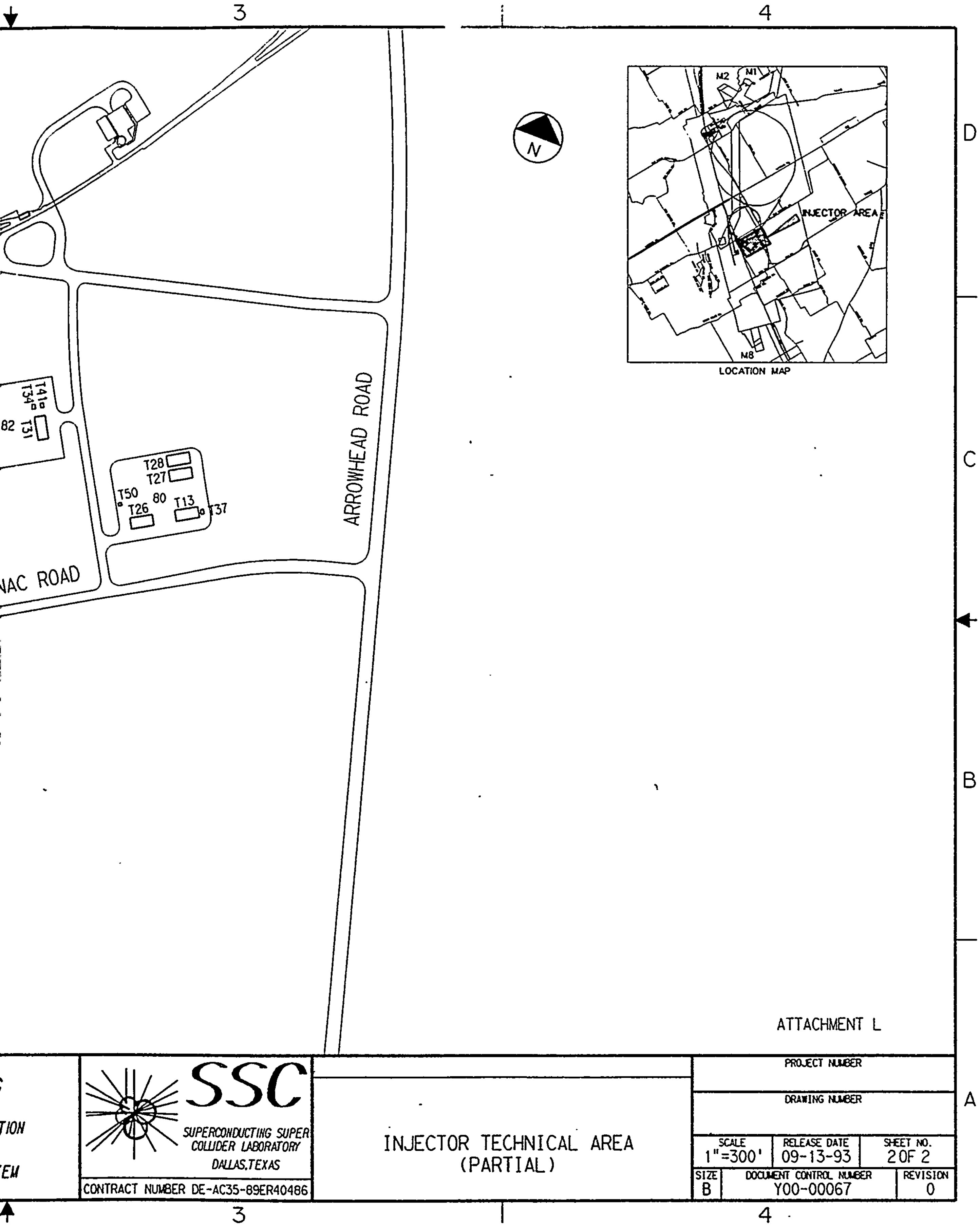

Figure 3.2.1-4. Injector Technical Area (Partial).

Table 3.2.1-2. West Central (WC) Site Facilities.

Site-Number	Facility	Building Type	Population	Sq. Ft.
Technical Area				
WC–1	Linac Gallery Bldg.	Industrial	10	26,398
WC–2	Proton Treatment Facility Bldg.	Service		12,656
WC–3	LEB Side 1 Injector Bldg.	Service		762
WC–4	LEB Arc 1 Power Supply Utility Bldg.	Service		1,046
WC–5	LEB Side 2 Extraction Bldg.	Service		2,370
WC–6	LEB Arc 2 Power Supply Utility Bldg.	Service		1,046
WC–7	LEB Side 3 Radio Frequency Power Bldg.	Service		6,208
WC–8	LEB Arc 3 Power Supply Utility Bldg.	Service		1,046
WC–9	LEB Side 3 Installation/Service Access Bldg.	Service		1,103
WC–10	LEB Arc 1 Emergency Exit Bldg.	Service		968
N/A	MEB RF Building	Service	10	8,030
N/A	MEB M15 Service Bldg.	Service		2,686
N/A	MEB M25 Service Bldg.	Service		2,686
N/A	MEB M35 Service Bldg.	Service		2,686
N/A	MEB M45 Service Bldg.	Service		2,686
N/A	MEB M55 Service Bldg.	Service		2,686
N/A	MEB M65 Service Bldg.	Service		2,686
N/A	MEB M75 Service Bldg.	Service		2,686
N/A	MEB M85 Service Bldg.	Service		2,686
N/A	MEB MH–1 Service Bldg.	Service		1,000
N/A	MEB MH–2 Service Bldg.	Service		1,000
N/A	MEB MH–3 Service Bldg.	Service		1,000
N/A	HEB H60 Shaft Service Bldg.	Service		23,300
N/A	HEB H70 Shaft Service Bldg.	Service		200
N/A	Collider Abort S Shaft Headhouse	Service		450
Experimental Area				
N/A	Target Hall Attached Building	Industrial		1,290
N/A	Target Hall Surface Facility	Industrial		3,080
N/A	Test Beam Surface Building 1	Service		1,530
N/A	Test Beam Surface Building 2	Service		1,530
N/A	Test Beam Surface Building 3	Service		1,530
N/A	Calibration Hall	Industrial	50	41,596
N/A	Calibration Hall Utility Building	Industrial		4,550
N/A	IR1 Headhouses	Service		2,000
N/A	IR1 Utility Building	Service		7,500
N/A	IR1 Iron Works Building	Industrial	20	10,000
N/A	IR1 Assembly Building	Industrial	30	40,000
Support Area				
N/A	Radioactive Material Handling	Special purpose		10,000
N/A	Radioactive material Storage	Special purpose		2,500
N/A	Emergency Services	Community	12	4,200
Total			132	241,377

N/A = Not assigned.

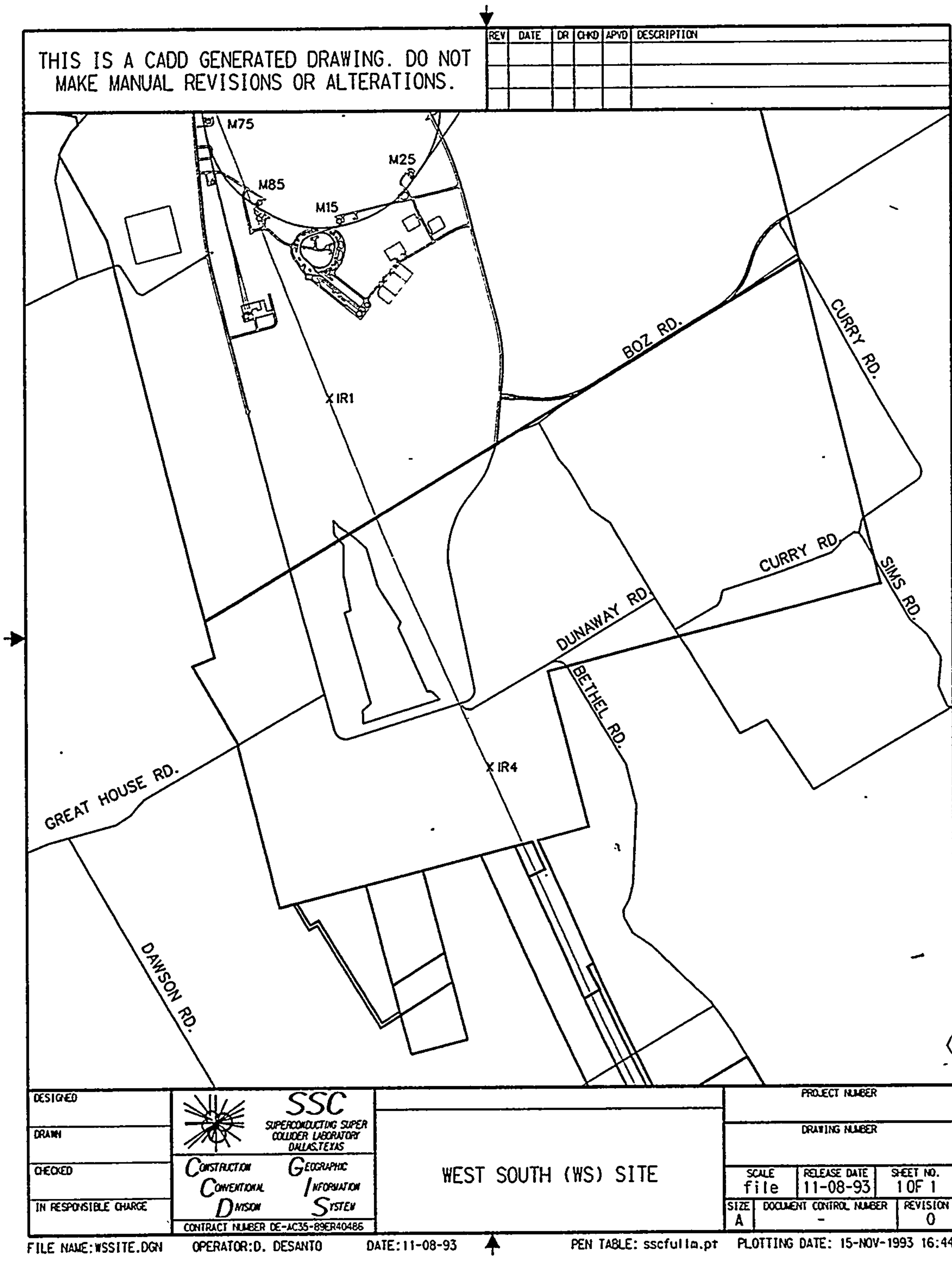

Figure 3.2.1-5. West South (WS) Site.

Figure 3.2.1-6. Main Campus Area.

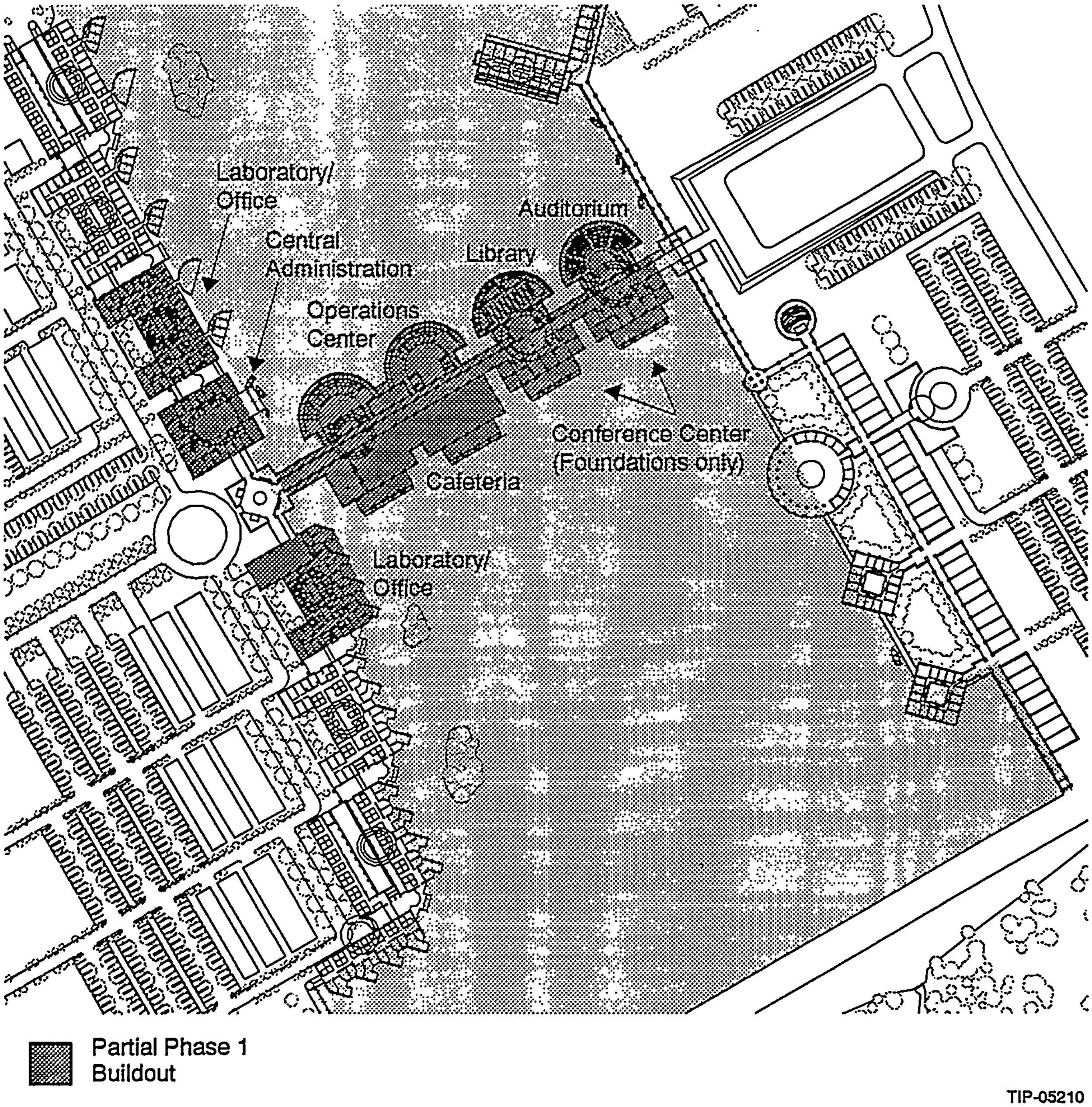

Figure 3.2.1-7. Main Campus Area — Partial Phase 1.

Table 3.2.1-3. West South (WS) Site Facilities.

Facility	Building Type	Population	Gross Sq. Ft.
Campus Area (Partial Phase 1)			
Bridge			
Auditorium	Community		15,100
Operations Center			
Operations Center	Industrial	50	40,733
Cafeteria	Community	20	23,500
Library	Admin./Lab	25	28,100
West Shore			
Administration	Community	225	34,400
Lab/Office	Admin./Lab	372	57,040
Lab/Office	Admin./Lab	372	57,040
Experimental Area			
IR4 Headhouses	Service		2,000
IR4 Utility Building	Service		7,500
IR4 Assemb ly Building	Industrial	30	40,000
Total		1,094	305,413

3.2.2 East Complex

The plans for the East Complex include substantial facilities development only at the East North (EN) and East Central (EC) sites. The East South (ES) site will contain only the service facilities at S15. Roadway improvements are not as substantial as on the West Complex. A single new road was constructed to carry heavy-industrial and passenger traffic to the IR8 and IR5 areas. The Connector Road will also provide a north-south linkage between FM 878 and FM879. Existing and planned roads were shown in Figure 3.1.2-1.

East North (EN) Site

The EN site is approached along FM 878 from either I-45 or SH 287. The site contains the Interaction Region 8 area and a support area for the entire East Complex. The facilities at these areas are shown in Figures 3.2.2-1 and 3.2.2-2, and their designation, type and square footage are listed in Table 3.2.2-1.

East Central (EC) Site

The EC site is best approached along the Connector Rd. from FM 878. The site contains the Interaction Region 5 area (and possibly the S10 ventilation area). The surface facilities at these areas are shown in Figures 3.2.2-3 and 3.2.2-4, and their designation, type, and square footage are listed in Table 3.2.2-2.

East South (ES) Site

The ES site is approached from FM 879 by turning south on FM 1722. The site is shown in Figure 3.2.2-5. The area is basically undeveloped except at the southern tip where the S15 Service Area is located. The service site contains a headhouse and compressor building totaling 19,400 sq.ft. and liquid helium and nitrogen tank farms. Also, the electrical substation providing power for the southeastern portion of the collider ring is located here.

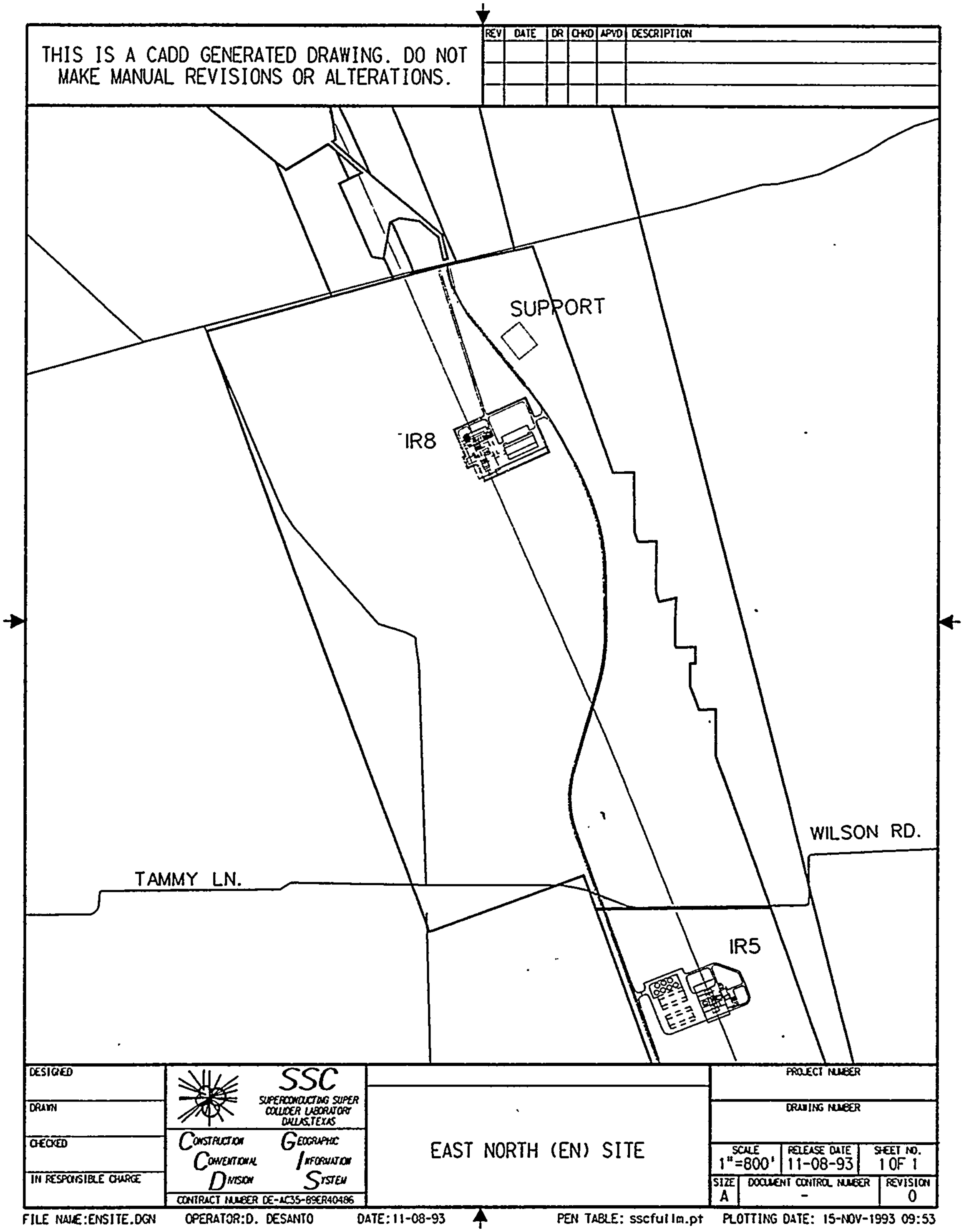

Figure 3.2.2-1. East North (EN) Site.

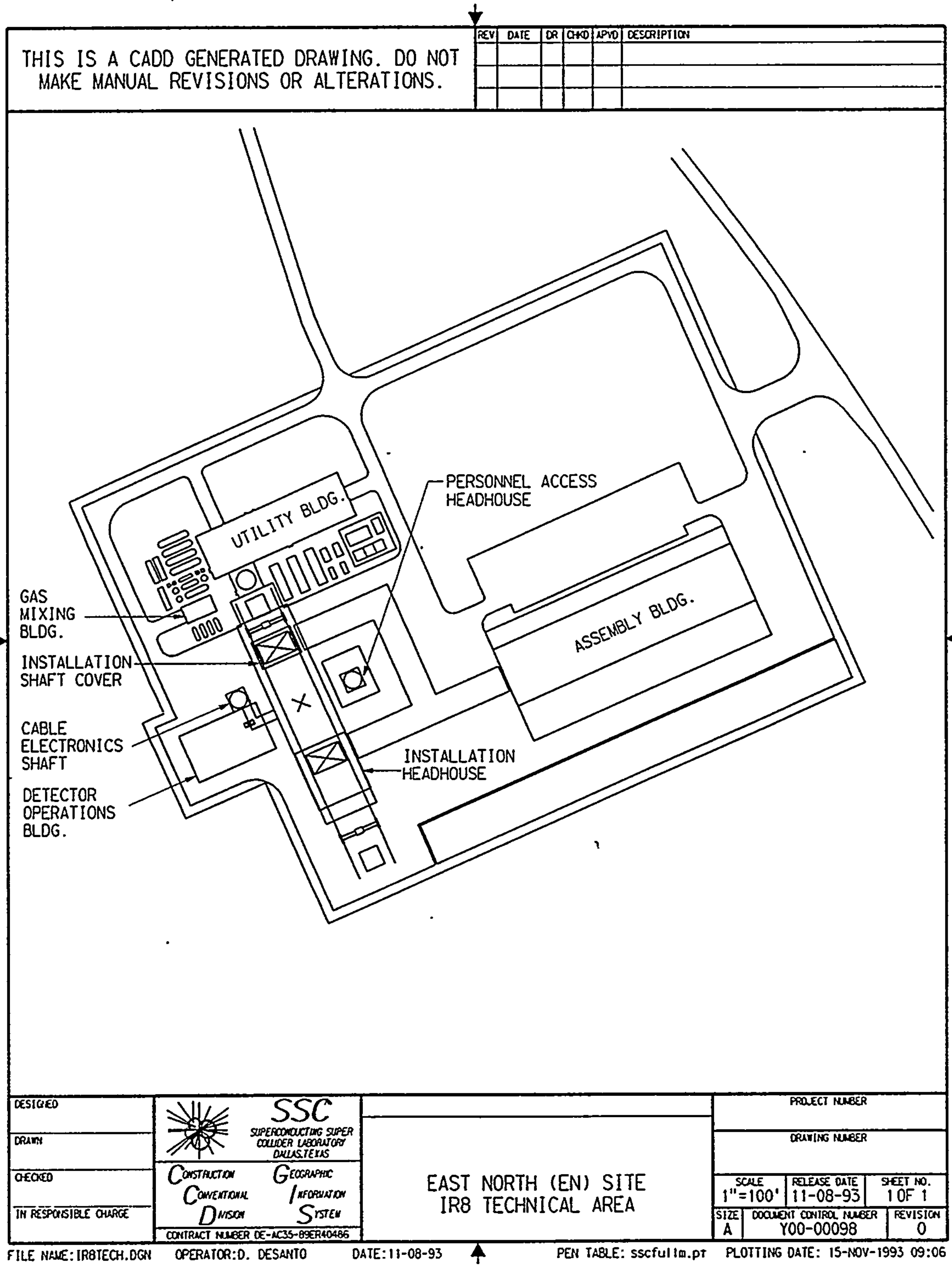

Figure 3.2.2-2. IR8 Technical Area.

Table 3.2.2-1. East North (EN) Site Facilities.

Facility	Building Type	Population	Sq. Ft.
Experimental Area (IR8)			
Assembly Building	Industrial	90	90,350
Detector Operations	Admin./Lab	200	25,920
Gas Mixing Building	Service		2,100
Installation Headhouse	Service	8	12,250
Pers./Equip. Headhouse	Service		2,128
Utility Building	Service	6	14,760
Support Buildings			
Radioactive Material Handling	Special Purpose		5,000
Radioactive Material Storage	Special Purpose		1,000
Emergency Facility	Community	12	4,200
Total		316	157,708

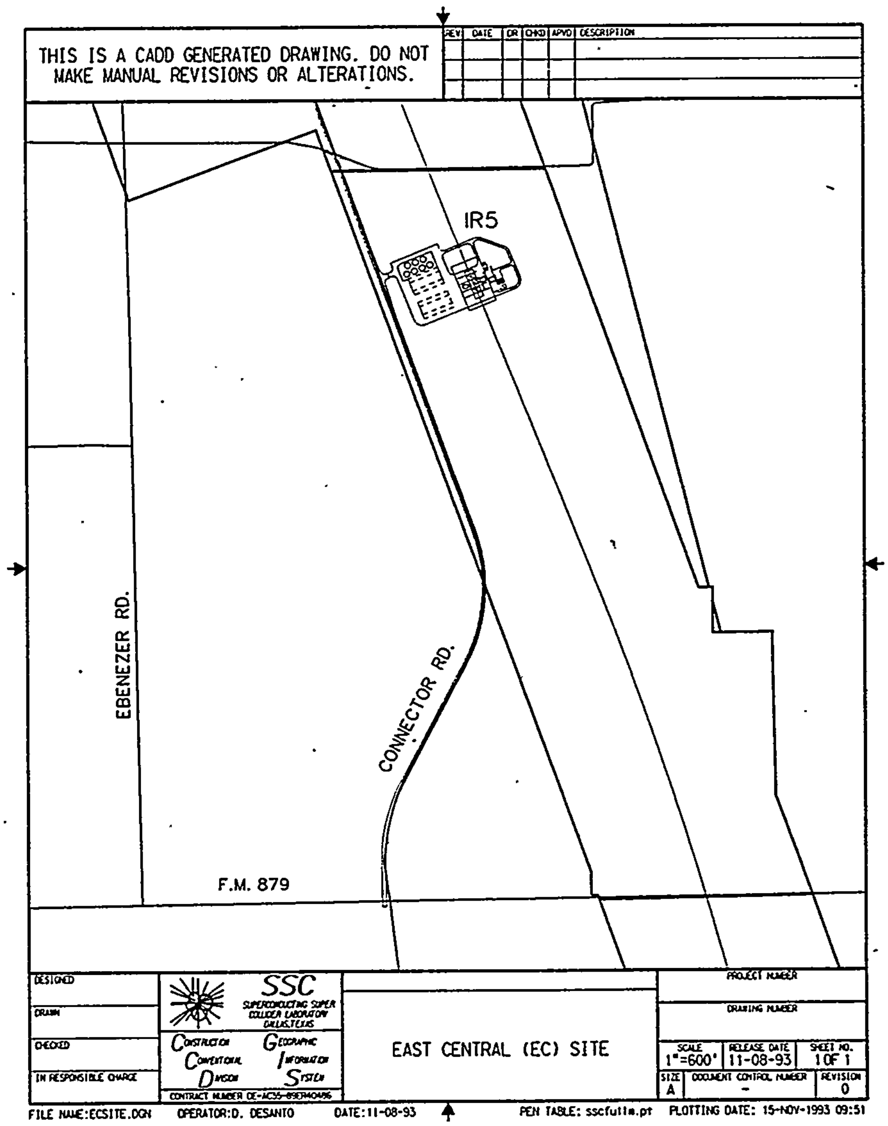

Figure 3.2.2-3. East Central (EC) Site.

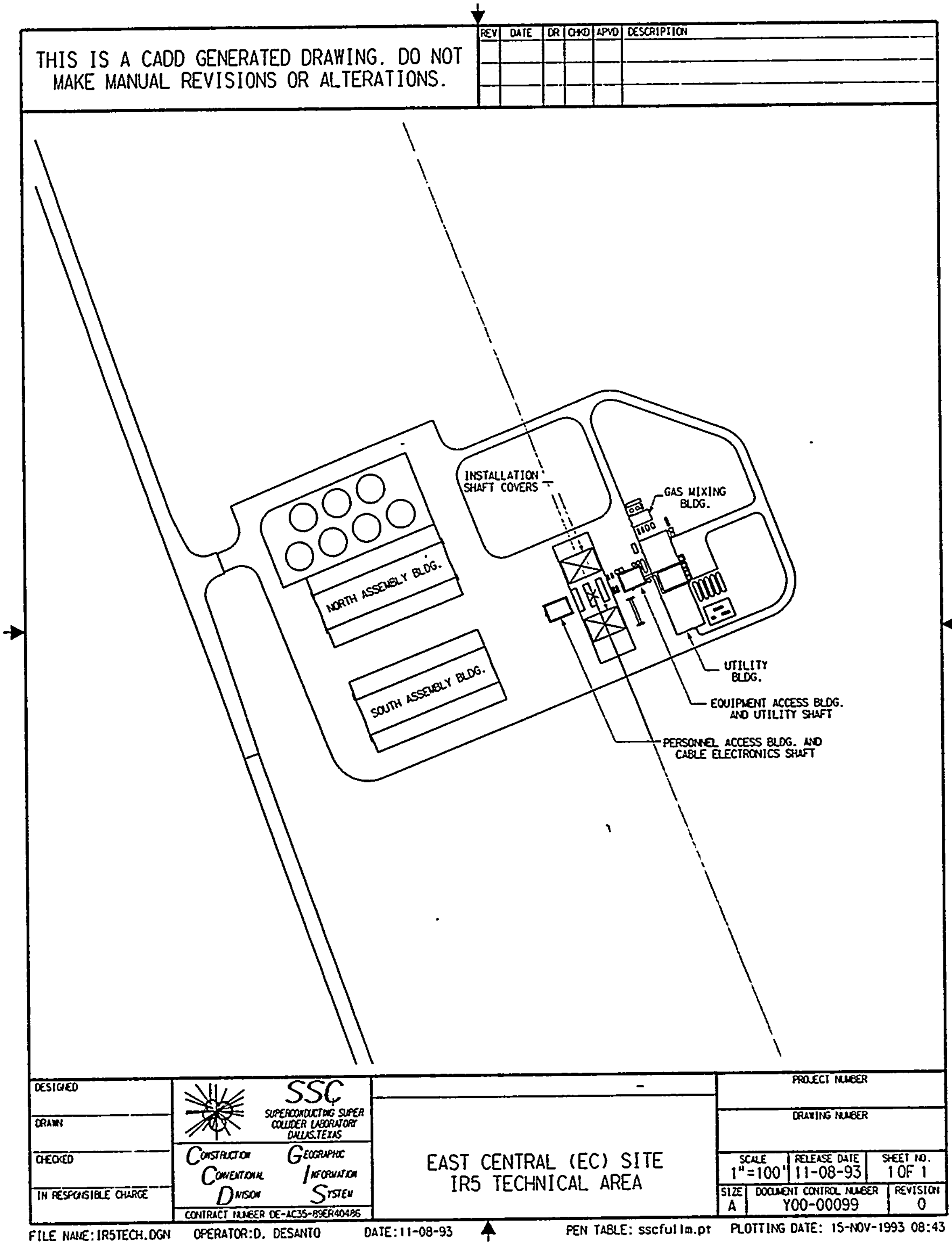

Figure 3.2.2-4. IR5 Technical Area.

Table 3.2.2-2. East Central (EC) Site Facilities.

Facility	Building Type	Population	Sq. Ft.
Experimental Area (IR5)			
North Assembly Building	Industrial	50	85,200
South Assembly Building	Industrial	60	92,950
Equipment Access Headhouse	Service		4,250
Gas Mixing Building	Service		2,100
Personnel Access Headhouse	Service		3,136
Utility Building	Service	6	14,760
Total		116	202,396

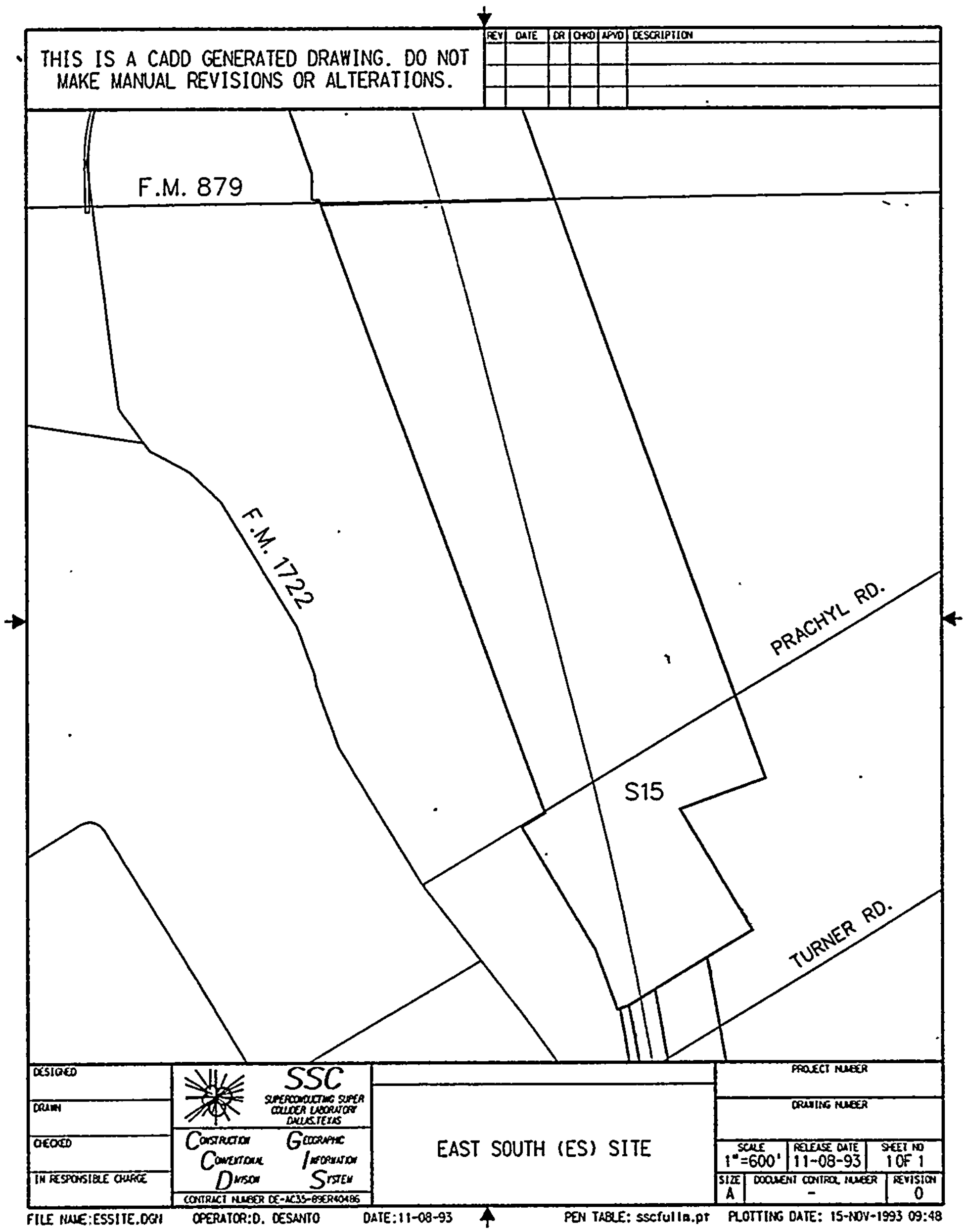

Figure 3.2.2-5. East South (ES) Site.

3.2.3 Collider Ring Service Areas

Two sites are shown to illustrate the facilities at the service areas. The N20 Service Area site, Figure 3.2.3-1, represents a design for a ventilation service area. This secondary (even-numbered) service area contains a 23-foot-diameter shaft and elevator for emergency egress from the tunnel. On the surface is a ventilation facility (463 sq. ft.) to maintain clean air in the tunnel. The design for the N20 site development includes shaft and headhouse location, sight pipe location, access roads, and spoils placement. These elements are sited in what is considered a preferred development zone except for the actual shaft location which will impact a ravine.

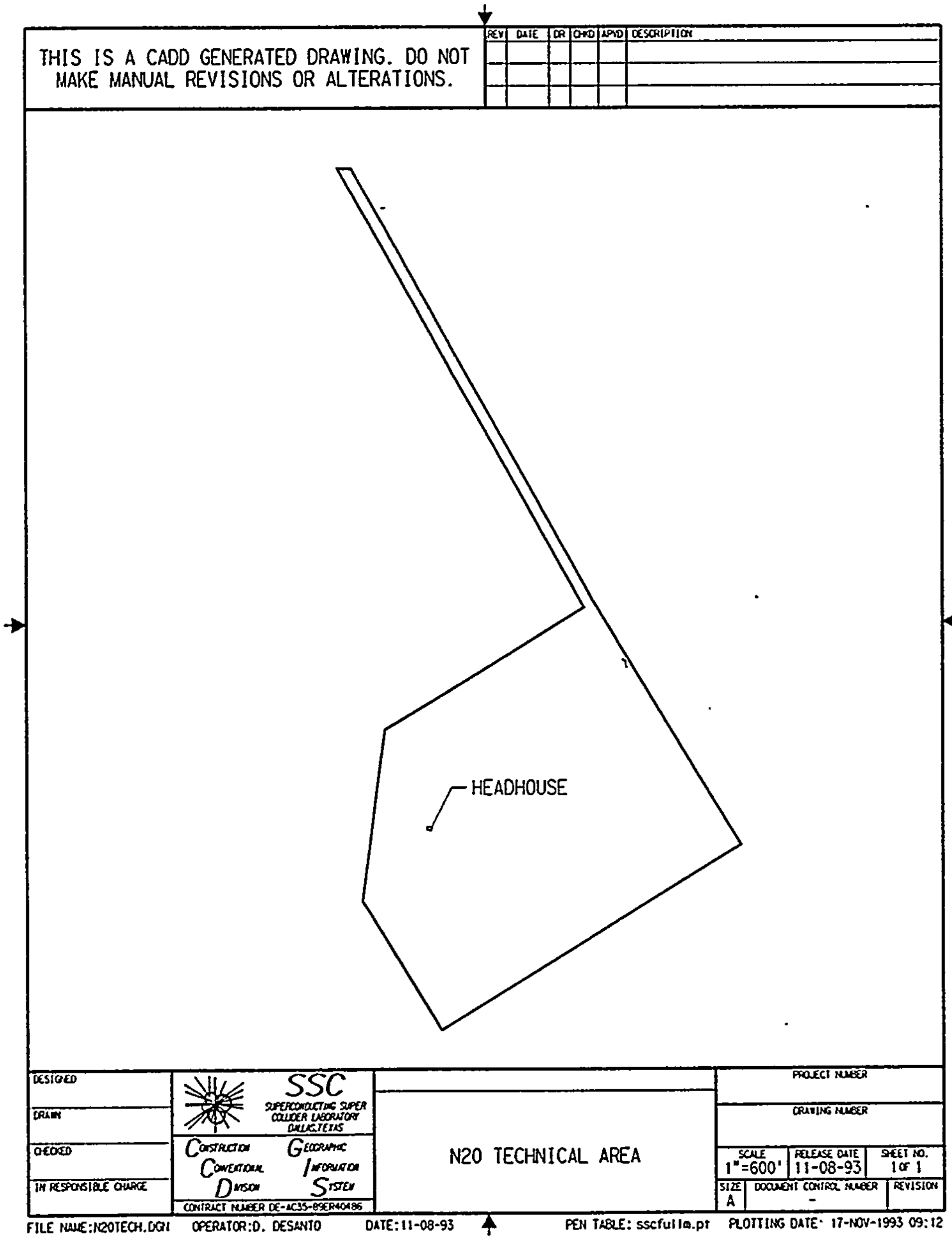

Figure 3.2.3-1. N20 Technical Area.

The N25 site plan satisfies the requirements for a typical refrigeration service site. The below-ground magnets are energized by power supplies located in service buildings located around the collider ring. The odd-numbered service areas also contain the helium compressors, refrigerators, and cryogen tanks used to cool the superconducting magnets to the 4K operating temperature. The site is a good example of the development restrictions that exist on several of the service areas, forcing a creative solution to pond and spoil locations. The facilities are shown in Figure 3.2.3-2; they consist of a headhouse and compressor building totaling 19,400 sq. ft.

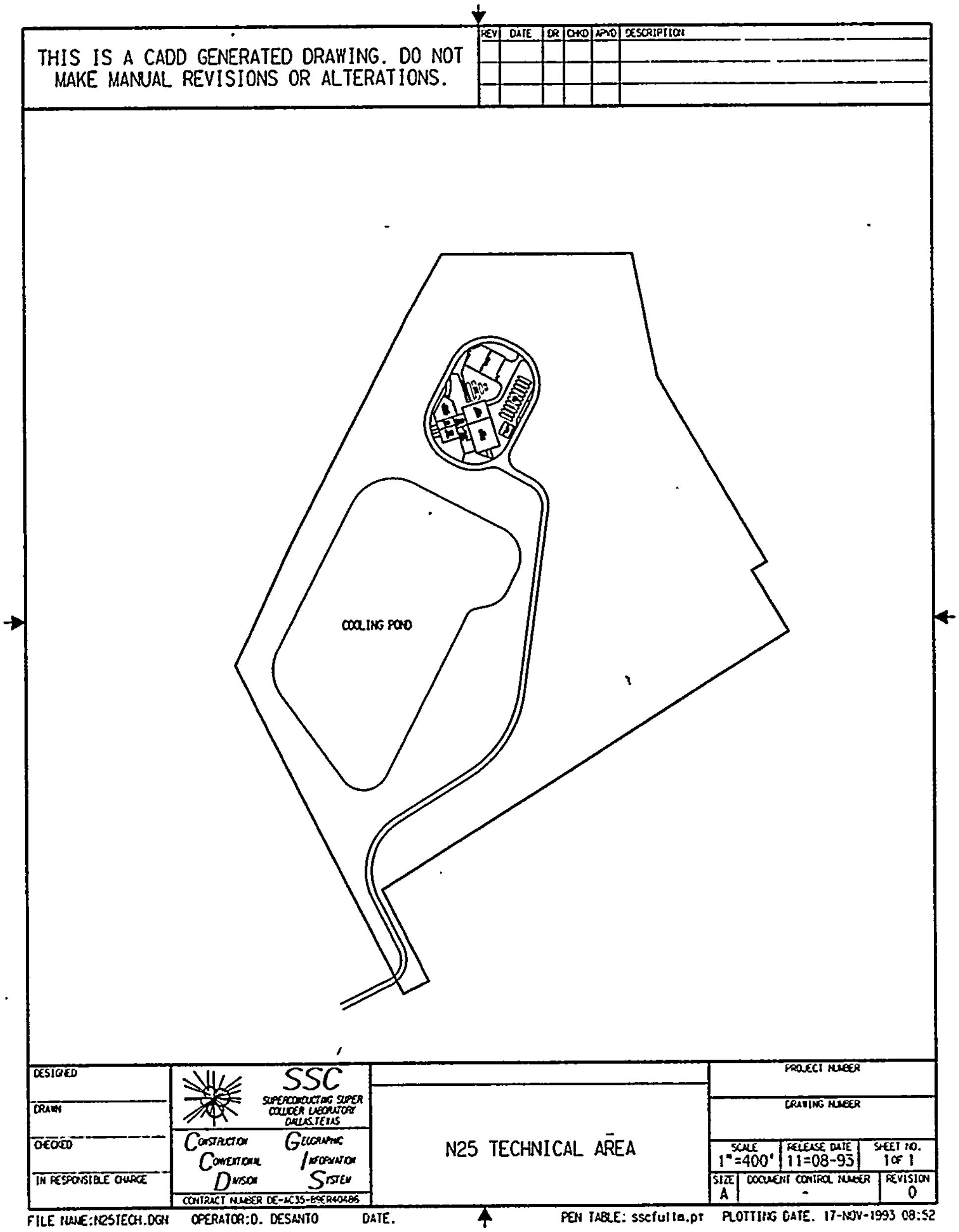

Figure 3.2.3-2. N25 Technical Area.

3.2.4 Populations by Site

By the end of construction, the staff population (given in Section 2.2.1) will be accommodated on-site and at the Central Facility. When the Main Campus becomes available, leased space will begin to be phased out. However, some leased space must be retained to get the Laboratory through its peak construction population year. Table 3.2.4-1 presents summary information on space availability throughout the sites. The second column shows the current availability. The third column shows the distribution during the peak construction year. Because of the phase-out of leased off-site offices, the model shows a continued need for trailers to accommodate the population. The fourth column shows the distribution at the start of operation, when it is shown that trailers can be eliminated. The model assumes that the campus space will be occupiable in 1996 and 1997, and that the peak construction year will be 1997.

Table 3.2.4-1. Space Projection by Site.

Facility	Office Space Available Current Year	 Peak Pop. Year	 Start Operation
WN Site			
Technical Facilities (MDL, MTL, and Gray's House)	159	173	173
Trailers	221	50	
WC Site			
Exp. Facilities (Calibration Hall and IR1)		50	100
Support Facilities			12
Trailers	22	100	
WS Site			
Main Campus		1,044	1,044
Experimental Facilities (IR4)			30
Trailers			
EN Site			
Experimental Facilities (IR 8)		290	250
Support Facilities			12
Trailers			
EC Site			
Experimental Facilities (IR5)		110	110
Trailers		100	
Off-Site			
Central Facility	1,062	1,166	1,150
Stoneridge	913		
Redbird, Other	148		
Total Capacity	2,525	3,083	2,881

3.3 Utilities Layouts

3.3.1 Electrical

Permanent service will be designed with a primary voltage delivered to main substations by the utility and then 69kV overhead lines as primary distribution on-site and in the tunnel. The permanent power supply is to be provided by the utility company through their off-site transmission system. Utility rights-of-way must conform to the site constraints. A minimum 450-foot-wide right-of-way is required for transmission and primary distribution lines. Costs planned for permanent electrical distribution begin at the main switch.

The west main substation will be located north of Old Maypearl Road on the west side of the Industrial Rd. Transmission lines will be located in the utility corridor along the western edge of the fee simple boundary. The 345-kV service will be supplied by two 345-kV single circuit transmission lines brought in from two directions. One line enters from the northwest, running down the utility corridor near the western boundary to the 345-kV main substation. The second line enters from the west, near the southwest corner of the West Complex, and will run north along the utility corridor to the 345-kV main substation.

On-site primary power distribution will be through 69 kV overhead lines. Lines will run to three site substations. One near the N15 Technical area will provide power for the N15 area, the north-west portion of the Collider ring, and the HEB. One substation in the Injector Technical Area will provide power for the Linac, LEB, MEB, Test Beams, and IR1. A substation located near to IR4 will provide power for the Main Campus, IR4, and the south-west portion of the Collider ring. Collider electrical power distribution is through the tunnel at a recommended voltage level of 69 kV. It will be brought to the surface at the Refrigeration Service Areas to be transformed down to various operational voltages. Figure 3.3.1-1 shows the plan for the West Complex primary distribution system.

A regional utility currently plans to construct a 345kV transmission line running NE/SW through Ellis county. The route of this line will cross the East Complex and near the N55 service. A 345/69 kV substation will be located north of FM 878 on the tongue of land leading to the N55 site. The primary distribution lines will run north along the access road to a substation at the N55 shaft and south to substations at IR8, IR5, and the S15 service area. Figure 3.3.1-2 shows the East Complex primary distribution system.

3.3.2 Natural Gas

Transmission of gas to the site from existing lines will be through new gas transmission lines. Primary distribution may be provided by an independent company. Assuming the Lone Star Gas Company as the source for the West Complex, a gas line will follow FM 66 to a single meter point near the intersection of FM 66 and New Arrowhead Rd. The primary on-site gas line would have to feed six distribution points: the N15 area, the injector area, IR1 and the test beams, the Main Campus, the Emergency Facility, and IR4. Figure 3.3.2-1 shows the conceptual layout for natural gas primary distribution on the West Complex.

Assuming the Lone Star Gas Company as source for the East Complex, the nearest supply line is at the northwest corner of the site. Transmission to the site from existing gas transmission lines will be through new gas transmission lines with a meter point at the intersection of FM 878 and the Connector Rd. The gas line would follow the Connector Rd. and feed three distribution points: the Support area, the IR8 area, and the IR5 area. Figure 3.3.2-2 shows the planned layout for natural gas primary distribution on the East Complex.

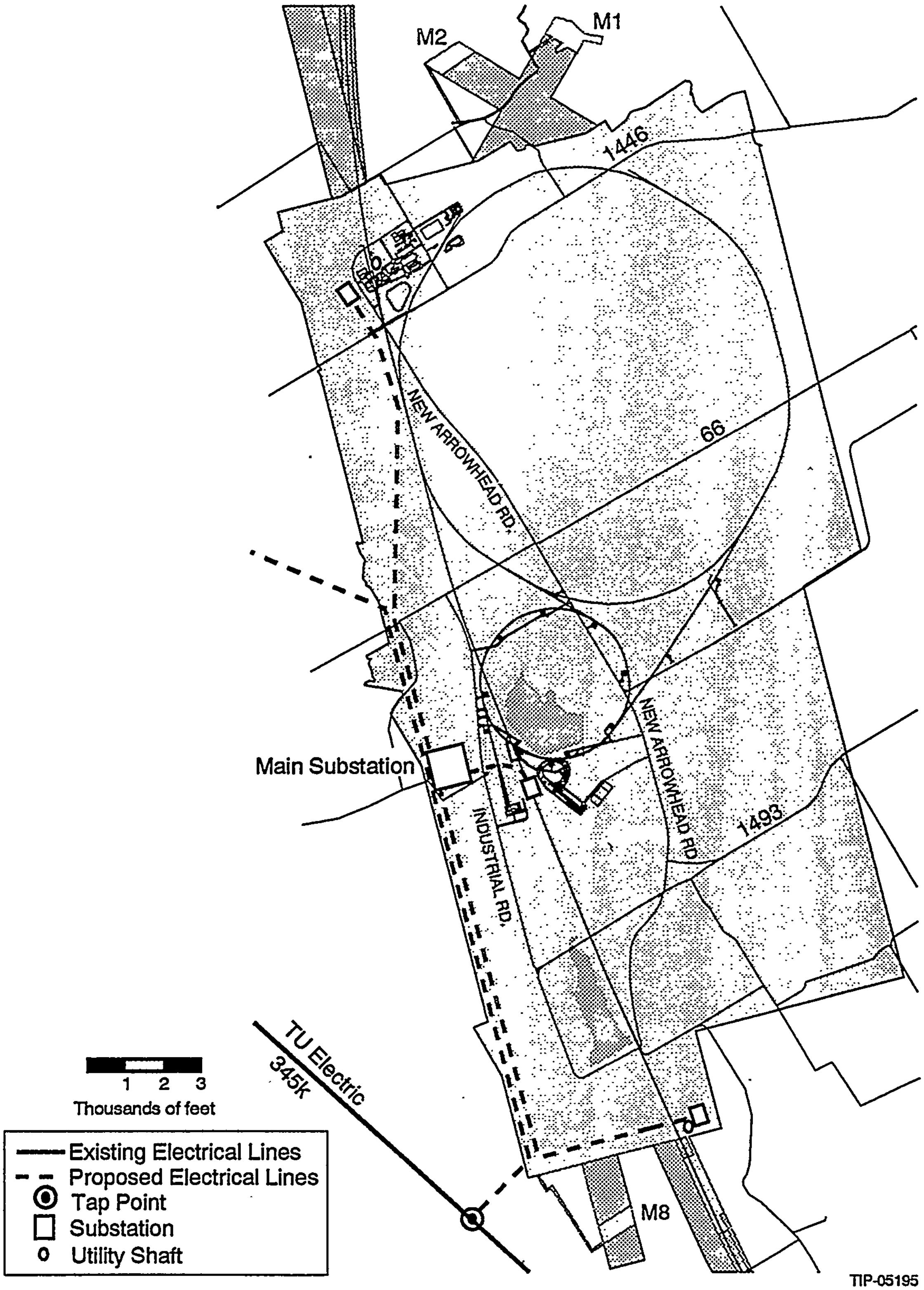

Figure 3.3.1-1. West Complex — Electrical Primary Distribution.

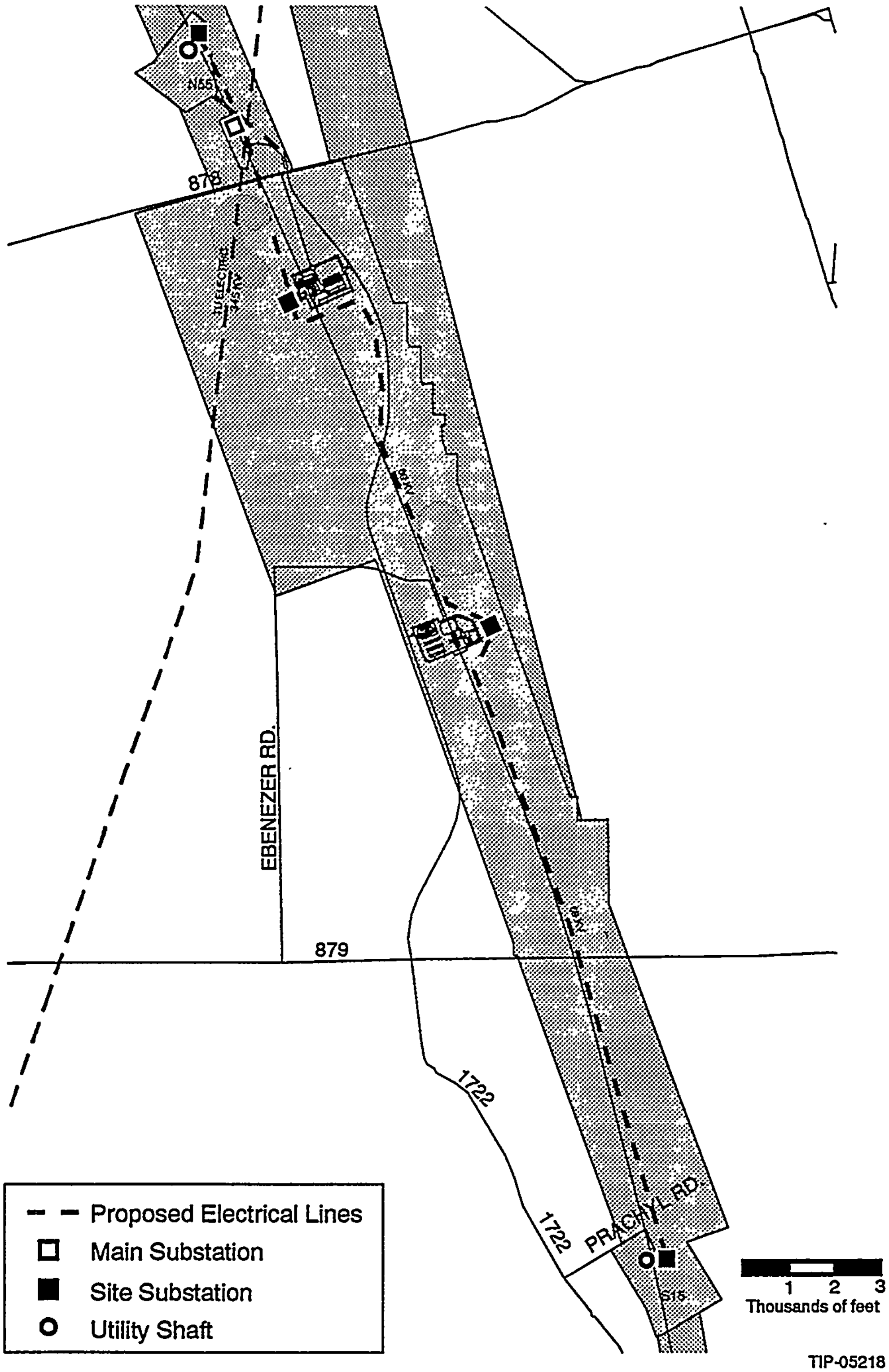

Figure 3.3.1-2. East Complex — Electrical Primary Distribution.

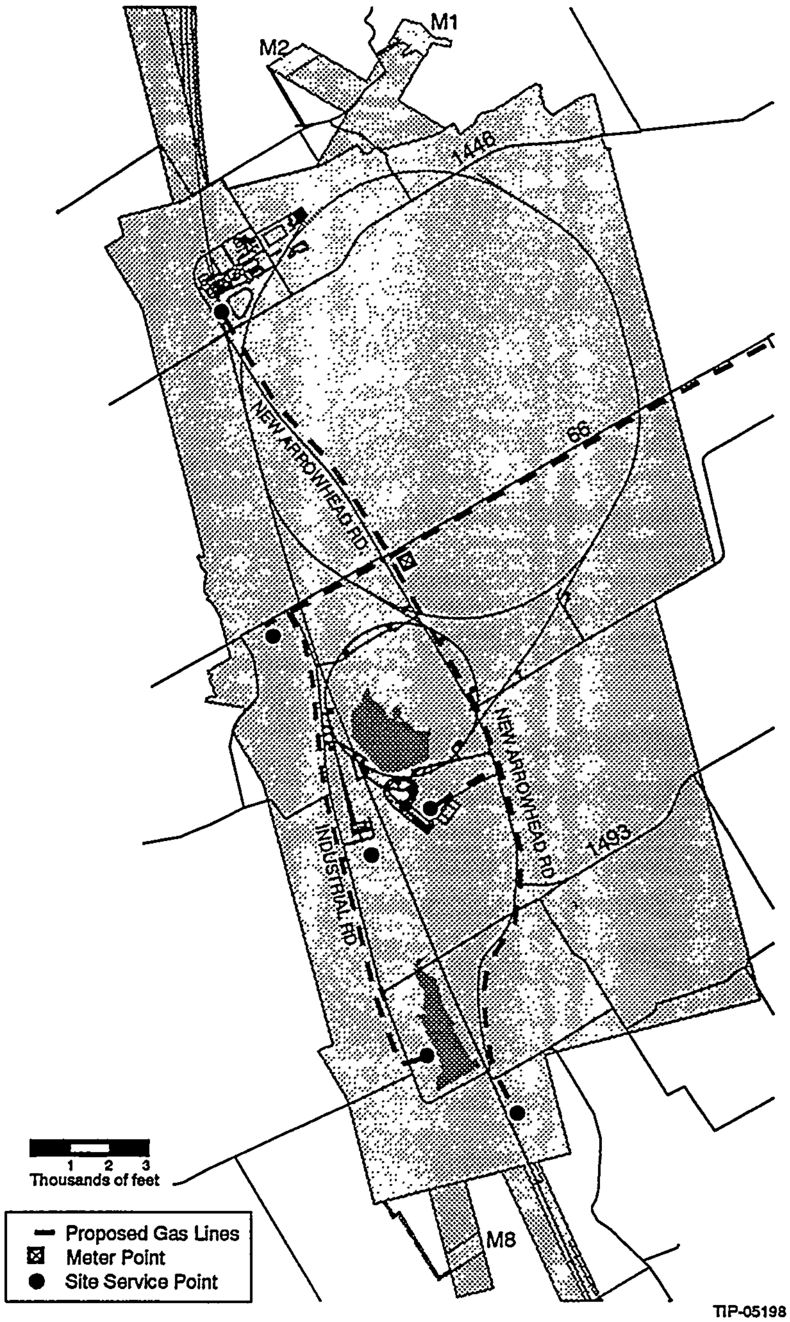

Figure 3.3.2-1. West Complex — Natural Gas Primary Distribution.

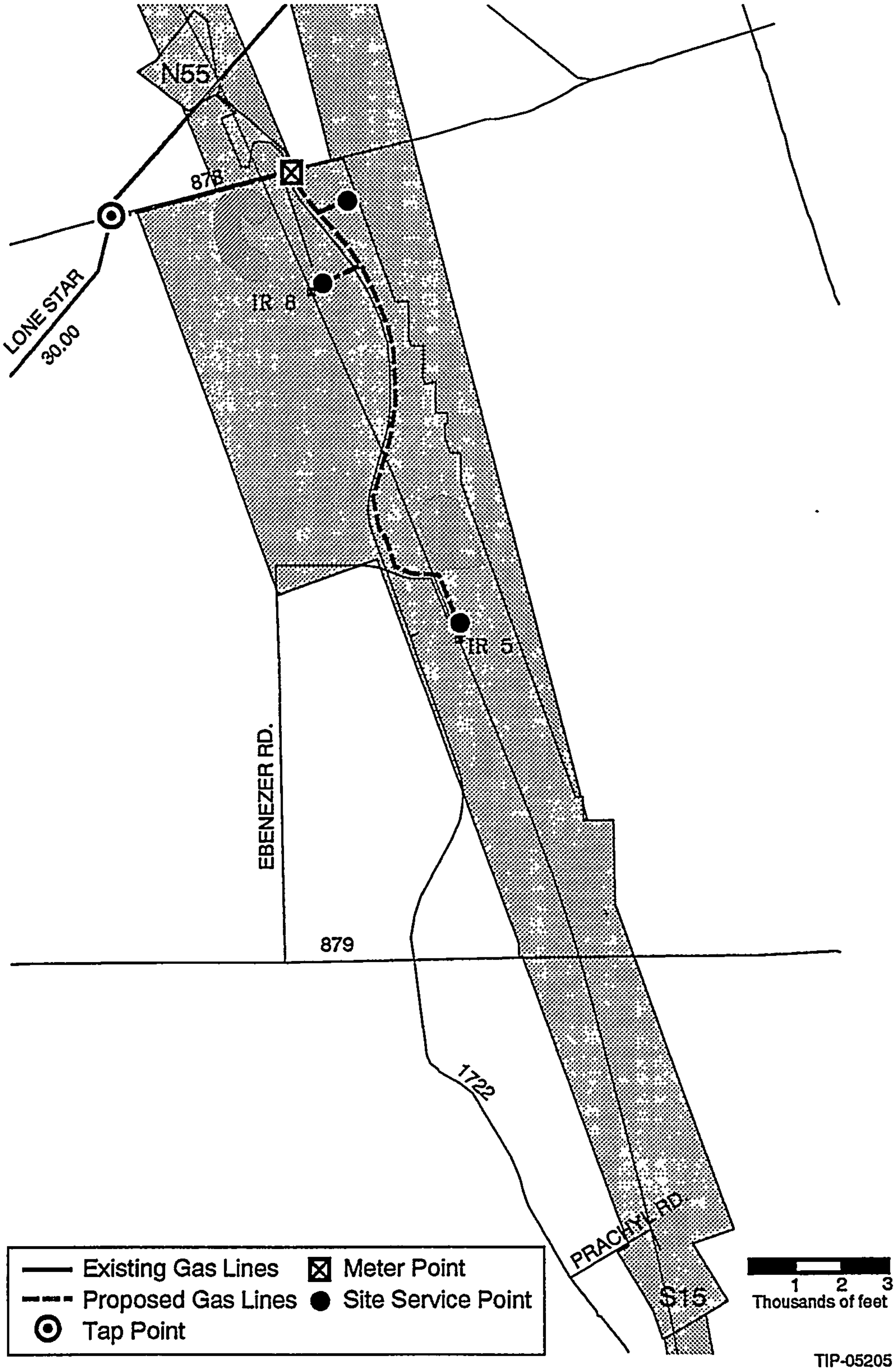

Figure 3.3.2-2. East Complex — Natural Gas Primary Distribution.

3.3.3 Communications

Southwestern Bell will have a single connection at the West Complex Operations Center to provide the SSC an interface to off-site telecommunication systems. All on-site, fiber optic communications lines will be maintained by the laboratory.

The Operations Center for the Laboratory will be located at the Main Campus. From the communications vaults, primary conduits will run across the campus bridge and then south to IR4 and to a utility shaft, where the cables will enter into the collider tunnel. Primary conduits will run north along Industrial Rd. and along New Arrowhead Rd. to the N15 site, where the cable will drop down into the collider tunnel through the utility shaft. Branches from the north conduits will serve four collection points: one at the MEB (serving the injector technical and experimental areas), one at the HEB, one at the West Main Substation, and one for the Emergency Facility. Figure 3.3.3-1 shows the conceptual routing of the primary 4" conduits on the West Complex.

The East Complex experimental systems and their utilities will be connected to the Operations Center through the collider tunnel. The cable will reach the surface at N55. Primary conduits will run south along the access road and then south along the Connector Road to the S15 shaft. At the S15 shaft, the cables will run down into the tunnel. Branches from the conduits will serve the East Main Substation, the East Emergency Facility, the IR8 area, and the IR5 area. Figure 3.3.3-2 shows the planned routing of the primary conduits on the East Complex.

3.3.4 Water

The raw water system must deliver make-up water to the cooling ponds. The pipeline serving the West Complex will run west to the complex along FM 1446. It will run to the N15 area and then follow New Arrowhead Road south. It will feed six distribution points on-site: two HEB cooling ponds, HEB cooling tower, the N15 site, the MEB cooling pond, and the campus pond. This routing is shown in Figure 3.3.4-1. The pipeline serving the East Complex will run north and south from the TCWCID pipeline on site. It will serve four distribution points: the S15 pond, the IR5 pond, the N55 pond, and the IR8 pond. Figure 3.3.4-2 shows the East Complex distribution.

The potable water for the West Complex will be supplied from the Waxahachie Treatment Plant. An existing pipe running west along FM 66 will connect to an on-site storage tank at the east boundary of the complex. From there existing and proposed pipelines will route the water to supply water to the facilities, the fire systems, and irrigation systems. The extensive network is shown in Figure 3.3.4-3. For the East Complex, the transmission line will route water from Ennis north along 1722 and the Connector Road to a on-site pump station and reservoir. From there, the on-site primary distribution will run along the Connector Road to a storage tank near the northern site boundary, as shown in Figure 3.3.4-4.

The N25, N35, N45, N55, S25, S35, S45, and S55 Areas will obtain raw water from a proposed network of distribution lines shown previously in Figure 1.4.2-4. The N20, N30, N40, N50, S20, S30, S40, and S50 Areas do not require cooling or potable water for initial operations. Possible future cryogenic upgrades could result in the need for cooling water at the ventilation sites. During operations, the N and S Sites will only be occupied for brief maintenance periods and will not require permanent potable water systems.

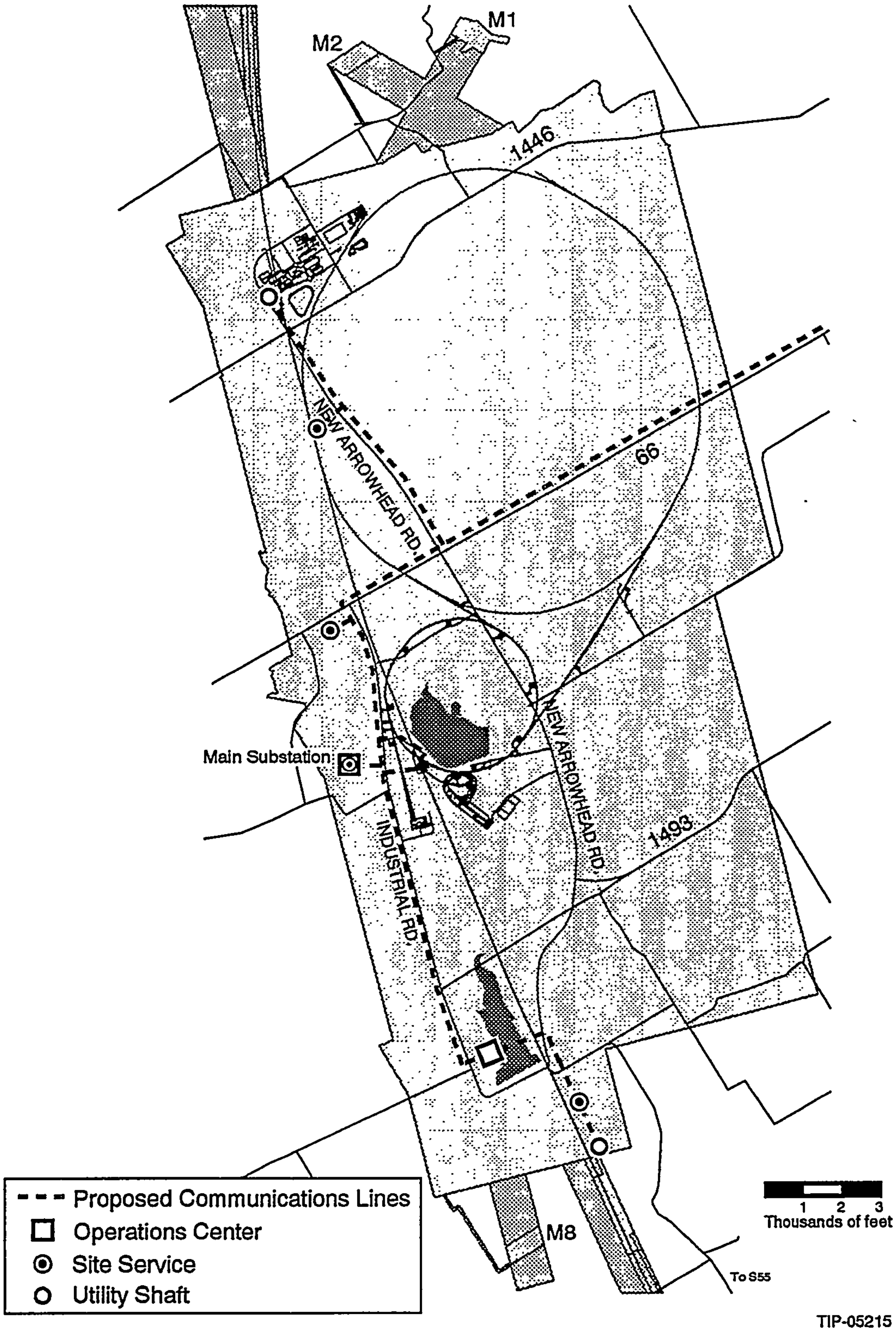

Figure 3.3.3-1. West Complex — Communications Primary Distribution.

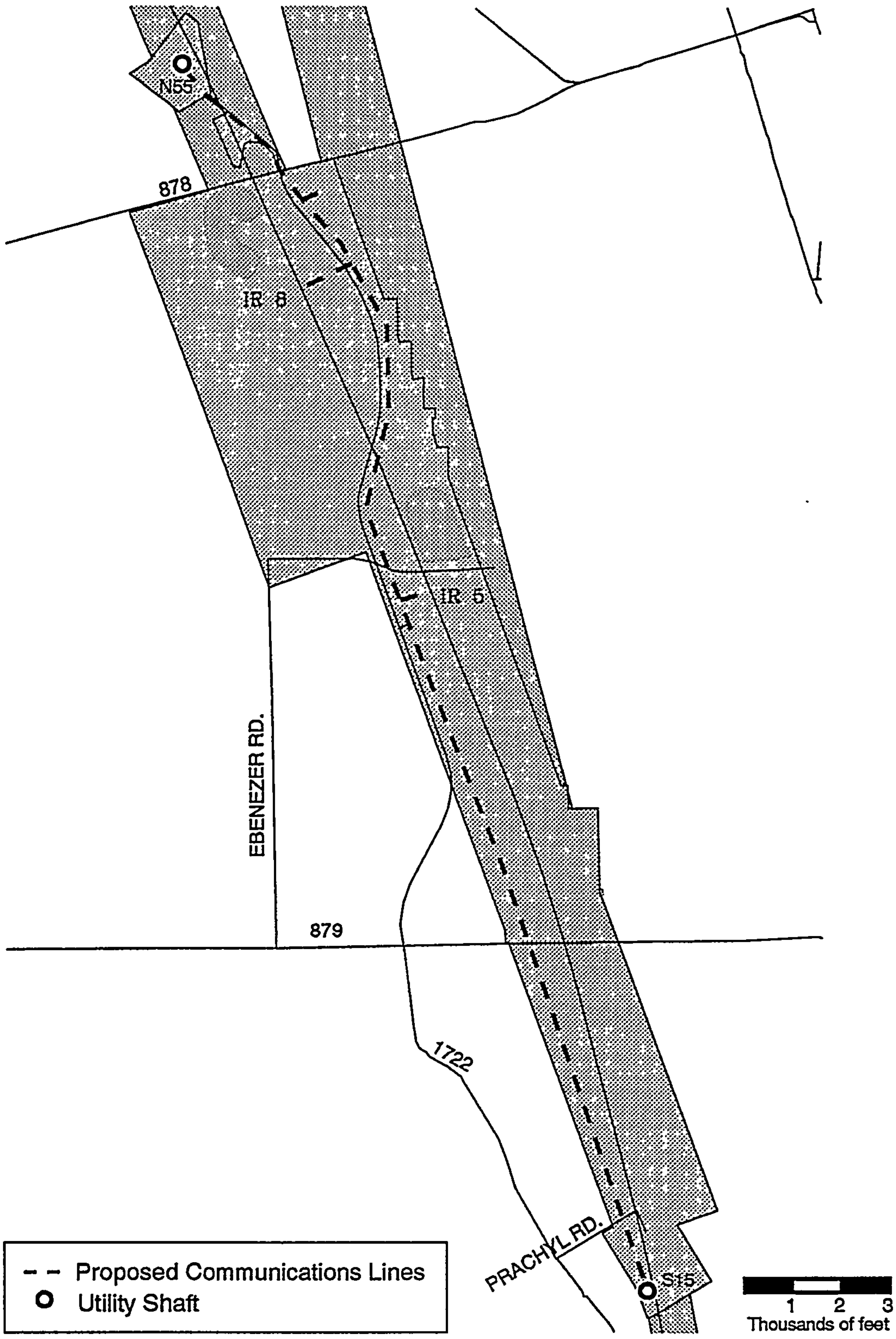

Figure 3.3.3-2. East Complex — Communications Primary Distribution.

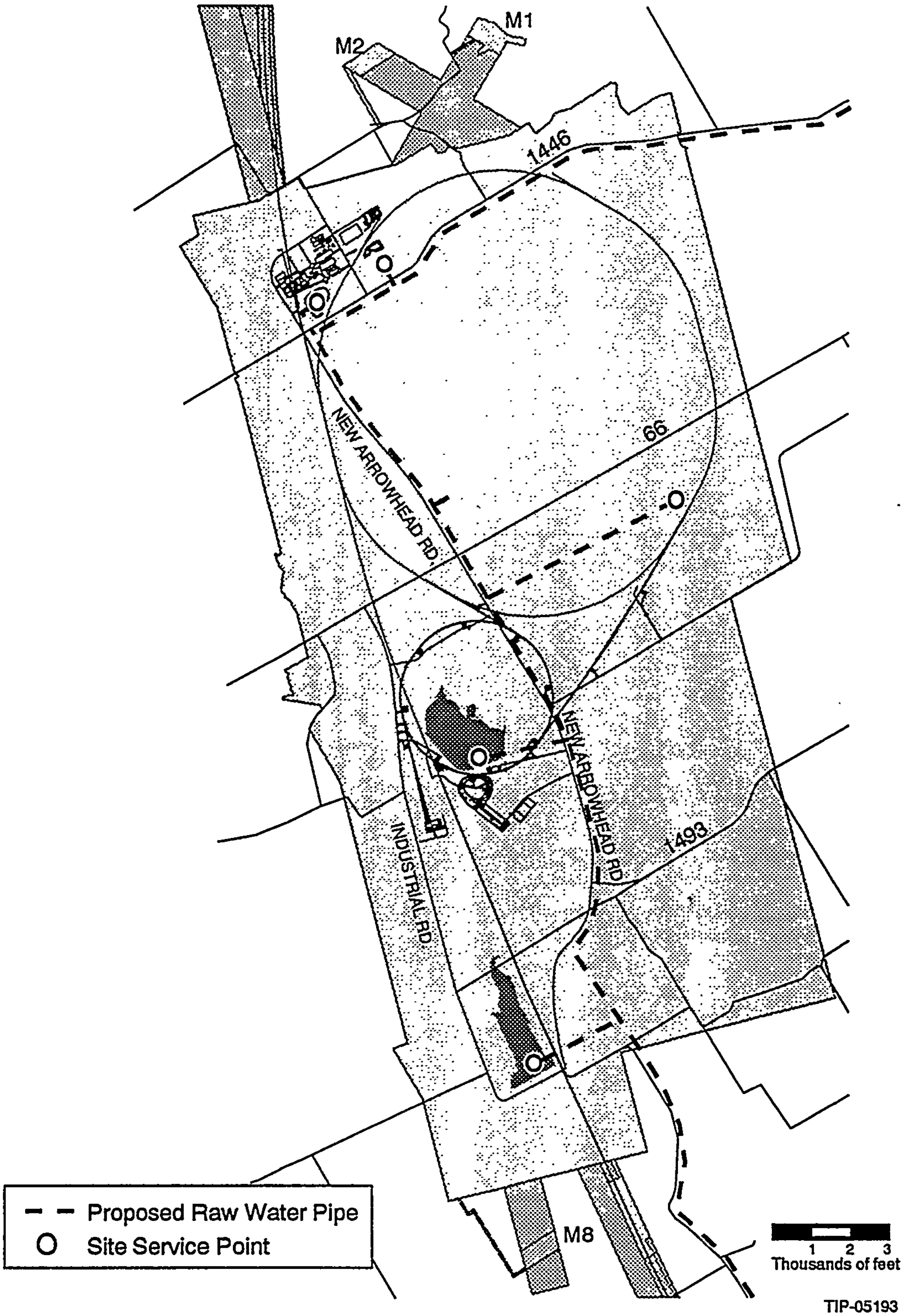

Figure 3.3.4-1. West Complex — Raw Water Primary Distribution.

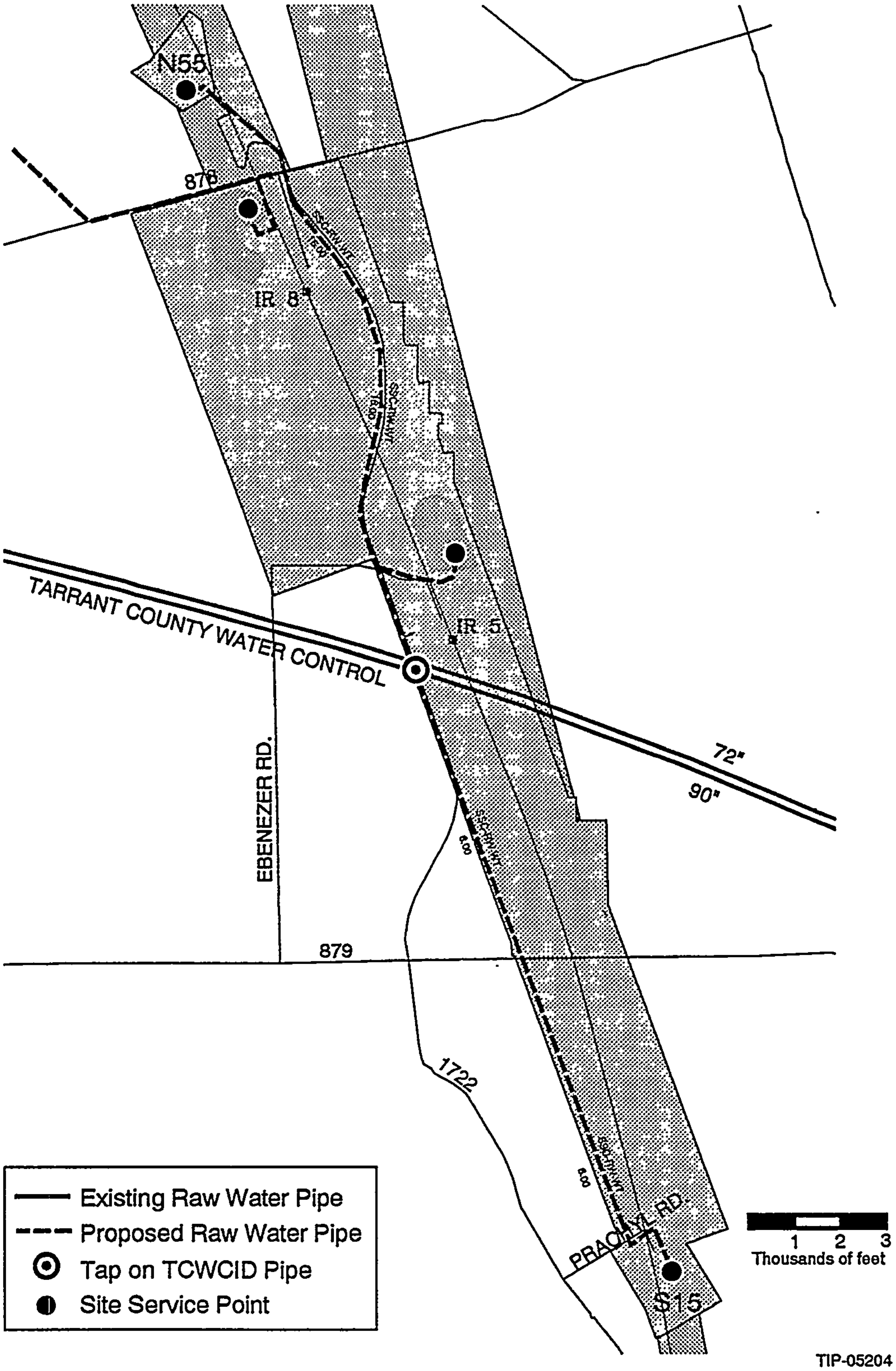

Figure 3.3.4-2. East Complex — Raw Water Primary Distribution.

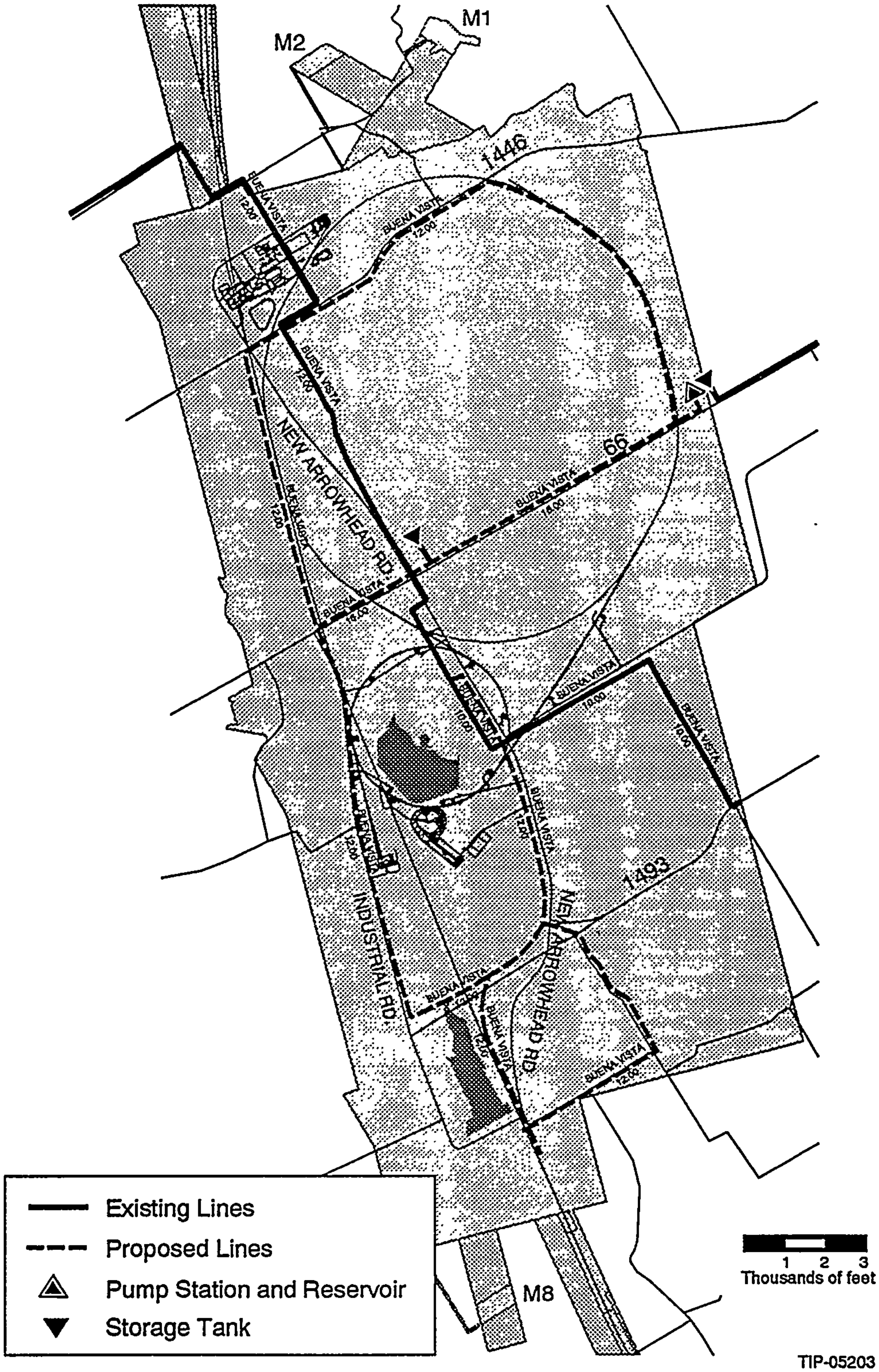

Figure 3.3.4-3. West Complex — Potable Water Primary Distribution.

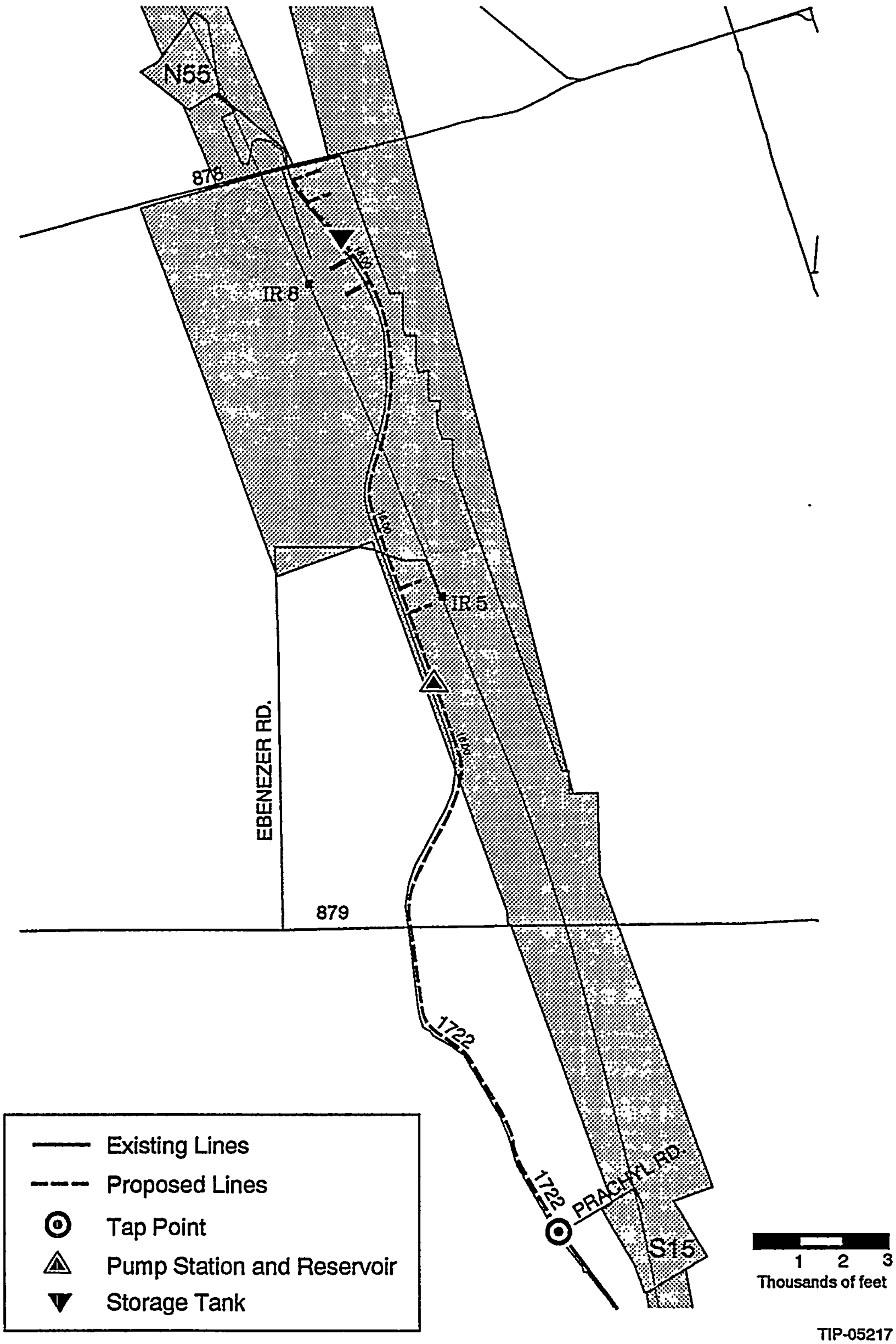

Figure 3.3.4-4. East Complex — Potable Water Primary Distribution.

3.3.5 Sewerage

A transmission line to off-site sewage treatment plants will be provided by the State of Texas. On the West Complex, an on-site pumping station will serve as a collection point for the West Central and the West South facilities requiring sewer service. The station will pump the sewage to the Waxahachie Wastewater Treatment Plant. Figure 3.3.5-1 shows a conceptual layout for the collection system from the West Complex Sites. The N15 area in the West North site has an existing treatment plant that will continue to serve its needs. On the East Complex, waste from the IR5, IR8, and Support areas will be collected and pumped to the city of Palmer's sewer system, as shown in Figure 3.3.5-2. Permanent sanitary sewage disposal is not required at the N and S Areas. Temporary sanitary sewage will be required at the N and S Areas during construction. This will be provided by portable units.

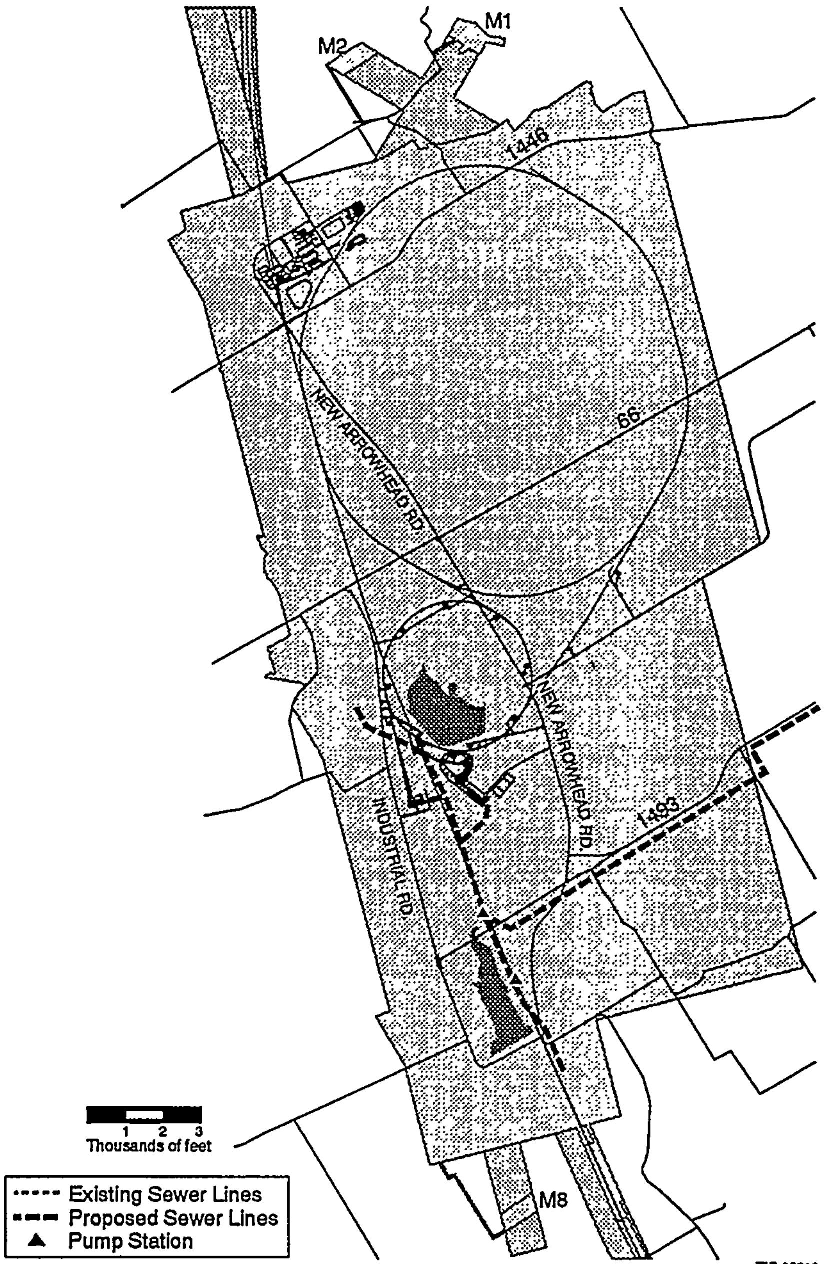

Figure 3.3.5-1. West Complex — Waste Sewage Primary Collection.

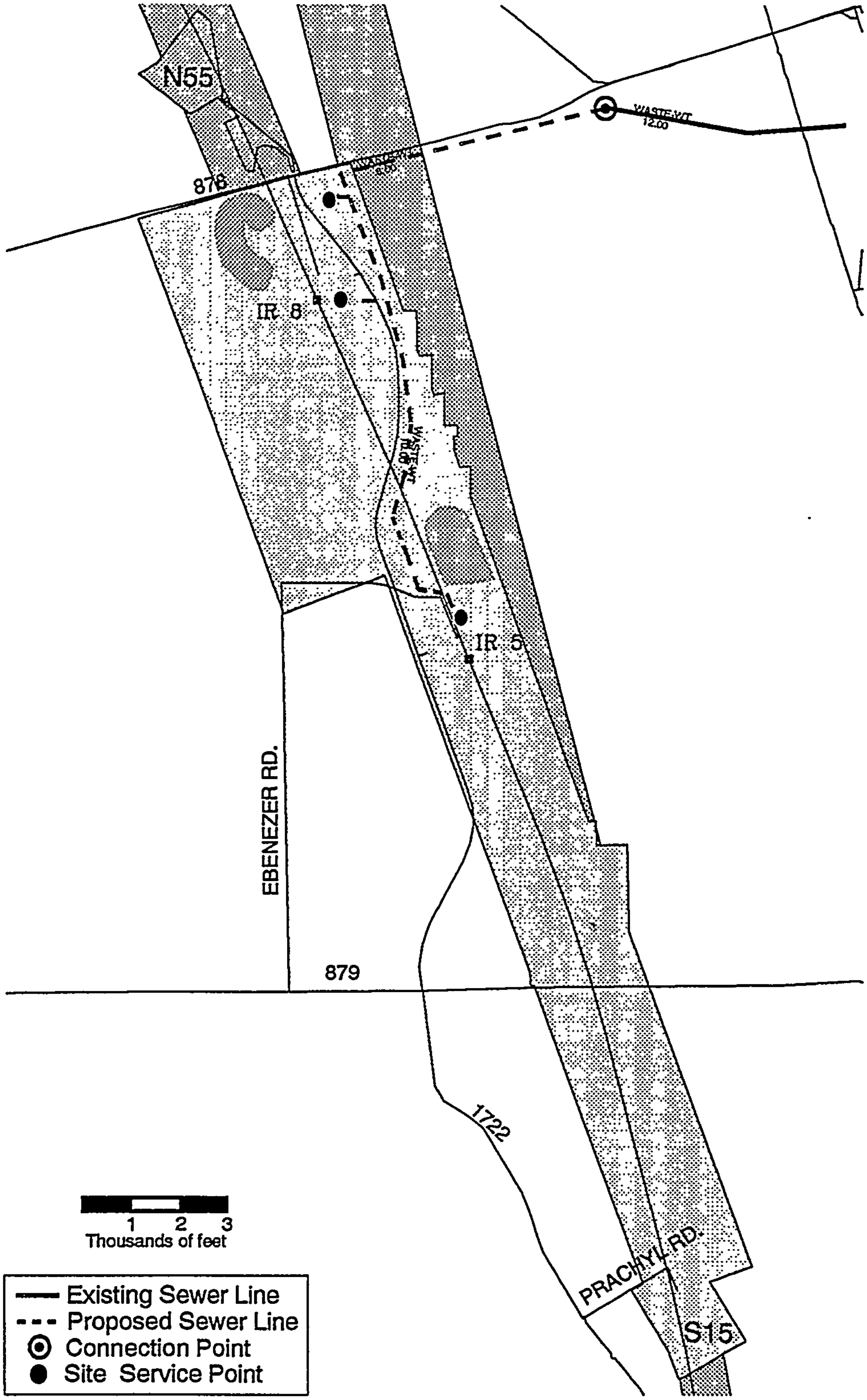

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Figure 3.3.5-2. East Complex — Waste Sewage Primary Collection.

3.4 Transportation

Transportation access to all SSC Laboratory properties is being developed to provide maximum efficiency for both Laboratory personnel and Ellis County residents. Issues such as magnet and detector component delivery, industrial corridors, and regional thoroughfares were been considered when the Conventional Construction Division developed the *Surface Transportation Requirements*[1] (April 1990) in cooperation with TNRLC. This earlier plan evolved into the plans for access to all sites and for on-site roads summarized in this section. The roadway development will comprise improvement/ upgrading of existing off-site roads and the construction of new on-site roads.

3.4.1 Access Roads to the Sites

The existing off-site roadways listed in Table 3.4.1-1 will be maintained and upgraded by the State Department of Highways and Public Transportation. FM 66 is planned as the primary interim access to the West Complex. FM 66 will become the industrial artery and will be upgraded to provide access for delivery of detector components to interaction halls. While FM 66 is being improved, FM 1446 will become the interim access route. FM 1493 will be aligned and developed to provide "front door" access to the Main Campus from IH 35E. FM 1493 will intersect IH 35E at Bingham Road underpass. These regional roadways are also considered as utility corridors across the West Complex. On the east side of the Collider, FM 878 will be upgraded to provide industrial access for detector components to the East Complex from IH 45 at the town of Palmer.

Table 3.4.1-1. Improvements to Access Roads.

Road Name	Segment	Length (mile)	Action
To West Complex:			
FM 1446	I35E to New Arrowhead Rd	7.2	Maintain
FM 66	I35E to SSC Industrial Rd	4.8	Improve interchange and upgrade for heavy loads
FM 1493	FM 876 to Arrowhead Rd Ext.	3.3	Overlay existing road and add shoulders
FM 876	I35E to FM 1493	2.0	Overlay existing road and add shoulders
To East Complex:			
FM 878	I45 to Ebenezer Rd	3.1	Upgrade for heavy loads
FM 878	US 287 to Ebenezer Rd	6.9	Upgrade and replace structures
FM 1722	FM 879 to East Campus Conn.	0.8	Construct new roadway

Table 3.4.1-2 lists the access roads to those N & S Service sites that are not adjacent to highways or farm roads. These access roads are in need of upgrade, in some cases paving and placement of new bridges capable of supporting construction traffic. The magnet shafts have been placed at N & S sites adjacent to major roads (N40, N55, S25, and S40) or on the Complex sites (N15). The N40 site is adjacent to FM 342 and near I35E. A new N55 site access road connects to FM 878, which is being upgraded. Both S25 and S40 are near to SH34, and FM 55 to site S40 is being upgraded as part of the Integrated Master Transportation Plan for Ellis County.

Table 3.4.1-2. Access Roads to Service Areas.

Road Name	Segment	Length (mile)
N25		
Skinner Road	FM 875 to Honeysuckle Road	0.7
Honeysuckle	Skinner Road to Site Road	0.7
N30		
Long Branch	FM 1387 to Site Road	1.6
N35		
E. Highland	IH 35E to Sterrett Road	0.3
Sterrett Road	E. Highland to Patrick Road	1.6
Patrick Road	Sterrett Road to Site Road	0.9
N45		
Lawrence Road	FM 2377 to Rockett Ln.	1.1
Rockett Ln.	Lawrence Road to Pritchett Road	0.5
Pritchett Road	Rockett Ln. to Site Road	0.4
N50		
Farrer Road	FM 813 to Site Road	0.6
S15		
Prachl Road	FM 1722 to Site Road	0.4
S25		
Bozek Lane	FM 34 to Site Access Road	0.5
S45		
Lumpkin Road	US 77 to Holder Road	0.3
Holder Road	Lumpkin Road to Site Road	0.7
S50		
Anderson Road	FM 876 to Lewis Road	1.7
Lewis Road	Anderson Road to Site Road	0.5
S55		
Bethel Road	FM 876 to Site Road	0.7
M3		
Dunn Road	Hoyt Road to Site Road	1.2

3.4.2 On Site Roads

On the West Complex, several pre-existing road segments will be closed or re-routed because of site development. A new West Complex primary north-south connector (New Arrowhead Rd.) will link the N15 technical area north of FM 1446 to the Main Campus south of FM 1493. Visitors will approach the Main Campus from its 'front door' along FM 1493 and then south along New Arrowhead Rd. The Industrial Rd. has been constructed to provide a service entrance to the campus. Deliveries for the laboratories or cafeteria will use the Industrial Rd. Also, heavy components for the Test Beams and IR1 will follow FM 66 to the Industrial Rd. The road has been routed over the cooling pond's dam in order to maintain a convenient thoroughfare along the line of the abandoned section of Great House Rd.

The transportation system for the East Complex is much simpler. There, one new road (the Connector Rd.) is being constructed to connect the two Interaction Regions with FM 878 and FM 879. Figure 3.4.2-1 shows the West Complex road, while Table 3.4.2-1 lists the road segments closed, maintained, or constructed. Figure 3.4.2-2 and Table 3.4.2-2 provide similar information for the East Complex.

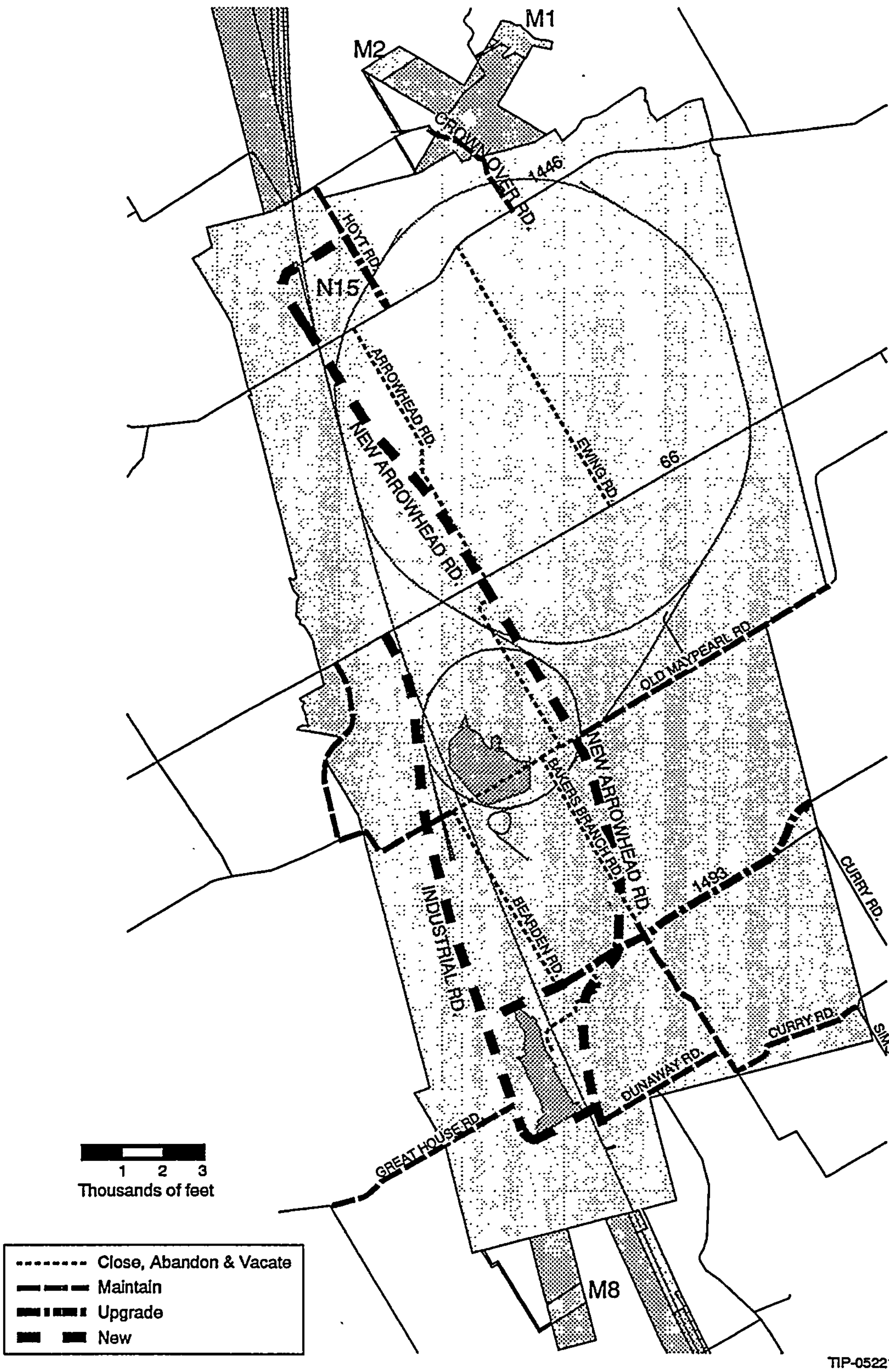

Figure 3.4.2-1. West Complex Roads.

Table 3.4.2-1. West Complex Roads.

Road Name	Segment	Length (mile)	Action
Old Maypearl Road	New Arrowhead to Industrial Road	0.9	Close
FM 1493	Curry Road to Bearden Road	2.4	Maintain
Dunaway Road	Bakers Branch Road to Boz Road	0.5	Maintain
Curry Road	Sims Road to Bakers Branch Road	0.5	Maintain
Great House Road	Boz Road to Dawson Road	1.2	Re-route
Hoyt Road	Cox Road to FM 1446	0.6	Upgrade
Crownover Road	Cox Road to FM 1446	0.6	Maintain
Ewing Road	FM 1446 to FM 66	1.3	Close
Arrowhead Road	FM 1446 to Old Maypearl Road	2.4	Close
New Arrowhead Road	Hoyt to Dunaway Road	5.2	Construct
Industrial Road	FM 66 to Great House Road	2.6	Construct
Bearden Road	Old Maypearl Road to FM 1493	1.0	Close
Bakers Branch Road	Old Maypearl Road to FM 1493	1.0	Close
	FM 1493 to Curry Road	0.8	Maintain

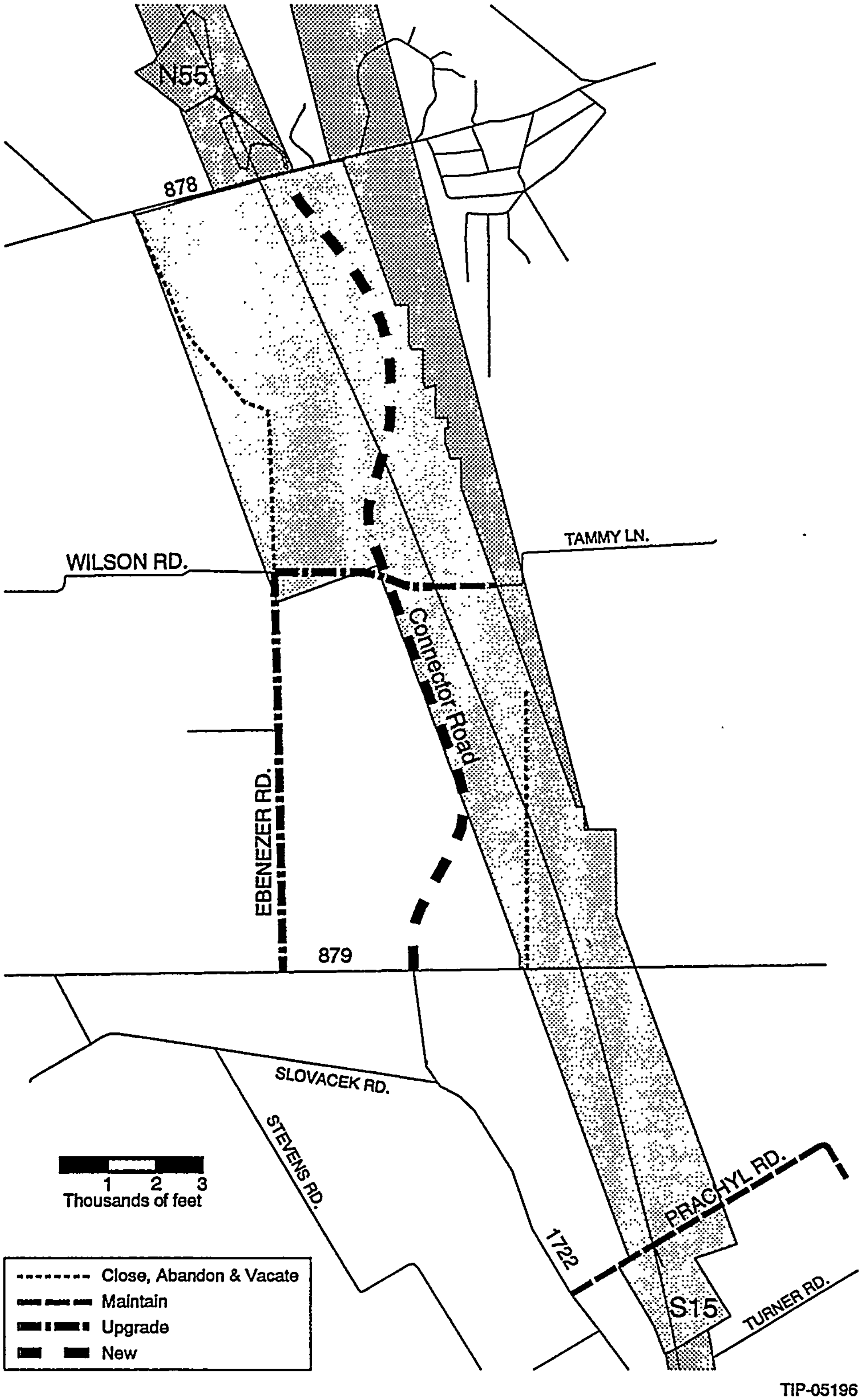

Figure 3.4.2-2. East Complex Roads.

Table 3.4.2-2. East Complex Roads.

Road Name	Segment	Length (mile)	Action
Tammy Lane	Ebenezer Road to IR5 Site	0.4	Upgrade
Tammy Lane	From IR5 Site East	0.2	Maintain
Ebenezer Road	FM 879 to Tammy Lane	1.7	Upgrade
Connector Road	FM 878 to FM 879	4.1	Construct

3.5 Security and Safety Issues

3.5.1 Site Security

It is intended that the SSC Laboratory site be open and accessible to the general public to the maximum extent possible. The Main Campus will eventually have a visitors center where individuals will receive maps and descriptive information about the site and the Laboratory program. In addition to viewing an exhibit area, people will be able to view the laboratory from separate viewing areas and to tour specific facilities as part of a group.

In a manner similar to other laboratories, the SSC Laboratory will provide patrol guards to occupy stations within selected buildings and to monitor the site, as needed. These security personnel are expected to monitor the flow of materials into and out of the buildings as well as to observe building activities, particularly after regular business hours. Developed areas on the West Complex (the N15 area, the Injector Areas, the Campus, and the IRs) will be patrolled after hours. The IRs on the East Complex and the N & S service buildings will be fenced to prevent unauthorized access.

3.5.2 Project Safety

Safety of personnel and equipment has always been an important consideration in the design of the accelerator and research facilities. The conventional aspects of safety are built into the designs of the facilities. Attention is paid to the provision of emergency lighting, fire escapes, and physical barriers in order to provide a secure environment for people. The buildings and enclosures are wired for fire and intrusion protection so that adequate alarms are generated during emergency conditions. With respect to technical systems, the SSC accelerator enclosures contain potential hazards to personnel such as the possibility of beam radiation, cryogenic, oxygen deficiency, and electrical hazards. Protective measures are described in the following two paragraphs.

The primary proton beam must always be considered a potential source of radiation inside the beam enclosures. Outside the enclosures, the radiation levels that can occur are minimal because of the shielding material between the beam enclosures and occupiable areas. Access interlocks are used shut down an accelerator if anyone enters its enclosure during operations. Similarly, the interlocks ensure that the beam from adjacent accelerators can neither be accidentally sent to the accessed enclosure nor be a source of radiation in that enclosure.

The cryogens in the magnets present the possibility of thermal injury and pose an oxygen deficiency hazard potential if the vessels become damaged, or if for some other reason there is a gaseous release in the tunnel when people are present. Access to enclosures will be controlled when cryogens are present. The surface buildings contain high-voltage, high-current capacity distribution cables in the system. Interlocks are used to ensure electrical power is off and stays off during normal accesses.

Low-level activated materials from SSC operations will be collected at prepared storage facilities on the West and East Complexes. After packaging, the small amount of material will be transported to a reprocessing center by an authorized handler. The low-level radioactive material storage facility and the low-level radioactive material handling facility will be surrounded by a low berm and will be fenced to prevent unauthorized access. Similarly, hazardous waste storage facilities will be fenced and locked.

3.6 Environmental Issues

3.6.1 Non-Hazardous Waste Disposal

In accordance with DOE policy, the SSC Laboratory will minimize waste generation as much as possible. Waste disposal for the SSC will be performed in accordance with the relevant acts and amendments discussed elsewhere, and the mitigation measures documented in Section 6.7 of the *FSEIS*. Texas regulations prevent solid waste collection, handling, storage, processing, or industrial waste disposal causing discharge into existing waterways without authorization from the Texas Water Commission. The creation or maintenance of a nuisance or endangerment to the public health and welfare is also prohibited.

Mitigation measures proposed by the SSC Laboratory provide that solid waste will be deposited in local landfills via a state-licensed collection and disposal contractor; sludge generated from SSC wastewater treatment facilities will be monitored to ensure that hazardous constituents are maintained below regulatory limits; and a volume reduction plan will reduce impacts on landfill capacity.

3.6.2 Wetland Mitigation

The avoidance of impacts to wetlands is a primary environmental goal of the SSC project. Impacts on existing wetlands will be closely monitored, avoided when possible, and mitigated when necessary. The creation of new and additional wetlands is proposed both for construction mitigation and site enhancement. Ideas for mitigation and wetland replacement were discussed in meetings with the Texas Parks & Wildlife Department, U.S. Fish and Wildlife Service, and U.S. Army Corps of Engineers.

The replacement of existing wetlands by the creation of new ones will be measured in terms of habitat value and acreage. The SSC has adopted the qualitative approach of improving the habitats already in existence, not just replacing those destroyed. As stated in the FSEIS, each acre of disturbed wetland will be replaced with 1.5 acres of newly created habitat. The current estimate is that 10.7 acres of wetland will be filled as a result of construction of the SSC Project. The A-E/CM has designed wetland mitigation ponds that total 26.2 acres project wide. Their proposal is contained in the *West Complex Wetland Mitigation*[2] (June 1993). They analyzed several sites based on the size of the wetland that can be developed, site hydrology and soils, and proximity to filled wetlands. The report proposed one site on the East Complex between Grove Creek and Bone Branch Creek and one site on the southeast corner of the West Complex near Baker's Branch Rd.

The disturbance of riparian habitats along stream and creek beds could occur on a portion of the Service Areas and will occur in construction of the Main Campus. Disturbed areas will be re-vegetated with the same native materials that existed before construction to ensure comparable habitat establishment within a short period of time. Wooded corridors are important wildlife habitats and should be maintained and enhanced.

3.6.3 Noise Mitigation

The plan considered ways to mitigate noise at the SSC during construction and operation. The *Service Site Adequacy Study*[3] (March 1991) investigated each Collider Ring Service Area in terms of impacts and rated them as minimal, low, and moderate, depending on the proximity of noise receptors to the shaft location.

Construction noise, a short-term concern, refers to construction machinery noise and truck traffic associated with construction. The proximity of potential site access roads to existing residences were mapped, and the roads were located to minimize effects of construction traffic. At the service sites, tunnel ventilation systems and cryogenic refrigerators will be the major noise sources during operations. The *Service Site Adequacy Study* documented structures within 600- and 1000-foot radiuses of the shaft location, and residences located within that range were determined to require active mitigation. The study identified four sites that would require noise mitigation: N25, N30, N40, and N45. Such mitigation could occur in the form of increased insulation in the headhouse or cryogenic facility, or use of spoils piles or vegetative buffers. Mitigation is intended to achieve noise EPA guidelines for rural areas. Residences located outside the 1000-foot buffer are not expected to require a mitigative response.

3.6.4 Spoil Placement

The reduction of construction traffic, noise, and dust from spoil removal from the sites is the first step in ensuring an environmentally responsible approach to spoil placement.

The disposal of spoil on each of the Service Areas as well as the West and East Complexes has been addressed as an important site development concept. Opportunities provided by spoil both as an environmental response and as a physical expression will be fully realized. In some cases, spoil piles will be incorporated into the existing topography to ensure positive drainage, promote wildlife habitation, minimize site disturbance, and avoid fill in 100-year flood plain, as well as to maintain the development concept for that particular site. In other instances, where existing conditions will not allow a natural response, spoil will be displaced in an aesthetically pleasing manner that responds to the site's constraints without adversely affecting existing drainage patterns and erosion on adjacent properties.

On every site, the spoil and areas disturbed by construction will be re-vegetated with native grasses to be used as forage for local wildlife, and to promote the re-establishment of the Blackland Prairie that once dominated Ellis County. Topsoil existing on the site will be scraped and stockpiled during construction and replaced over the spoil piles at a depth of approximately 6 inches. Local prairie experts and representatives from the Soil Conservation Service and Agricultural Extension Office will participate in the re-vegetation and prairie establishment process to ensure effective, healthy reclamation.

Placement of spoil on each site will be tested against existing runoff and drainage patterns, and every effort will be made to avoid negative impacts. Retention and detention ponds in conjunction with cooling ponds will be used to capture excess water for release when existing systems allow. In many cases, SSC property is adjacent to some of the most productive agricultural land, which will make runoff control imperative.

3.6.5 Cooling Ponds

The location, performance, and construction of cooling ponds must be carefully monitored so that negative effects on the environment can be minimized. Cooling pond sizes and expected temperatures should have the potential for creating new wildlife habitats. Such habitats should be realized on the East and West Complexes because of the larger size of their ponds.

Cooling ponds also present opportunities for aquatic habitats that could survive under the proposed pond conditions. Rather than changing the cooling ponds to accommodate existing aquatic life patterns, it is more practical to monitor species that would adapt to the planned temperatures. An algaecide successfully used at Fermilab will be applied to control algae growth.

Storm water and runoff management will be considered for all construction activities. Cooling pond construction and operation could have impacts on the existing patterns, so appropriate planning and design are essential. Use of the ponds to accumulate excess runoff before its release into the existing drainage system is necessary to minimize off-site erosion. Depending on the existing geology, ponds on certain sites may require liners to prevent leakage and groundwater contamination.

3.6.6 Construction Mitigation

Mitigating the impact of construction is one of the most important development measures associated with the SSC project. Construction activities at the SSC are planned to take place between 1991 and 2003. Because of the nature and length of construction at each site, proper mitigation measures will be necessary to minimize negative impacts and to ensure responsible and sensitive site development. The type and extent of construction activity at each of the sites will vary considerably. Each type could have impacts on the environment, and each must be dealt with accordingly. Activities will include cut-and-cover excavation, building and pad development, site clearing and stockpiling, and shaft boring and experimental hall excavation.

Construction activities could have adverse effects on the atmosphere. Construction and wind erosion on unprotected spoil could suspend particulates in the air. This possibility requires the application of water and chemical dust-control measures. Oil can be used as a control measure on paved roads but not on spoil piles. Water will be applied in such volume and with such frequency so as to control dust but not to increase runoff or erosion or both.

Planned mitigation to minimize various negative impacts will include: construction laydown and storage areas for efficient use of materials and machinery, siltation and erosion control fencing to prevent increased runoff and siltation on adjacent properties, signs to protect trees, fencing to protect existing vegetation, cost-efficient and environmentally sensitive construction techniques to minimize impacts to the site, and efficient scheduling of construction activities to minimize conflicting activities on the site.

REFERENCES

1. *Surface Transportation Requirements,* April 12, 1990, SSC Laboratory.

2. *West Complex Wetland Mitigation*, Doc. No. CPB-100446, June 1993, The PB/MK Team.

3. *Service Site Adequacy Study Phase 1 Draft*, Doc. No. CPB-000564, March 29, 1991, The PB/MK Team.

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Appendix I

Comparison of the SSC Technical Site Information to DOE Order 4320.1B

Technical Site Information Section:	DOE Order, Chapter II, Section:
1. Regional Conditions	
1.1 History of the Site	a.(1) History
1.2 Regional Overview	a.(2) Regional Overview
1.3 Specific Local Conditions	a.(3) Specific Locale Conditions
1.4 Regional Infrastructure	
1.4.1 Transportation	a.(4) Public Transportation
1.4.2 Utilities	b.(5) Utilities
1.5 Regional Physical Characteristics	
1.5.1 Topography	a.(5) Geology/Topography
1.5.2 Geology	a.(5) Geology/Topography
1.5.3 Hydrology	a.(5) Geology/Topography
1.5.4 Ecological Areas	a.(5) Geology/Topography
1.5.5 Climate and Weather	a.(6) Meteorology
2. SSC Laboratory Existing Programs	
2.1 Mission and Programs	b.(5) Missions and Programs
2.2 Resources Requirements	
2.2.1 Staff	b.(3) Population
2.2.2 Technical Systems	b.(4) Functions
2.2.3 Facilities	b.(4) Functions
2.2.4 Infrastructure	b.(5) Utilities
2.3 Physical Characteristics of the Sites	b.(7) Physical Characteristics
2.4 Existing Facilities	b.(6) Site Improvements
2.5 Summary of Siting Studies	
2.5.1 Facilities	b.(4) Functions
2.5.2 Infrastructure	b.(5) Utilities
3. SSC Project Site Plans	
3.1 Land Use – Site Zoning	b.(1) Existing Land Use b.(3) Population
3.2 Facilities Layout	b.(4) Functions b.(6) Site Improvements

Technical Site Information Section:	DOE Order, Chapter II, Section:
3.3 Utilities Layouts	b.(5) Utilities b.(6) Site Improvements
3.4 Transportation	
3.4.1 Regional	a.(4) Public Transportation
3.4.2 On Site	b.(7) Flood plains/Wetlands
3.5 Security and Safety Issues	
3.5.1 Site Security	b.(8) Security
3.5.2 Project Safety	b.(9) Safety
3.6 Environmental Issues	b.(10) Environmental Issues
4. SSC Laboratory Operations Phase	
4.1 Missions and Programs	c.(1) Mission Resource Requirements
4.2 Resource Requirements	c.(1) Mission Resource Requirements
4.3 Facilities and Utilities Requirements	
4.3.1 Facilities	c.(2) Facility Land Requirements d.(3) Future Facility Locations and Uses
4.3.2 Utilities	c.(2) Facility Land Requirements d.(4) Utilities
4.4 Evaluation of Existing Facilities	c.(4) Evaluation
4.5 Objective & Analysis	c.(3) Goals c.(5) Analyze Alternatives
4.6 Development of the Long Range Plan	c.(6) Develop a Plan
5. Future Laboratory Site Plans	
5.1 Land Use – Site Zoning	d.(1) Future Land Uses d.(2) Future Functional Locations
5.2 Facilities Layouts	d.(3) Future Facility Locations and Uses
5.3 Utilities Layouts	d.(4) Utilities
5.4 Transportation	
5.4.1 Regional	
5.4.2 On Site	d.(5) Future Circulation
5.5 Security and Safety Issues	
5.5.1 Site Security	d.(6) Future Security
5.5.2 Project Safety	d.(7) Future Safety
5.6 Environmental Issues	d.(8) Future Environmental Issues