EPA-456/R-98-001

Ambient Air Monitoring Plan for Ciudad Acuña and Piedras Negras, Coahuila, Mexico

U.S.-Mexico Border
Information Center on Air Pollution

CICA

Centro de Información sobre Contaminación de Aire
Para la frontera de EE. UU.-México

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U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

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Ambient Air Monitoring Plan for Ciudad Acuña and Piedra Negras, Coahuila, Mexico

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PREFACE

The U.S.-Mexico border Information Center on Air Pollution /*Centro de Información sobre Contaminación de Aire* ***(CICA)***, was established by the U.S. Environmental Protection Agency (EPA), Office of Air Quality Planning and Standards (OAQPS) to provide technical support and assistance in evaluating air pollution problems along the U.S.-Mexico Border. These services and products are available at no cost to Federal, State and Local Agencies and universities in Mexico. Others can use these services depending on available resources.

CICA provides ready access to EPA information and expertise. It draws on professional staff from the EPA's OAQPS and Office of Research and Development (ORD). Private contractors also are available when appropriate.

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This *CICA* assistance project resulted from a request from the State of Coahuila, Mexico. Coahuila was interested in improving ambient air quality monitoring capabilities in the two cities, *Ciudad Acuña and Piedras Negras.* To accomplish this, *CICA* was asked to help develop and ambient air quality monitoring plan for these cities. This report is the result of that effort. This report presents recommendations on implementing an ambient air quality monitoring network for the two cities based the existing air quality monitoring equipment, emission sources potentially affecting these cities, and the human resources needed to operate and maintain the network.

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EXECUTIVE SUMMARY

During the week of June 17, 1996, two air quality monitoring specialists from Midwest Research Institute (MRI) visited Ciudad Acuña and Piedras Negras in the State of Coahuila, Mexico. The purpose of the visit was to assist the two cities in establishing an ambient air quality monitoring network, using existing equipment to the extent possible. Equipment and facilities in the two cities were inspected and discussions were held with city officials. Additionally, existing monitoring station sites were toured and new sites were identified for locating future monitoring stations.

As a result of this visit, a number of recommendations were developed. These recommendations are summarized below.

1. Both cities have existing PM_{10} monitors that represent the latest technology and are fully functional. The number of PM_{10} monitors available to each city (i.e., four each) is adequate. However, several monitors have not been placed at monitoring station locations, and none of the monitors are currently being operated. The existing monitor locations were determined to be appropriate, and locations for the remaining monitors are identified in this report. In evaluating existing monitor locations and selecting new locations, the objective was to allow air contaminant concentrations in residential and industrial areas to be evaluated and to measure concentrations both upwind and downwind of the cities.

2. To begin operation of the PM_{10} monitors, both cities need to be supplied with quartz fiber filters that have been conditioned, labeled and stored according to established protocols. In addition, operating manuals, standard operating procedures, data quality objectives, log books, calibration kits, and a variety of auxiliary equipment are also needed. Access to the existing monitoring stations needs to be improved. Additionally, facilities for calibrating and maintaining equipment and meteorological monitoring stations are needed in each city.

The level of training provided to operating personnel by the National Institute of Ecology is adequate, although Ciudad Acuña should identify and train a second operator as a back up to the first operator. The number of trained operators in Piedras Negras (i.e., two) is adequate.

3. As a second priority, it is recommended that both cities monitor SO_2, lead, and possibly ozone at the same locations as the PM_{10} monitors, which will require purchasing monitors and associated equipment and training operators. (An alternative lead monitor location is discussed in the report.) While additional operators would not be required to operate this equipment, the total amount of time both operators devote daily to operating and maintaining the network and to analyzing data would increase, possibly to as much as 8 hours per day. The monitoring of SO_2 is important due to the proximity of the Carbon I and II electric power plants. The monitoring of lead is important due to the presence of many older automobiles not having emissions controls and the potential use of unleaded gasoline. (Lead emissions may also be associated with local steel mill and trash dump burning operations.) The monitoring of ozone, while not a crucial need, is desirable due to the presence of ozone precursors (i.e., nitrogen oxides from the power plants and volatile organic compounds from local factories). An existing SO_2 monitor and data logger in Piedras Negras need repair and associated supplies.

4. The State of Coahuila can play an important role in ensuring successful operation of the air monitoring networks in Ciudad Acuña and Piedras Negras. In particular, it is recommended that Coahuila establish a comprehensive quality assurance oversight program and provide periodic operator training. There may also be some advantage to having Coahuila coordinate the purchase, preparation, and handling of all monitoring supplies and equipment and the conditioning and analysis of particulate filters. Finally, it is recommended that Coahuila be responsible for all coordination with the National Institute of Ecology in Mexico City. These oversight activities could be conducted by a state air quality coordinator.

1.0 INTRODUCTION

The Cities of Ciudad Acuña and Piedras Negras and the State of Coahuila in Mexico are interested in improving ambient air quality monitoring capabilities in the two cities through the establishment of a network of ambient air monitors. The purpose of the networks is to characterize population exposure to potentially harmful air contaminants, possibly including sulfur dioxide (SO_2), nitrogen oxides (NO_x), ozone (O_3), carbon monoxide (CO), total suspended particulate matter (TSP), particulate matter with aerodynamic diameter less than 10 µm (PM_{10}), and lead. The networks are not intended to assess other ambient air quality issues, such as toxic air contaminant concentrations or regional transport phenomena.

This report presents the results of an evaluation of existing air quality monitoring equipment and facilities in Ciudad Acuña and Piedras Negras. Additionally, the report presents recommendations for developing an air quality monitoring network for PM_{10}, SO_2, lead, and ozone in these cities, using a combination of both new and existing equipment. The human resources currently available and ultimately needed to operate and maintain the network are also discussed.

The report presents background information on the study in Section 2, a discussion of criteria used to select potential monitoring station locations and equipment in Section 3, site visit approach and observations in Section 4, and recommendations in Section 5. Additionally, the Appendix contains information used in support of the study.

2.0 BACKGROUND

The Mexico-U.S. border region is typically defined as the region within 100 km of either side of the 3,200 km international boundary between Mexico and the United States. Fourteen pairs of twin Mexican/U.S. cities share common airsheds along the border region. Ciudad Acuña and Piedras Negras are both located within this border region.

Formal cooperation between Mexican and U.S. environmental authorities was established in 1983 with the La Paz Agreement. In 1992, the Integrated Environmental Plan for the Mexican-U.S. border area (IBEP) established goals for border environmental quality, and a follow-up agreement addressing long range plans for border environmental quality is currently being developed.

The remainder of this section provides a brief description of Mexican and U.S. regulatory authorities, characteristics of Ciudad Acuña and Piedras Negras, a review of historical air quality data, the study approach, and the site visit itinerary.

2.1 MEXICAN AND U.S. REGULATORY AUTHORITIES

Environmental protection and restoration in Mexico has been mandated by constitutional provisions under a General Law of Ecological Equilibrium and Environmental Protection. The law is implemented following six titles, as follows: Title I-General Provisions, Title II-Protected Natural Areas, Title III-Rational Use of Natural Elements, Title IV-Environmental Protection, Title V-Public Participation, and Title VI-Measures for Control, Safety, and Sanctions.

Title I-General Provisions regulates authority among local, state, and federal governments. The *Secretaria* de Desarrollo Social (SEDESOL) has been charged with responsibility for federal environmental enforcement as of May 25, 1992. Two main agencies constitute SEDESOL: (1) the Instituto Nacional de Ecologia (INE), which is responsible for establishing environmental policy and administering regulations and (2) the Procuraduria Federal de Proteccion al Ambiente, which is responsible for enforcing environmental regulations.

Title IV-Environmental Protection regulates seven general categories of environmental protection. Air pollution is covered in the first category, which prescribes the control of air pollution and the classification of static and dynamic emission sources. State and local governments have jurisdiction over air emissions, and regulations governing air pollution control require industries planning to release emissions to the atmosphere to obtain an operational license. The development of air quality standards is under the authorization of the Federal Law of Measurement and Standards, dated July 1, 1992. INE's Bureau of Environmental Standards develops air quality standards and provides regulatory guidance for the sampling and analytical methodology necessary to carry out air monitoring.

The U. S. Environmental Protection Agency (EPA), under authorization of the Clean Air Act and its amendments, has promulgated primary and secondary national ambient air quality standards (NAAQS). (Whereas primary standards are intended to provide for the immediate protection of public health, secondary standards provide for public welfare.) Primary standards for the United States are presented in Table 2-1 and compared with the similar Mexican standards.

Air quality monitoring data in the United States are used to determine if an area attains the NAAQS and to evaluate air pollution control strategies. Consequently, the NAAQS and associated ambient air monitoring networks provide a means of assessing and evaluating compliance with regulatory limits within a defined geographical area. Reference methods have been prescribed to monitor NAAQS pollutants using uniform sampling and analytical techniques. Table 2-2 identifies the reference and equivalent methods for the six NAAQS pollutants listed in Table 2-1.

2.2 CHARACTERISTICS OF CIUDAD ACUÑA AND PIEDRAS NEGRAS

Characteristics of Ciudad Acuña and Piedras Negras are sumarizes in Table 2-3. Both cities cities are moderatelly sized, and while neither city has any large industries, both have a number of small - to medium -sized factories and shops. Additionally, both cities are subject

TABLE 2-1. COMPARISON OF PRIMARY AMBIENT AIR QUALITY STANDARDS BETWEEN MEXICO AND THE U.S.

	Mexico		United States	
Pollutant	Standard	Average	Standard	Average
PM_{10}	150 g/m^3	24 hr	150 g/m^3	24 hr
	50 g/m^3	Annual arithmetic mean	50 g/m^3	Annual arithmetic mean
TSP	260 g/m^3	24 hr	--	--
	75 g/m^3	Annual arithmetic mean	--	--
SO_2	0.13 ppm	24 hr	0.14 ppm	24 hr
	0.03	Annual arithmetic mean	0.03 ppm	Annual arithmetic mean
O_3	0.11 ppm	1 hr	0.12 ppm	1 hr
NO_2	0.21 ppm	1 hr	0.25 ppm	1 hr
	--	--	0.053 ppm	Annual arithmetic mean
CO	11 ppm	8 hr	9 ppm	8 hr
	--	--	35 ppm	1 hr
Pb	1.5 g/m^3	3 month	1.5 g/m^3	3 month

TABLE 2-2. U.S. REFERENCE AND EQUIVALENT METHODS

Pollutant	Method
TSP	High-volume sampler (manual)
PM_{10}	High-volume sampler (manual)
	Beta-gauge microbalances (automated)
Lead	High-volume sampler with atomic absorption (manual)
SO_2	Pararosaniline method (manual)
	Fluorescence spectroscopy (automated)
O_3	Chemiluminescence with ethylene (automated)
NO_2	Chemiluminescence with ozone (automated)
CO	Nondispersive infrared spectroscopy (automated)

TABLE 2-3. CHARACTERISTICS OF CIUDAD ACUÑA AND PIEDRAS NEGRAS

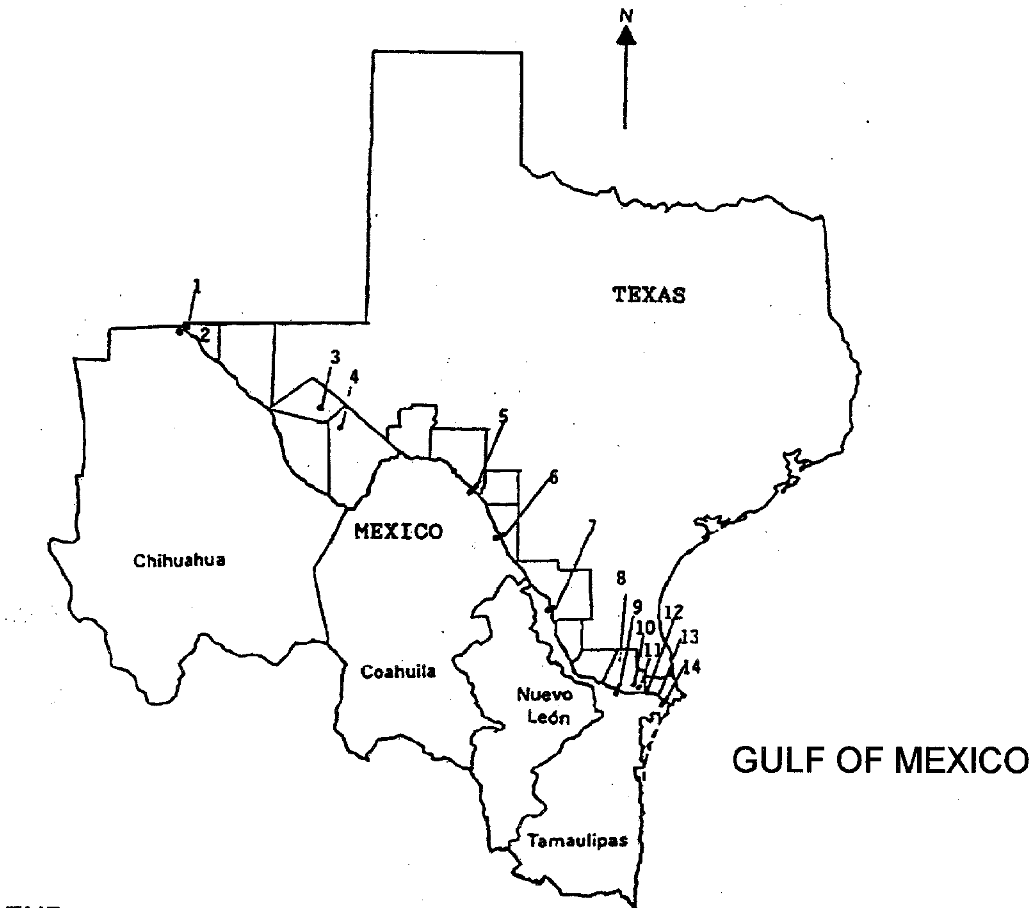
City	Ciudad Acuña	Piedras Negras
Location	In the State of Coahuila, near the U.S. border, about 2 km south of Del Rio, Texas	In the State of Coahuila, near the U.S. border, about 5 km south of Eagle Pass, Texas
Population	87,000	98,185
Industry	Automobile wiring, seat covers, water bottling, and fishing lures	Recycling steel mill, small motor manufacturing, electrical components
Major sources and pollutants	No major sources; however, a number of smaller industries are believed to emit VOC's; considerable fugitive dust from unpaved roads and dry lands surrounding the city; local dump burns trash and tires	Steel recycling mill with large storage piles; large electric utility power plants located 30 km south of the city; considerable fugitive dust from unpaved roads and dry lands surrounding the city
Prevailing winds	Generally from the S to ESE; occasionally from the N to NNE; winds are calm about 8% of the time	Generally from the S to ESE; occasionally from the N to NNE; winds are calm about 8% of the time; winds reportedly from the SE at night
Land Use	Housing: 53% Industry: 22% Agriculture: 21% Roads: 4%	Housing: 50% Industry: 7% Agriculture: 16% Roads: 13% Other: 14%
Other facts	Area: 26 km^2 (10 mi^2) Avg. temp.: 21.5 C (71 F) Avg. rainfall per month: 51.5 mm (2") Elevation: 220 meters No. of vehicles: 12,000	Area: 36 km^2 (14 mi^2) Avg. temp.: 21.5 C (71 F) Avg. rainfall per month: 51.5 mm (2") Elevation: 250 meters No. of vehicles: 20,000

to periodic episodes of wind-blown dust, originating from unpaved roads and dry lands surrounding the cities.

Both cities contain numerous “Maquillas, otherwise known as Maqilladoras,” or “Twin Plants.” These industrial facilities were originally established by the Mexican government in 1966 under the Border Industrialization Program. This program was commissioned in Mexico to assist in providing employment for Mexican workers along the U.S. border, thereby alleviating the unemployment resulting from termination of the Bracero Program and international competition from Asian manufacturing. In the early 1980's, the Mexican government provided special economic opportunities and incentives for foreign companies to establish facilities along the Mexico-U.S. Border region; Ciudad Acuña and Piedras Negras participated in this program.

The total number of foreign owned plants in the region grew steadily from the early 1980's to an estimated 2,000 facilities by 1996 in the States of Chihuahua, Coahuila, Nuevo Leon, and Tamaulipas, as illustrated in Figure 2-1. Maquila activities are as diverse as the two countries that participate in the program, ranging from assembly of finished products to the production of feedstocks and parts for the automobile industry. As illustrated in Figure 2-2, over 30 percent of the facilities assemble, rebuild, or construct materials associated with electronic components. These facilities have the potential to emit a wide range of substances, both organic and inorganic, that can affect air quality locally as well as regionally. Table 2-4 lists the major Maquilas with employment greater than 100 workers and their associated air pollutant category for both Ciudad Acuña and Piedras Negras. Sources of emissions for the two cities are summarized below, by pollutant type.

SO_2. Results largely from coal and oil combustion sources, refineries, pulp and paper mills, and nonferrous smelters. Ciudad Acuña and Piedras Negras lack major stationary emission points as sources of SO_2. Additionally, home heating is minimum, with few combustion furnaces. The only major SO_2 point sources in the region are the Carbon I and II power plants. Carbon I and II comprise a complex of coal-fired electric generating stations approximately 30 km south of Piedras Negras on Highway 57. These power plants are considered "mine-mouth" operations because they are located at the site of Mexico's only known commercial coal deposits. Carbon I, a 1,200 megawatt (Mw) power plant consisting



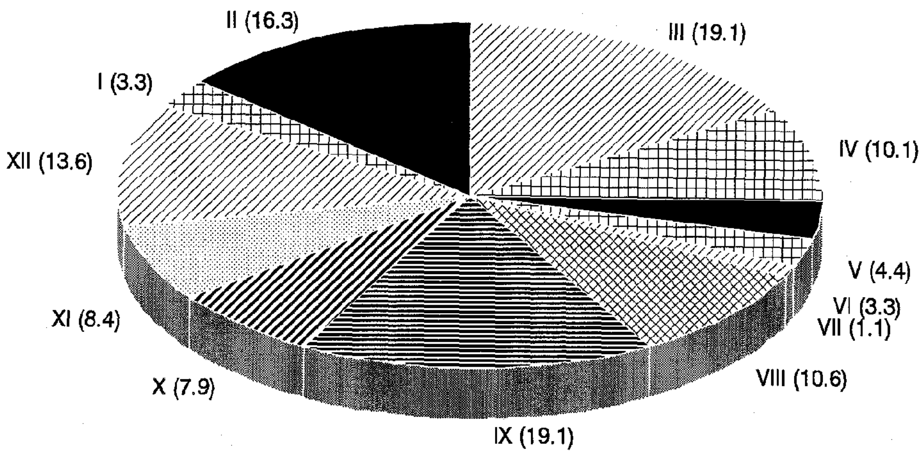
LEGEND:

1. El paso (City)/Juarez
2. El Paso (County)
3. Fort Davis
4. Alpine
5. Del Rio/Acuna
6. Eagle Pass/Piedras Negras
7. Laredo/Nuevo Laredo
8. Hidalgo County
9. McAllen/Reynosa
10. Weslaco
11. Santa Maria
12. Harlingen
13. San Benito
14. Brownsfille/Matamoros

Figure 2-1. Mexican states and cities containing Maquilas along the Texas/Mexican border.

Categories of Maquilas on the Texas-Mexico Border

CATEGORY (% of facilities)



I. Electronic material accessories
II. Assembly of electrical electronic machinery, equipment, & goods
III. Construction, rebuilding, assembly of transport equipment and accessories
IV. Textiles and wearing apparel
V. Assembly of metalic & wooden furniture accessories
VI. Services
VII. Toys and sporting goods
VIII. Assembly of equipment tools and parts (non-electrical)
IX. Shoes and leather goods
X. Food processing
XI. Chemical products
XII. Other manufacturing and assembly products

Figure 2-2. Categories of Maquilas along the Texas/Mexican border.

TABLE 2-4. MAQUILAS IN CIUDAD ACUÑA AND PIEDRAS NEGRAS

Industry	Product	Potential air pollutants
CIUDAD ACUÑA/DEL RIO		
1. A.D. Smith Electrical	Hermetic motors	VOCs
2. ALCOA Fujikura	Wiess harnesses	VOCs
3. Allied Signal Automotive	Compressors, dryers	VOCs
4. Border Opportunity Saver Systems	Diapers, cotton balls	PM_{10}/VOCs
5. Carolina Coupon	Commercial coupons	VOCs
6. Douglas & Lomason	Automotive seat covers	VOCs
7. Eagle Picher Construction	Welded steel parts	PM_{10}/VOCs
8. Gateway Safety Systems	Seatbelts	PM_{10}/VOCs
9. General Electric	Wiring devices	VOCs
10. Irvin Automotive Products	Trim products	VOCs
11. N.S.C. Electronics	Test equipment	VOCs
12. SAS of Del Rio	Shoes	VOCs
13. Sunbeam Products	Blenders	VOCs
PIEDRAS NEGRAS/EAGLE PASS		
1. Alamo Lumber	Building materials	PM_{10}
2. Eagle Broom	Brooms	PM_{10}
3. Maverick Arms	Pump shotguns	VOCs
4. Newell Recycling	Metal recycling	PM_{10}
5. Texas Apparel	Work apparel	PM_{10}
6. Williamson-Dickie Company	Jeans	VOCs/PM_{10}

of four separate 300 Mw units, has been generating electricity since the early 1980's, with the fourth unit coming on line in late 1986. Carbon II is a 1,400 Mw plant consisting of four 350 Mw units, with only two of the four units currently on-line. Carbon I and II represent approximately 9 percent of Mexico's power generating capacity, with a total coal consumption of 8 million tons annually. Both plants have particulate emission control devices on the operating units, but lack SO_2 emission controls. Prevailing winds in the region from the southeast have the potential to transport Carbon I and II SO_2 emissions in the general direction of Ciudad Acuña and Piedras Negras.

CO. A colorless, odorless, and toxic gas produced by incomplete burning of carbon in fuels. Nearly two-thirds of all emissions of CO are from transportation sources. Consequently, the highest concentrations often occur along busy roads. Ciudad Acuña and Piedras Negras have a number of automobiles operating in relatively small geographical areas. Also, many of the automobiles are older models that are generally less efficient combustors, thereby creating greater CO emissions than new models.

NO_x. Emitted almost entirely from fuel combustion sources; only a limited number of industrial processes emit NO_x. A small fraction of total NO_x emissions consist of NO_2, and most of the NO_2 found in the atmosphere results from atmospheric oxidation of NO to NO_2. (When ozone is present, the oxidation of NO to NO_2 proceeds rapidly.) Major NO_x sources are not present in either Ciudad Acuña or Piedras Negras. However, NO_x transport into the cities from the Carbon I and II plants is a possibility.

O_3. Not directly emitted into the atmosphere, but results from a complex photochemical reaction involving organic compounds, NO_x, and sunlight. The buildup of ozone oxidants tends to be rather slow and occurs over relatively large areas. Peak ozone concentrations normally occur several kilometers downwind of industrial areas. Ozone concentrations are expected to be relatively low within the city limits of both Ciudad Acuña and Piedras Negras due to constant winds, low NO_x emissions, and the occurrence of organic compound emissions from manufacturing facilities generally sited near city perimeters. While ozone may be present in the two cities, no ozone monitoring data currently exist.

TSP/PM$_{10}$. Particulate matter is a broad class of airborne liquid and solid substances that varies greatly in chemical and physical properties. There are two distinct types of particulate emissions: coarse and fine particles. Coarse particles (2.5 microns to 10 microns in diameter) generally make up most of the total particulate mass and include particles formed by anthropogenic processes and reentrained surface dust. Fine particles (less than 2.5 microns) usually result from combustion processes, including the condensation and atmospheric transformation of exhaust gases to particles. Pollutants that contribute to fine particle formation include sulfates, nitrates, condensable organics, ammonium, and lead. Because Ciudad Acuña and Piedras Negras are located in dry areas with minimal rainfall, wind-entrained dust can be problem. Local industries and automobiles also contribute to particulate concentrations in the atmosphere.

Pb. A major source of lead is the use of unleaded gasoline in automobiles. Unleaded gasoline has been phased out in Piedras Negras, but may still be used in Ciudad Acuña. Industrial sources of lead also may be present in the two cities (e.g., the burning of city dump trash in Ciudad Acuña and a steel recycling mill in Piedras Negras), although emissions from these sources may be minor.

2.3 REVIEW OF HISTORICAL AIR QUALITY DATA

Various ambient air monitoring studies have been conducted over the past 25 years in both Ciudad Acuña and Piedras Negras, although the majority of the data have been validated only during the last 17 years. Sources for these data include the Texas Natural Resource Conservation Commission (TNRCC), the El Paso City-County Health Department, the State Government of Coahuila, and the EPA.

The first ambient air monitoring performed along the boarder was conducted by the U.S. Public Health Service (PHS), starting in 1954, as part of their National Air Sampling Network. In 1957, the El Paso City-County Health Department began monitoring for TSP, and later in 1957, the TNRCC (then called Texas Air Control Board) began a sampling program along its 1,600 km boarder. Most collected data involve monitoring for TSP and metals and continuous monitoring for SO_2. However, as identified in Table 2-5, other analytes also have been monitored in close proximity to Ciudad Acuña and Piedras Negras over the past 25 years using a variety of methodologies. The quality of these data varies from excellent for

TSP to fair for SO_2. Early data suffered from lack of quality control procedures, which where not initiated until the mid-70's.

TABLE 2-5. AMBIENT AIR MONITORING IN CLOSE PROXIMITY TO ACUÑA AND PIEDRAS NEGRAS, YEAR

Ambient Air Monitoring Location	Pollutant				
	TSP	$SO_4^{=}$	NO_3^{-}	Pb	Other, Including Metals
	Year				
1. Del Rio, TX (near Ciudad Acuña)	1975-1984	1975	1975	1975-1984	1975-1984
2. Eagle Pass, TX (near Piedras Negras)	1971-1984	1973-1976	1973-1976	1973-1976	1973-1976

As identified in Table 2-6, monitoring often involved TSP evaluation with subsequent analysis for metals and nonmetals captured on the high volume filter. However, review of the data indicates that, except for Pb, metals were generally not detected during the monitoring periods identified in Table 2-5.

TABLE 2-6. ANALYSIS OF HIGH-VOLUME FILTER FOR NONMETALS AND METALS

Nonmetals
• TSP, SO_4, NO_3, benzene soluble organics (BSO)
Metals
• NAAQS Metal: Pb • Other Priority Metals: As, Cd, Cr • Intermediate Metals: Co, Hg, Mn, Ni, Sb, Sn • Rare Earth Metals: Be, La, Sr, V, Co, Mo, Ti, Ge, Rb, Tl • Naturally Occurring Metals: Al, Cu, Ba, Si, Fe, Se, Br, I, Ca, K, Zn, Cl, P

Figures 2-3 and 2-4 illustrate lead concentrations for Ciudad Acuña and Piedras Negras, respectively, for the 1976-77 monitoring period. The Mexico air quality standard for lead is 1.5 micrograms per cubic meter for a 3-month average. With respect to TSP

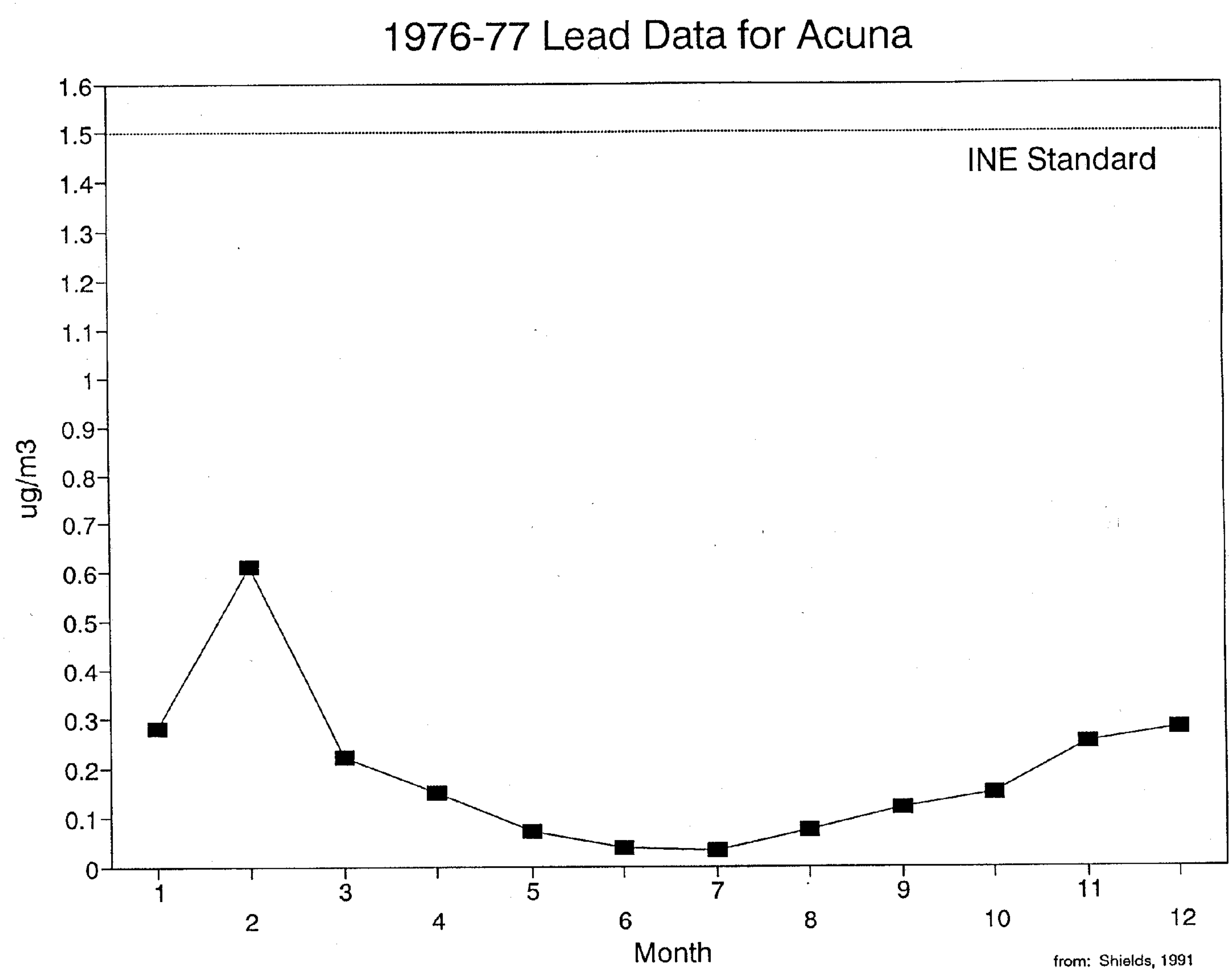


Figure 2-3. Typical lead concentrations for Ciudad Acuña.

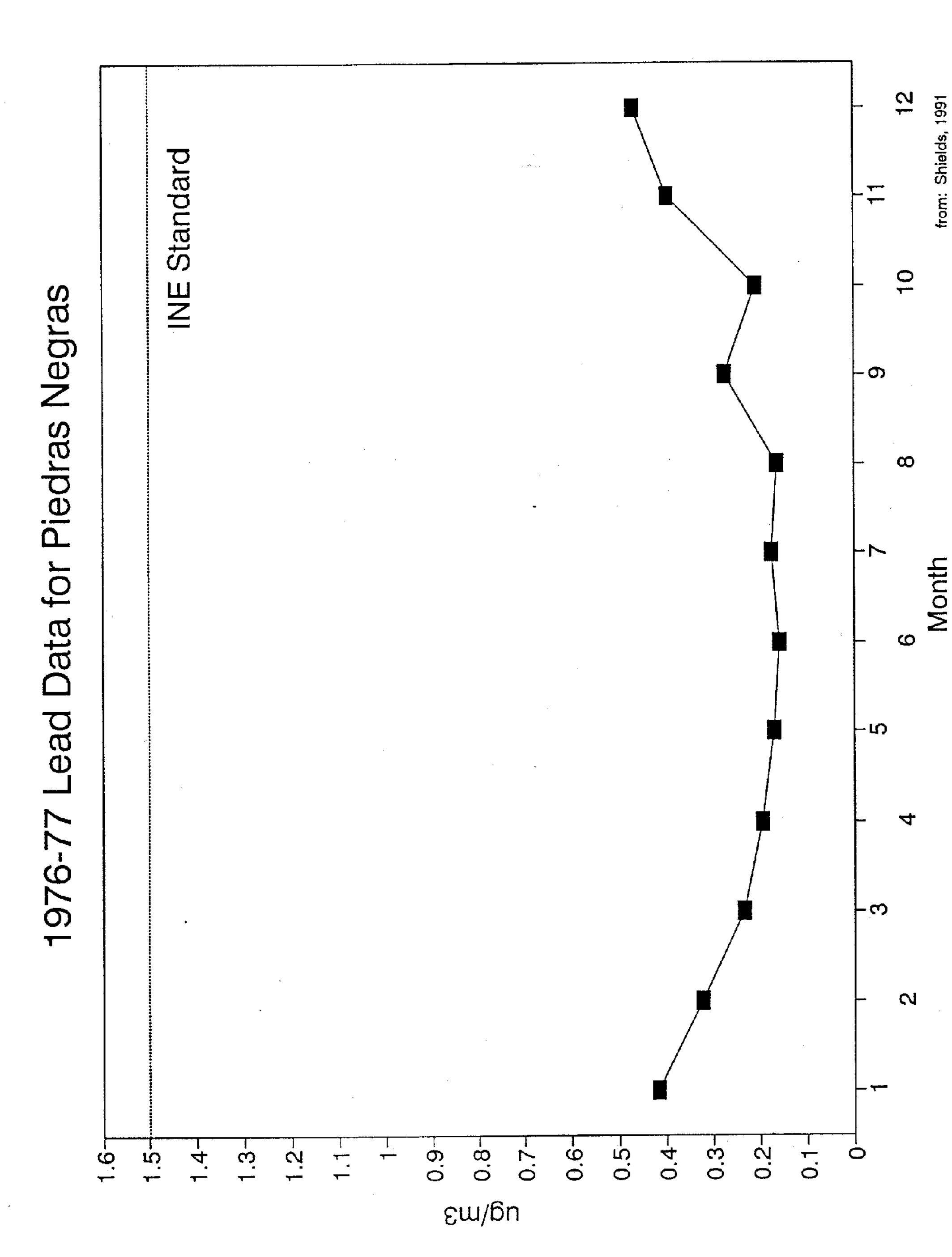


Figure 2-4. Typical lead concentrations for Piedras Negras.

concentrations, Figures 2-5 and 2-6 illustrate a 10-year period of monitoring in Ciudad Acuña and Piedras Negras. The national TSP standard for that period was 75 micrograms per cubic meter based on an annual geometric mean and 150 micrograms per cubic meter based on a maximum 24-hour concentration, not to be exceeded more than once per year.

Both Ciudad Acuña and Piedras Negras are located near the southwest Texas border. Elevations are near 220 to 250 meters, the climate is semi-arid continental, and annual precipitation is insufficient for dry farming, averaging 19.6 inches per year. Over 80 percent of the average annual precipitation occurs from April through October. During this period, rainfall is chiefly in the form of showers and thunderstorms. The small amount of precipitation occurring in November through March usually falls as steady light rain.

Temperature averages indicate mild winters and hot summers. Cold periods in winter are ushered in by strong, dry, dusty north and northwest winds known as northers. During the summer, winds are generally out of the southeast, as illustrated by the windrose in Appendix A for San Antonio, Texas, for 1992 and wind data from Del Rio, Texas, from 1969 to 1984. Hot weather persists from late May to mid-September, and temperatures above 100 F (38 C) have been recorded as early as March and as late as October. The mean early-morning humidity is about 79 percent, and the mean afternoon humidity is near 44 percent. Clear to partly cloudy skies predominate, and even during the more cloudy winter months, the mean number of cloudy days is less than the mean number of clear days.

2.4 STUDY APPROACH

The first step in conducting the study was to review available information about the two cities, including maps, emission inventories, and meteorological and air quality data. Based on this initial review, preliminary decisions were made about potential monitor locations.

The second step was to review all relevant technical references for information regarding the procedures and criteria for selecting monitor locations for the pollutants of interest. As part of this review, three checklists were prepared to help evaluate facilities and

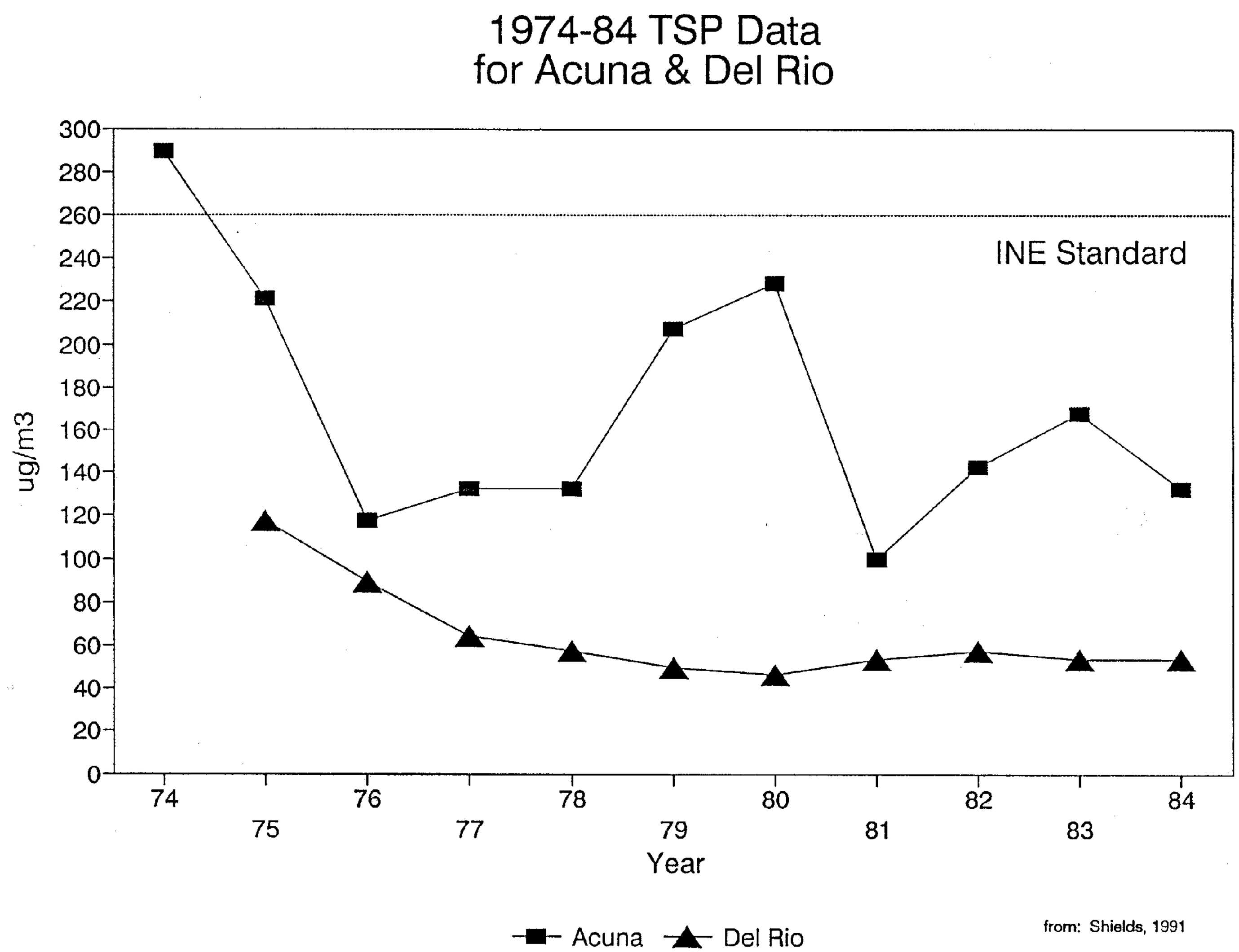


Figure 2-5. TSP concentrations for monitoring period 1974-84 for **Ciudad Acuña** and **Del Rio**.

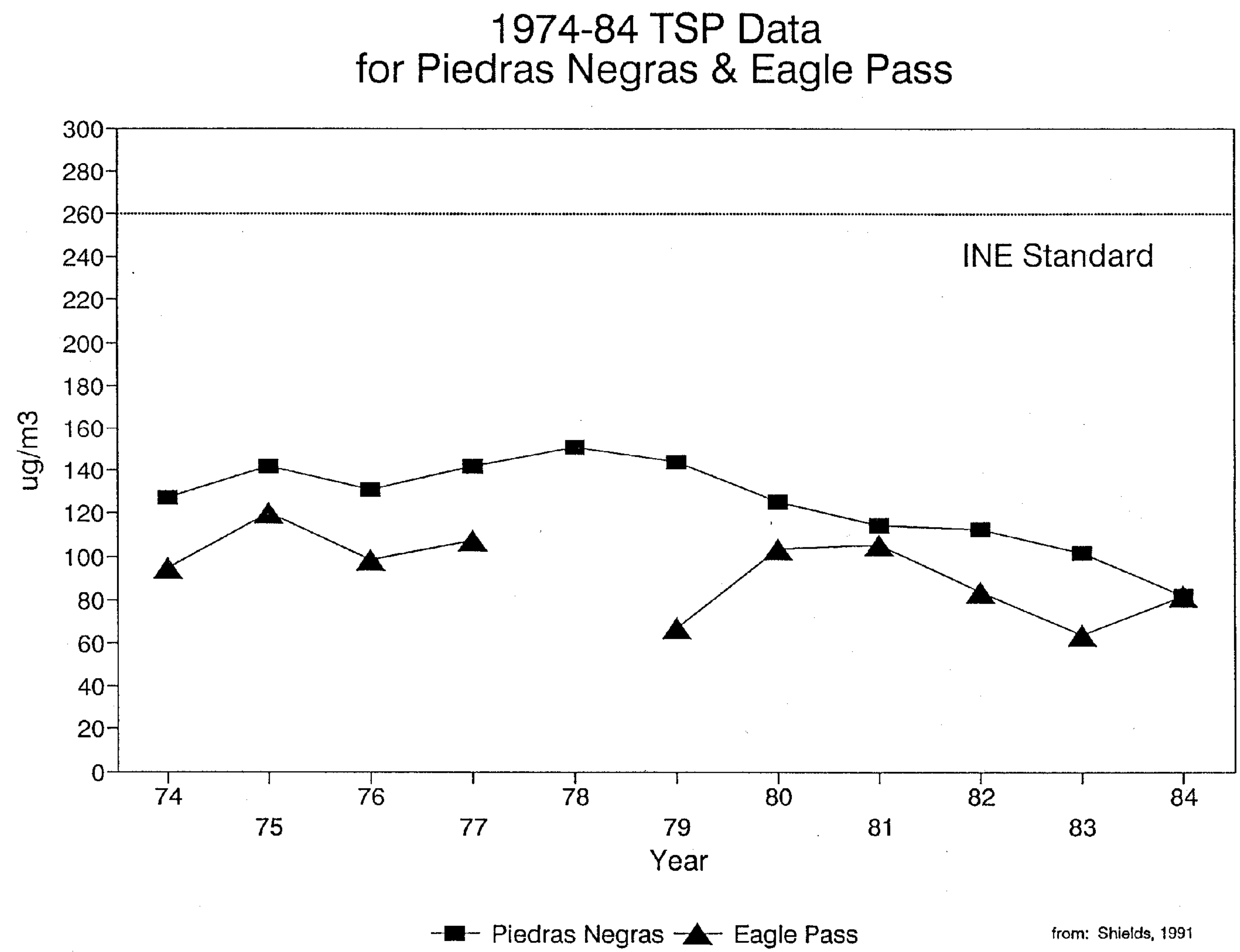


Figure 2-6. TSP concentrations for monitoring period 1974-84 for Piedras Negras and Eagle Pass.

equipment, assess the availability of the human resources required to operate and maintain a monitoring network, and guide the evaluation of specific candidate monitor locations.

Finally, a 5-day site visit to Ciudad Acuña and Piedras Negras was conducted by two senior air quality specialists. The purpose of the site visit was to evaluate existing equipment and procedures, assess human resource needs, and develop recommendations for improving existing monitoring stations and the siting of new stations. During the visit, considerable time was spent meeting with local officials; studying topographical, meteorological, and population data; evaluating existing equipment; and touring existing and potential monitoring sites. Detailed discussions were held with local officials regarding their air monitoring needs and associated human resource requirements.

Upon returning from Ciudad Acuña and Piedras Negras, the recommendations presented in Section 5.0 were developed for improving existing equipment and procedures and for establishing the air quality monitoring networks. In developing these recommendations, the authors were guided by the following objectives:

- Existing equipment and monitor locations should be used to the extent practicable.
- The purchase of new equipment, although probably necessary, should be limited.
- Only those pollutants believed to contribute to air quality degradation need be monitored.
- The level of training and availability of staff for operating and maintaining the networks and analyzing data need to be considered.

Based upon these considerations, recommendations were formulated that allow for the assessment of air quality within the cities while minimizing any unnecessary costs.

2.5 SITE VISIT ITINERARY

The site visit was conducted from June 17 through 21, 1996, by two air quality monitoring specialists from Midwest Research Institute (MRI): Messers. Lance Henning and Jerry Winberry. The itinerary for the visit is summarized in Table 2-7, and a list of Mexican officials participating in the study, including their addresses and telephone numbers, is provided in Appendix B.

Messrs. Henning and Winberry first traveled to Ciudad Acuña, where they met with officials from the City and the State of Coahuila. Additionally, they were accompanied

TABLE 2-7. ITINERARY FOR SITE VISIT

Date	Activity
June 17 (Monday)	• Noon arrival at Del Rio, Texas, airport • Meeting with representatives of Coahuila and Ciudad Acuña at airport; drive over border to Ciudad Acuña • Tour of Ciudad Acuña and investigation of potential monitoring sites
June 18 (Tuesday)	• Meeting with Ciudad Acuña administrative officials and technical staff • Acquire additional data associated with emission inventories, meteorological and topographical information, and human resources • Continue investigation of potential monitoring sites
June 19 (Wednesday)	• Morning: Conclusion of survey of potential Ciudad Acuña monitoring sites and travel to Piedras Negras • Afternoon: Meeting with Piedras Negras administrative and technical staff
June 20 (Thursday)	• Investigation of potential monitoring sites in Piedras Negras • Acquire additional data associated with emission inventories, meteorological and topographical information, and human resources
June 21 (Friday)	• Conclusion of potential monitoring sites survey in Piedras Negras • Return to Del Rio for mid-afternoon departure

during part of the trip by Ms. Maria Rodriguez of the TNRCC. Over the 2½-day period in Ciudad Acuña, Messrs. Henning and Winberry conducted several meetings, visited two existing PM_{10} monitoring sites, inspected two uninstalled PM_{10} monitors and meteorological equipment, and visited potential sites for locating additional monitors. Additionally, they met with the Mayor to discuss the objectives of the study.

During the remainder of the week, Messrs. Henning and Winberry traveled to Piedras Negras, where they met with the Mayor and other officials from the City and the State of Coahuila and Ms. Rodriguez of the TNRCC. Activities included visits to four existing PM_{10} monitoring sites, inspection of a data logger and SO_2 monitor, and review of a recent government report containing particulate monitoring data and an emissions inventory for the city.

3.0 CRITERIA FOR DESIGNING AIR MONITORING NETWORK

3.1 INTRODUCTION

Before decisions could be made regarding recommended monitoring station locations, it was necessary to develop a clear understanding among all parties of the purpose of the network. The primary objectives for establishing air quality monitoring networks in the cities of Piedras Negras and Ciudad Acuña were to *characterize urban air contaminant concentration*, and to do so in a *cost-effective manner*, using available monitoring equipment to the extent practicable. The data collected by the networks will be useful for assessing exposure levels for residents and workers, trends in city-wide air quality, and the effectiveness of any future air pollution control strategies.

It is important to note that the air monitoring networks are not intended to characterize localized neighborhood concentrations, concentrations in close proximity to major point-sources, mobile source impacts, urban plumes, regional concentrations, air toxics, or ozone precursor concentrations, or to define the extent to which urban concentrations can be attributed to regional transport phenomena. However, depending on the locations ultimately selected for siting the monitoring stations, some characterization of the above phenomena may still be feasible.

3.2 SITE SELECTION CRITERIA

Once the purpose of the networks was defined, the next step was to develop the general criteria for siting the monitors. Although final locations necessarily depend upon observations made during the site visit, priorities for monitor siting were determined beforehand to serve as guidance during the site visit.

Selecting the appropriate site is one of the most important tasks associated with monitoring network design, as it must be the most representative location to monitor air quality conditions. General siting requirements are identified in Appendix D of the U.S. Code of Federal Regulations (40 CFR 58). These requirements help classify sites by their intended objective and spacial scale of representativeness. More specific guidelines are delineated in the following EPA documents:

- *Site Selection for the Monitoring of Photochemical Air Pollutants*, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, EPA-600/7-88-022.

- *Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD)*, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, EPA-450/2-77-010.

- *Network Design and Optimum Site Exposure Criteria for Particulate Matter*, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, 1983.

- *Network Design for State and Local Air Monitoring Stations (SLAMS) and National Air Monitoring Stations (NAMS)*, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, Code of Federal Regulations, Title 40, Part 58, Appendix D, 1990.

- *Network Design and Site Exposure Criteria for Nonmethane Organic Hydrocarbons*, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, SYSAPP-89/138, 1989.

The basis for monitor site selection is to match each site-specific monitoring objective to an appropriate scale of spatial representation and then to choose a monitoring location that is characteristic of that spatial scale. Six spatial scales are commonly applied to siting air pollution monitoring systems: microscale, middle scale, neighborhood scale, urban scale, regional scale, and global scale. To better understand the spatial scale setting and its relationship to network design, a brief description of each of the scales is provided below.

- **Microscale Scale.** Ambient air volumes with dimensions ranging from several meters to approximately 100 meters are associated with this scale (e.g., ozone, CO, and NO_x). For gaseous monitors, this scale is used to evaluate the distribution of the gas within the plume either over flat or complex terrain or within building wake cavities. For total suspended particulate (TSP) and PM_{10} monitoring, this scale is used to characterize emissions from close proximity point sources. This type of scale might also be used to define health effects for certain individuals, such as policemen, who remain near a fixed location for extended periods.

- **Middle Scale**. This scale represents dimensions from about 100 meters to 0.5 kilometers and characterizes air quality in areas up to several city blocks in size. Some data uses associated with middle scale measurements for both gaseous and TSP/PM_{10} include assessing the effects of control strategies to reduce urban concentrations and monitoring air pollution episodes.

- **Neighborhood Scale.** Neighborhood scale measurements characterize conditions over areas with dimensions of 0.5 km to 4 km. This scale applies in areas where the gaseous and TSP/PM_{10} concentration gradient is relatively flat (i.e., mainly suburban areas surrounding the urban center) and in large sections of small cities and towns. In general, these areas are homogeneous in terms of concentration profile. Neighborhood scale measurements may be associated with baseline concentrations in areas of projected growth and in studies of population responses to exposure to pollutants (i.e., health effects). Also, concentration maxima associated with air pollution episodes may be reasonably uniformly distributed over areas of neighborhood scale, and measurements taken within such areas represent neighborhood as well as middle scale concentrations. Finally, this scale is used for interneighborhood comparisons within or between cities. This scale also meets most of the objectives of city and regional planners and decision-makers.

- **Urban Scale.** Urban scale measurements characterize conditions over an entire metropolitan area. Such measurements are useful for assessing trends in city-wide air quality, and hence, the effectiveness of larger-scale pollution control strategies. Measurements that represent city-wide areas also serve as a valid basis for comparisons among different cities.

- **Regional Scale.** Conditions over areas with dimensions of as much as hundreds of kilometers are represented by regional scale measurements. These measurements are applicable mainly to large homogeneous areas, particularly those sparsely populated. Such measurements provide information on background air quality and interregional pollution transport.

- **Global Scale.** This measurement scale represents concentrations characterizing the globe as a whole. Such data are useful in determining pollutant trends, studying international and global transport processes, and assessing the effects of control policies on global scale. With any monitoring network design, each spatial scale is designed to meet specific monitoring objectives.

The specific objectives for most air monitoring network designs are to determine (1) the highest concentrations expected to occur in the area covered by the network, (2) the representative concentrations in areas of high population density, (3) the impact on ambient pollutant levels of significant sources or source categories, and (4) the general background concentration levels. The goal in siting air monitoring stations is to correctly match the spatial scale most appropriate for the monitoring objective of that station. Table 3-1 illustrates the relationship between these four basic monitoring objectives and the scales of representativeness that are generally most appropriate for that objective.

TABLE 3-1. RELATIONSHIPS AMONG MONITORING OBJECTIVES AND SCALES OF REPRESENTATIVENESS

Monitoring Objective	Appropriate Siting Scales
Highest Concentration	Micro, Middle, and Neighborhood (sometimes Urban)
Population	Neighborhood, Urban
Source Impact	Micro, Middle, and Neighborhood
General Background .	Neighborhood

3.3 PROBE PLACEMENT CRITERIA

Once the monitoring objectives of the sites have been well defined, the placement of the monitors at the sites must be determined based on specific probe siting criteria. Guidelines are given in 40 CFR 58, Appendix E, for probe siting after the general station location has been selected. Adherence to the siting criteria is necessary to ensure the uniform collection of compatible and comparable air quality data. As summarized in Tables 3-2 and 3-3, the probe siting criteria address horizontal and vertical probe placement and spacing from obstructions, trees, and roadways. Tables 3-2 and 3-3 are specific to TSP/PM_{10} sampling. However, more general guidelines for all pollutants are summarized below.

- **Vertical and Horizontal Probe Placement.** The height of the inlet probe or monitor should be as close as possible to the breathing zone and 3 to 15 meters above ground level. A minimum separation distance of 2 meters between the inlet probe or monitor and any walls, parapets, penthouses, etc. is required for probes located on roofs or other structures. In addition, probes or monitors should be located far from any furnace or incineration flues.

TABLE 3-2. MINIMUM TSP/PM_{10} SAMPLER SITING CRITERIA

Scale	Height Above Ground, meters	Distance From Supporting Structure, meters	
		Vertical	Horizontal[a]
Micro	2 to 7	--	>2
Middle, neighborhood, urban, and regional scale	2 to 15	--	>2

Other Spacing Criteria

1. Should be >20 meters from trees.
2. Distance from sampler to obstacle, such buildings, must be twice the height the obstacle protrudes above the sampler.
3. Must have unrestricted airflow 270   around the sampler inlet.
4. No furnace or incineration flues should be nearby.
5. Spacing from roads varies with traffic (see Table 3-3 and 40 CFR 58, Appendix E).
6. Sampler inlet should be at least 2 m but not greater than 4 m from any collocated PM_{10} sampler (see 40 CFR 58, Appendix A).

[a]When inlet is located on rooftop, this separation distance is in reference to walls, parapets, or penthouses located on the roof.

TABLE 3-3. MINIMUM SEPARATION BETWEEN ROADWAYS AND TSP/PM_{10} STATIONS

Average Daily Traffic (vehicles/day)	Minimum Separation Distance (meters)
<10,000	>10
15,000	20
20,000	30
40,000	50
70,000	100
>110,000	>250

- **Spacing from Obstructions.** The probe or monitor must be located away from obstacles and buildings such that the distance between any obstacle and the inlet probe or monitor is at least twice the height that the obstacle protrudes above the sampler. An unrestricted airflow in an arc of at least 270 must exist around the inlet probe or monitor. If the probe is located on the side of a building, a 180 clearance is required.

- **Spacing from Roads.** Motor vehicle emissions constitute a major source of particulate, lead, and volatile organics emissions. Therefore, a minimum separation distance between roadways and monitoring sites must be maintained so valid data can be acquired. Table 3-3 provides the required minimum separation distances from roadways for various traffic volumes when monitoring for TSP/PM_{10}. The minimum separation distance also must be maintained between the sampling station and other areas of automotive traffic, such as parking lots.

- **Spacing from Trees.** Trees can provide surfaces for adsorption and/or reactions and can affect normal wind flow patterns. To limit these effects, probe inlets or monitors should be placed at least 20 meters from the dripline of any trees.

Similar to pollutant monitors, meteorological stations collocated with particulate and/or gaseous monitors should be located so that the measurement data are representative of the meteorological conditions that affect pollutant transport and dispersion within the monitoring site area. Meteorological stations should meet the same siting criteria as the pollutant monitors and should be located away from the immediate influence of trees, buildings, steep slopes, ridges, cliffs, and hollows on wind patterns.

3.4 MONITOR LOCATION PRIORITY

Based on the guidelines in 40 CFR 58, Appendix D, the first priority for siting monitors in Ciudad Acuña and Piedras Negras was to locate at least one station in a *residential area*, where many individuals receive 24-hour exposure and where sensitive populations (e.g., children and the elderly) and schools are located. The second priority was to establish a monitoring station in an *industrial* and/or *business area*, where exposure levels are probably higher than in residential areas, but where worker exposure to these higher levels occur for fewer hours per day. The third priority was to locate a monitor near the *city center* to characterize combined emissions from all sources on a city-wide air quality basis. The final priority was to site a monitoring station *upwind* (i.e., in the southeast) of each city, thereby allowing background concentrations to be measured.

During the site visit, the above siting criteria were used in combination with other site-specific information to develop recommendations about specific monitoring sites. Background information related to factors such as climate, topography, and population distribution was evaluated. Additionally, to guide the collection and evaluation of site-specific information, a number of technical references on monitor siting and operation were reviewed, as identified in Section 3.2. Checklists were then prepared to facilitate the site inspections.

The first checklist was designed to assist in the evaluation of potential monitoring site locations by highlighting factors that are crucial to monitoring siting decisions, including:

- If the location will allow a representative sample to be collected, including average or typical concentrations in the areas of interest.
- If the site is subject to potential monitoring interferences or unusual micrometeorological conditions.
- If there is adequate road access, electric power, and accessibility to the monitors.
- If inlet orientation and placement criteria can be met with regard to separation from nearby obstacles and roadways, unrestricted airflow, distance above ground level and from tree driplines, distance above the instrument shelter, and ground elevation.
- If the site can be made secure from vandalism.

This checklist is presented in Figure 3-1.

The second checklist, presented in Figure 3-2, was designed to assist with inspection of the monitoring equipment and any laboratory facilities and to determine the availability of required equipment and materials. Example items include:

- Which instruments are in operating condition or require repair?
- Are operating instructions, calibration procedures, and associated monitoring supplies, materials, and equipment available?
- Is laboratory space available for equipment set-up, calibration, and maintenance? And if so, what supplies and facilities are included in the laboratory?

The third checklist (see Figure 3-3) was designed to assist with the assessment of personnel resources available to operate and maintain the equipment and analyze the data.

SITING CHECKLIST FOR AIR MONITORING STATIONS

- ☐ Measurements to be made at this site (NO_x, SO_2, O_3, CO, Pb, PM_{10}/2.5, meteorological parameters)

- ☐ Description of site (e.g., surface material, surrounding terrain, nearby obstructions, road access, and any unusual features)

- ☐ Is the general location representative of a priority exposure scenario? For example:

  - ☐ Residential areas, schools, sensitive populations
  - ☐ Business or industrial areas
  - ☐ Downwind location near city limits (especially for ozone measurements)
  - ☐ Upwind location near city limits (for background measurements)

- ☐ Is the site sufficiently distant from emissions sources having the potential to cause bias or interference? For example:

  - ☐ Point sources:

    - ☐ Manufacturing facilities
    - ☐ Refineries
    - ☐ Power plants
    - ☐ Other

  - ☐ Area sources:

    - ☐ Fugitive dust
    - ☐ Agricultural chemical application
    - ☐ Roadways

      (criteria for locating monitors away from roadways is attached; also see Table 3-3).

Figure 3-1. (continued)

☐ Is there any reason to believe that unusual micrometeorological conditions could bias results (especially for particulates)?

☐ Is the site appropriate for determining average or typical concentration levels for the required averaging period? For example:

- ☐ Gases (NO_x, SO_2, CO)
- ☐ Ozone (taking into account time of day and wind direction when photochemical reactivity is greatest)
- ☐ Particulate (PM_{10}/2.5 and lead)

☐ Is road access adequate?

☐ Are electric power and data transmission lines available?

☐ Can the location be made secure with respect to vandalism?

☐ Are there any nearby buildings, trees, terrain features, or other obstructions that would alter flow patterns or serve as sinks or reactive surfaces? For example:

- ☐ Can the inlet locations be separated from nearby obstacles by 2 to 3 times the height of the obstacle above the inlet?
- ☐ Can unrestricted airflow (at least 270) be provided around the inlet probe?
- ☐ For ozone measurements, can the monitor be located on a small hill to minimize surface destructive processes? Can low-lying areas be avoided?
- ☐ For particulate measurements, is the site at least 20 meters away from the dripline of trees?

☐ Can the inlets be located 3 to 15 meters above ground level (ideally as close as possible to the breathing zone, but high enough to discourage vandalism)? (For particulate, specified level is $\underline{2}$ to 15 meters.)

☐ Can the inlets be positioned 1 to 2 meters above the instrument shelter (at least 2 meters for particulate
measurements)? Can inlets that protrude from the shelter walls be avoided?

☐ Are the following criteria for minimum distance from roadway to monitor location met:

Figure 3-1. (continued)

Roadway average daily traffic (vehicles per day)	Minimum distance between roadway and monitoring station (meters)		
	CO	O_3	NO_2
$\leq$10,000	$\geq$10	$\geq$10	$\geq$10
15,000	25	20	20
20,000	45	30	30
30,000	80	--	--
40,000	115	50	50
50,000	135	--	--
$\geq$60,000	$\geq$150	--	--
70,000	--	100	100
$\geq$110,000	--	$\geq$250	$\geq$250

Monitor Height (meters)	Minimum Distance Between Roadway and Monitoring Station (meters)
	TSP/PM_{10}
2	25
5	20
10	13
15	5

Figure 3-1. (continued)

FACILITIES AND EQUIPMENT CHECKLIST

- ☐ Is an inventory of monitoring equipment available?
- ☐ Which instruments are in operating condition?
- ☐ Which instruments are not in operating condition; why?
- ☐ Are operating instructions and calibration procedures available for each instrument?
- ☐ Are associated air monitoring materials, supplies, and equipment available, such as:
  - ☐ Operation and maintenance supplies (e.g., spare parts, fuses, and filters)?
  - ☐ Calibration standards and equipment (calibration gases, dilution systems, and flowmeters)?
  - ☐ Meteorological measurement equipment?
  - ☐ Data transmission equipment (e.g., computer download capabilities)?
- ☐ Are meteorological data available from local airports?
- ☐ Is laboratory space available? If so, is the following provided?
  - ☐ Well-ventilated or air conditioned work space?
  - ☐ Adequate electric power and lighting?
  - ☐ Benchtop areas for testing and repairing equipment and processing samples?
  - ☐ Hand tools and electrical testing equipment?
  - ☐ Storage space for reagents, glassware, etc.?
  - ☐ Laboratory sink with running water?
  - ☐ Filter conditioning room or desiccator?
  - ☐ Exhaust hood?
  - ☐ Analytical balance?
  - ☐ Light box or light table?
  - ☐ Atomic adsorption spectrophotometer (lead analyses)?
  - ☐ Ultrasonic waterbath?
  - ☐ Source of distilled or deionized water?
  - ☐ Drying oven and refrigerator?
  - ☐ Communications equipment for field work?
  - ☐ Chemistry and engineering reference texts?
  - ☐ Safety apparatus (e.g., fire extinguisher)?

PERSONNEL RESOURCES CHECKLIST

- ☐ Is an organizational chart showing agency staff and reporting relationships available?
- ☐ Are staff are available to operate and service the monitoring stations, provide laboratory support, and analyze data; what are their names and home office locations?
- ☐ What percent of their normal working hours are available to support the air monitoring network project?
- ☐ Are the available staff trained and/or experienced in any of the following areas:
  - ☐ Air quality monitoring?
  - ☐ Meteorological station operation?
  - ☐ Laboratory analysis/chemistry?
  - ☐ Data analysis/personal computer operation?

Figure 3-3. Personnel resources checklist.

This checklist includes questions related to staff availability, experience, education, skill level, and location.

Using the generalized siting criteria and checklist information, various site inspections were conducted and recommendations for candidate sites were developed. In several instances, the sites recommended in Section 5.0 represent existing monitor locations; in other cases, entirely new sites are recommended. The entire process by which siting recommendations were developed is summarized in Figure 3-4.

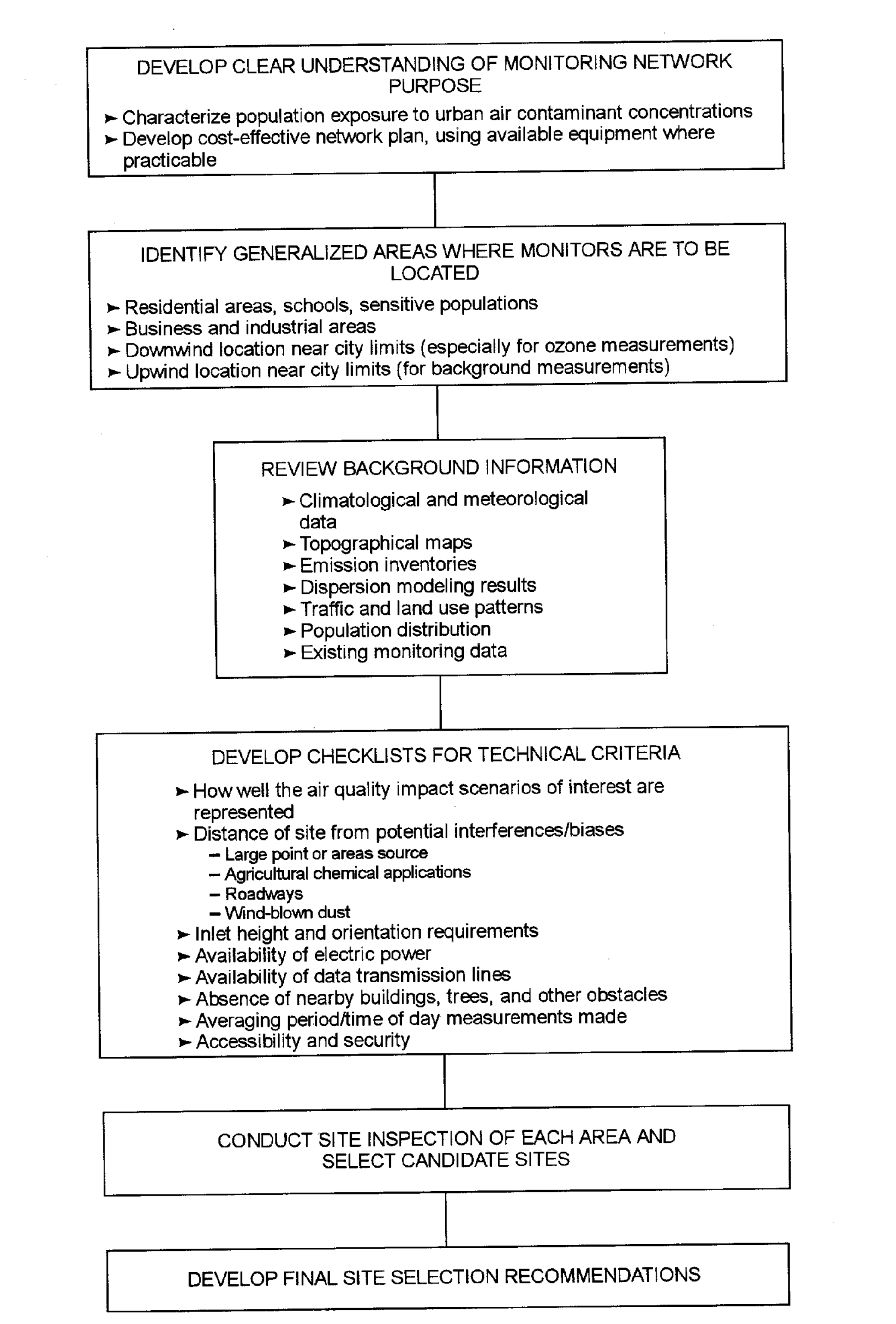


Figure 3-4. Summary of process by which siting recommendations were developed.

4.0 SITE VISIT APPROACH AND OBSERVATIONS

4.1 OVERVIEW OF APPROACH

The initial step in preparing for the site visit was to review and evaluate background materials and emissions data for the two cities. MRI worked with the EPA, TNRCC, and State of Coahuila to acquire all relevant information, including terrain and land-use data for prospective monitor siting areas, the distribution of point and area sources, the location of appropriate airport meteorological stations from which weather data can be obtained, and population distribution and density for each city. Examples of specific items reviewed include:

- Isopleth maps of pollutant concentrations from previous studies.
- Emission inventories.
- Regional meteorological data and wind roses (see Appendix A).
- Topographic, population, and land-use maps.

After reviewing this informatiion, MRI worked with EPA, Texas, and Coahuila to define project data quality objectives (DQOs). DQOs are useful in ensuring that the information collected and observations made during a field study are of the right type, quality, and quantity to support their intended use. The DQOs for this project were as follows:

- Lay the groundwork for establishing ambient air monitoring networks in Ciudad Acuña and Piedras Negras for pollutants of concern to city and state officials.
- Provide for the measurement of urban concentrations of pollutants in residential and industrial areas.

- Incorporate the measurement of upwind and downwind concentrations to provide a better understanding of background concentrations and regional transport phenomena.

- Develop realistic network designs within the constraints of available administrative, technical, and financial resources, using existing equipment and personnel to the greatest extent possible.

Guided by these DQOs, two MRI air monitoring specialists conducted the site visit to Ciudad Acuña and Piedras Negras and collected the information used to develop the recommendations in Section 5.0. The site visit included meetings with administrative and technical staff of the two cities and the State of Coahuila, visits to potential monitoring locations, acquisition of additional data associated with local emission inventories and meteorological/topographical characteristics, and evaluation of the human resources needed and available to operate the networks. MRI also evaluated existing equipment for its potential use in the proposed air monitoring networks.

The site selection process itself was an elimination process: the recommended sites were chosen from prospective sites selected from general siting areas. The underlying logic in this process was to determine the general locations of the monitoring sites; refine the locations to minimize undue influences from nearby sources, including meteorological effects; and ultimately place the monitor inlets according to established siting criteria so that defensible data could be acquired throughout this process. Careful attention was paid to the siting criteria presented in the checklists in Section 3.0.

4.2 SUMMARY OF OBSERVATIONS

During the visit to Ciudad Acuña, the MRI staff observed that the city has four operational EPA reference PM_{10} monitors manufactured by Wedding and Associates. This equipment is of the latest design and appropriate for its intended purpose of collecting PM_{10} data at multiple locations with the city. Two of the monitors are already located at specific sites within the city limits (Stations 1 and 3), while the remaining two monitors are stored in the offices of the Director of Ecology (i.e., the responsible official for air monitoring). The municipality does not have a working meteorological station, a PM_{10} monitor calibration kit, or other facilities to support the continued operation and maintenance of the monitors. Logbooks and operating manuals were also not available.

Ciudad Acuña's Department of Ecology has one person trained in the operation of PM_{10} monitors. The NIE had previously calibrated the monitors and provided operator training, including instructions on changing and handling filters and operation of the monitors. However, follow-up training addressing the detailed steps involved in receiving, loading, unloading, packaging, and shipping filters to an analytical laboratory had not been conducted. Troubleshooting and maintenance training also had not been conducted.

During the visit to Piedras Negras, it was observed that the city has an inventory of four operating PM_{10} monitors manufactured by Wedding and Associates. As with Ciudad Acuña, these monitors are appropriate for use in the city. All four PM_{10} monitors are already located at specific sites within the city limits. In addition, Piedras Negras has one SO_2 analyzer manufactured by Measurement Control Corporation and an associated data logger system by Odessa. Neither the SO_2 analyzer nor the data logger are operational, and the support equipment needed for future operation was not present. The municipality does not have a working meteorological station, PM_{10} calibration kit, or other facilities to support the continued operation and maintenance of the PM_{10} monitors. However, the city does have operating manuals for the PM_{10} monitors, which have been translated from English into Spanish.

Piedras Negras's Department of Ecology has two people trained by the INE to operate the PM_{10} monitors. Additionally, the INE had previously calibrated the PM_{10} monitors. Training included instructions on changing and handling filters and operating the monitors, but excluded detailed instructions addressing the receiving, loading, unloading, packaging, and shipping of filters and troubleshooting and maintaining equipment.

5.0 RECOMMENDATIONS

Recommendations are presented below for implementing improved ambient air quality monitoring networks in Ciudad Acuña and Piedras Negras. Additionally, steps that can be taken by the State of Coahuila to improve data quality and ensure measurement consistency between the two cities are recommended. All of the recommendations are summarized in Table 5-1

5.1 CIUDAD ACUÑA

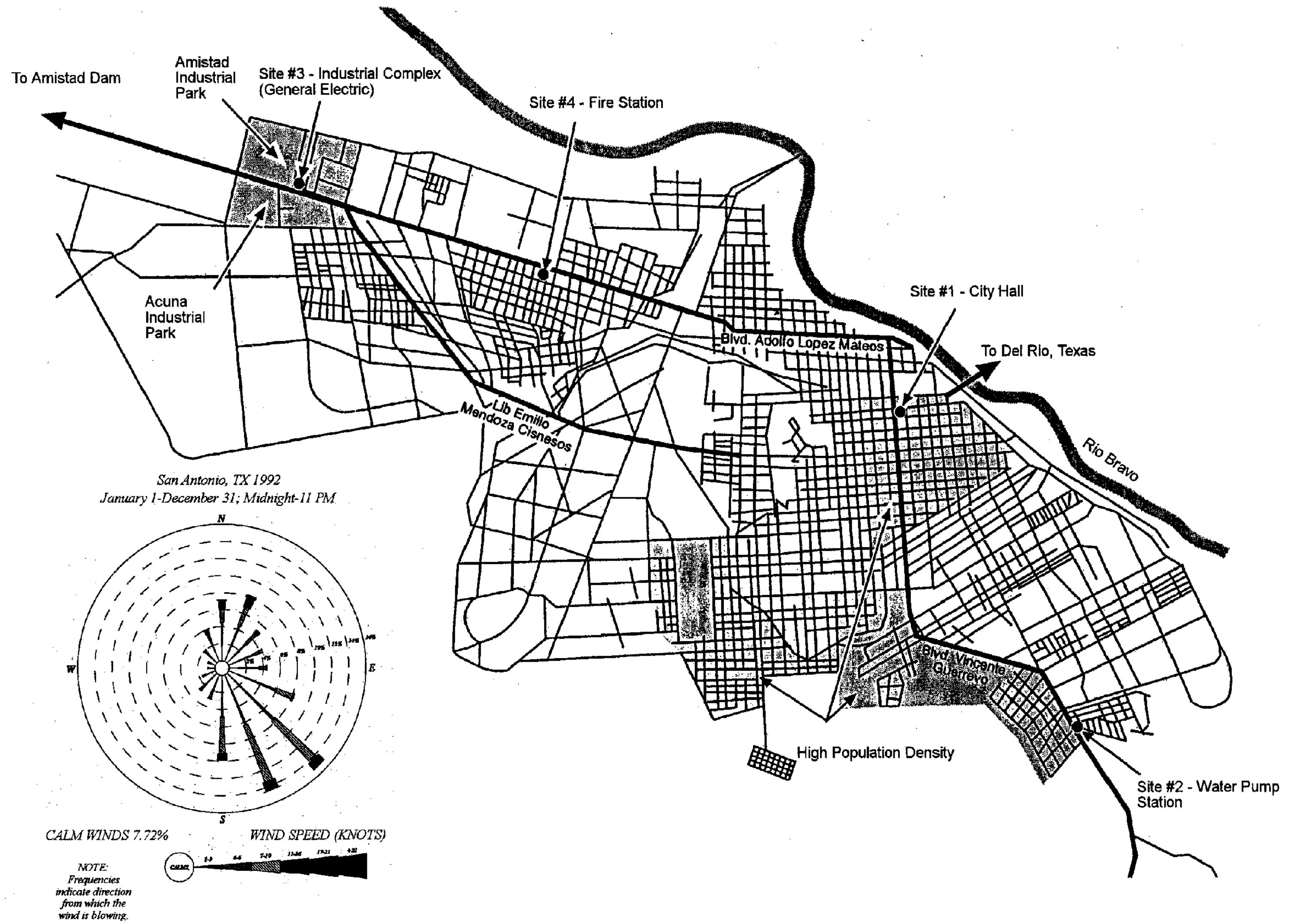
Ciudad Acuña currently has four operational PM_{10} monitors, two of which are located at monitoring sites within the city limits, and the other two are stored at the office of the Director of Ecology. Because these monitors are immediately available to the city, and because two the monitors are already sited, it is recommended that siting of the other two monitors and operation of all four monitors be the city's highest priority.

The two monitors that have already been located at monitoring sites are considered appropriately sited, and the relocation of these monitors is not recommended. While improvements to these locations could be suggested, it is doubtful that these improvements would significantly improve the quality of data collected. Recommendations for the locations of all four monitors are summarized below, and the locations are illustrated in Map 5-1

- Station 1 (East): Existing location on top of City Hall (see Figure 5-1.and Photograph 5-1); provides measurements in vicinity of highly populated residential area.
- Station 2 (Southeast): New location on top of one-story building at water pumping station (see Figure 5-2 and Photograph 5-2); provides measurements of upwind background concentrations.
- Station 3 (Northwest): New location on top of one-story building at General Electric facility in local industrial park (see Figure 5-3 and Photograph 5-3); provides measurements downwind of industrial area (e.g., numerous maquilas).

TABLE 5-1. SUMMARY OF RECOMMENDATIONS

CIUDAD ACUÑA
• Locate two remaining PM_{10} monitors and begin operation of all four monitors as highest priority.
• Establish additional SO_2, lead, and possibly ozone monitors at each PM_{10} location as second priority.
• Install meteorological monitoring station.
• Obtain operating manuals, log books, and required auxiliary equipment such as calibration kits and inventory of spare parts.
• Establish support facility for set-up, calibration, and maintenance of equipment.
• Develop SOPs; data reduction, validation, and reporting procedures; and DQOs.
• Improve accessibility to existing stations.
• Provide at least one additional trained employee for operating and maintaining air monitoring network.
PIEDRAS NEGRAS
• Begin operation of all four PM_{10} monitors at existing sites as highest priority.
• Repair and set up existing SO_2 monitor and associated data logger as second priority; locate monitor at Station 2 (i.e., upwind, in the direction of the power plant).
• Establish additional SO_2, lead, and possibly ozone monitors at each PM_{10} location as third priority.
• Install meteorological monitoring station.
• Obtain log books and required auxiliary equipment such as calibration kits and inventory of spare parts.
• Establish support facility for set-up, calibration, and maintenance of equipment.
• Develop SOPs; data reduction, validation, and reporting procedures; and DQOs.
• Improve accessibility to existing stations.
STATE OF COAHUILA
• Establish comprehensive quality assurance program, providing for: (1) periodic inspection and performance audits of monitoring sites; (2) preparation of written operating, data analysis, and report procedures; (3) DQOs, including limits for precision, accuracy, and completeness; and (4) certification requirements for analytical laboratories.
• Provide periodic training for air quality monitor operators.
• Coordinate purchase, preparation, and handling of all monitor supplies and equipment and conditioning and analysis of particulate filters.
• Assume responsibility for all coordination with National Institute of Ecology.
• Consider hiring an air quality coordinator.



Map 5-1. Illustration of monitoring station locations in Ciudad Acuña.

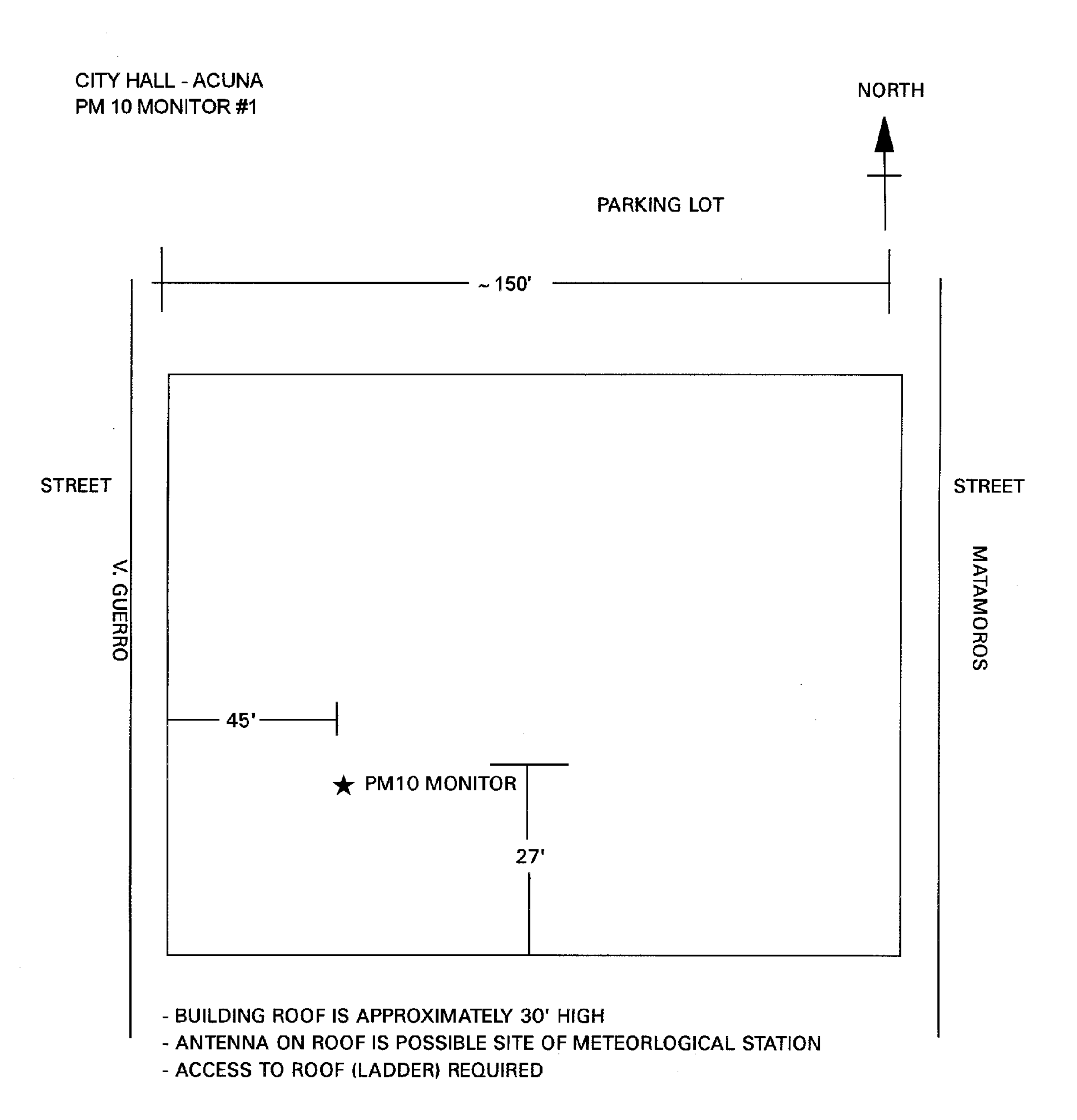
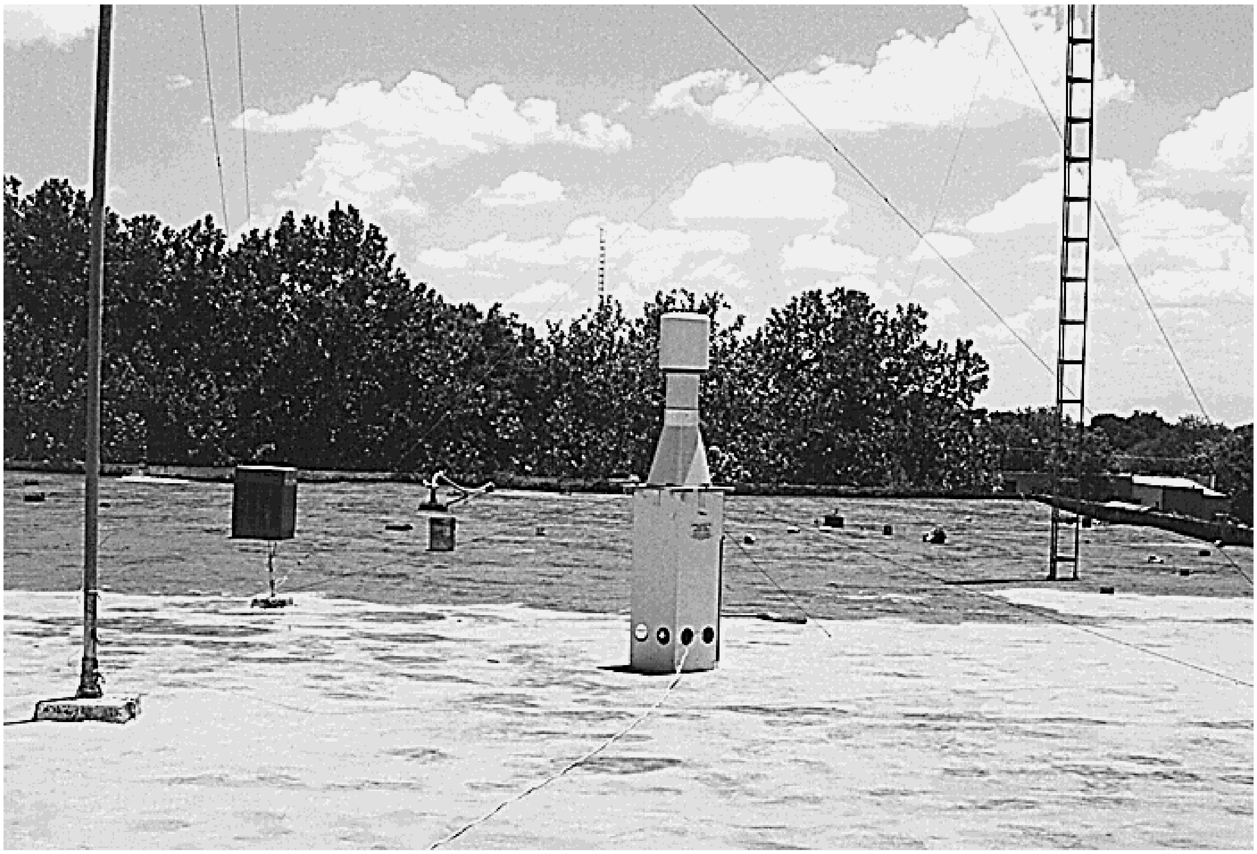


Figure 5-1. Location of Station No. 1 on top of City Hall, Ciudad Acuña.



Photograph 5-1. Station No. 1 on top of City Hall, Ciudad Acuña.

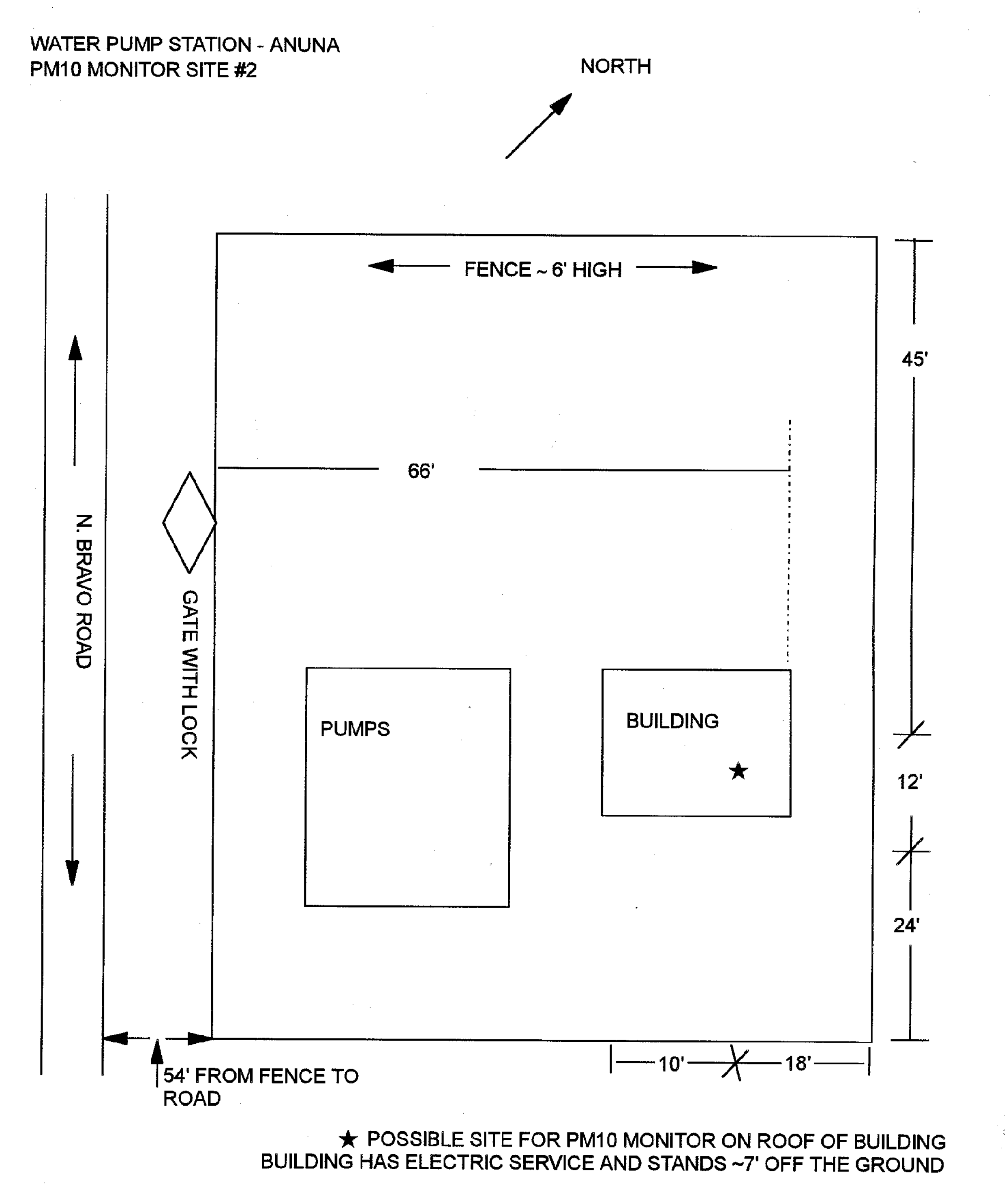
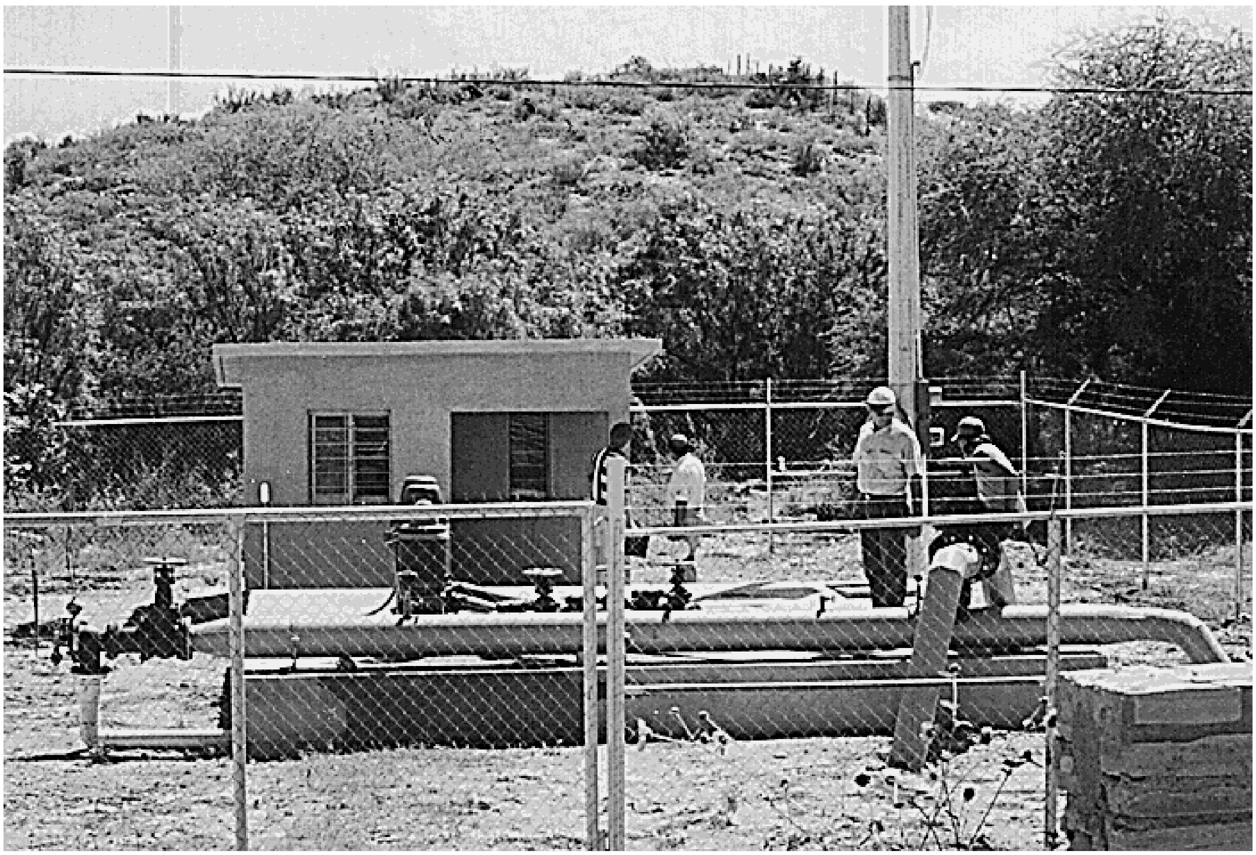


Figure 5-2. Location of Station No. 2 on roof of pump house, Ciudad Acuña.



Photograph 5-2. Proposed Station No. 2 on roof of pump house, Ciudad Acuña.

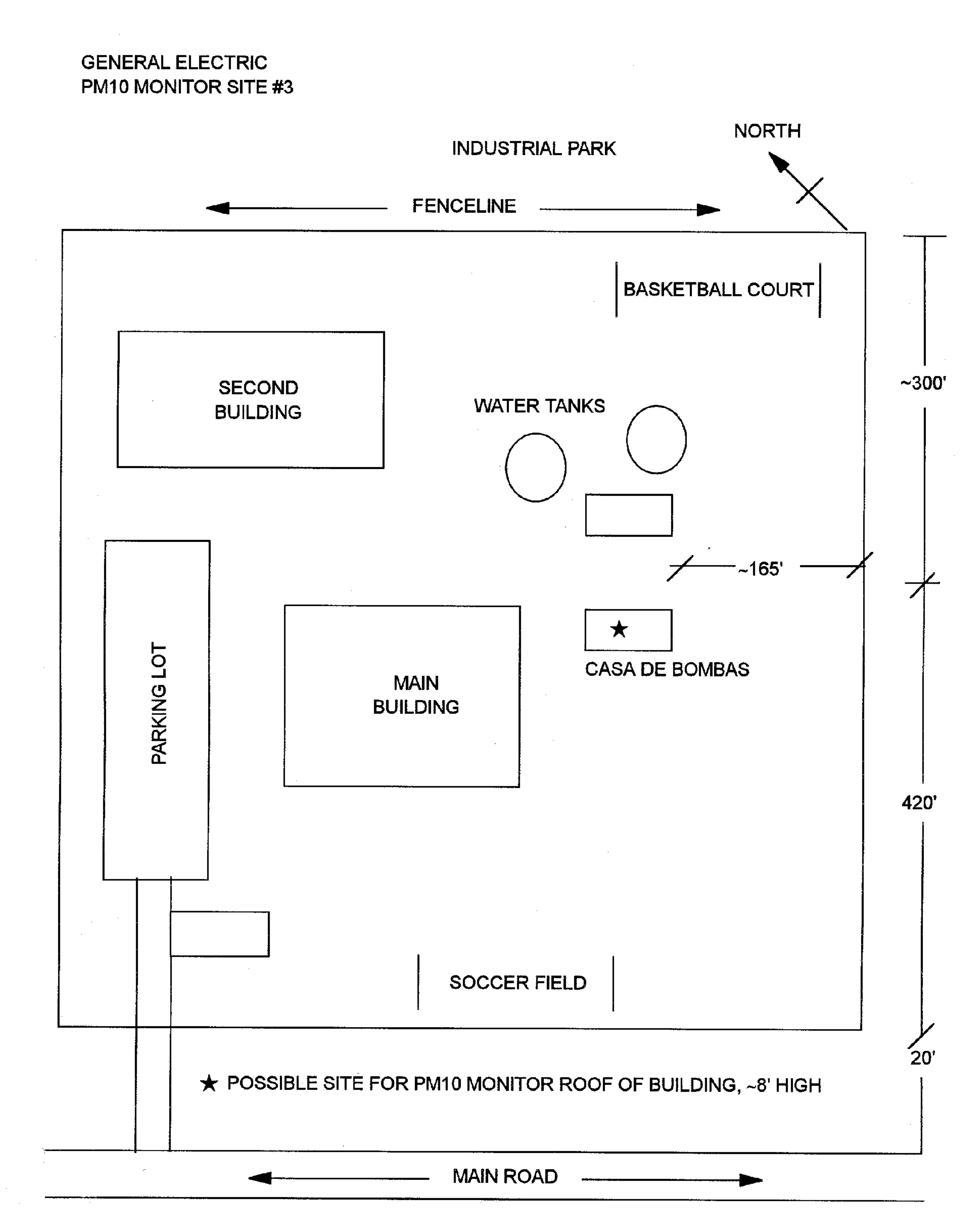


Figure 5-3. Proposed location of Station No. 3 at General Electric in industrial park, Ciudad Acuña.

Photograph 5-3. Proposed Station No. 3 at General Electric in industrial park, Ciudad Acuña.

- Station 4 (North): Existing location on top of two-story fire station (see Figure 5-4 and Photograph 5-4); measurements represent city-wide air quality associated with the urban/neighborhood scale.

We believe that a total of four monitor locations is sufficient for a city the size of Ciudad Acuña, and that additional monitors are not needed.

Once these monitoring stations are operational, we recommend that the city establish additional monitors at each location for SO_2, Pb, and possibly O_3. While there are no monitoring data or other evidence that these contaminants represent a concern for the city, monitoring for these contaminants is recommended for the following reasons:

- SO_2: As discussed previously, the Carbon I and II electric power plants are located to the southeast, and wind rose data indicate that winds from the southeast are common. Because this facility does not employ SO_2 emission controls, the potential exists for significant levels of SO_2 to be transported in the direction of the cities.

- Pb: Ciudad Acuña has many older cars without emission control devices. Because leaded gasoline may be used in the city, and because other sources of Pb emissions may be present, the potential exists for significant lead exposure, especially in the vicinity of major roadways. As an alternative to locating Pb monitors at all four previously identified stations, a single micro-scale lead monitor could be located beside the busiest roadway.

- O_3: Because Ciudad Acuña is a relatively small city and because there is no strong evidence for the regional transport of ozone from the U.S. border region (e.g., prevailing winds are from a different direction), the monitoring of O_3 may not be critical. Nevertheless, the many uncontrolled automobiles in the city and the numerous small industrial facilities probably contribute significant volatile organic compounds (VOCs), and the Carbon I and II plants emit NO_x emissions. Because these precursor compounds can lead to the formation of ozone, ozone monitoring may be appropriate. However, we recommend that the monitoring of this contaminant be given lower priority than the monitoring of the other compounds.

If monitoring for SO_2, lead, and possibly ozone is to be conducted, the city would need to purchase the monitors and associated equipment and provide operator training. The monitors can be co-located with the PM_{10} monitors, with the possible exception of lead, as noted above.

To operate the existing PM_{10} stations, a meteorological station and calibration kit will be required. Support facilities for setting up, calibrating, and maintaining equipment also are

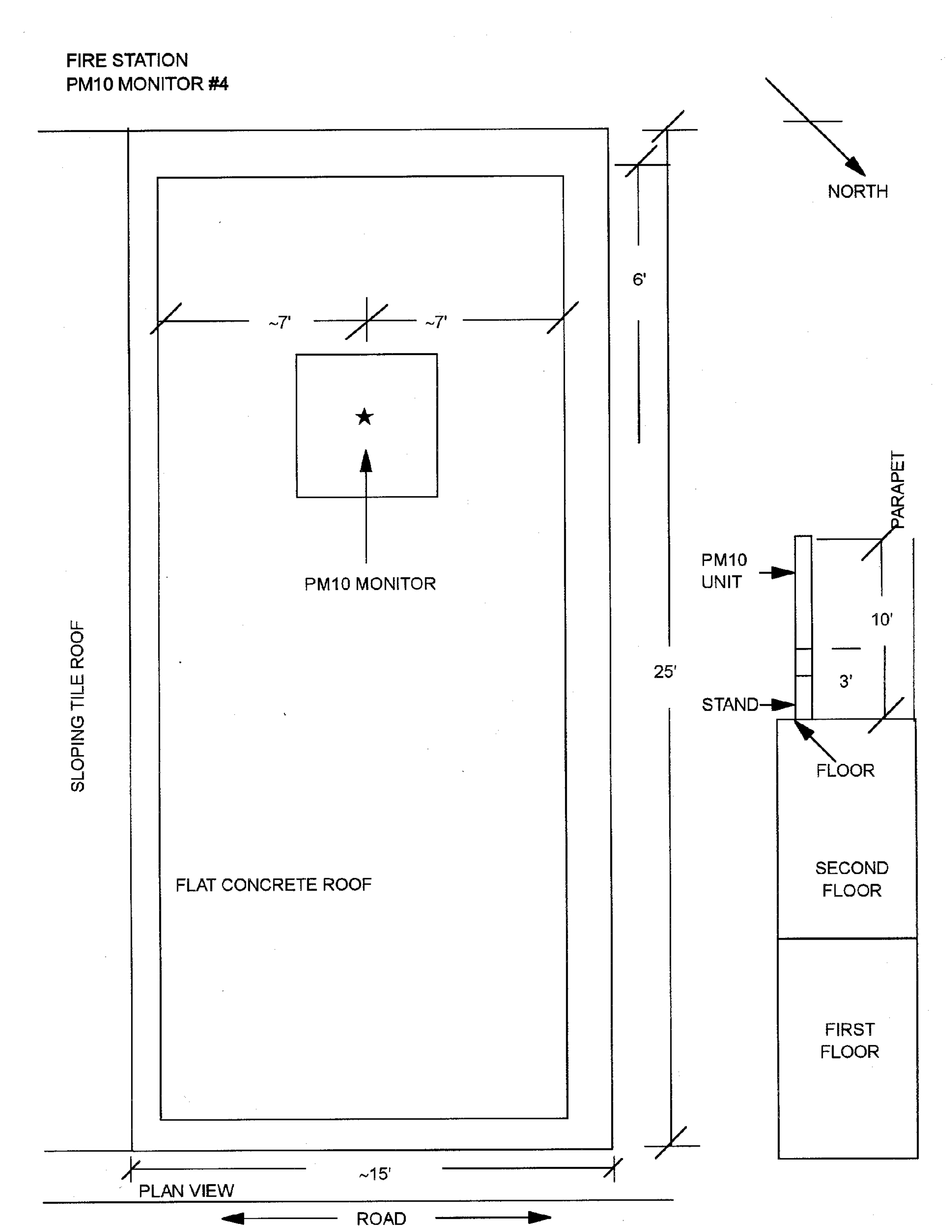


Figure 5-4. Location of Station No. 4 on top of two-story fire station, Ciudad Acuña.

Photograph 5-4. Station No. 4 on top of two-story fire station (right), Ciudad Acuña.

needed, as are log books and operating manuals. Similar equipment and facilities are needed for operation of the SO_2, Pb, and O_3 monitors.

Ciudad Acuña currently has one employee who is trained in the operation of PM_{10} monitors. At least one additional trained employee should be provided so that a minimum of two individuals are familiar with monitor operation and maintenance (i.e., one employee will serve as a backup to the other). If monitoring is conducted for other contaminants, two trained personnel will probably still be sufficient. However, with more monitors in operation, one of these two employees may need to devote his/her entire workday to operation, maintenance, data reduction, and reporting activities.

In addition to the above recommendations, a number of operational details that need to be addressed are listed below.

- Site-specific standard operating procedures (SOPs), including procedures for monitor operation, preventive maintenance, and corrective action, are needed for each monitor. Procedures for data reduction, validation, and reporting also are needed.

- Data quality objectives (DQOs), especially for precision, accuracy, and completeness, should be established.

- Accessibility to the existing monitoring stations needs to be improved (e.g., platforms are needed to facilitate routine operation and maintenance) and electrical connections need to be weatherized.

- A spare parts inventory should be established, which includes items such as a PM_{10} gasket kit, motor brushes, motors, filter holders, and timers.

5.2 PIEDRAS NEGRAS

Piedras Negras currently has four operational PM_{10} monitors and one inoperable SO_2 monitor and associated data logger. The four PM_{10} monitors are located at monitoring sites within the city limits. Because these monitors are already on hand, the operation of these monitors should be the city's highest priority.

We recommend that the four PM_{10} monitors be operated at their current locations. While improved locations probably could be identified, we doubt that the quality of data collected could be significantly improved. Given the expense associated with relocating the monitors and the difficulty likely to be experienced in locating suitable sites that provide adequate security, we recommend that all four monitors be left at their current locations. These recommended locations are summarized below, and the locations are illustrated in Map 5-2.

- <u>Station 1 (North)</u>:Existing location on top of City Hall (see Figure 5-5 and Photograph 5-5); measurements represent city-wide air quality associated with the urban/neighborhood scale.

- Station 2 (Southeast): Existing location on top of one-story school (see Figure 5-6 and Photograph 5-6); provides measurements of upwind background concentrations.

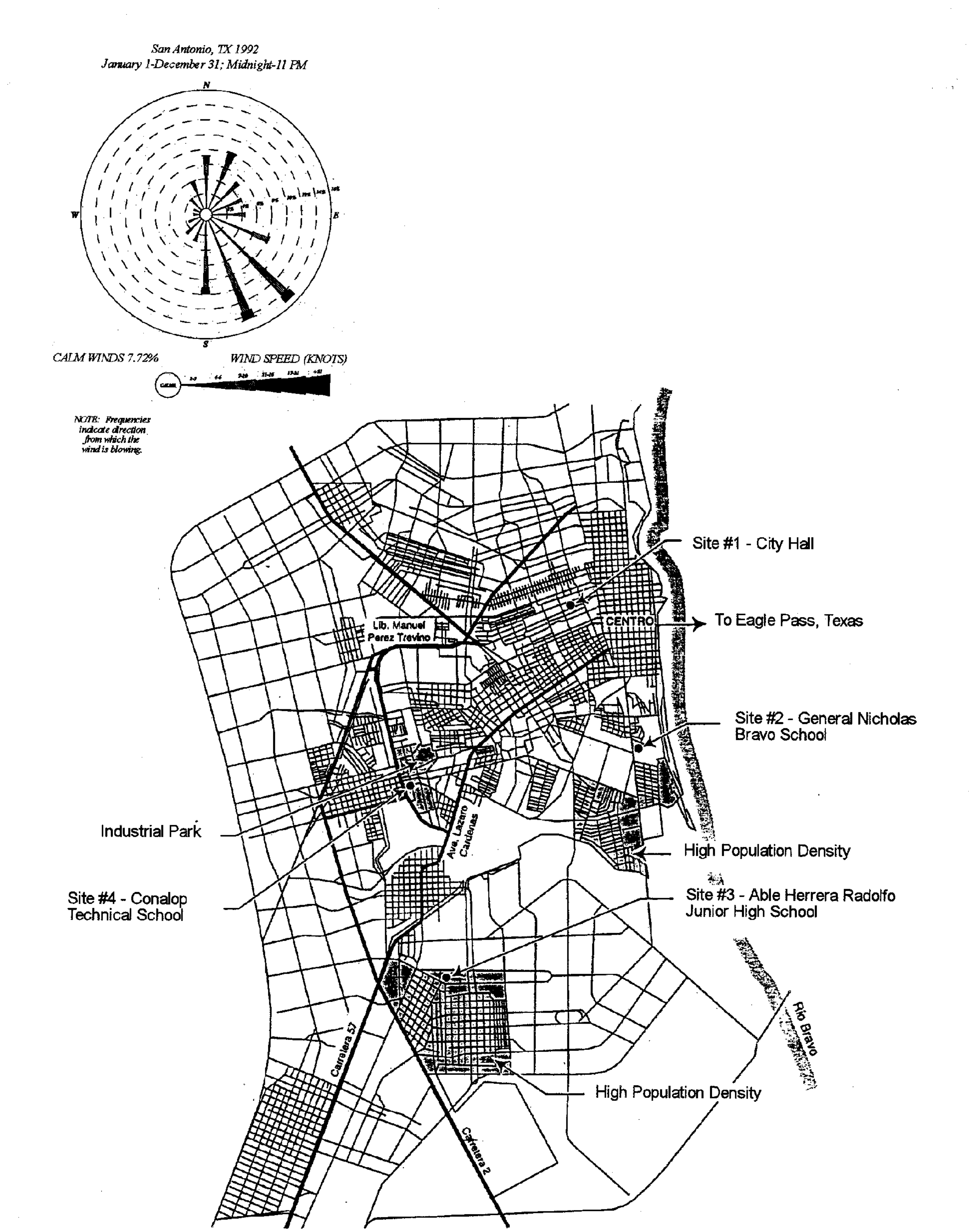
- Station 3 (South): Existing location at junior high school building (see Figure 5-7 and Photograph 5-7); provides measurements in vicinity of highly populated residential area. (Note that the figure and photograph represent the original location of the monitoring station, on top of a one-story school building. However, based on recommendations of the MRI site visit team, the monitoring station has been relocated about 100 meters east to a ground level location where potential interferences from surrounding trees can be avoided.)

- Station 4 (West): Existing location on top of a one-story technical college building within local industrial park (see Figure 5-8 and Photograph 5-8); provides measurements in vicinity of industrial area (e.g., numerous maquilas).

As with Ciudad Acuña, we believe that a total of four monitor locations is sufficient for a city the size of Piedras Negras, and that additional monitors are not needed.

Once these monitoring stations are operational, we recommend that the city establish additional monitors at each location for SO_2, Pb, and possibly O_3. As with Ciudad Acuña, there are no monitoring data or other evidence that these contaminants represent a concern for the city. However, given the nearby electric power plants, number of uncontrolled older cars, and numerous sources of VOCs, significant concentrations of SO_2, Pb, and possibly O_3 may be present.

If monitoring for SO_2, Pb, and possibly O_3 is conducted, the city would need to purchase the monitors and associated equipment and provide operator training. The monitors can be co-located with the PM_{10} monitors, with the possible exception of Pb, as discussed Section 5.1. Because an SO_2 monitor and associated data logger currently are available to the city, we recommend that this equipment be set up and operated as a second priority. The best location for this monitoring equipment would be at Station 2 (i.e., upwind, in the direction of the power plant).



Map 5-2. Illustration of monitoring station locations in Piedras Negras.

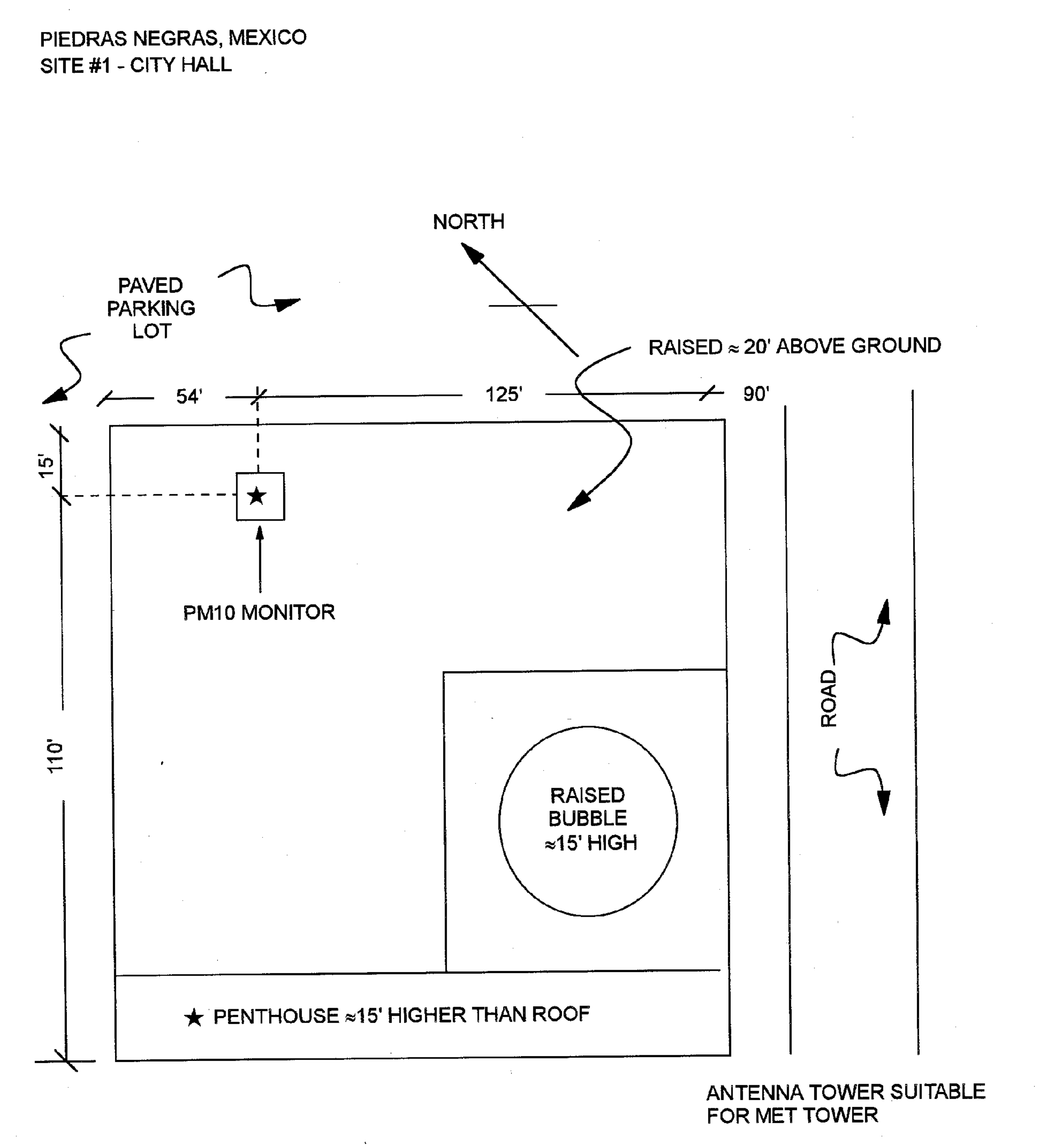


Figure 5-5. Location of Station No. 1 on top of City Hall, Piedras Negras.

Photograph 5-5. Station No. 1 on top of City Hall, Piedras Negras.

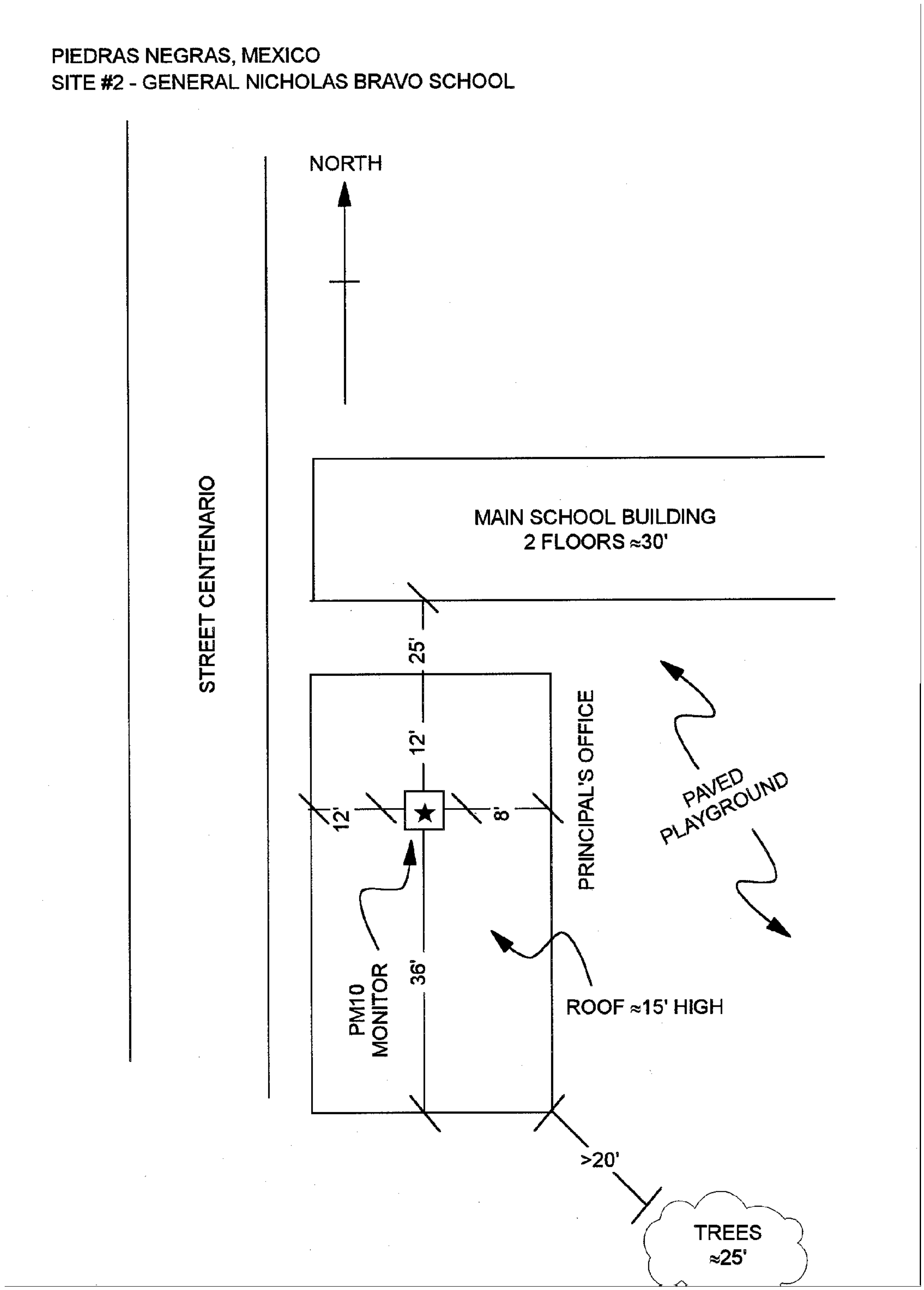


Figure 5-6. Location of Station No. 2 on one-story building at General Nicholas Bravo School, Piedras Negras.

Photograph 5-6. Station No. 2 on one-story building at General Nicholas Bravo School, Piedras Negras.

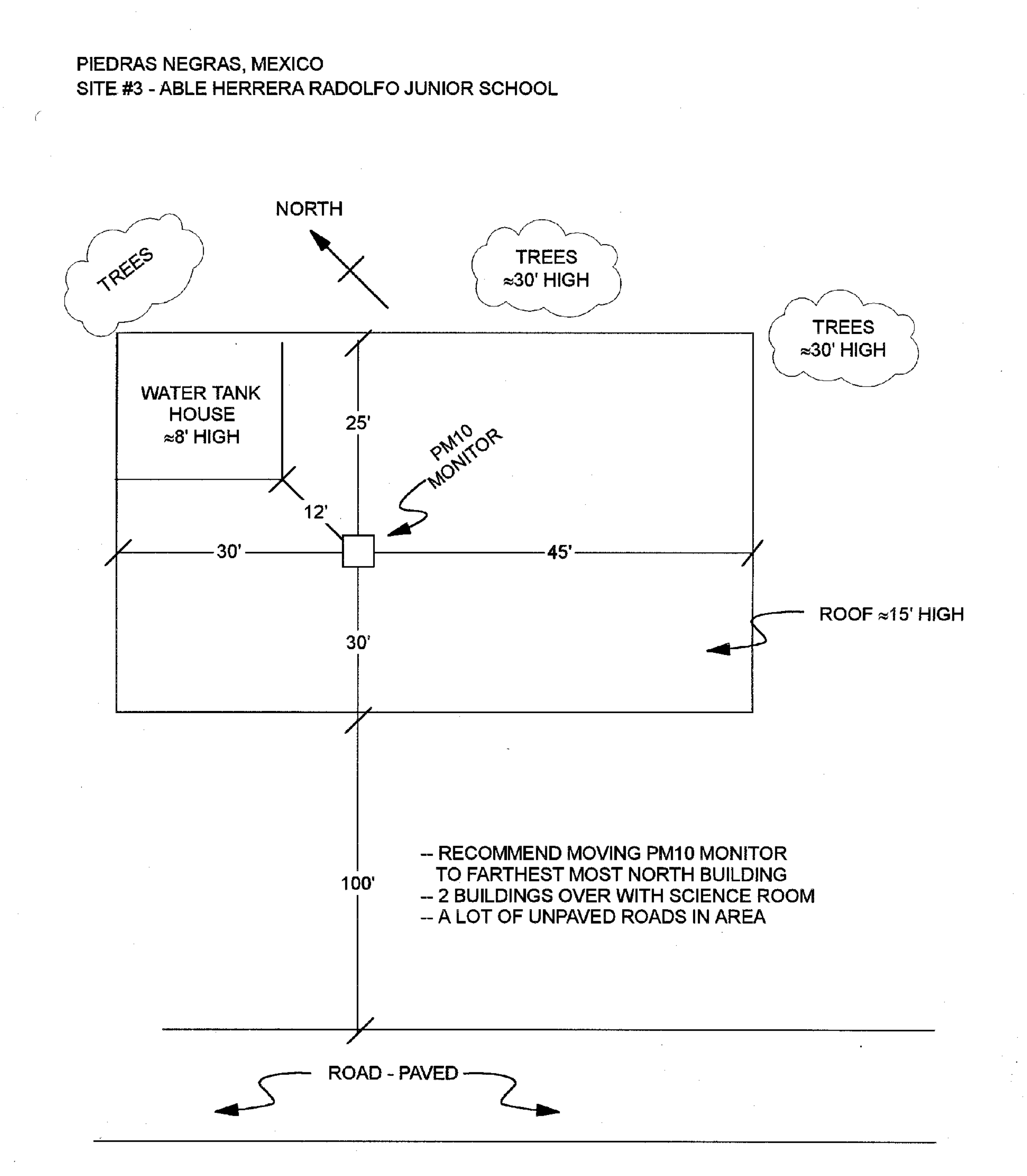


Figure 5-7. Location of Station No. 3 on top of junior high school building (later moved 100 meters east), Piedras Negras.

Photograph 5-7. Station No. 3 on top of junior high school building (later moved 100 meters east), Piedras Negras.

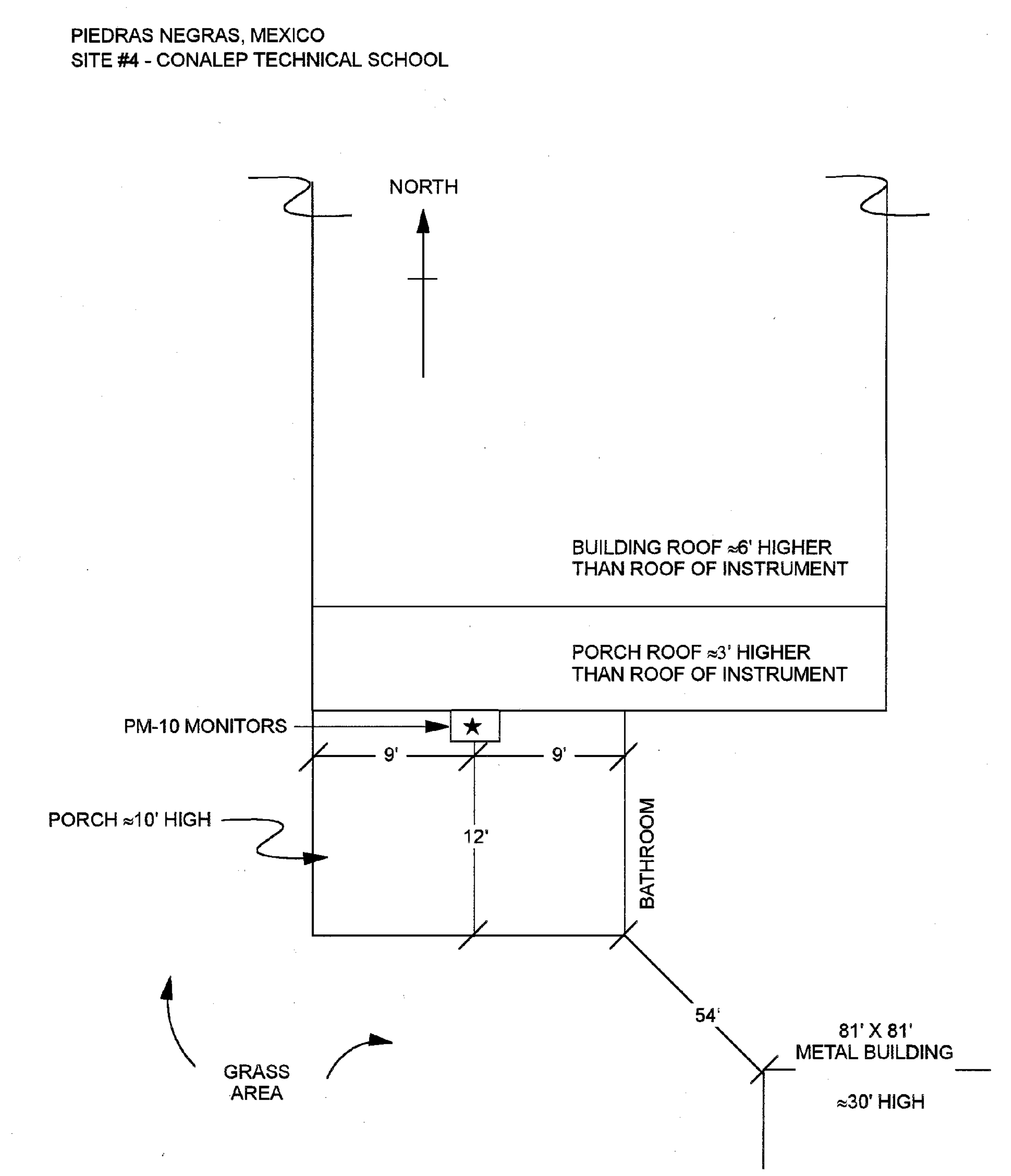
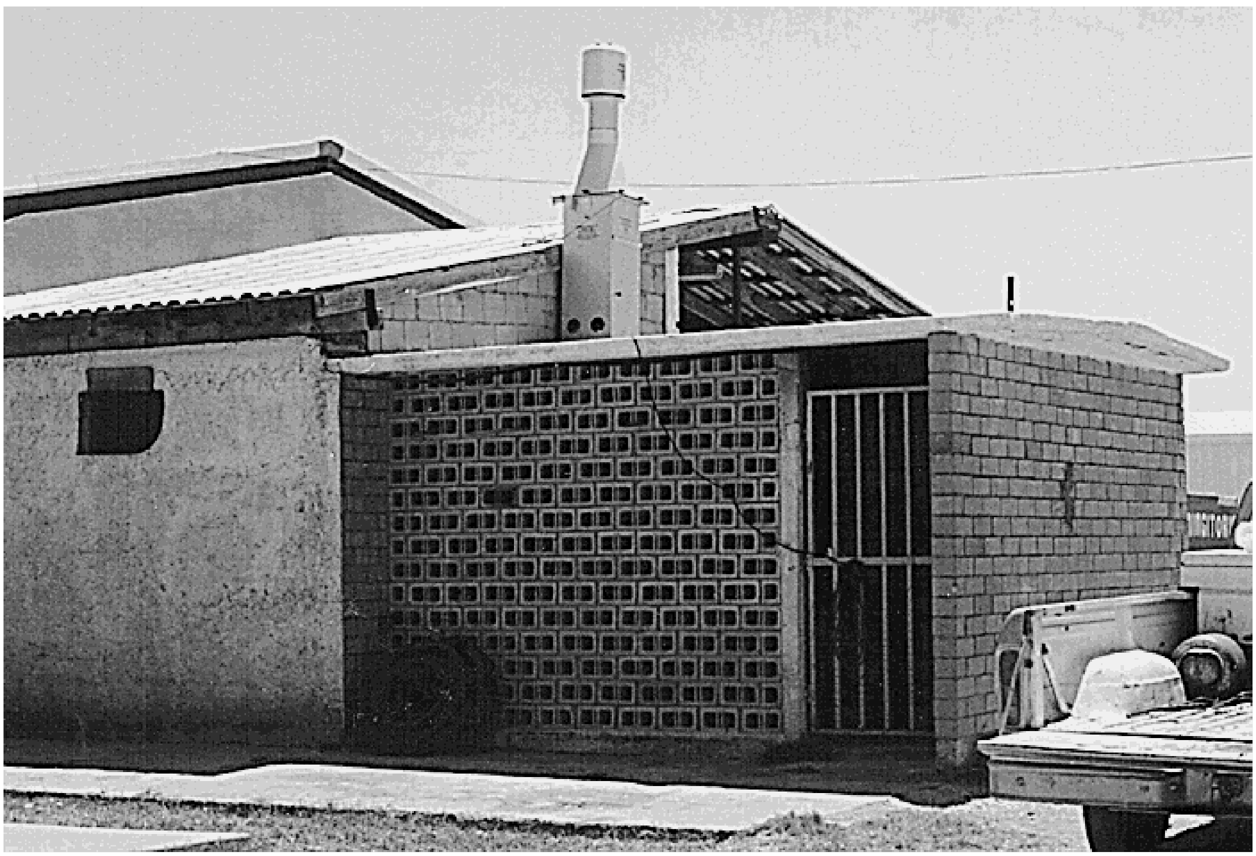


Figure 5-8. Location of Station No. 4 on one-story building at Conalep Technical School, Piedras Negras.



Photograph 5-8. Station No. 4 on one-story building at Conalep Technical School, Piedras Negras.

To operate the existing PM_{10} stations, a meteorological station and calibration kit is required. Additionally, log books and support facilities for setting up, calibrating, and maintaining equipment are needed. (Spanish language operating manuals are already available.) Similar equipment and facilities are needed to operate the SO_2, Pb, and O_3 monitors.

Piedras Negras currently has two employees who are trained in the operation of PM_{10} monitors. This number of trained employees is sufficient for operating and maintaining the four PM_{10} stations (i.e., one employee will serve as a backup for the other). If monitoring is ultimately conducted for other contaminants, two trained personnel is still probably sufficient. However, with more monitors in operation, one or the other of these two employees may need to devote his/her entire workday to operation, maintenance, data reduction, and reporting activities.

In addition to the above recommendations, a number of operational details need to be addressed, as discussed in Section 5.2. Also, the inoperable SO_2 monitor and associated data logger need repair and auxiliary equipment (tubing, connectors, etc.) must be provided.

5.3 STATE OF COAHUILA

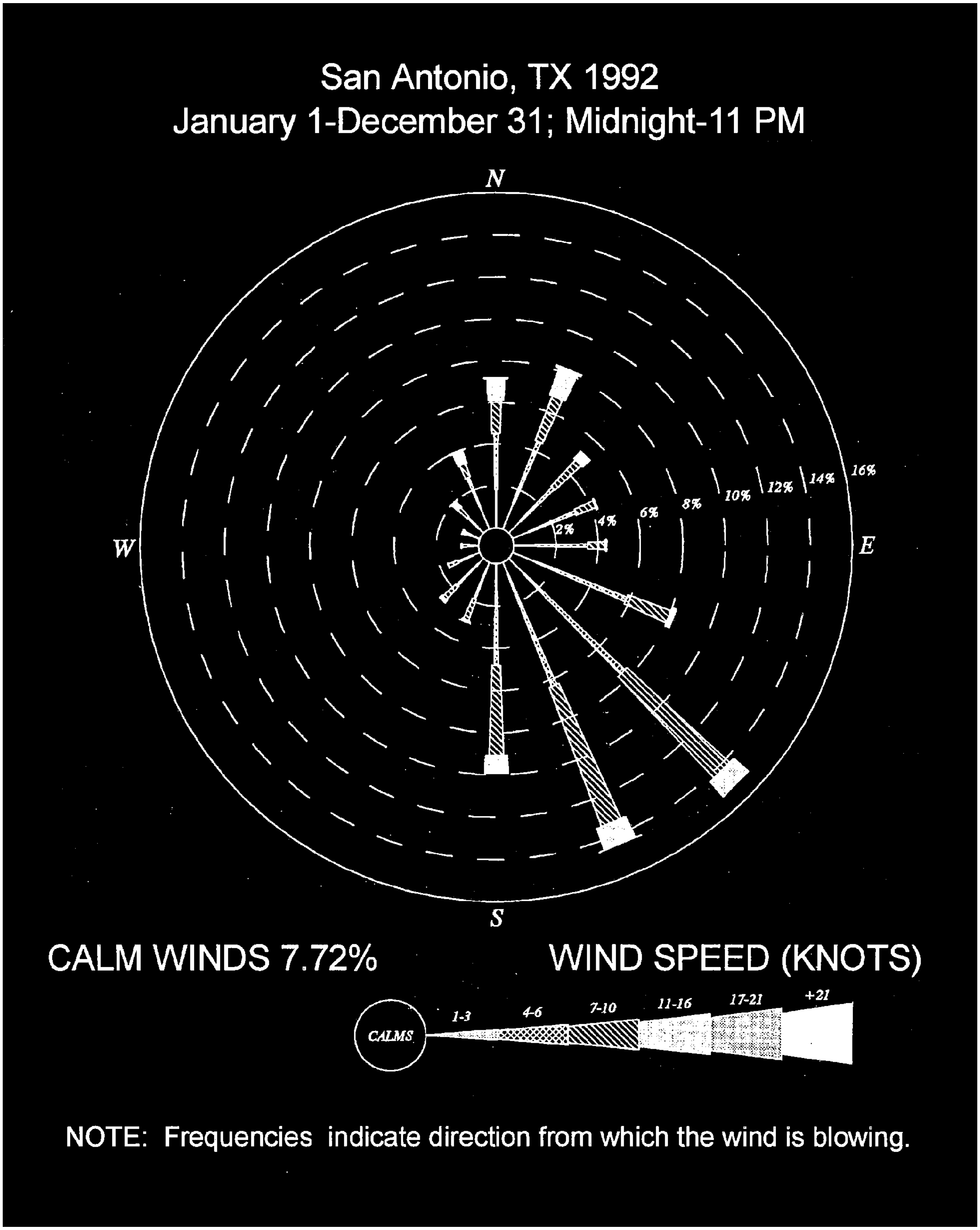
The State of Coahuila plays an important role in ensuring successful operation of the air monitoring networks in Ciudad Acuña and Piedras Negras. In particular, we recommend that Coahuila establish a comprehensive quality assurance (QA) program that includes:

- Periodic inspections and performance audits of monitoring sites.
- The preparation of written operating, data analysis, and reporting procedures for the two cities.
- DQOs, including limits for precision, accuracy, and completeness.
- Certification requirements for analytical laboratories.

Additionally, we recommend that Coahuila provide periodic training for the air quality monitor operators. We believe there would be some advantage to having Coahuila coordinate the purchase, preparation, and handling of all monitor supplies and equipment and the conditioning and analysis of particulate filters. We also recommend that Coahuila take responsibility for all coordination with the INE. Finally, we recommend that Coahuila consider hiring an air quality coordination to provide oversight for all of the above activities.

APPENDIX A.

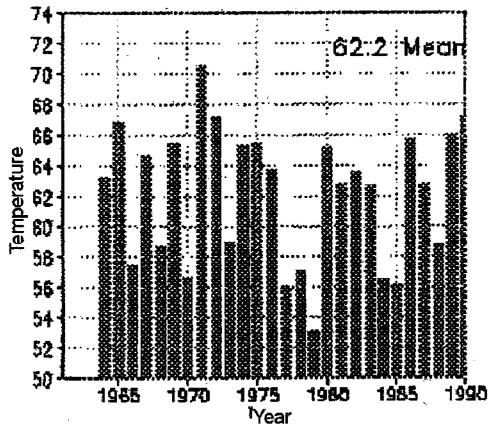
WIND, TEMPERATURE, AND PRECIPITATION DATA


San Antonio, TX 1992
January 1-December 31; Midnight-11 PM
N
S
E
W
2%
4%
6%
8%
10%
12%
14%
16%
CALM WINDS 7.72%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21
NOTE: Frequencies indicate direction from which the wind is blowing.

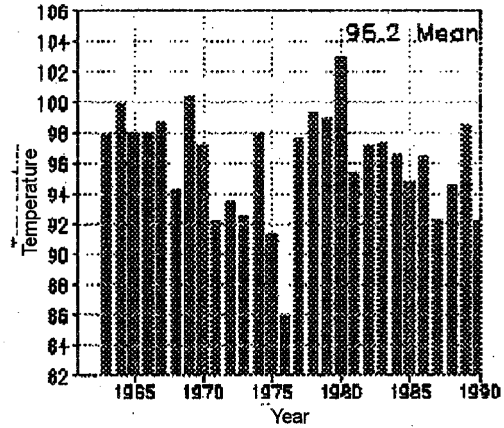
Lat=29.2N Lon=100.5W Elevation=1092 feet
Number of years available from 1961 to 1990: 27

Del Rio, TX, 1961 - 1990 Monthly Means

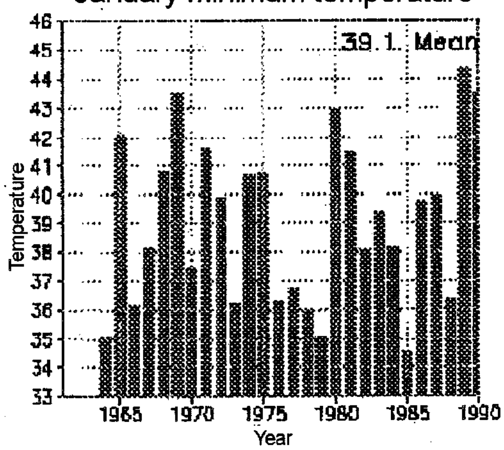
January maximum temperature



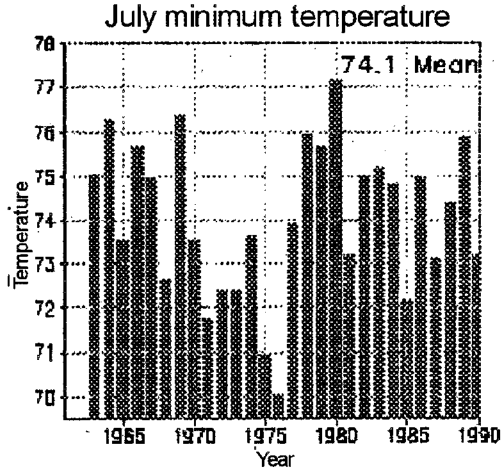
July maximum temperature



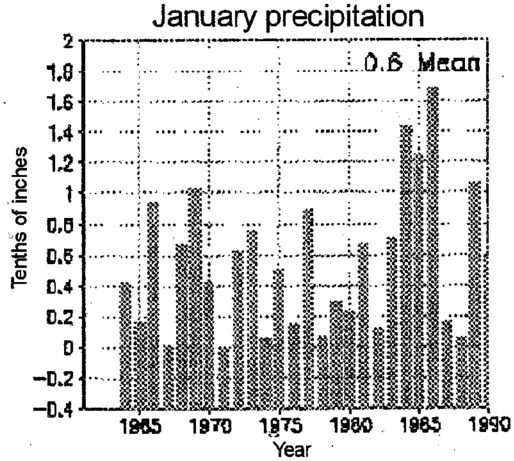
January minimum temperature



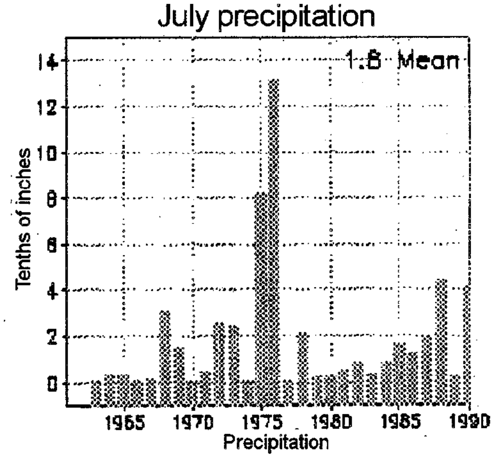
July minimum temperature



January precipitation

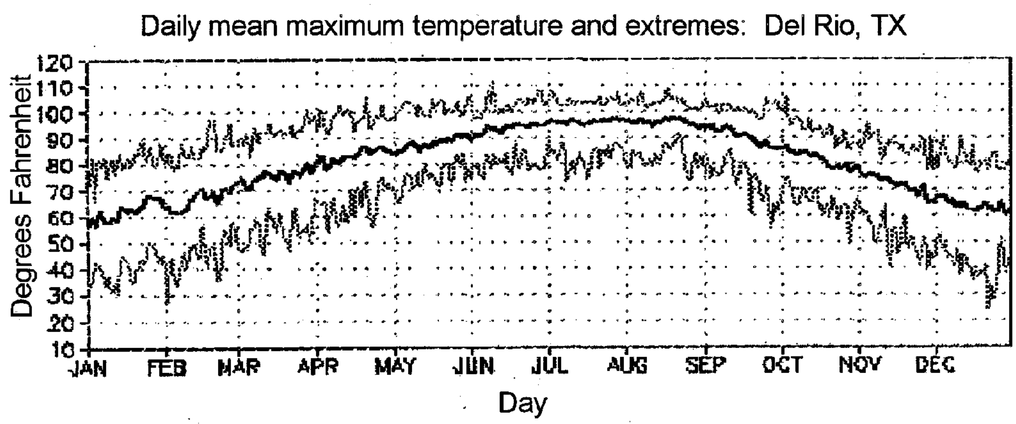


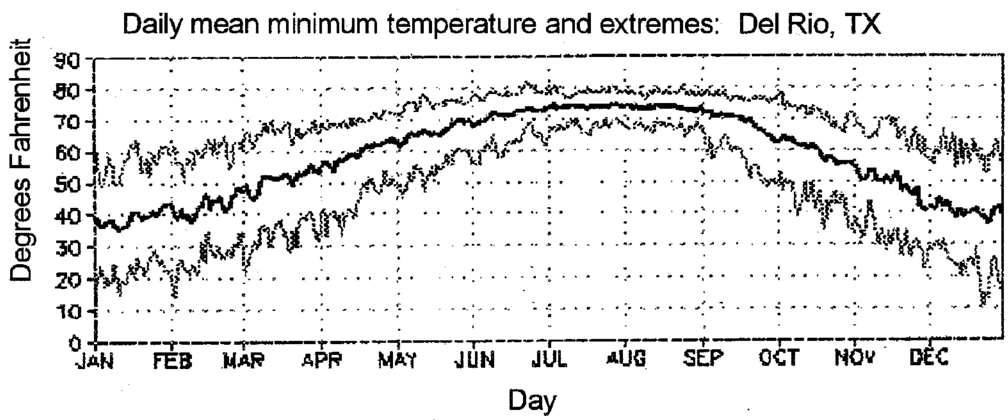
July precipitation

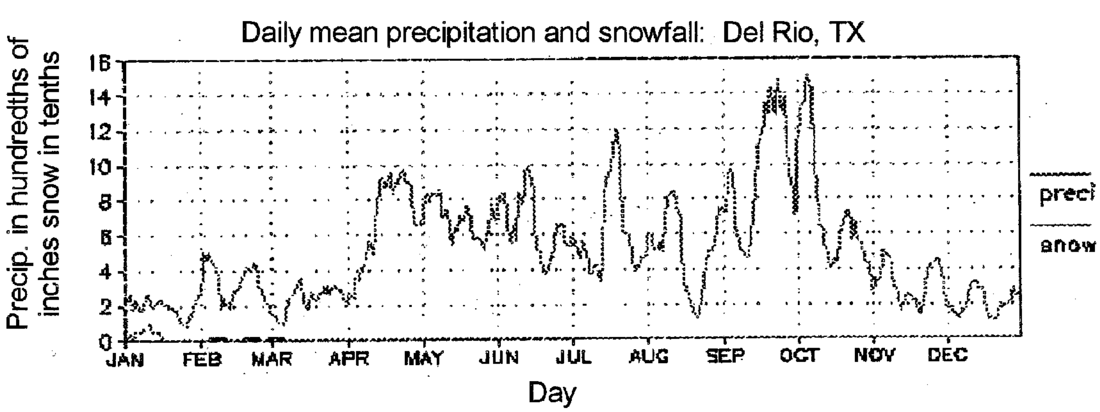


Lat=29.2N Lon=100.5W Elevation=1092 feet
Number of years available from 1961 to 1990: 27

Maximum temperature 1961 to 1990: 112°F; Minimum temperature 1961 to 1990: 10°F
Mean annual precipitation: 18.6 inches; Mean annual snowfall: 1.1



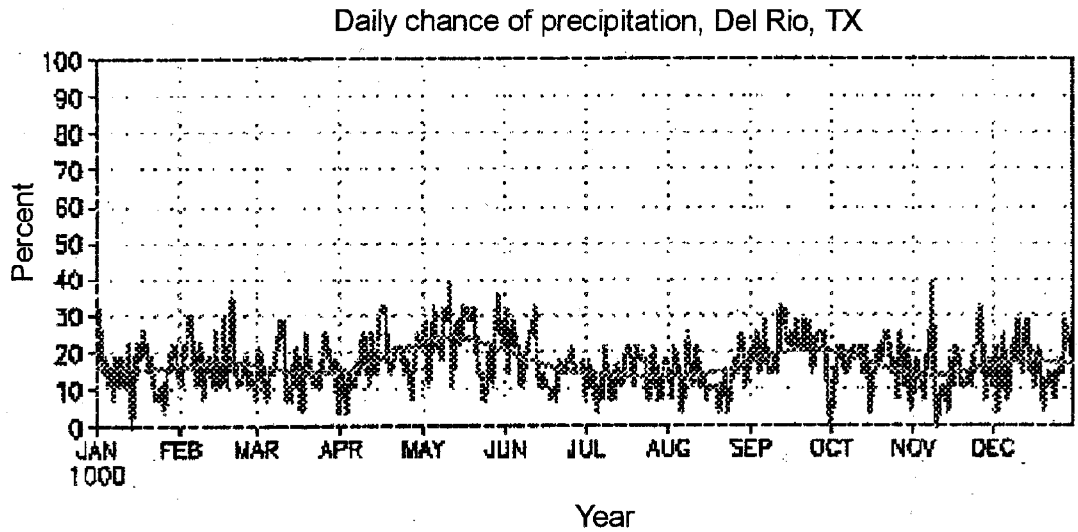




Daily % chance precipitation, wind speed and % sunshine
Monthly anomalies 1961-1990
Monthly means 1961-1990

Lat=29.2N Lon=100.5W Elevation=1092 feet

Annual average chance of precipitation: 16.9%
Annual average wind speed: -999.0 mph
Annual average percent of available sun: -999.0



APPENDIX B.

SITE VISIT CONTACT LIST

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