DRAFT ENVIRONMENTAL IMPACT STATEMENT

SAN ANTONIO, TEXAS WASTEWATER TREATMENT SYSTEM

The following individuals at Radian Corporation provided major contributions to this Environmental Impact Statement:

Program Manager:	M. Lee Wilson
Program Advisor:	W.F. Holland
Technical Director:	Thomas W. Grimshaw
Climate:	David L. Harper
Odor:	Bruce Cerepaka
Air Quality:	Bruce Cerepaka
Noise:	Charles Riese M. Lee Wilson
Geology:	Thomas W. Grimshaw
Soils:	Thomas W. Grimshaw
Hydrology:	
Surface Water Hydrology:	Ken Choffel
Surface Water Quality:	David Malish
Ground Water:	Thomas W. Grimshaw
Biology:	
Terrestrial Biology:	Larry Michel
Aquatic Biology:	Steve James
Man-Made Environment:	Dennis Harner
Descriptions of Alternatives and Facilities:	David Malish
Archaeology:	Anne Fox, University of Texas at San Antonio

SUMMARY SHEET FOR ENVIRONMENTAL IMPACT STATEMENT

San Antonio, Texas
Wastewater Treatment System
EPA Project No. C-48-1211-01

Draft (X)
Final ( )

Environmental Protection Agency
Region VI
1201 Elm Street
Dallas, Texas 75270

1. <u>Type of Action</u>: Administrative Action (X)
   Legislative Action ( )

2. <u>Brief Description of Proposed Action</u>

This Environmental Impact Statement was prepared in response to the action of awarding grant funds to the City of San Antonio, Texas, under the provisions of Section 201 of the Federal Water Pollution Control Act Amendments of 1972. The purpose of these grant funds is to upgrade the wastewater treatment facilities of the city in order to meet the requirements of the Act. The project consists of the necessary facilities to treat approximately 154 million gallons per day (MGD) of wastewater from the city.

The proposed action consists of the following principal elements:

- Abandonment of the existing Rilling Road wastewater treatment plant
- Expansion and improvement of the Leon Creek and Salado Creek treatment plants
- Construction of a new wastewater treatment plant near the confluence of the San Antonio and Medina Rivers
- Emplacement of sewage transfer lines from the existing Rilling Road site and the Leon Creek and Salado Creek plants to the new Confluence treatment plant
- Expansion and improvement of the sewage collector and interceptor system

The proposed action will provide for the removal of discharges of inadequately treated wastewater to streams in the area and will substantially improve the water quality in these streams. The action will provide wastewater treatment facilities that will accommodate existing and future sources of wastewater, and it will allow for orderly growth in the San Antonio and Bexar County area.

3. Summary of Major Environmental Impacts

The construction and operation of the wastewater treatment system expansions and improvements will have several direct impacts on the existing environment of the San Antonio area. The removal of the Rilling Road plant will have the beneficial effect of eliminating a major source of odor from the southern edge of the city. Approximately 100 acres of prime farmland soil will be committed to the treatment plants that will be built or expanded. The water quality of the San Antonio River will be greatly enhanced by the improvement of the quality of the effluent from the wastewater treatment system, but the decrease in streamflow in stream segments between the existing outfall locations and the new outfall location will result in less available water for irrigation, particularly during droughts. The sensitive Edwards aquifer recharge zone could potentially be affected by leakage from segments of the sewage collection system that cross the zone. The construction of some collection system segments will also cause serious impacts on riparian biota along minor drainages north and west of San Antonio and along portions of Salado Creek. The improvement in stream water quality will be reflected in a substantial increase in the quality of the aquatic habitat below the existing outfall locations. There is a substantial archeological resource in the area, particularly along the streams, that could be endangered by excavation for the collection system segments, but a program is under way to ensure that this resource is investigated before excavation begins.

The most significant secondary impacts of the proposed project are associated with the population growth and attendant urbanization that will be supported by the project. The increased urban activity may aggravate the existing air quality problems in the area, particularly with respect to particulates and oxidants. The urban growth will also result in the removal of prime farmland soils from productivity, but most of the urban growth will occur on the northern edge of San Antonio where prime farmland soils are not abundant. The surface-water hydrology of the watersheds that become more urbanized will be affected principally by reduced baseflow and increased flood peaks brought on by the added impervious area. Urban runoff increases will result in added non-point source pollution and attendant decreases in stream quality. Ground-water in the Edwards aquifer, which is a critical water supply source for San Antonio, will be affected both by the increased withdrawals associated with population growth and by potential urbanization over the aquifer's recharge zone in the northern fringe of the city. Urbanization will also remove a substantial acreage of wildlife habitat in the hill country north of the city.

4. Summary of Alternatives Considered

A total of 26 different alternatives were considered for the proposed action. These alternatives are variations of seven basic types of alternatives:

(1) Upgrade the Rilling Road, Leon Creek, and Salado Creek plants in place

(2) Build a new plant or a tertiary treatment plant at the Salado Creek plant location

(3) Build a new plant near the confluence of the Medina and San Antonio Rivers

(4) Build a new treatment plant near Mitchell Lake

(5) Build a tertiary treatment plant near Mitchell Lake

(6) Pipe secondary-treated effluent to Mitchell Lake and pump from the lake for land application

(7) Take no action

Several non-structural alternatives were also considered to meet the needs of the program.

5. Federal, State and Local Agencies and Other Sources From Which Comments Have Been Requested:

Federal:

U.S. Department of the Interior
U.S. Department of Health, Education and Welfare
    Public Health Service
U.S. Department of Agriculture
    Soil Conservation Service
    Agricultural Stabilization and Conservation Service
    Forest Service
    Farm and Home Administration
U.S. Department of Housing and Urban Development
U.S. Department of Energy
U.S. Department of Commerce

U.S. Department of Transportation
Federal Highway Administration
Federal Aviation Administration
U.S. Army Corps of Engineers
Water Resources Council
Advisory Council on Historic Preservation
Office of Archeology and Historic Preservation
Kelly Air Force Base
Brooks Air Force Base
Randolph Air Force Base
Fort Sam Houston
Honorable John Tower - U.S. Senate
Honorable Lloyd Bentson - U.S. Senate
Honorable Henry B. Gonzales - U.S. House of Representatives
Honorable Robert Krueger - U.S. House of Representatives
Honorable Abraham Kazan, Jr. - U.S. House of Representatives

State:

Texas Budget and Planning Office (A-95 Clearinghouse - distributes statements to all state agencies)
Texas Department of Water Resources
Texas Historical Commission
San Antonio River Authority
Cibolo Creek Municipal Authority
Guadalupe-Blanco River Authority

Local Agencies, Environmental Groups, and Other Interested Parties:

San Antonio 201 Advisory Committee
San Antonio City Manager
Honorable Lila Cockrell, Mayor of San Antonio
San Antonio City Council
San Antonio Department of Public Works
San Antonio Department of Planning
San Antonio Metropolitan Health District
San Antonio City Water Board
Alamo Area Council of Governments (208 Areawide Wastewater Treatment Management Planning Agency)
City of Alamo Heights
City of Balcones Heights
City of Castle Hills
City of Kirby
City of Leon Valley
City of Olmos Park
City of Terrell Hills
Concord Public Utilities District
Denton Utilities

Gateway Water Supply Co.
San Antonio State Hospital
San Antonio Chest Hospital
Timber Creek Public Utilities District
Windcrest Water Control and Improvement District No. 10
City of Schertz
City of China Grove
City of Converse
City of Elmendorf
City of Grey Forest
Hill Country Village
City of Hollywood Park
City of Live Oak
City of Selma
City of Shavano
City of Somerset
Universal City
City of Garden Ridge
City of Cibolo
City of Marion
City of La Vernia
County Judge A. J. Ploch
County Commissioner's Court
Greater San Antonio Chamber of Commerce
Junior Chamber of Commerce
Alamo City Chamber of Commerce
Mexican Chamber of Commerce
South Bexar County Chamber of Commerce
North San Antonio Chamber of Commerce
South Texas Chamber of Commerce
Greater Randolf Area Chamber of Commerce
Edwards Underground Water District
Bexar Metropolitan Water District
Bexar County Water Control and Improvement District No. 13
Bexar County Water Control and Improvement District No. 16
Bexar County Water Control and Improvement District No. 17
Bexar County Water Control and Improvement District No. 18
Booker Public Utility District
San Antonio Municipal Utilities District No. 1
City Public Service
San Antonio Express
The News
San Antonio Light
Aquifer Protection Association
VOICE
Alta Association
King William Association
Pomona Grange
Downtown, Inc.
American Federation of Government Employees

American Institute of Architects
Teamsters Local 657
Communities Organized for Public Service (COPS)
Monte Vista Association
Texas Society of Professional Engineers
National Alliance of Businessmen
San Antonio Apartment Association
San Antonio Urban Council
San Antonio Board of Realtors
Associated General Contractors
Building and Trades Council
AFL-CIO
American Institute of Planners
American Association of Retired Persons
Mexican American Unity Council
Bexar County Farm Bureau
Harlandale Lions Club
Highland Park Lions Club
Greater San Antonio Builders Association
Alamo Soil and Water Conservation
Independent Cattlemen's Association
C.U.R.E.
San Antonio Planning Commission
League of Women Voters
Conservation Contractors of Texas
Sierra Club
National Wildlife Federation
Sportsmen's Clubs of Texas
National Audubon Society
Environmental Defense Fund
Natural Resources Defense Council
Izaak Walton League of America
Texas Organization for Endangered Species
Nature Conservancy - Texas Chapter
Texas Committee on Natural Resources

6. Date Made Available to EPA and the Public:

April, 1978

7. Distribution of Final Environmental Impact Statement:

The final environmental impact statement will be sent only to those agencies and interested parties who request a copy or who make substantive comment on the Draft EIS.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

EXECUTIVE SUMMARY

1.0 INTRODUCTION

The City of San Antonio seeks to participate in the federal water pollution control program set forth in the Federal Water Pollution Control Act Amendments of 1972 (FWPCAA) by applying for a grant for upgrading municipal wastewater treatment facilities under the provisions of Section 201 of the Act. The purpose of this EIS is to meet the requirements of the National Environmental Policy Act of 1969 (NEPA), because the federal action of granting the Section 201 funds to San Antonio has been judged to be a significant action affecting the quality of the human environment.

2.0 DESCRIPTION OF THE EXISTING ENVIRONMENT

The study area used in this Environmental Impact Statement (EIS) is the 201 planning area that is also being used in preparation of the 201 Facilities Plan. This area is entirely in Bexar County, Texas, and includes most of the watersheds of Leon Creek, Salado Creek, and the upper San Antonio River to the confluence with the Medina River. The total environment is divided into natural and man-made aspects, and each aspect is discussed separately. Supporting documentation is provided in a Technical Reference Document.

2.1 Natural Environment

The San Antonio area enjoys a humid subtropical climate with continental influences during the winter. Rainfall is usually sufficient for agricultural activities, but snowfall is rare. Thunderstorms are fairly common, and sometimes produce short-term high rainfall rates. Tornadoes are very unusual in the San Antonio area, and tropical storms only occasionally affect the area. On an annual basis, southeasterly and southerly winds are most prevalent in the area. Dispersion conditions are generally good.

The major existing odor sources in San Antonio are the stockyard area, various industrial plants, Mitchell Lake, and the Rilling Road treatment plant. Current plans to continue the clean-up of Mitchell Lake should essentially remove this source of nuisance. Other odor sources in the study area have been responsive to complaints and have reduced odors to the extent possible. A recent study by the city has shown that significant levels of a very offensive gas, hydrogen sulfide (H_2S), do exist on the grounds of the Rilling Road plant. Detectable levels of H_2S most probably affect residential areas within one mile of the plant.

Currently, air quality in San Antonio is relatively good for a large urban area. However, violations of the ambient air standards for total suspended particulates (TSP) and photochemical oxidants are of some concern. Apparent violations of the TSP standard have been short-term, localized events which may be caused by fugitive dust from both natural and man-made sources. Photochemical oxidant violations, as in many urban areas of the state, constitute a regional problem that is not well understood.

The noise environment of San Antonio is quite typical of similar metropolitan areas in the United States. Most noise sources are associated with major traffic thoroughfares and the airports. Residential areas are characterized by low to moderate noise levels that permit pursuit of outdoor activities in most areas without interference from intruding noise. The strongest noise source associated with existing treatment facilities is the Rilling Road plant. However, the ambient noise level in the area is high even without the plant because of the proximity of south Loop 410 and Stinson Field. The Salado Creek and Leon Creek plants emit low levels of noise and are isolated from population concentrations that would be offended by noise.

The topography of the Bexar County area is dominated by the Balcones Escarpment. North of the escarpment, the topography is rugged, and slopes are steep. South of the scarp, the topography is gently rolling. The geology is also quite different on either side of the escarpment. The predominant bedrock type on the north side is hard and mixed hard and soft limestone. South of the scarp, the dominant bedrock lithology is alluvium and clay.

The soils in the San Antonio area are quite varied because of the differences in slope and bedrock type throughout the area. The soils north of the Balcones Escarpment are thin and rocky, whereas south of the scarp they are deep and clayey or sandy in texture.

The City of San Antonio is drained by three major watersheds of the San Antonio River Basin. These watersheds include the Salado Creek, San Antonio River, and Leon Creek basins. Flows within these three streams are normally small, with the 7 day-2 year low flows ranging from 0 cfs on Leon Creek to 11 cfs on the San Antonio River. However, several miles south of San Antonio where the Medina River empties into the San Antonio River, low flows are much greater. The 7 day-2 year low flow of the San Antonio River just below the confluence of the Medina River is 53 cfs.

The water quality of the San Antonio River is generally poor owing primarily to the discharge of treated wastewater from the City of San Antonio's municipal wastewater treatment facilities. The dissolved oxygen sag below the Rilling Road treatment plant discharge is below the stream standard of 5.0 mg/ℓ and does not recover as far as 20 miles downstream. BOD_5, ammonia-nitrogen, and total phosphate concentrations are also excessive in this stream segment.

Leon Creek water quality is also poor as a result of several wastewater discharges to the creek including the Kelly Air Force Base industrial wastewater and the Leon Creek plant municipal wastewater. During low flow conditions the total flow in the stream is composed of treated wastewater, and the dissolved oxygen concentration falls below 5.0 mg/ℓ daily.

With the exception of the short segment below the Leon Creek confluence, the Medina River maintains a generally good water quality. However, this river maintains a relatively large sediment loading as a result of the agricultural activities in its watershed. The water quality of Salado Creek is also relatively good. The quality of this creek is primarily influenced by small package plant discharges and surface runoff.

The water quality of Braunig Lake is considered poor but it maintains an aesthetic appearance. Because make-up water to the lake is withdrawn from the San Antonio River below the treatment plant discharges, the lake is highly eutrophic. However, the recreational usage of Braunig Lake has been maintained.

The water quality of Calaveras Lake is much better than that of Braunig Lake. Much less make-up water has been required from the San Antonio River because the desired water level is generally maintained by surface runoff. The drainage area to the lake is currently free of wastewater sources.

Mitchell Lake was constructed over 75 years ago as a wastewater receptacle for the City of San Antonio, and it remains an integral part of the city's wastewater treatment facilities today. The water quality of this lake is very poor as a result of the continued discharge of treated wastewater and excess waste activated sludge from the city's treatment facilities. The lake is highly eutrophic and malodorous, and it supports no recreational uses.

Ground water is a very important resource in the area because San Antonio is presently totally dependent on water from the Edwards aquifer for municipal water supply. The Edwards aquifer is a limestone aquifer that has secondary (solutional) porosity. Most of the recharge to the aquifer occurs in the western end in Uvalde and Medina Counties. Most of the natural discharge is at the eastern end at Comal and San Marcos Springs in Comal and Hays Counties. The total discharges from the aquifer at present are about 50 percent from natural discharge (springs) and about 50 percent from artificial discharge (wells). The annual water budget (amount of recharge and discharge) is about 500,000 acre-feet. The importance of the Edwards aquifer to the area has resulted in considerable public concern for potential depletion and pollution of the aquifer.

San Antonio and its urban halo contain representatives of three major vegetative associations or three biotic provinces. To the north of the Balcones Escarpment, the Edwards Plateau or "hill country" vegetation predominates. Vegetative elements of the Blackland Prairie lie east and south of the city while the vegetation of the South Texas Plains can be observed to the south. In urban San Antonio, most natural vegetation has been eliminated. The remaining vegetation is restricted to city parks and/or streamcourses. Wildlife in these urban areas are those species that are adapted to urban habitats. The house mouse, house sparrow, cardinal, fox squirrel, and raccoon are typical of these urban "wildlife" species.

Vegetation and wildlife around the periphery of the city have been subjected to habitat removal by agriculture practice or livestock grazing. In spite of these disturbances, some of the habitats still exhibit good stands of mostly native vegetation which support recreationally unimportant wildlife species. Whitetail deer, turkey, mourning dove, and bobwhite quail are important game species.

Aquatic environments in the San Antonio area are largely restricted to the southern third of the city. The southern third of Leon Creek provides comparatively poor aquatic habitat. The southern reaches of Salado Creek and the San Antonio River provide aquatic habitats of moderately good quality. Fishing pressure in these areas can be locally heavy. Calaveras and Braunig Lakes are important recreational areas and support regionally significant sport fisheries.

2.2 Man-Made Environment

The City of San Antonio is experiencing population growth. By 1975 it had over 770,000 people. It is now Texas' second largest city, and the three-county metropolitan area is third largest in the state. The population growth is occurring primarily in the northern portion of Bexar County. The City of San Antonio will have nearly 1.1 million people by the year 2000.

Ethnically, the area is very diverse with large Mexican-American and Anglo communities and a small Black population. Mexican-Americans and Blacks are more dominant in central and southern San Antonio while Anglos are more clustered in the northern portion. The age of the population in 1970 was very young (median age of 24.1) relative to both Texas (26.0) and the U.S. (28.1). The median income and median educational achievement are both relatively low.

The San Antonio area economy has a relatively small manufacturing sector and a large government employment sector because of the military installations. Employment in services, such as insurance and health care, are increasing in importance. However, San Antonio's economic growth is slower than the state's, while unemployment is somewhat high.

As would be expected, residential areas are the predominant land use. Commercial land use is particularly extensive in the Central Business District and in the north along North Loop 410. Industrial developments are scattered near the Central Business District and to the east. Military installations represent a major land use in San Antonio. Land use projection shows considerable growth in residential development in the north half of Bexar County.

San Antonio has a wealth of archaeological and historical resources which are being actively protected. The pre-Columbian Indians were active in the central Texas area and artifacts abound, particularly along the streams. The Spanish era had a tremendous impact on San Antonio, both architecturally and culturally. The total number of historic sites and structures is impressive, even from national perspectives.

San Antonio is not particularly well endowed from a natural resource perspective, if sales are the only criterion. Cement and stone are the most important, although there is some recoverable lignite in southern Bexar County. Electric power is provided by gas and coal-fired plants. The future will see more reliance on lignite or coal, and nuclear power.

The existing wastewater treatment facilities of the City of San Antonio consist of a large sewage collection system and three regional sewage treatment plants as well as several smaller, local treatment plants. The three regional treatment plants are the Rilling Road plant (capacity: 93.5 MGD), the Leon Creek plant (capacity: 24 MGD), and the Salado Creek plant (capacity: 24 MGD).

The ground transportation system of San Antonio reflects the importance of the automobile, especially in the northern suburban areas. This pattern will continue into the near future. The heaviest traffic is on the Interstate highways leading to the CBD and along Interstate 410 in the north.

3.0 SYSTEM ALTERNATIVES

A systematic method of development was used to identify all reasonable system alternatives sufficient for attainment of the project objectives. Both structural and non-structural subsystems were considered. An inventory of the existing facilities and their capability was compared with the effluent limitation requirements imposed under the provisions of the FWPCAA. From this comparison, the necessary improvements were identified. This process forms the basis for the identification of system alternatives evaluated in the EIS.

A total of 26 alternatives including the "no action" alternative were identified for evaluation. These selected alternatives actually represent variations of seven basic types of alternatives. These seven basic alternatives are as follows:

Alternative Type	Summary Description
1	Upgrade Rilling Road, Leon Creek, and Salado Creek plants in place.
2	Build a new plant or tertiary plant at Salado Creek plant location.
3	Build a new plant near the confluence of Medina and San Antonio Rivers.
4	Build a new treatment plant near Mitchell Lake.
5	Build a tertiary treatment plant near Mitchell Lake.
6	Pipe secondary effluent to Mitchell Lake and pump from the lake for land application.
No Action	Take no action.

The 26 selected alternatives were rigorously evaluated for cost-effectiveness. This analysis includes both an environmental and economic evaluation in which the selected alternatives were ranked and a final cost-effective alternative was selected.

According to the evaluation criteria, three system alternatives emerged as the most desirable and were more closely evaluated. The cost-effective, environmentally-compatible alternative was determined from among the three remaining alternatives. However, the proposed action selected was the second most cost-effective alternative. This decision was based on the city's desires to replace the Rilling Road treatment plant with a new plant at some distance south of the city near the confluence of the San Antonio and Medina Rivers. The proposed action is more costly than the cost-effective alternative, but it will have approximately the same magnitude of environmental impact. The city has agreed to provide the difference in cost between the cost-effective, environmentally-compatible action and the proposed action actually selected in order to meet the city's desires to construct a new plant at a downstream location.

4.0 DESCRIPTION OF THE PROPOSED ACTION

The proposed action for the improvements of San Antonio wastewater treatment facilities includes the following principal elements:

- Abandon the existing Rilling Road treatment plant
- Expand and improve the Leon Creek and Salado Creek plants
- Construct a new wastewater treatment facility near the confluence of the San Antonio and Medina Rivers
- Emplace sewage transfer lines from the existing Rilling Road site and the Leon Creek and Salado Creek plants to the new Confluence treatment plant

The new Confluence site will accept raw sewage from the present Rilling Road plant service area and will also accept secondary-treated effluent from the Leon Creek and Salado Creek treatment plants. The new plant will treat the raw sewage from the Rilling Road service area to a secondary level of treatment. This secondary treated effluent will be combined with the effluent from the Leon Creek and Salado Creek plants, and the combined waste will be treated to a tertiary level of treatment. The tertiary-treated effluent will be discharged at a point in the San Antonio River near the confluence of the Medina River.

The Salado Creek plant will be expanded from approximately 24.0 MGD to 36.0 MGD and the Leon Creek plant will be expanded from approximately 24.0 MGD to 35.0 MGD. The new facility at the confluence will have a capacity to treat approximately 83 MGD of raw wastewater to a secondary level, and subsequently approximately 154 MGD of secondary treated wastewater to a tertiary level. The existing Rilling Road plant will be dismantled and the site will be designated for other uses.

In addition to these improvements, the city is currently expanding the existing collection system by constructing several new sewer lines. An infiltration and inflow analysis has also been completed, and an extensive rehabilitation program is underway to improve the collection system. These expansions and improvements are included as part of the proposed action.

5.0 ENVIRONMENTAL EFFECTS OF THE PROPOSED ACTION AND MITIGATIVE MEASURES FOR ADVERSE EFFECTS

The effects of the proposed action on the existing environment are summarized in this section.

5.1 Natural Environment

The climate of the San Antonio area is not expected to be affected significantly by the facilities of the proposed action.

The proposed action will have a substantial benefit to the area within one mile of the Rilling Road treatment plant, particularly the historic Mission Trail area. The replacement of this plant with the new Confluence plant will eliminate odors generated by plant processes at this site. But the potential for significant odors will still be present due to the addition of the Rilling-to-Confluence raw sewage transfer line. The release of offensive odors from man-holes along this transfer line and at the headworks of the new Confluence plant may warrant predisinfection measures. The rural nature of the new Confluence plant site will result in low odor impacts from the plant itself.

The primary air quality impacts will occur from construction activities attendant to collector system rehabilitation upgrading of the existing Salado and Leon Creek wastewater treatment plants, and the construction of the new Confluence plant. The amount of dust generated without preventive measures could total approximately 500 tons over the entire construction period. Most of this will be at the new Confluence plant site. Because of the rural nature of the treatment plant construction sites and the generally localized nature of dust dispersion, impacts should be minor. Dust generated by collector system construction in residential areas may cause a short-term nuisance condition that is unavoidable. Secondary growth-related impacts can also be expected due to increased urban activity and attendant air pollutant emissions. The impact of these new emissions on currently high photochemical oxidant levels is difficult to predict.

The impacts of noise associated with construction of the interceptor system are expected to be minor and occur only in those areas where outdoor activities are sensitive to noise intrusion. Schools, parks, and other recreational areas may be subjected to construction noise that may be intermittently disruptive. These effects will be transient, lasting only for a few days in most cases. Noise from construction activities at each of the wastewater treatment plants is not expected to create adverse impacts of sufficient degree to be of concern. Operation of the wastewater treatment plants is not considered to be a source of environmental noise that will cause adverse impacts.

The most significant geology-related impact of the proposed action is the blasting that will be necessary for emplacement of some segments of the collection system. The greatest impact on the soils will be the permanent removal of about 100 acres of prime farmland soils from agricultural productivity at the treatment plant sites. Urban growth that will be supported by the proposed project may also cover a significant acreage of prime farmland soils.

The major impacts of the proposed project on streamflow in the San Antonio area will occur on those stream segments downstream of the existing outfalls and upstream of the proposed outfall at the new Confluence site. Low flows in these segments will be reduced substantially, resulting in insufficient water for irrigation along these reaches during severe drought conditions. An additional impact of the proposed project on the surface-water hydrology is the reduced baseflow and increased flow peaks caused by increased urbanization in the watersheds of the area. This urbanization is supported but not enhanced by the proposed project.

Implementation of the proposed action will improve the water quality of the San Antonio River to a level consistent with the stream standards. Additionally, the recommended removal of the Leon Creek treatment plant discharge will improve the water quality in the Leon Creek segment from the existing outfall to its confluence with the Medina River and in the Medina River segment from the confluence with Leon Creek to the confluence with the San Antonio River. However, the water quality of Leon Creek will remain poor primarily due to the continued discharge of treated water from various other sources. No other significant primary impacts are anticipated on the area streams. Secondary impacts resulting from construction activities and increased urbanization will be minimal.

The proposed action will have little or no effect on the water quality of the area lakes. The intake for the cooling lake's make-up water is below the proposed outfall and nutrient removal is not included with the proposed action. Therefore, nutrients should continue to enter the cooling lakes at the present rate. Mitchell Lake will be removed as an integral part of the treatment facilities as a result of the proposed action. Studies are presently underway to determine the future management of this lake.

The most significant impacts of the proposed project on ground water are related to the very important Edwards aquifer. The water quality of the aquifer could be affected directly if the collection system line segments that are emplaced in the recharge zone leak and allow sewage to enter the aquifer directly. The direct impact of the collection system on the Edwards aquifer recharge zone will be mitigated by following the provisions of the Texas Department of Water Resources order, which stipulates strict pipeline construction measures to prevent sewage leaks. The indirect impacts will occur as a result of the population increase and attendant increase in urbanization that will be supported by the project. The increasing number of people in San Antonio will result in an increased withdrawal of water from t aquifer because the city presently takes all its municipal water supply from the Edwards. This increased withdrawal will aggravate the existing depletion problem of the aquifer. The potential depletion problem at the aquifer caused by population increases can best be mitigated by development of a comprehensive aquifer management plan. The increased urbanization will be primarily northward in the direction of the Edwards recharge zone. If urbanization is allowed to occur in the recharge zone, the urban runoff may seriously damage the water quality of the aquifer. The potential pollution problem caused by urbanization over the Edwards recharge zone should be largely mitigated when the results of an ongoing study of the type and amount of urbanization that can safely occur are known and when the results are incorporated into city policy.

Environmental impacts on terrestrial and aquatic biota in the San Antonio planning area will result from construction and operation of new treatment facilities, transfer lines, and the interceptor system. Impacts on terrestrial biota resulting from construction of the new treatment facilities and their associated transfer lines are expected to be minor. Construction of the interceptor system will cause serious direct and indirect impacts on terrestrial and riparian biota along minor drainages north and west of the city and along segments of Salado Creek. These impacts will arise from vegetation removal, wildlife displacement and loss of additional habitat during future urbanization of previously unsewered areas. Measures to mitigate the relatively small losses of vegetation and wildlife focus primarily on quick revegetation of areas denuded during construction.

Impacts on aquatic biota associated with construction of new treatment facilities and transfer lines will be minimal. A segment of Leon Creek will lose its flow entirely, causing potential disease vector control problems. A segment of the San Antonio River will undergo a 90 percent reduction in flow, but there will nevertheless be an increase in remaining aquatic habitat quality. Discharge of 154 MGD of tertiary-treated sewage effluent to the San Antonio River will not cause serious adverse impacts due to the comparatively good quality of the effluent, particularly in comparison with the existing effluent quality. Aquatic habitats along the southern one-third of Salado Creek and along minor drainages to the north and west of the city will be subjected to major disturbance or destruction as segments of the interceptor system are constructed.

Although biologically sensitive areas exist in the San Antonio area, most will not be directly affected by the proposed action. Notable exceptions are stands of riparian vegetation and wildlife along segments of Salado, Elm, Mud, and Panther Springs Creeks. Future urbanization of previously unsewered area in the urban halo of San Antonio will further deplete available habitats.

5.2 Man-Made Environment

The proposed action will have little or no effect on the present or future population of the area. Economically, these activities will stimulate the local economy through the materials purchased in the area and the employment generated by construction and operation. The land use pattern which already exists will be maintained and reinforced to some extent by these activities.

Some historical and archaeological resources may be threatened by construction activities. However, appropriate engineering design and advanced reconnaissance by archaeologists should insure the protection of heretofore undetected resources. The proposed action will allow the Rilling Road plant to be decommissioned, which will make the Mission Trail a more attractive resource.

6.0 HIGHER-ORDER EFFECTS OF THE PROPOSED ACTION

One of the most significant higher-order effects of the Section 201 facilities that constitute the proposed project is their potential impact on the Section 208 water quality management planning in progress in the Bexar County region.

However, several 201/208 coordination meetings have been held to ensure that the planning of the two programs is compatible. The facilities planned for funding under Section 201 do not preclude any of the options under consideration in 208 planning efforts.

Several resources are irreversibly and irretrievably committed by the proposed project. The major resources that will be directly consumed are construction materials and prime farmland soil areas that will be used during construction. During operation, substantial quantities of electrical energy will be consumed by the treatment plants. The population growth that will be sustained by the proposed project will consume far larger quantities of resources than are used by the project directly.

The Edwards aquifer and the issues associated with it are topics of widespread concern in the San Antonio area. This concern is derived from five aspects of the aquifer:

- The almost total reliance of the city on the aquifer for municipal water supply,
- The wide perception of the susceptibility of the aquifer to contamination by urbanization over the recharge zone of the aquifer,
- The northward encroachment of San Antonio urban growth over the recharge zone,
- The danger that the aquifer will be depleted as municipal and other water demands increase, and
- The presence of interest groups who wish to protect the aquifer.

The proposed project will support urban growth that will contribut to two problems associated with the aquifer--depletion and pollution. However, it should be recognized that the proposed project is designed only to meet the sewage treatment needs of population growth that is expected to occur with or without the project.

The depletion problem of the Edwards aquifer will worsen as the population increases and places additional demands on the water supply in the aquifer. The Edwards Underground Water District was created by the Texas Legislature in 1959 to help protect the aquifer from depletion, particularly during periods of drought. A comprehensive aquifer management plan to allocate the available water in the Edwards is clearly needed in the interest of San Antonio and other water users who rely on the aquifer as a water source.

The City of San Antonio has commissioned a study of the Edwards aquifer to identify the type and intensity of development that can be sustained over the recharge zone of the aquifer without damaging the quality of the ground water. The results of this study should be adopted as development control policy by the city as soon as they are known.

The proposed project is not expected to solve all the water quality problems of the streams in the area, but the stream standards are expected to be met after the proposed facilities are in operation. It is expected that the peripheral adverse environmental effects of the project will be more than offset by the greatly enhanced quality of the streams in the area.

1.0 INTRODUCTION

The Federal Water Pollution Control Act Amendments (FWPCAA, PL 92-500) were enacted in 1972 in order to establish a water pollution control program to protect the quality of the Nation's navigable waters. The City of San Antonio is participating in this federal pollution control program to achieve the current and future water quality goals for streams in the area and to prevent violations of water quality standards.

The basic objective of the FWPCAA is to eliminate the discharge of pollutants into the navigable waters of the U.S. by 1985. The pollution control program set forth in the FWPCAA provides for research into pollution control, establishes requirements for industrial and municipal waste treatment facilities, requires a planning process which will result in water quality standards for the navigable waters of the nation, sets up a permit and license system for discharges into the nation's waters, and provides for a massive grant-in-aid program for the construction of publicly-owned treatment works. The purpose of the grant-in-aid program is to assist municipalities in meeting the stringent water quality goals and standards of the FWPCAA.

Two interim objectives were set forth in the FWPCAA to help achieve the 1985 "zero discharge" goal. By July 1, 1977 publicly-owned treatment works were required to provide secondary treatment, and by July 1, 1983, they are required to provide the best practicable waste-treatment technology. The 1977 Amendments to the FWPCAA (Clean Water Act of 1977, PL 95-217) have extended the deadlines for these interim objectives in those systems where Federal funds have been required but unavailable. The feasibility or environmental desirability of meeting the "zero discharge" goal by 1985 has not been established. However, the stringent interim requirements will be enforced. Since the July 1, 1977 date has now passed, the City of San Antonio will be required to meet the "1983 type" requirements for controlling conventional, non-conventional and toxic pollutant categories.

The City of San Antonio and its municipal sewage effluent discharge points are located in the San Antonio River basin. A Water Quality Management Plan for this basin (TE-330)* has been prepared by the Texas Department of Water Resources (formerly Texas Water Quality Board) under the provisions of Section 303(e) of the FWPCAA. Six stream segments are recognized in the basin plan, which sets forth water uses deemed desirable and water quality standards for each segment. The segment of interest for San Antonio municipal treatment works is Segment 1901. For this segment, the water uses deemed desirable are domestic raw water supply, propagation of fish and wildlife, and noncontact recreation (TE-263). The segment is deemed not presently suitable for contact recreation.

The water quality standards established for Segment 1901 are as follows (TE-263):

Constituent	Standard
Chloride	200 mg/ℓ (avg. not to exceed)
Sulphate	150 mg/ℓ (avg. not to exceed)
Total Dissolved Solids	700 mg/ℓ (avg. not to exceed)
Dissolved Oxygen	5.0 mg/ℓ (not less than)
pH Range	6.5 - 8.5
Fecal Coliform	1000/100 ml (log. avg. not more than)
Temperature	90°F

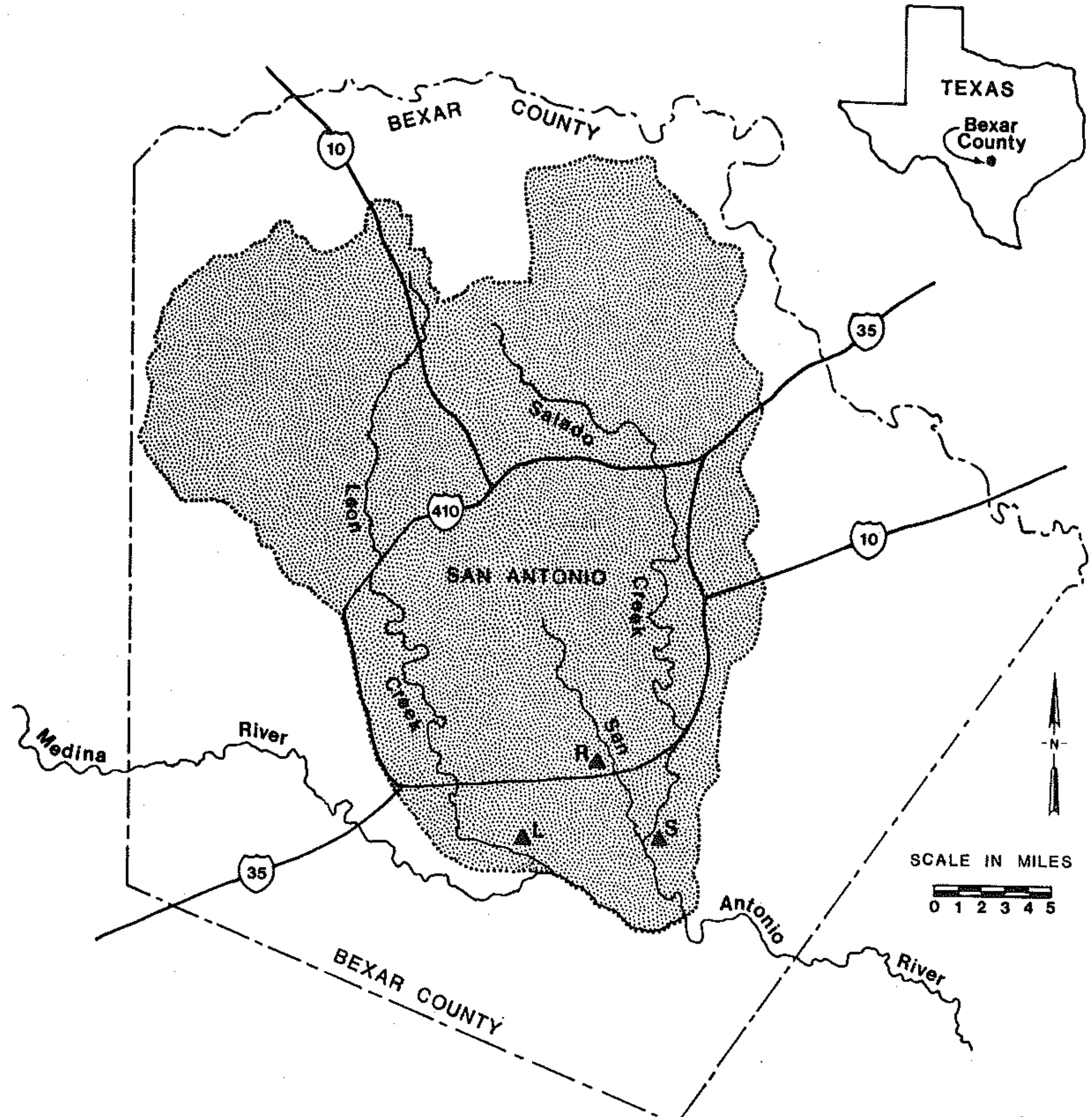
*Designation refers to reference listed in bibliography.

Segment 1901 has been classed as a "water quality limited segment," which indicates that the measured instream water quality does not meet the above proposed water quality standards or cannot meet the standards with 1977 level treatment. Waste load allocations have been made for the segment, and permits (Waste Control Orders) have been issued for the San Antonio wastewater treatment plants and other point sources of pollution. These permits include effluent limits to be met until July 1, 1977 and proposed effluent limits to be met after July 1.

Because the treatment plants of San Antonio could not meet the more strict effluent limits in force after July 1 with existing facilities, the City's Department of Public Works applied to the Texas Department of Water Resources (TDWR) and the Environmental Protection Agency (EPA) for a construction grant under the provisions of Section 201 of FWPCAA. Section 201 provides for grants-in-aid to municipalities (up to 75% of project costs) to upgrade their treatment facilities to meet FWPCAA requirements. Subsequently, approval was given for Step 1 of this grant. The grant number is C-48-1211-01. A map showing the approximate location of the San Antonio 201 planning area is shown in Figure 1-1.

In addition to the City of San Antonio, several other communities and installations will eventually be provided sewage collection and treatment service by the upgraded treatment facilities. The existing separate sewage collection systems that are expected to be included in this extension of service by the year 2000 are as follows (PA-275):

Meadow Village
Alamo Heights
Terrell Hills
Kelly Air Force Base
Lackland Air Force Base
Brooks Air Force Base



201 PLANNING AREA (APPROXIMATE)
L LEON CREEK SEWAGE TREATMENT PLANT
R RILLING ROAD SEWAGE TREATMENT PLANT
S SALADO CREEK SEWAGE TREATMENT PLANT

FIGURE 1-1

SAN ANTONIO 201 PLANNING AREA AND REGIONAL SEWAGE TREATMENT PLANTS

Olmos Park
Castle Hills
Balcones Heights
Leon Valley
Windcrest
Kirby
Grey Forest
Shavano Park
Hollywood Park
Hill Country Village
Fort Sam Houston
Martindale Army Airfield (National Guard)
Gateway
Lackland City
Westwood Village
Concord Public Utility District
Timber Creek Utility District
Southton
Canyon Creek Country Club
Canyon Oaks Mobile Home Park
Industrial Park

The alternative actions considered for grant C-48-1211-01 consist primarily of improvements and expansions of the existing interceptor and collector system and the existing wastewater treatment plants. Several non-structural alternatives, such as administrative decisions and policies, were also considered. The City presently operates three regional treatment plants--the Rilling Road, the Leon Creek, and the Salado Creek treatment plants. The locations of these treatment plants are shown in Figure 1-1. These existing plants provide the framework for the structural alternatives that were considered. Detailed maps and descriptions of the existing wastewater treatment facilities are given in Chapter 3 of this EIS. The cost of upgrading and expanding the interceptor and collector system is approximately $130 million, but not all of these improvements are grant-eligible. The expansion and improvement of the treatment plants will cost between $138 and $150 million, including both capital costs and operation and maintenance costs. About $68 million (the capital cost portion) will be eligible for support by a Section 201 grant.

The National Environmental Policy Act (NEPA, PL 91-190) requires that Environmental Impact Statements (EISs) be prepared for federal actions that significantly affect the quality of the human environment. Section 511(c)(1) of FWPCAA requires that NEPA apply to the awarding of grants for public wastewater treatment systems under Section 201 of FWPCAA. It was decided by EPA early in the grant-awarding process for the City of San Antonio that the funding of the proposed sewage treatment facilities improvements constitutes a federal action requiring the preparation of an EIS. The Notice of Intent to prepare an EIS was issued on 14 May 1976.

The objectives of this EIS are to: (1) build into the decision-making process an appropriate and careful consideration of all environmental aspects of the proposed action, (2) explain potential environmental effects of the proposed action and its alternatives for public understanding, (3) avoid or minimize adverse effects of the proposed action, and (4) restore or enhance the quality of the environment as much as possible.

In most cases in the past, EIS's prepared for Section 201 grants have been prepared after Step 1 of the grant process (Facilities Plan) has been completed. Thus, the plans for the facilities to be constructed were already made before the EIS was begun. This approach was less than optimal because the findings of the EIS sometimes necessitated changes in the Facilities Plan after it was completed. The early determination of the need for an EIS for the San Antonio grant has resulted in the preparation of the EIS simultaneously with formulation of the Facilities Plan. This procedure has increased the input of environmental considerations into the facilities planning process for San Antonio.

In order to obtain input from representatives of the citizens of San Antonio during the wastewater facilities planning process, a Wastewater Facilities Planning Advisory Committee was created by the City Council of San Antonio (Ordinance 46511, 8 April 1976 and Ordinance 46580, 22 April 1976). This committee is composed of representatives of several interest groups in the San Antonio area. The committee has met monthly since its inception to receive progress reports and make recommendations to the San Antonio Department of Public Works and its consultants. The committee has provided guidance and made several key decisions in the formulation of the Facilities Plan and this EIS. The role of the committee in this decision-making process is outlined at appropriate places in this EIS.

Another key factor in the formulation of the Facilities Plan and this EIS is the coordination with the areawide water quality planning being conducted in the San Antonio region under the provisions of Section 208 of FWPCAA. The agency responsible for 208 water quality planning efforts in the San Antonio area is the twelve-county Alamo Area Council of Governments (AACOG). The planning efforts being conducted under Section 201 and Section 208 have proceeded concurrently in the San Antonio area, although the 201 planning has been somewhat ahead of the 208 efforts. Several coordination meetings between representatives of the 208 and 201 efforts were held to ensure that the goals and procedures of the two programs were kept in line with each other. The decisions that were made as a result of these coordination meetings are presented at appropriate points in this EIS.

Additional supportive material and tabular data for the EIS have been compiled in a Technical Reference Document (RA-R-420). This document, which contains detailed information that may be of interest to specialists in specific disciplines, is available for review at the following reference centers:

- San Antonio Public Library
  203 South St. Marys
  San Antonio, Texas

- Rilling Road Sewage Treatment Plant
  1600 Rilling Road
  San Antonio, Texas

- Department of Public Works
  San Antonio City Hall
  West Commerce and Military Plaza
  San Antonio, Texas

- Texas Department of Water Resources
  Stephen F. Austin Building
  1700 North Congress Avenue
  Austin, Texas

- Region VI Headquarters
  Environmental Protection Agency
  First International Building
  1201 Elm Street
  Dallas, Texas

This EIS was prepared for EPA Region VI by Radian Corporation, the environmental consulting firm for the project. Much of the engineering information for the alternatives and the proposed project was provided by the 201 Facility Plan consulting firm, which is a joint venture of Pape-Dawson, Inc., Vickrey and Associates, Inc., and Lockwood, Andrews, and Newnam, Inc.

2.0 DESCRIPTION OF THE EXISTING ENVIRONMENT

The existing environment of the San Antonio area is divided into the natural environment and the man-made environment. The natural environment includes things which are external to, but which influence and are influenced by man's social structures. The man-made environment includes the products of man and his social structures.

This chapter provides a background for assessing the environmental impacts of the proposed wastewater treatment facilities. The study area is defined as the San Antonio 201 planning area, which is delineated in Figure 1-1. This chapter summarizes information directly pertinent to the impact assessment. Supportive detail is contained in the Technical Reference Document (RA-R-420).

2.1 Natural Environment

The natural environment can be conveniently divided into two major categories--physical components and biological components.

2.1.1 Physical Components

The physical components of the natural environment include climate, odor, air quality, noise, geology, soils, and hydrology. Each component is treated separately in the following sections.

2.1.1.1 Climate

The San Antonio area enjoys a humid subtropical climate with continental influences during the winter. The average annual temperature at San Antonio is 68.8°F, with an average daily maxi-mum of 79.8°F and an average daily minimum of 57.8°F. The warmes months of the year are July and August, each of which has a month average temperature of 84.7°F. The coolest month of the year is January, which has an monthly average temperature of 50.7°F. The mean length of the freeze-free period (between the last 32°F tem-perature in the spring and the first 32°F temperature in the fall is 268 days.

The average annual precipitation at San Antonio is 27.5 inches. Annual precipitation since 1936 has ranged from 13.70 inches in 1954 to 52.28 inches in 1973. The wettest month is September, when an average of 3.71 inches of rain falls. The driest month is December, with an average of 1.46 inches of precipitation (NA-273). Snowfall is rare.

The mean annual Class A pan evaporation is 85 inches. Lake evaporation averages 58 inches annually. Annual evaporatio excess averages 28 inches (evaporation excess equals lake evapora tion minus precipitation) (OR-021). The relative humidity at Sa Antonio averages about 67 percent. The most humid month is May, when the relative humidity averages approximately 71 percent. The driest month is August, with an average humidity of about 60 percent (UT-308). Heavy fog (which restricts visibility to one-fourth mile or less) occurs on an average of twenty-three days during the year. The highest frequency of heavy fog occurs during the winter months (NA-273).

Wind speeds in the San Antonio area average 9.3 mph on an annual basis. Winds tend to be stronger in the spring months than in other months of the year. April is the windiest month, with an average wind speed of 10.6 mph. The least windy months are September and October, both of which have a monthly average wind speed of 8.4 mph (NA-273).

The annual wind rose for Kelly Air Force Base in southern San Antonio is presented in Figure 2-1. This wind rose shows that southeasterly and southerly winds are the most prevalent winds on an annual basis. On a seasonal basis, southeasterly winds prevail in the spring and summer and south-southeasterly winds prevail in the fall. The highest percentage of winds in the winter are from the north due to the relatively frequent passage of cold frontal systems. However, southerly and southeasterly winds are also common during the winter months.

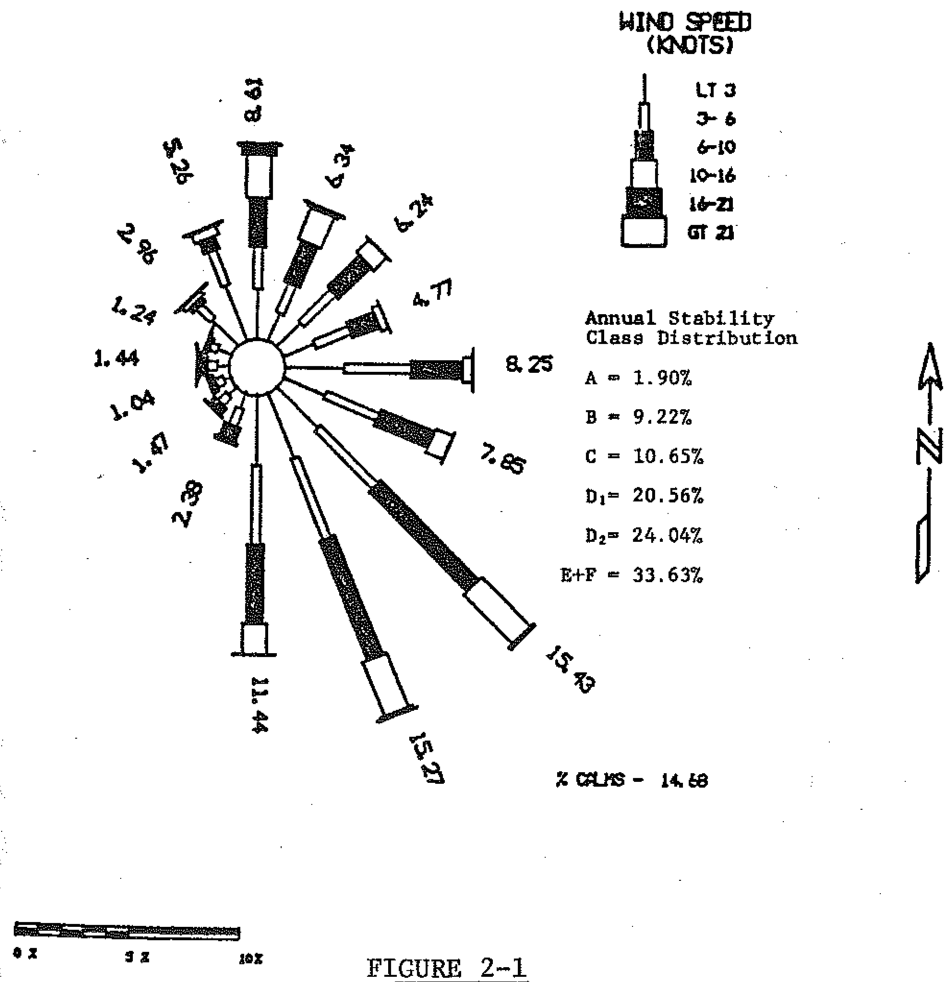


FIGURE 2-1

ANNUAL WIND ROSE

KELLY AIR FORCE BASE (SOUTHERN SAN ANTONIO), TEXAS 1959-1968

An average of 36 thunderstorm days occur during the year at San Antonio. Twenty years of tornado data show that only one tornado in two years can be expected in a 1,000 square mile area that includes San Antonio (OR-021). The proximity of San Antonio to the Gulf of Mexico (140 miles) causes the city to be affected on occasion by tropical storms. The primary effect of these tropical storms on San Antonio is heavy rainfall rather than strong winds. However, the fastest wind recorded at San Antonio, 74 mph, was recorded when a tropical storm moved inland east of the city in August, 1942 (NA-273).

Maximum expected rainfall amounts in the San Antonio area for various durations and selected recurrence intervals are presented in Table 2-1. As an example, a 24-hour rainfall of 9.9 inches may be expected once every 100 years (HE-163).

TABLE 2-1

MAXIMUM EXPECTED RAINFALL AMOUNTS (INCHES) PER DURATION FOR SELECTED RECURRENCE INTERVALS

Rainfall Duration (Hours)	Rainfall Recurrence Interval (Years) 1	2	5	10	25	50	100
½	1.3	1.5	2.0	2.3	2.6	3.0	3.3
1	1.6	1.9	2.5	2.9	3.4	3.8	4.3
2	1.8	2.3	3.0	3.6	4.2	4.6	5.3
3	2.0	2.5	3.3	4.0	4.6	5.2	5.8
6	2.3	3.0	4.0	4.7	5.6	6.2	7.1
12	2.7	3.5	4.7	5.6	6.7	7.6	8.5
24	3.1	4.0	5.5	6.5	7.8	8.8	9.9

Dispersion conditions are generally good in the San Antonio area. The ventilation (mixing depth times wind speed) is lowest during the winter months and highest during the summer (HO-049). On an annual basis, the low-level inversion frequency in the San Antonio area (in percent of total hours) is about 24 percent, a relatively low frequency of occurrence.

2.1.1.2 Odor

The major sources of odor in the San Antonio area, and the sources of greatest concern for the proposed project, are the city's sewage treatment plants. The major sources of odor production in sewage treatment plants are those facilities, including the collection system, which produce anaerobic conditions in the sewage. Hydrogen sulfide (H_2S), which has a rotten egg odor, is the most frequently perceived odor around the treatment plant. H_2S is produced as a metabolic by-product of anaerobic processes in sewage treatment plants and collection systems. Aerobic treatment facilities will help minimize H_2S production, but it is difficult to completely eliminate anaerobic occurrences. Additionally, specific sludge handling facilities, such as anaerobic digesters, are designed to utilize anaerobic bacteria for sludge stabilization. The H_2S which is produced in digesters can be difficult to control.

Treatment plant processes may also produce other malodorous compounds such as organic nitrogen compounds (e.g., pyradine, skatole) and organic sulfur compounds (e.g., mercaptans). Combinations of odors make odor analysis difficult because the presence of various odors in different quantities can have synergistic effects. Since hydrogen sulfide is the only compound for which measured data exist, the following discussion of odor impact is related only to H_2S.

Since odor perception is subjective, it is difficult to assess the environmental effects of odor exposure. However, qualitative effects may be determined by the source or type of odor, the level of exposure, and the sensitivity of the exposed person.

The Salado Creek and Leon Creek plants are operated so that offensive odors are minimized. However, odors associated with H_2S occur within the Rilling Road Plant boundaries. Raw wastewater which has a relatively long travel time before reaching the treatment plant may become septic or anaerobic in the collection system as the available dissolved oxygen is depleted. Once this wastewater reaches the plant, H_2S that is formed within the sewer pipe will be released to the atmosphere. The odor level is highest at the inflow division box at the plant, where H_2S is stripped from the incoming raw wastewater by turbulence. Various other processes at the plant are acknowledged to be odor sources. Leaks in the anaerobic digester covers are also reported to be a source of the malodorous H_2S (GR-348).

The impact of the measurable H_2S levels on the community can be predicted by estimating the reduction in odor concentration as a function of distance from the plant. Concentrations will be reduced with increasing distance from the plant according to a complex set of parameters. In the event wind speed is absolutely zero, reduction in odor concentration is governed by molecular diffusion. In fact, even light winds disperse concentrations rapidly.

Concentrations must be reduced below the threshold level before odor nuisance is removed. This threshold is difficult to define because of variable human sensitivity. A hydrogen sulfide concentration of 0.57 parts per billion (ppb) is the reported population perception threshold (PPT) or the level at which 100 percent of the population will recognize the odor (CH-196). It is difficult to specify which direction from the Rilling Road plant will receive the highest concentrations, because the light, variable winds usually disperse the odors in all directions. The extent of odor nuisance and discomfort caused by exposure to H_2S may be higher or lower than the determined PPT depending on the individual. The question of detectability is a matter of measurement, but the matter of discomfort falls into the area of aesthetics. Other factors that must be considered include the amount of time that an odor is perceived and the presence of other odorous compounds from the treatment plant and/or other sources. A community odor survey could be used to more quantitatively determine the level of odor insult on the community. The OSHA threshold limit value for health in a work environment is 10 parts per million (ppm) (CH-196).

A recent program was undertaken by the City of San Antonio to determine the results of adding hydrogen peroxide (H_2O_2) to raw wastewater at the Rilling Road Plant. The details of this study are described in the Technical Reference Document (RA-R-420). The results of the study were inconclusive since the reduction in H_2S levels was not consistently related to the H_2O_2 addition. However, the study did show that the H_2S levels were quite high and appear to be in excess of the range of concentrations allowed by Texas Air Control Board Regulation 203 (19 January 1974). This regulation allows a maximum concentration of 0.12 ppm averaged over any 30-month period for measurements taken outside the plant boundary. A summary of the test data is given in Table 2-2.

TABLE 2-2

SUMMARY OF AIR TEST DATA FOR ADDITION OF HYDROGEN PEROXIDE TO REDUCE HYDROGEN SULFIDE

Date	Time	H_2O_2 Added?	Between Rilling Primaries	Division Box*
6/15/77	0830	No	.072 ppm_v H_2S**	.238 ppm_v H_2S**
6/21/77	1430	Yes	.032	.192
7/14/77	0900	No	.078	.265
7/15/77	1400	No	.038	.239
7/21/77	0935	Yes	.032	.071
7/22/77	1450	Yes	.057	.321
7/27/77	0830	Yes	.116	.287

*Entrance to plant.

**Units (ppm_v) are parts per million by volume, 30-minute average.

The measurements made in this test program were used to estimate the H_2S dilution as a function of distance from the Rilling Road Plant using the Gaussian dispersion equation (TU-001). The results of this exercise are tabulated in Table 2-3. Three conditions are depicted in the table -- B stability (good mixing), D stability (fair mixing), and F stability (very stable atmosphere). The affected area around the Rilling Road Plant for the worst-case conditions is depicted in Figure 2-2. In the event that the affected area has to be more accurately defined (not likely), the results of the dispersion equation estimates would have to be confirmed by a sampling program.

TABLE 2-3

THREE DISPERSION ESTIMATES FOR H_2S LEVELS AT RILLING ROAD PLANT

1 Downwind Distance (miles)	2 June 21, 1977 Dispersion Under B Stability (ppb_v)*	3 June 15, 1977 Dispersion Under D Stability (ppb_v)*	4 Hypothetical Worst Cast Dispersion (F Stability) (ppb_v)*
0.006	192	238	321
0.01	10	14	19
0.06	3.2	4	5.4
0.12	0.90	1	2.5
0.18	0.40	0.6	1.2
0.24	0.25	0.34	0.74
0.30	0.16	0.22	0.54
0.36	0.11	0.16	0.4
0.42	0.08	0.13	0.3
0.48	0.06#	0.1	0.25
0.54	0.05	0.09	0.20
0.60	0.04	0.07	0.17
0.66	0.03	0.06#	0.15
0.72	0.03	0.05	0.13
0.9	0.02	0.04	0.09
1.2	0.01	0.02	0.059#
1.5			0.042

*H_2S concentration is parts per billion measured near the division box.

#Distance at which odor becomes undetectable (based on odor detection level of 0.057 ppb).

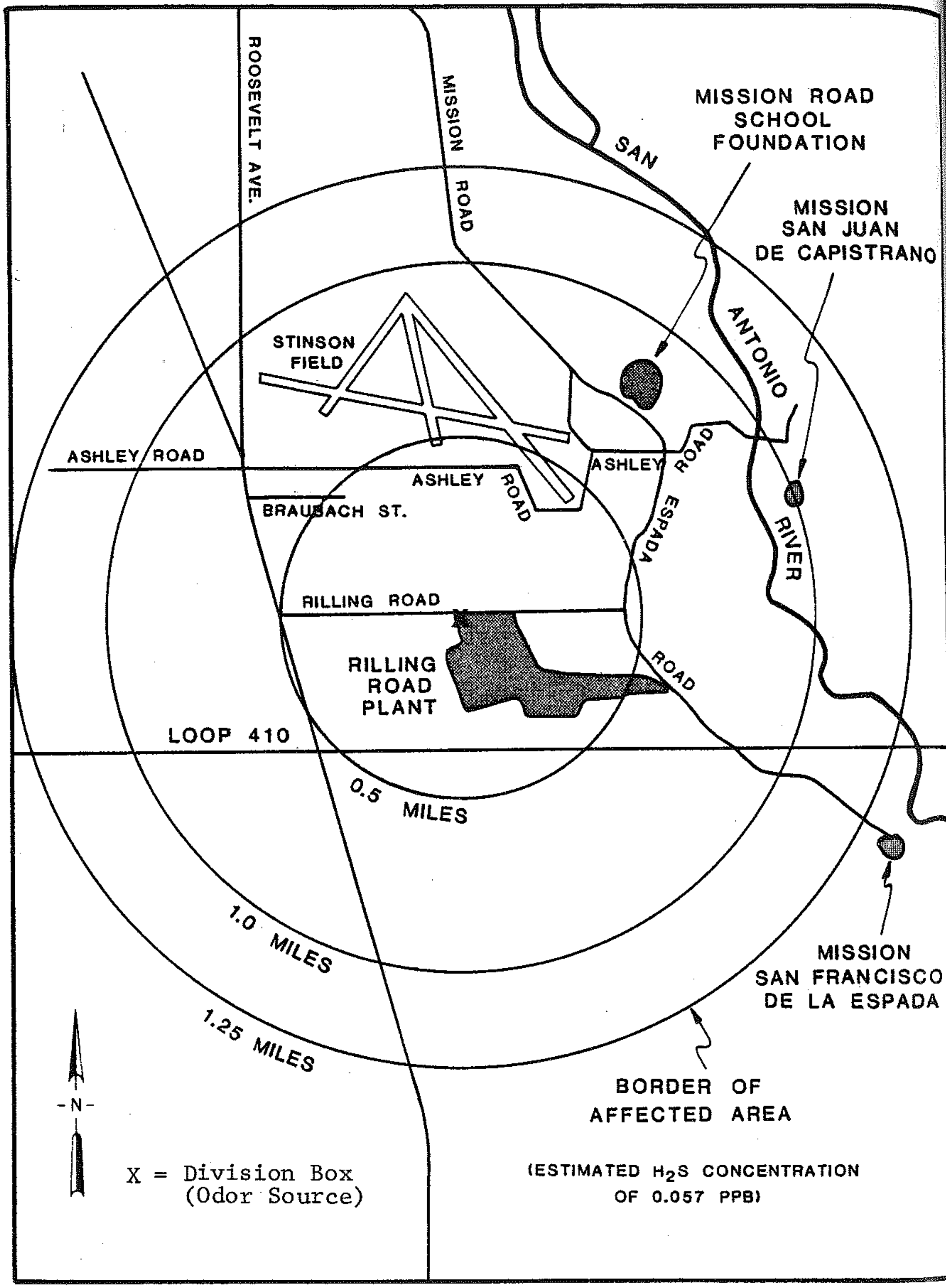


FIGURE 2-2

AFFECTED AREA FROM H_2S ODORS UNDER WORST CASE DISPERSION CONDITIONS

The results of these calculations are in general agreement with those of other investigations. Odor surveys taken from people living near treatment plants in other parts of the country have shown that the highest probability for odor nuisance occurs within one mile of the plant (EN-483). The Mission Trail, part of which is near the Rilling Road Plant, may at times be within the affected area. In general though, the west and southwest winds that would cause the highest impact to the Mission Trail occur infrequently. The U.S. Department of Interior National Park Service has advocated removal of the Rilling Road Plant because of its reported detrimental effect on the visitors' enjoyment of the historical features of the area (see Appendix 1).

Another factor that must be considered in assessing odor impacts is the amount of time that offensive odors are detectable to the community. On an annual basis, ventilation rates are good in the San Antonio area, so no area should experience odor impacts for a long period. On a diurnal basis the worst-case dispersion conditions occur during the late evening and early morning hours during the summer. In residential areas, these periods are the most likely to cause odor nuisance since more people are likely to be affected. The occurrence and persistence of the odor-producing anaerobic conditions are more probable during the summer months, thus aggravating this potential odor problem.

Mitchell Lake and the canal connecting the Rilling Road Plant to Mitchell Lake have been a source of odor in the past. The canal was used to discharge storm water, raw wastewater, and treated effluents to Mitchell Lake (SA-259). In 1962, the open canal was replaced by a sewer line except for a short section of one-fourth mile at the lake. Sludge buildup from the Rilling Road Plant at the north end of Mitchell Lake is in the process of being removed. Currently, only treated effluent from the Leon Creek Plant is being discharged to the lake. Discharges are made as necessary to maintain the desired lake level for irrigation purposes. The discharges are not made on a daily basis.

Another assessment of odor impacts in the existing environment was made through analysis of odor complaints received by the Metropolitan Health District. The Health District recently prepared a list of confirmed complaints. It was emphasized by the Health District that not all complaints received can be traced to a source (RA-R-420). In general, if the source can be located, the reason for the odor production can be determined and the problem corrected. One of the sources of complaint reportedly was a sewer manhole. Another source of odor in the southeast San Antonio community is the Sulfur Springs area.

The relative impact of the odor sources cannot be accurately determined on the basis of the number of complaints received. For example, a single individual may register numerous complaints regarding a single source. The Health District has received no complaints specifically regarding the regional wastewater treatment plants. However, the lack of recorded complaints regarding the treatment plants could be due to the fact that complaints are usually made directly to the office located at the Rilling Road Plant, rather than to the Health District. Records of odor complaints are not maintained at the Rilling Road Plant (GR-348).

2.1.1.3 Air Quality

The three agencies contacted for information on existing air quality in the study area were the San Antonio Metropoli

Health District (Air Pollution Control Section), the Texas Air Control Board (TACB) state headquarters in Austin, and the Texas Air Control Board Regional Office in San Antonio.

The study area is located in the twenty-four county Metropolitan San Antonio Air Quality Control Region (AQCR). This AQCR is numerically designated as 217. In 1972, this AQCR was classified as priority I (poor air quality) for photochemical oxidants and particulates, and as priority III (good air quality) for sulfur oxides, nitrogen oxides, and carbon monoxide. These priorities were established to assist development of plans to achieve the national ambient air quality standards (NAAQS)(CO-RF-547).

The current state implementation plan (SIP) regulations have not reduced photochemical oxidant levels below the NAAQS. As a result, EPA has proposed additional control measures. For San Antonio these measures consist of more stringent controls on industrial sources of organic (hydrocarbon) emissions and transportation controls designed to reduce emission from automobile use. If these measures are not sufficient, other measures such as inspection and maintenance of automobiles may be required (EN-502). Another air quality problem in the San Antonio AQCR is total suspended particulates (TSP). In recent years, violations of the NAAQS for TSP have occurred in various portions of the AQCR. The SIP for the entire AQCR has been judged inadequate (EN-609).

The recent 1977 Clean Air Act Ammendments require the State of Texas to develop more current air pollutant designations. The Texas Air Control Board has proposed that San Antonio, Bexar County be designated a nonattainment area for both particulates and oxidants (TE-322). The U.S. Environmental Protection Agency has promulgated several designations for Bexar County (3 March

1978). The county is now classified "attainment" for sulfur dioxide, carbon monoxide, and nitrogen dioxide. The entire county is classified "non-attainment" for oxidants. A small portion of the area surrounding the West Southcross monitor is "non-attainment" for total suspended particulates. Based on these designations, the TACB is required to submit to EPA revised state implementation plan regulations for TSP and oxidants. These revisions are due on 1 January 1979. The plan must provide measures to attain the standards by December 31, 1982. For oxidants the deadline for attainment may be extended until December 31, 1987 (TE-322).

Measurements of air pollutant levels in the environment have been made in San Antonio for several years. Levels of TSP have been measured at eight locations in the city (RA-R-420). Measurements of the gaseous pollutants sulfur dioxide and nitrogen dioxide have been made at five sites.

According to these measurements, sulfur dioxide levels are low (less than 10 percent of the annual standard). Particulate levels are much nearer the standard. For example in 1975 the monitor at 2242 West Southcross measured an annual geometric mean of 93 $\mu g/m^3$. The primary standard is 75 $\mu g/m^3$. Measurements that exceed the standard are termed violations if sampling procedures are within EPA guidelines. Recent determinations by the TACB conclude that these violations are not now widespread (ME-222, TE-332). Nitrogen dioxide measurements have been judged not comparable with standards because of revisions in the approved measurement methods. As mentioned above, photochemical oxidant levels have exceeded the standards in recent years. These violations have been measured in at least two locations (EN-609).

There are a variety of air pollutant emission sources in the study area. Industrial plants and highway vehicles are the major sources of TSP and hydrocarbons. The types of industries classified as major point sources include cement plants, mineral processing, asphalt plants, city electric plants, and bulk petroleum storage (RA-R-420).

2.1.1.4 Noise

To enable an evaluation to be made of the impact of the three sewage disposal plants on their noise environments (see Chapter 5), the existing city-wide noise level trends were investigated. This provided an estimate of noise levels that residents are accustomed to, which is a measure of tolerable plant-radiated noise levels.

Acoustic characteristics of the three treatment plants were also investigated. Radiated sound spectral levels were measured, and sound pressure levels in the surrounding community were predicted using a mathematical model. The results of this study are presented in the Technical Reference Document (RA-R-420). The results indicate that the Rilling Road Plant is the strongest acoustic radiator of the three plants. But the ambient noise levels in the Rilling Road area are also high. Traffic on Loop 410 and Roosevelt Road and low-flying light aircraft using Stinson Field contribute to the noise level. Therefore, the plant is not the dominant noise source for any populated neighborhood.

The Salado Creek and Leon Creek plants are weaker acoustic sources. They are located in quieter neighborhoods so less noise from them would be tolerated. There are only a few houses at which the noise of these two plants can be perceived even under very quiet ambient noise level conditions.

2.1.1.5 Geology

The geology of San Antonio area determines in part the suitability of the land for different urban uses. This section describes the geology in terms that are applicable to urbanization of the area. Three aspects of the geology of the area are important to urbanization--the landform or topography, the geologic substrate (below the soil zone), and the geologic processes. The soils of the area are described in a subsequent section.

A. Topography

Bexar County lies in parts of three major physiographic regions--the Edwards Plateau, the Blackland Prairie, and the South Texas Plains portion of the Gulf Coastal Plain. The Balcones Escarpment is the most prominent topographic feature of the county. It traverses the area from west to east and separates the dissected southern margin of the Edwards Plateau in the northern one-third of the county from the flatter area in the southern part of the county. The southwestern tip of the Blackland Prairie province extends westward across the middle of the county. The South Texas Plain takes in the southern part of the county.

The drainage of Bexar County is almost entirely southward and southeastward off the Balcones Escarpment. The major streams of the county are Medina River, Leon Creek, San Antonio River, Salado Creek, and Cibolo Creek. The elevation of the county decreases from about 1,900 feet north of the scarp to below 450 feet in the southern part of the county.

The primary land use limitation imposed by the landform is in the areas where steep slopes occur. The land areas having slopes greater than 25 percent (RA-R-420) are almost entirely located in the Edwards Plateau area in north and northwest west Bexar County. These areas are generally suitable only for agricultural (rangeland) or recreational use or low density housing.

B. Substrate

The geologic substrate includes the bedrock below the soil zone. The geologic substrate of the San Antonio area consists of sedimentary rock units having a variety of lithologies and physical characteristics. Figure 2-3 shows the location and distribution of generalized rock units in Bexar County. Six major rock types are present in the area. They are hard limestones, mixed hard and soft limestones, clay, unconsolidated to consolidated sand, mixed sand and clay, and alluvium and terrace deposits. The physical properties and urban land use suitabilities of these units have been investigated and documented (RA-R-420).

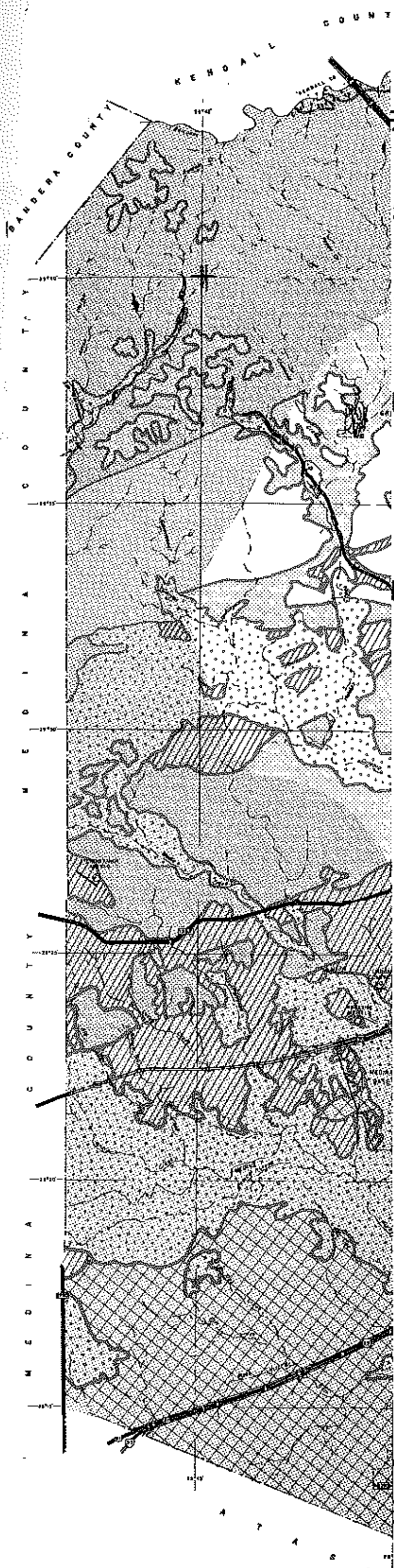
The hard limestone unit includes a suite of carbonate rocks ranging in composition from almost pure limestone to dolomite. The hardness of the limestone of this unit imposes some of the most severe limitations on land use in the San Antonio area. Slope stability and foundation strength are high. However, the potential for excavation, septic tank use, disposal of sewage effluent, and sanitary landfill use are extremely limited.

The mixed limestone unit inlcudes a group of carbonate rocks having a large variety of lithologies. Hard limestones, soft limestones, marls, dolomites, and chalks make up this group. Slope stability and foundation strength are both good, but the suitability for sanitary landfills is extremely limited. The limitations for septic tank use and land treatment are somewhat less than in the hard limestone area, but they are still quite restrictive. Corrosion potential for iron pipelines is somewhat higher.

The clay unit includes several stratigraphic units that occur in a generally northeast-southwest oriented band composed mostly of expansive clays mixed with calcium carbonate and other components. Separate beds of sandstone and siltstone also occur. The unit has almost as many land use limitations as the hard limestone unit, but the causes of the limitations are much different. The suitability for sanitary landfill use and for land treatment and disposal is good, but the suitability for most other uses is poor. Excavation is easily accomplished, but the corrosion potential for iron pipelines is very high. Both the slope stability and the foundation strength characteristics are very poor. As will be described in a later section, one of the most destructive geologic processes, shrink-swell, is active in the clay unit.

The mixed sand and clay unit is composed of complexly interbedded sand, silt, and clay strata having bed thicknesses ranging from less than one foot to several tens of feet. The area underlain by sand and clay is suitable for most urban-related land uses, although the clay portion does impose some limitations. The slope stability and foundation strength are variable depending on whether the substrate is sand or clay and on the degree of consolidation of the sand. The potential for excavation is good, but the corrosion potential is likely to be high in the clay beds. The suitabilities for septic tank and sanitary landfill use and for land treatment and disposal of sewage effluent are all good.

The unconsolidated to consolidated sand unit has a composition similar to that of the mixed sand and clay unit,



STONE

STONE

DATED TO CONSOLIDATED SAND

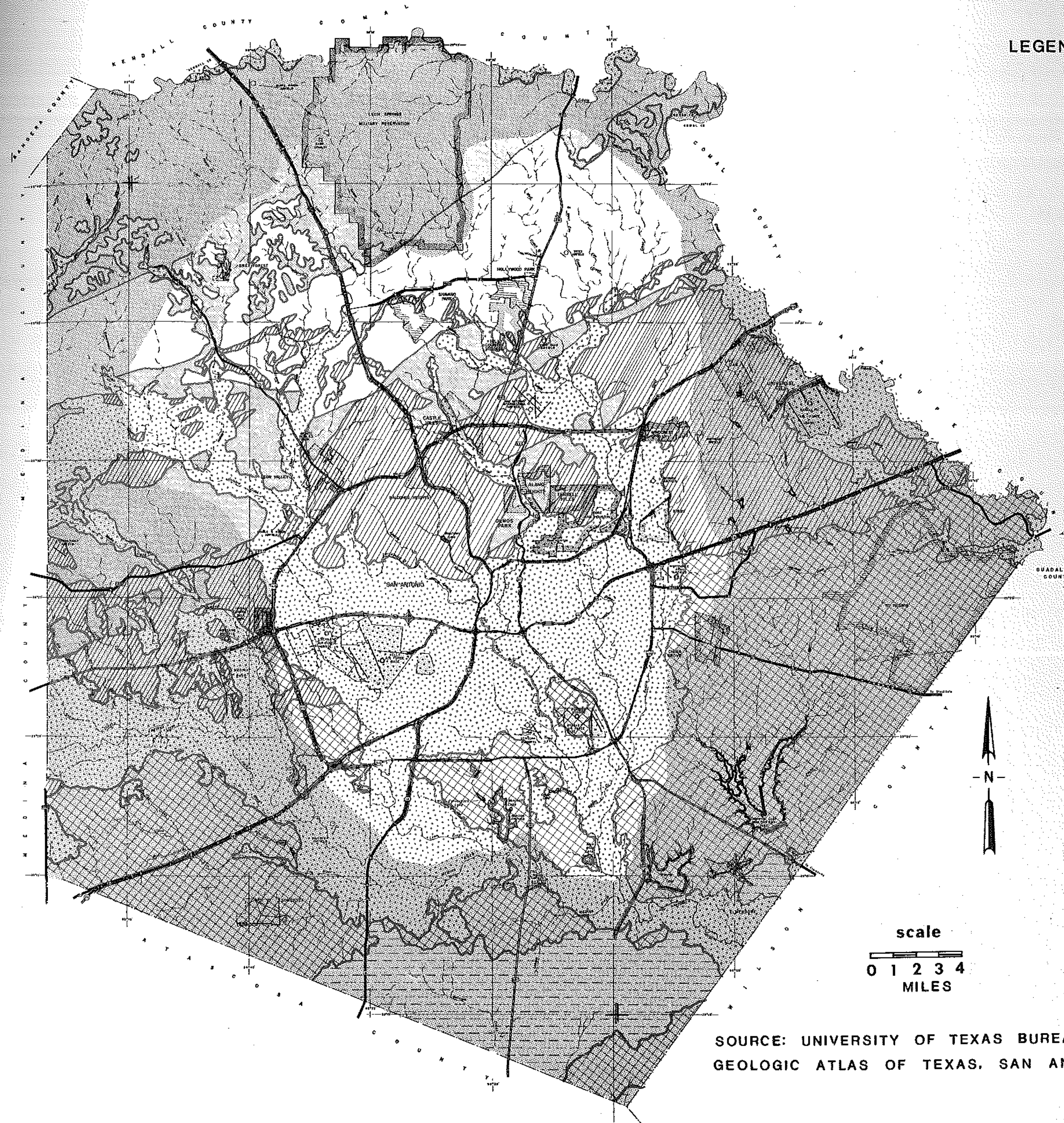
AND CLAY

ND TERRACE DEPOSITS

FIGURE 2-3

LIZED ROCK TYPE MAP
XAR COUNTY, TEXAS

LOGY,



LEGEND

- HARD LIMESTONE
- MIXED LIMESTONE
- CLAY
- UNCONSOLIDATED TO CONSOLIDATED SAND
- MIXED SAND AND CLAY
- ALLUVIUM AND TERRACE DEPOSITS

scale

0 1 2 3 4
MILES

FIGURE 2-3

GENERALIZED ROCK TYPE MAP
OF BEXAR COUNTY, TEXAS

SOURCE: UNIVERSITY OF TEXAS BUREAU OF ECONOMIC GEOLOGY,
GEOLOGIC ATLAS OF TEXAS, SAN ANTONIO SHEET

except there is much less clay strata. This unit is generally more suited for urban-related uses because of the lesser amount of clay.

The alluvium and terrace deposits form a mantle over the other rock-type units of the San Antonio area. Most of the southern half of the City of San Antonio is built on one of these large terrace deposits. The lower terraces and alluvium occur chiefly along the major streams of the area, including Medina River, San Antonio River, and Leon, Salado, and Cibolo Creeks. These alluvial and terrace deposits consist of a variety of lithologies including consolidated and unconsolidated clay, silt, sand, and gravel. These deposits generally pose few limitations on urban-related land uses.

C. Processes

Several geologic processes having an impact or a potential impact on urbanization are active in the San Antonio area. One of the most important of these, flooding, is described in a later section on surface-water hydrology. Aquifer recharge, another important process in the area, is discussed in the section on ground-water hydrology. Most of the slopes in the area are stable under natural conditions, although in areas underlain by clay substrate they may become unstable if over-steepened during construction.

The hard limestone area coinciding with the outcrop of the Edwards limestones may also be susceptible to sinkhole collapse. Sinkholes do exist in this area, but they are not likely to collapse further unless disturbed. Such sinkholes should be avoided during construction.

An important process that occurs in most of the clay unit is shrink-swell. Seasonal changes in the moisture content of the expansive clays cause them to change volume and undergo a cyclic shrinking and swelling process. This annual cycle causes large cracks to be opened and closed in the upper part of the clay unit, including the soil zone. Highways and small structures that are constructed on the clay without an adequate subbase of gravel or other suitable fill material are subjected to severe stresses. Foundation failures and cracked and broken highway pavement are common on the clay unit. Pipelines for sewer lines and septic tank and drainfield systems may also be broken by the shrinking and swelling activity.

Earthquake processes are not very active in the San Antonio area. The Balcones fault zone, which occurs along the Balcones Escarpment, is generally considered to be a dead system. The south-central Texas region is in Zone Zero of the Seismic Risk Map of the United States (OL-046), which indicates very low seismic activity.

2.1.1.6 Soils

The San Antonio area is in a zone of transition between different geologic, vegetational, and climatic provinces. The soils of the area are residual. The most important factor controlling the soil characteristics is the geologic bedrock that serves as the parent material for the soils. The soils range from deep, rich, black soils to thin, rocky soils. Nine soil associations are present in Bexar County. These associations have been investigated, a soil map has been obtained, and tabulations have been prepared for this EIS (RA-R-420). The specific properties included in this investigation include general descriptions, delineation of the various soil series composing each association, the topographic and bedrock occurrence, predominant land use, texture, and drainage.

In general, the thin, poor, and rocky soils occur in the rugged hill country north of the Balcones Escarpment. The thick, black, clayey soils of the Blackland Prairie extend from east to west across the middle of Bexar County. The sandy soils of the South Texas Plain are in the southern third of the county.

The soil association map has been interpreted to show the suitability of the land for various uses. Figures 2-4 and 2-5 show the suitability of the different parts of the county for septic tank and drainfield systems and land application of sewage effluent and/or sludge. The suitabilities for general cropland agriculture and for excavation have also been prepared (RA-R-420). The ratings used for the areas are generally as follows: Good indicates that the area is well-suited for the use. Few areas are unsuited, and most of the limitations are easily overcome by engineering measures. Fair indicates that some parts of the area are poorly-suited for the use. Most limitations can be overcome by engineering modifications but only at considerable expense. Poor indicates that much of the area is not suited for the use. Where engineering modifications will overcome the limitations, such modifications would be expensive. Unsuitable indicates that most of the area is not suitable for the use. Engineering modifications may render some sites suitable, but the associated costs are likely to be prohibitive.

The generalized soil maps in Figures 2-4 and 2-5 are useful only for preliminary planning purposes. It should be noted that these maps shows the suitability of the land with respect to the soils, but not necessarily for the geologic substrate below the soils. Other features of the land (such as the Edwards aquifer recharge zone, which is discussed below) may also affect land suitability for various uses. If these features are not reflected in the soil characteristics, their effect on land suitability will not appear on these maps. A more detailed study would be required at a particular site before its suitability for a specific use can be evaluated.

2.1.1.7 Hydrology

This section describes both the surface- and ground-water systems in the San Antonio area. The relationship between these systems (i.e., the springs and the Edwards recharge area) is discussed in detail in the ground-water section.

A. Surface-Water Hydrology

Because of inherent differences between stream and reservoir (lake) hydrology, this section deals with each separately.

1) Streams

With the exception of the extreme southern corner, all of Bexar County is located within the San Antonio River Basin, a subbasin of the Guadalupe River (Figure 2-6). The San Antonio River Basin is slightly less than 200 miles long and has a maximum width of 50 miles. Elevations range from about 2,300 feet in the tributary headwaters to about two feet at the mouth. The San Antonio River has its headwaters in Olmos Creek which rises in central Bexar County northwest of San Antonio (refer to Figure 2-6). During dry weather the San Antonio River receives its first substantial base flow from San Antonio and San Pedro springs located just above the confluence of Olmos Creek. The principal tributary of the San Antonio River, the Medina River, rises much further west in Bandera County. Below its confluence with the Medina River, the San Antonio River flows southeast and joins the Guadalupe River eleven miles above San Antonio Bay (Figure 2-6).

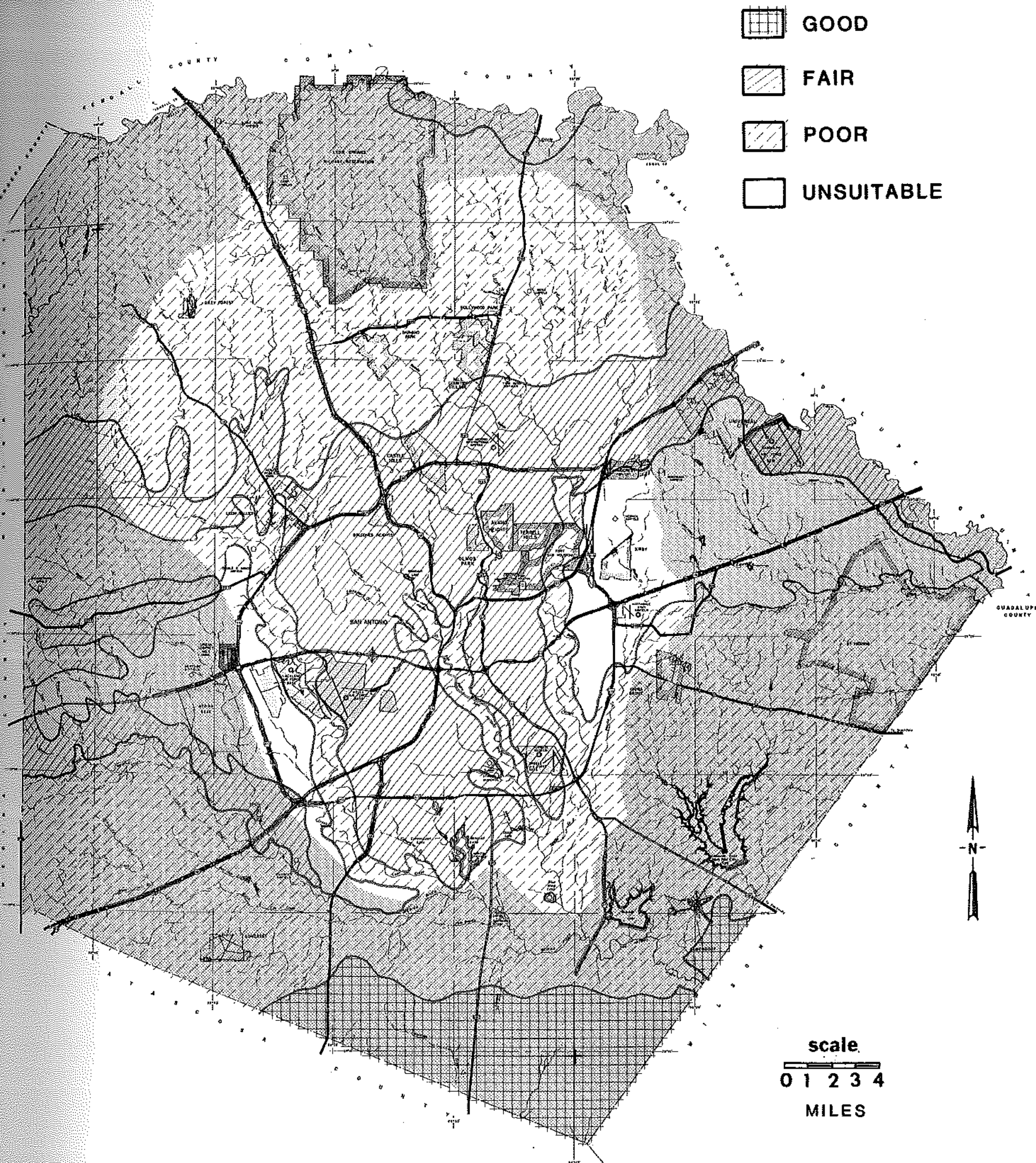


FIGURE 2-4

SOIL SUITABILITY FOR SEPTIC TANK USE

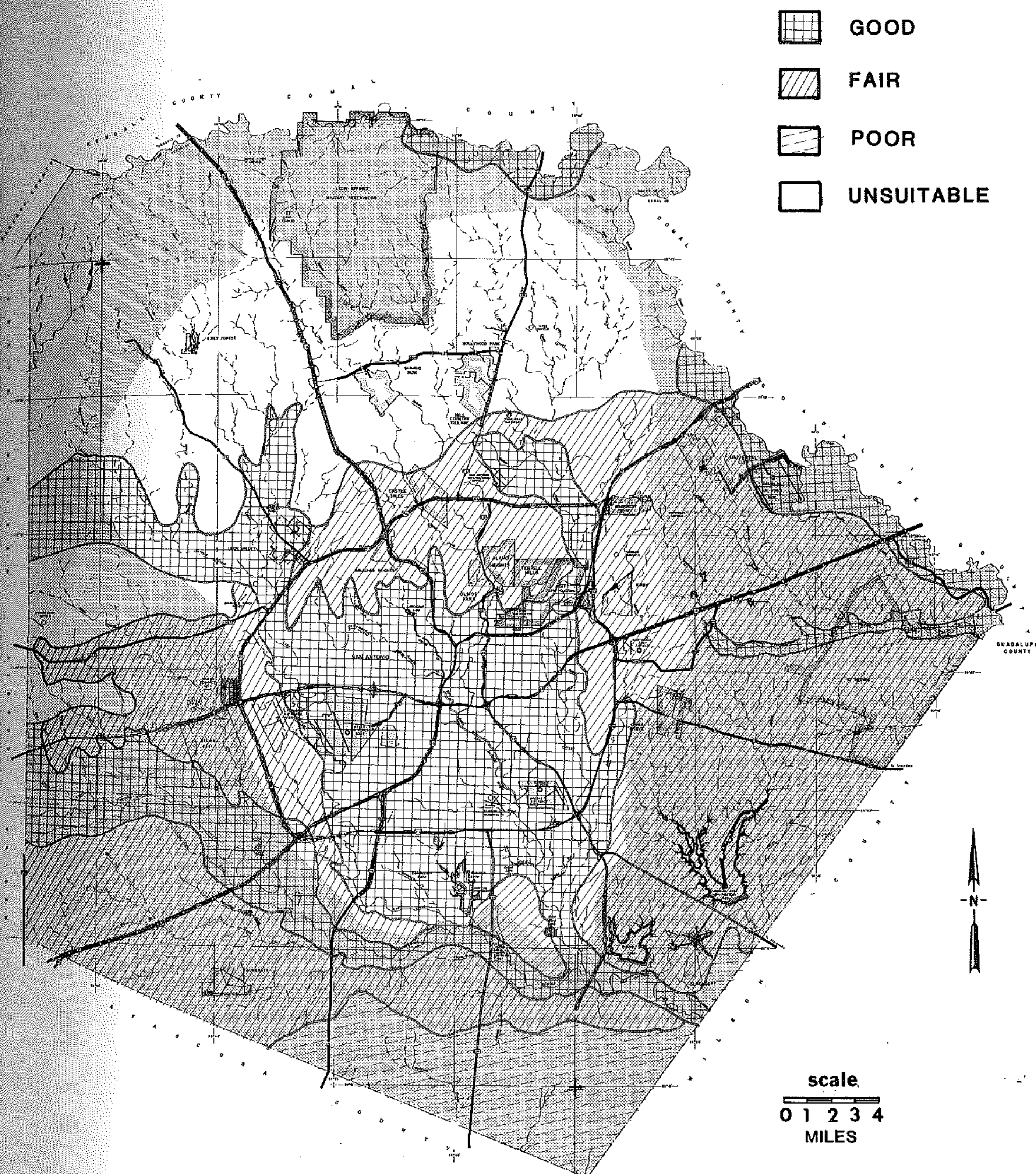


FIGURE 2-5

SOIL SUITABILITY FOR LAND APPLICATION OF TREATED EFFLUENT OR SLUDGE DISPOSAL

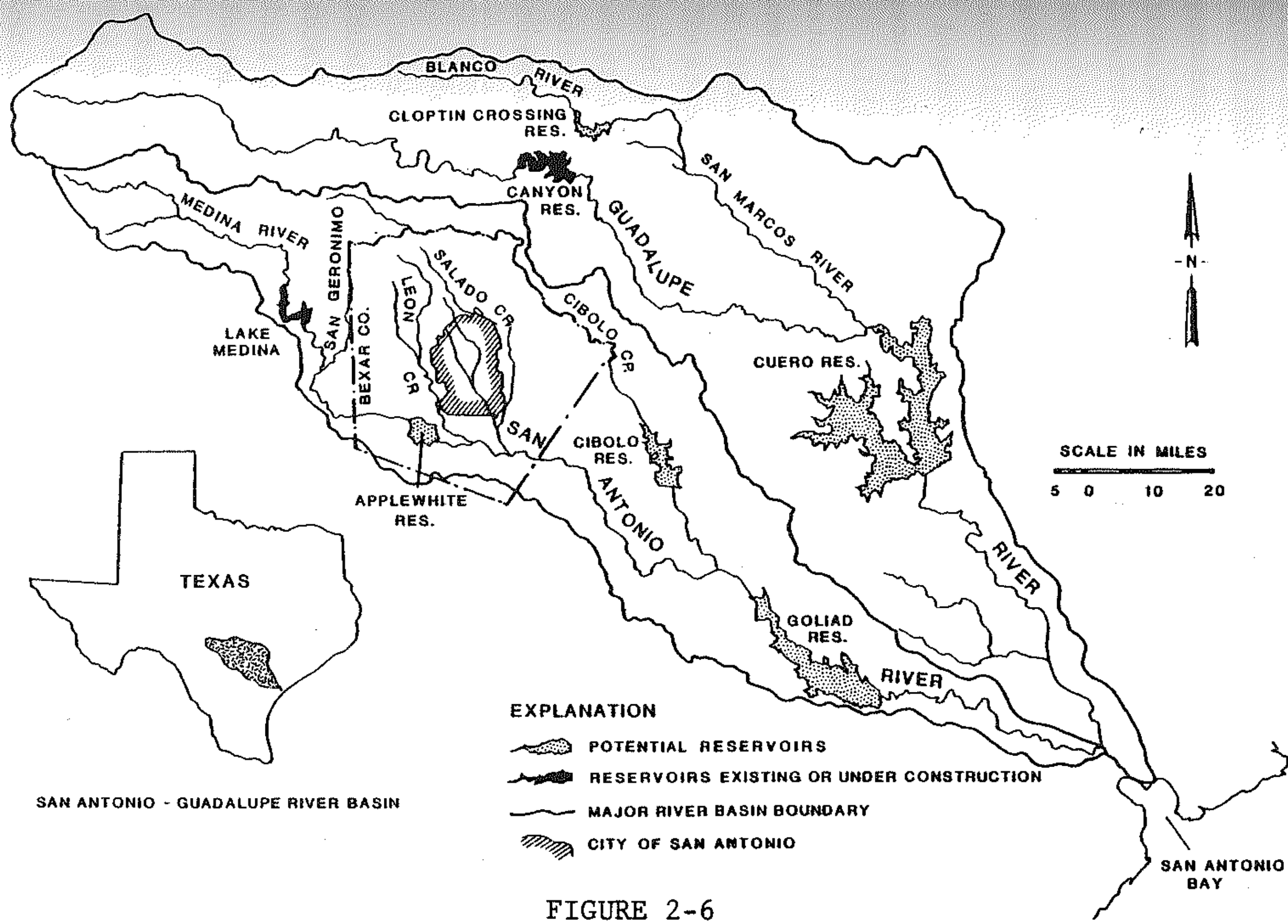


FIGURE 2-6

SAN ANTONIO - GUADALUPE RIVER BASIN

The other major tributaries in the area are San Geronimo and Leon Creek, which are tributaries to the Medina River, and Salado and Cibolo Creeks, which drain into the San Antonio River. The flow patterns of all of these streams are affected by the Edwards aquifer recharge zone.

Flow in area streams has been characterized by a survey of existing streamflow monitoring points (RA-R-420). These U.S. Geological Survey stream gaging points were arranged according to their respective geologic region to show differences in runoff patterns within these regions. The results of this survey indicate that about 18 percent of the rainfall contributes to surface runoff in the undeveloped areas of the Edwards Plateau About 20 percent of the rainfall contributes to surface runoff in the West Gulf Coastal Plain areas. The survey also documents the substantial loss of streamflow into the Edwards aquifer in the Edwards recharge zone (RA-R-420).

Effects of urbanization on streamflow in the area are difficult to quantify. Changes in flow are caused by the recharge zone and varying spring flow. Comparisons of runoff rates of two watersheds located over the recharge zone indicate that urbanization has caused an increase in runoff to about double that of a relatively undeveloped basin. Since the recharge rates have not been determined for each drainage basin, the runoff rates have limited utility. For this reason the true effects of urbanization can only be partially quantified. Quantification was partly accomplished by a comparison of two large watersheds within Bexar County. The first consists of 350 square miles drained by Leon and Elm Creeks west of San Antonio. About ten percent of this area is affected by urban development. The second watershed has a drainage area of about 462 square miles and consists mostly of those areas drained by the San Antonio River and Salado Creek.

About 50 percent of this area is affected by urban development with very dense development in the San Antonio River Basin. The runoff rate for Leon and Elm Creek watershed was 35 percent less than that of the more highly urbanized San Antonio and Salado watersheds. Although this difference is inflated by increased amounts of spring flow in the San Antonio-Salado area, it is some indication of the amount of increase in runoff caused by urbanization.

2) Lakes

Calaveras Lake and Braunig Lake are two impoundments on tributaries to the San Antonio River southeast of the city. The lakes were created as cooling ponds for hydroelectric plants. They are about 1,100 and 2,600 acres in size respectively. Both have relatively small watersheds and must be supplemented with water diverted from the San Antonio River to provide an adequate volume of water for cooling purposes. These lakes are discussed more thoroughly in the water quality section of this report.

Currently the Edwards aquifer is the sole source of drinking water for the City of San Antonio. The Texas Water Plan, which was released in 1968, states that surface water will be required for the San Antonio area by 1985. According to the Plan, San Antonio's initial supplemental surface water supply will come from Canyon Lake which is located in the Guadalupe River Basin about 35 miles northeast of the city (Figure 2-6). This plan calls for an initial supply of 30,000 acre-feet/year of water from Canyon Lake in 1980. An additional supply of 20,000 acre-feet/year will come from the proposed Cloptin Crossing Reservoir. The completion date for the Cloptin Reservoir is unknown. It will be located on the Blanco River (Figure 2-6).

Another proposed source of water supply is the Applewhite Reservoir (completion about 1990), which is located 30 miles southeast of San Antonio.

B. Surface-Water Quality

There were two sources of information for assessing the water quality of the streams in the 201 study area. One was U.S. Geological Survey water quality records. The second was the results of an intensive surface water monitoring survey conducted by the Texas Water Quality Board (now Texas Department of Water Resources) during the week of September 1-5, 1975.

1) Wastewater Sources

The three existing municipal wastewater treatment facilities presently servicing the study area constitute the major point sources of wastewater discharge. The treatment facilities are described in detail in Chapter 3. Most industrial wastewaters are treated at the municipal facilities. The discharge rate, BOD_5 loading, and suspended solids loading of the plants are shown in Table 2-4. The Rilling Road plant discharges into the San Antonio River near the plant. The Salado Creek plant also discharges into the San Antonio River, but further downstream below the confluence of Salado Creek. The Leon Creek plant discharges to Leon Creek just above its confluence with the Medina River.

Major non-point sources of wastewater include both urban and rural runoff. Rural runoff includes unregulated irrigation return flows and agricultural runoff following rainfall.

TABLE 2-4

1976 DISCHARGES FROM SAN ANTONIO WASTEWATER TREATMENT FACILITIES

Wastewater Treatment Facility	Average Discharge Rate (million gallons/day)	BOD_5 (lb/day)	Suspended Solids (lb/day)
Rilling Road	83.4	8,764	10,642
Salado Creek	16.6	1,481	2,395
Leon Creek	17.5	1,124	2,452

Source: SA-329

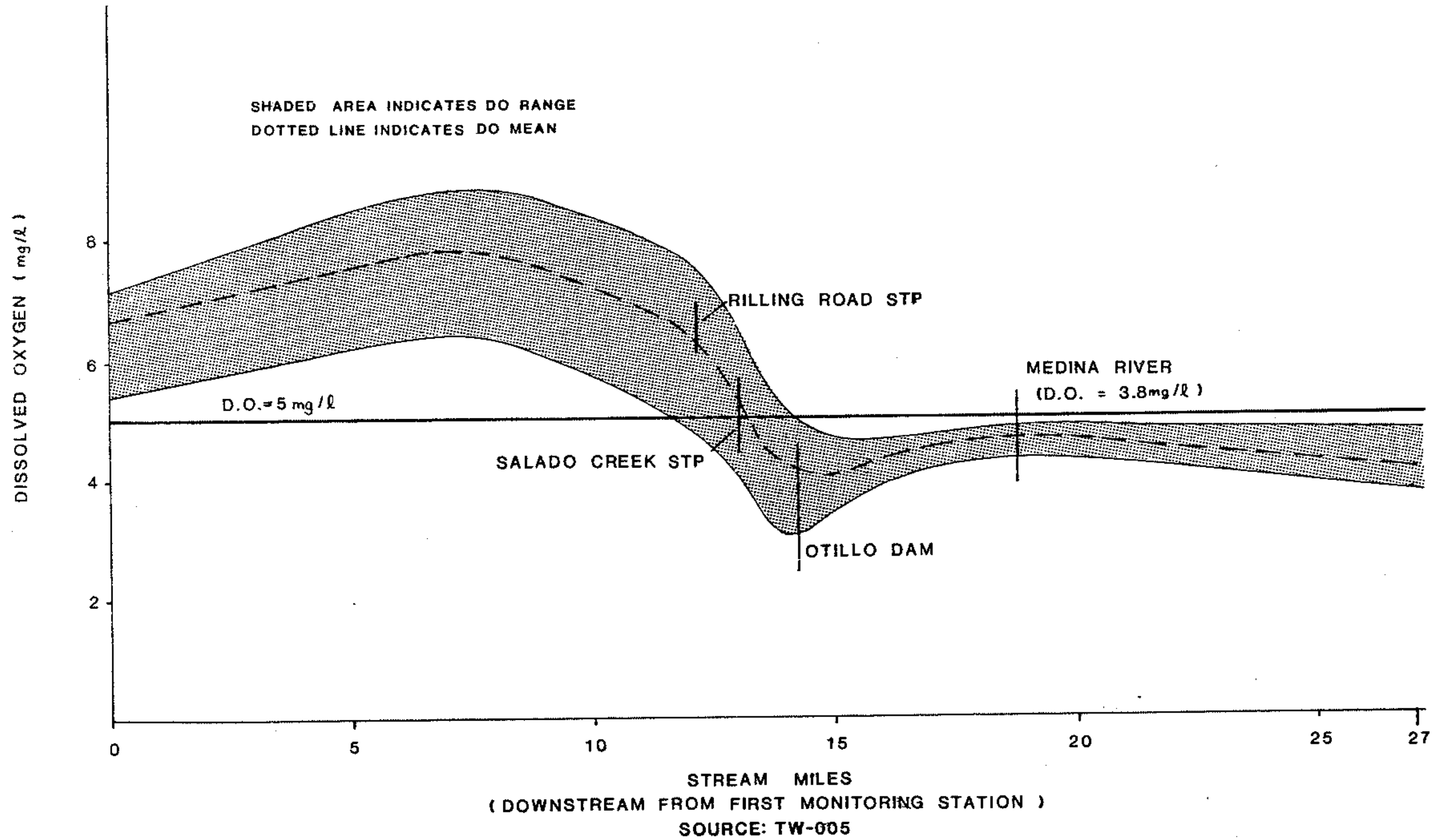
2) Stream Water Quality

The intensive field survey of the Texas Department of Water Resources (TDWR) indicated that a portion of the San Antonio River which lies below the Rilling Road wastewater treatment facility maintains a low dissolved oxygen level. This result is shown graphically in Figure 2-7 which shows a large decrease in dissolved oxygen (D.O.) immediately downstream of the Rilling Road wastewater discharge. In this area the D.O. concentration is below the specified minimum of 5 mg/ℓ (TE-263). This situation is further aggravated by Otillo Dam, which is downstream of the Rilling Road plant. This small dam causes a decrease in stream velocity which reduces reaeration potential. Although not shown in Figure 2-7, the dissolved oxygen level increases about 5 mg/ℓ through reaeration as the stream falls approximately 15 feet at Otillo Dam. However, that increased dissolved oxygen level is maintained only a short distance downstream where it again drops below 5 mg/ℓ.

FIGURE 2-7

DISSOLVED OXYGEN PROFILE OF SAN ANTONIO RIVER

(SEGMENT 1901)



The Medina River flows into the San Antonio River approximately five miles downstream of Otillo Dam. The TDWR survey reports a dissolved oxygen concentration in the Medina River of approximately 3.8 mg/ℓ at this point (TW-005). Mixing of the two streams results in a continuing dissolved oxygen sag.

Temperatures measured in the San Antonio River and its tributaries are well below the standard of 90°F. The pH values, although slightly alkaline, are in the acceptable range of 6.5 to 8.5. The underlying limestone formations are at least partially responsible for the slightly alkaline pH values (TW-005).

Nutrient levels measured in the survey (including both phosphorus and nitrogen) are low at locations sampled upstream of the Rilling Road facility wastewater discharge. Ammonia nitrogen concentrations are either very low or not detectable. However, immediately below the treated wastewater discharge, nutrient levels increase dramatically. Ortho- and total phosphate concentration levels increase 20.5 mg/ℓ each, and ammonia nitrogen levels as high as 8 mg/ℓ have been observed. Additional nutrient loadings are introduced by the Leon Creek and Salado Creek wastewater treatment facilities. Relatively high ammonia nitrogen levels (i.e., above 3 mg/ℓ) are sustained for approximately 10 to 15 miles downstream from the Rilling Road wastewater discharge. Phosphate levels decrease slowly downstream from the Rilling Road wastewater discharge but remain relatively high (i.e., above 4 mg/ℓ) through the remaining stretch of the San Antonio River (TW-005).

Information compiled from the U.S. Geological Survey water quality survey on the San Antonio River for water year 1974 is presented in Figure 2-8. The streamflow data in Figure

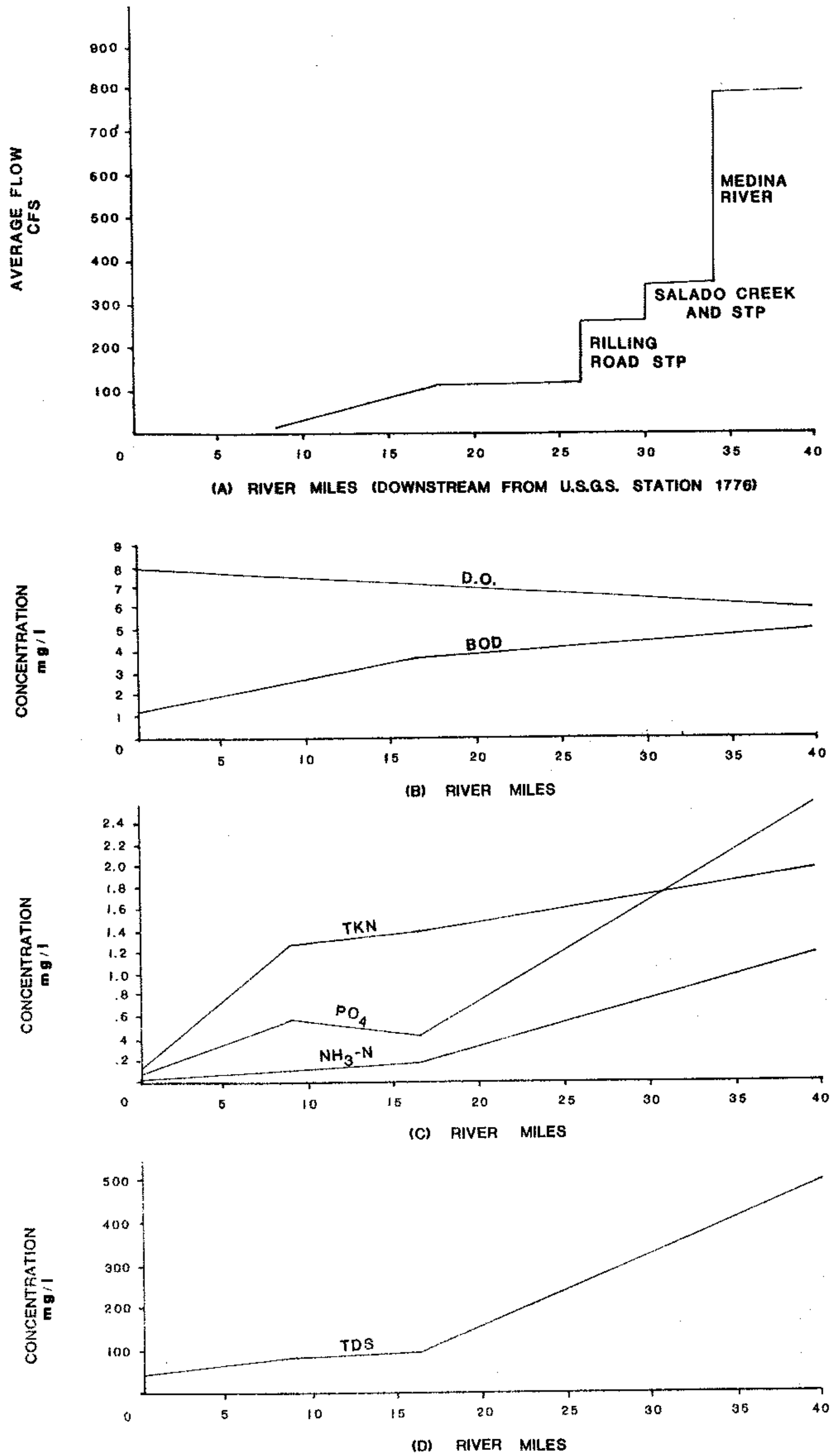


FIGURE 2-8

U.S.G.S. SAN ANTONIO RIVER (SEGMENT 1901) WATER QUALITY DATA
WATER YEAR 1974

2-8(A) represent average annual flows and show step increases resulting from wastewater discharges and contributions from Salado Creek and the Medina River. This figure shows that a substantial portion of the flow of the San Antonio River is derived from treatment plant effluent.

Concentrations of various water quality parameters as a function of distance downstream from the San Antonio River headwaters are shown in Figures 2-8(B) through 2-8(D). These concentrations were determined by instantaneous measurements rather than continuous monitoring and may not be representative of average conditions. Consequently, the figures are not intended to represent a typical characterization of the San Antonio River. Instead they show trends which occur as the streamflow is augmented with either wastewater or other area streams. The survey monitoring stations are located at large intervals, so the conditions between monitoring stations can vary significantly. Figure 2-8(B) shows the response of the dissolved oxygen concentration to the BOD loading. As expected, dissolved oxygen concentrations decrease with increasing BOD concentrations. This trend supports the findings of the Texas Department of Water Resources survey described earlier. Figure 2-8(C) shows increasing concentrations of total Kjeldahl nitrogen (TKN), ammonia nitrogen (NH_3-N), and total phosphorus (P). Figure 2-8(D) shows the trend of increase of total dissolved solids (TDS) in the San Antonio River. The rate of increase in these parameters is larger at locations where treated wastewater is introduced.

3) Reservoir Water Quality

Smaller lakes in the study area with capacities of less than 5,000 acre-feet are generally of good water quality. Further discussion of reservoir water quality will be limited to the larger reservoirs, including Braunig Lake, Calaveras Lake, and Mitchell Lake.

The filling of Braunig Lake began in 1963. The source of water was the San Antonio River below the Rilling Road wastewater discharge. Flow in the river at that location was approximately 60 percent secondary-treated wastewater, and the water quality of the new lake was poor. Braunig Lake is an offstream reservoir and has a relatively small drainage area (8 mi^2), so make-up water is still frequently pumped from the San Antonio River. As a result, the water quality of the lake remains poor. Make-up water pumpage and estimates of nutrient loads from make-up water for the years 1970 through 1975 are presented in Table 2-5 (AL-144). Braunig Lake currently maintains a total dissolved solids (TDS) concentration of approximately 950 mg/ℓ, a chloride (Cl^-) concentration of approximately 200 mg/ℓ, and a sulfate ($SO_4^=$) concentration of approximately 350 mg/ℓ. The pH of the lake ranges from approximately 8.5 to 9.0 (FU-065). The nitrogen and phosphorus concentrations range, respectively, between 0.18 to 1.4 mg/ℓ and 1.1 to 2.1 mg/ℓ (TA-114). Primary productivity in Lake Braunig is nitrogen limited (AL-144). The lake is considered highly eutrophic, but it is still aesthetically pleasing and its recreational uses of boating and fishing have been maintained (TA-114).

A seasonal temperature profile for Braunig Lake indicates thermal stratification during the summer months which prevents reaeration of deep water layers. This condition results in very low to zero dissolved oxygen conditions, as shown by dissolved oxygen (D.O.) profiles. The lake is vertically mixed during the late fall and winter months and no D.O. problems exist during these times. Temperatures in the lake range from around 75°F at depths greater than 40 feet to around 90°F at the surface

TABLE 2-5

NUTRIENT LOADS TO LAKE BRAUNIG

FROM MAKEUP WATER*

Year	Total Makeup Water Use (MG/Year)	Total Makeup Water Use MGD Average	Makeup Water Quality* Nitrogen (mg/ℓ)	Makeup Water Quality* Phosphorus (mg/ℓ)	Nutrient Loads Nitrogen (lbs/yr)	Nutrient Loads Phosphorus (lbs/yr)
1970	3,287	9.0	7.2	3.2	197,000	88,000
1971	3,300	9.0	4.9	1.8	135,000	50,000
1972	2,572	7.0	6.2	2.1	133,000	45,000
1973	1,704	4.7	3.9	1.8	55,000	26,000
1974	2,287	6.3	5.9	2.3	113,000	44,000
1975	1,585	4.4	4.6	1.8	61,000	24,000

*Makeup water for Lake Braunig is pumped from the San Antonio River. The quality of the San Antonio River water is based on the time weighted average of monthly measurements taken by the USGS at the USGS Station 08181800.

Source: AL-144

during summer stratification. The lake has been as cold as 55°F during the winter when the system is completely mixed (TA-114).

The water quality of Calaveras Lake is much better than that of Braunig Lake because it was filled by heavy rainfall. Also the much larger drainage area above the dam (approximately 65 mi^2) reduces the frequency of make-up requirements from the San Antonio River. Make-up water pumpage and estimates of nutrient loads from make-up water for the years 1971 through 1975 are presented in Table 2-6 (AL-144). Additionally there are no point source discharges within the lake's drainage basin. Calaveras Lake currently maintains a TDS concentration of approximately 250 mg/ℓ, a chloride concentration of approximately 20 mg/ℓ, and a sulfate concentration of approximately 40 mg/ℓ. The pH of the lake ranges from approximately 7.5 to 8.5 (FU-065). According to the National Eutrophication Survey (EN-659) conducted in 1974, the temperature of the lake ranged from approximately 60°F to 90°F. The nitrogen and phosphorus concentrations ranged, respectively, from 0.42 to 1.02 mg/ℓ and from 0.024 to 0.164 mg/ℓ. Chlorophyl concentration ranged from 12.1 to 55.4 mg/ℓ. Calaveras Lake is considered eutrophic with nitrogen limiting primary productivity (AL-144).

Mitchell Lake was constructed over 75 years ago to serve as a holding reservoir for wastewater and was used as both an oxidation pond for wastewater treatment and as a storage reservoir for irrigation water. Although the Rilling Road and Leon Creek plants occasionally discharge portions of their treated or untreated wastewater to Mitchell Lake, the largest single source of inflow results from stormwater. A small portion of excess waste activated sludge and digester supernatant liquor is also occasionally discharged to the lake. Mitchell Lake is in a highly eutrophic state (PA-237).

TABLE 2-6

NUTRIENT LOADS TO LAKE CALAVERAS

FROM MAKEUP WATER*

Year	Total Makeup Water Use (MG/Year)	Total Makeup Water Use MGD Average	Makeup Water Quality Nitrogen (mg/ℓ)	Makeup Water Quality Phosphorus (mg/ℓ)	Nutrient Loads Nitrogen (lbs/yr)	Nutrient Loads Phosphorus (lbs/yr)
1971	2,573	7.0	4.9	1.8	105,000	39,000
1972	309	0.8	6.2	2.1	16,000	5,400
1973	84	0.2	3.9	1.8	2,700	1,300
1974	1,501	4.1	5.9	2.3	74,000	29,000
1975	17	0.1	4.6	1.8	650	250

*Makeup water for Lake Calaveras is pumped from the San Antonio River. The quality of the San Antonio River is based on the time weighted average of monthly measurements taken by the USGS at USGS Station 08181800.

Source: AL-144

The continued discharge of excess waste activated sludge has resulted in the accumulation of thick sludge deposits within Mitchell Lake. These sludge deposits and the algae blooms that occur both contribute to the odor problems associated with the operation of the lake during low water levels. Because of this notorious odor nuisance, the Texas Department of Water Resources (formerly Texas Water Quality Board) undertook legal and legislative action to mitigate the odor condition. Consequently a Temporary Board Order (No. 77-52E) was issued on June 24, 1977. It outlined specific corrective measures that were to be carried out by the City of San Antonio. These corrective measures include, (1) the removal of sludge in the north section of the lake to an elevation of 516 feet MSL, (2) the installation of flow measuring and recording devices, and (3) the establishment of the operation level of Mitchell Lake consistent with provisions contained in the permit (TE-328). A copy of the existing permit (No. 10137-4 corresponding to NPDES Permit No. TX0065641) and a fact sheet discussing the city's recent permit application is contained in the Technical Reference Document (RA-R-420).

C. Ground-Water Hydrology

Ground water is extremely important in the growth and well-being of the San Antonio area. The City of San Antonio is the largest city in the United States that is dependent solely on ground water for its municipal water supply. Several minor aquifers are present in the area, but most of these are insignificant compared to the Edwards aquifer, which is the water source for the city.

The Edwards aquifer is one of the most prolific and important aquifers in the southwestern United States. It has been estimated that nearly one million people depend on the aquifer directly or indirectly for their well being and livelihood. The most significant part of the aquifer is in south-central Texas extending eastward and northeastward from Brackettville (Kinney County) to Kyle (Hays County).

1) Geologic Descriptions of the Edwards Aquifer

The Edwards is a carbonate (limestone and dolomite) aquifer having mostly secondary (solution) porosity. The rock body composing the aquifer includes several stratigraphic units, so the term "Edwards and Associated Limestones" has often been applied to the aquifer. The aquifer is also sometimes referred to as the "Balcones Fault Zone Aquifer," because of its close association with that fault zone. For the sake of simplicity, the aquifer is referred to here as the Edwards aquifer. The aquifer is a relatively thin, tabular rock body ranging in thickness from 450 feet in Hays County to more than 1,000 feet in Uvalde and Kinney Counties. The aquifer actually consists of two parts--a water table part and an artesian part*-- that are often separated at the Balcones fault zone as shown in Figure 2-9. Elsewhere, the two parts are in continuous hydraulic connection across the fault zone. The hydraulically separated water table part of the aquifer is not greatly significant to the San

---

*Wells drilled in the water-table part of the aquifer will have water levels below the top of the Edwards. In the artesian part of the aquifer, water levels in wells will be above the top of the Edwards aquifer. Thus, the ground water in the artesian part of the aquifer is generally under higher pressure than it is in the water-table part of the aquifer.

Antonio area except for the secondary recharge that its springs provide to the artesian part of the aquifer. For this reason, the artesian part of the aquifer, commonly called the Edwards Underground Reservoir, will be given the greatest emphasis in this description.

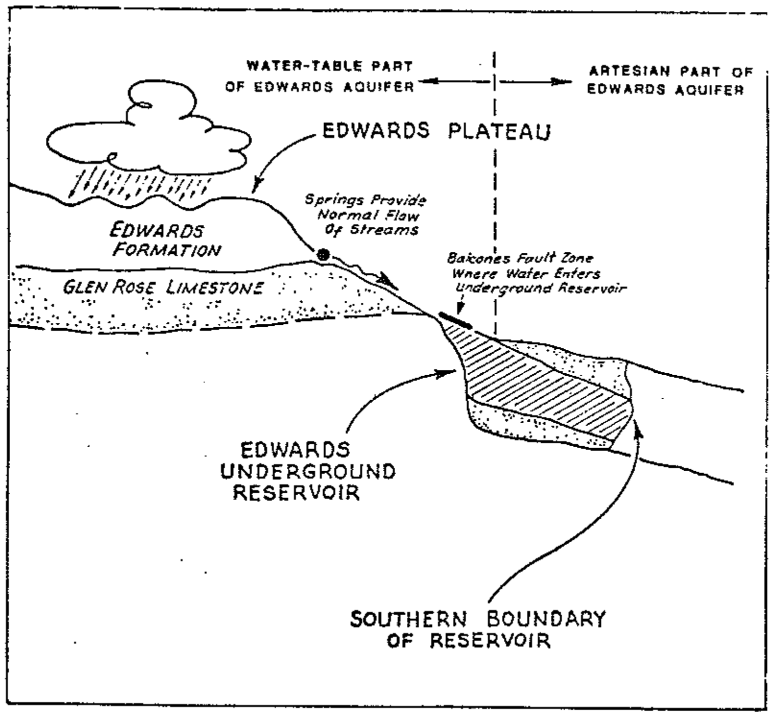


FIGURE 2-9

WATER TABLE AND ARTESIAN PARTS OF THE EDWARDS AQUIFER

Source: Edwards Underground Water District

The artesian part of the aquifer generally underlies the surface south of the Balcones Escarpment. It becomes artesian where overlain by younger, impermeable strata and is progressively deeper to the south and southeast. The average dip is about 100 feet per mile to the southeast.

2) <u>Hydrologic Characteristics of the Edwards Aquifer</u>

As noted earlier, water in the Edwards occurs in secondary openings. These openings formed as the result of solution of the limestone and dolomite by circulating ground water. The openings thus created range in size from small holes to large caverns.

For the purpose of this description, the Edwards aquifer is considered to have four boundaries. The updip (northern and western) boundary is in the Balcones fault zone where the aquifer passes from water table to artesian conditions. In many areas this boundary lies along one of the faults of the zone. The downdip (southeastern) boundary is located in a zone of transition from potable to unpotable water. The northeastern and southwestern ends of the aquifer are at poorly-defined ground water divides in the vicinity of Kyle and Brackettville. The aquifer extends in both directions beyond these divides, but these two end segments are not significant to the San Antonio area. The different parts of the aquifer in Bexar County are shown in Figure 2-10.

Discharge from the Edwards aquifer is both natural (from springs) and artificial (through wells). Before the advent of ground water use, all discharge was from springs. Withdrawal from wells has increased steadily, and in recent years about half the total aquifer discharge has been from wells. The productivity of wells is highly variable and depends principally on the location of the wells in the aquifer and the size and number of caverns encountered by the bore holes. The San Antonio Public Service Well No. 164, which was completed in 1942, flowed at a rate of 16,600 gallons per minute. This discharge is the largest known natural flow from a well in the United States.

The natural discharge from the Edwards is principally through five major springs located on faults along the Balcones Escarpment at San Marcos (San Marcos Springs), at New Braunfels (Comal Springs), at San Antonio (San Antonio and San Pedro Springs) and near Uvalde (Leona Springs). The largest of the springs is Comal Springs, which often flows in excess of 300 cubic feet per second (cfs). San Marcos Springs, the second largest, usually flows between 150 and 200 cfs. The remaining three springs each generally flow less than 50 cfs. The annual total discharge, including both natural and artificial discharge, was approximately 542,000 acre-feet for the period 1934 to 1971 (KL-042).

Recharge to the Edwards aquifer takes place both from direct infiltration of precipitation and from loss of streamflow in the outcrop area of the Edwards in the Balcones fault zone. The recharge zone closely coincides with the water table part of the aquifer shown in Figure 2-10. It has been estimated that 46 percent of runoff from the streams goes to recharge the aquifer (BR-333). The average annual rate of recharge for the aquifer for the period 1934 to 1971 was about 531,000 acre-feet (KL-072). About 65 percent of the recharge occurred in the western part of the aquifer (in the Medina River basin or in basins further west). This means that most of the recharge takes place in the western part of the aquifer, whereas the primary natural discharge points, Comal and San Marcos Springs, are on the eastern end. The rate of water movement is probably less than 50 feet per day (MA-581), but pressure changes in the aquifer travel much faster. If water levels in the western part of the aquifer are raised by a recharge event, the water levels and spring flow in the eastern end of the aquifer are increased within a few days.

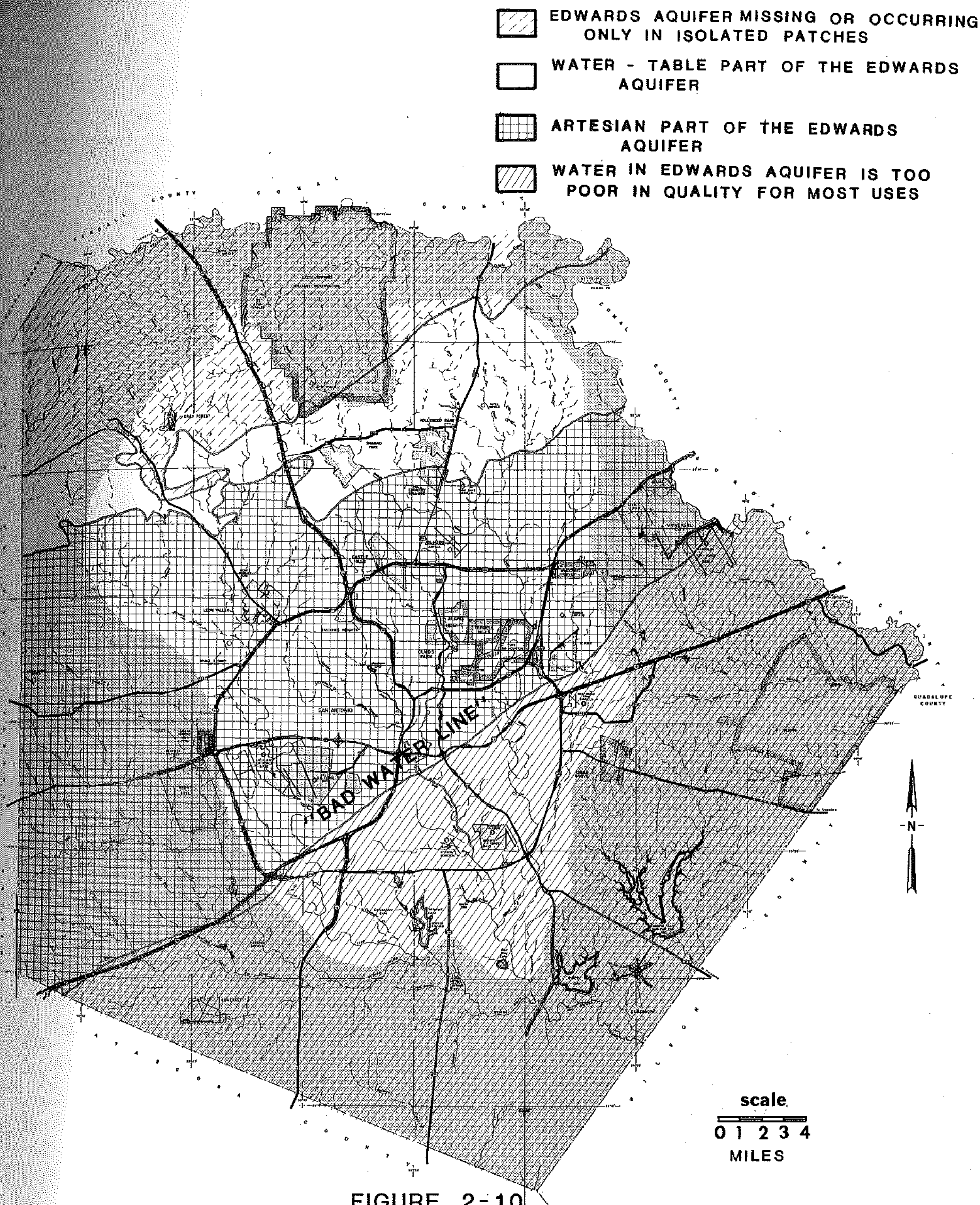


FIGURE 2-10

GENERAL LOCATION OF WATER-TABLE AND ARTESIAN PARTS OF THE EDWARDS AQUIFER IN BEXAR COUNTY

3) Water Quality in the Edwards Aquifer

The quality of water in the water table and artesian parts of the Edwards aquifer is relatively uniform and quite good. The water is of the calcium bicarbonate type and has a total dissolved solids content of about 250 to 300 mg/ℓ. Along the southern boundary of the aquifer the quality of water deteriorates sharply over a relatively narrow zone. This zone marks the downdip limit of fresh ground-water circulation; very little recharge that enters the aquifer migrates beyond this zone, but instead it moves eastward and northeastward. The southeastern boundary of the aquifer (the "bad water line") is arbitrarily placed in this zone along the line where the total dissolved solids content becomes greater than 1,000 mg/ℓ. Not only does the dissolved solids content of the water increase dramatically across this zone, but the water also becomes charged with hydrogen sulfide, which further decreases its usefulness and palatability.

4) Use of Water From the Edwards Aquifer

As noted earlier, about half of the discharge from the Edwards aquifer is now from wells rather than springs. The water withdrawn from the Edwards is used by municipalities (chiefly the City of San Antonio), by military installations in the Bexar County area, for irrigation of cropland (mostly west of San Antonio), by industrial users, and for domestic and stock purposes. The approximate percentages fo discharge from the aquifer are shown in Table 2-7 (BR-333).

TABLE 2-7

DISCHARGE FROM THE EDWARDS AQUIFER

		Percent of Artificial Discharge	Percent of Total Discharge
1.	Municipal and Military	53	25
2.	Irrigation	29	14
3.	Industrial	8	4
4.	Domestic, Stock, and and Miscellaneous	10	5
	Sub-Total:	100	52
	Spring Discharge	-	48
	TOTAL:	100	100

5) Depletion Problems of the Edwards Aquifer

As the population of the San Antonio region continues to grow, more and more people become dependent on the Edwards aquifer as a source of water supply. As a result, artificial discharge will undoubtedly account for a larger percentage of the total discharge of the aquifer, and discharge from springs will become less and less. Depletion of the aquifer will begin when the total discharge exceeds the total recharge over the long term. When this occurs, water is taken from storage and water levels begin to drop. During the dry years withdrawals usually exceed the rate of recharge. The rate of recharge is reduced because of decreased precipitation and streamflow, and the rate of withdrawal is increased because of increased water needs for irrigation. This set of circumstances prevailed during a drought that lasted from 1947 to 1956, in which water levels in the Edwards dropped to historic low levels. During this period, Comal Springs ceased flowing altogether for a time, and the flow at San Marcos Springs was reduced to an all-time low. Concern about excessive withdrawals and lowering water levels in the Edwards during this drought led the Texas Legislature to establish the Edwards Underground Water District. This organization was formed in 1959 to protect, conserve, and recharge the Edwards aquifer.

The average annual yield of the aquifer without withdrawing significant quantities of water from storage is equal to the annual rate of recharge, assuming that all flow to the springs is intercepted and the springs are allowed to dry up. As noted earlier, the average annual recharge rate is very close to 500,000 acre-feet per year. However, many residents of the area are opposed to diverting all the spring discharge to wells. Also, it may be feasible to withdraw from the aquifer at rates higher than 500,000 acre-feet per year during dry years and allow water to be taken from storage. The water thus lost during several consecutive drought years may then be quickly made up by high recharge rates during wet years. The ability of the Edwards to recover quickly from excessive withdrawals over a long period was demonstrated during the 1947-1956 drought; although water levels dropped to all-time record lows, high rates of recharge during 1957 and 1958 restored the levels to pre-drought conditions.

The Texas Department of Water Resources (formerly the Texas Water Development Board) has prepared a mathematical model of the Edwards aquifer in order to predict the response of the aquifer (primarily spring flow and water levels) under differing conditions of recharge and pumping withdrawals (KL-072). This model predicts that if the current rate of increase of pumping withdrawal is continued through 2020, and if the recharge follows the same pattern in the 25-year period after 1972 that it followed in the 25 years before 1970, then Comal Springs will go dry by 1995 and San Marcos Springs will be dry by 2010. A total of twenty aquifer simulations were used to investigate the behavior of the aquifer in different scenarios of artifical recharge, reduced or constant pumping for irrigation, a 12-year drought-flood sequence at various times in the future, and different aquifer management plans. One of the more significant findings of the study was that the springs will continue to flow through 2020 only under careful management. San Marcos Springs would flow continuously under pumpage rates up to 540,000 acre-feet per year, but Comal Springs will probably go dry if the pumpage exceeds 450,000 acre-feet per year. This eventuality also has substantial implications for surface water quality and quantity, as well as aesthetics and recreational use.

A major concern of users of water from the Edwards is the impact of lowered water levels on the quality of water near the "bad-water line." If the water in storage is decreased sufficiently, it may be possible that the water levels south of the line will be higher than north of the line. As a result, water could flow from the bad-water part of the aquifer into the fresh-water part, thus ruining wells near the line. Garza (GA-195) studied changes in dissolved solids of wells within and near the bad-water zone at different water levels and concluded that lowering of the water level 100 feet below the record low of 1956 would result in a dissolved solids increase of about seven percent in wells near the zone.

6) Pollution Problems of the Edwards Aquifer

Whereas the depletion of the Edwards aquifer has been a problem of long standing concern, the problem of pollution of the aquifer has emerged only in recent years as a major issue. The pre sent agricultural ranchland use of most of the recharge area is not widely perceived as a threat to the quality of water in the aquifer. However, the increasing encroachment of urbanization over the recharge area, particularly north of San Antonio, has caused considerable concern.

Urbanization causes several changes in the flow characteristics of surface water. For example, a larger fraction of the precipitation goes to runoff and a lesser amount infiltrates into the subsurface. The limited resistance to flow provided by sewers and paved surfaces causes runoff to move more quickly out of the drainage basins. For these reasons, peak flows of streams in urbanized areas usually occur more quickly after precipitation events, and the volume of flow is increased considerably. Since most of the recharge to the Edwards occurs in streambeds during high flow events, these changes in flow characteristics may affect the amount of water that recharges the aquifer.

Urbanization in general is also known to lower the quality of both surface runoff and water that infiltrates into the subsurface. Sources of surface contaminants from urbanization include leaks and spills of petroleum products, volatiles from asphalt pavement, sediment from areas that have been cleared of vegetation, and lawn fertilizers. Because streamflow provides recharge for the aquifer, surface water contamination results in potential ground-water contamination. Examples of potential sources of ground-water pollution by direct infiltration are septic tanks and drainfield systems, leaky sewer lines, and lawn fertilizers.

The Edwards aquifer is widely perceived as being particularly susceptible to contamination. Flow in limestone aquifers like the Edwards is often compared to flow in a maze of pipes. Contaminated ground water in this regime has less opportunity for renovation than water in sandstone-type aquifers.

Flow in sandstone-type aquifers is through small pore spaces, and the water is cleansed by filtration and by adsorption of contaminants by clays associated with the sand. No such renovation processes are available in limestone-type aquifers such as the Edwards. However, little field investigation has been done as yet to determine the actual susceptibility of the Edwards aquifer to urban-derived pollution.

Once ground water is contaminated it usually remains contaminated. If a stream or river is polluted, its water quality will usually improve dramatically in a few months or years after the source of pollution is removed. The rapid flushing action in surface water streams is absent in most aquifers; the rates of ground-water movement are usually much slower than surface-water movement. Thus, contaminants that enter an aquifer are likely to remain there for several decades or centuries. If the water is rendered unfit for human use, the aquifer is likely to be permanently ruined as a water source. As noted earlier, the velocity of water in the Edwards probably does not exceed about 50 feet per day.

Concern for the quality of water in the Edwards aquifer has resulted in litigation and political action in opposition to specific projects proposed for the recharge zone of the aquifer. Also, the Texas Department of Water Resources has issued a series of orders for each county in the recharge zone to provide protection for the aquifer. These orders specify a recharge zone for the aquifer that is defined generally on a set of Texas County Highway Maps which are issued with the orders. The zone is defined specifically on larger scale maps that are on file at the Board. The Board order applicable to Bexar County is #77-0303-3. The zone includes most of the outcrop of the Edwards aquifer in the Balcones fault zone. Within this zone animal feeding operations (feedlots) and industrial and municipal sanitary landfills are prohibited. In addition, strict controls are set forth for sewage disposal systems of subdivisions that are put in over the recharge zone.

Projects that are built on the recharge zone or that will stimulate urban growth over the zone continue to be a source of controversy. The Edwards Underground Reservoir has been designated by the Environmental Protection Agency, under the provisions of Section 1424(e) of the Safe Drinking Water Act (PL 93-523), as the principal source of drinking water for the San Antonio area. This designation means that major federally-financed projects having a significant impact on the safety of drinking water in the reservoir must be reviewed by the Administrator of the Environmental Protection Agency before federal funds can be approved for expenditure on the project (40 FR 149). In a further attempt to protect the aquifer, the City of San Antonio has commissioned a study to determine the nature of development or activity that can occur over the recharge zone without endangering the water quality in the Edwards.

2.1.2 Biological Components

The following discussion describes the existing terrestrial (land) and aquatic (water) plants and animals as well as the communities they form in the San Antonio area. San Antonio's 201 planning area includes two major areas. One is the area of urban San Antonio, and the other is the area of the "halo" effect of this urbanization. These two areas are generally discussed separately in the following biologic descriptions.

2.1.2.1 Terrestrial Biota

The flora and fauna of central and north-central Bexar County are representative of three major vegetation areas--Edwards

Plateau, Blackland Prairie, and South Texas Plains (GO-190). Three biotic provinces--Balconian, Texan, and Tamaulipan--are also recognized (BL-118). The diversity of plant and animal life in the San Antonio region reflects this biotic confluence. The biota of the planning area has been extensively studied for this EIS (RA-R-420), and the pertinent results and conclusions of these studies are presented in this section.

A. Vegetation

Species representative of the Edwards Plateau, the Blackland Prairie, and to a much lesser degree, the South Texas Plains (GO-190, GO-140) form a vegetative mosaic in the San Antonio region. Man's urban and agricultural use of this area has resulted in disturbance of the natural climax condition in all three major vegetative types.

The San Antonio River Basin largely consists of metropolitan San Antonio. Natural vegetation in this heavily urbanized area has been removed and replaced by "exotic" or horticultural plant species restricted to yards, gardens, or city parks. The drainages of Leon and Salado Creek encircle the populated area. Urbanization in this "halo" area is much less developed, but both farming and livestock production are major influences on vegetation. As a result of these urban and agricultural influences, the vegetation types in the urban and urban halo areas are quite dissimilar. Table 2-8 lists the prinicipal species of plants in the various vegetative types.

Urban Areas

Two types of vegetated areas exist within the city. Commercial or residential areas and city or area parks support the predominantly non-native, urban plant species which remain in the city.

TABLE 2-8

MAJOR VEGETATIVE ASSOCIATIONS IN THE SAN ANTONIO AREA

Vegetative Type	Vegetative Associations	Major Trees	Major Shrubs	Major Grasses/Herbs	Comments
Urban	Commercial/ Residential	Live Oak Pecan Mesquite Sycamore Lombard Poplar	Crepe Myrtle Arborvitae English Ivy Pyracantha	St. Augustine Bermuda	
	Parks	Cedar Elm Live Oak Spanish Oak Pecan Mesquite Hackberry	Crepe Myrtle Oleander	Bermuda St. Augustine Floratam	The City of San Antonio attempts to plant native trees in city parks
Edwards Plateau	Oak-Juniper Savannah	Live Oak Juniper ("Cedar") Hackberry Cedar Elm	Algerita Mountain Laurel Prickley Pear Yucca Poison Ivy	Needlegrass Texas Gramma Three-awn Little Bluestem	Canyon bottoms, alluvial fans at canyon mouths
	Juniper-Oak Woodland	Live Oak Shin Oak Juniper Hackberry	Algerita Yucca Scrubby Juniper Mountain Laurel Persimmon	Needlegrass Panic grass Three-awn Curly mesquite Croton Milkweed Verbena	Northern and eastern slopes exhibit larger trees and more brush; southern slopes have more, smaller junipers.
Blackland Prairie	Old Field	Hackberry } fence Mesquite } rows	Prickley Pear Bee Bush Moonseed	Johnson Grass Sunflowers Evening Primrose Verbena Prickley Poppy	Old Fields are once-cultivated areas undergoing vegetative succession and are sometimes grazed
	Cultivated Field			Milo Maize Mexican Hat* Prickley Poppy* Sunflower* Johnson Grass*	*These species are invaders between growing seasons
	Mesquite Savannah	Mesquite Live Oak Hackberry Cedar Elm	Texas Holly Prickley Pear Bee Bush	Three-awn Needlegrass Grassburr Horehound Silver Nightshade	Originally an Oak-Elm-Hackberry Savannah; overgrazing has permitted invasion by brush and mesquite
Transition Zone	Balcones Escarpment Zone	Live Oak Cedar Elm Scrubby Juniper Mesquite	Persimmon Mountain Laurel Algerita Squaw Bush Snakewood	Needlegrass Fluff grass Buffalo grass Bitterweed Phlox	Oaks and junipers on shallow soils close to Edwards Plateau; Mesquites on deeper soils nearer the Blackland Prairie
	Blackland Prairie/ South Texas Plains Zone	Live Oak Post Oak Blackjack Oak Mesquite Hickory Pecan	Huisache Whitebush Prickley Pear	Arizona Cottontop Buffalo grass Curly Mesquite Grassburr	Clayey soils of Blackland Prairie become sandy and more permeable in this zone
Bottomland Forest	Riparian (Streamside, Pond/Lake Shore, Ephemeral Pools, Springs, Seeps)	Bald Cypress Spanish Oak Live Oak Ash Cottonwood Pecan Walnut Mexican Buckeye Black Willow Bois d'arc	Greenbriar Poison Ivy Algerita Persimmon Bee Bush Boneset	Sedges Purple Cliff Brake Stinging Nettle Ragweed Pigweed Baccharis Johnson grass Vine Mesquite Muhly Pennywort Cattails	

Vegetation is conspicuous by its absence in the commercial district, though there are infrequent, heavily vegetated areas in the residential sections. Ground cover, when present, is usually species of lawn grass such as St. Augustine or Bermuda. Shrubby or ornamental species include Crepe Myrtle, Arborvitae, English Ivy, Pampas Grass, and Pyracantha. Native trees such as Live Oak, Pecan, Sycamore, American Elm, Mesquite, and Arizona Ash still comprise part of the arboreal vegetation. The more exotic trees are Lombard Poplar, Mediterranean Pine, Banana, Italian Cypress, Chinaberry, Palms, and Chinese Tallow.

At present, about 5,260 acres of parks are contained in the City of San Antonio. Where ground cover is maintained, it is frequently Bermuda or St. Augustine grass. Recently, a hardy grass species from Florida, Floratam, has been used as a replacement for these grasses (KE-186). Trees planted by the city are Cedar Elm, Live and Spanish Oaks, Redbud, and Crepe Myrtle. Other tree species often observed in city parks include Pecan, Hackberry, Mesquite, Magnolia, Chinaberry, Bald Cypress, and Ash.

Urban Halo Area

Vegetative components of the Edwards Plateau and the Blackland Prairie dominate the urban halo area. Species characteristic of the South Texas Plains make a relatively minor contribution to the Blackland Prairie along the southern edge of the area.

The Edwards Plateau occupies the northern third of the area and is delineated by the Balcones Escarpment. The potential climax vegetation of this region is Juniper-Oak savannah (US-155). The topography is generally deeply incised. Limestone-derived clayey soils interspersed with bare limestone outcrops typically support a mixed grass understory and a shrub-oak-juniper overstory. Heavy grazing has altered the composition of the grassy understory and allowed the invasion of brushy species. The two major vegetative associations in the plateau area are Juniper-Oak savannah and Juniper-Oak woodland.

The Blackland Prairie, a very gently rolling area, lies south and east of the Edwards Plateau and was historically a Little Bluestem Prairie (US-155). Deep clayey soils supported localized climax savannah conditions typified by stands of Live Oak, Hackberry, and Cedar Elm. The trees were underlain by lush grasses like Little and Big Bluestem, Side Oats Gramma, and Indian Grass. The area has been managed for grazing and farming and today displays the disclimax effects of these practices. Much of the prairie in this area is presently under cultivation, undergoing old-field succession, or is heavily utilized for grazing. Table 2-8 lists the major species of the three vegetative associations found in the prairie.

Two zones of transition occur in the urban halo area. One is the area around the Balcones Escarpment which separates the Edwards Plateau from the Blackland Prairie. The other zone is much less distinct and separates the Blackland Prairie from the South Texas Plains. This latter zone is rather broad and vegetative influences from the South Texas Plains are minor.

B. Terrestrial Animals

The fauna of Bexar County is derived from three biotic provinces (RA-R-420). The concept of a biotic province generally includes plant and animal species common to a given geographic area, as well as characteristic climatic, soil, and topographic features. The Balconian province represents the Edwards Plateau, the Tamaulipan province corresponds to the South Texas Plains, and the Texan Province is the Blackland Prairie (BL-118). As with the major vegetative areas, the contributions of each province to the fauna of the study area become generally mixed in this region of transition. A list of species found in this area has been compiled (RA-R-420).

Urban Area

The terrestrial animal populations within the urban San Antonio area are generally characterized by cosmopolitan, urbanized species. There are two major vegetation types within this area: Commercial/Residential and Parks. Table 2-9 lists the major animal species inhabiting this area by vegetation types

Generally speaking, only those truly cosmopolitan, urban species such as the House sparrow, Grackle, Starling, House mouse, and Norway rat are found in sizeable numbers. Others may be found, usually in very low numbers, where localized conditions allow them to exist.

None of the major game species (deer, turkey, quail, dove) or sensitive species (e.g., Golden-cheeked warbler) inhabit the urban areas in large numbers. Small numbers of deer inhabit the western edges of the city where residential development is low-density and some wooded creek beds remain for cover. They will slowly be pushed north and west as urbanization increases. The other three game species may be seen in the urban area during migrations or when they accidentally wander in.

Urban Halo Area

The terrestrial animal communities in the urban halo area are much more diverse than those of the urban area because urbanization is reduced and natural habitats are more available.

TABLE 2-9

MAJOR VERTEBRATE WILDLIFE SPECIES OF THE SAN ANTONIO AREA

Vegetation/ Habitat Type	Major Large Mammals	Major Small Mammals	Major Birds	Major Herptiles
Urban Riparian		Raccoon Opossum Cottontail Rabbit	Cardinal Killdeer Ruby-Crowned Kinglet Myrtle Warbler Mockingbird	Cricket Frog Leopard Frog Diamond-backed Water Snake Ribbon Snake Redear Turtle
Rural/Non-Urban Riparian	Whitetail Deer Bobcat Gray Fox	Raccoon Opossum Fox Squirrel White-Footed Mouse Cottontail Rabbit Nutria	Great Blue Heron Blue-Winged Teal Killdeer Cardinal Belted Kingfisher Myrtle Warbler	Leopard Frog Bullfrog Ribbon Snake Gulf Coast Toad Spring Softshell Turtle Redear Turtle Texas Blind Salamander
Urban		Norway Rat House Mouse squirrels	House Sparrow Boat-tailed Grackle Starling Rock Dove	Dekay Snake Garter Snake Green Anole
Edwards Plateau	Whitetail Deer Bobcat Gray Fox Coyote	Armadillo Cave Myotis Raccoon Ringtail Rock Squirrel Deer Mouse	Chapparal (Road Runner) Turkey Turkey Vulture Red-tailed Hawk Tufted Titmouse Golden-cheeked Warbler Painted Bunting Bewicks Wren	Diamond-backed Rattlesnake Striped Whipsnake Collared Lizard Tree Lizard Rocky Mountain Toad
Blackland Prairie	Coyote Whitetail Deer	Striped Skunk Jackrabbit Cottontail Rabbit Badger Cotton Rat Thirteen-Lined Ground Squirrel Hispid Pocket Mouse Fulvous Harvest Mouse	Turkey Bobwhite Quail Mourning Dove Red-tailed Hawk Turkey Vulture Mockingbird Scissor-tailed Flycatcher Savannah Sparrow Meadowlark	Coachwhip Diamond-backed Rattlesnake Texas Rat Snake Horned Lizard Prairie Lizard

The Edwards Plateau, with its characteristic flora of Juniper-Oak woodlands, savannahs, and rocky outcrops, contains a greatly different animal community than that of the Blackland Prairie. The only major populations of Texas white-tailed deer and turkey within the urban halo area are located on the Edwards Plateau. The deer population of Bexar County has remained between 31,000 and 44,000 for the past 10 years with no evident decline (WI-217). Both the deer and the turkey have been pushed to the northwest into the rocky hills of the Plateau by encroaching urbanization. Neither do well when continually disturbed by man's activities. Turkey are especially wary of man, and their exact numbers in this area are not known by the Texas Parks and Wildlife Department. However, they are still hunted in Bexar County, primarily on Camp Bullis (WI-217). Both of these animals are widespread throughout the various vegetation types on the Edwards Plateau, but they prefer the cover and water provided by bottomlands.

In general, the terrestrial animals of the Edwards Plateau region of the study area are species that favor brushy, rocky habitats. There are few burrowing animals such as small rodents or spadefoot toads because the soils are thin and rocky. This situation is reversed in the Blackland Prairie.

The terrestrial fauna of the Blackland Prairie portion of the urban halo area is composed of species that prefer mesquite savannah and old-field habitats with deep soils and relatively flat terrain. Many of these species feed on agricultural crops that are cultivated in the area. Both of the game bird species, Bobwhite quail and Mourning dove, eat maize and other grain grown in the southern portion of the study area. The Bobwhite populations fluctuate annually in response to rainfall and winter severity; however, it is believed that they are not as plentiful today as they were prior to the large amount of urbanization in the halo area. The Mourning dove is a carefully managed, somewhat migratory bird that nests over most of the United States. Its populations are relatively stable and are not easily affected locally.

For the most part, the Blackland Prairie habitats have been altered by man through land use practices discussed in the vegetation section. As a result, animals inhabiting these areas today are not necessarily the same species that would inhabit the natural climax grassland of the Blackland Prairie area. Some occur in greater abundance at the present time due to their ability to live in close proximity to man and utilize the vast artificial food sources he provides through agriculture. Others occur in reduced numbers due to destruction of their grassland habitats by overgrazing. None of the terrestrial species listed for the Blackland Prairie of the urban halo area are truly endangered within Bexar County.

C. Riparian Biota

Riparian biota consists of plants and animals common to streambanks, lakeshores, springs, or seeps. Plant species in these areas require the increased amounts of water provided by this habitat although perennial flow is not required to sustain them.

1) Riparian Vegetation

Urban Area

The San Antonio River, which is mostly channelized, forms a riparian corridor through the eastern half of the study area. Isolated remnants of riparian woodland along this corridor are all that remain of the native vegetation removed by urbanization. Large Bald Cypress trees, Spanish and Live Oaks, Ash, Cottonwood, Pecan, and Hackberry are scattered along the river. Because of urban encroachment, no natural riverbank remains to support further riparian growth. Where soil is present, Ragweed, Pigweed, and Johnson Grass indicate continuing disturbance. Alazan, San Pedro, Olmos, Zarzamora, Apache, and Martinez Creeks are minor drainages that range from narrow, dirt-banked, often intermittent creeks to concrete-lined drainage channels. Little, if any, natural vegetation remains along these waterways. Mesquite, Johnson Grass, Baccharis, Ragweed, Pigweed, Bermuda, and Chinaberry are indicative of both disturbance and escaped horticultural species in these riparian areas.

Urban Halo Area

Intermittent streams, such as Helotes Creek, ephemeral pools, springs and seeps, and canyon bottoms provide habitat for riparian plants in the northern third of the planning area. Shaded canyon bottoms, depressions in or near bedrock and small alluvial fans at the mouths of the canyons collect moisture and support a varied and unusually luxurious vegetation assemblage.

In open areas of canyon bottoms and on alluvial fans where disturbance by infrequent flooding occurs, brush species such as Algerita, Persimmon, Mountain Laurel, and Mesquite invade. Shallow depressions in or near bedrock hold pools of water after rains and support sedges like Eleocharis and Carex. Seeps or small springs, usually in canyon bottoms, create isolated microhabitats for several moisture-loving species. Maidenhair fern, Pennywort, Virginia creeper, and Mexican buckeye are typical of these habitats.

In the southern two-thirds of the planning area, riparian vegetation is encountered in and along stream beds and, to a lesser degree, around artificial stock ponds. Although not all the creeks or streams are intermittent, water is often restricted to deeper pools during dry conditions. Leon, Salado, Culebra, and Rosillo Creeks are probably the most permanent streams. Streamside trees are usually Live Oak, Cedar Elm, Hackberry, and Blackwillow. Because these riparian habitats are frequently disturbed by both flooding and man-related activities, species such as Johnson Grass, Cattails, Prickley Poppy, Sunflower, and Thistle are common.

2) Riparian Animals

Riparian habitats support species common to all habitats in the San Antonio region but often in larger numbers due to an increase in cover, food, and water. In addition to these animals, certain species which require moist habitats, such as frogs, toads, aquatic snakes, and salamanders, will be found only near water bodies. The riparian habitats are the most important to the overall faunal diversity of the planning area.

Mammals commonly associated with riparian vegetation include squirrels, raccoons, skunks, cottontail rabbits, oppossum, and nutria. Some shorebirds such as killdeer, herons, and migratory ducks can be seen. Some warbler species prefer the dense vegetation along watercourses. Leopard and cricket frogs, diamond-backed water and ribbon snakes, the cottonmouth, and several turtle species are also found in this habitat. Although these species can be found in riparian habitats throughout the planning area, the likelihood of their occurrence is greater where urban encroachment is least.

2.1.2.2 Aquatic Biota

A. Aquatic Vegetation

In the San Antonio study area, the major aquatic plant species are common to all water bodies. The predominant species in the San Antonio have been identified (RA-R-420).

1) Urban Area

The San Antonio River and associated tributaries provide pool and riffle habitats that support Pondweed, Water Milfoil, Water Hyacinth, and Arrowhead or Water Plantain. Woodlawn Lake, on Alazan Creek, and other segments of these watercourses with nearly natural streambanks often have growths of Cattails, Bulrushes, Lotus, and Bushy Pondweed. In channelized segments of the river within the city, these species occur very infrequently.

The predominant phytoplankton species in the San Antonio River are diatoms and green algae with some pigmented flagellates and blue-green algae (TW-005). Nuisance or bloom levels are not encountered as the river flows south to its confluence with the Medina River.

2) Urban Halo Area

The primary sources of natural runoff to Leon Creek are Indian Creek and an unnamed creek. A variety of habitats support mixed populations of vascular aquatic plants (RA-R-420). Periphytic or phytoplanktonic growth are highest above outfall sites for the various wastewater treatment facilities and lowest below them (RA-304).

Salado Creek is an intermittent stream that provides adequate aquatic habitat only where pools retain the moisture required to sustain aquatic vegetation through extended dry periods. South of northeast Loop 410, springs supply a constant source of water. The predominant algae present are those characteristic of the San Antonio River (TE-254, TW-005).

The rock shallows of Braunig Lake are not suitable habitat for delicately-rooted, submerged, or emergent plants.

Cattails and a few willows, however, are well-established (PR-133). The lake's waters support relatively high algal concentrations but not in nuisance proportions (YO-044).

The water of Calaveras Lake is generally cooler and less nutrient-enriched than that of Braunig Lake. Aquatic plant habitat quality is generally high in this lake. Water milfoil and water hyacinths are approaching nuisance population levels (PR-133).

Mitchell Lake has been enriched in past years by regular discharges of waste-activated sludge and digester supernatant liquor, as well as raw sewage during storm flow periods from the Rilling Road sewage treatment plant. Intense algal blooms which result from this enrichment occur year around and give the lake a brillant green color. Blue-green algae predominate; particularly the filamentous *Oscillatoria formosa* and *Oscillatoria splendida* (PA-237). High concentrations of green algae and pigmented flagellates also occur.

B. Aquatic Animals

Fishes common to the San Antonio River Basin in Bexar County have been investigated and documented for this study (RA-R-420). Because of the variability in habitat quality within each stream or lake, the fauna of each water body is discussed separately.

1) Urban Area

The creeks, San Antonio River, and three small lakes in this area provide adequate aquatic habitats for fish and other aquatic species above the Rilling Road sewage treatment plant. Urban runoff, channelization, and oil from outboard motors in the

Riverwalk area are some of the factors which reduce habitat quality in these reaches of the river. In the past, nuisance plant eradication programs have severely limited the extent and quality of this habitat. A pesticide-induced fish kill occurred in Woodlawn Lake in 1963 (TE-256). Gamefish presently occur primarily in the three small lakes and in suitable sections of the river (RA-R-420). Easy public access to these waters allows heavy fishing pressure.

The density and diversity of invertebrate organisms appear to be quite low in the San Antonio River (TW-002), RA-R-420). The low numbers of planktonic species observed are expected in relatively fast-moving, spring-fed, comparatively unpolluted streams. Numbers and types of benthic macroinvertebrates are somewhat more abundant because of the variety of substrate habitats provided by these same conditions. Sediment samples taken as part of a Texas Department of Water Resources study contained heavy metals and pesticides in higher concentrations than those observed in near-natural sediments (TW-005).

The river receives the treated discharge of the Rilling Road sewage treatment plant, Salado Creek sewage treatment plant, the nutrient load carried by Leon Creek, and considerable urban and agricultural runoff in the southern third of this area. The species that have been identified and documented (RA-R-420) should occur in these southern portions of the river, though their densities or diversity are probably altered by the quality of the waters they inhabit.

2) Urban Halo Area

Leon Creek

Treated effluent from several sources maintains perennial flow in Leon Creek below Kelly AFB. Samples from these waters contain high levels of cyanide and phenols below Kelly AFB and high levels of DDT and its metabolites in other stream segments (RA-304). Although substantial sustained populations of fish probably do not occur in Leon Creek, some species such as the Rio Grande Perch and pollutant-tolerant macroinvertebrates persist (RA-304, RA-R-420). All of these species have been the object of eradication programs, primarily during the 1960's (YO-044, DI-123).

Salado Creek

Fauna in the northern two-thirds of Salado Creek are reduced due to the intermittent character of the creek in these areas. Springs east of the city maintain a perennial flow in the creek for the southern third of its length. Fish and other vertebrate species that occur are those common to the San Antonio River at the mouth of the creek (RA-R-420).

Braunig Lake

An elevated temperature regime and enrichment by make-up waters from the San Antonio River are the major factors affecting habitat quality in this lake. Fish production is high, with a standing crop of 657 lbs/acre (PR-133) including 450 lbs of Rio Grande Perch and the cichlid Tilapia, both introduced forage species. Large-mouth bass and catfish compose only 5 and 13 percent by weight respectively, and the bass average under 1 pound. The elevated water temperature and lack of suitable habitat are probably responsible for the apparent reproductive quiescence of the bass (PR-133).

Calaveras Lake

Calaveras Lake presently enjoys good water quality with a near normal temperature regime. Make-up water from the San Antonio River is seldom needed and only a portion of the planned cooling water discharge is currently being released. It supports a very good sport fishery. Largemouth bass and channel catfish account for about 163 and 103 lbs/acre respectively (PR-133).

Mitchell Lake

It is doubtful that sport fish survive in Mitchell Lake. A constant algal bloom and repeated loadings with municipal wastes preclude the likelihood of populations of any but the most pollutant-tolerant life forms.

2.1.3 Sensitive Natural Areas

Two types of sensitive areas, physically sensitive and biologically sensitive, are present in the San Antonio region. A map depicting both is shown in Figure 2-11. This map portrays a composite of map units presented and described in earlier sectons.

The areas that are sensitive because of physical characteristics are the Edwards Recharge Zone and areas where slopes greater than 25 percent occur. In addition to these, the flood-prone areas must also be considered sensitive. These areas have been delineated and described in earlier sections.

Biologically sensitive areas in both the urban and urban halo areas are also shown in Figure 2-11. Because nearly all of the available natural habitat in the urban area has been removed, those vestiges of natural vegetation which remain, particularly large native trees, should be considered sensitive. Animal species which remain within the city are generally those that have readily adapted to man's activities and cannot be truly

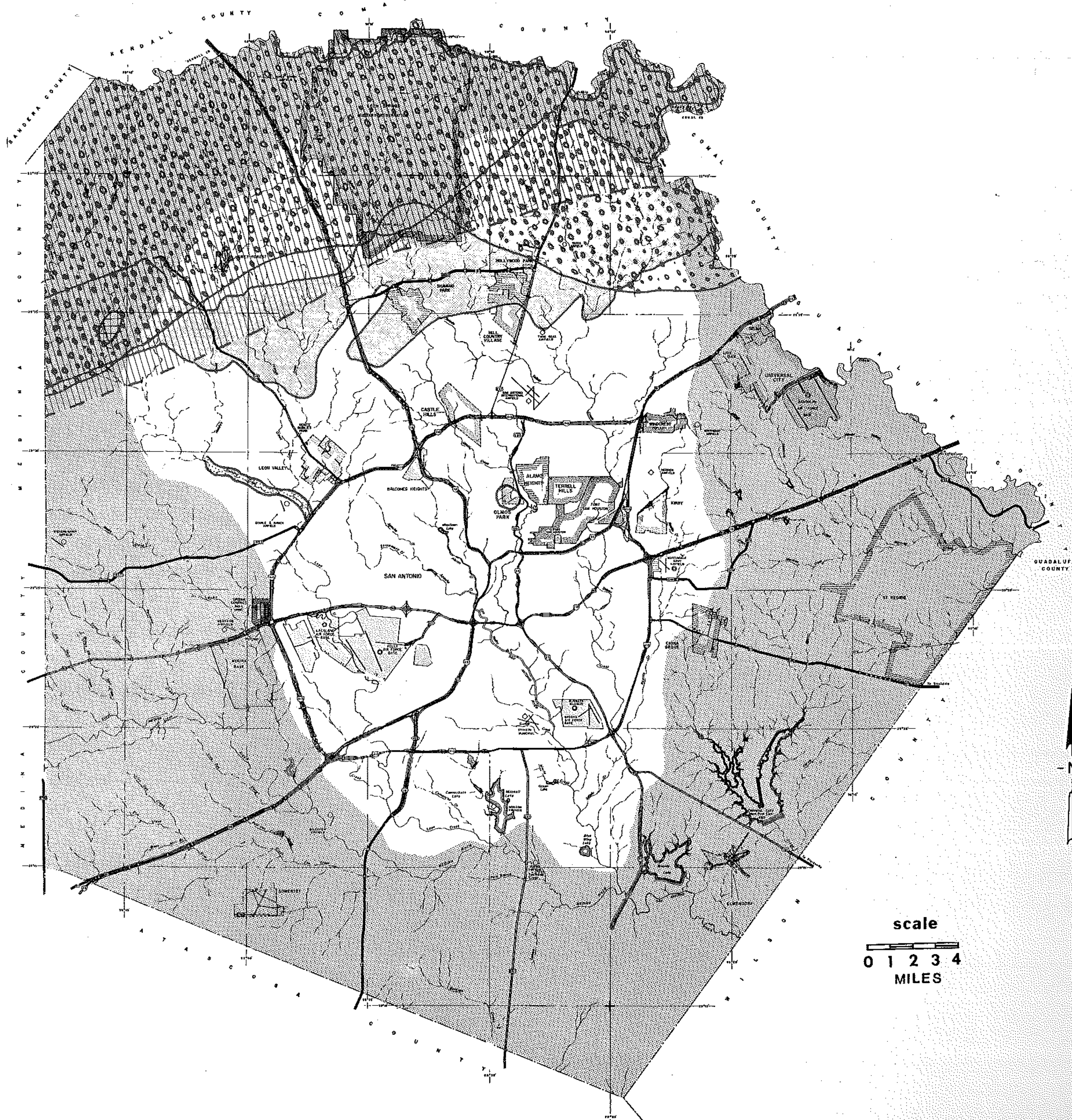


FIGURE 2-11
SENSITIVE NATURAL AREAS

considered sensitive. Native trees which occur in parks or along the rivers, such as the large Bald Cypress trees along Riverwalk on the San Antonio River, are irreplaceable resources and should be protected.

In the urban halo area there are species and areas which are sensitive to the halo effect of urban San Antonio. The Golden-cheeked warbler breeds only in the Edwards Plateau region and only in those areas which have stands of mature Juniper trees. Bexar County is one of the 30 Texas counties which contain suitable nesting habitat for this bird. Juniper stands to the north of San Antonio on the southern edge of the Edwards Plateau are characterized as "marginal" habitat for this warbler (JA-149) but are very important as a buffer zone around more suitable nesting sites. Juniper (known locally as "cedar") eradication programs sponsored by the Soil Conservation Service and housing developments in the Hill Country are destroying this species' habitat (PU-065).

Another bird species considered sensitive is the Black-capped Vireo (GE-147). Little is known of this species' natural history. The Black-capped Vireo occurs in much the same area of Texas as the Golden-cheeked warbler but appears to favor second growth Oak-Juniper stands instead of mature juniper. So little is known of this species at this time that its status is uncertain.

Two species of blind catfish from deep artesian wells in the vicinity of San Antonio, Satan eurystomus and Trogloglanis pattersoni, are the only sensitive fish species that might be encountered (YO-004, GE-147). A recommendation has been made to add these two species to the U.S. Fish and Wildlife Service (USFWS) list of threatened and endangered species, but no action has yet been taken on this recommendation.

The several species of cave salamanders that occur in the Edwards aquifer in the area are sensitive because disturbance of their habitats can result in loss of the entire species population. These animals are a valuable scientific research resource. The Bexar County Salamander (*Eurycea neotenes*) has as its type locality Culebra Creek. An undescribed species of neotenic salamander (*Eurycea* sp.) has been reported from a spring in the northwestern portion of the study area near Helotes (JA-149). Still another undescribed species has been reported from a cave in Olmos Park. Other species known to occur in the Bexar County area are listed below with their habitats (YO-004, GE-147).

	Location
Eurycea sp.	Spring in Government Canyon near Helotes
Eurycea sp.	Olmos Park Cave, San Antonio
Eurycea latitans	Cascade Caverns, Boerne
Eurycea tridentifera	Honey Creek Cave stream near Bulverde, Comal County
Eurycea neotenes	Culebra Creek, Bexar County
Eurycea troglodytes	Valdina Farms, Medina County

The possibility that these salamanders move from spring to spring via above-ground or underground routes has been discussed by several researchers but has not been proven. A notice of review has been published in the Federal Register (14 July 1977) by the U.S. Fish and Wildlife Service for consideration of the Honey Creek Cave blind salamander and the Valdina Farms salamander as possible additions to the Federal list of endangered species. This notice represents an effort by the Service to obtain sufficient information to determine the exact status of these salamanders. None of the other animals mentioned above are listed or being considered for listing on the USFWS list of threatened and endangered animal species.

TABLE 2-10

THREATENED AND ENDANGERED PLANT SPECIES
OF THE SAN ANTONIO AREA

Acacia emoryana	Emory acacia (E)
Arbutas xalapensis	Texas madrone (E)
Bernardia myricaefolia	Brush myrtlecroton (T)
Carex davisii	Davis sedge (T)
Carex hyalina	Whitesheath sedge (T)
Carex physoryncha	Offshoot sedge (T)
Cenchrus myosuroides	Big cenchrus (T)
Cheilanthes alabamensis	Lipfern (T)
Garrya lindheimeri	Lindheimer silk tassel (T)
Matelea edwardsensis	Plateau milkvine (T)
Potamogeton panormitanus	- - (T)
Psoralea reverchoni	Rock scurfpea (T)
Saggitaria brevirostra	Shortbeak arrowleaf (T)

E = Endangered

T = Threatened

Source: TE-259

Endangered or threatened plant species found in the study area are listed in Table 2-10. Silk tassel and Plateau milkvine are endemic to the Edwards Palteau and occur in the northwestern third of this study area. The lipfern, *Cheilanthes alabamensis*, is threatened in Bexar County and is also considered endangered (TE-259). Two species, the Emory acacia and the Plateau milkvine, have been listed as endangered on the USFWS proposed list of endangered and threatened plant species (*Federal Register*, 16 June 1976).

2.2 Man-Made Environment

The man-made or cultural environment results from the acts of man, both in organized groups and as individuals, to provide food, shelter, clothing, and other wants peculiar to human beings. Included are the visible cultural landscape, that is, the result of man's remaking of the physical environment, and the social organization that has evolved. The following sections present the salient features of the cultural environment including demography, economics, and economic geography.

2.2.1 Demography

Demography is the study of population trends and phenomena as they relate to a social context. The following sections describe growth trends, analyze the characteristics of the population, and present projections through the year 2000 for the San Antonio area.

2.2.1.1 Current Population Data

Although the 201 Planning Area lies entirely within Bexar County, data for the three-county San Antonio Standard Metropolitan Statistical Area (SMSA) are considered in some parts of this analysis.

Both Bexar County and San Antonio have grown continuously and at approximately the same rate since the first census tabulations were compiled for the area (RA-R-420). In general, the growth of the area has always been more rapid than that of the state of Texas. Through 1920 San Antonio was the largest city in the state. Its growth was stimulated by railroad expansion, livestock and related industries, wholesaling, and military expenditures. During the Depression Era of the 1930's, population growth in San Antonio fell to an all time low as jobs became particularly scarce in most urban areas. World War II and the post-war era were periods of rapid growth. However, in the 1960's the growth of San Antonio and Bexar County slowed, approaching that of the State of Texas as a whole.

Both San Antonio and Bexar County have continued to grow since 1970. Unlike many central cities which are encircled by incorporated communities, San Antonio has annexed suburban developments. As a result San Antonio has grown so rapidly that it is now the second largest city in Texas. Due to the expanding nature of the city limits, it is useful for certain analyses to expand the scope to include the entire county. Population variables described for Bexar County are: (1) population density; (2) ethnicity; (3) age; (4) sex composition; (5) income; (6) education; and (7) spatial patterns within the county.

As would be expected, the inner areas of the city are more densely populated than the suburban fringe areas (RA-R 420). The northern half of the county is currently the growth area. The areas of high density in the inner city are not growing rapidly, if at all (RA-R-420).

Ethnic composition is very significant in Bexar County because of the multi-ethnic nature of the area. There are large Mexican-American and Anglo communities with a much smaller Black community. Table 2-11 shows the percentages of ethnic groups in the city and the county populations.

TABLE 2-11

RACIAL AND ETHNIC CHARACTERISTICS OF THE POPULATION, BEXAR COUNTY AND SAN ANTONIO, 1950-70

Year	Mexican-American No.	Mexican-American %	Black No.	Black %	Anglo No.	Anglo %
			Bexar County			
1950	176,877	35.4	32,220	6.4	290,353	58.0
1960	257,090	37.4	45,314	6.6	382,666	55.7
1970	376,029	45.3	56,394	6.8	388,822	46.8
			City of San Antonio			
1950	160,420	39.3	28,495	7.0	218,677	53.5
1960	243,627	41.4	41,605	7.1	300,870	51.2
1970	341,333	52.2	50,041	7.6	256,390	39.2

Source: SA-244

In the 19th Century the San Antonio area was predominantly Mexican-American. However, growth of the Anglo population followed the 20th Century expansion of the military complex. By 1950 the Anglo population was more than 50 percent of the total for both the city and the county. Since 1950 the Anglo population of the county has increased. However, the Mexican-American community grew rapidly through in-migration and higher fertility, and the two groups were approximately equal in number by 1970. There was a decline in the number of Anglos in the city between 1960 and 1970 due to migration to suburbs. Hence, the Mexican-American community had attained a majority by 1970. This trend has reversed recently through extensions of the city limits which incorporated many Anglos who earlier had moved from the central city. By 1975, the City of San Antonio estimated that 400,121 of its 772,719 citizens (51.8 percent) were Mexican-Americans, a lower percentage than in 1970.

Throughout the recent past, the percentage of Blacks and other non-whites in both San Antonio and Bexar County has remained fairly stable at approximately seven percent.

Table 2-12 shows the median age of the population of Bexar County compared to other urban counties in Texas, the entire state, and the United States. Each unit has become younger in the 20-year period due to high fertility for the county in the post-World War II period. The Texas population is younger than that of the nation due to in-migration of relatively young people and due to relatively high fertility, especially in the Mexican-American population.

TABLE 2-12

MEDIAN AGE

Year	U.S.	Texas	Bexar County	Harris County	Dallas County	Tarrant County
1950	30.2	27.9	26.8	28.8	30.0	29.6
1960	29.5	27.0	24.4	27.1	28.1	27.9
1970	28.1	26.0	24.1	25.7	26.3	26.5

Source: SA-244

The Bexar County population is the youngest of the four largest counties in the state. This youth is due primarily to the large Mexican-American community with its high fertility and relatively large family size. Age profiles for the Bexar County population show its youth (RA-R-420). The large proportion of people in younger age groups is particularly noticeable. When the profile is broken down by ethnicity, the influence of the Mexican-American community on the age structure becomes obvious. That community is a very youth-dominated group with a large number of members five to nine years old. The Black community is somewhat less youth-dominated than the Mexican-American, with smaller percentages in the younger age groups. The Anglo community is more typical of the United States as a whole with a more even distribution throughout the profile. The large percent of the population in the 15 to 24 age group can be attributed to the large military employment in the area.

Analysis of the sex composition shows a greater percent of males in the younger age groups. Table 2-13 shows the percent male/female for Bexar County compared to other units. By each standard, Bexar County has a higher percent of males in the population. Certainly the military complex accounts for much of the difference.

TABLE 2-13

SEX COMPOSITION OF SIX POPULATION UNITS (1970)

	Percent Male	Percent Female
United States	48.9	51.1
Texas Metro	48.8	51.2
Bexar County	49.2	50.8
Harris County	48.9	51.1
Dallas County	48.3	51.7
Tarrant County	48.9	51.1

Source: US-343

With respect to income, San Antonio and Bexar County are relatively poor. The entire area has a high percent of families living at sub-poverty levels. The percent below poverty level is particularly high (25.2) for Mexican-American families in San Antonio (RA-R-420). The Bexar County population has a higher median income and less poverty than San Antonio because of Anglo dominance in portions of the county beyond the city limits.

The San Antonio area is below average in educational levels. Table 2-14 shows this fact. It also shows that the city is lower than the county.

TABLE 2-14

MEDIAN NUMBER OF YEARS OF EDUCATION IN FIVE POPULATION UNITS

	Median Years Education (1970)
United States	12.1
Texas	11.6
Metropolitan Texas	12.0
Bexar County	11.6
San Antonio	10.8

Source: US-343, US-054

Spatial variation in the above social indicators adds considerable insight (RA-R-420). The central city is predominantly Mexican-American with the highest concentration in the area around the central business district and to the west. A low percentage of Mexican-Americans is located in the northern areas of the county. These more recent suburban developments are predominately Anglo.

Like the Mexican-American population, the Black population is concentrated within the city. There is a major cluster of Blacks east of the central business district and a secondary cluster in the western fringe of the town. In general, Anglos are predominant in the northern half of the county and in the northern third of San Antonio.

Unemployment is highly concentrated in the center of San Antonio, especially in the predominantly Black community northeast of the central business district and in the Mexican-

American community west of the central business district. Unemployment obviously has an ethnic component (RA-R-420).

2.2.1.2 Population Projections

The San Antonio area population will grow in the near future because of natural increase (a relatively large percent of the population has not entered the child-bearing years) and in-migration. Various projections are available with different assumptions about the future. The OBERS series E projection (US-122, V.1) predicts that population in the San Antonio SMSA including Bexar, Guadalupe, and Comal Counties will grow significantly through 2020 (RA-R-420).

The City of San Antonio has published projections (Table 2-15) for both the city and for Bexar County. These projections show a somewhat greater rate of increase in population than the OBERS projections show. This is because the San Antonio area has a higher fertility rate than was used in the OBERS projections. These projections reflecting higher fertility were used in the San Antonio Growth Sketch (SA-304) to project the future distribution of population. Those growth sketch projections are used in subsequent analyses (Chapter 3) to determine projected sewage flow until the year 2000. While the population projections in Table 2-15 vary slightly from the growth sketch projections (because of the different geographic regions in questions), both projections are based upon the same original analysis. The projections for the city and Bexar County are presented in Table 2-15 for consistency with previously reported statistics in this chapter.

TABLE 2-15

POPULATION ESTIMATES

Year	Bexar County	City of San Antonio
1970	830,460	654,153
1980	926,084(+15.8%*)	846,153(+29.4%)
1990	1,092,037(+13.5%)	964,705(+14.0%)
2000	1,198,319(+9.7%)	1,070,219(+10.9%)

*Percent change for the decade.

Source: SA-245

2.2.2 Economics

Economics is the study of how society allocates physical and human resources to satisfy subsistence requirements. The following sections describe the current economy of the San Antonio area and project future conditions through the year 2020.

2.2.2.1 Current Economic Structure

An examination of employment by major sectors of the economy in 1970 indicates the economic structure of Bexar County. The most noticeable difference between Bexar County and the other large metropolitan counties of the state is the manufacturing sector. The low percent (11.7) of the labor force in manufacturing is remarkable. Even Texas, as a whole, has a much higher percentage (18.5) employed in manufacturing. In 1967 (US-343) only 1.0 percent of Bexar County's manufacturing firms employed more than 100 employees, while 9.8 percent of the firms in Texas had more than 100 employees. Thus, Bexar County manufacturing employment is spread over a great number of companies rather than being concentrated in only a few (RA-R-420).

Another major deviation in economic structure is in the area of government employment. Bexar County has an unusually large number of government employees compared to similar metropolitan counties. This is attributed to the large military employment at the Army and Air Force bases in the county. In other major economic sectors, Bexar County closely resembles other metropolitan counties.

From 1970 to 1974, there were few significant economic changes (RA-R-420). The civilian labor force grew by 11.0 percent, while the total employed grew by 11.0 percent. Unemployment remained at 5.7 percent of the labor force. Manufacturing, the lagging sector, only grew by 7.0 percent for the four-year period. Thus, there was no expansion in the manufacturing sector during the period. Construction employment grew by 54.3 percent while a 25.5 percent gain was achieved by the business service sector (finance, real estate, and insurance).

The civilian government sector experienced relatively slow growth. By City Planning Department forecasts, military employment in Bexar County should have decreased from 51,164 in 1970 to 48,000 in 1975. According to the San Antonio Chamber of Commerce, military employment on June 30, 1975 was 48,023 (including Reserves and National Guard), close to the prediction. These trends indicate that few new jobs will be provided by government employment in the near future.

With respect to the skills of the area's labor force, and considering the fact that the area's industrial structure is somewhat atypical, the occupational structure appears to be normal. Bexar County is somewhat low in the number of white collar workers and high in sales workers, clerical staff, and service workers (RA-R-420).

Current reports on the three-county San Antonio SMSA employment situation show that the total civilian labor force grew from 378,500 in July, 1975 to 388,200 in July, 1976, an increase of 2.6 percent. Unemployment in the same period dropped by 200 people from 8.1 percent to 7.9 percent. By comparison, the state's employment grew by 2.1 percent, while the unemployment dropped from 6.0 percent to 5.7 percent. Thus, the San Antonio SMSA has slower growth in employment and higher unemployment than the state as a whole. The overall economic situation is revealed by indicators such as building permits, bank deposits, loans and debits, and gross retail sales. These indicators show a steady growth pattern since 1960 (RA-R-420).

2.2.2.2 Economic Projections

Per capita income in San Antonio is projected to increase through 2020 (Table 2-16). However, San Antonio's income is predicted to remain below the national and state averages.

TABLE 2-16

PERSONAL INCOME PER CAPITA

AS PERCENT OF NATIONAL AVERAGE

	1970	1980	1990	2000	2010	2020
United States	100	100	100	100	100	100
Texas	91	91	92	93	93	94
San Antonio (SMSA)	84	85	86	87	88	89
Dallas (SMSA)	109	109	107	106	104	103
Houston (SMSA)	105	104	102	101	101	100
Fort Worth (SMSA)	99	98	98	97	96	96

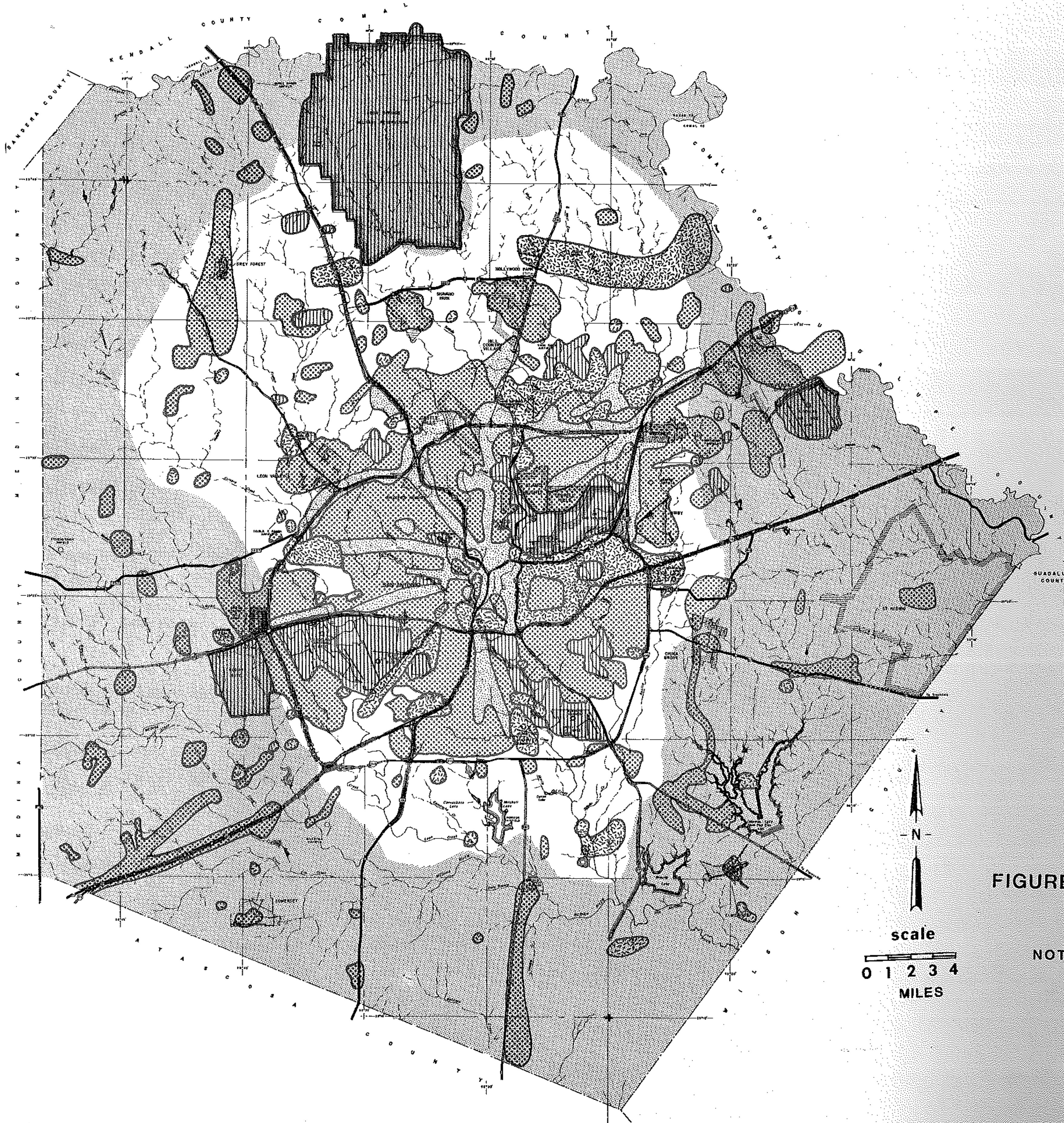
Source: US-122

Projections for Bexar County show that most employment sectors will remain relatively constant over the next 15 years. Small declines will occur in agriculture, mining, manufacturing, transportation, and wholesale and retail trade. The largest decline in employment will occur in the federal government sector, already a disproportionately large sector. Significant gains will occur in state-local government and the medical and professional services (RA-R-420).

2.2.3 Land Use

This section examines the organization of land as a resource in the study area. Figure 2-12 shows existing land use for the City of San Antonio and Bexar County as of January, 1975. The information was compiled from a land use map prepared by the Planning Department of the City of San Antonio. Its purpose is to show patterns rather than exact land use. Table 2-17 describes existing land use by percent of acreage.

Table 2-17 shows that residential land use dominates the urban San Antonio area. In 1973 San Antonio had approximately 213,000 housing units (SA-261). Seventy percent were single-family units, 10 percent were townhouse-type units, and 20 percent were apartments. This housing mix, along with support services, represents a gross site density of 4.4 units per acre (SA-265). San Antonio is a low-density metropolis and probably will remain so even though there are 50,000 acres of vacant land within the city limits. Of these 50,000 acres, 34,300 acres are suitable for development. The unsuitable land falls on the Edwards Aquifer Recharge Zone (6,900 acres), the Aquifer Recharge Zone Drainage Area (4,100 acres), and floodplains (5,300 acres) (SA-264). Population density has declined from 6,301 persons per square mile in 1940 to 2,942 persons per square mile in 1974. This indicates a trend toward suburban developments featuring single-family housing.



LEGEND

- OPEN SPACE AND LOW DENSITY RESIDENTIAL
- HIGH DENSITY RESIDENTIAL
- COMMERCIAL AND OFFICE
- INDUSTRIAL
- PUBLIC OPEN SPACE AND PUBLIC FACILITIES

FIGURE 2-12 BEXAR COUNTY GENERAL LAND USE, 1975

NOTE: THIS MAP WAS DERIVED FROM A LAND USE MAP PREPARED BY THE SAN ANTONIO PLANNING DEPARTMENT. THE PLANNING DEPARTMENT MAP IS VERY DETAILED AND EXACT. THE ONLY GOAL OF THIS VERY GENERAL MAP IS THE DEPICTION OF PATTERNS. ACTUAL LAND USE AT A PARTICULAR SITE SHOULD NOT BE ASSESSED FROM THIS MAP.

SOURCE: SA-M-307

TABLE 2-17

EXISTING LAND USE BY PERCENT

BEXAR COUNTY

Unit	Percent of Coverage
Residential:	7.28%
Single-Family	6.80%
Moderate	.05%
Multi-Family	.28%
Mobile Homes	.15%
Commercial:	1.33%
Retail (light)	.16%
Retail (heavy) and Warehouses	.55%
Manufacturing	.62%
Transportation:	5.51%
Streets, Alleys, and Road Rights-of-Way	4.89%
Communications, Public Utilitiies	.62%
Public:	.74%
(Parks, Recreation, Cultural)	
Public Service:	.70%
(Schools, Hospitals, Churches, Cemeteries)	
Military Bases:	5.82%
Streams and Lakes:	1.02%
Vacant:	77.42%

Table 2-17 shows that commercial and industrial land use accounts for 1.33 percent of the Bexar County land area or approximately 16.57 square miles. The majority of the commercial land use occurs in the central business district and various shopping nodes serving the developing fringes. Other commercial land use occurs in strip development along San Pedro Avenue, Old Austin Highway, and Loop 410.

The percentage of industrial land use is low for a city the size of San Antonio. It is composed of several concentrations such as breweries, stockyards, and railroads.

Extractive land use is included with industrial in Figure 2-12. Extractive operations include production of cement, stone, oil, gas, sand and gravel, lime, and clays. The quarrying activities are concentrated in the north and west of the county, mostly outside the city. Oil and gas fields are generally to the east and south of the city (TE-257). Current resource use is discussed in a later section.

Educational and military facilities account for institutional land use in the study area. Educational institutions include San Antonio and St. Phillips Junior Colleges and the following senior colleges: Incarnate Word College, Our Lady of the Lake College, St. Mary's University, Trinity University, and The University of Texas at San Antonio. Military installations include Camp Bullis, Ft. Sam Houston, and Randolph, Medina, Lackland, Kelly, and Brooks Air Force Bases. These military bases occupy approximately 77 square miles in Bexar County (RA-R-420).

There are over 4.6 acres of parks per 1,000 population in the study area. The San Antonio Master Plan includes the National Park Council's recommended standard of 6.0 acres of large urban parks per 1,000 population. In 1975 the city had approximately 5,000 acres of parklands including four municipal golf courses, 16 recreation centers (three additional under construction), 55 tennis courts, and 58 baseball, softball, football, and soccer fields (RA-R-420). Several other unique outdoor recreational areas are included in the study area. Brackenridge Park and the San Antonio Zoological Gardens within the park are located just north of the central business district on either side of the San

Antonio River. The Hemisfair site and the Riverwalk are located in the downtown area. San Antonio Missions Trail runs southeast from the central business district. La Villita, an historical area adjacent to the Hemisfair, is used for various recreational and commercial activities.

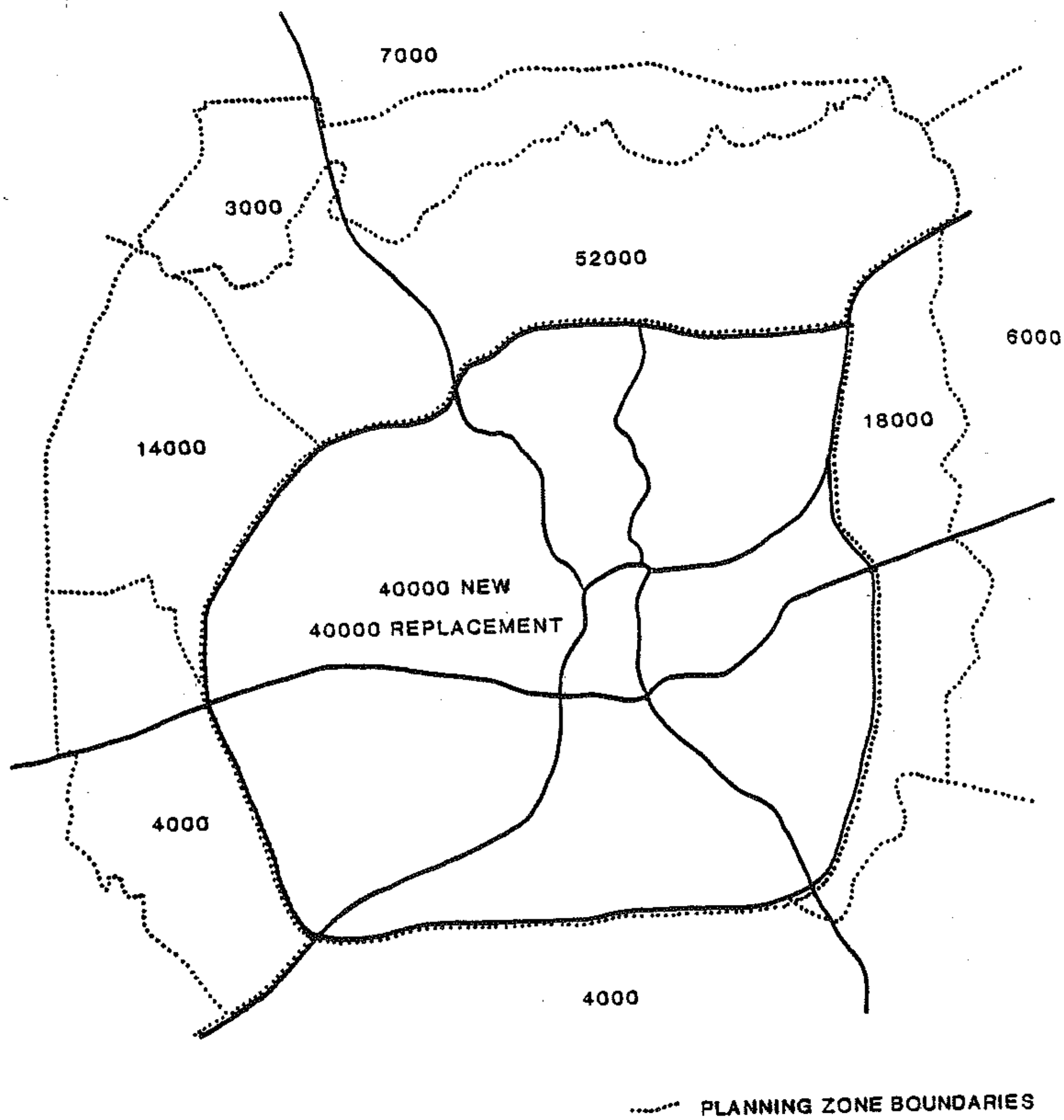
Bexar County annually produces approximately $28 million in agricultural goods (TE-257). Approximately two-thirds of the county (830 square miles) supports some form of agricultural activity. Beef production generates approximately 60 percent of the annual revenue. Dairy cattle, poultry, sheep, goats, grain, vegetables, and nursery plants are also important. Irrigation is common in southern and western Bexar County.

San Antonio has established mechanisms for land use control such as zoning, building permit issuance, road construction, and utility provision. Future land use patterns are governed by a comprehensive Master Plan now in progress. In the interim, San Antonio has a "Growth Sketch" (SA-304) which describes the future location of residential development.

Figure 2-13 shows the approximate number of new residential units which are expected in the major planning zones. Probably the most distinctive feature is the growth in the northern area up to Edwards Recharge Zone. Growth in the southern part of Bexar County is projected to be minimal. Land use in the central city is expected to change both through new development on land that is now vacant and through redevelopment.

2.2.4 Archaeological and Historical Resources

Archaeological artifacts abound in the San Antonio area, and it is certain that more will be uncovered in the future.



NOTE: THE NUMBERS IN EACH PLANNING ZONE REPRESENT THE APPROXIMATE NUMBER OF HOUSING UNITS (APPROXIMATELY 2.8 PERSONS PER HOUSEHOLD) WHICH WILL BE REQUIRED TO MEET POPULATION PROJECTIONS FOR THE YEAR 2000. ALSO, THE PLANNING ZONE BOUNDARIES ARE ONLY APPROXIMATE.

FIGURE 2-13

PROJECTED GROWTH IN HOUSING BY THE YEAR 2000

Source: SA-304 Updated by HI-196

Evidence from numerous archaeological sites strongly indicates that early occupants of Central Texas were hunting and gathering peoples (SU-100). Compared to sedentary societies, they used simple tools and left a limited array of artifacts.

The most common types of sites found are quarrying operations, temporary campsites, and semipermanent occupation sites. Quarrying operations are frequently found where chert outcrops occur, usually in areas of exposed limestone. Chert was of primary importance to early peoples as a material for tool manufacture. Temporary campsites are usually found along intermittent streams. The semipermanent occupation sites, however, are usually restricted to those areas where permanent waters coincide with chert outcrops. Various other types of sites, including isolated burials, pictographs, and mortar holes, have been identified (SU-100).

Since there is considerable potential for the existance of significant archaeological resources in the Bexar County area, a preliminary survey of those areas which may be disturbed as a direct result of 201 projects has been completed. The Center for Archaeological Research of The University of Texas at San Antonio performed the survey. Emphasis was on undeveloped parcels on the periphery of the urbanized area in which collector system additions will be made. Also, sites for new treatment facilities were included. The complete results have been published (FO-145) and a brief summary of the findings is presented here.

Figure 2-14 is a map showing the principal areas of concern which were surveyed. The archaeological resources are located in three areas designated in Figure 2-14 as sections A, B, and C. Section A is in the drainage basin of Leon Creek, Section B is in the San Antonio River basin, and Section C is in

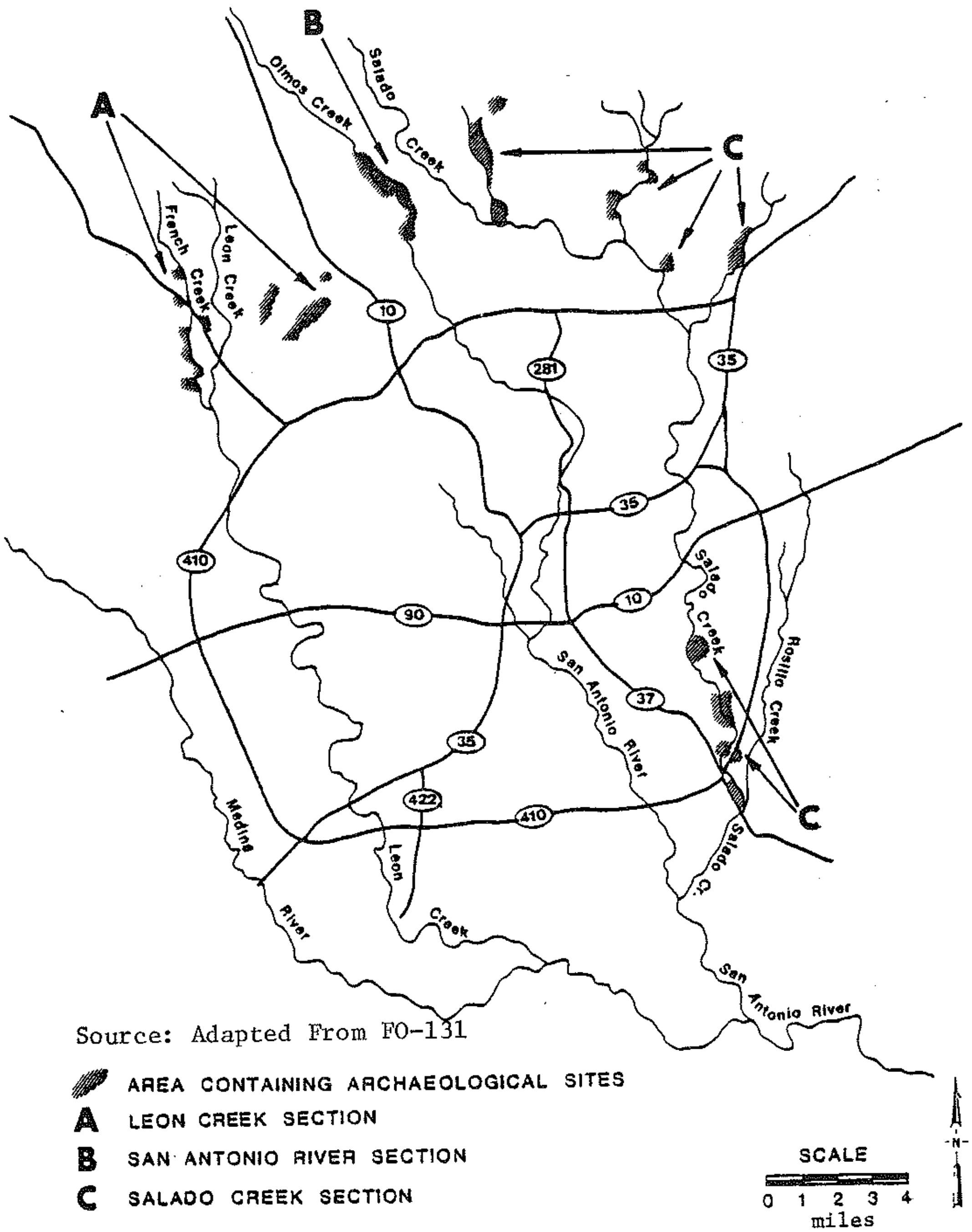


FIGURE 2-14

LOCATION OF SURVEYED ARCHAEOLOGICAL AREAS the drainage basin of Salado Creek. The surveyed areas are indicated by shaded areas on the map. In Section A, seven prehistoric and two historic sites have been identified. The value of two of these sites has not been determined. Three of the sites have minor value, two have medium importance, one has primary importance, and another has probable importance.

The area in Section B was found to have six prehistoric sites and one historic site. The importance of these sites is as follows: two have minor value; three have medium value; one has major value; and one has probable importance.

Section C has proved to be rich in archaeological resources. Nineteen prehistoric and two historic sites have been identified. Four sites have been classified as having primary importance while seven have probable value, six have medium value, and three are of minor importance. The value of one of the 21 sites has not been determined.

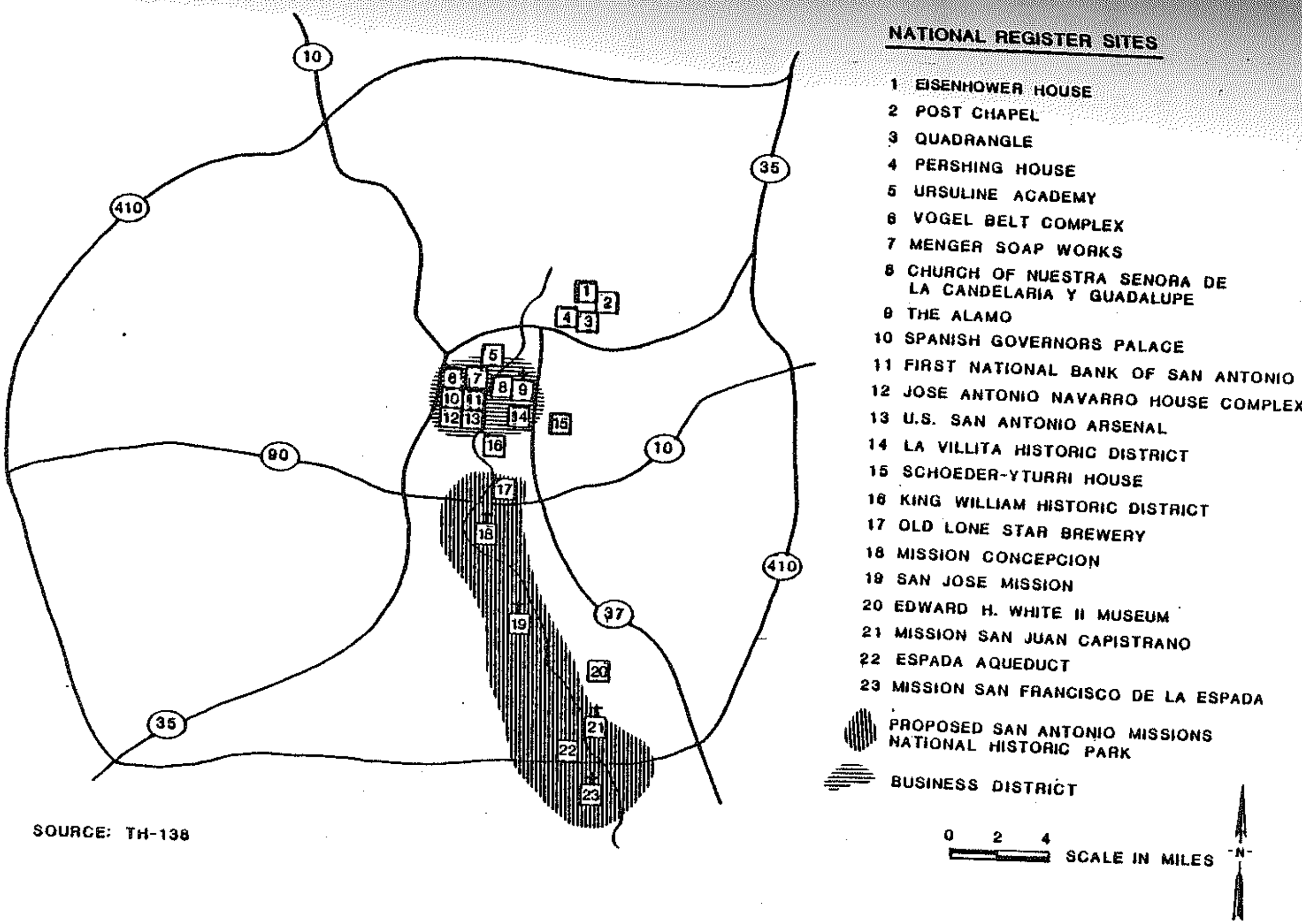
Currently, there is little knowledge on the archaeology in the southern portion of Bexar County. Many sites are thought to exist here, but, unlike the sites in the northern part of the county, many are deeply buried under alluvium. However, it is noted that the owner of a potential building site at the confluence of the Medina and San Antonio Rivers has a collection of artifacts which indicates that, if selected, the site would require further analysis. As noted in subsequent chapters, further archaeological work will be done before construction of certain parts of the wastewater treatment system is undertaken. Any activity which might affect the historic Jose de la Garza land grant in southern Bexar County will also require further analysis.

As with archaeological resources, Bexar County has a significant historical heritage. Thirty-three sites in the county are listed in the National Register of Historic Places, and inclusion of three more is pending (RA-R-420). The locations of those historical sites that are significant to this study are shown in Figure 2-15. In addition, the City has an inventory (SA-246) of sites of historic significance. The fact that a local inventory exists indicates local recognition of the historic heritage.

The first Spaniards to enter the area in 1691 were led by the first Governor of Texas, Domingo Teran de los Rios. Their goal was to establish Spanish domination in the area between northern Mexico and the Mississippi River, where the French were settling. Impressed with the beauty and the abundant fish and buffalo of the area, the Spaniards named the area San Antonio de Padua, after the saint on whose day they arrived. The first missions failed and it was not until 1718 that Mission San Antonio de Valero, later famed as the Alamo, was established. Within 13 years, four more missions were established within a seven-mile reach of the San Antonio River.

After a period of prosperity, the missions declined in 1793-1794. The forts, villas, and settlements surrounding the secularized Mission San Antonio de Valero were consolidated to form San Antonio de Bexar, the capital of the Province of Texas (HA-515).

Mexico declared its independence from Spain in 1821 after Moses Austin had received permission to settle Americans in Texas. Chafing under the strict rule of Santa Anna, the local Mexicans and the Texans fought for their independence



SOURCE: TH-138

FIGURE 2-15

MAJOR HISTORICAL RESOURCES OF SAN ANTONIO AND LOCATION OF PROPOSED MISSIONS NATIONAL HISTORIC PARK starting in 1834. After the defeat of the Mexicans at the Battle of San Jacinto in April, 1836, San Antonio became an outpost of the new Repulbic of Texas. It was vituallly deserted city until Texas became a state in December, 1845.

In 1846 the population was estimated at 800, but by by 1860, it was 8,235 (RA-310). The cattle drives, which began just after the Civil War, and the coming of the first railroad in 1877 brought great changes to the city (HA-515). San Antonio became a concentration point for the livestock industry and developed meat packing, flour plants, cement plants, and breweries (HA-515).

The most recent project to develop San Antonio's historical heritage has been a proposed San Antonio Missions National Historical Park. The National Park Service has completed a feasibility study (TH-138) and legislation is now in the U.S. Congress to create this park. Figure 2-15 shows the approximate boundary for the park.

2.2.5 Resource Use

City Public Service (CPS) is the utility company which provides natural gas and electricity to the San Antonio area. Electricity is generated in five power plants (Figure 2-16). Natural gas is the primary fuel, but the boilers can also be fired with oil. Total generating capacity includes 2,588 megawatts (MW) with gas firing and 2,290 MW with oil firing Presently, San Antonio has two plants with cooling ponds, Braunig and Sommers Plants. An additional plant, Deely, is under construction adjacent to the Sommers Plant. The total design capacity of the cooling ponds will accommodate 5,000 MW of production.

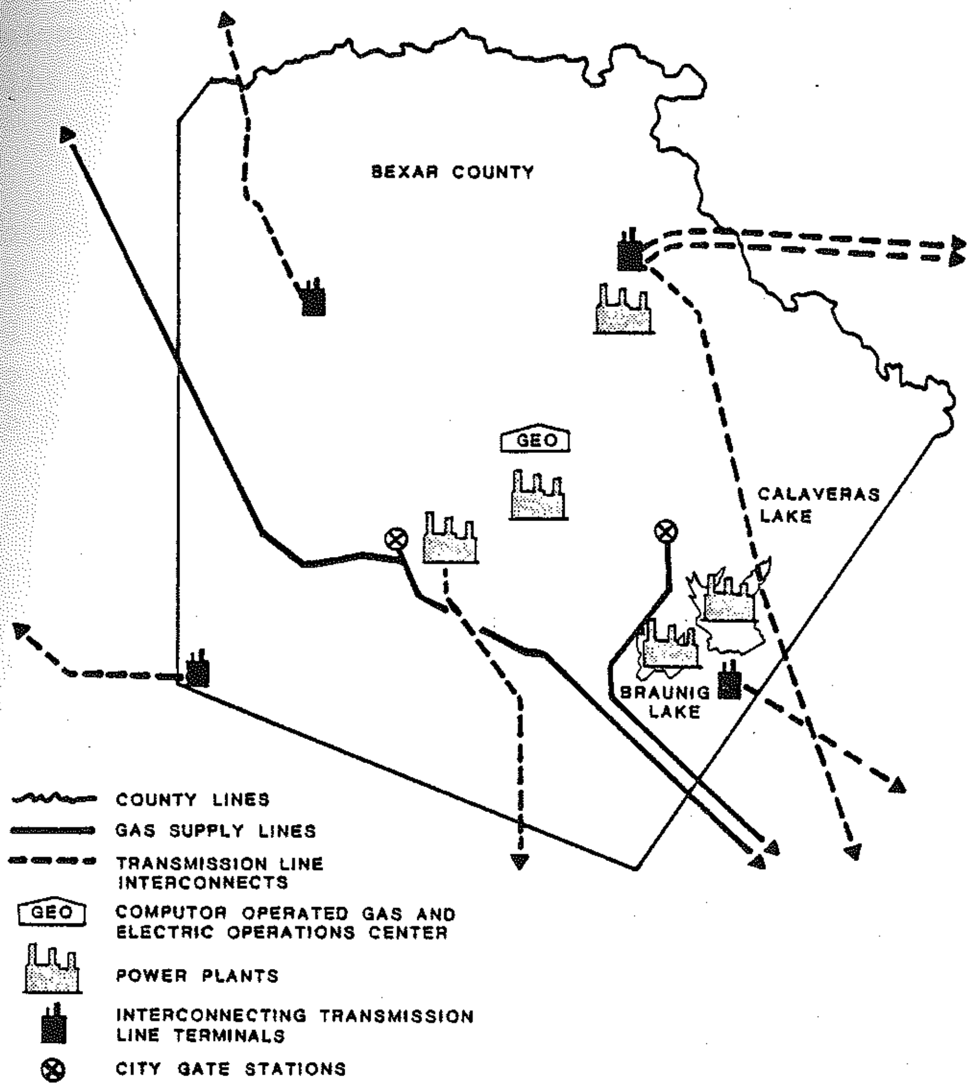


FIGURE 2-16

CITY PUBLIC SERVICE GAS AND ELECTRIC SERVICE DISTRIBUTION SYSTEM

Source: SA-267

In addition to the construction of the Deely lignite-fired generating plant, the City Public Service has a 28 percent interest in the South Texas Nuclear Power Plant. The nuclear plant will be complete around 1982 and will supply the city with 700 MW of generating capacity (SA-267).

CPS provides electrical energy for the entire county and natural gas for most of the county. CPS previously projected its future generating capacity needs on the historic 11 percent growth rate in annual peak usage. Assuming the slowing of population increase in the service area, the growth rate in demand for electrical generating capacity may decline in the future. CPS has reevaluated its future energy needs to reflect this decline in growth rate (RA-R-420).

Bexar County currently produces minerals in the following order of value: cement, stone, natural gas liquids, petroleum, lime, sand and gravel, clays and natural gas (TE-257). Total value in 1973 was $39.5 million. There is recoverable lignite in southwest Bexar County (BU-M-218). Crude oil production in 1974 was only 838 barrels per day for the entire county (TE-257).

2.2.6 Transportation

The major ground transportation network serving the City of San Antonio (Figure 2-17) forms a series of concentric rings around the central business district (CBD). Radiating from the CBD are arms which connect the CBD with the periphery and link the concentric rings. As Figure 2-17 shows, the City plans to expand this system in all directions in the future.

The Thoroughfare Plan does not reflect the total transportation situation. A clearer picture emerges when average daily trips (ADT) are considered for the major thorough-

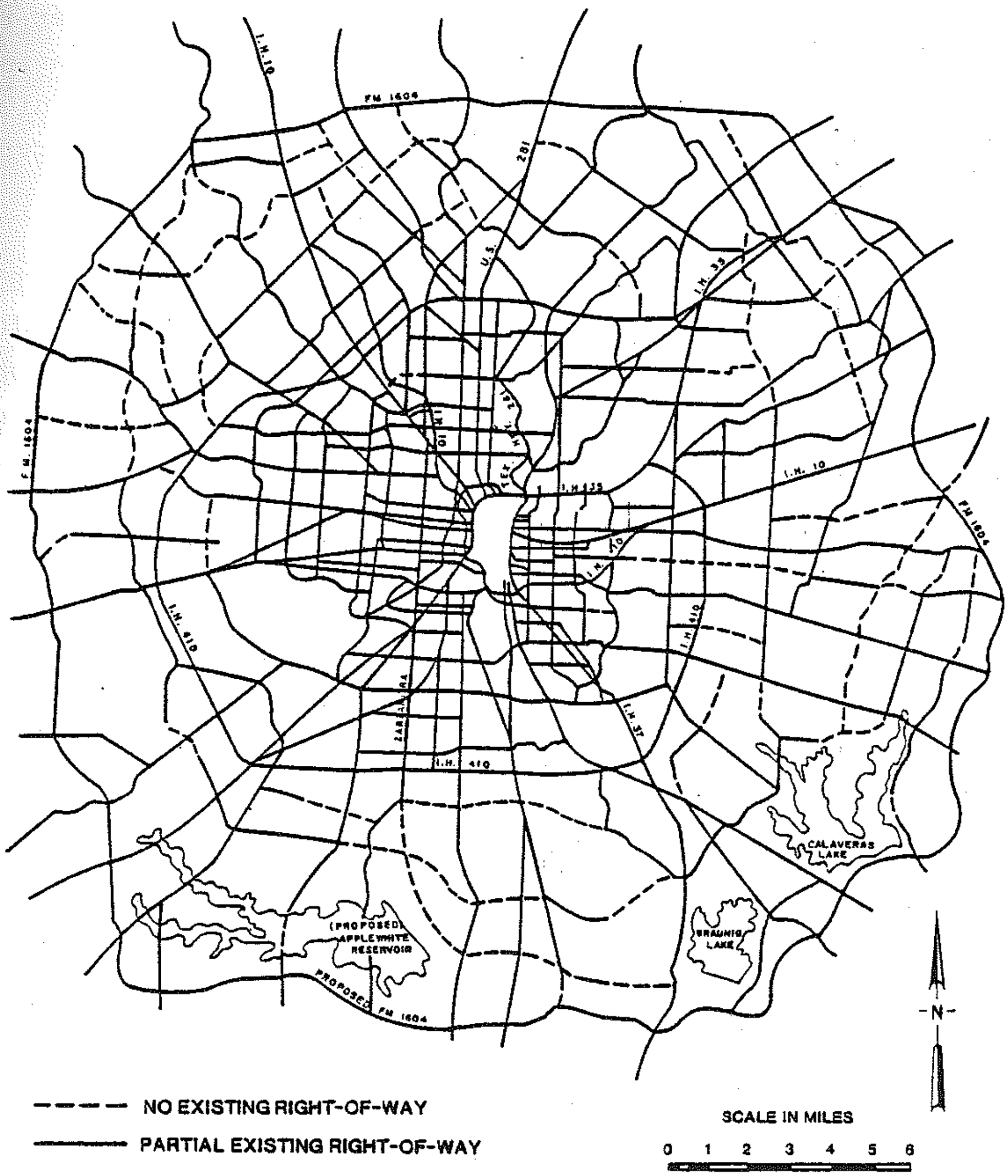


FIGURE 2-17

THOROUGHFARE PLAN

Source: SA-263

fares (RA-R-420). Routes in northern Bexar County, particularly Loop 410, are used much more than those in the southern part of the county. Radial traffic from the CBD is much heavier toward the north than toward the south. This trend should continue in the future since major traffic generators such as The University of Texas, the South Texas Medical Center, and United Services Automobile Association are growing in the north.

Critical traffic areas (RA-R-420) are in the CBD and at the intersections of radial thoroughfares with Loop 410 in the north. There is also a series of problem intersections just north of the CBD. These areas are probably still sources of congestion, and more congested areas can be predicted at intersections of Loop 410.

2.2.7 Existing Wastewater Treatment Facilities

The City of San Antonio is serviced by three major wastewater treatment facilities including the Rilling Road plant, the Salado Creek plant, and the Leon Creek plant. Seven small package or temporary treatment facilities are also operated by the City throughout newly developed areas to provide wastewater treatment services until such waste flows are reached to justify hook-ups to the regional facilities. Figure 1-1 shows the location of the three major wastewater treatment facilities serving San Antonio.

Wastewater treatment is accomplished at each of the three regional facilities using the activated sludge process. Preliminary treatment for grit removal and screening is followed by primary clarification where suspended material is settled out by gravity. The settled solids are wasted to anaerobic digesters. Secondary treatment is accomplished with modified activated sludge units with diffused aeration followed by clarification.

Excess water activated sludge is wasted to the anaerobic digesters. Treated wastewater receives chlorination before final discharge. Stabilized sludge is spread on sandy drying beds and allowed to air dry before being removed for ultimate disposal. The Rilling Road treatment plant has a design capacity of approximately 94 MGD while the Salado Creek and Leon Creek plants have a design capacity of approximately 24 MGD each. A more detailed description of the wastewater treatment facilities is included in Chapter 3 of this EIS.

2.2.8 Sensitive Man-Made Areas

The rich cultural and historical heritage of San Antonio guarantees that the area contains certain artifacts which are irreplaceable. These include physical structures which are known and valued by the majority of the citizenry, such as the Alamo and the other missions along the San Antonio River. Also included are Hemisfair, many buildings in the downtown area, and the colorful Riverwalk. Brackenridge Park, with its zoo, gardens, and wide expanses of open space, is essential to San Antonio. Also important and deserving of preservation are the many open spaces of the City such as Elmendorf Lake, Woodlawn Lake, the many college campuses, and public parks.

Also very important, though not as conspicuous as the above, are features essential to a mental image of San Antonio. For instance, Fort Sam Houston, the Air Force facilities, and the breweries are very important parts of the San Antonio image. Also, German Town, Mexican Town, and the institutions of higher learning are part of the image. The many churches representing various denominations, historical eras, and cultural impacts are also important. The cultural spaces within the City are as important as the physical environment.

3.0 SYSTEM ALTERNATIVES

As noted in Chapter 1, the purpose of the proposed program being considered in this EIS is to upgrade the wastewater treatment facilities of the City of San Antonio. This program is necessary to enable the City to meet the effluent limitations that are being imposed on its municipal wastewater discharges in order to upgrade the quality of the streams in the area. The purpose of this chapter is to describe the process used for selecting the specific proposed action to accomplish the objective of the program. The results of this selection process are also presented.

The selection process consists of several steps. First, the alternatives available for the City to participate are developed and described. In general, these alternatives consist of actions that utilize and build upon the existing sewage transport and treatment facilities. Because of the topography and drainage of the city and the layout of the existing sewage collection system, the additions to the collection system in the future are the same for all alternatives considered.

After the feasible alternatives are developed and described, they are evaluated on the basis of their relative merit from the standpoint of two factors -- cost and environmental acceptability. For each alternative an estimate is made of its cost and relative degree of adverse environmental impact. The cost is estimated on the basis of both capital costs and operation and maintenance costs. The degree of environmental impact is estimated by use of a rigorous system of weights and scores for 20 environmental categories. The purpose of this system is to reduce the large number of environmental factors that must be considered into a concise, easily understood form.

After the alternatives have been rated on the basis of cost and environmental acceptability, they are subjected to a successive screening process until all alternatives are eliminated except one. The remaining alternative is then selected as the proposed action that is further described in Chapter 4. The remainder of this chapter will present in detail the process of development, evaluation, and screening of the alternatives.

3.1 Development of Alternatives

The identification of feasible alternatives required for the attainment of the project objectives is based on a systematic method of development. Existing facilities are first inventoried with respect to location, capacity, and present treatment level capability. Second, the design period wastewater flow is determined, and all regulatory, legal, fiscal, and engineering constraints are identified. By comparing the results of these tasks, deficiencies in existing treatment plant capacity and capability are determined. Available structural and non-structural subsystem corrective measures are then identified, evaluated, and screened. These selected subsystem alternatives are assembled into feasible system alternatives for environmental and economic evaluation.

Structural subsystem alternatives include wastewater treatment and associated facilities which must be constructed. Some of the subsystem alternatives cannot be completely identified until Step 2 of Section 201 planning (during the value engineering process). Non-structural subsystem alternatives include other measures which may be taken to approach or attain the project objectives. Examples of non-structural measures are legal and administrative decisions.

3.1.1 Existing Wastewater Treatment Facilities

The existing wastewater treatment facilities comprise two major systems -- the sewage collection system and the wastewater treatment plants.

3.1.1.1 Collection System

The study area is serviced with approximately 13,980,000 lineal feet of sewer lines (excluding private service laterals) and approximately 44,300 manholes. The lines generally follow the three natural drainage areas within the study area including the upper San Antonio River, the Leon Creek, and the Salado Creek drainage areas. The collectors transport sewage from north to south, taking advantage of the natural topography with gravity sewers. However, small temporary pump stations are located throughout the collection system and will continue in operation until they can be economically eliminated. Manholes are spaced approximately 400 feet apart and are typically constructed of brick, precast concrete, or cast-in-place concrete. Gravity sewers are constructed of brick and mortar, concrete, vitrified clay, cast iron, and plastic. Forcemains and siphons are constructed of cast iron, concrete steel cylinder, asbestos cement, and plastic (PA-275). Raw sewage which has a long travel time in the collectors can become anaerobic and produce malodorus septic conditions at the head works of the Rilling Road treatment plant. Raw sewage may travel as far as 25 miles in the existing San Antonio collection system.

Sewer lines in the Rilling Road service area range from 6 inches to 72 inches in diameter. The total length is approximately 9,903,000 lineal feet. Most of these lines are constructed of concrete, and the remainder are made of vitrified clay and some very old brick and mortar. The lines range in depth from 3 to 25 feet with an average depth of approximately 8 feet (PA-275).

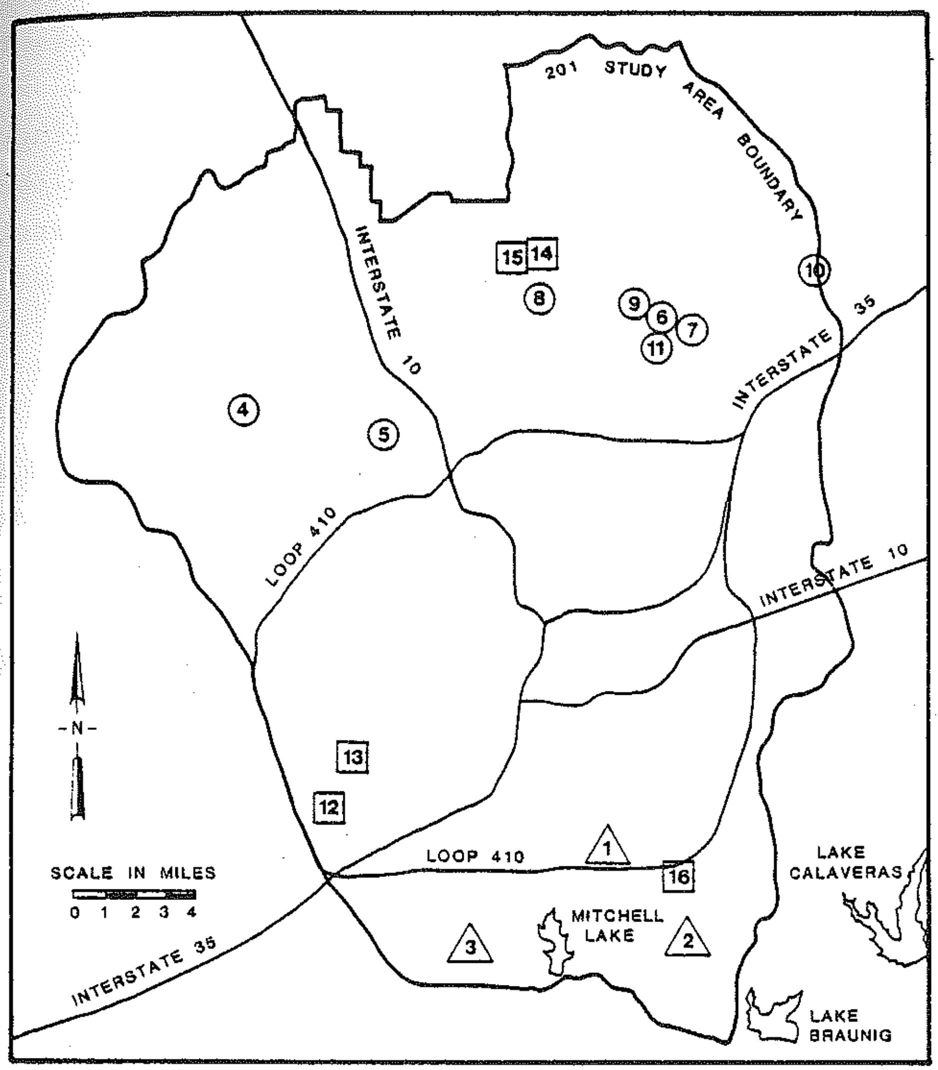
Sewer lines in the Leon Creek service area range from 6 inches to 60 inches in diameter and extend approximately 613,000 lineal feet. Most of the smaller lines are constructed of vitrified clay or plastic while the larger trunk lines are generally constructed of concrete. The lines range in depth from 4 to 20 feet with an average depth of approximately 6 feet (PA-275).

Sewer lines in the Salado Creek service area range from 6 inches to 60 inches in diameter and extend approximately 3,464,000 lineal feet. The newer, smaller lines are constructed mainly of plastic and vitrified clay while the remaining lines, including the older, smaller lines and trunk lines, are mainly constructed of concrete (PA-275).

The city operates 58 of the 61 lift stations (excluding lift stations at the treatment plants) in the study area. These lift stations provide a temporary, economical means of sewage collection but the city has initiated a program to phase out these lift stations, where possible, as funding becomes available (PA-275).

3.1.1.2 Wastewater Treatment Plants

The City of San Antonio is served by and operates three regional wastewater treatment facilities and seven temporary or interim plants. Five additional small treatment plants also service parts of the study area but are not owned or operated by the city (PA-275). Figure 3-1 shows the approximate locations of wastewater treatment plants within the study area.



△ City-Owned Regional Plants

1-Rilling Road
2-Salado Creek
3-Leon Creek

○ City-Owned Temporary Plants

4-Concord
5-Cinnamon Cr.
6-Ravenwood
7-Encino Park
8-Hidden Valley
9-San Pedro Hill (Inactive)
10-Monaco
11-Burning Tree

□ Non-City-Owned Plants

12-Indian Creek
13-Kelly AFB
14-Canyon Creek
15-Canyon Oaks Mobile Home
16-Southton

FIGURE 3-1. LOCATION OF WASTEWATER TREATMENT FACILITIES

A. Regional Treatment Plants

The three regional plants include the Rilling Road, the Salado Creek, and the Leon Creek plants. The Rilling Road plant and the Salado Creek plant discharge directly to the San Antonio River, while the Leon Creek plant discharges directly to Leon Creek, a tributary of the Medina River.

1) Rilling Road Plant

The Rilling Road plant was constructed in 1930 and is located approximately 8 miles south of San Antonio just north of Loop 410 and east of U.S. Highway 281. This facility has been improved and expanded since its initial construction to a design capacity of approximately 93.5 million gallons per day (MGD). The plant provides preliminary treatment (mechanical bar screens and grit chambers), primary settling, modified activated sludge treatment, secondary clarification, and chlorination. Treated wastewater is discharged to the San Antonio River. A small portion of the treated effluent and sludge is presently discharged into an oxidation pond that was constructed by isolating a portion of Mitchell Lake. Chlorination is accomplished in clarifiers that serve the dual purpose of stormwater clarification and chlorine contact. The modified activated sludge process provides re-aeration of the return activated sludge before it is mixed with the primary effluent. Waste-activated sludge is either settled in the primary clarifiers or treated in an oxidation lagoon at the Mitchell Lake facility. Primary sludge is anaerobically digested for stabilization and then spread on sand drying beds. Dried sludge is removed from the beds under contract with a local processor and may be used as a fertilizer by area residents. This plant treated an average flow of approximately 83.4 MGD in 1976. The monthly average high was approximately 95.7 MGD in December and the monthly average low was approximately

71.6 MGD in February. Influent five-day biochemical oxygen demand (BOD_5) concentrations average 201 mg/ℓ, while effluent BOD_5 concentrations averaged 12.6 mg/ℓ for an average removal efficiency of 93.7 percent. Influent total suspended solids (TSS) concentrations averaged 179 mg/ℓ while effluent TSS concentrations average 15.3 mg/ℓ for an average treatment efficiency of 91.4 percent. Orthophosphate effluent concentrations averaged approximately 14.1 mg/ℓ. The discharge of fecal coliform was high in 1976, when the average count was approximately 720/100 ml (SA-329).

2) Salado Creek Plant

The Salado Creek plant was constructed in 1970 with a design capacity of approximately 24 MGD. It is located approximately 12 miles southeast of San Antonio and one and one-half miles southwest of U.S. Highway 181 on Blue Wing Road. This facility provides preliminary treatment (mechanical bar screens and aerated grit chambers), primary settling, modified activated sludge treatment, secondary clarification, and chlorine contact. The modified activated sludge process provides re-aeration of the return sludge before it is mixed with the primary effluent. Treated wastewater is discharged to the San Antonio River. Primary sludge is anaerobically digested and waste-activated sludge is aerobically digested. The stabilized sludge is disposed of by spray irrigation at the plant site (PA-275). Dried sludge removed from the drying beds is removed under contract to a local processor. This plant treated an average flow of approximately 16.6 MGD in 1976. The monthly average high was approximately 20.4 MGD in October and the monthly low was approximately 11.0 MGD in February. Influent BOD_5 concentrations averaged 154 mg/ℓ while effluent BOD_5 concentrations averaged 10.7 mg/ℓ for an average removal efficiency of 93.1 percent. Influent TSS concentrations averaged 158 mg/ℓ while effluent TSS concentrations averaged 17.3 mg/ℓ for an average removal efficiency of 89.1 percent. Fecal coliform concentrations were relatively low at 38/100 ml (SA-329).

3) Leon Creek Plant

The Leon Creek plant was constructed in 1965 with a design capacity of approximately 12 MGD and was expanded in 1976 to a capacity of 24 MGD. It is located approximately 10 miles south of San Antonio and one-half mile west of U.S. Highway 281 on Mauerman Road. This facility provides preliminary treatment (mechanical bar screens and grit chambers), primary settling, modified activated sludge treatment, secondary clarification, and chlorination. The treated wastewater is discharged to Leon Creek, a tributary of the Medina River. Approximately 13 percent of the annual average treated wastewater was diverted into Mitchell Lake in 1976 to maintain the desired lake level for irrigation purposes. Chlorination is accomplished in clarifiers that are used for both chlorine contact and stormwater clarification. The modified activated sludge process provides re-aeration of the return activated sludge before it is mixed with the primary effluent. Primary sludge is pumped directly to anaerobic digesters. Waste activated sludge is either thickened in centrifuges or settled in primary clarifiers and then pumped to the anaerobic digesters. The stabilized sludge is spread on sand drying beds. Dried sludge is removed from the drying beds under contract to a local processor. This plant treated an average flow of approximately 17.5 MGD in 1976. The monthly average high was approximately 20.7 MGD in November and the monthly average low was approximately 14.2 MGD in February. Influent BOD_5 concentrations averaged 154 mg/ℓ while effluent BOD_5 concentrations averaged 7.7 mg/ℓ for an average removal efficiency of 95.0 percent. Influent TSS concentrations averaged 148 mg/ℓ while effluent TSS concentrations averaged 16.8

mg/ℓ for an average removal efficiency of 88.6 percent. Fecal coliform counts in all months of the year were low and averaged approximately 61/100 ml for the year (SA-329).

B. City-Owned Temporary Treatment Plants

Of the seven small temporary or interim wastewater treatment facilities operated by the city, two are located in the service area of the Leon Creek plant and five are located in the service area of the Salado Creek plant. The construction and arrangement of these facilities varies somewhat, but each provides essentially a secondary level of treatment (PA-275).

The two facilities in the Leon Creek service area include the Concord plant and the Cinnamon Creek plant. The Concord plant is located on Guilbeau road approximately one mile west of Bandera Road and has a capacity of approximately 80,000 gallons per day. The Cinnamon Creek plant is located on Hamilton-Wolfe Road, approximately 0.7 miles west of Fredericksburg Road and also has a capacity of approximately 80,000 gallons per day (PA-275).

The five temporary facilities in the Salado Creek service area include the Ravenwood, Encino Park, Hidden Valley, San Pedro Hills, and the Monaco plants. The Ravenwood facility is presently under construction and is located north of Northeast Preserve Park on Floral Way. The design capacity will be approximately 40,000 gallons per day when completed. The Encino Park facility is located north of Thousand Oaks Road, south of Bulverde Road, east of Jones-Maltsberger Road, and west of Wetmore Road. It too has a design capacity of approximately 40,000 gallons per day. The Hidden Valley facility is located east of Blanco Road and north of the intersection of Panther Springs Creek and Bitters Road. The design capacity is approximately 80,000 gallons per day. The

San Pedro Hills facility is located on the east side of Henderson Pass Road between Brook Hollow Road and Thousand Oaks Road. Its capacity is approximately 580,000 gallons per day. This facility is currently inactive and the site is to be used to test new package plants prior to acceptance by the city. The Monaco facility is located near the intersection of Lookout Road and Toepperwein Road and has a design capacity of approximately 80,000 gallons per day. The city has secured a permit from the Texas Department of Water Resources (TDWR) for a new 240,000 gallon-per-day plant. This plant will be named the Burning Tree plant and will be located just north of Northeast Preserve Park, approximately one-half mile south of the Ravenwood treatment facility (PA-275).

C. Non-City-Owned Treatment Plants

Of the five additional small treatment facilities which are not operated by the city, two are located in the Leon Creek service area, and the remaining three are located in the Salado Creek service area. These facilities are permanent (i.e., not movable) and provide a secondary level of treatment (PA-275).

The two facilities in the Leon Creek service area are the Indian Creek plant and the Kelly Air Force Base plant. The Indian Creek facility is owned by the Lackland City Water Company and is located south of Lackland Air Force Base at the intersection of Stoney Creek Street and Little Beaver Street. This facility provides secondary treatment with an oxidation ditch (race track) and has a capacity of approximately 1.5 MGD. The Kelley Air Force Base facility is located on the southern portion of Kelly Air Force Base on Citrus Road. The facility treats industrial wastewaters and has a capacity of approximately 2.0 MGD (PA-275).

The facilities located in the Salado Creek service area include the Canyon Creek plant, the Canyon Oaks Mobile Home Park plant, and the Southton plant. The Canyon Creek facility services the Canyon Creek Country Club and is located south of Charles W. Anderson Loop and east of Blanco Road. The facility provides extended aeration and has a capacity of approximately 12,000 gallons per day. The Canyon Oaks Mobile Home Park facility is owned by William Swinney and is located on Blanco Road just south of Loop 1604. This facility provides extended aeration and has a capacity of approximately 4,000 gallons per day. The Southton facility services the Southton Alcoholic Rehabilitation Center with extended aeration and has a capacity of approximately 60,000 gallons per day (PA-275).

3.1.2 Treatment Level Requirements

Wastewater treatment facilities improvements and management techniques which are authorized to receive federal funding after June 30, 1974 must comply with the treatment requirements as specified in the FWPCAA and must be consistent with best practicable waste treatment technology (BPWTT) as defined by the Environmental Protection Agency. The level of treatment required to protect the integrity and quality of the affected receiving bodies of water is set forth and enforced by the TDWR. This level is dependent on the size of the discharge and the ability of the receiving streams to assimilate the waste load.

3.1.2.1 Projected Design Flow

To establish waste load allocations from which effluent limitations can be derived, it is necessary to determine the projected wastewater flow for the 20-year design period. Additionally the analysis and development of alternative wastewater treatment facilities require an estimate of the projected flows expected during the design period for both dry and wet-weather conditions. The 20-year projected average daily flows on an annual basis and on a monthly basis are given in Table 3-1. Also shown in the table are the original treatment capacities (based on the average daily flow) of each of the three regional wastewater treatment plants. A detailed description of the calculations of the projected flows is provided in the Technical Reference Document (RA-R-420). The projected flows shown in this table are based on the assumption that the flows introduced by infiltration and inflow into the collection system will be substantially reduced by the rehabilitation program presently being undertaken by the city. The projected flow reductions are estimates only, so the data presented in the table may change somewhat.

TABLE 3-1

PROJECTED WASTEWATER FLOWS AND PRESENT TREATMENT PLANT CAPACITIES

Treatment Facility	20-year Projected Flow Annual Basis (MGD)	20-year Projected Flow Monthly Basis (MGD)	Original Design Capacity for Average Daily Flow (MGD)
Rilling Road	76	83	93.5
Salado Creek	31	36	24.0
Leon Creek	30	35	24.0
	137	154	141.5

Source: BA-583

The average daily flow determined on an annual basis is the average of the total volume expected to be discharged in a year. The average daily flow determined on a monthly basis is the average of the total wastewater expected to be discharged during the month having the highest average flow. Effluent limitations are based on the average daily flow determined for the highest month and on the maximum daily rate. Treatment plant design capacities are also established from the average daily flow determined on a monthly basis. Although the Rilling Road facility has a sufficient capacity for the 20-year projected average flow, the plant will require additional facilities to accomodate projected maximum hourly flows if it is retained. The design capacities of the Leon Creek facility and the Salado Creek facility are inadequate and expansion of these facilities will be necessary.

3.1.2.2 Effluent Limitations

To upgrade the water quality of the streams receiving effluent from San Antonio sewage treatment plants, the TDWR has proposed that the effluent limitations listed in Table 3-2 apply to all municipal wastewaters discharged in the study area. These limitations emerged as a result of the series of 208/201 coordination meetings conducted by the TDWR. The response of the San Antonio River and its tributaries to receiving waste flows was simulated using mathematical water quality models. Five possible alternatives were evaluated under five effluent limitation conditions. The five alternatives evaluated included not only direct discharges to the stream but also various hook-ups to Braunig Lake and/or Calveras Lake. It was determined that under all sets of conditions, the most stringent limitation of 5 mg/ℓ BOD_5, 5 mg/ℓ suspended solids, and 3 mg/ℓ ammonia nitrogen would be required to protect the stream quality. A description of the TDWR modeling effort, which was completed in November 1976, is included in the Technical Reference Document (RA-R-420). The proposed limitations are applicable not only to discharges from the three existing wastewater treatment facilities but also to any discharges from area lakes which are designated as receiving bodies for treated or untreated wastewater.

TABLE 3-2

PROPOSED EFFLUENT LIMITATIONS

Parameter	30-day Average	7-day Average	24-hour Composite
Biochemical Oxygen Demand (5-day) (mg/ℓ)	5	10	20
Suspended Solids (mg/ℓ)	5	10	20
NH_3-N (mg/ℓ)	3	6	10
Fecal Coliform #/100 ml	200	400	--

Source: BA-494

3.1.2.3 Present Plant Efficiencies and Necessary Improvements

The evaluation and selection of reasonable subsystem alternatives for expanding and/or upgrading the existing wastewater treatment facilities is predicated upon the inability of the present facilities to meet proposed standards. Deficiencies occur when a facility or system does not have the capacity to treat the projected quantity of flow or if it cannot produce the level of treatment required.

The present treatment plant efficiencies with respect to BOD_5 and TSS are shown in Table 3-3. The treatment efficiencies shown are the lowest average monthly efficiencies reported. None of the existing facilities have unit processes specifically designed for the control of ammonia-nitrogen (NH_3-N). Consequently, little ammonia-nitrogen (NH_3-N) is removed, and additional facilities will be required to meet the proposed effluent limitations of 3 mg/ℓ NH_3-N.

TABLE 3-3

PRESENT TREATMENT PLANT REMOVAL EFFICIENCIES[1]

Treatment Plant	Removal Efficiency BOD_5 (%)	TSS (%)
Rilling Road	90.3	81.9
Salado Creek	88.5	82.3
Leon Creek	92.1	88.6

[1]Based on 1976 wastewater treatment data

The level of treatment required is based on the projected waste loads and the proposed effluent limitations. Basically, the San Antonio facilities, which now provide a secondary level of treatment with modified activated sludge, must be improved to provide a tertiary level of treatment. This level of control generally implies some form of nutrient control whether it be complete removal or conversion to an innocuous form. The projected waste load concentrations and the treatment efficiencies required to meet standards are presented in Table 3-4. A comparison of Table 3-3 and Table 3-4 shows that the BOD_5 removal efficiency at the Rilling Road plant will have to be increased from 90.3 percent to 98.1 percent. The TSS removal efficiency must be increased from 81.9 percent to 97.9 percent. At the Salado Creek plant the BOD_2 removal efficiency must be increased from 88.5 to 97.2 percent. The TSS removal efficiency must increase from 82.3 to 97.1 percent. The BOD_5 removal efficiency at the Leon Creek plant must be increased from 92.1 to 97.2 percent. The TSS removal efficiency at the Leon Creek plant must increase from 82.4 to 97.1 percent. Each plant must also provide approximately 82.4 percent removal of ammonia-nitrogen.

TABLE 3-4

PROJECTED WASTE LOAD CONCENTRATIONS AND REQUIRED TREATMENT EFFICIENCIES

	BOD			TSS			NH_3-N		
Treatment Plant	Influent[1] (mg/ℓ)	Effluent (mg/ℓ)	Eff* (%)	Influent[1] (mg/ℓ)	Effluent (mg/ℓ)	Eff* (%)	Influent[2] (mg/ℓ)	Effluent (mg/ℓ)	Eff* (%)
Rilling Road	260	5	98.1	240	5	97.9	17	3	82.4
Salado Creek	180	5	97.2	170	5	97.1	17	3	82.4
Leon Creek	180	5	97.2	170	5	97.1	17	3	82.4

[1]Determined from PA-254

[2]PA-254 (Revised Sept. 1977)

*Efficiency

3.1.3 Available Subsystem Alternatives

All reasonable subsystem alternatives available for upgrading and/or expanding the San Antonio wastewater treatment facilities to a level consistent with TDWR requirements are identified and presented in outline form in Table 3-5. Major subsystems include alternatives for treatment plant locations, treatment unit processes, effluent disposal locations and methods, and sludge treatment and disposal.

These subsystem alternatives represent components which can be combined to form total system alternatives. All combinations of subsystems which will provide the necessary facilities to meet the project's goals and objectives constitute a complete list of system alternatives.

3.2 Description of System Alternatives

System alternatives capable of providing the required level of treatment are developed for environmental and economic evaluation by supplementing the existing facilities with various available subsystem alternatives. Both structural and

TABLE 3-5

SUBSYSTEM ALTERNATIVES FOR SAN ANTONIO WASTEWATER TREATMENT FACILITY

I. Plant Locations

- A. Existing Sites
    1. Rilling Road
    2. Salado Creek
    3. Leon Creek
- B. Potential New Sites
    1. Near Mitchell Lake
    2. Near confluence of San Antonio and Medina Rivers
    3. Other

II. Treatment Plant Unit Processes

- A. Pretreatment
    1. Flow equilization
    2. Screening
    3. Grit removal
    4. Pre-aeration
    5. Pre-chlorination
- B. Primary Treatment
- C. Secondary Treatment
    1. Activated Sludge
        - a. Conventional
        - b. Extended aeration
        - c. Contact stabilization
        - d. Rotating biological discs
        - e. Complete mix
        - f. Step aeration
        - g. Pure oxygen
    2. Trickling filters
    3. Physical-chemical
- D. Advanced Waste Treatment
    1. Nitrogen removal or ammonia control
        - a. Nitrification-denitrification
        - b. Trickling filters
        - c. Rotating biological discs
        - d. Ammonia stripping
        - e. Break point chlorination
        - f. Ion exchange
        - g. Land application

TABLE 3-5 (Continued)

SUBSYSTEM ALTERNATIVES FOR

SAN ANTONIO WASTEWATER TREATMENT FACILITY

2. Phosphorus removal (if necessary)

   a. Alum (Al^{++}) addition
   b. Lime (Ca^{++}) addition
   c. Iron (Fe^{++}) addition
   d. Land application

3. Filtration

   a. Granular media
   b. Microstraining

4. Carbon adsorption

E. Disinfection

   1. Chlorination
   2. Ozonation
   3. Others (heat energy, shortwave radiation, ultrasonic disruption)

F. Land Application

III. Effluent Disposal Locations and Methods

A. Discharge to Surface Waters

   1. Streams and Rivers

      a. San Antonio River
      b. Leon Creek
      c. Medina River

   2. Lakes

      a. Braunig
      b. Calaveras
      c. Mitchell

B. Discharge to Soil Systems

   1. Spray irrigation
   2. Overland flow
   3. Infiltration/percolation

C. Well Disposal

D. Reuse

   1. Recharge to potable water supply
   2. Recharge to non-potable water supply
   3. Boiler water make-up
   4. Cooling waters for industry
   5. Recharge to ground water

TABLE 3-5 (Continued)

SUBSYSTEM ALTERNATIVES FOR

SAN ANTONIO WASTEWATER TREATMENT FACILITY

IV. Sludge Treatment and Disposal

A. Sludge Stabilization

1. Aerobic digestion
2. Anaerobic digestion
3. Lime addition
4. Chlorination
5. Heat treatment
6. Composting

B. Sludge Thickening

1. Gravity
2. Flotation
3. Centrifuge

C. Conditioning Stabilization

1. Chemical
2. Elutriation
3. Heat Treatment

D. Dewatering

1. Sand beds
2. Vacuum filters
3. Centrifuge
4. Filter press
5. Lagoons

E. Reduction Stabilization

1. Flash dryer
2. Incineration
3. Wet air oxidation
4. Pyrolysis

F. Final Disposal

1. Land spread
2. Landfill
3. Landfill of incinerator ash
4. Reuse for energy

nonstructural alternatives must be considered. System alternatives identified for investigation should represent the most reasonable possible solution and must include consideration for direct discharge to area surface waters, land application, and reuse as required by law. Additionally, a "no action" alternative must be included for evaluation.

3.2.1 Non-Structural Alternatives

Nonstructural alternatives can be implemented to help reduce water quality problems by discouraging the use of water and, consequently, the discharge of wastewater and by encouraging the reuse of water where possible. Nonstructural alternatives include flow and waste reduction measures such as industrial water reuse and recycling, land use and zoning controls, negative or no growth policies, education programs for decreased water use and wastewater generation, and water and sewer rate adjustments. An additional measure that could be taken is to implement city ordinances requiring the use of water-saving devices in the city.

The reuse alternatives selected for San Antonio consider discharging wastewater of various qualities to the power plant cooling lakes owned by City Public Service. The first reuse alternative provides for discharge of the effluent from all three existing treatment plants to Braunig Lake. The second alternative provides for the discharge of Salado Creek effluent to Calaveras Lake and upgrading the treatment efficiencies at the Rilling Road and Leon Creek plants to allow for continued discharge to area streams. However, the public demand for water-oriented recreation on these cooling lakes is increasing and public acceptance of these alternatives is questionable. Additionally, the TDWR has identified two policy issues relevant to these two alternatives. The first policy questions the viability of transforming lakes presently used by the public into components of a wastewater treatment system and thereby removing their use from the public realm. The second policy issue is concerned with the public health implications of using the lakes both for recreation and as recipients of effluent where no provisions exist to insure that raw or partially treated sewage is not inadvertently discharged to the lakes. Consequently, participants in the November 17, 1976, 208/201 Coordination Meeting concluded that discharge of effluent to Braunig and Calaveras Lakes is not a feasible alternative at the present time (GL-070). Additional direct reuse alternatives which were considered included potable and non-potable reuse and aquifer recharge. However, during the preliminary screening process, these systems were determined to not be viable and, consequently, were eliminated (GA-262).

Other nonstructural alternatives include improved treatment plant operation and maintenance techniques, control of non-point sources of pollution through zoning ordinances, and institutional arrangements during planning stages of projects for combining facilities and wastewater discharges rather than designing and constructing individual treatment and/or collection systems. Improved operation and maintenance techniques will help insure a consistently high-quality wastewater. With the design and construction of these federally funded improvements, the city is required to staff the facility with certified operators and technicians to insure proper operation and maintenance.

These nonstructural alternatives were considered in estimating the 20-year design flows presented in Table 3-1. One such consideration assumed that while per-capita return flows have historically increased with time, present trends indicate that the per-capita return flow rates will not increase significantly above current levels (BA-583). Per-capita water use rates have historically increased since the installation of distribution systems. However, recent observations indicate that these increases have leveled off somewhat. The City of San Antonio should attempt to implement nonstructural control strategies throughout the design period when applicable to promote water conservation, reduce wastewater discharges, and meet water quality objectives. The design flows presume continuation of this strategy.

3.2.2 Structural Alternatives

The structural alternatives include changes and additions to existing facilities, including the sewage collection system and the treatment plants.

3.2.2.1 Collection System

Collection system extensions and improvements are not dependent on the selected wastewater treatment alternative. Proposed improvements are necessary to eliminate existing or potential pollution sources and should be implemented regardless of the wastewater treatment alternative selected. A description of the proposed improvements in the collection system is presented in Chapter 4 of this EIS.

3.2.2.2 Wastewater Treatment Plants

For initial planning and environmental evaluation purposes, only subsystem alternatives (Table 3-5) for treatment plant locations and capacities and for effluent disposal sites and methods are considered. Additional information providing the engineering details of each treatment plant alternative at this initial planning stage is not warranted. However, additional subsystem alternatives for unit processes and sludge treatment and disposal will be identified for the economic evaluations.

For environmental evaluation of the alternatives selected, it must be assumed that the unit processes used for each proposed facility will produce the required effluent quality. Selection of unit processes will be based on both cost and environmental criteria. Additionally, it must be assumed that each plant will be properly staffed and operated and that potential adverse impacts associated with the operation of the facility will be minimized. However, all possible adverse impacts will not necessarily be eliminated. These assumptions are justified because proper unit processes and operations are necessary for the attainment of the goals as set forth by FWPCAA. The value engineering process essentially guarantees compliance.

For the economic evaluation, additional subsystem alternatives must be selected to further identify each alternative being investigated. A brief description of unit processes assumed for the economic evaluation is presented in the economic evaluation section. However, it should be noted that the subsystems selected for each alternative are for preliminary evaluation purposes only and should not be construed as the final selection that will be used in the alternative selected. It is possible that the details of the proposed action finally selected will differ slightly with descriptions provided within this set of alternatives. However, the descriptions do provide a proper basis for comparisons among alternatives. The selected alternative will be subjected to a value engineering study in the 201 Step 2 process, when refinements to most cost-effective unit processes will be made.

The system alternatives selected for consideration comprise seven basic types of alternatives. These basic types, which are designated 1 to 6 and No Action, are described in Table 3-6. Several variations of each of the seven basic types were evaluated, which resulted in 18 alternatives. In addition, both upland and bottomland pipeline routes were considered for eight of the 18 alternatives. Thus, a total of 26 alternatives were evaluated in all. These alternatives are described in the following sections, and the schematic illustrations of each alternative are shown in Figure 3-2.

Alternative 1

Alternative 1 involves upgrading the Rilling Road plant by adding a tertiary treatment process and upgrading and expanding the Leon Creek and Salado Creek plants. Each plant would discharge at its respective existing outfall. A schematic of this alternative is shown in Figure 3-2A.

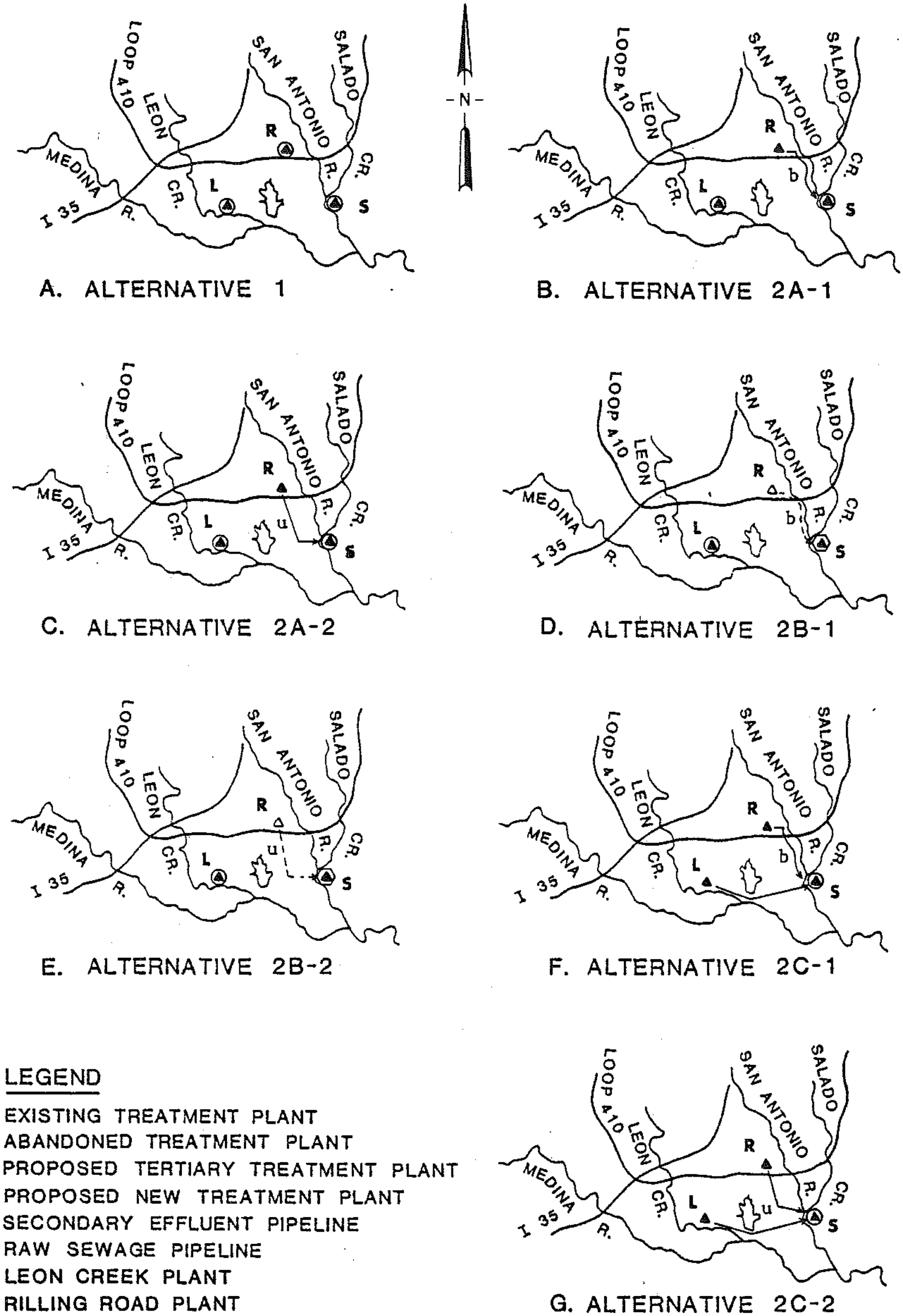
Alternative 2A

This alternative would require maintaining the existing treatment efficiency and capacity at the Rilling Road plant and transporting the secondary effluent to the Salado Creek plant. The Salado Creek plant will be improved and expanded and discharge would be at the existing outfall. The Leon Creek plant would be upgraded and expanded and tertiary-treated effluent would be discharged at the existing outfall. This alternative includes two subalternatives for evaluation. Alternative 2A-1 assumes that the transfer lines for secondary effluent from the Rilling Road plant to the Salado Creek plant would be located in bottomlands along the San Antonio River. Alternative 2A-2 assumes

TABLE 3-6

DESCRIPTION OF BASIC ALTERNATIVE TYPES

Alternative Type	Description
1	Upgrade Rilling Road, Leon Creek, and Salado Creek plants in place.
2	Build a new plant or tertiary plant at Salado Creek plant location.
3	Build a new plant near the confluence of Medina and San Antonio Rivers.
4	Build a new treatment plant near Mitchell Lake.
5	Build a tertiary treatment plant near Mitchell Lake.
6	Pipe secondary effluent to Mitchell Lake and pump from the lake for land application.
No Action	Take no action.



LEGEND

- ▲ EXISTING TREATMENT PLANT
- △ ABANDONED TREATMENT PLANT
- ○ PROPOSED TERTIARY TREATMENT PLANT
- ⬡ PROPOSED NEW TREATMENT PLANT
- ——→ SECONDARY EFFLUENT PIPELINE
- - - -→ RAW SEWAGE PIPELINE
- L LEON CREEK PLANT
- R RILLING ROAD PLANT
- S SALADO CREEK PLANT
- b PIPELINES IN BOTTOMLANDS
- u PIPELINES IN UPLANDS

FIGURE 3-2 WASTEWATER TREATMENT SYSTEM ALTERNATIVES the lines would be located in the uplands. Schematics of alternatives 2A-1 and 2A-2 are shown in Figures 3-2B and 3-2C, respectively.

Alternative 2B

Alternative 2B requires abandoning the existing Rilling Road plant and transporting the raw wastewater to an improved and expanded Salado Creek plant before discharging tertiary-treated wastewater at the existing Salado Creek discharge point. The Leon Creek plant would be upgraded and expanded and tertiary treated effluent would be discharged at the existing outfall. This alternative includes two subalternatives for evaluation. Alternative 2B-1 assumes that the transfer lines for raw sewage from the abandoned Rilling Road plant to the Salado Creek plant would be located in bottomlands along the San Antonio River. Alternative 2B-2 assumes the lines would be located in the uplands. Schematics of alternatives 2B-1 and 2B-2 are shown in Figures 3-2D and 3-2E, respectively.

Alternative 2C

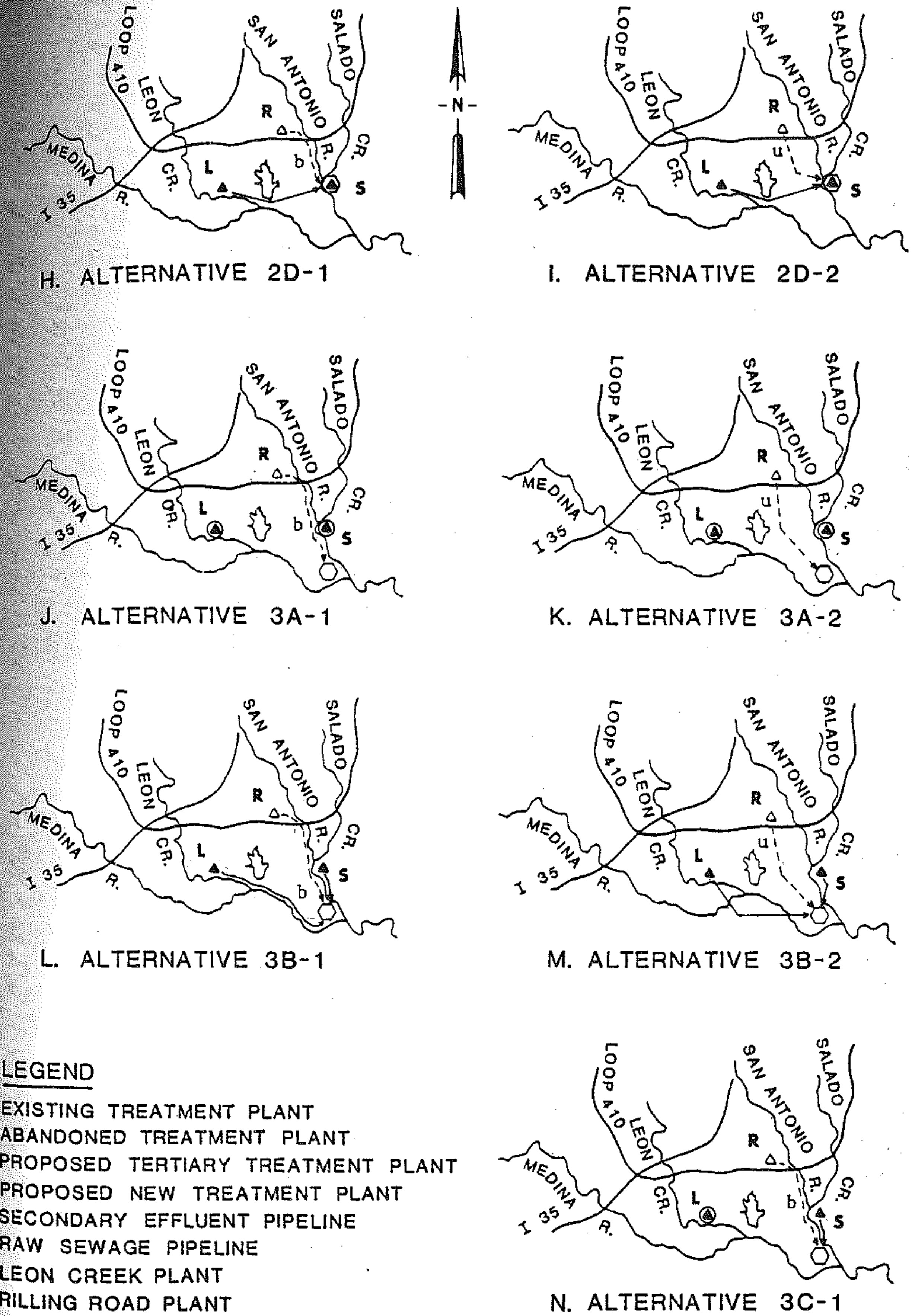
Alternative 2C requires maintaining the treatment efficiency but expanding the capacity of both the Rilling Road plant and the Leon Creek plant. The secondary effluent from these two facilities would be transported to an improved and expanded Salado Creek plant. Tertiary effluent would be discharged at the existing Salado Creek outfall. This alternative includes two subalternatives. Alternative 2C-1 assumes the transfer lines for secondary effluent from the Rilling Road plant to the Salado Creek plant would be located in bottomlands along the San Antonio River. Alternative 2C-2 assumes the lines would be located in the uplands. Schematics of Alternatives 2C-1 and 2C-2 are shown in Figures 3-2F and 3-2G, respectively.

Alternative 2D

Alternative 2D requires abandoning the existing Rilling Road plant and transporting the raw wastewater to an improved and expanded Salado Creek plant. The Leon Creek plant would be maintained at its present capacity and treatment capability and secondary effluent would be transported to the new and improved Salado Creek plant for tertiary treatment. Tertiary effluent from the Salado Creek plant would be discharged at the existing outfall. This alternative includes two subalternatives for evaluation. Alternative 2B-1 assumes the transfer line for raw wastewater from the abandoned Rilling Road plant to the Salado Creek plant would be located in bottomlands along the San Antonio River. Alternative 2B-2 assumes the line would be located in the uplands. Schematics of Alternatives 2D-1 and 2D-2 are shown in Figures 3-2H and 3-2I, respectively.

Alternative 3A

This alternative requires abandoning the Rilling Road plant and transporting the raw wastewater to a new facility near the confluence of the Medina and San Antonio Rivers. The existing Salado Creek plant and Leon Creek plant would be improved and expanded and tertiary-treated effluent would be discharged at the respective existing outfalls. The new facility near the confluence would discharge tertiary effluent into the San Antonio River near the confluence. This alternative includes two subalternatives for evaluation. Alternative 3A-1 assumes the raw sewage transfer line from the abandoned Rilling Road plant to the new facility would be located on bottomlands along the San Antonio River. Alternative 3A-2 assumes the line would be located on the uplands. Schematics of Alternatives 3A-1 and 3A-2 are shown in Figures 3-2J and 3-2K, respectively.



LEGEND

▲ EXISTING TREATMENT PLANT
△ ABANDONED TREATMENT PLANT
○ PROPOSED TERTIARY TREATMENT PLANT
⬡ PROPOSED NEW TREATMENT PLANT
→ SECONDARY EFFLUENT PIPELINE
--→ RAW SEWAGE PIPELINE
L LEON CREEK PLANT
R RILLING ROAD PLANT
S SALADO CREEK PLANT
b PIPELINES IN BOTTOMLANDS
u PIPELINES IN UPLANDS

FIGURE 3-2 (CONTINUED) WASTEWATER TREATMENT SYSTEM ALTERNATIVES

Alternative 3B

This alternative requires abandoning the existing Rilling Road plant and transporting the raw wastewater to a new facility near the confluence of the Medina and San Antonio Rivers. The Salado Creek and Leon Creek plants would be expanded and secondary effluent from each would be transferred to the new facility near the confluence for tertiary treatment. The new facility would discharge tertiary treated wastewater to the San Antonio River. This alternative includes two subalternatives for evaluation. Alternative 3B-1 assumes that the transfer lines for raw wastewater from the abandoned Rilling Road plant and for secondary effluent from the Salado Creek and Leon Creek plants would be located in bottomlands along the San Antonio and Medina Rivers. Alternative 3B-2 assumes these lines would be located in the uplands. Schematics of alternatives 3B-1 and 3B-2 are shown in Figures 3-2L and 3-2M, respectively.

Alternative 3C

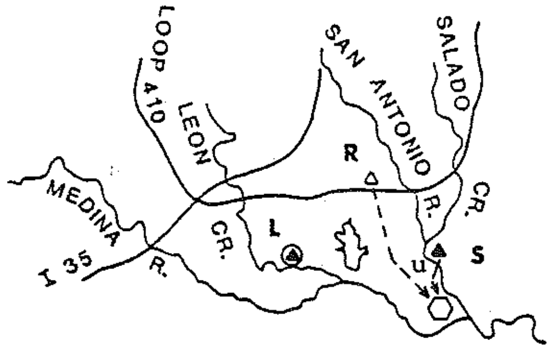
Alternative 3C requires abandoning the existing Rilling Road plant and transporting the raw wastewater to a new facility near the confluence of the Medina and San Antonio Rivers. The Salado Creek plant would be expanded and secondary effluent would be transported to the new facility near the confluence for tertiary treatment. Tertiary-treated effluent from the new facility will be discharged to the San Antonio River. The Leon Creek plant would be improved and expanded and tertiary treated effluent would be discharged to Leon Creek at the existing outfall. This alternative includes two subalternatives for evaluation. Alternative 3C-1 assumes the transfer lines for raw wastewater from the Rilling Road plant to the new facility and for secondary effluent from the Salado Creek facility to the new facility would be located in bottomlands along the San Antonio River. Alternative 3C-2 assumes these lines would be located in the uplands. Schematics of Alternatives 3C-1 and 3C-2 are shown in Figures 3-2N and 3-2O, respectively.

Alternative 3D

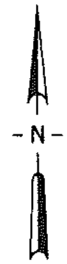
Alternative 3D requires abandoning the Rilling Road plant and transporting the raw wastewater to a new facility near the confluence of the Medina and San Antonio Rivers. The Leon Creek plant would be expanded and secondary effluent would be transported to the new facility for tertiary treatment. The Salado Creek facility would be improved and expanded and tertiary effluent would be discharged at the existing outfall. Tertiary effluent from the new facility near the confluence would be discharged to the San Antonio River. This alternative includes two subalternatives for evaluation. Alternative 3D-1 assumes the transfer lines for raw wastewater from the Rilling Road plant to the new facility and secondary effluent from the Leon Creek facility to the new plant would be located in the bottomlands along the Medina and San Antonio Rivers, respectively. Alternative 3D-2 assumes the transfer line will be located in the uplands. Schematics of Alternatives 3D-1 and 3D-2 are shown in Figures 3-2P and 3-2Q, respectively.

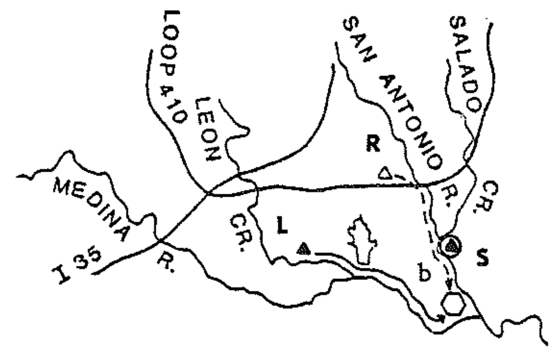
Alternative 4A

Alternative 4A requires abandoning the Rilling Road plant and transporting the raw wastewater to a new facility near Mitchell Lake. The Salado Creek plant and the Leon Creek plant would be improved and expanded, and tertiary treated wastewater would be discharged at the existing respective outfalls. The new facility near Mitchell Lake would discharge tertiary treated

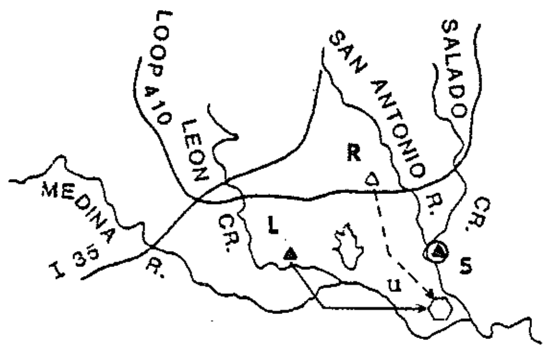


O. ALTERNATIVE 3C-2

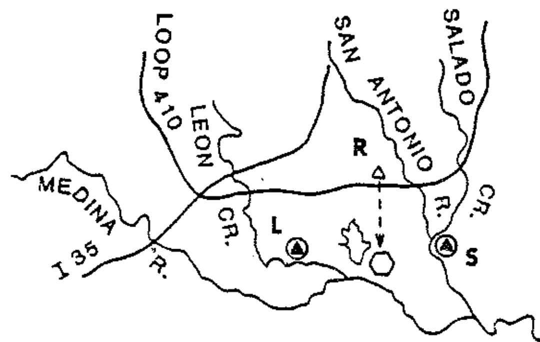




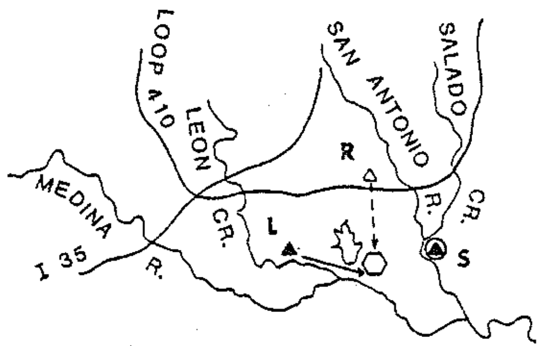
P. ALTERNATIVE 3D-1



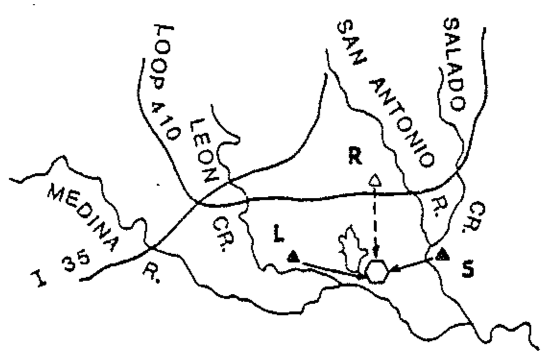
Q. ALTERNATIVE 3D-2



R. ALTERNATIVE 4A



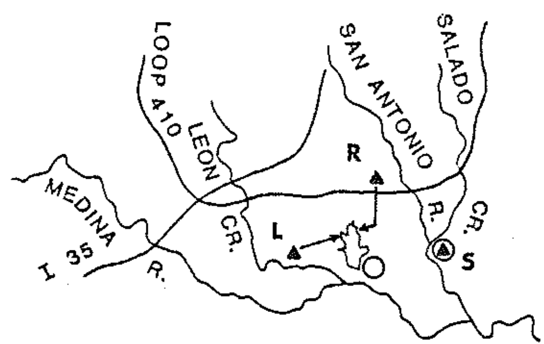
S. ALTERNATIVE 4B



T. ALTERNATIVE 4C

LEGEND

- ▲ EXISTING TREATMENT PLANT
- △ ABANDONED TREATMENT PLANT
- ○ PROPOSED TERTIARY TREATMENT PLANT
- ⬡ PROPOSED NEW TREATMENT PLANT
- ——→ SECONDARY EFFLUENT PIPELINE
- - - -→ RAW SEWAGE PIPELINE
- L LEON CREEK PLANT
- R RILLING ROAD PLANT
- S SALADO CREEK PLANT
- b PIPELINES IN BOTTOMLANDS
- u PIPELINES IN UPLANDS



U. ALTERNATIVE 5A

FIGURE 3-2 (CONTINUED) WASTEWATER TREATMENT SYSTEM ALTERNATIVES

wastewater to the Medina River. A schematic of this alternative is shown in Figure 3-2R.

Alternative 4B

This alternative requires abandoning the Rilling Road plant and transporting the raw wastewater to a new facility near Mitchell Lake. The Leon Creek plant would be expanded and secondary effluent would be transported to the new facility for tertiary treatment. The Salado Creek plant would be improved and expanded, and tertiary wastewater will be discharged at the existing outfall. The new facility near Mitchell Lake would discharge tertiary-treated effluent to the Medina River. A schematic of this alternative is shown in Figure 3-2S.

Alternative 4C

This alternative requires abandoning the Rilling Road plant and transporting raw wastewater to a new facility near Mitchell Lake. The Salado Creek and Leon Creek plants would be expanded and secondary effluent from each plant would be transported to the new plant near Mitchell Lake. The new plant would discharge tertiary-treated wastewater to the Medina River. A schematic of this alternative is shown in Figure 3-2T.

Alternative 5A

This alternative involves expanding the Rilling Road and Leon Creek plants and discharging secondary-treated wastewater to Mitchell Lake for storage and equalization. The Salado Creek plant would be improved and expanded, and tertiary-treated wastewater would be discharged at the existing outfall. A new advanced treatment plant would be constructed near Mitchell Lake to treat water stored in Mitchell Lake. The new facility would discharge tertiary-treated wastewater to the Medina River. A schematic of this alternative is shown in Figure 3-2U.

Alternative 5B

Alternative 5B involves expanding the Rilling Road and Leon Creek plants and discharging secondary effluent to a new tertiary facility near Mitchell Lake. The Salado Creek plant would be improved and expanded, and tertiary-treated wastewater would be discharged at the existing outfall. The new tertiary plant near Mitchell Lake would discharge tertiary-treated effluent to the Medina River. A schematic of this alternative is shown in Figure 3-2V.

Alternative 5C

This alternative involves expanding the three regional plants and discharging secondary effluent from each to a new tertiary facility near Mitchell Lake. Tertiary-treated wastewater from this new plant would be discharged to the Medina River. A schematic of this alternative is shown in Figure 3-2W.

Alternative 6A

This alternative involves expanding the Rilling Road and Leon Creek plants and discharging secondary effluent to Mitchell Lake for storage and equalization. The Salado Creek plant would be improved and expanded and tertiary-treated effluent would be discharged at the existing outfall. Stored wastewater in Mitchell Lake would be pumped for land application on city-owned land. A schematic of this alternative is shown in Figure 3-2X.

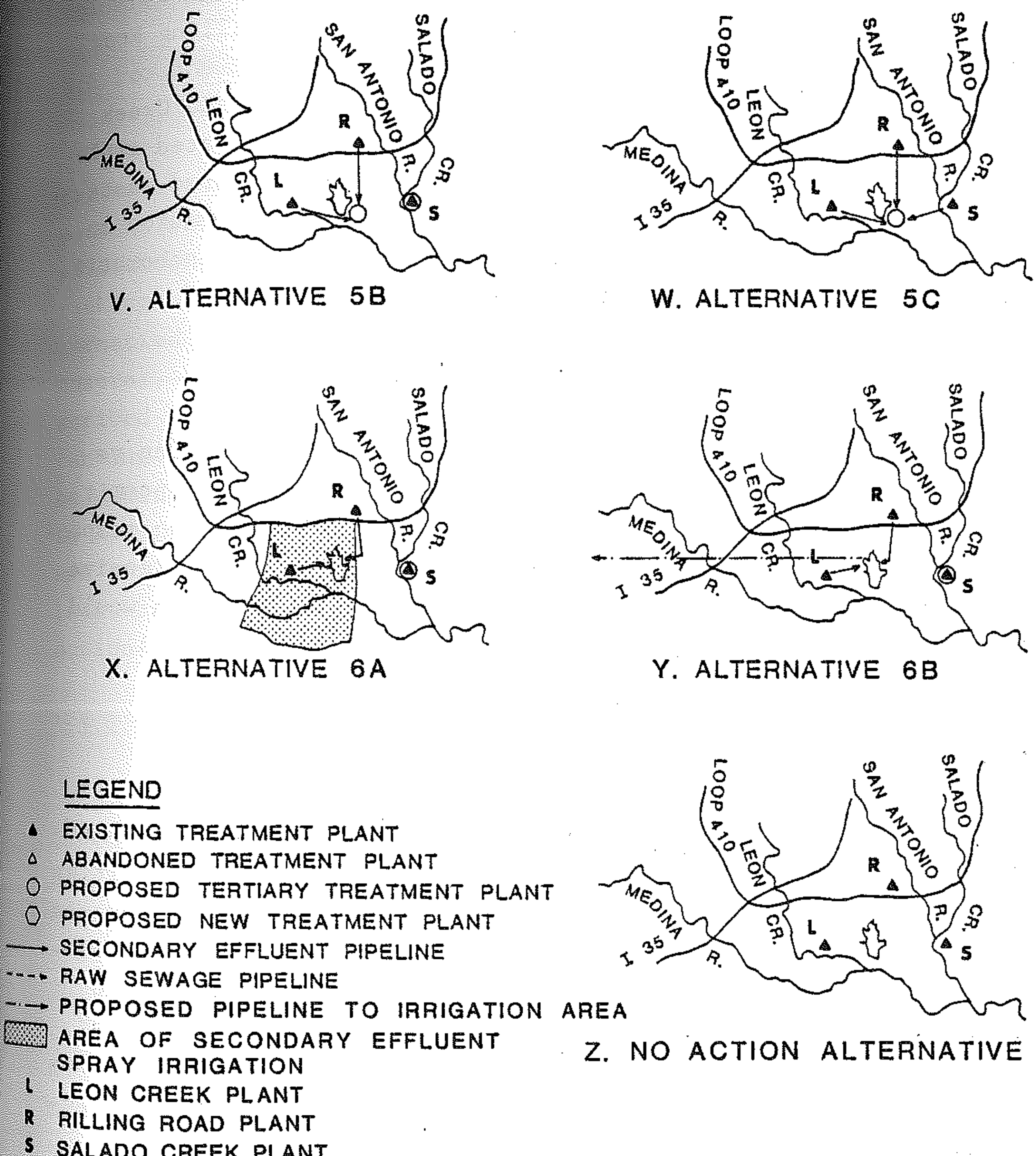


FIGURE 3-2 (CONTINUED) WASTEWATER TREATMENT SYSTEM ALTERNATIVES

Alternative 6B

This alternative involves expanding the Rilling Road and Leon Creek plants and discharging secondary effluent to Mitchell Lake for storage and equalization. The Salado Creek plant would be improved and expanded and tertiary-treated effluent would be discharged at the existing outfall. Stored wastewater in Mitchell Lake would be pumped for land application on privately-owned land at some distance to the west. A schematic of this alternative is shown in Figure 3-2Y.

No Action

"No Action" constitutes maintaining the existing regional treatment facilities and violating the discharge permit by discharging secondary treated effluent at the existing respective outfalls. The interceptor/collection system would receive minor expansion but no rehabilitation. Additional growth would most likely be accomodated with septic tank facilities. A schematic of this alternative is shown in Figure 3-2Z.

3.3 Alternatives Evaluation

According to Construction Grants for Waste Treatment Works, 40 CFR, Part 35, subpart E, section 35.917-1, "Facilities planning which is initiated after April 30, 1974, must encompass... a cost-effectiveness analysis of the alternatives for the treatment works and for the waste treatment system(s) of which the treatment works is a part. The selection of the system(s) and the choice of the treatment works on which construction drawings and specifications are to be based shall reflect the cost-effectiveness analysis." Additionally, this section of the regulation states that the cost-effective analysis must include "...an adequate assessment of the expected environmental impact of alternatives and sites..." In this section the evaluation methodologies and results are presented and described.

3.3.1 Evaluation Methodologies

The methodology for evaluating and screening the identified alternatives primarily includes the development of independent rankings of costs, using various measures of economic effectiveness, and of environmental impact. The environmental ranking of the alternatives is obtained by superimposing the alternative treatment systems, described in the first part of this chapter, on the existing environment of the study area, as described in Chapter 2. The combination of these two independent rankings constitute a "cost-effectiveness analysis." It should be understood that "cost effectiveness" does not refer exclusively to economics but rather to the combined results of the economic and environmental rankings. Therefore, it is possible that a least-cost alternative will not emerge as the selected proposed action.

3.3.1.1 Environmental Evaluation Methodology

The 26 alternatives (including "No Action") were evaluated for environmental impact using a systematic and comprehensive approach. The objective of this evaluation was to generate a Figure of Merit (FOM) based on (1) the relative importance of specific environmental categories as perceived by the San Antonio 201 Wastewater Facilities Advisory Committee, and (2) an objective evaluation of the adverse impacts of the alternatives by a multidisciplinary professional group. This group used environmental criteria that corresponded to the environmental categories used by the Advisory Committee. The environmental categories used in the evaluation system are shown in Table 3-7. The relative importance (expressed as a weighting value) that was assigned to each category by the Committee is shown in the Technical Reference Document (RA-R-420). The evaluation process delineates adverse impacts rather than optimizing the mix of beneficial and adverse impacts. The FOM rating is supplemented by a listing of "Red Flags," which signify adverse impacts, and "Green Flags," which indicate substantial beneficial impacts other than the lack of "adverse" impacts. The details of the environmental evaluation system are presented in the Technical Reference Document (RA-R-420).

TABLE 3-7

ENVIRONMENTAL CATEGORIES USED IN ALTERNATIVES EVALUATION PROCESS

Natural Environment	Man-Made Environment
Air Quality	Existing Land Use
Noise	Future Land Use Changes
Odor	Historical, Archaeological, Cultural, and Recreational Resources
Water Quality of Streams	Transportation
Water Quality of Lakes	Resource Utilization
Streamflow and Surface Water Quantity	Community Services and Facilities
Ground Water Quality	Ongoing Projects and Programs
Springflow and Ground-Water Quantity	
Natural Vegetation	
Terrestrial Fauna	
Aquatic Biota	
Biologically Sensitive Areas	
Substrate Suitability	

3.3.1.2 Economic Evaluation Methodology

Construction costs for the unit processes considered within each wastewater treatment plant included in the alternatives were estimated using information sources in general use for that purpose (PA-193, PO-167, VA-123). These sources were supplemented by personal communication with various equipment manufacturers and suppliers. For those alternatives that include existing wastewater treatment plants, an optimum use is made of the existing unit processes. Primary clarification, two stage biological nitrification, multimedia filtration, and disinfection formed the basis for estimating the costs of the alternatives.

In those alternatives which consider the retention of the Rilling Road plant (1, 2A, 2C, 5A, 5B, 5C, 6A, and 6B), costs are also included for rehabilitation or replacement of major portions of the existing plant. The components requiring replacement or rehabilitation include the headworks, odor control facilities, the electrical system, primary and final clarifier mechanisms, aeration system for part of the plant, return sludge pumping, digester covers and controls, maintenance and storage building, and an in-plant process water distribution system. In addition, equalization facilities will be required for peak flows. Costs for nitrification for the alternatives considering the retention of the Rilling Road plant or a transfer of secondary effluent from the Rilling Road plant to another plant site are based on using the air-activated sludge process followed by synthetic-media trickling filters.

Alternative 5A, which involves the discharge of secondary effluent from the Rilling Road and Leon Creek plants through Mitchell Lake, includes a cost for removal of algae by air flotation in addition to the costs of the other unit processes.

The alternatives which involve the relocation of the Rilling Road plant considered primary clarification, biological nitrification using a two-stage activated sludge process, multi-media filtration, and disinfection.

The costs for the two alternatives considering land application are based on applying chlorinated secondary effluent from the Rilling Road and Leon Creek plants. The flow from the Salado Creek plant would be upgraded and discharged to the San Antonio River.

Biological sludges were considered to be thickened (primary sludge by gravity and waste-activated sludge by air flotation), anaerobically digested, and air-dried on sand drying beds. Ultimate sludge disposal would involve land application by area residents for fertilizer. This method of ultimate sludge disposal has proven to be successful in the San Antonio area.

3.3.2. Evaluation Results

3.3.2.1. Environmental Evaluation Results

The first step of the environmental evaluation was to obtain the weighting values for each of the environmental categories from the San Antonio 201 Wastewater Facilities Advisory Committee. The Committee was provided with materials describing the meaning of each of the environmental categories in Table 3-7. Education and information sessions were also held to promote additional understanding of the meaning of the categories in the San Antonio area. A detailed advance information version of Chapter 2 (Existing Environment) of this EIS was prepared for review by members of the Advisory Committee to inform them of elements of the environment as they now exist.

After this educational process, each committee member was asked to judge the importance of each environmental category relative to the others in the San Antonio area environment. The values were normalized, averaged, and squared to reduce citizens' responses to a single weighting value for each category (RA-R-420)

The categories are shown with their weighting values and in order of perceived importance in Table 3-8. In the natural environment, the ground water quality category was clearly judged to be the most important, with a weighting value of 1.67. The second most important category was air quality, with a value of 1.46. The next four categories--water quality of streams, springflow and ground-water quantity, streamflow and surface-water quantity, and water quality of lakes--all deal with water and rated nearly equal in importance, with values ranging from 1.19 to 1.31. Water-related categories clearly ranked the highest in the evaluation. The remaining categories range downward from 0.80 (odor) to 0.37 (terrestrial fauna).

In the man-made environment, resource utilization (including energy use) ranked highest, with a weight of 1.62. Next was future land use changes, which received a weight of 1.49. Ongoing projects and programs ranked lowest in weight, with a value of 0.71.

For technical evaluation of the impact of the alternatives upon each environmental category, a multidisciplinary professional jury was assembled. Assessments were made for each major component of each candidate alternative. A total of 31 components were evaluated and then the appropriate components were combined to comprise the alternatives under study.

TABLE 3-8

WEIGHTING VALUES OF ENVIRONMENTAL CATEGORIES AS JUDGED BY SAN ANTONIO 201 WASTEWATER FACILITIES ADVISORY COMMITTEE

	Weighting Value
Natural Environment	
Ground-Water Quality	1.67
Air Quality	1.46
Water Quality of Streams	1.31
Springflow and Ground-Water Quantity	1.26
Streamflow and Surface Water Quantity	1.26
Water Quality of Lakes	1.19
Odor	0.80
Substrate Suitability	0.75
Natural Vegetation	0.74
Aquatic Biota	0.72
Biologically Sensitive Areas	0.67
Noise	0.54
Terrestrial Fauna	0.37
Man-Made Environment	
Resource Utilization	1.62
Future Land Use Changes	1.49
Historical, Archaeological, Cultural, and Recreational Resources	1.20
Existing Land Use	1.00
Transportation	0.99
Community Services and Facilities	0.91
Ongoing Projects and Programs	0.71

In addition to the components evaluated for each alternative, the aggregate impacts of the alternative which do not emerge from the evaluation of the impacts of individual components were also assessed. The relative degree of adverse impact of the 31 components and the aggregate impacts of the alternatives are summarized in the Technical Reference Document (RA-R-420).

After the impact values of the various components and the aggregate impact values were determined, they were combined to derive the FOM's for each alternative. The alternatives were then grouped into six environmental rank categories based on their FOM values. The environmental rank categories of the 26 alternatives evaluated are shown in Table 3-9. The alternatives are listed in order of relative environmental acceptability, but the FOM's of alternatives in each category are close enough in value to indicate that all alternatives in that category are about equal in terms of environmental acceptability.

Table 3-9 shows that a large group of alternatives are in the most environmentally acceptable group (Category 1). The least desirable alternatives (Category 6) are the "No Action" alternative and the alternatives that include bottomland routes for sewage and secondary effluent pipelines.

An additional set of factors was also considered in the evaluation system. Some impacts of the alternatives were considered to be especially severe or beneficial and were assigned red flags or green flags accordingly. Red or green flags are assigned to components and alternatives which have impacts that are not adequately reflected in the numerical environmental evaluation system. In the evaluation, the number of red flags and green flags was about the same for all alternatives, so there

TABLE 3-9

ENVIRONMENTAL RANKING OF SYSTEM ALTERNATIVES

Environmental Rank Category	Average FOM Value	Alternatives Included
1	3.68	5A
		5B
		5C
		4B
		4C
		4A
		2A-2
		3B-2
		3A-2
		2C-2
		3D-2
		2B-2
2	3.21	2D-2
		3C-2
		1
3	2.55	6B
		6A
4	2.13	2A-1
		3A-1
		2C-1
5	1.52	2B-1
		2D-1
		3C-1
6	0.35	3D-1
		No Action
		3B-1

is no discernible difference among the alternatives from the standpoint of particularly severe or beneficial impacts. Red flags can indicate impacts that are potentially severe enough to eliminate an alterntaive for environmental reasons, but no such red flags were assigned to any alternatives for the proposed project. The red flags and green flags assigned to each alternative are summarized in the Technical Reference Document (RA-R-420).

3.3.2.2 Economic Evaluation Results

A present-worth cost summary for each alternative, including capital costs and operation and maintenance costs, is provided in Table 3-10. Cost differences between upland and bottomland routes for sewage pipelines in the various alternatives were insignificant in comparison to total project costs, so no distinction is made here between these two choices. The cost estimates shown in Table 3-10 reflect fourth quarter 1976 prices and ahould not be construed as the final cost estimates for the construction and operation of the facilities. Final estimates will be determined by the equipment and construction costs at the time of construction. However, the cost estimates presented do provide a valid basis for a cost comparison among the alternatives.

Assumptions for the present worth analysis include an interest rate of 6.375 percent, a useful life of 30 years for all structures, a useful life of 40 years for all piping, and a design period of 20 years. Land is assumed not to depreciate.

The operation and maintenance costs also reflect fourth quarter 1976 prices and are based on an average labor rate of $5.00 per hour, which includes direct and indirect labor costs, an electricity cost of $0.03/kwh and a fuel cost of $2.00 per million Btu. The cost of materials other than electricity were

TABLE 3-10

PRESENT WORTH COST SUMMARY
($ million)

Alternative	Capital	O&M	Present Worth
1	59.2	74.9	134.1
2A	61.1	74.4	135.5
2B	65.2	70.0	135.2
2C	63.8	74.5	138.3
2D	67.7	69.5	137.2
3A	71.1	71.3	142.4
3B	74.7	69.6	144.3
3C	71.5	70.0	141.6
3D	75.1	70.8	145.9
4A	67.2	71.2	138.4
4B	67.8	70.5	138.4
4C	69.2	70.1	139.3
5A	70.7	121.1	191.7
5B	64.9	75.2	140.1
5C	66.8	76.4	143.2
6A	108.0	90.6	198.6
6B	84.5	75.0	159.5
No Action	No cost involved		

adjusted in accordance with the appropriate wholesale price index. Cost indexes for the fourth quarter of 1976 as used for this investigation are provided in the Technical Reference Document (RA-R-420).

3.3.3 Alternatives Screening

A review process of the 26 alternatives was undertaken by representatives of the Environmental Protection Agency, the Texas Department of Water Resources, the City of San Antonio, and the consultants to those organizations. During this review, the alternatives utilizing bottomland routes for sewage and secondary effluent pipelines were eliminated on the basis of environmental considerations. The alternatives having upland and bottomland route options (2A, 2B, 2C, 2D, 3A, 3B, 3C, and 3D) were reduced to single alternatives as a result. Further analysis of the remaining alternatives on the basis of cost, environmental rank, implementability, public acceptance, and other factors led to the reduction of the number of alternatives considered to seven. These remaining alternatives were 1, 2A, 2B, 3A, 3B, 4B, and 5B.

These seven alternatives were then presented and described to the San Antonio 201 Wastewater Facilities Advisory Committee. The members of the Committee were asked to rank the alternatives in order of their preference. The results of this exercise are presented in Table 3-11. Alternative 2B was not ranked by two of the nine committee members present. Based on the results of this survey and on additional engineering and cost considerations, three of the seven alternatives--1, 2B, and 3B--were selected for final evaluation.

TABLE 3-11

RESULTS OF 201 ADVISORY COMMITTEE RANKING OF ALTERNATIVES

	Number of Votes Received in Rank							
Alternative	1	2	3	4	5	6	7	No Vote
1	-	-	-	1	1	4	3	-
2A	-	-	1	3	3	2	-	-
2B	1	-	5	-	-	-	1	2
3A	1	7	-	-	1	-	-	-
3B	7	1	-	1	-	-	-	-
4B	-	1	2	2	3	1	-	-
5B	-	-	1	2	1	2	3	-

3.3.4 Final Alternatives Evaluation

Each of the three alternatives selected for final evaluation has advantages and disadvantages from both the cost and environmental standpoint. Alternative 1 has a clear cost advantage because it is the least costly, exclusive of the No Action alternative (Table 3-10). However, this alternative is inferior in its environmental rank in that it falls in Category 2 (Table 3-9). This alternative involves continued operation of the existing Rilling Road treatment plant. The Rilling Road plant is located in a culturally significant area because of the proximity of the Mission Trail area. Odors emanating from the plant in the past have caused public concern. This is particularly important now that the San Antonio Missions National Historical Park has been proposed. As noted in Chapter 2, a bill is before the U.S. Congress to create this national park, but action has not yet been taken. The U.S. Department of Interior National Park Service has expressed the view that "the removal of the plant would be of substantial benefit in preserving and restoring the historical integrity of these very significant historic sites." (Appendix 1.) Also, Alternative 1 is viewed in low favor by the 201 Advisory Committee, as shown in Table 3-11.

Alternatives 2B and 3B rank about equally in terms of environmental acceptability, in that both fall in Category 1. Each alternative has both advantages and disadvantages from an environmental standpoint. For example, Alternative 2B has the advantage of less land disturbance associated with sewage transfer lines because less total length of transfer line is required. However, the upland routes of these lines will result in minimal and temporary impact of transfer line emplacement in any case. The new treatment plant associated with this alternative would be constructed at the existing Salado Creek plant site, where the land use is already committed to a treatment plant. The added direct environmental effects of a new treatment plant at this site would thus be relatively slight. A major disadvantage of Alternative 2B is the upstream location of the treated sewage outfalls. Those stream segments from the existing outfalls of the Leon Creek and Salado Creek plants to the confluence of the Medina and San Antonio Rivers would continue to receive a high volume of treated effluent, although the quality of this effluent would be greatly improved over the existing quality. Also, the sewage transfer line leading from the Rilling Road plant to the new plant at the Salado Creek site would cross the San Antonio River. If this line were to be damaged or otherwise fail, raw sewage could be released to the river at the crossing, thus decreasing the water quality of the river and possibly also damaging the aquatic biota.

The major disadvantage of Alternative 3B is the location of the new plant at the confluence of the Medina and San Antonio Rivers where a treatment plant does not now exist. This location is somewhat environmentally sensitive because of the presence of a floodplain and the possible presence of significant archeological resources. Depending on the exact location of the treatment plant at the site, part of the plant may be in the 100-year floodplain, and appropriate mitigative measures would be required. Also, if preliminary surveys indicate the presence of a significant archeological resource, this resource would have to be salvaged before plant construction or would have to be avoided when plans are made for construction. The major advantages of Alternative 3B are the downstream location of the outfall and the expanded service area in southern San Antonio. The location of the outfall near the confluence of the Medina and San Antonio Rivers will mean that the stream segments presently receiving effluent above the confluence will no longer receive this effluent. The location of the plant at the confluence will increase the potential service area (a benefit from the community services standpoint) not only in the immediate area between the Medina and San Antonio Rivers, but also in the Medina River basin, if this service extension is required in the future. In addition, the sewage transfer line that must cross the San Antonio River from the existing Salado Creek plant to the new treatment plant will carry secondary-treated effluent rather than raw sewage. The impact of this treated effluent on the river in the event of a break or other type of leakage would be much less severe than if raw sewage were to enter the river.

The capital cost of Alternative 3B is approximately $9.5 million higher than the capital cost of Alternative 2B (Table 3-10). Thus, Alternative 2B is considered to be the cost-effective, environmentally compatible alternative to achieve the objectives of the program. However, the City of San Antonio has on several occasions expressed a preference for Alternative 3B over Alternative 2B. The rankings of these two alternatives by the 201 Wastewater Facilities Advisory Committee (Table 3-11) clearly indicate a strong preference for 3B over 2B. A public meeting was held in San Antonio on 12 July 1977 to present Alternatives 1, 2B, and 3B to the public and to obtain input on public opinion regarding these alternatives. Although the meeting was not well attended, a clear preference for Alternative 3B was expressed by a show of hands. Subsequently, on 25 August 1977, the City Council of San Antonio passed a resolution expressing a preference for Alternative 3B (Resolution 77-45-56A, see Appendix 2). This resolution was followed on 10 November 1977 by a second resolution (Resolution 77-57-82, see Appendix 2) that stated that the City will assume responsibility for the additional cost of Alternative 3B over the cost of Alternative 2B.

3.4 Selection of the Proposed Action

Alternative 2B is considered to be the cost-effective, environmentally compatible alternative. For this reason, the U.S. Environmental Protection Agency will participate in funding the program at a level not to exceed the capital cost of Alternative 2B. However, to meet the desires of the City of San Antonio, the Proposed Action is considered to be Alternative 3B, which has a capital cost of approximately $74.7 million. The grant-eligible facilities for Alternative 3B will be limited to the wastewater treatment plants and a segment of gravity sanitary sewer interceptor line, including appurtenances, not to exceed the costs for the grant-eligible facilities in Alternative 2B. The City of San Antonio will assume responsibility for the difference in capital cost between Alternative 2B and 3B, as stated in Resolution 77-57-82.

4.0 DESCRIPTION OF THE PROPOSED ACTION

4.1 Introduction

Alternative 3B, the proposed action for improvements to the City of San Antonio wastewater treatment facilities, includes abandoning the existing Rilling Road plant and expanding and improving both the Salado Creek plant and the Leon Creek plant to provide a secondary level of treatment. A new wastewater treatment facility will be constructed near the confluence of the San Antonio River and the Medina River to treat the raw wastewater generated in the Rilling Road service area to a tertiary level of treatment. Facilities at the new plant will also receive the combined secondary wastewater from the Leon Creek and Salado Creek plants and provide additional treatment to a tertiary level. The Salado Creek plant will be expanded from approximately 24.0 MGD to 36.0 MGD and the Leon Creek plant will be expanded from approximately 24.0 MGD to 35.0 MGD. The new facility at the confluence will have a capacity to treat approximately 83 MGD of raw wastewater to a secondary level, and subsequently approximately 154 MGD of secondary treated wastewater to a tertiary level. The existing Rilling Road plant will be dismantled and the site will be designated for other uses. Three wastewater transfer lines will transport wastewater from the existing Rilling Road plant and the Leon Creek and Salado Creek plants to the new Confluence plant. All transfer lines will be emplaced in uplands rather than stream bottomlands. A schematic of these parts of the proposed action showing the location and size of the proposed facilities and the necessary transfer lines is shown in Figure 4-1.

Also included as part of the proposed action are the expansions and improvements of the sewage collection system. This work will include the construction of new lines and relief lines for presently overloaded lines as well as rehabilitation work to reduce infiltration and inflow into the collection system.

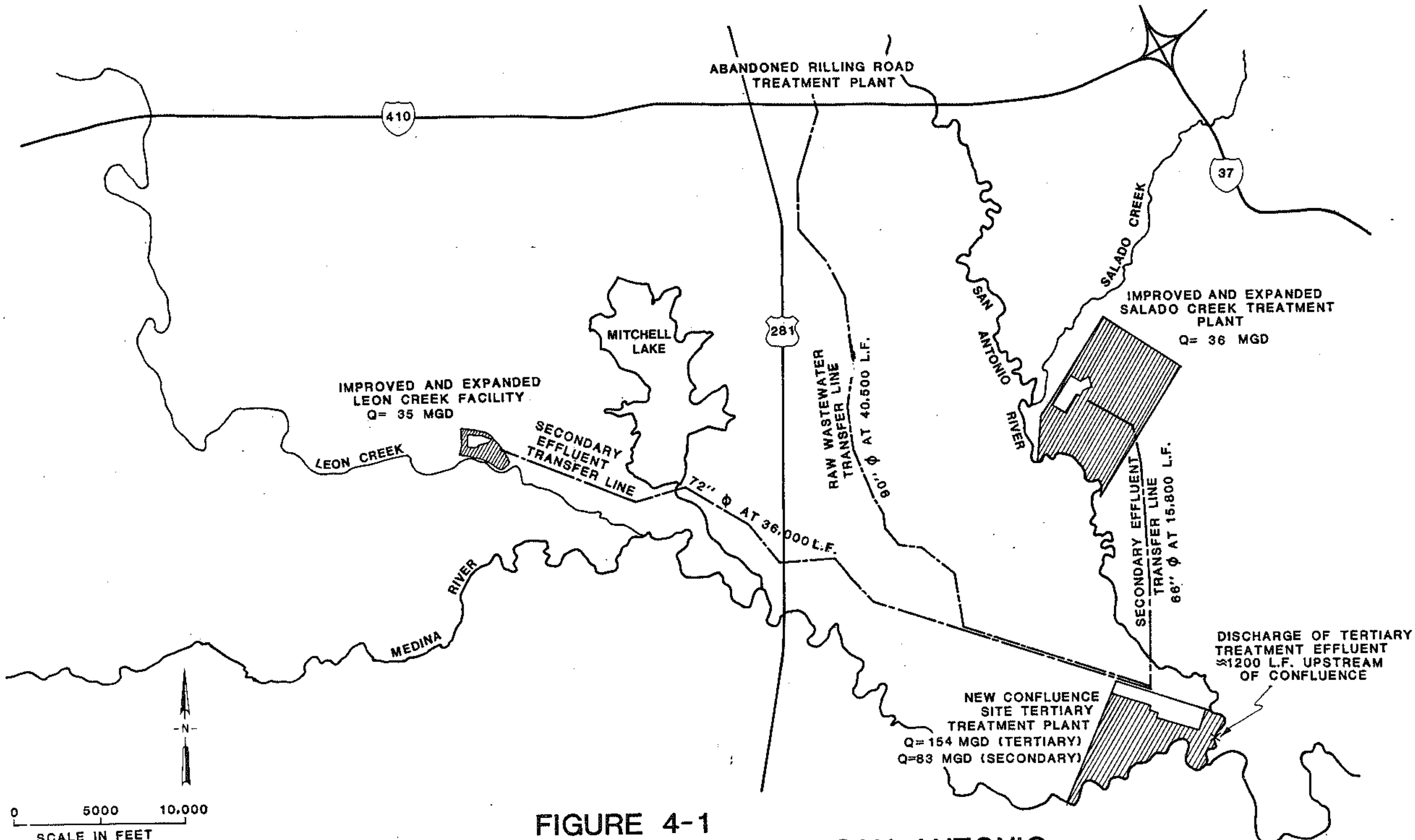


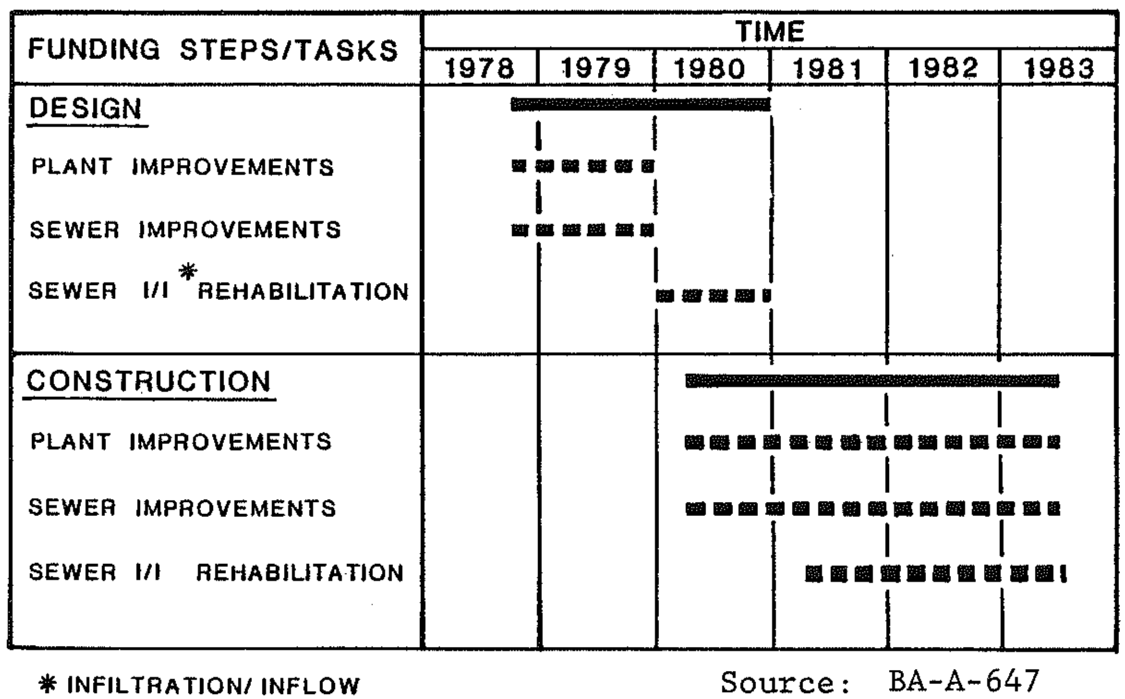
FIGURE 4-1
PROPOSED ACTION FOR CITY OF SAN ANTONIO WASTEWATER TREATMENT FACILITIES IMPROVEMENTS

The planning, design, and construction of the proposed action are scheduled so as to meet the July 1, 1983 deadline of FWPCAA for publicly-owned treatment even though this deadline was recently extended to July 1, 1984. A tentative schedule for design and construction of the proposed action is shown in Figure 4-2.

A description of each component of the proposed wastewater treatment facilities included in the proposed action is presented in this chapter. All proposed facilities and improvements to existing facilities will be designed to meet the Reliability Class II criteria as outlined in EPA-430-99-74-001. Detailed design drawings and specifications will be provided during Step 2 of the Section 201 grant process. Information provided here is preliminary, and caution should be used when reviewing these design descriptions. Presently unforeseen problems or new design considerations may occur which could alter these descriptions.

4.2 Confluence Site Wastewater Treatment Plant

The proposed new wastewater treatment plant to be located near the confluence of the San Antonio and Medina Rivers will provide preliminary treatment, primary treatment, two-stage biological activated sludge treatment, filtration, and disinfection. Wastewater emanating from the present Rilling Road service area (approximately 83 MGD), will be treated through the first stage of the activated sludge facilities. At that point, following the intermediate clarifiers, this secondary treated wastewater will be combined with the secondary treated wastewater from the Leon Creek and Salado Creek plants and the total flow of approximately 154 MGD will be further treated to a tertiary level beginning with the second stage activated sludge process. Waste activated sludge from the two-stage system will be thickened



Source: BA-A-647

FIGURE 4-2

SCHEDULE FOR DESIGN AND CONSTRUCTION OF WASTEWATER TREATMENT WORKS using the dissolved air flotation process. This thickened sludge will be combined with the primary sludge and stabilized with two-stage anaerobic digestion. The digested sludge will be air dried on sand drying beds. Ultimate disposal will be by distribution to local residents or to a contractor for land application as a soil conditioner. A schematic and flow diagram of the proposed new facility is shown in Figure 4-3.

Preliminary treatment will be accomplished with pre-aeration, bar screens, and grit removal. Flow measurements will be taken at this stage. These facilities will be designed for a peak hydraulic capacity of 193 MGD, which is the projected maximum two-hour flow rate.

Primary treatment facilities will include eight 135-foot diameter circular clarifiers. The total surface area of the clarifiers will be 107,300 square feet. These facilities will provide a design overflow rate of approximately 1,800 gallons per day per square foot (gpd/sq.ft.) at peak flow and approximately 800 gpd/sq.ft. at average flow.

The first stage of the activated sludge process will satisfy a majority of the carbonaceous biochemical oxygen demand (CBOD) of the wastewater effluent from the primary clarifiers. The second stage is necessary to satisfy the nitrogenous biochemical oxygen demand (NBOD) of the wastewater from the first stage as well as the secondary effluent from both the Leon Creek and Salado Creek wastewater treatment plants. The two-stage facilities will utilize a pure oxygen system and will demand approximately 285,000 pounds of oxygen per day to meet the ammonia-nitrogen (NH_3-N) limitation of 3 mg/ℓ. Compressors required to deliver this oxygen will have a nameplate horsepower of approximately 3,000 and an operating horsepower of approximately

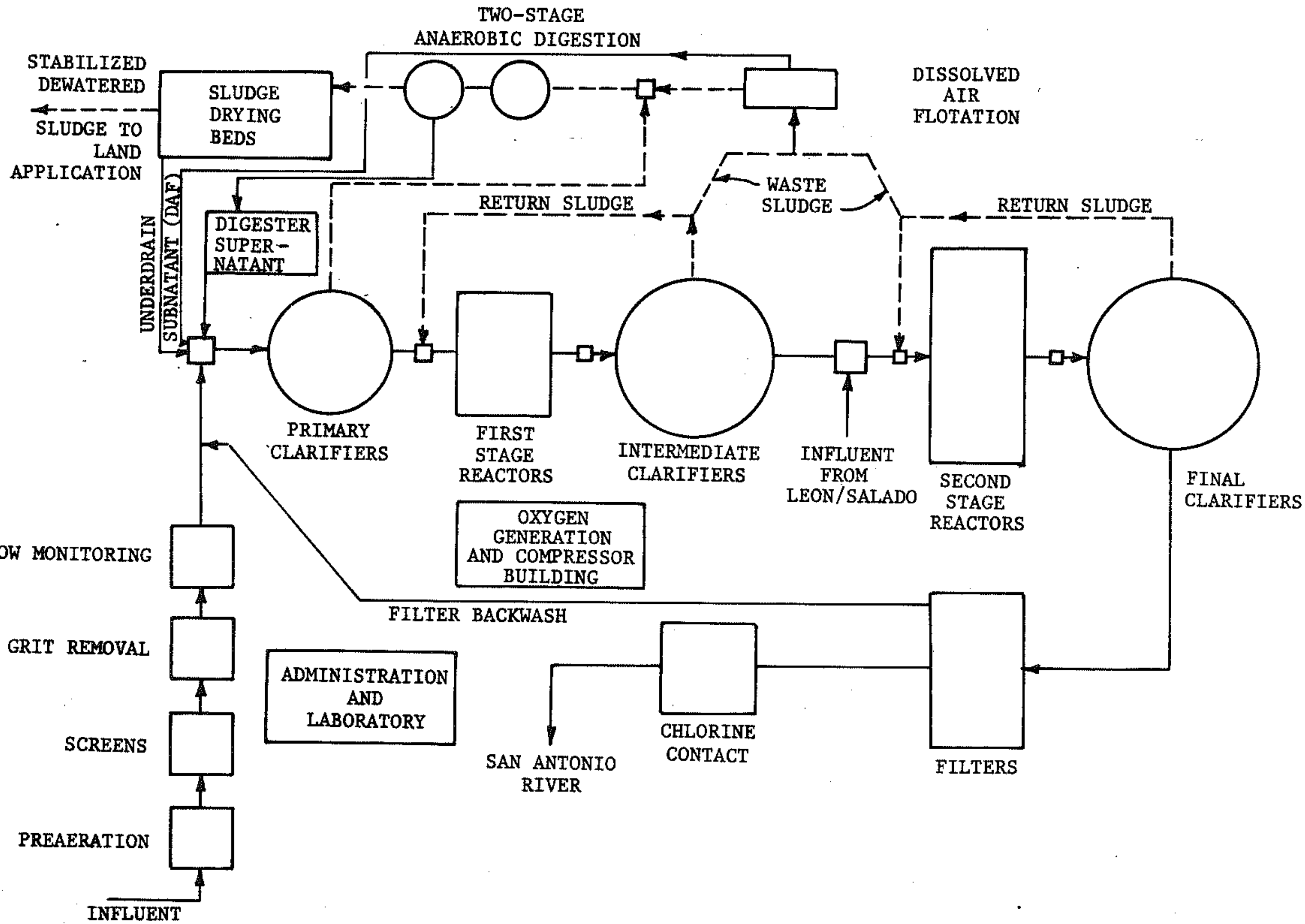


FIGURE 4-3

SCHEMATIC OF PROPOSED CONFLUENCE SITE WASTEWATER TREATMENT PLANT

2,400. The hydraulic retention time utilizing this pure oxygen system will be slightly in excess of one hour for each stage of the two-stage process. The first stage will be accomplished with four trains while the second stage will be accomplished with twelve trains.

Intermediate clarification following the first stage will be provided with eight 150-foot diameter circular clarifiers. The total surface area will be approximately 138,000 square feet. This surface area will provide an overflow rate of approximately 1,400 gpd/sq.ft. at peak flow and an overflow rate of approximately 600 gpd/sq.ft. at average flow.

Final clarification following the second stage will be provided with twelve 175-foot diameter circular clarifiers giving a total surface area of approximately 280,000 square feet. This surface area will provide an overflow rate of approximately 1,200 gpd/sq.ft. at a peak flow of 335 MGD and an overflow rate of approximately 500 gpd/sq.ft. at average flow.

The two-stage activated sludge process will be followed with tertiary effluent filters to ensure an effluent quality consistent with the effluent limitations. These filters will be designed for a hydraulic loading of 4 gallons per minute per square foot (gpm/sq.ft.) at peak flow which provides a hydraulic loading of approximately 1.7 gpm/sq.ft. at average flow. This hydraulic loading rate requires a bed surface area of approximately 58,000 square feet.

Disinfection will be accomplished using chlorination. For the required detention time of 20 minutes, a contact basin volume of 622,000 cubic feet will be provided. The chlorine feed system will deliver approximately 4,450 pounds of chlorine per day or approximately 810 tons annually.

The final treated wastewater will be discharged to the San Antonio River approximately 1,200 feet upstream of the confluence with the Medina River. The estimated concentrations of pollutants through each of the unit processes within the new treatment facility are provided in Table 4-1 (LO-231).

TABLE 4-1

CONCENTRATIONS OF POLLUTANTS THROUGH

CONFLUENCE SITE WASTEWATER TREATMENT PLANT

	Pollutants			
	BOD_5 (mg/1)	TSS (mg/1)	NH_3 -N (mg/1)	Fecal Coliform (No./100ml)
Influent	260	240	17	-
Preliminary Treatment	260	240	17	-
Primary Treatment	175	120	17	-
First Stage Activated Sludge	50	30	17	-
Second Stage Activated Sludge	8	15	3	-
Filters	5	5	3	-
Disinfection	5	5	3	200

Auxiliary power will be provided at the treatment plant with on-site generators to ensure continued operation in the event of power failure. This backup power source will provide sufficient power to operate all vital components, including critical lighting and ventilation, during peak flow conditions.

Odor control measures will be incorporated into the design of the facility. These measures include preaeration of the influent raw wastewater and removal of screens and washed grit to an enclosed container via a conveyor system. However, the inherent odors associated with sludge handling may persist, especially in the event of malfunctioning digesters. These odors are expected to be minimal.

The major source of noise at the facility will be associated with the cryogenic oxygen plant including the switch valves, centrifugal air compressors, and air compressor vent valves. These noises are estimated to approximate 95 dBA at 50 feet. Noise control measures will include structural enclosures that are lined with acoustical materials as well as high quality vent silencers. These measures are designed to attenuate the noise levels to less than 50 dBA at 1,000 feet. Possible sources of noise that will not be controlled include pumps, turbulence, and flow noise. However, these noises are not appreciable and will contribute only to the local plant noise field (LO-231).

The hydraulic profile through the plant is dependent on the layout and specific location and design of the unit processes. To accurately develop this profile requires the completion of the detailed drawings and specifications which will be provided under Step 2 of the 201 grants program. Therefore, the hydraulic profile of the confluence site wastewater treatment plant cannot be provided as yet. However, it is estimated that the water surface in the preliminary treatment facilities will be at an elevation of 490 feet MSL and the elevation of the water surface in the chlorine contact basin will be at 470 feet MSL. The treated wastewater will be discharged to the San Antonio River at an elevation of approximately 410 feet (LO-231).

Waste activated sludge from the two-stage activated sludge system will be thickened to approximately 4 percent solids using dissolved air flotation. This thickener will be designed for a solids loading rate of 48 pounds per square foot per day which will require a surface area of approximately 4,000 square feet. Approximately 400 pounds per day of polymer to enhance thickening will be added to the thickeners.

The thickened waste activated sludge will be combined with the primary sludge and stabilized with two-stage anaerobic digestion. The first stage is well mixed and heated to ensure adequate contact and biological stabilization. The second stage is neither mixed nor heated, but it provides quiescent conditions to ensure sufficient solid-liquid separation. The primary digester will have a capacity of 1,620,000 cubic feet providing a 15-day detention time for the estimated 106,000 cubic feet per day of sludge. The sludge digester will have a volume of 780,000 cubic feet, thus providing a total digester volume of 2,400,000 cubic feet.

The sand drying beds will be designed on the basis of 1.3 square feet per capita and will have a bed surface area of 750,000 square feet. The stabilized dried sludge will be removed from the drying beds on a contract basis and distributed to local residents or to a contractor for land application. Approximately 50 tons per day will be available for distribution. Additional heat stabilization and grinding of the dried sludge will also be available (LO-231). A possible site plan of the proposed facilities is given in Figure 4-4.

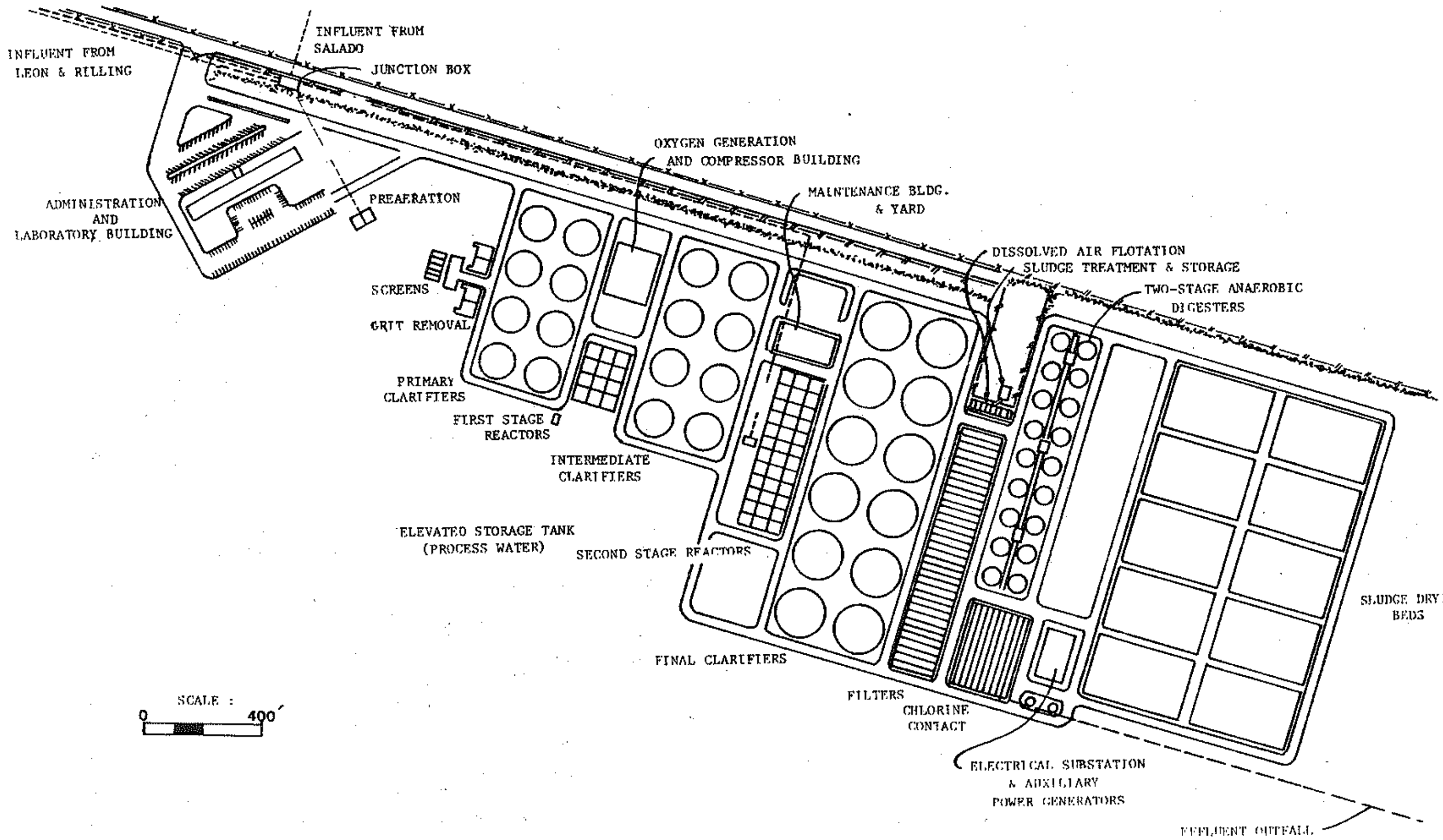


Figure 4-4

PROPOSED LAYOUT FOR THE CONFLUENCE SEWAGE TREATMENT PLANT

Construction of the new facility will require an average of approximately 200 workers over a three-year period. Job responsibilities for construction workers will range from skilled to unskilled and will include laborers, equipment operators, welders, concrete finishers, steel workers, truck drivers, mechanics, electricians, carpenters, painters, plumbers, as well as a foreman/superintendent.

The construction of the new facility will require approximately 100 acres. Excavations at the site will average approximately 10 feet with maximums of approximately 25 feet. Equipment necessary for the construction include air compressors, an asphalt machine, bulldozers, backhoes, cranes, front end loaders, graders, a trenching machine, trucks, mixers, rollers, and scrapers (LO-231).

Part of the Confluence facility will be located in the 100-year floodplain which has been designated by the U.S. Army Corps of Engineers to be at an elevation of approximately 474 meet MSL (US-845). A map showing the 100-year floodplain at the Confluence site is given in the Technical Reference Document (RA-R-420). To provide flood protection, side wall elevations for treatment works' structures and mechanical and electrical equipment will be located at a minimum elevation of one foot above the 100 year floodplain elevation. It is estimated that the treatment plant will remain fully operational during the 25-year flood as required by law. This is because the treatment plant will be above the controlling banks of the San Antonio River, and these banks are at an elevation of 470 feet whereas the 50-year floodplain elevation is at an elevation of only approximately 468 feet (LO-231). Since the plant is above the 50-year floodplain, it is also above the 25-year floodplain.

Additional right-of-way (R-O-W) will be necessary for the construction of this facility. Approximately 50 feet of R-O-W will be acquired on the south side and adjacent to Rabel Road for two major transfer lines. Additionally, Rabel Road will be improved and widened but this activity will take place with the existing road R-O-W and the proposed transfer line R-O-W.

No construction phasing for future growth is planned for this activity within or beyond the anticipated three year construction period. No significant abrupt flow increases are expected to occur during the design period to warrant consideration of phasing (LO-231). Some additional treatment capacity may be necessary if the collection system rehabilitation does not reduce flows as much as expected.

Approximately 133 personnel will be required to staff and operate the new facility. Of that total, approximately 76 will be required on weekdays, 24 on weeknights, and 33 on weekends. The staff should include eight administrative personnel, five for clerical, 80 for operation, 26 for maintenance, seven for laboratory, and seven for yard work (LO-231).

Annual electrical energy consumption will be approximately 42,700 megawatt hours at the design flow. Materials required to operate the facilities will include makeup sand for the sludge drying beds, maintenance supplies, and equipment replacement parts. Traffic to and from the facility will approximate 225 vehicles per day (LO-231).

4.3 Salado Creek Plant

The Salado Creek plant will be improved and expanded from 24.0 MGD to 36.0 MGD to provide a secondary level of treatment and to produce an effluent quality suitable for tertiary treatment at the proposed new Confluence Site plant. Design and operation characteristics of the existing unit processes are described in detail in Water Pollution Control for the City of San Antonio (SA-258). The existing unit processes and treatment capability of the plant are summarized in Chapter 3 of this EIS. The additional unit processes required for the improvements are similar to those used at the Confluence Site.

The improved and expanded Salado Creek plant will provide preliminary treatment (bar screen, grit removal, and flow monitoring), primary treatment, modified activated sludge secondary treatment and intermediate clarification. The existing aerobic digestion basins will be converted to additional aeration basins for expansion of the activated sludge process. Two additional primary clarifiers and two additional intermediate clarifiers will be constructed using similar design criteria as used for the new Confluence site. The existing aeration facilities provide a blower capacity of 31,000 cfm. An additional capacity in excess of 20,000 cfm will be provided to ensure sufficient aeration and adequate reserve capacity.

Disinfection will no longer be necessary at this plant. However, small amounts of chlorine will be required to control sludge bulking in the activated sludge units.

Secondary treated wastewater will be transferred by pipeline to the new Confluence plant for tertiary treatment. The final effluent will be discharged to the San Antonio River. The estimated concentrations of pollutants through each of the unit processes within the Salado Creek facility is provided in Table 4-2. The secondary effluent produced for transfer to the Confluence facility will contain a BOD_5 concentration of 15 mg/ℓ, a total suspended solids concentration of 20 mg/ℓ, and an ammonia-nitrogen concentration of 17 mg/ℓ (LO-228).

TABLE 4-2

CONCENTRATIONS OF POLLUTANTS THROUGH THE PROPOSED IMPROVED AND EXPANDED SALADO CREEK WASTEWATER TREATMENT PLANT

	Pollutants		
	BOD_5 (mg/ℓ)	TSS (mg/ℓ)	NH_3-N (mg/ℓ)
Influent	180	170	17
Preliminary Treatment	180	170	17
Primary Treatment	125	85	17
Activated Sludge Secondary Treatment	15	20	17

A schematic and flow diagram of the existing Salado Creek facilities and proposed improvements are shown in Figure 4-5.

Auxiliary power will be provided at the Salado Creek plant with the installation of an additional transmission line from a utility substation different from the one currently servicing the plant. No on-site backup generators are included in the proposed improvements.

Significant odor problems do not currently exist at the Salado Creek plant and none are anticipated. Therefore, no definitive odor control measures are planned with the proposed improvements. However, potential odor sources which may be identified include the plant headworks (if influent wastewater is septic) and the sludge handling facilities.

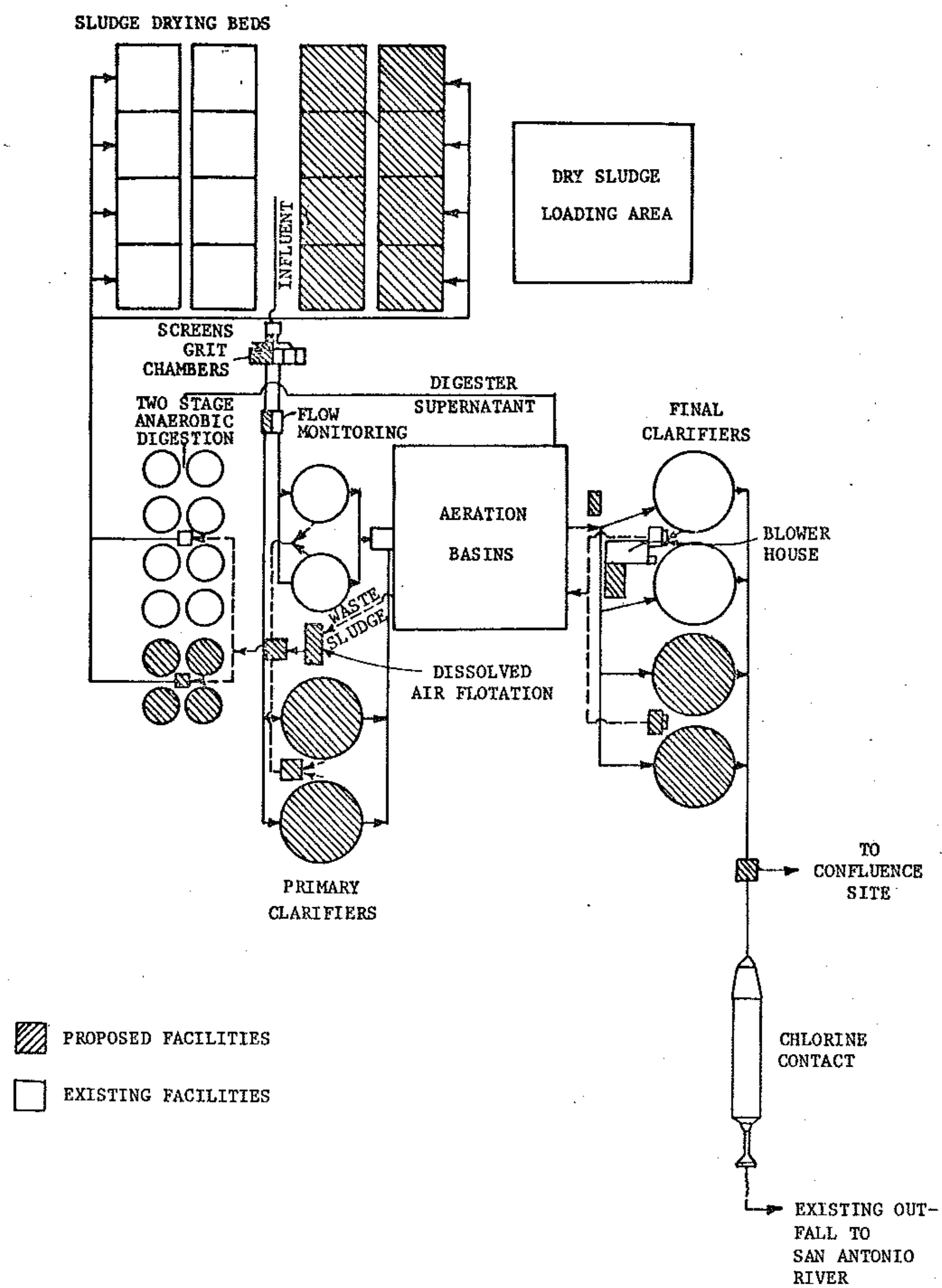


FIGURE 4-5

SCHEMATIC OF SALADO CREEK WASTEWATER TREATMENT PLANT WITH PROPOSED IMPROVEMENTS

Blower motors for the aeration facilities constitute the major source of noise but measurements of only 88 dBA are currently observed at a distance of 50 feet. The additional blower motors required are not expected to increase the noise levels significantly, and no control measures are proposed (LO-228).

The estimated hydraulic profile through the plant is provided in Figure 4-6. The water surface elevation in the preliminary treatment facilities will be approximately 520.10 feet MSL, and the water surface elevation in the intermediate clarifier will be approximately 512.55 feet MSL (LO-228).

Waste activated sludge will be thickened using the dissolved air flotation process and then combined with the primary sludge for stabilization using two-stage anaerobic digestion. Approximately 85 pounds per day of polymer will be added to the thickening units to enhance sludge handling. The existing digesters will be used to the extent possible, but additional capacity will be required. Approximately two-thirds of the stabilized sludge will be air dried on sand drying beds and one-third will be land-applied to approximately 130 acres by spray irrigation and subsequently disked into the ground. Additional sludge drying bed area will be constructed with the proposed improvements. Dried sludge will be distributed to local residents or to a contractor for land application for ultimate disposal. Consideration is also being given to the possibility of using any excess dried sludge for sanitary landfill cover. Digester supernatant will be returned to the reaeration basin (LO-228). A site plan of the existing Salado Creek plant with the proposed expansion and improvements is given in Figure 4-7.

Construction of the proposed improvements and expansion will require an average of approximately 50 workers over a one-year period. However, some improvements may be constructed in stages which would extend the period of construction. Job

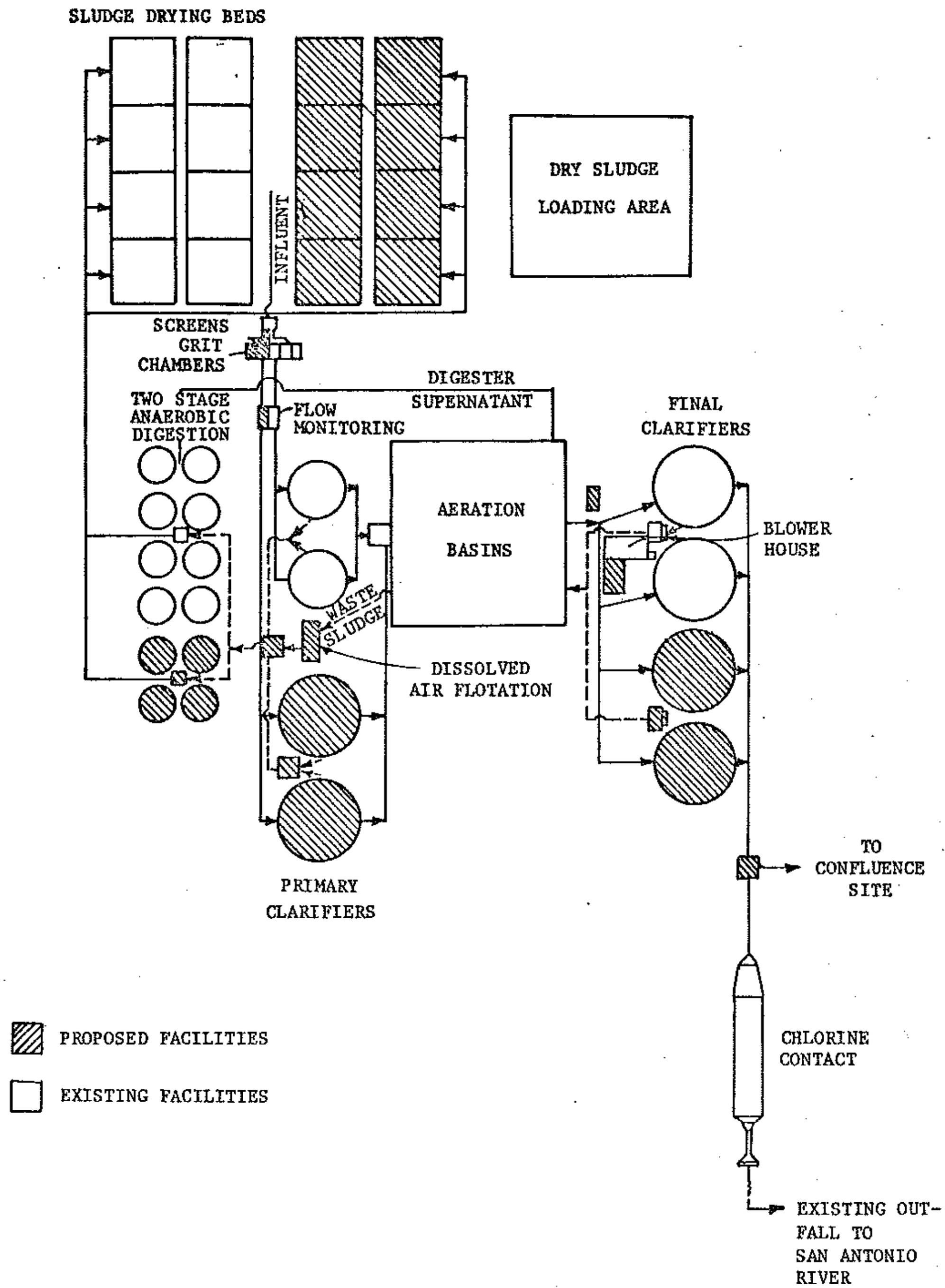


FIGURE 4-5

SCHEMATIC OF SALADO CREEK WASTEWATER TREATMENT PLANT
WITH PROPOSED IMPROVEMENTS

Blower motors for the aeration facilities constitute the major source of noise but measurements of only 88 dBA are currently observed at a distance of 50 feet. The additional blower motors required are not expected to increase the noise levels significantly, and no control measures are proposed (LO-228).

The estimated hydraulic profile through the plant is provided in Figure 4-6. The water surface elevation in the preliminary treatment facilities will be approximately 520.10 feet MSL, and the water surface elevation in the intermediate clarifier will be approximately 512.55 feet MSL (LO-228).

Waste activated sludge will be thickened using the dissolved air flotation process and then combined with the primary sludge for stabilization using two-stage anaerobic digestion. Approximately 85 pounds per day of polymer will be added to the thickening units to enhance sludge handling. The existing digesters will be used to the extent possible, but additional capacity will be required. Approximately two-thirds of the stabilized sludge will be air dried on sand drying beds and one-third will be land-applied to approximately 130 acres by spray irrigation and subsequently disked into the ground. Additional sludge drying bed area will be constructed with the proposed improvements. Dried sludge will be distributed to local residents or to a contractor for land application for ultimate disposal. Consideration is also being given to the possibility of using any excess dried sludge for sanitary landfill cover. Digester supernatant will be returned to the reaeration basin (LO-228). A site plan of the existing Salado Creek plant with the proposed expansion and improvements is given in Figure 4-7.

Construction of the proposed improvements and expansion will require an average of approximately 50 workers over a one-year period. However, some improvements may be constructed in stages which would extend the period of construction. Job

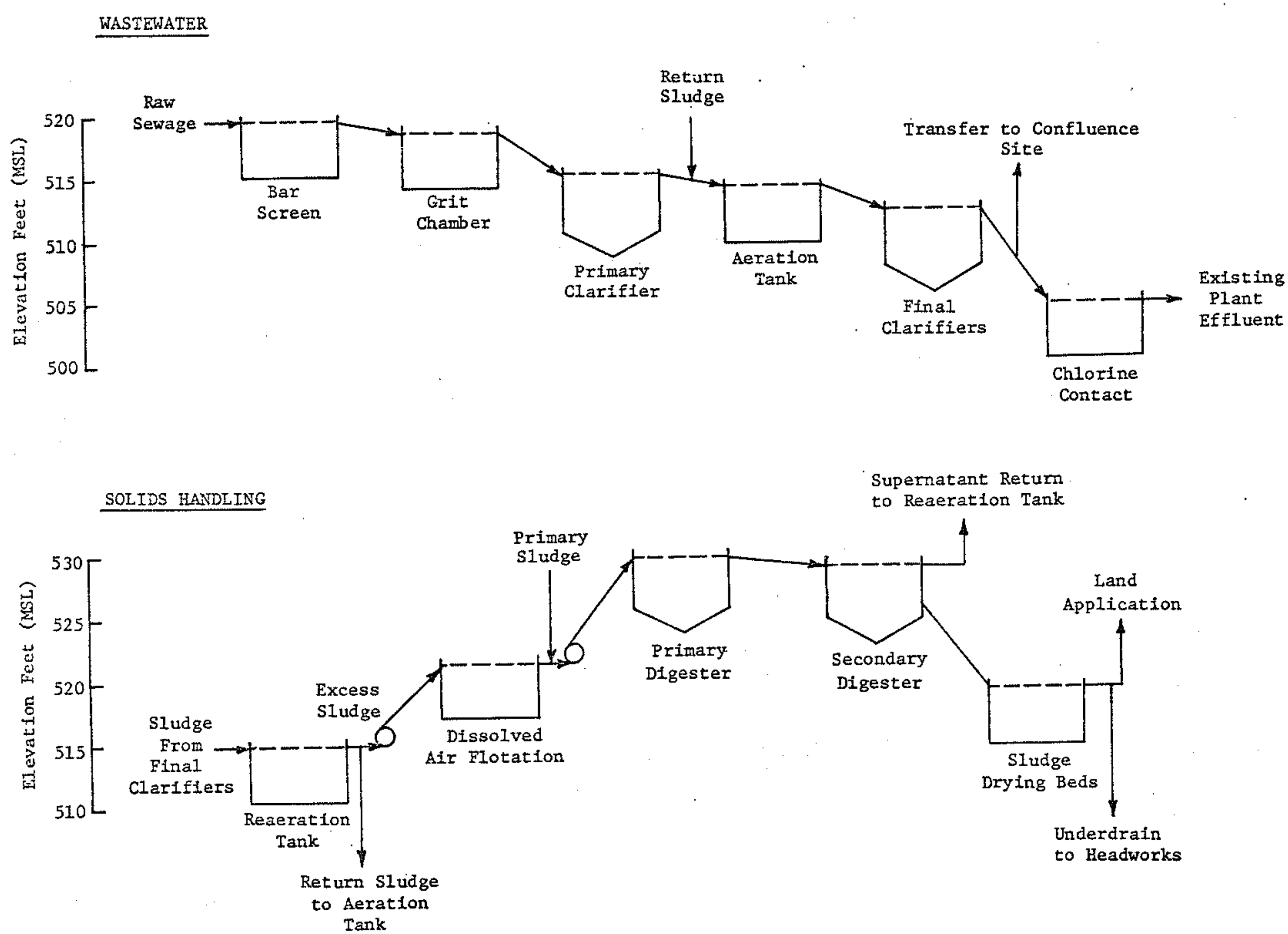


FIGURE 4-6

SCHEMATIC OF HYDRAULIC FLOW DIAGRAM FOR SALADO CREEK WASTEWATER TREATMENT PLANT

SCHEMATIC OF HYDRAULIC FLOW DIAGRAM FOR SALADO CREEK WASTEWATER TREATMENT PLANT

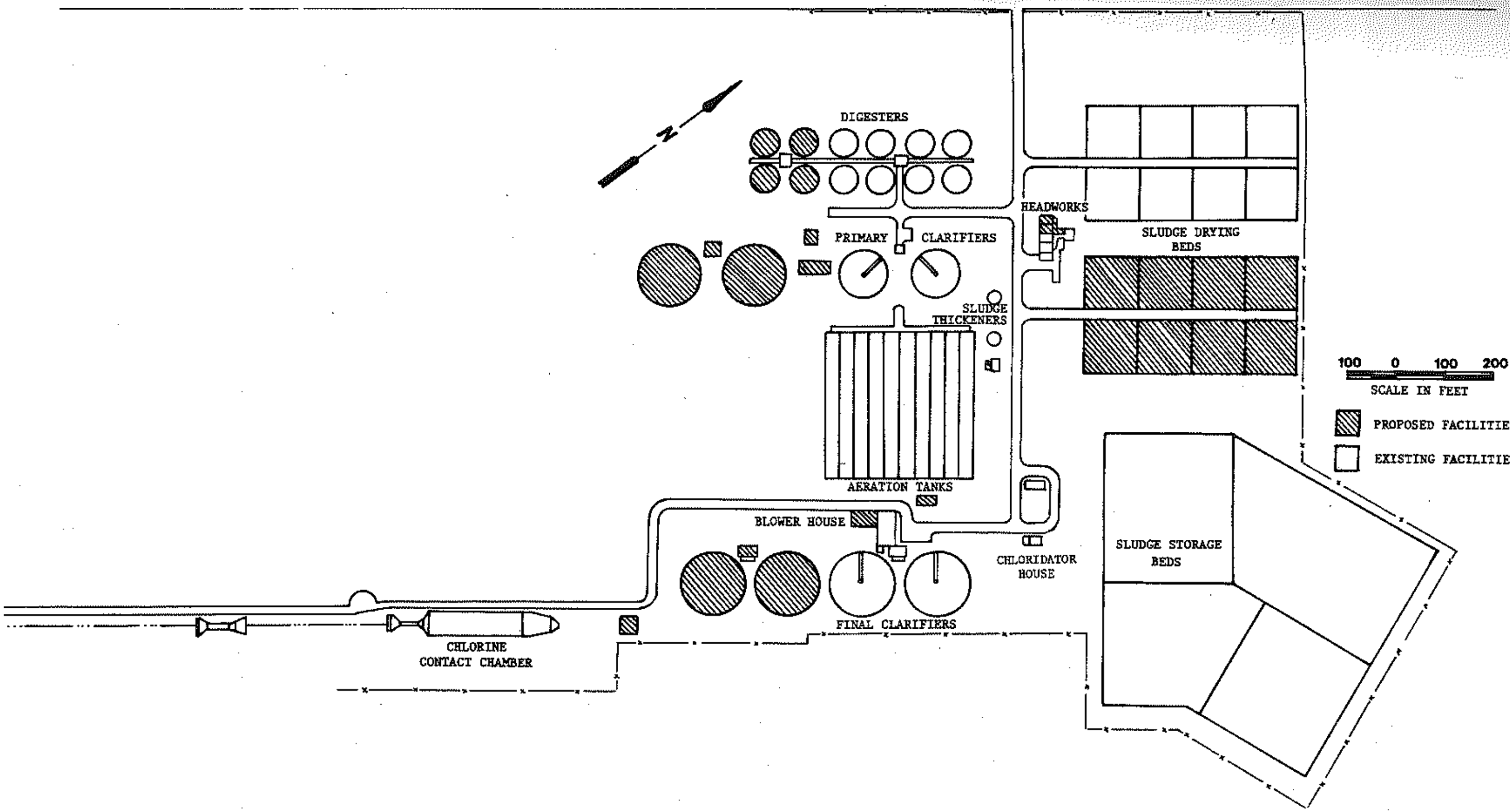


FIGURE 4-7

PROPOSED PLAN FOR SALADO CREEK WASTEWATER TREATMENT PLANT WITH IMPROVEMENTS responsibilities of construction workers will include similar skills as required for the construction of the Confluence plant.

The construction of the new facilities will require an additional 15 acres. Excavation at the site will average approximately 10 feet with maximum depths of approximately 25 feet. Equipment necessary for construction includes bulldozers, backhoes, cranes, front end loaders, air compressors, graders, a trenching machine, and trucks (LO-228).

Neither the existing facilities nor any proposed additions are located in the floodplain and no flood protection will be provided. However, some diking will be required along the perimeter of the spray irrigation area. No additional R-O-W is required for plant access and no significant construction phasing is anticipated (LO-228).

The Salado Creek plant currently employs 17 personnel for operation and maintenance. However, the operation of the plant requires additional personnel (who will be located at the new Confluence plant) for administrative, laboratory, clerical, and maintenance operations. Thus, a total staff of 37 personnel at the two locations will be required to operate the improved and expanded facility. These personnel should include three for supervisory duties, two for clerical work, nineteen for plant operation, seven for maintenance, three for laboratory work, and three for yard work. A staff of approximately 22 personnel will be required for weekdays, six for weeknights, and nine for weekends (LO-228).

Annual electrical energy consumption will approximate 10,800 megawatt hours at the design flow. Materials required to operate the facilities will include makeup sand for the sludge drying beds, maintenance supplies, and equipment replacement parts.

Traffic to and from the facility will approximate 75 vehicles per day (LO-228).

4.4 Leon Creek Plant

The Leon Creek plant will be improved and expanded from 24.0 MGD to 35.0 MGD to provide a secondary level of treatment and to produce an effluent quality suitable for tertiary treatment at the proposed new Confluence plant. The existing unit processes will be used to the extent possible.

The improved and expanded Leon Creek plant will provide preliminary treatment (bar screen, grit removal, and flow monitoring), primary treatment, activated sludge, and intermediate clarification. The existing aeration facilities provide a blower capacity of 36,000 cfm. An additional capacity in excess of 15,000 cfm will be provided to ensure sufficient aeration and adequate reserve capacity.

Disinfection will no longer be necessary at this plant. However, small amounts of chlorine will be required to control sludge bulking in the activated sludge units (LO-229).

Secondary treated effluent will be transferred by pipeline to the new Confluence plant for tertiary treatment and the final effluent will be discharged to the San Antonio River. The estimated concentrations of pollutants through each of the unit processes within the Leon Creek facility is provided in Table 4-3. Secondary effluent transferred to the Confluence facility will contain a BOD_5 concentration of 15 mg/ℓ, a total suspended solids concentration of 20 mg/ℓ, and an ammonia-nitrogen concentration of 17 mg/ℓ. A schematic and flow diagram of the existing Leon Creek facilities and proposed improvements are shown in Figure 4-8.

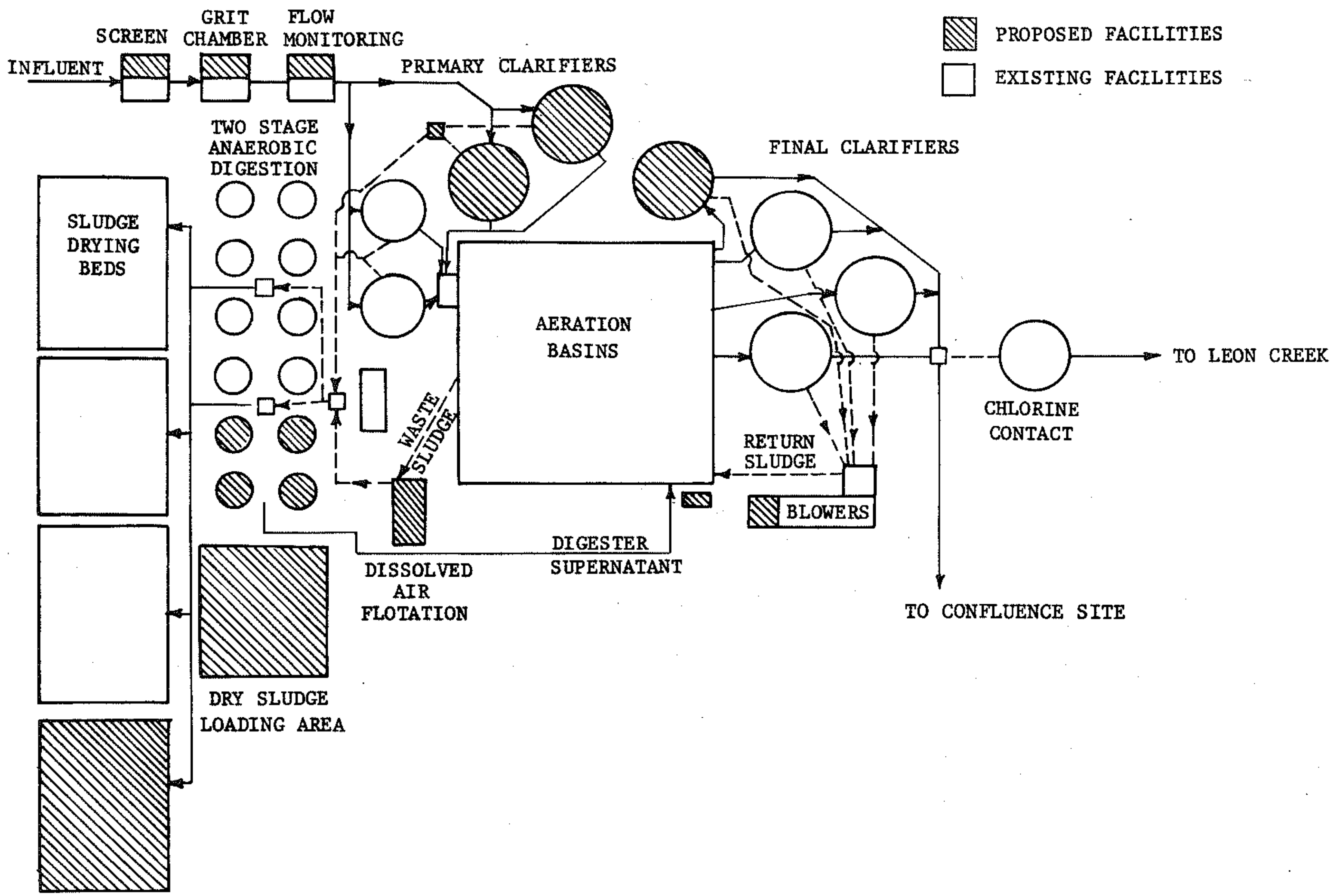


FIGURE 4-8

SCHEMATIC OF LEON CREEK FACILITY WITH PROPOSED IMPROVEMENTS

FIGURE 4-8

SCHEMATIC OF LEON CREEK FACILITY WITH PROPOSED IMPROVEMENTS

TABLE 4-3.

CONCENTRATIONS OF POLLUTANTS THROUGH THE PROPOSED IMPROVED AND EXPANDED LEON CREEK FACILITY

	Pollutants		
	BOD_5 (mg/l)	TSS (mg/l)	NH_3-N (mg/l)
Influent	180	170	17
Preliminary Treatment	180	170	17
Primary Treatment	125	85	17
Activated Sludge	15	20	17

Auxiliary power will be provided at the Leon Creek plant with the installation of an additional transmission line from a utility substation different from the one currently servicing the plant. No on-site backup generators are included in the proposed improvements.

Significant odor problems do not currently exist at the Leon Creek site and none are anticipated. Therefore no definitive odor control measures are planned with the proposed improvements. Potential odor sources which may be identified include the plant headworks (if influent wastewater is septic) and the sludge handling facilities.

Blower motors for the aeration facilities constitute the major source of noise. Noise levels range from 78 to 86 dBA and depend on the distance of the measurement from the source. The additional blower motors required are not expected to increase the noise levels significantly and no control measures are proposed (LO-229).

The estimated hydraulic profile through the plant is provided in Figure 4-9. The water surface elevation in the preliminary treatment facilities will be approximately 540.4 feet MSL and the water surface elevation in the intermediate clarifiers will be approximately 533.0 feet MSL (LO-229).

Waste activated sludge will be thickened using either the recently installed centrifuges or a new dissolved air flotation process if the existing centrifuges fail to work properly. The city is presently having problems with the centrifuges, and they may have to be replaced with more reliable dissolved air flotation units. If dissolved air flotation thickeners are required, approximately 70 pounds per day of polymer will be used to enhance sludge handling. Thickened waste activated sludge will be combined with primary sludge and stabilized using a two-stage anaerobic digestion process. Stabilized sludge will be air dried on sand drying beds and will be distributed to local residents or to a contractor for land application. Consideration is also being given to the possibility of using any excess dried sludge for sanitary landfill cover. Digester supernatant will be returned to the reaeration basin. The existing anaerobic digesters and sand drying bed will be used to the extent possible, but additional facilities will need to be constructed (LO-229). A site plan for the existing Leon Creek plant with the proposed expansion and improvements is given in Figure 4-10.

Construction of the proposed improvement and expansion will require an average of approximately 50 workers over a one-year period. However, some improvements may be constructed in stages which would extend the period of construction. Job responsibilities of construction workers will include similiar skills as required for the construction of the Confluence plant.

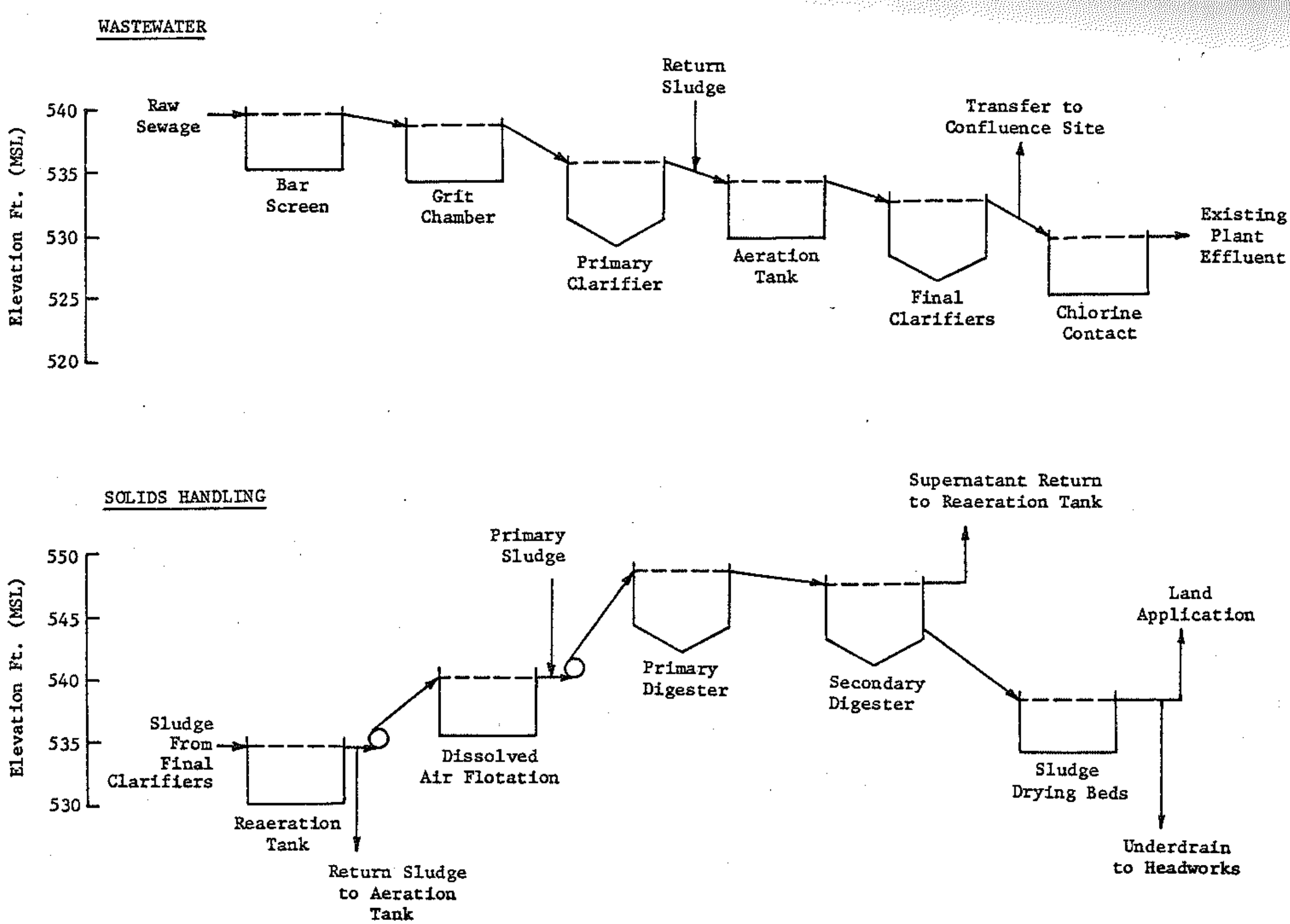


FIGURE 4-9

SCHEMATIC OF HYDRAULIC FLOW DIAGRAM FOR LEON CREEK WASTEWATER TREATMENT PLANT

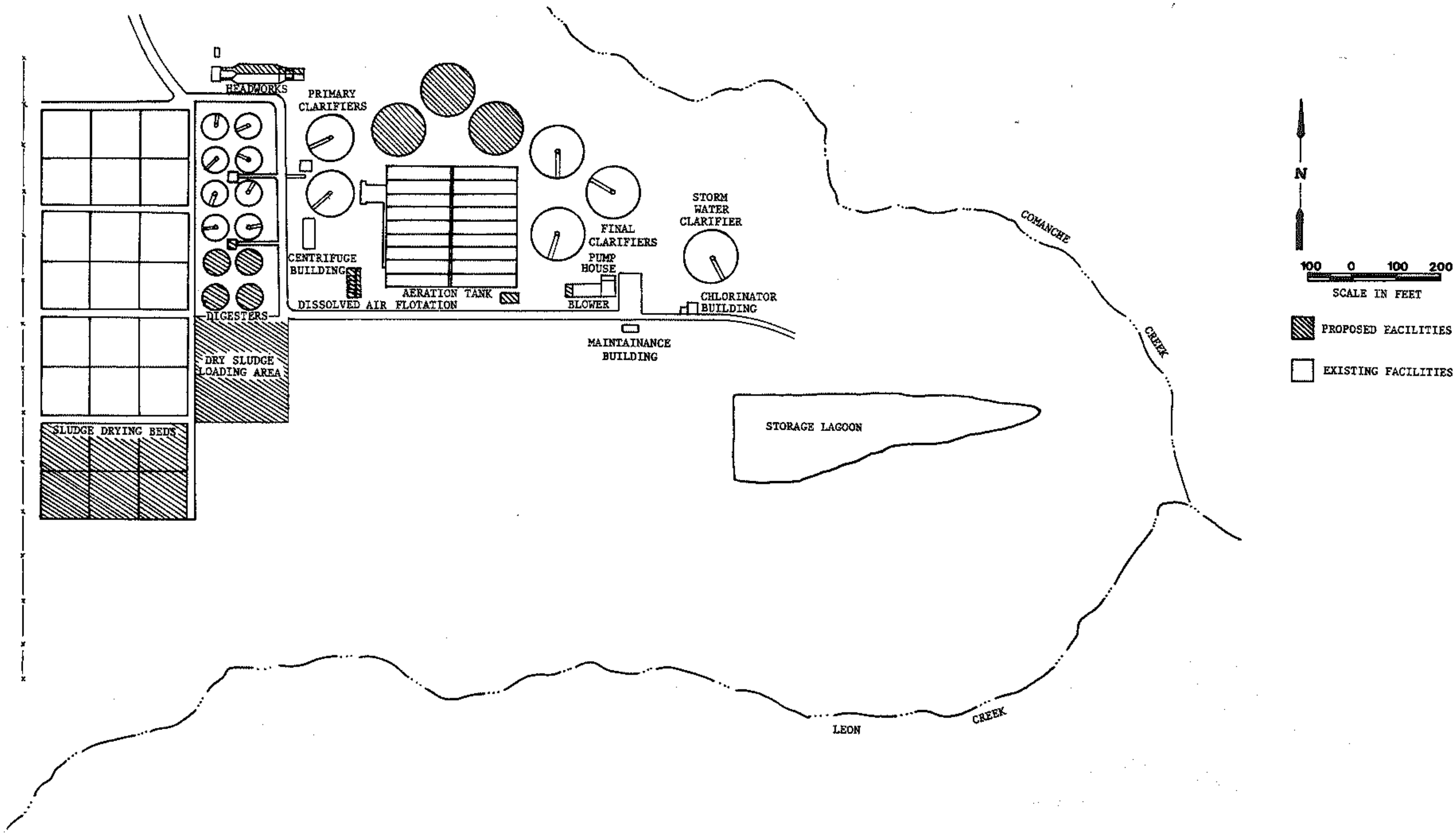


FIGURE 4-10

PROPOSED PLAN FOR LEON CREEK WASTEWATER TREATMENT PLANT WITH IMPROVEMENTS

FIGURE 4-10

PROPOSED PLAN FOR LEON CREEK WASTEWATER TREATMENT PLANT WITH IMPROVEMENTS

The construction of the new facilities will require an additional 12 acres. Excavations at the site will average approximately 10 feet with maximum depths of approximately 25 feet. Equipment necessary for construction includes bulldozers, backhoes, cranes, front end loaders, air compressors, graders, a trenching machine, and trucks (LO-229).

Neither the existing facilities nor any proposed additions are located in a floodplain, and no flood protection will be provided. No additional R-O-W is required for plant access and no significant construction phasing is anticipated. However, construction of the additions to the sludge handling facilities could possibly be delayed until the latter part of the design period when sludge volumes warrant these additions (LO-229).

The Leon Creek plant currently employs 19 persons for operation and maintenance. However the operation of the plant requires additional personnel for administrative, laboratory, clerical, and maintenance operations who are located at the Rilling Road plant. A complete staff of 36 personnel will be required to operate the improved and expanded facility. These personnel should include three for supervising, two for clerical work, nineteen for plant operation, six for maintenance, three for laboratory work, and three for yard work. A staff of approximately 21 personnel will be required for weekdays, six on weeknights, and nine on weekends (LO-229).

Annual electrical energy consumption will approximate 10,300 megawatt hours at the design flow. Materials required to operate the facilities will include makeup sand for the sludge drying beds, maintenance supplies, and equipment replacement parts. Traffic to and from the facility will approximate 75 vehicles per day (LO-229).

4.5 Transfer Lines

The proposed action will require the construction of three major transfer lines to transport wastewater from the three existing treatment facilities to the proposed new Confluence facility. Raw wastewater will be transferred from the abandoned Rilling Road plant site while secondary treated wastewater will be transferred from both the Salado Creek plant and the Leon Creek plant. Tentative route locations for these transfer facilities are shown in Figure 4-1. It is likely that these routes will change somewhat when they are surveyed.

Transfer of raw wastewater from the abandoned Rilling Road plant will require a 90-inch diameter pipe extending approximately 40,500 lineal feet. Construction of the line will occur over approximately two and one-half years and will result in temporary disturbance to approximately 190 acres. Excavation depths will average approximately 21 feet with maximum depths of 30 feet.

Transfer of secondary treated wastewater from the Salado Creek facility will require the construction of a 66-inch diameter pipe extending approximately 15,800 lineal feet. Construction of this line should be complete within one year and will cause temporary disturbance to approximately 75 acres. Excavations depths will average approximately 25 feet with maximum depths of 40 feet.

Transfer of secondary treated wastewater from the Leon Creek facility will require the construction of a 72-inch diameter pipe extending approximately 36,000 lineal feet. Construction of this line will occur over a two year period and will cause temporary disturbance to approximately 135 acres. Excavation depths will average approximately 22 feet with maximum depths of 34 feet (LO-230).

Construction of each of the proposed transfer lines will require the employment of approximately 50 workers at any one time. Job responsibilities will range from skilled to unskilled and will include laborers, equipment operators, welders, and mechanics. Equipment required for the construction of each transfer line will include 6 scrapers, 1 backhoe, 3 bulldozers, 2 blades, 1 crane, and several trucks and pickups. No phasing of construction activities is anticipated (LO-230).

4.6 Collection System

A preliminary description of the proposed collection system improvements and extensions is presented in Planning Area and Collection System Studies, Interim Report, San Antonio 201 Facilities Planning Area C-48-1211-01-0 and C-48-1279-01-0, dated February, 1977 (PA-275). The nomenclature of the lines on the improvements has been revised since that report, and the revised version is used here. Only a brief summary of these proposed improvements will be presented in this chapter as a part of the selected course of action. The collection system improvements are divided into three major categories for discussion. These include proposed relief lines, proposed system extensions and proposed internal collection systems for unsewered areas. A map showing the locations of the collection system improvements is presented in Figure 4-11. This map indicates the best estimate presently available for the routes of the lines. It is likely that some of the routes will change when detailed engineering studies are undertaken. Detailed descriptions of the proposed routes are contained in the Technical Reference Document (RA-R-420). Collection system rehabilitation projects will be developed after the completion of the Sewer System Evaluation Survey, which is presently in progress.

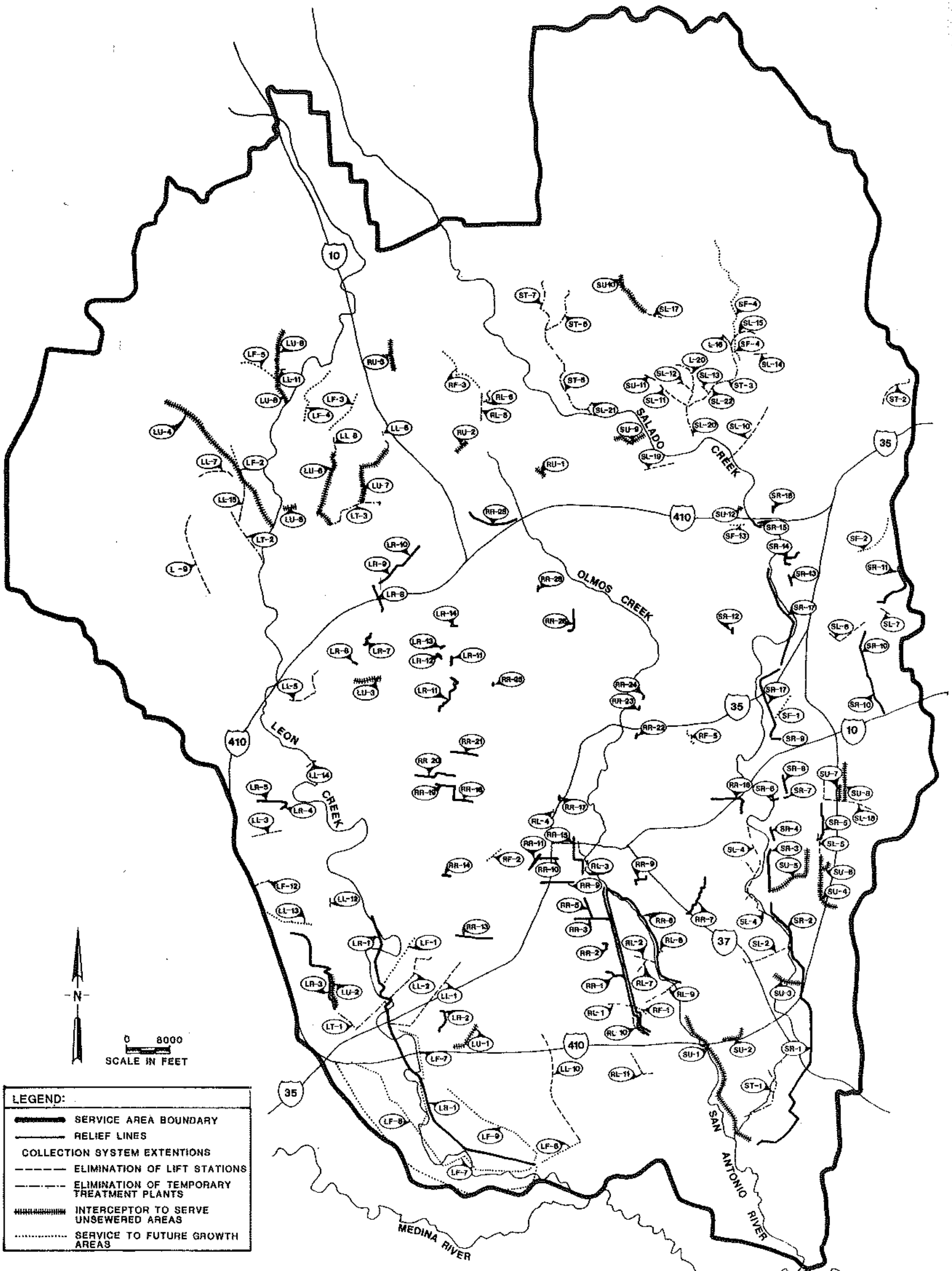


Figure 4-11

LOCATION OF PROPOSED COLLECTION SYSTEM IMPROVEMENTS

02-2812-3

A few of the proposed projects are presently listed by the City of San Antonio as possibly being funded by sewer revenue bonds. However, the majority of the proposed projects are presently unfunded. There are two funded projects listed in the Rilling Road Service area, five in the Leon Creek service area and four in the Salado Creek service area.

4.6.1 Relief Sewer Lines

The proposed relief lines are necessary to alleviate surcharging and/or overflowing of existing lines within the 201 Planning Area. Preliminary studies indicate that 59 relief line projects involving approximately 280,000 feet of line are required to overcome deficiencies associated with 80 separate line segments. In the Rilling Road service area, 28 projects are proposed to relieve 39 undersized line segments. Four of the projects involve increasing the capacity of existing siphons* and one project, in addition to relieving an undersized line segment, eliminates three lift stations. This project also eliminates the Hart Avenue stormwater clarifier and provides service to an unsewered area. Fourteen relief line projects are proposed to relieve 23 undersized line segments in the Leon Creek service area. A major portion of the approximately 80,700 feet of relief line required in this service area is involved in the outfall line from south of Kelly Air Force Base to the Leon Creek regional treatment plant. In the Salado Creek service area, 17 projects are proposed to relieve 18 undersized line segments. One project is proposed to increase the capacity of an existing siphon. The total length of relief lines in this area is approximately 112,600 feet.

---

* Any dip or sag introduced into a sewer to pass under structures encountered, such as conduits or subways, or under a stream or across a valley, is termed an inverted siphon. It is misnamed, for it is not a siphon; and the term "depressed sewer" has been suggested as more appropriate. Since the pipe constituting the inverted siphon is below the hydraulic grade line, it is always full of water under pressure although there may be little flow in the sewer.

4.6.2 System Extensions

The proposed collection system extensions include those improvements to the City of San Antonio's regional trunk main system which are needed to eliminate temporary treatment plants and lift stations. In addition, system extensions will provide outfall mains to existing unsewered areas and future growth area.

The nine proposed projects to eliminate existing temporary treatment plants total approximately 72,000 feet of sewer main. Three of these projects are in the Leon Creek service area and will eliminate the need for the Indian Creek, Concord, and Cinnamon Creek treatment plants. Proposed extensions in the Salado Creek service area will eliminate the Encino Park, Southton, Hidden Valley, Canyon Creek Country Club, Canyon Oaks Mobile Home, and Monaco treatment plants as well as Lift Station #65.

Forty-four projects are proposed to eliminate 59 of the 68 lift stations in the 201 Planning Area. The nine remaining lift stations will be eliminated by other types of improvements. These proposed main extensions total approximately 233,100 feet. Sixteen lift stations are to be eliminated by 14 projects in the Leon Creek service area, which will require approximately 83,700 feet of sewer main extension. Within the Rilling Road service area, 11 proposed projects with approximately 41,400 feet of sewer mains will eliminate 17 lift stations. The nineteen projects proposed in the Salado Creek service area will require approximately 108,000 feet of sewer main extension to eliminate 26 lift stations.

In the Leon Creek service area there are eight proposed projects to extend service to nine unsewered areas. One project also provides service to two adjacent unsewered areas. No extension is required for one unsewered area since service can be provided from existing mains. The required extensions will total approximately 71,000 feet. Three projects will provide service to the unsewered areas located in the Rilling Road service area and will require approximately 9,500 feet of extensions. Two unsewered areas are located adjacent to existing outfall mains and, therefore, require no extensions. Within the Salado Creek service area, 12 proposed projects to serve unsewered areas will require approximately 68,000 feet of main extension. Two other unsewered areas are located adjacent to existing outfall mains. Included in the above totals are the proposed extensions to serve the Grey Forrest 201 Planning Area, Tradesmen North Industrial Park and the Hollywood Park 201 Planning Area.

Nineteen extensions that require approximately 203,600 feet of main extensions are proposed to serve future growth areas within the study area. Eleven projects proposed for the Leon Creek study area will require approximately 156,000 feet of main extension. Four projects totaling approximately 14,300 feet are proposed for the Rilling Road study area. Four projects are also proposed for the Salado Creek area. These projects will require approximately 33,000 feet of main extensions to serve future growth areas.

4.6.3 Internal Collection Systems for Unsewered Areas

In providing service to unsewered areas, the internal collection system for the area must be considered as well as the outfall main. Internal collection systems were estimated on an acreage basis using a typical line size of eight inches. Proposed projects include internal systems for eight unsewered areas within the Leon Creek service area, five within the Rilling Road service area and 14 within the Salado Creek service area. Internal systems were not proposed for the Cities of Hollywood Park and Grey Forrest.

5.0 ENVIRONMENTAL EFFECTS OF THE PROPOSED ACTION AND MITIGATIVE MEASURES FOR ADVERSE EFFECTS

The proposed action described in Chapter 4 has been analyzed to determine the impacts on the existing environment, which was described in Chapter 2. Both the primary and secondary impacts as well as the short-term and long-term impacts are delineated in this chapter. Some of the impacts described in this chapter, including primary water quality impacts and numerous secondary impacts related to the growth of the San Antonio area, address conditions that will prevail only at the end of the 20-year design period. Initial operational impacts will be considerably less than these ultimate conditions, but they will gradually increase to the level of effect described herein.

Impacts are discussed for each environmental parameter or category discussed in Chapter 2, and both beneficial and adverse effects are considered. Value judgements have been avoided to maintain objectivity, but some impacts have been assessed primarily on the basis of professional judgment in the absence of definitive information. On the other hand, some impacts have been evaluated using quantitative or semi-quantitative methods, and some have been assessed by using a data base that is too detailed to incorporate into the Draft EIS. These supplementary descriptions data, concept formulations, and rationale which were generated by the evaluation process are included in the Technical Reference Document (RA-R-420).

For those unavoidable adverse effects that require mitigation, appropriate measures are discussed in this chapter. Some of the impacts delineated will not be accompanied by mitigative measures because the impacts are not adverse enough to warrant mitigation or because the severity of the impact is not sufficient to justify the cost of mitigation.

In general, five major components of the proposed action are evaluated for environmental impact. These components are the sewage collection system, the expansion and operation of the Leon Creek sewage treatment plant, the expansion and operation of the Salado Creek plant, the construction and operation of the Confluence plant, and the emplacement of the sewage transfer lines from the Leon Creek and Salado Creek plants to the new Confluence plant. The general impacts of the collection system are summarized from a preliminary, line-by-line environmental evaluation that was conducted in the early phases of the project. This line-by-line evaluation is given in the Technical Reference Document (RA-R-420). The nomenclature of the sewer lines has been changed since the evaluation was made, and several new lines were added. However, the added lines are all in the same areas as the original lines, so no differences in overall environmental impact as described in this chapter were found when these new lines were examined.

5.1 Natural Environment

The natural environment is composed of those areas of the total environment that are external to man and his social organization. For consistency with Chapter 2, impacts of the proposed action upon the natural environment are presented in two major components -- physical and biological.

5.1.1 Physical Components

5.1.1.1 Climate

Climate is a large-scale, relatively immutable aspect of the environment that may in the long term be susceptible to the total influence of man's activities, but it is not subject to change by local projects such as the proposed action under consideration in this EIS. No climatic impacts are anticipated to occur as a result of the proposed action.

5.1.1.2 Odor and Airborne Pathogens

This section addresses the community impact of potential odors, airborne bacteria, and viruses emitted from components of the proposed action. Analysis of impacts will center on the treatment plants, collector system, and transfer lines. No adverse impact is anticipated from the improvement and rehabilitation of the collection system.

A. Collection System Improvements and Rehabilitation

The rehabilitation of the existing collection system should have substantial benefit with regard to odor impacts. Extension of the collector system into new areas at the northern end of the system will have mixed benefits. A slight benefit will result in the northern part because the extensions will allow retirement of several temporary facilities which may at times be sources of odor nuisance. The negative impacts of the extensions will occur at the lower end of the system nearest the treatment plants. Additional raw sewage will be traveling greater distances, thereby increasing the possibility that odors such as hydrogen sulfide (H_2S) will be formed in the lines. These odors may at times escape through manholes in the lower part of system and at the entrance to the Salado, Leon, and Confluence site treatment plants. These aspects will be discussed further below under impacts associated with the transfer lines.

B. Confluence Site Wastewater Treatment Plant

Replacement of the Rilling Road plant with the Confluence site plant will have a substantial benefit for two basic reasons. First, the existing odor sources at the Rilling plant will be eliminated, and second, the new plant will be well operated. The Rilling transfer line will connect the existing Rilling service area to the new Confluence plant. Analysis of odor impacts from this line are considered in a subsequent paragraph. The new Confluence plant will have two potential odor sources: pretreatment and sludge handling facilities. The pretreatment facilities will be controlled through pre-aeration of influent raw sewage and removal of screenings and waste grit. The anaerobic digesters under normal operations are not appreciable sources of hydrogen sulfide, ammonia, and other malodorous gases.

During operation of the Confluence plant, as well as the two other regional wastewater treatment plants, the city will undertake routine odor control measures. These measures will not be defined until the final designs are completed in the Step 2 program, but may include the use of masking agents, covers, and gas scrubbers for the major odor-producing unit processes at the plant.

The community impact of any odor emissions from the Confluence plant will be low due to its rural location. A study of wastewater treatment plant odors has concluded that the greatest possibility for adverse odor impacts occurs within one mile (1.6 km) of the plant (EN-485). The 1975 population of the area within one mile of the Confluence site is estimated to have been 542 (SA-310). The nearest residence is over 2000 feet from the planned facility boundary. The rural location of the plant will mean that the vacant area surrounding the plant will act as a buffer, and the overall odor impacts will be small.

C. Salado Creek and Leon Creek Plants

The upgrading of these two facilities should not alter the presently low odor impacts. Only two potential odor sources have been identified for these facilities -- the raw sewage entering at the headworks and the sludge drying beds. Raw sewage traveling down the Leon and Salado collector systems usually does not turn septic (odor producing) as in the larger Rilling collector system. Therefore, odors at the headworks are negligible. The sludge drying beds under normal operation are also only a minor source of odors. The rural location of both these plants also is a benefit to continued low community odor impacts. Spray irrigation of digested sludge at the Salado Creek Plant is a potential source of pathogenic bacteria and viruses. This potential is low due to the low level of these organisms generally present in digested sludge.

D. Leon, Salado, and Rilling Transfer Lines

The Leon and Salado transfer lines will carry only secondary treated effluent. No odor sources should be associated with these lines. The Rilling line will carry untreated sewage. The current problem of septicity at the entrance to the Rilling Road Plant will be shifted down the transfer line to the new Confluence plant. The estimated maximum travel time for sewage in the Rilling service area to the new plant site is 26 hours (LO-230). If travel times are greater than 24 hours, raw sewage may become septic and malodorous. An adverse impact may therefore occur from odors escaping from manholes along the transfer line. The portion of the line which traverses the existing pipeline route from the Rilling plant to Mitchell Lake may adversely affect the neighboring residential area. More likely though, odors will not escape until the raw sewage reaches the headworks of the new Confluence plant. The City will consider several options to reduce the odor impact of the Rilling-to-Confluence transfer line, including pre-chlorination, but the final decision will not be made until the Step 2 program. Because of the rural location of the Confluence plant, any odors generated at the headworks will not have an impact as severe as the impact at the present Rilling Road plant.

5.1.1.3 Air Quality

This section will analyze the primary and secondary air pollution impacts from the following components of the proposed action: (1) collection system expansion and improvements, (2) the Leon Creek wastewater treatment plant, (3) the Salado Creek wastewater treatment plant, (4) the Confluence site wastewater treatment plant, and (5) the Rilling, Leon, and Salado sewage transfer lines. The six criteria air pollutants will be addressed. The impact of airborne gaseous contaminants which may cause community odor problems was discussed in the preceding section.

Primary impacts could potentially occur during two phases for each component -- construction and operation. During operation, no emissions are expected from any components except the treatment plants. The possible sources of emissions at the treatment plants include vehicles, small engines, and possibly large engines that would be used in the event of power failure. These emissions are expected to be negligible.

Each of the five components will have air pollutant emissions during construction. The combustion emissions will occur from gasoline- and diesel-powered construction equipment. These emissions, which will consist of particulates, sulfur oxides, nitrogen oxides, carbon monoxide, and hydrocarbons, will have a small, short-term impact on air quality.

The level and impact of fugitive dust emissions may be more severe. The amount of fugitive dust generated is difficult to predict accurately. The EPA has published factors which estimate the amount of dust suspended based on the size of the construction site (EN-071). The factor, 1 ton per acre-month, was developed for large projects such as shopping centers, subdivisions, etc. It is probably more applicable to construction activities at the treatment plant sites than to the collector system routes. The estimated dust emissions presented below should be considered as conservative, i.e., as maximum amounts that may be generated under worst-case conditions.

The collector system extensions and improvements will total between 900,000 and 1,000,000 lineal feet. Assuming an average 75-foot right-of-way and a construction rate of 75 lineal feet per day, the following equation can be used to predict the amount of dust that will be generated.

$$D_t = (F)\ (A)\ (t) \qquad (1)$$

where:

F = Factor (1 ton/acre-month - 0.033 ton/acre-day)
A = Area (acres) disturbed in one day
t = Time (days)

The area disburbed in one day is a 75-foot square, which is equivalent to 0.13 acres. The number of days that the disturbance will continue is as follows:

$$t = \frac{950{,}000 \text{ ft}}{75 \text{ ft/day}} = 12{,}670 \text{ days}$$

By substituting into equation (1), the following results are obtained:

$$D_t = \left[.033 \ \frac{\text{ton}}{\text{acre-day}}\right]\left[0.13 \text{ acres}\right]\left[12{,}670 \text{ days}\right] = 55 \text{ tons}$$

Thus a total of 55 tons of dust will likely be generated during the collection system improvement program. This amount of dust should, over the 20-year life of the project, have negligible impact on the study area. Short-term localized nuisance may be caused by construction near residential areas.

The construction activities required for the emplacement of the Rilling, Leon, and Salado transfer lines will also generate fugitive dust. The 40,500 lineal feet (approximate) required for the Rilling transfer line may generate approximately 6.3 tons of dust over the entire construction period. This assumes the construction area to be 190 acres (LO-230) and construction will proceed at 75 lineal feet per day. For the Leon transfer line, approximately 36,000 lineal feet and 135 acres of construction may generate 4.5 tons of dust. For the Salado transfer line, approximately 15,300 lineal feet and 75 acres of construction may generate 2.5 tons of dust. Impact of these emissions will be short-term and minor as described above.

The construction at the three wastewater treatment plants may generate appreciably more dust. Construction at the Leon plant will involve 12 acres for a period of 12 months (LO-229). Assuming that only 1/3 of the site will be undergoing construction activity during any month, dust generation may total 48 tons. Construction at the Salado plant will involve 15 acres for 12 months (LO-228). Again, assuming 1/3 of the total acreage for any one period yields approximately 60 tons of dust. The Confluence wastewater treatment plant will involve a 100-acre construction site over a 3-year period (LO-231). Without controls, the total dust generated may be up to 400 tons per year or 1200 tons over the 3-year period. Because part of the Air Quality Control Region in which San Antonio is located has been classed as "non-attainment," it is possible that the Texas Air Control Board may require that dust prevention measures be taken at the wastewater treatment plant sites. However, the regulations are still in process of interpretation, so it is not known if these measures will be required. The impact of controlled emissions will be small due to the fact that each plant is in a relatively rural area, away from residential centers.

Another possible source of fugitive dust during construction of the treatment plants will be that generated by fast-moving haul trucks and other earth-moving equipment. Speed control restrictions will be imposed on the operators of this equipment, and this additional dust source is expected to be minor.

Secondary growth-related air quality impacts of the proposed action are moot in that presently the study area is designated non-attainment for both particulates and oxidants (TE-322). The actual spatial residential development patterns caused by or attendant to collection system improvements and the location of the new treatment plant will not in themselves cause more serious air quality problems than currently exist. Until the reasons for current air quality violations are more clearly understood, the secondary impact of the proposed action cannot be determined.

5.1.1.4 Noise

This section describes the methodology and criteria for noise impact assessment and the expected impact of noise associated with implementing the proposed action. Additional details of the methodology used and the results of analysis of noise impacts are given in the Technical Reference Document (RA-R-420).

A. Methodology and Criteria

Criteria for assessment of noise impacts was based upon EPA's "levels" document, "Information on Levels of Noise

Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety" (EN-108). This was selected because the State of Texas does not have an in-place noise regulation and the City of San Antonio municipal noise ordinance specifies "nuisance" factors only, not quantitative acoustical criteria. Also, EPA criteria are generally accepted as a good predictor of human response to noise of the type expected from construction of the collection system and treatment plants and from the operation of the treatment plants. The EPA criteria include consideration of noise as a possible adverse effect by including health and welfare factors that affect such aspects of health as spoken communication, sleep disturbance, and hearing hazards.

The "levels" document recommends the use of Table 5-1 as a general indicator of the threshold at which human annoyance begins to occur.

TABLE 5-1

SOUND LEVELS REQUIRED TO PROTECT PUBLIC HEALTH AND WELFARE

EFFECT	LEVEL	AREA
Hearing Loss	$L_{eq(24)} \leq 70$ dB	All Areas
Outdoor activity interference and annoyance	$L_{dn} \leq 55$ dB	Outdoor and residential areas, farms and other outdoor areas where people spend widely varying amounts of time, and other places in which quiet is a basis for use.
	$L_{eq(24)} \leq 55$ dB	Outdoor areas where people spend limited amounts of time such as school playgrounds, etc.
Indoor activity interference and annoyance	$L_{dn} \leq 45$ dB	Indoor residential areas.
	$L_{eq(24)} \leq 45$ dB	Other indoor areas with human activities such as schools, etc.

Source: EN-108

L_{eq} = The 24-hour sound level equivalent

L_{dn} = The long-term equivalent A-weighted sound level that is the basis for prediction of effects on humans. The A-weighted sound level (expressed dBA) is a measure that approximates human hearing response.

Note that L_{dn} = 55 dB and L_{eq} = 55 dB are values that apply to outdoor areas that are most likely to be impacted by construction of the collection system and wastewater treatment plants. The values of this table should be taken as general guidelines; areas particularly sensitive to noise (such as schools, hospitals, places of worship, etc.) will be examined on a case-by-case basis.

To forecast the expected response of humans to noise of various levels and times of exposure, the criteria of Figure 5-1 were used. Basically, the figure illustrates that L_{dn} = 55 dB or less will not likely initiate overt response by humans. Levels in excess of 65 dB can be expected to cause considerable organized reaction.

The effects of noise upon wildlife and domestic animals are not well understood. Studies of animals subjected to varying noise exposures in laboratories have demonstrated physiological and behavioral changes, and it may be assumed that these reactions are applicable to wildlife. However, no scientific evidence currently correlates the two. It is known that large animals adapt quite readily to high sound levels. Conversely, it has been demonstrated that loud noise disrupts brooding in poultry and, consequently, can affect egg production.

The major effect of noise on wildlife is related to the use of auditory signals. Acoustic signals are important for survival in some wildlife species. Probably the most important effect is related to the prey-predator situation. An animal that relies on its ears to locate prey and an animal that relies on its ears to detect predators are both impaired by intruding noise. In addition, the reception of auditory mating signals could be limited, and reproduction could be affected. Distress or warning signals from mother animals to infants (or vice versa) or within groups of social animals could be masked and such

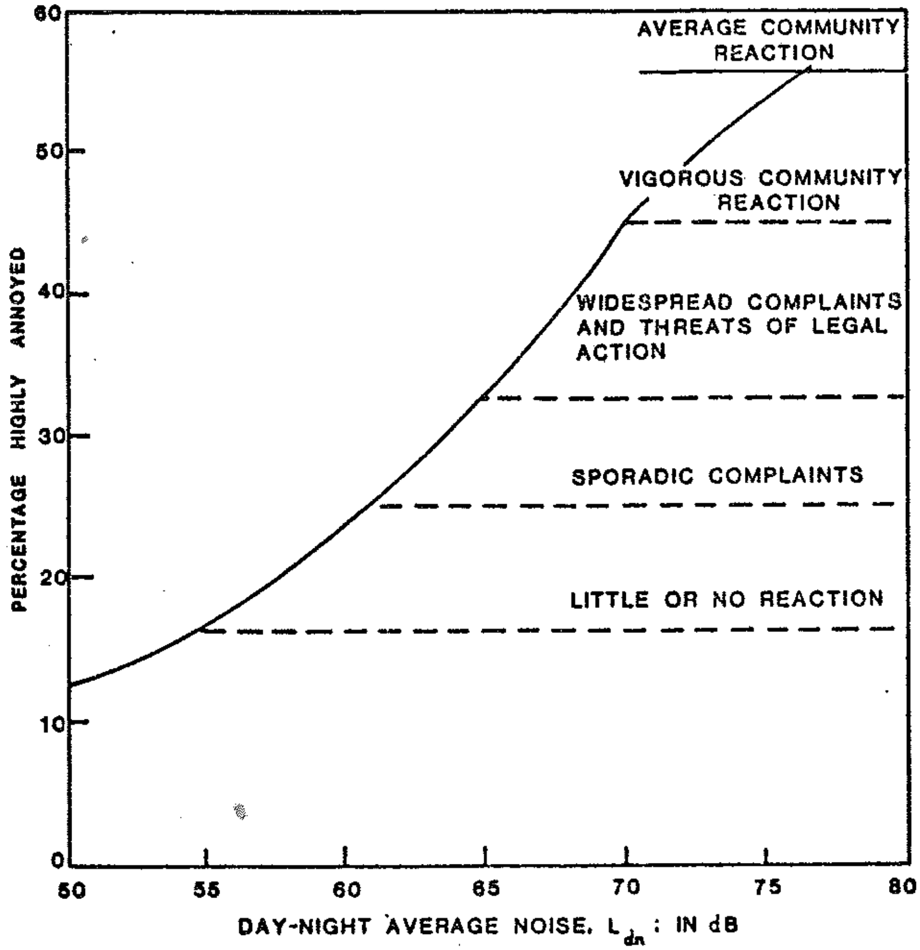


FIGURE 5-1
EXPECTED COMMUNITY RESPONSE TO VARIOUS LEVELS OF NOISE

Source: Based on EN-108

masking could lead to increased mortality. There are suggestions that short-term high noise levels may startle wild game birds and stop the breeding cycle for an entire season (ME-050).

B. Impacts

Short-term noise is caused by activity of construction equipment along and near collectors and at each STP location. To ascertain possible adverse effects from this activity, the complement of construction equipment outlined in Chapter 4 was used. Based on the radiated sound pressure level of each equipment item, predictions were made using standard acoustical field equations and assuming worst-case mitigating factors such as a standard day, no attenuating barriers (such as trees) and acoustically-untreated noise sources. This approach yields results that may be considered as a worst-case noise condition and will provide clues about the adverse impact that may be caused.

Construction of a collector requires equipment that is standard in earth-working, hauling, and pipeline machinery inventories. In uninhabited areas, a right-of-way (ROW) is cleared with dozers, and debris is removed with front-end loaders and dump trucks. Crews with chain saws are active for short periods in timbered areas. A ditch digger with a backhoe follows; rock drills and blasting may be required in pavement or hard rock areas. The pipe laying activity requires heavy trucks, cranes, dozers, and other equipment. Essentially these same types of equipment will be required for construction of the STP. Typical sound level spectra for the above equipment items are given in Table 5-2 (BO-054).

Assuming that the construction activity occurs from 8:00 a.m. to 5:00 p.m. and that ambient sound levels are 50 dBA from 5:00 p.m. to 11:00 p.m. and 45 dBA from 11:00 p.m. until

8:00 a.m., the values of L_{dn} in Table 5-2 were computed as a function of distance for each type of equipment and are shown in Table 5-3.

TABLE 5-2

SOUND PRESSURE LEVEL IN dB AT A DISTANCE OF 50 FEET FROM VARIOUS TYPES OF CONSTRUCTION EQUIPMENT

	Frequency (Hz)								
	63	125	250	500	1000	2000	4000	8000	dBA
Dozer (Soil 270 hp)	75	73	80	77	75	72	65	61	77
Dump Truck	73	78	80	75	67	65	58	50	72
Backhoe/Front Loader	73	73	73	73	73	68	62	58	75
Rock Drill	86	94	91	90	93	93	91	89	98
Crane	83	91	88	87	83	77	71	65	86
Concrete Mixer	70	70	70	70	70	63	57	51	72

TABLE 5-3

L_{dn} IN dB AS A FUNCTION OF DISTANCE FROM VARIOUS TYPES OF CONSTRUCTION EQUIPMENT

	Distance from Source (Feet)				
	250	500	750	1000	2000
Dozer	60	56	54	--	--
Dump Truck	56	--	--	--	--
Backhoe	59	55	--	--	--
Rock Drill	81	75	73	70	62
Crane	70	63	60	58	--
Concrete Mixer	57	--	--	--	--

Referring to the criteria of Figure 5-1 and L_{dn} = 55 dB as the threshold value for creating annoyance, it is seen that operation of certain equipment items will be a source of concern at certain distances. These are summarized in Table 5-4.

TABLE 5-4

DISTANCES FROM CONSTRUCTION EQUIPMENT AT WHICH ANNOYANCE OCCURS DUE TO SOUND LEVEL

Equipment Item	Distance (ft.)
Dozer	100
Dump Truck	100
Backhoe	500
Rock Drill	>2,000
Crane	2,000
Concrete Mixer	500

The actual sound levels depend upon ambient duty cycle and the number and mixture of types that are operating simultaneously. In general, however, mild adverse reaction may be expected during development of the ditch at a distance of up to about 700 feet due to noise caused by dozers, backhoes, and trucks. Laying the sewer pipe will cause a more severe impact, since noise from crane operations will dominate the noise field up to 2,000 feet. Where blasting is required, the rock drill operation will be a major noise source causing extreme annoyance up to distances of about 2,000 feet.

Without the presence of human receptors of noise, environmental impact of noise upon human activity will not exist. Construction of major portions of the collector system will take place in populated areas; therefore, many more people will be exposed to this construction noise than construction and operation noise at the treatment plants. Construction noise can be better tolerated by human inhabitants than long-term noise can because of its transient nature. This observation does not preclude the possibility of generating considerable adverse reaction, particularly with the higher noise offenders.

The length of time that such noise intrusion will occur is highly variable, depending upon soil conditions, accessibility, weather, and other factors. Assuming that approximately 1,000 feet of interceptor can be completed in a typical one-month period, the length of time a given group of residents will be affected can be estimated directly. As discussed previously, noise intrusion can be expected to cause adverse human reaction at distances typically up to about 1,000 feet from the center of construction activity. At a completion rate of 1,000 feet per month, such inhabitants could expect noise to be in excess of limiting threshold levels for a total time of six to sixteen weeks.

From field reconnaissance of the proposed line segments, judgments were made concerning the potential adverse effects of noise and the primary reason for these effects. The results of this investigation are given in the Technical Reference Document (RA-R-420). The major conclusion of the investigation is that there should be no major adverse impacts caused by noise from construction of the collection system. Some minor impacts can be expected near park areas and other areas where outdoor activity may be disrupted by construction noise.

The proposed action will cause short-term construction noise generation at the existing Rilling Road, Salado, and Leon Creek plants and the new plant at the Confluence site. Referring to Table 5-4 it is seen that noise from the rock drill and crane operation are the principal noise offenders. The rock drill is not expected to be required for construction so it is not considered a potential source. Operation of the crane will be during normal working hours and could cause annoyance to outdoor activities up to 2,000 feet from its operation. Noise from all construction equipment will be controlled by proper use and maintenance of the equipment, particularly muffling devices.

The potential for noise impacts is not considered serious at any of the locations but is of more concern at the Rilling Road site principally because of interest in the Mission Park district. The construction noise aspect of demolition operations could cause disturbances for visitors at the missions. However, the missions themselves are considerably greater than 2,000 feet from the plant, and intruding noise is expected to be negligible.

Noise from operation of the treatment plant is not expected to cause adverse impacts. Results of measurements (see Chapter 2) illustrate that boundary line noise is well within the threshold levels of annoyance. Upgrading of the Leon and Salado plants will not appreciably increase the noise levels previously measured.

Diffused aeration systems in an acoustically untreated condition can create noise levels at a distance of about 1,000 feet that typically approach 55 dB. Because of the absence of human inhabitants near the Confluence site, no adverse impact is expected.

5.1.1.5 Geology

As noted in Chapter 2, the geology and topography of the San Antonio area are quite complex because of the variety of substrate materials (limestones, clays, sands, and other rock types), the presence of the Balcones Escarpment in the northern part of the area, and the geologic processes that are active throughout the area. Several of these aspects will have an impact on various parts of the proposed action or will be affected by the action.

A. Primary Impacts

The primary impacts of the proposed action are associated with the interceptor and collector system that carries the wastewater to the three existing treatment plants and with the treatment plants and wastewater transfer lines that will be constructed or upgraded as part of the proposed action.

The geologic impacts of the collection system have been analyzed for most of the new line segments. Most segments of the system will not experience adverse impacts. The major geologic impact results from the hard limestone bedrock that occurs in some segments of the collection system in the northern part of the area. Several segments will be emplaced in hard limestones, and rock drilling and blasting will undoubtedly be required during excavation for these segments. The blasting will be of relatively short duration for each individual line segment, however, which reduces the magnitude of the impact. Another geologic factor that could have an adverse impact on the sewer lines is the high shrink-swell potential of some of the clay bedrock units. This factor is also reflected in the soils of the area and is described in the soils section. No adverse topographic impacts were indicated for any of the line segments.

The additional construction that will be undertaken at the Leon Creek and Salado Creek treatment plants also will have minimal adverse geologic impact. The substrate at the two sites is well suited for construction, in that little or no blasting will be required. The strength of the geologic material appears to be adequate to support all of the proposed additional treatment facilities at both sites. Both sites are located on uplands where no geologic processes are present that might cause a hazard to the additional facilities. Operation of the plants will not have any effect on the geologic environment. The topography at both plant sites is well suited for addition of the new facilities.

Little or no adverse geologic impact is expected from the construction and operation of the new plant at the Confluence site. The unconsolidated alluvial terrace substrate should be highly suitable for excavation and construction of the new plant. The only geologic process of concern is the potential flood hazard at the site, which is discussed in the hydrology section of this chapter. No problems are expected for the operation of the plant in the geologic environment of the site. The area where sewage sludge will be stored temporarily before being hauled away by local residents for land application is well suited for this use. The topography is generally highly suitable for construction of a new sewage treatment plant. Sufficient slope is available to provide for the head loss through the plant, and there is a substantial drop from the plant to the discharge point in the river, which should provide for good aeration of the effluent between the plant and the river.

The wastewater transfer lines from the existing plants to the new Confluence plant are expected to have little or no adverse geologic impact. The substrate along the routes of the lines is either mixed sand and clay or alluvial terrace material, so excavation should be easy and blasting will not be required. The lines are generally located on uplands where geologic processes do not present any danger. No problems are expected to be encountered from the topography along the routes of the lines.

B. Secondary Impacts

The most important secondary geologic impacts from the proposed project will be the additional urbanization that will occur during the 20-year timeframe of the project. As noted earlier, the objective of the project is to meet the wastewater treatment needs of the anticipated growth in population as well as to upgrade the quality of the effluent discharged by the City of San Antonio to meet stream quality standards. Most of the anticipated growth will occur in the northern part of the city, with a lesser amount of growth on the west and east sides. A much smaller amount of growth is expected to occur on the south side.

In general, the geologic environment is well suited for urbanization in the areas where most of the urban growth is expected to occur. However, some blasting of the hard limestone substrate will be necessary during site preparation for some homesites in the northern part of the city. Elsewhere in the western and eastern parts of the city, the mixed limestone, clay, and terrace alluvium of the substrate should be relatively easily excavated. Sinkhole areas should be withheld from development to avoid possible structural damage from sinkhole collapse. The potential impact of urbanization on recharge to the Edwards aquifer will be addressed in the ground-water hydrology section of this chapter.

Significant areas having slopes greater than 25% are present in the northern part of the study area where much of the projected growh is expected to occur. These slopes are not unstable, however, and should present no problems for urbanization provided that good land use and construction practices are used. Slopes in excess of 25% are rare in other parts of San Antonio.

5.1.1.6 Soils

The soils in the Bexar County region have highly variable properties, particularly thickness, because of the variability of the geologic substrate parent material. Some of these soils will have a significant impact on parts of the proposed action.

A. Primary Impacts

The impacts of the sewage interceptor and collector system on the soils were analyzed for each new line segment proposed. The most important impact anticipated is the effect of the high shrink-swell soils on the sewer lines. Several segments of the collection system will be placed in soils having high shrink-swell potential. Unless special construction methods are used, the volumetric changes of these soils can cause stresses in the pipeline system that can result in breaks and leaks in the pipes.

Any disruption of prime farmland soils caused by emplacement of the collection system will be restricted to the relatively narrow pipeline right-of-way and would be limited to a single growing season at most. Once the pipeline is in place, the agricultural productivity of the soil will be restored.

The addition of facilities at the Leon Creek and Salado Creek treatment plants will have impacts on prime farmland soils. At the Leon Creek plant, the soils that will be disturbed and removed from potential productivity are as follows:

Lewisville silty clay, 0 to 1 percent slope
Lewisville silty clay, 1 to 3 percent slope
Frio clay loam

At the Salado Creek site, the following soils will be affected:

Willacy loam, 1 to 3 percent slope
Karnes loam, 3 to 5 percent slope
Venus clay loam, 0 to 1 percent slope
Venus clay loam, 1 to 3 percent slope

All of these soils except the Karnes loam have been classed as prime farmland soils by the USDA Soil Conservation Service (TH-188, RA-R-420).

Approximately 12 acres of land will be required for the additional facilities at the Leon Creek plant, and about 15 additional acres will be needed at the Salado Creek plant, so this amount of potential prime farmland will be permanently removed from agricultural use. This land is not now used for cropland agricultural purposes.

The soils at the two sites are quite suitable for the construction of the facilities proposed. Excavation should be easily accomplished, and shrink-swell processes do not appear to be excessive. The predominant texture of the soils is loamy, so the soils should be well suited for sludge drying beds and temporary storage of dried sludge before it is carried offsite by local residents for land application, provided that impermeable liners are used.

At the Confluence site the soils are also well suited for construction of a new treatment plant. The soils present at the site are as follows:

Venus clay loam, 1 to 3 percent slope
Willacy loam, 1 to 3 percent slope
Hilly gravelly land
Gullied land

None of these soils are difficult to excavate or appear to have excessive shrink-swell potential. The predominantly loamy texture of the soils should make them quite suitable for sludge drying beds and for temporary storage of dried sludge if impermeable liners are provided.

The Venus clay loam and Willacy loam have both been classed as prime farmland soils by the Soil Conservation Service. Up to three-fourths of the 100 acres required for construction at the Confluence site may be over these prime soils. The soils are presently used primarily as hayland, so the permanent removal of this acreage from agricultural productivity represents a substantial impact on the soils of this area.

A possible solution to the problem of the loss of prime farmland soils to the proposed project would be to put into crop production an equivalent acreage of prime farmland soils located elsewhere but not presently used for cropland. There is a large acreage of prime farmland soil in Bexar County that is not presently used to its maximum productivity. However, the need for crop production is a question of agricultural economics that is outside the scope of the proposed project, so the measure suggested above is not likely to be necessary.

The wastewater transfer lines from the existing treatment plants to the Confluence plant will have impacts similar to the impacts of the collection system improvements. Some of the soils along the pipeline routes have high shrink-swell properties, so care must be taken udring construction to assure that excessive stresses and resulting breaks and leaks will not occur. Any disruption in the productivity of prime farmland soils will be restricted in extent and duration, so this impact will be minimal. The soils are quite deep, and the substrate below the soils (see Geology section) is not consolidated, so the excavation for the pipelines should pose little or no problem. The maximum depth of excavation for the transfer lines is expected to be about 40 feet.

B. Secondary Impacts

Most of the secondary impacts on soils will result from the urban growth that will be supported by the proposed program. The majority of this growth will occur in the northwest, north, and northeast parts of the fringe of San Antonio. Inspection of the general soil map of Bexar County (TA-111) shows that the soils in the area of most intensive urbanization may not be ideally suited for this urbanization.

In the northern part of the area, the soils are thin and rocky and are underlain by hard limestone bedrock that may require blasting when put to many kinds of urban land use (see Geology section). The urban growth that will occur in the northwest and northeast fringes of the city will be over thick, black soils having a high shrink-swell potential. Unless special, and sometimes expensive, construction techniques are used, small structures built on these soils may experience severe structural damage.

The soils in the northern fringe of San Antonio are generally too thin and rocky to be classed as prime farmlands, so urbanization in this area will result in the removal of few prime farmland soils from agricultural productivity. However, the urbanization projected for other parts of Bexar County may result in the permanent removal of significant areas having prime farmlands from agricultural productivity.

5.1.1.7 Water

Water-related impacts are addressed in the broad categories of surface water and ground water, and within these categories according to specific hydrologic aspects.

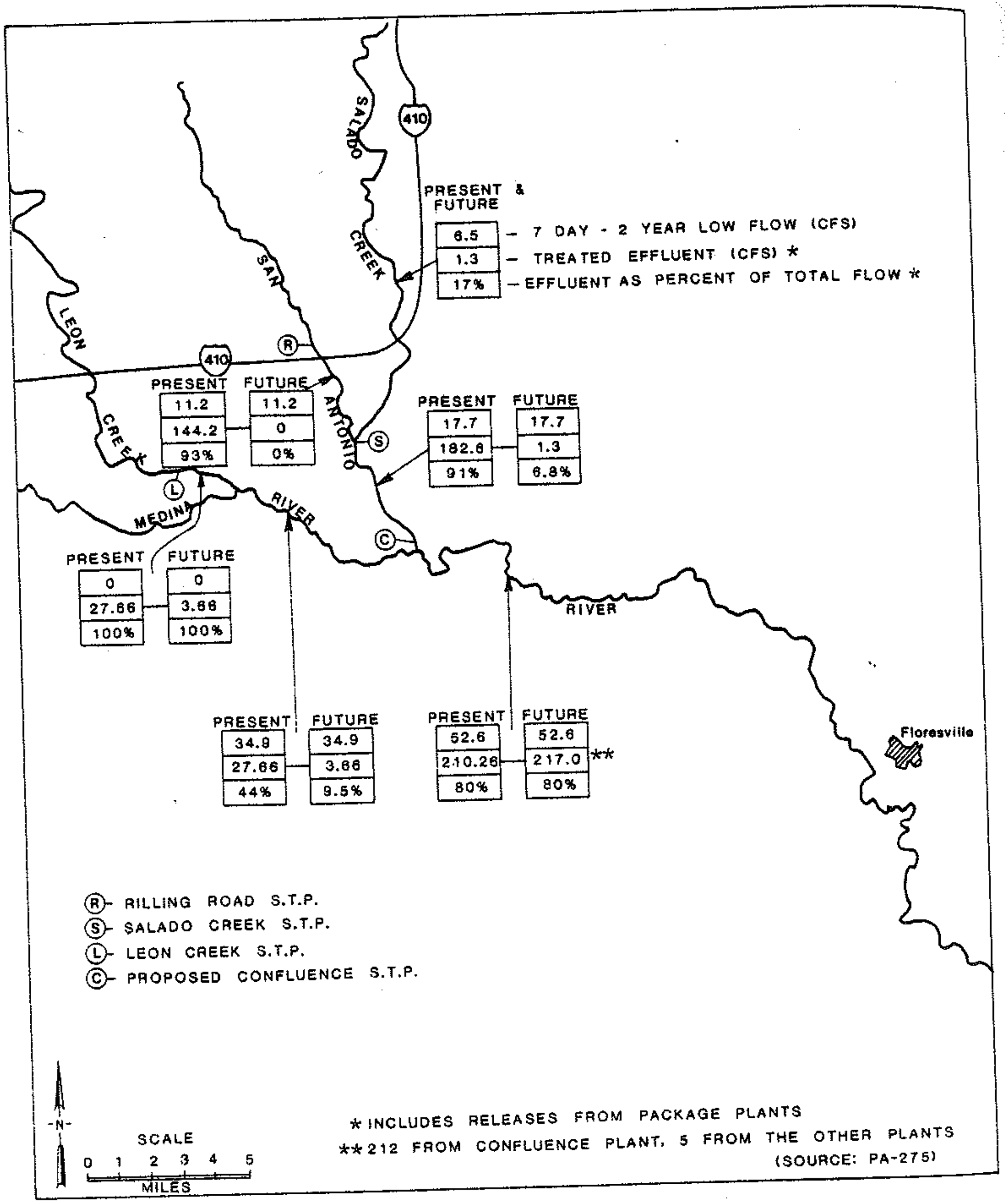
A. Surface Water

Both streamflow and stream water quality will be directly affected as a result of the proposed action. In addition, secondary effects will also be imposed on streamflow, stream quality, and reservoir quality. Impacts to these three aspects of the surface water regime in the San Antonio area are discussed in the following sections.

1) Streamflow

Primary Impacts

Streams draining the San Antonio area are small relative to the existing and proposed wastewater discharge. Figure 5-2 shows, for example, that immediately downstream of the three existing treatment plants the percent of treated sewage in the 7 day-2 year low flow ranges from 91 to 100 percent. Downstream of the confluence of the Medina and San Antonio Rivers, 80 percent of the flow currently is treated sewage. After the proposed Confluence plant is in operation and flows from both the Leon Creek and Salado Creek plants are routed to the new plant, the percentage of treated sewage in the streamflow will decrease to zero downstream of the Rilling Road plant and to less than 7 percent downstream of the Salado Creek plant (not zero because of upstream package treatment plants). Although the Leon Creek plant will terminate its discharge to Leon Creek, the percentage of treated sewage (from the Kelly Field and other wastewater treatment plants) during low flows will remain 100 percent because the 7 day-2 year low flow of the Leon Creek is zero. The percent of wastewater in the San Antonio River below the confluence with the Medina River will remain at about 80 percent.



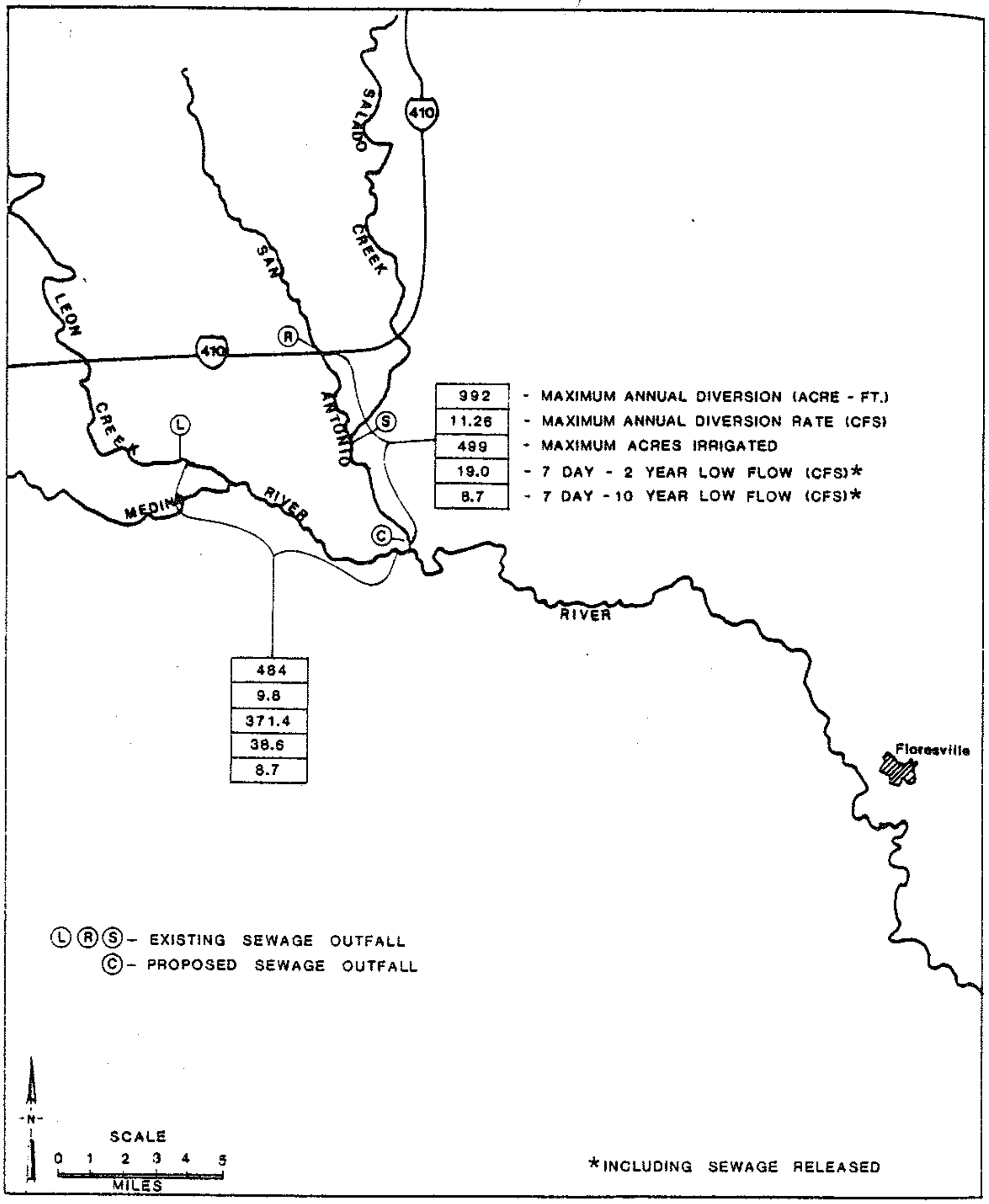
7 DAY - 2 YEAR LOW FLOWS AND PRESENT AND FUTURE TREATED EFFLUENT IN MAJOR STREAMS DRAINING SAN ANTONIO

FIGURE 5-2

02-2379-1

The most significant impact associated with the relocation of these wastewater discharges other than the improvement in stream water quality (discussed in detail in subsequent sections) will be to water users downstream of the existing outfalls. The Texas Department of Water Resources (TE-325, TE-326) has appropriated 1,476 acre-feet of water on those reaches of the Medina and San Antonio Rivers downstream of the existing treatment plants and upstream of the proposed Confluence plant (Figure 5-3). This water is used to irrigate 870 acres with a maximum diversion rate of 9.8 cfs (cubic feet per second) from the Medina River and 11.26 cfs from the San Antonio River.

With the removal of the effluent of the existing treatment plants, low flows in the reaches from the existing outfalls to the Confluence outfall will drop significantly. Although the natural 7 day-2 year low flows will be adequate to supply irrigation needs, the 7 day-10 year low flows will not be adequate at the maximum diversion rates. However, at the maximum diversion rate it will take a minimum of 25 days to pump the allotted volume of water. Since this represents a less severe case than a 7 day flow, streamflow during a 25 day-10 year low flow period will probably be adequate for irrigation needs, although the pumping rate will have to vary depending on flow conditions and will necessarily have to be extended for longer than 25 days. Although flow records (RA-R-420) indicate that sufficient water will be available for existing water users in the two affected reaches for up to about a 25-year low flow condition, additional water use within these reaches will have to be restricted during severe drought conditions. However, it must be emphasized that this is a result of the natural low flow conditions within these stream segments.



SUMMARY OF APPROPRIATED WATER USE AND NATURALLY OCCURING LOW FLOWS DOWNSTREAM OF EXISTING SEWAGE TREATMENT PLANTS

FIGURE 5-3

02-2378-1

Flow conditions below the confluence of the San Antonio and Medina Rivers will remain about the same inasmuch as treated sewage will continue to make up about 80 percent of the total flow. Hydraulic calculations indicate that daily wastewater fluctuations will cause only minor water-level elevation changes in the San Antonio River. For example, a decrease in flow from 250 cfs to 150 cfs will cause the water level to change 0.6 feet at the U.S. Geological Survey stream gage south of Braunig Lake (US-398). Similarly, the increase in flood levels caused by the sewage release is small, amounting to less than an inch during a 25-year flood and much less during a 100-year flood (US-793).

Because decreases in stream water levels will occur when the existing sewage outfalls are removed, a substantial part of the existing streambed may be exposed to the atmosphere. These stream reaches which formerly contained treated municipal effluent could become a breeding ground for disease-carrying or transmitting insects during the first few years after sewage releases are stopped. These vectors will be controlled in accordance with applicable regulations of the county and state public health authorities.

Because the new treatment plant site and transfer lines are located on mild slopes (i.e., less than 5 percent) on the uplands, impacts to streamflow associated with their construction will be temporary and of no important consequence with two possible exceptions. These exceptions include the two major creek crossings. The first is on Comanche Creek where it is crossed by the 72-inch pipe from the Leon Creek plant to the Confluence site, and the second is on the San Antonio River where it is crossed by a 66-inch pipe connecting the Salado Creek plant to the new site. Measures will be taken at these crossings to minimize stream cross-section changes. This will allow for the natural conveyance of flood waters without any increase in flood elevations caused by decreasing the cross-section of these streams or increased scouring and subsequent loss of land. Preliminary discussions with the U.S. Army Corps of Engineers have shown that a permit application to the Corps for these crossings will be necessary under the provisions of Section 404 of FWPCAA (BA-A-648). The City of San Antonio will make this application when detailed designs of the structures at the crossings are formulated during the Step 2 phase of the project. The District Engineer (Fort Worth District) will then make the determination of the necessity for a permit on the basis of information provided on the permit application.

The floodplain elevation at the Confluence plant site is at 475 feet MSL (US-845). A floodplain map of the Confluence site is given in the Technical Reference Document (RA-R-420). It is likely that a portion of the treatment plant will be located within this floodplain. The exact location of the plant on the site will be determined during the Step 2 phase of the project. The impact of the plant on the portion of the floodplain affected is expected to be minimal because of the small area involved (less than 50 acres) and because the floodplain does not contain wetlands at this location. Also, the conveyance capacity of the river will not be affected because the affected area of the plant is mostly in backwaters. When the plant is laid out during Step 2 design activity, the City will minimize the extent of incursion of the plant into the floodplain. The plant will be protected from floods by provision of embankments with minimum sidewall elevations that are one foot above the 100-year flood elevation. That is, the sidewall elevations will be a minimum of 476 feet MSL.

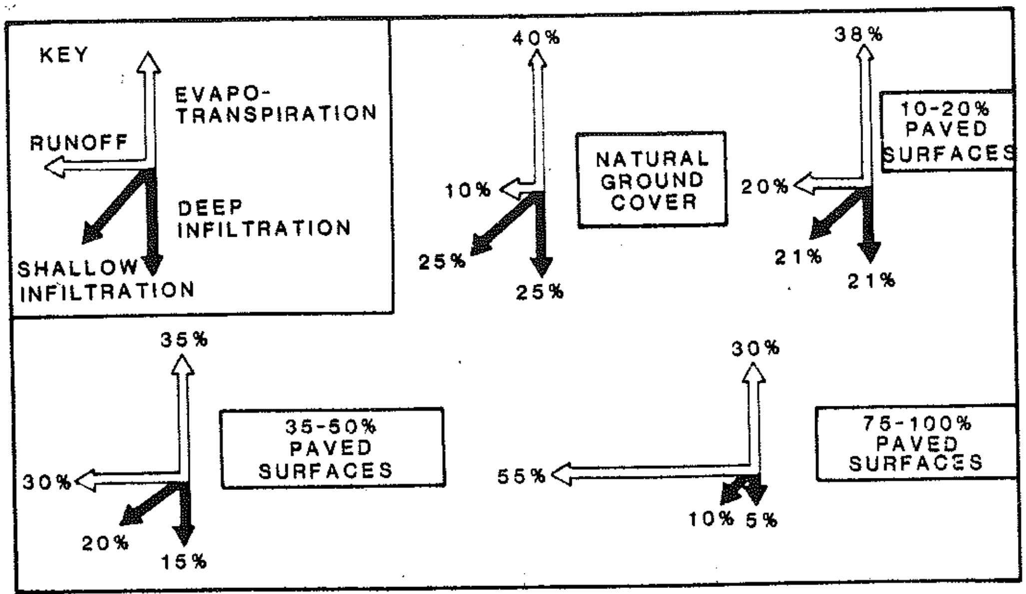
Impacts to streamflow from extending and replacing collector lines in the San Antonio area are mostly minor and temporary. Temporary inadvertent release of raw sewage during line replacements poses the biggest threat. However, sound engineering practices will be used, and this impact will be avoided. As with the transfer lines, major stream crossings will be properly re-contoured to avoid hydraulic changes.

Secondary Impacts

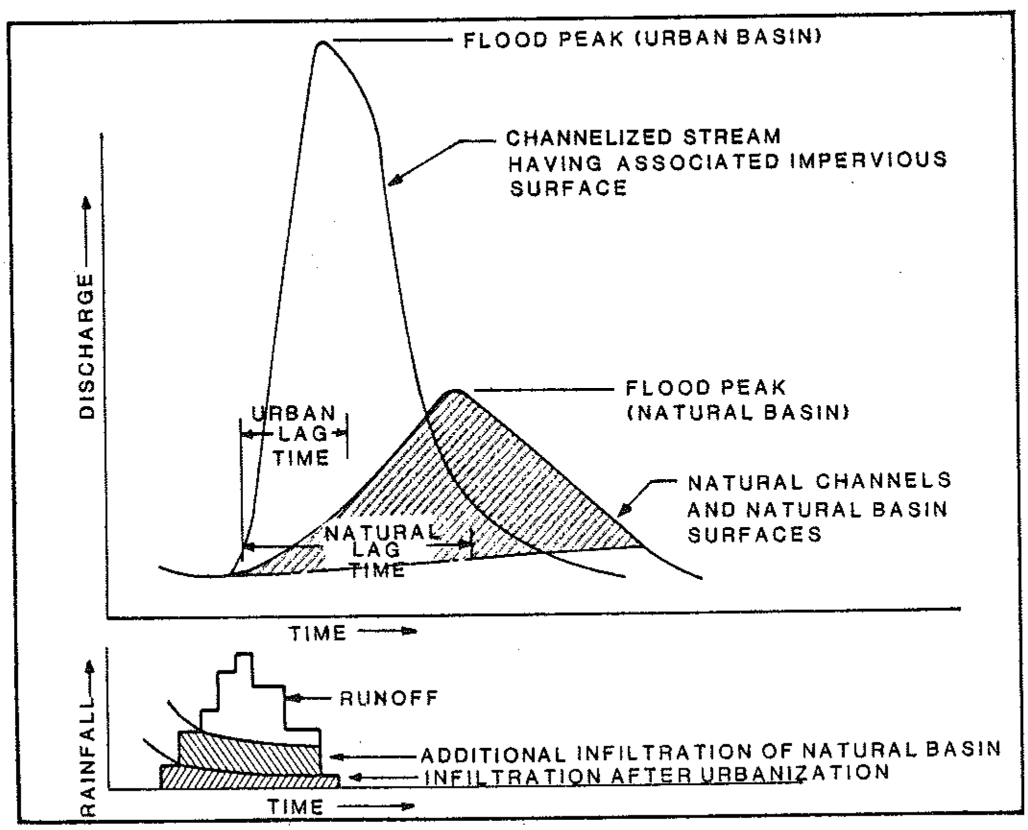
The most significant secondary impacts to streamflow in the San Antonio area are a result of the continued urban development in the area's watersheds. The major effects of this increased urbanization have included higher flood flows, increasing flood elevations and floodplains and, if development is extensive, significant decreases in the natural low flows of area streams.

The volume of runoff and ground-water recharge which occurs during storm events is governed primarily by the infiltration characteristics of a watershed. As urbanization changes natural soil conditions and the infiltration rate, the percentages of rainfall going to runoff and infiltration change accordingly. The best example of this is the response of the watershed to changes in impervious cover (i.e., parking lots, streets, rooftops, etc.). As less of the watershed's area becomes available for infiltration, a larger percentage of the rainfall ends up as runoff (Figure 5-4A). This often decreases the water available to recharge local ground-water aquifers, resulting in a possible lowering of the ground water table. As most natural low flow comes from ground water, this lowering of the ground water table often results in a decrease in the low flows of urban streams, thereby reducing the water available to assimilate the treated effluent and further degrading water quality.

To illustrate the changes in flood flows and elevations as a result of increasing impervious cover, the Austin Standard



A. HYDROGRAPH CHANGES DUE TO INCREASING THE AREA OF IMPERMEABLE SURFACES-ROOFS, ROADS, ETC. IN A DEVELOPED AREA (HO-310)



B. TYPICAL HYDROGRAPHS FOR URBAN AND NATURAL WATERSHEDS (PU-050)

FIGURE 5-4

02-1616-2

Method (PO-210) was used together with stage records of the U.S. Geological Survey stream gage on Helotes Creek. This method was developed for the City of Austin located 75 miles north of San Antonio. Since Austin has topographic, soil, and climatic conditions similar to San Antonio, this method will give an indication of the increases in peak flood flows from increasing impervious cover. To relate the peak discharges obtained in this manner to the corresponding flood stage, a stage-discharge relationship on Helotes Creek is used. The results of this analysis are shown in Table 5-6. Although the increases in flood elevations determined for this site are approximate and not representative of all streams in the San Antonio area, they do show how urbanization significantly increases peak flood flow and levels. Figure 5-4B shows typical changes in flood hydrographs resulting from changes in watershed characteristics caused by urbanization.

TABLE 5-6

CHANGES IN FLOOD ELEVATIONS AS A RESULT OF INCREASES IN IMPERVIOUS COVER, HELOTES CREEK WATERSHED

Percent Impervious Cover	25-Year Peak Flow (cfs)	Change In Flood Elevation Above Rural (ft)
Rural	10,800	0
20	13,800	1.8
37	17,400	3.7
50	18,200	4.2
70	19,800	4.8

Numerous streams in the San Antonio area have been channelized in an attempt to accommodate these higher flows from urban areas that exceed the capacity of the natural stream.

Channelization, beyond its aesthetic degradation, has other adverse impacts, such as increased erosion from higher velocities and increased flooding downstream of the channelized reach. Other better (i.e., more environmentally sound) methods exist to mitigate the adverse hydrologic effects of urbanization, such as temporary ponding of runoff in the headwaters of the affected basins. However, these measures are less direct and more difficult to implement than channelization projects. The U.S. Department of Housing and Urban Development has an ongoing program to alleviate the hardships and other effects associated with flooding in urban areas. The Department sponsors studies to determine flood-prone areas in cities and smaller communities, and it sponsors a flood insurance program to enable persons residing on floodplains to obtain insurance protection against flood losses when they are not otherwise able to obtain this protection because of high flood risk.

Elevated flood levels associated with urbanization will also expose land previously not subject to flooding to high velocity waters, thus increasing the erosion potential of the previously unflooded areas. This increased soil load will be carried downstream until the stream velocity slows enough to deposit the additional sediment. Some previously unflooded areas will experience this increased erosion while other previously unflooded areas will experience the increase in sedimentation. Because these projected increases in flooding from urbanization will occur gradually with time, the impacts to the flood-prone areas are expected to be gradual and mostly minor with respect to the natural environment. However, man-made developments bordering the existing floodplain will need to take costly flood protection measures if urbanization of watersheds continues.

2) Water Quality

Surface water quality is affected by both point and non-point source discharges. The magnitude of the impact is dependent on the quality of the discharge and the ability of the receiving water to assimilate the pollutional loading. The quality and quantity of point source discharges are regulated and can be controlled by the application of various levels of treatment technology. The necessary or desired level of treatment is determined through the planning processes of Section 201 and 303 of the FWPCAA. Non-point sources are more difficult to regulate and control because they originate throughout the entire drainage area. Runoff water quality and quantity are largely dependent on basin-wide land use and recommended action for control is the responsibility of the Section 208 areawide planning agencies. As noted earlier, the 208 planning agency for the San Antonio area is the Alamo Area Council of Governments.

Implementation of the proposed action will induce both primary and secondary water quality impacts. Primary impacts will result from the removal of the three municipal secondary-treated wastewater discharges from their present outfall locations and the addition of a single municipal tertiary-treated wastewater discharge near the confluence of the San Antonio and Medina Rivers. Secondary impacts will result from increased runoff and changes in runoff water quality that occur as a result of construction activities and as increased urbanization and development continues on the watershed. These primary and secondary impacts cannot be considered separately as both may contribute significantly to reductions in the surface-water quality. The ultimate quality of the receiving surface waters results from the interaction of both primary and secondary sources. Therefore, primary and secondary impacts are considered simultaneously in this assessment.

To predict the effects of the proposed action on the surface water quality, existing surface-water quality sampling data are used, and the facilities of the proposed action are hypothetically superimposed on the planning area. Where a point source is eliminated, it is assumed that the water quality upstream of that discharge will predominate, and the water quality of the stream segment downstream to the new discharge point or to the confluence with another stream, will approximate the water quality upstream of the old discharge point. Additionally, the water quality of stream segments which are determined to be primarily affected by runoff from increased urbanization is assumed to approach the water quality identified by sampling stations for basins within the study area which are now predominantly influenced by urban runoff. To project the impact on lake water quality, the changes in makeup water quality and runoff characteristics from the respective watersheds is estimated. A comparison of the existing surface-water quality with the projected water quality forms the basis for the impact assessment.

Various sources of water quality sampling data are used for the impact assessment, and caution must be exercised during review. Water quality parameters can fluctuate over a wide range during the course of a day or season, and samples collected may not be representative of either worst-case or average conditions. Most samples obtained for the various water quality surveys are grab samples which increases the possibility for nonrepresentative sampling conditions.

The hydraulic conditions of the stream at the time the sample is collected will also influence the water quality data. Runoff during storm events may predominantly influence the surface-water quality, especially for naturally low-flowing streams, whereas point source discharges may predominantly influence surface water quality during normal low flow conditions.

Because of these diurnal and seasonal variations, an adequate assessment of water quality impacts must include a range of concentration values for various pollutants. A more definitive assessment would require an intensive and comprehensive study on each stream segment over a sufficient period. The level of effort requried for such synoptic water quality studies is beyond the scope of this investigation, so the impact assessment provided here is largely qualitative.

Water quality parameters evaluated in this assessment include dissolved oxygen, five-day biochemical oxygen demand (BOD_5), ammonia-nitrogen, total phosphate, pH, and temperature. These water quality parameters are used as indicators and are sufficient to adequately represent the relative quality of the surface waters.

a. Stream Water Quality

Non-point sources of pollution including runoff from both urbanized and rural areas will continue to occasionally degrade the surface-water quality of all streams in the study area. Measures to minimize or eliminate this occurrence are being investigated by the 208 planning agencies, and proposed actions for non-point source controls should emerge from the areawide planning efforts.

The water quality impacts on Leon Creek, Medina River, and Salado Creek are assessed first because each of these streams influences the water quality of the San Antonio River. The San Antonio River is divided into three segments for assessment. The first segment is from the headwaters to the confluence with Salado Creek; the second segment is from the confluence with Salado Creek to the confluence with the Medina River; and the third segment is from the confluence with the Medina River downstream for approximately 20 miles.

Leon Creek

The impact on Leon Creek's water quality is assessed using information provided in the Intensive Surface Water Monitoring Survey for Segment No. 1906 (TE-331) and USGS water quality data for water years 1973 through 1976 for sampling station number 0817800 located near the headwaters of the San Antonio River. The Intensive Survey was conducted July 9 through 11, 1974 and represents the water quality during normal or low flow conditions. The USGS data are used to project the water quality during storm events for urbanized areas in San Antonio. It is assumed that as urbanization increases in the Leon Creek watershed, the resulting water quality during storm events will approach that water quality now observed during storm events at a sampling station near the headwaters of the San Antonio River. The water quality at that sampling station is significantly influenced by an intensively developed watershed and should be somewhat representative of the Leon Creek water quality as urbanization progresses within the watershed.

Leon Creek's existing water quality is generally poor as a result of several wastewater discharges to the creek and its tributaries. The two major wastewater treatment facilities which discharge to the creek include the Kelly Air Force Base industrial wastewater treatment plant and the City of San Antonio's Leon Creek plant. During low flow conditions, all of the flow in Leon Creek can be attributed to the wastewater sources. Temperature and pH are well within the stream standard of $90^{\circ}F$ maximum and 6.5 to 8.5 range, respectively.

No improvement in the Leon Creek water quality is expected with the proposed action except for the 1.5 mile segment between the city's Leon Creek wastewater treatment plant discharge and the confluence with the Medina River. The quality of this segment will improve, only slightly, to a level similar to that upstream.

The mean dissolved oxygen concentration is approximately 4.2 mg/ℓ below the Leon Creek wastewater discharge. This mean concentration should increase to above 7.0 mg/ℓ with the removal of the wastewater discharge, but during extreme conditions will fall below the standard of 5.0 mg/ℓ in the evenings or early morning. The BOD_5 concentration below the Leon Creek plant outfall of 21.0 mg/ℓ and the ammonia-nitrogen concentration of 4.2 mg/ℓ will be reduced to approximately 4.0 mg/ℓ and 0.1 mg/ℓ respectively after the plant is removed. Ortho-phosphate will be reduced from the average of 13.1 mg/ℓ to approximately 0.3 mg/ℓ while total phosphate will be reduced from approximately 14.3 mg/ℓ to 0.50 mg/ℓ.

The Leon Creek segment above the city's treatment plant will remain essentially unchanged and of rather poor quality. The measured mean dissolved oxygen will range from approximately 0.3 mg/ℓ to 12.0 mg/ℓ and will frequently be below 5.0 mg/ℓ. BOD_5 concentrations will remain rather high throughout most of the segment with values ranging from 3.5 mg/ℓ to 13.0 mg/ℓ. Ammonia-nitrogen levels should remain relatively low with values ranging from less than 0.1 mg/ℓ to 0.7 mg/ℓ. Total phosphate will range from approximately 0.4 mg/ℓ to nearly 1.0 mg/ℓ.

The water quality of Leon Creek during storm events will be similar to the water quality during normal and low-flow conditions as described above. However, the dissolved oxygen concentrations should be slightly higher with values approaching 8.0 or 9.0 mg/ℓ.

Construction of the Leon Creek plant proposed improvements and the secondary effluent transfer line could increase the sediment loading to Leon Creek. However, the proposed route for the transfer line is in the uplands and does not cross Leon Creek. Additionally, the construction of the proposed expansion and improvements to the Leon Creek plant do not require extensive excavation or earth moving. Therefore, these impacts are expected to be minor.

Medina River

The impact on the Medina River water quality is estimated using data provided in Water Quality Modeling Data -- San Antonio Planning Region (DE-221) and the 1976 City of San Antonio annual wastewater treatment report (SA-329). These data indicate that the Medina River is of relatively good quality throughout the segment downstream to the confluence with Leon Creek. Water quality below the confluence with Leon Creek is somewhat degraded from the inflow of the rather poor water quality of Leon Creek.

Dissolved oxygen concentrations above the Leon Creek confluence ranged from 7.0 mg/ℓ to 10.5 mg/ℓ for samples taken in 1976. BOD_5 concentrations ranged from 0.0 mg/ℓ to 6.0 mg/ℓ with an average of 1.6 mg/ℓ. Ammonia-nitrogen and total phosphorus concentrations averaged 0.8 mg/ℓ and 0.4 mg/ℓ respectively. However, the average total suspended solids concentrations were relatively high with values ranging from 12 mg/ℓ to nearly 70 mg/ℓ. This high suspended solids loading is probably due to the relatively intense agricultural activities occuring on the watershed.

The Medina River segment below the Leon Creek confluence maintained an average dissolved oxygen concentration ranging from 4.0 mg/ℓ to 10.6 mg/ℓ in the samples taken in 1975. BOD_5 concentrations ranged from 0.2 mg/ℓ to 16.8 mg/ℓ while ammonia-nitrogen and total phosphorous concentrations ranged from 0.1 mg/ℓ to 3.8 mg/ℓ and 0.3 mg/ℓ to 6.7 mg/ℓ, respectively.

The proposed action should have little or no effect on the upper segment of the Medina River but should slightly improve the segment below the confluence with Leon Creek. As a worst-case condition, the quality of the segment below the Leon Creek confluence should approximate the estimated quality of Leon Creek as it enters the Medina River. Therefore the average dissolved oxygen concentration should be in excess of 7.0 mg/ℓ but could fluctuate below 5.0 mg/ℓ daily. BOD_5 and ammonia-nitrogen concentrations will average approximately 4.0 mg/ℓ and 0.1 mg/ℓ, respectively, while total phosphorus will average approximately 0.49 mg/ℓ.

No data are available to project the secondary impacts resulting from storm events. However, little urbanization is anticipated on the Medina River watershed, and agricultural activities should continue to predominate. Therefore the relatively large sediment load in the river will probably persist throughout the study period.

Salado Creek

The impact on the Salado Creek water quality is assessed using data provided in Water Quality Modeling Data-San Antonio Planning Region (DE-221), and USGS water quality data for water years 1973 through 1976 for sampling station numbers 08178800 and 08178000. These stations are located on Salado Creek in San Antonio and near the headwaters of the San Antonio River, respectively. The USGS sampling station on the San Antonio River is used to estimate the effects of urban runoff on Salado Creek. It is assumed that increased urbanization will occur on the Salado Creek watershed and water quality will approach that now observed at that USGS station on the San Antonio River.

The water quality of Salado Creek is relatively good with measured dissolved oxygen concentrations ranging from 5.5 mg/ℓ to 10.0 mg/ℓ. Observed BOD_5 concentrations range from approximately 1.1 mg/ℓ to 12.0 mg/ℓ with an average of approximately 5.1 mg/ℓ. Ammonia-nitrogen concentrations are very low and range from 0.0 mg/ℓ to 0.24 mg/ℓ. Total phosphate concentrations range from approximately 0.12 mg/ℓ to 1.0 mg/ℓ. Temperature and pH measurements are well within the stream standards.

The proposed action will produce no primary effects on the water quality of Salado Creek, and the stream water quality should remain essentially unchanged during normal and low flow conditions. However, as urbanization continues on the Salado Creek watershed, the water quality of the Creek during storm events should approach that quality now observed in the headwaters of the San Antonio River during storm events. From available sampling data, that water quality is not significantly different from the water quality now observed and little or no secondary impacts are anticipated.

San Antonio River

The impact of the proposed project on the San Antonio River water quality is assessed using information provided in the Intensive Surface Water Monitoring Survey for Segment No. 1901 (TW-005), the 1976 City of San Antonio annual wastewater treatment report (SA-329), and USGS water quality data for water years 1973 through 1976 for sampling station numbers 08178000 and 08181800, which are located at the headwaters of the San Antonio River and near Elmendorf, respectively.

The San Antonio River is generally of poor quality owing to the discharge of secondary treated wastewater from the city's three municipal wastewater treatment plants. Mean dissolved oxygen levels range from approximately 3.8 mg/ℓ to 7.7 mg/ℓ with an average of approximately 4.5 mg/ℓ. At various sampling points along the river, the dissolved oxygen concentrations never recover to the stream standard of 5.0 mg/ℓ.

BOD_5 levels observed by the USGS range from 3.4 mg/ℓ to 26.0 mg/ℓ and are generally highest just below the Rilling Road wastewater treatment plant outfall. Ammonia-nitrogen levels are frequently in excess of 3 mg/ℓ with an observed high of 8 mg/ℓ. Total phosphate levels as high as 20.5 mg/ℓ are observed just below the Rilling Road treatment plant outfall and remain high throughout the segment. Measured temperature and pH values are within the range of the stream standards of 90°F and 6.5 to 8.5, respectively.

The proposed action should significantly improve the quality of the San Antonio River between the existing Rilling Road outfall and the Medina River confluence by removing the two secondary treated wastewater discharges. Effluent limitations imposed on the proposed new tertiary treatment facility at the Confluence site should protect the quality of the stream below the new outfall. Dissolved oxygen concentrations from the headwaters of the San Antonio River to the confluence with Salado Creek should range from approximately 5.6 mg/ℓ to 10.1 mg/ℓ. With the inflow of Salado Creek, the dissolved oxygen concentrations should increase slightly for the segment downstream to the confluence with the Medina River.

BOD_5 concentrations from the headwaters of the San Antonio River to the confluence with the Medina River will range from approximately 0.8 mg/ℓ to 9.0 mg/ℓ with an average of approximately 2.9 mg/ℓ. At the point of discharge near the confluence the average BOD_5 concentration will increase slightly but should remain below 5.0 mg/ℓ.

Ammonia-nitrogen and total phosphate should also be significantly reduced. Ammonia-nitrogen concentration in the upper segment of the San Antonio River will range from approximately 0.1 mg/ℓ to 1.3 mg/ℓ with an average of approximately 0.6 mg/ℓ. Total phosphate levels in this segment will range from approximately 0.1 mg/ℓ to 1.4 mg/ℓ with an average of approximately 0.3 mg/ℓ. Ammonia-nitrogen levels will increase slightly below the discharge while total phosphate levels will increase drastically since no phosphate controls are included with the proposed action. Total phosphate levels as high as 20.0 mg/ℓ may be observed just below the outfall. However, the daily average concentration should be much lower, possibly below 9.0 mg/ℓ.

The Texas Department of Water Resources uses the Qual II mathematical model to determine waste load allocations for discharges to surface waters. The waste load allocations for the San Antonio River are based on maintaining a minimum dissolved oxygen concentration of 5.0 mg/ℓ as established in the 303e Basin Plan (see Chapter 1). The predicted instream dissolved oxygen sag resulting from the proposed tertiary-treated wastewater discharge, as predicted by the Qual II model, is superimposed on the presently observed dissolved oxygen sag (see also Chapter 2) in Figure 5-5. The model was run and its results are presented in the Technical Reference Document (RA-R-420). From Figure 5-5, it can be seen that the proposed action will significantly improve water quality of the San Antonio River to a level consistent with the stream standard.

Runoff during storm events will cause a slight increase in the BOD_5 concentration. However, other water quality parameters discussed in this section will remain essentially unchanged.

Increased sediment loadings to the San Antonio River will result from the construction of the Confluence treatment

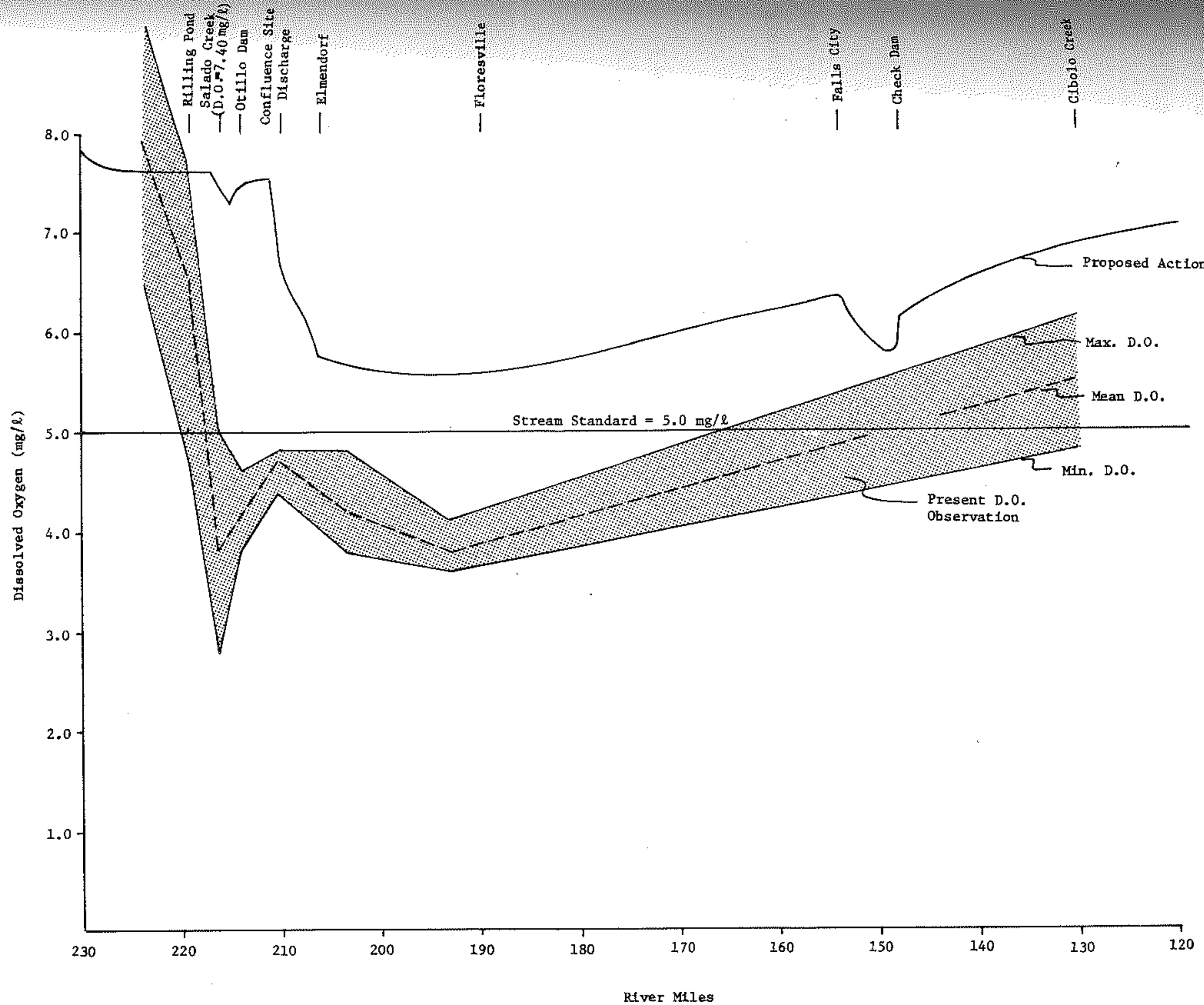


FIGURE 5-5

IMPACT OF PROPOSED ACTION ON DISSOLVED OXYGEN OF SAN ANTONIO RIVER plant and the three wastewater transfer lines. However, because the facilities will be constructed on relatively gentle slopes, runoff velocities will be low and easily controlled, and resulting impacts should be very minor.

b. Lake Water Quality

The proposed action should have little or no effect on Braunig Lake and Calaveras Lake. These two cooling lakes draw makeup water from the San Antonio River just below the confluence with the Medina River. While the oxygen demanding constituents in this water should be somewhat reduced by the proposed action as previously discussed, total nitrogen and total phosphate concentrations will remain essentially unchanged as nutrient removal is not included with the proposed action. Therefore nutrients should continue to enter these lakes at approximately the present rate. Nitrogen may be in a somewhat more available form, but phosphorus is more likely to be a limiting factor. The reduction of the oxygen demanding materials may enhance the quality of the lakes slightly, but no severe adverse impacts are currently identified with these constituents. Additionally, increased BOD_5 concentrations which could result from increased urbanization in the cooling lake watersheds could easily offset any BOD_5 reductions in makeup water.

Mitchell Lake is not expected to remain part of the city's wastewater treatment system. On December 5, 1977 the Texas Department of Water Resources claimed jurisdiction over the reservoir as state waters. The city is expected to complete studies and seek federal funds for the further improvement and restoration of the lake; additionally, the Texas Department of Water Resources has issued a Board Order to the city to improve the condition of that lake. The city is presently involved in an effort to comply with that directive. The impact of those efforts has not yet been determined, but the proposed action is not judged to be inconsistent with these efforts.

B. Ground Water

As described in Chapter 2, ground water is very important to the San Antonio area. San Antonio is the largest city in the U.S. that is dependent solely on ground water for its municipal water supply. The aquifer of greatest significance to the area, and the water source for the city, is the Edwards limestone aquifer. The Edwards aquifer could potentially be affected by both the primary and secondary effects of the proposed project. The recharge zone of this aquifer (see Chapter 2) is one of the most environmentally sensitive areas in the San Antonio region.

1) Primary Effects

The interceptor and collection system potentially could have a direct adverse impact on the quality of ground water in the Edwards aquifer. The sewer line segments that cross the recharge zone of the aquifer could pose a threat to water quality if leaks develop after pipeline construction. However, this potential impact will be mitigated for the most part by the rather strict sewer line construction requirements of Texas Water Quality Board (now Texas Department of Water Resources) Order No. 77-0303-3. This order, which was issued for the express purpose of protecting the ground-water quality in the Edwards aquifer in Bexar County, is quite detailed in the specifications of the construction procedure to be used for sewer lines in the recharge zone.

Other sewer lines are designated as having minor potential ground-water impacts because of proximity to creeks. This type of impact is concerned with the potential leakage from sewer pipes into local alluvial aquifers. The aquifers that may potentially be contaminated are generally small, limited in area extent, and not highly important.

The construction and operation of the Leon Creek and Salado Creek plant additions will have little incremental adverse effect on ground-water systems at the two sites. It is likely that small, local alluvial aquifers are present at the two sites, but the existing quality of ground-water in these aquifers is not known. There is some evidence that ground-water quality at the Salado Creek site has already been degraded by the existing treatment plant. The additions to the two plants for the proposed project are unlikely to increase significantly the impacts of the existing plants on ground-water quality.

The Confluence treatment plant could have a significant impact on the quality of ground-water in an alluvial aquifer associated with the Medina and San Antonio Rivers. Leakage or spillage of wastewater in various parts of the plant may infiltrate through the soil zone and enter ground-water systems. However, much of this pollution problem can be alleviated by good construction practices for potentially leaky facilities and by good plant operation practices once the plant is working.

The wastewater transfer lines connecting the existing treatment plants to the new Confluence treatment plant are unlikely to have significant impacts on ground-water systems. In general, the lines are located in uplands underlain by shallow alluvial terrace deposits or by relatively impermeable clayey bedrock. These deposits are generally well drained or contain small and unimportant quantities of ground water. Thus even if leaks of sewage or secondary effluent were to develop in the lines, little ground water is present to be contaminated by such leaks. Also, the high clay and sand content of the substrate should provide good renovation of wastewater fluids that leak into the subsurface.

The proposed project should provide a significant improvement in the alluvial aquifers associated with the river segments that are downstream of the present sewage outfall locations. There is usually a considerable exchange of water between these aquifers and the rivers with which they are associated. If the objective of the proposed program is met (that is, to upgrade the water quality of the rivers), then the water quality of the associated alluvial aquifers should also be improved.

2) Secondary Effects

The most significant potential impacts on ground water are the secondary effects associated with the urban growth that will be supported by the proposed project. Both the quality and quantity of ground water in the critically important Edwards aquifer may potentially be affected.

Virtually all of the municipal water supply for San Antonio comes from ground water withdrawn from the Edwards aquifer. As the city continues to grow in population, the quantity of water withdrawn from the aquifer will increase. Yet the quantity of water recharging the aquifer remains essentially unchanged over the long term. Up to the present time, the water levels in the aquifer have not been lowered significantly as a result of excessive pumpage except during times of drought, notably in the 1947 to 1956 period.

As shown in Table 2-3, the artificial discharge from the aquifer (by pumpage) now accounts for about one-half of the total discharge from the aquifer. The remainder is discharged from such springs as San Marcos, Comal, San Antonio, San Pedro, and Leona Springs. The City of San Antonio and associated military installations account for 53 percent of the artificial discharge and 25 percent of the total discharge from the aquifer. As San Antonio's portion of the discharge increases, the deficit must be made up by reductions in withdrawals from one or more of the other artificial discharges. Otherwise, water levels in the aquifer will begin to fall, and the springflow will be reduced.

A comprehensive water management plan is clearly called for regarding water use from the Edwards aquifer. Several difficult choices will need to be faced in the near future regarding allocation of water from the aquifer. The share of water allocated for the continued growth of San Antonio must be considered in the content of a total aquifer management plan. The quantity of water available from the Edwards continues to be a topic of study by several federal and state agencies. Preliminary aquifer modeling studies by the Texas Department of Water Resources indicates that all of the major springs issuing from the aquifer will continue to flow until 2000 only if the aquifer is carefully managed. The Edwards Underground Water District was formed in 1959 to protect, conserve, and recharge the Edwards aquifer. A permitting system for wells has not been instituted as yet to regulate ground-water withdrawals from the aquifer.

It seems clear that the impact of the proposed action on the quantity of water in the Edwards can be evaluated only after a clear and concise aquifer management plan has been formulated, including an establishment of priorities of water demands. The City of San Antonio has also considered surface water sources as an alternative to the Edwards aquifer in the past, and this option may again have to be considered and implemented. The total quantity of water that will be required by the urban growth of San Antonio until 2000 has not been accurately estimated, nor has an appraisal been made of how this demand will be apportioned between surface-water and ground-water resources.

The impact of the proposed project on the quantity of ground-water contained in the Edwards aquifer is best viewed in terms of the impact of the urban growth of San Antonio that will occur until 2000. The project will support this growth, but it is not intended to promote additional growth beyond what would occur even if the project were not instituted. No significant impacts of this urban growth are expected on aquifers other than the Edwards.

The water quality of the Edwards aquifer may also potentially be affected by the urban growth that will be supported by the proposed project. The area of greatest concern is the recharge zone of the Edwards aquifer, which occurs in the northern part of the San Antonio area. The potential pollution of the Edwards from increased urbanization stems from such sources as contaminated storm runoff and is discussed in Chapter 2 of this EIS. The quality of ground-water in aquifers other than the Edwards aquifer is not presently perceived as being significantly threatened by urban growth.

The current growth plans for the city call for minimal future development over the Edwards recharge zone (SA-304). The City of San Antonio has commissioned a study to determine the type and intensity of development that can occur over the recharge zone without significantly impairing the water quality of the aquifer. It is possible that formal growth plans will change when the results of this study are known. The city is presently using its subdivision control of that part of the recharge zone within its area of extraterritorial jurisdiction (ETJ), to prevent development at a density of greater than one dwelling unit per five acres. This interim meausre will remain in effect until 31 December 1978 to try to prevent development until the results of the city's study are known.

In summary, the secondary effects of the proposed project on the water quantity and quality of the critically important Edwards aquifer will occur as the result of the urban growth that the project will be supporting. Other ongoing efforts by the Edwards Underground Water District (water quantity) and the City of San Antonio (water quality) are designed to evaluate and minimize these impacts. When the results of these efforts are known, the extent of adverse impacts and possible mitigative measures will be more evident than they are at present.

5.1.2 Biological Components

5.1.2.1 General

Construction and operation of the proposed facilities will cause environmental impacts on biota in the San Antonio planning area. The proposed action includes expansion of treatment facilities at Leon and Salado Wastewater Treatment Plants, construetion of a large, tertiary treatment plant at the confluence of the Medina and San Antonio Rivers and three large transfer lines for secondary effluent and raw sewage. The construction and expansion of the collection system will be evaluated as an integral component of the proposed action. Direct impacts caused by construction and operation of the new wastewater facilities are discussed with regard to both their short-term and long-term effects. Indirect impacts arising from implementation of San Antonio's facilities plan are evaluated on the basis of growth-induced changes in future land use.

5.1.2.2 Terrestrial Biota

A. Treatment Plants and Transfer Lines

All of the terrestrial habitats that will be directly affected by construction at the Salado Creek plant, the Leon Creek plant, and the new Confluence site have a history of disturbance by man's land uses. All construction at the Salado and Leon Creek plants will occur within existing plant boundaries. The Confluence site is currently used for hay and swine production. The three large transfer lines are to be in a rural, agricultural region. Because of this disturbed environmental setting, direct impacts on terrestrial biota in these areas should be slight.

Direct short-term impacts at all construction sites will result from removal of vegetation, equipment noise, increased vehicular traffic, dust, and local increases in human activity. A total of about 530 acres of vegetation will be removed or heavily disturbed during construction (see Table 5-7). Most of this will be coastal bermuda, agricultural crops, or similar non-native species. Trees are not numerous in any of the plant construction areas, so losses of arboreal vegetation should be small. The transfer lines do not closely follow area stream courses, although the line from the Salado Creek plant will cross the San Antonio River just northeast of the new Confluence facility. This stream crossing should account for the only major loss of riparian vegetation associated with the transfer lines. A few of the riparian trees (see Table 5-7) destroyed at the crossing will be large mature individuals.

In all the areas of construction previously mentioned (Table 5-7), a few small mammals, herptiles and birds will be destroyed. Removal of vegetation and construction disturbance will drive others to similar habitats adjacent to the sites. Before construction ceases, some will habituate to the noise, dust and human activity and return to the periphery of the sites.

Operation of the newly constructed facilities will cause some minor long-term direct impacts on wildlife in their vicinity. The current level of operational plant noise and/or human activity

TABLE 5-7

VEGETATION AND WILDLIFE IN AREAS OF CONSTRUCTION

Location	Size (acres)	Common Plants	Common Wildlife
Leon Creek Site	12	Mesquite (*Prosopis glandulosa*)	Raccoon (*Procyon lotor*)
Salado Creek Site	15	Live Oak (*Quercus virginianus*)	Oppossum (*Didelphis marsupialis*)
Confluence Site	100	**Hackberry** (*Celtis varigatus*)	Blacktailed jackrabbit (*Lepus californicus*)
		Sunflower (*Helianthus annus*)	Cottontail Rabbit (*Sylvilagus floridanus*)
		Johnson Grass (*Sorghum halepense*)	**Thirteen-lined groundsquirrel** (*Citellus tridecemlineatus*)
		Coastal Bermuda (*Cynodon dactylon*)	White footed mouse (*Peromyscus leucopus*)
Transfer Lines:		NOTE: in riparian areas, especially at the confluence site, the following tree species are present:	Coyote (*Canis latrans*)
Rilling Road to Confluence Site	190	Cottonwood (*Populus deltoides*)	Redtail Hawk (*Buteo jamaicensis*)
Leon Creek to Confluence Site	135	Pecan (*Carya illinoensis*)	Meadowlark (*Sternella neglecta*)
Salado Creek to Confluence Site	75	Ash (*Fraxinus spp.*)	Coachwhip (*Masticophis flagellum*)
		Black Willow (*Salix nigra*)	Prarie Lizard (*Sceloporus undulatus*)
		Bald Cypress (*Taxodium distichum*)	

at all three plant sites minimizes the impact of long-term operation-related disturbance.

All phases of construction activities for the treatment plants and transfer lines will be conducted so as to minimize the impacts on wildlife to the maximum extent possible. None of the plant or animal species destroyed or disturbed during construction of new treatment facilities and transfer lines are considered threatened or endangered by the U.S. Fish and Wildlife Service (RA-304). Habitat losses resulting from construction are not considered regionally or locally significant.

B. Collection System

Generally, interceptor routes within metropolitan San Antonio do not cause adverse biological impacts. Routes for lines in the urban halo region and beyond generally cause more adverse impacts. Only those routes evaluated as having serious adverse impacts on terrestrial riparian habitats and wildlife are discussed here.

Very few interceptors follow minor drainages through city parks and/or college campuses. Very large, mature, native trees such as bald cypress and pecan remain in these areas. Because mature vegetation in these areas is very restricted, the natural and aesthetic value of these large trees is considerably enhanced. Clearing of interceptor rights-of-way, which damages or destorys these trees in these areas, will cause serious adverse impacts. However, measures will be taken during construction to minimize these impacts to the maximum possible extent.

Sewer interceptors laid in or very near minor drainages to the north and west of urban San Antonio will cause adverse impacts. Similarly, interceptors laid in or along segments of Salado Creek will adversely affect resident riparian biota. In both areas, direct impacts will result from removal of riparian vegetation along pipeline rights-of-way. Riparian vegetation along Elm Creek, Panther Springs, and W. W. Wilkerson Park to the west and north of the city provides food and cover for native wildlife. Segments of Salado Creek exhibit comparatively mature stands of riparian trees. In many cases, this vegetation is all that remains of a once extensive floodplain forest. Remnant riparian wildlife in these areas is almost totally dependent on this remaining habitat for food and cover.

Along rights-of-way in all of these areas, riparian vegetation (see Table 5-7) will be removed, and riparian wildlife will be destroyed or displaced. Ash, pecan, willow, and bald cypress will be major tree species affected. In most areas, these trees are large and numerous. Whitetail deer, raccoon, squirrels, warblers and semi-aquatic herptiles will be destroyed by construciton crews and equipment. This impact could be locally severe if construction occurs during breeding or nesting seasons in the spring. Long-term direct impacts will arise from the continuing disturbance caused by repeated mowing and maintenance of the rights-of-way. Temporary roads will be revegetated as quickly as practicable after abandonment to minimize adverse construction impacts.

Perhaps the most important impact of these lines on biota is the indirect effect of future urbanization. In all of the areas where lines will be laid to the north and west of the city, the current land use trend is tract development. This type of land use is particularly disruptive of wildlife and their habitats. New sewer lines such as the ones considered here continue this land use trend. As development proceeds along these routes, more and more wildlife habitat is removed or highly disturbed. Species utilizing these habitats must move to adjacent suitable areas. As more habitat is removed, less becomes available to wildlife displaced by removal. Increased human presence and vehicular traffic also degrade affected habitats.

Species with restricted breeding habitats, (e.g., the Golden-cheeked warbler) and those sensitive to human intrusion (e.g., the wild turkey) are most severely affected by these indirect impacts. Others, such as the raccoon, can tolerate extensive disturbance. However, because quality wildlife habitat is not an infinite resource, its continued removal north and west of the city must be considered a serious indirect impact of the interceptor lines on area biota.

5.1.2.3 Aquatic Biota

Short-term direct impacts on aquatic environments in the San Antonio area will be caused by construction at Leon Creek, Salado Creek, and the new Confluence wastewater treatment plants. To a much lesser degree, construction of the transfer lines between the three existing treatment plants and the new Confluence plant will cause direct short-term aquatic impacts. Long-term direct impacts will stem from the removal of secondary effluent from segments of Leon Creek, Salado Creek, and the San Antonio River upstream from the new Confluence plant. Additionally, discharge of approximately 135 MGD of tertiary treated effluent to the confluence of the San Antonio and Medina Rivers will cause some direct long-term aquatic impacts. Direct and indirect aquatic impacts arising from construction of the collector system will be discussed separately.

A. Treatment Plants and Transfer Lines

Construction of new facilities at the Leon and Salado Creek sites will occur within existing plant boundaries. The Confluence plant site construction will also occur in an already disturbed agricultural environment. In each case, sedimentation or siltation of Leon Creek, Salado Creek, or the San Antonio River from construction site stormwater runoff should be comparatively minimal. The topography at all the proposed construction sites is relatively flat. This feature, coupled with a generally good coastal bermuda ground cover, should minimize the potential impact of construciton site runoff during storm events.

Sediment-laden stormwater introduced into a stream decreases light penetration and, therefore, can temporarily lower dissolved oxygen levels. Heavy sediment loading can scour the streambed, destroying plants and benthic organisms. When flow velocity decreases downstream, this sediment falls to the bottom of the stream (i.e., siltation), thereby suffocating some benthic invertebrates. Sediment-related impacts on aquatic biota will be minimized by revegetation of all construction areas as quickly as possible after construction is completed.

Laying the large transfer lines from each of the existing treatment plants to the new Confluence facility should not cause appreciable siltation or sedimentation in any of the area streams. The routes of these lines follow the highlands; therefore, distance from the receiving streams should minimize siltation. However, the route of the line from Salado Creek plant crosses the San Antonio River northeast of the new Confluence site. Removal of riparian vegetation and general construction activity at this stream crossing will cause some increased, short-term siltation of the San Antonio River downstream. Sediment related effects of transfer line construction, like the effects associated with the treatment plant construction, will be minimized by quick revegetation of all construction areas.

Long-term direct impacts on aquatic environments will occur after construction of the new facilities and transfer lines is completed. Treated effluent will no longer be discharged from any of the three existing treatment plants. Hence the 7,400 foot segment of Leon Creek between the Leon Creek plant and the Medina River will undergo an almost total reduction in flow (see Figure 5-2). As a result, flow in a 45,200 foot segment of the Medina River between its confluence with Leon Creek and the San Antonio River will be reduced by one-third. Similarly, the flow in the 50,000 foot segment of the San Antonio River below the Rilling Road treatment plant will diminish by about 90 percent. Flows in the San Antonio River below the Confluence site will remain about the same.

The impact of these flow reductions will be most severe in Leon Creek. The affected segment will continue to receive comparatively small point source discharges which now account for high cyanide, phenol, and DDT metabolite levels. In addition, the exposed streambed will cause an occasional increased in pests and vectors (flies, mosquitos) as it drys. These vectors will be controlled in accordance with state and local public health agency regulations. Odor associated with the decay of algae and/or aquatic plants could also be a problem. However, the aquatic habitats presently afforded by Leon Creek are poor at best. No important sport fisheries or critical aquatic habitats will be lost. The entire stream will eventually resemble the intermittent segment which now exists above the Leon Creek plant.

The segment of the San Antonio River below the Rilling Road plant will eventually benefit from the removal of secondary treated effluent. Though flows will be substantially reduced (see Figure 5-2) in this segment, water quality should generally improve. As flows are reduced, the areas of streambed exposed will provide temporary breeding places for flies/mosquitos. Algae and macrophytes will decay, possibly causing temporary odor or water quality impacts. However, when flows are stabilized, the spring fed waters will eventually offer higher quality aquatic habitat than this segment now offers. It is important to note that although the habitat quality will be better, there will be less habitat available as a result of the flow reduction.

The new Confluence plant will discharge about 137 MGD of tertiary-treated effluent into the San Antonio River just above its confluence with the Medina River. Flows below the new plant will be essentially the same as they are today. Water quality in this stream segment will improve. The dissolved oxygen levels of less than 5 mg/ℓ now observed (see Figure 5-5) will rise to about 5 mg/ℓ. Ammonia nitrogen levels will decrease to about 2.5 mg/ℓ. Nutrients (i.e., nitrogen and phosphorus) will not be removed by the new treatment, however, and nutrient loading of the river will continue. As a result, the growths of aquatic macrophytes now observed in the river should continue to be abundant and dense. The projected rise in dissolved oxygen and diminution of ammonia should generally improve aquatic habitat quality below the new Confluence plant. Because flows will remain about the same, no decrease in the amount of aquatic habitat is anticipated.

B. Interceptor System

The routes which could potentially cause the most severe direct and indirect impacts on aquatic habitats are those proposed for previously unsewered areas north and west of the city. More specifically, lines to be laid in, across, or on the banks of Elm, Mud, or Panther Springs Creeks will cause major adverse aquatic impacts. Because these streams occur in the urban halo of San Antonio, their water quality is still good. These are small, intermittent streams and do not support important sport fisheries. Their value to the ecosystem is derived from the clean water and riparian habitat that they provide for resident wildlife.

Direct short-term and long-term environmental impacts in these areas will be caused by siltation and sedimentation of these streams. Removal of riparian vegetation for interceptor rights-of-way and excavation in the stream channel to lay pipelines will cause a considerable amount of siltation. When the lines are laid and construction ceases, lack of a riparian buffer will continue to cause bank erosion and subsequent sediment loading during storm events. Indirect impacts will be caused by further removal of vegetation and increased urban runoff as these newly sewered areas undergo development.

Major adverse environmental impacts will also be caused by sewer interceptors laid in or near Salado Creek. Comparatively long rights-of-way will destroy the riparian vegetation which remains along the affected segments. Short and long term direct impacts will be caused by siltation and sedimentation of Salado Creek when the lines are laid. Erosion of the streambank and additional sedimentation will be more significant here because of the absence of a riparian buffer. This is particularly true in the southern third of the creek. Springflow in this segment makes aquatic habitats generally good. Some of these areas are locally important as sport fisheries or general recreation areas. In addition, sediment loading of Salado Creek will also cause additional sediment loading of the San Antonio River.

5.1.2.4 Sensitive Natural Areas

A. Treatment Plants and Transfer Lines

None of the previously identified biologically sensitive natural areas (see Section 2.1.3) will be disturbed or destroyed by construction and operation of new treatment facilities or the three large transfer lines. The Edwards aquifer recharge zone is also not expected to be significantly affected.

B. Collection System

Riparian vegetation and wildlife which persist along the southern third of Salado Creek are considered sensitive because they represent all that remains of a once extensive floodplain forest. Similarly, mature native bald cypress and pecan trees which remain along the San Antonio River in metropolitan San Antonio are irreplaceable resources.

Mature native trees in or along rights-of-way, particularly those in city parks, will be protected from construction damage to the maximum possible extent. In other areas, rights-of-way will be kept as narrow as possible, and construction access road will be limited in number. All areas denuded of vegetation will be quickly revegetated.

In the northern and western urban halo areas, nearly natural vegetative associations and wildlife are sensitive because they have not yet been subjected to high density urbanization. Construction of interceptor segments in these areas will cause serious adverse impacts. Once removed, riparian vegetation in these areas will be slow to regenerate, and likely will be permanently lost. Habitats which this vegetation afforded to wildlife will also be lost, which will cause affected species to disappear.

The construction that will be undertaken during rehabilitation of existing sewer lines will occur primarily in areas that are already disturbed. Thus the impacts of this rehabilitation work are expected to be minimal.

Future developments constructed in newly sewered areas will continue this trend of vegetation removal and wildlife displacement. Nearly natural vegetation north and west of the city which presently acts as a buffer for sensitive species like the golden cheeked warbler will be seriously depleted.

The recharge zone of the Edwards aquifer could potentially be affected by leakage from some of the collection system line segments. This hazard should be minimized if the provisions of Texas Department of Water Resources Order #77-0303-3 are followed. The Edwards recharge zone may also be potentially affected by urban growth that will be supported by the proposed project. As noted earlier in this chapter, the City of San Antonio has commissioned a study to determine the type and amount of urbanization that can occur over the recharge zone without significantly affecting the water quality of the Edwards. The impacts of urbanization can be more accurately predicted and controlled when the results of this study are available.

The proposed project is not expected to have any direct adverse impact on any threatened or endangered species occuring in the San Antonio area. If urbanization has a substantial impact on ground-water quality in the Edwards aquifer, the sensitive and endangered species of salamanders and blind catfish dwelling in the aquifer could also be adversely affected (see Section 2.1.3). Provided that the recommendations of the City's study of the aquifer are adopted as city policy, and provided that urban growth and its water quality impacts are controlled by this policy, the effects on these species should be minimal. The salamander at the Valdina Farms location (Eurycea troglodytes) will not be affected because the direction of ground-water flow in the San Antonio area is not toward the salamanders' location. Also, it should be pointed out that the urban growth that will be supported by the proposed project may occur even if the project were not built. Therefore, the urban growth effects on these species are possible even without the project. The impacts on the two plants proposed for listing as an endangered species are also expected to be minimal. The Emory acacia has not been documented in Bexar County, and the Plateau milkvine will not be directly affected by the proposed project. Any indirect effects on the milkvine by urbanization would likely occur even if the proposed project were not built.

5.2 Man-Made Environment

The proposed action, including the expanded collector system, will cause changes to occur in the man-made environment at two levels. First, there will be direct impacts associated with (1) the work force required for construction and operation of the proposed action, and (2) the effects on people living and working near the various components. Second, there will be indirect effects of an expanded sewage treatment system related to the population growth which can be expected. Each of the major components considered in the man-made environment section of Chapter 2 will be addressed from these two perspectives so that the consequences of the proposed actions can be understood.

5.2.1 Demography

Demographic effects are those related to the population of an area. The major problems which may arise, either in the short-term or the long-term will manifest themselves in (1) change in population size, (2) change in demographic characteristics (age, ethnicity, etc.), or (3) change in geographic distribution.

5.2.1.1 Direct Effects of Extended Sewage Collection System

The majority of the collection system extensions are in rural, undeveloped areas. While there may be some irritation due to the construction activities, few, if any, people should be displaced because of right-of-way acquisition. Collectors in urban areas will follow existing rights-of-way. Other than short-term disruptions, there will be no adverse impacts.

5.2.1.2 Indirect Effects of Extended Sewage Collection System

Upgrading and expanding the collection system in the 201 planning area will have a definite effect on the future geographic distribution of population. A more thorough discussion of this impact will be reserved for the land use section. It will suffice in this section to mention that the system is being expanded to accommodate the spatial distribution as presented in the San Antonio Growth Sketch (SA-304). That sketch features relatively low-density, suburban-type development at the periphery of the city, especially in the northern part. This housing will tend to be occupied by middle-class families with children. The multi-family units in the growth sketch will tend to be occupied by families without children, that is, older people, single people, or childless couples.

Also, due to cost, these newly developed residential areas will tend to attract Anglo households rather than Blacks or Mexican-Americans. In general, these latter groups will remain in the southern and central portion of the city in less expensive housing. Thus, it can be concluded that the collection system will serve to maintain the current geographic patterns for demographic characteristics that are discussed in Section 2.2.

5.2.1.3 Direct Effects of the Treatment Plant and Transfer Lines

The various components of the selected alternative must be considered individually to adequately assess the direct population impacts. The expansion of the Leon Creek and Salado Creek plants will not have a noticeable effect. Likewise, the sewage transfer lines will have no effect, other than the possibility of temporary nuisance during construction as with the collector system (5.2.1.1).

The closing of the Rilling Road plant will have beneficial aesthetic and land-use impacts on the surrounding area (discussed below). However, that event should not affect the population size or characteristics of the area.

The building of a new plant at the confluence of the San Antonio and Medina Rivers will affect relatively few people directly. As Table 5-8 shows, this is a very sparsely settled area, considering the size of the area. Within one mile of the site, there are fewer than 100 people. No households will be displaced other than the current owner of the land at the site.

5.2.1.4 Indirect Effects of the Treatment Plants and Transfer Lines

The question of principal interest with regard to indirect effects is whether or not the proposed plant capacity is excessive, thus inducing inordinate growth. The capacity of the system will be expanded by only nine percent as a result of the proposed action. If the planned rehabilitation work on

TABLE 5-8

POPULATION NEAR CONFLUENCE SITE, 1975

Serial Zone	Population	Houses	Acres
410	144	41	4,305
420	139	42	2,950
421	140	40	2,100
422	119	36	2,295
	542	159	11,650

3.4 People/House

29.8 People/Square Mile

Source: SA-310

the sewage collection system reduces infiltration and inflow as expected, the projected flow decreases will be about equal to the flow increase expected to occur as a result of population growth. Thus, no large increases in treatment capacity are expected to be needed.

5.2.2 Economics

The direct effects of the various parts of the proposed project are associated with the money brought into the region by them and the jobs they provide. The indirect effects are less obvious and are related to the growth which may follow the provision of additional upgraded, wastewater treatment capacity. Both types of impacts are examined in the following sections.

5.2.2.1 Direct Effects of Extended Collection System

Table 5-9 shows preliminary cost estimates for the collection system to be built in the San Antonio area through the year 2000. These figures may appear somewhat high because they are escalated through the year 1990 at a compounded interest of 6 percent per year. Presumably, a large part of this money will be spent locally, and local contractors and local labor will benefit from these activities. Since the schedule is uncertain, employment figures are not available.

TABLE 5-9

COLLECTION SYSTEM COSTS

Type of Action	Cost (Million $)
Extensions for Temporary Treatment Plants	5
Extensions for Future Growth	11
Relief Lines	39
Extensions to Replace Life Stations	13
Interceptors (unsewered areas)	7
Internal Sewer Lines (unsewered areas)	55
TOTAL	130[1]

[1]Costs escalated to the mid-point of the planning period (1990) with 6 percent compounded inflation.

Source: BA-626

On the negative side, someone will have to pay for these collectors. Some of the collectors may be eligible for partial funding by EPA under the provisions of Section 201 of the FWPCAA. The difference will have to be made up by revenue bonds issued by the city. This, of course, means long-term indebtedness for the city. However, San Antonio has an excellent AA bond rating and a low 4.72% debt ratio ($147 per capita) in its favor to minimize the impact on public finance (WH-131). Also, the sewer rate increase (approximately 20 percent) to pay for these bonds will be very small for residential users when it is considered that the average monthly sewer charge is presently only $3.00. Industrial rates will increase 100 percent to help pay for increased costs. While the percentage increase is great, the actual increases should not be unbearable for industrial users since the previous rates were relatively low.

5.2.2.2 Indirect Effects of Extended Collection System

As with population growth, the economic growth projected for the City of San Antonio will be accommodated by the collection system. The geographical distribution of that growth will be examined in the land use section. Hence, the collection system will have very little indirect effect on the economy.

5.2.2.3 Direct Effects of the Treatment Plants and Transfer Lines

The selected alternative will be an economic stimulus for the San Antonio area. First, the construction activity will provide jobs in an areas where unemployment is fairly high. Table 5-10 shows the number of jobs associated with each of the major actions. Second, there will be additional jobs, approximately 71, for the operation and maintenance of the new and expanded facilities. Area residents will fill these jobs so that local spending will be increased. While these employment increases are beneficial, they are not major when the size of the total labor force is considered.

Another economic benefit will be the purchasing of equipment and construction materials from local sources. Approximately 30 percent of the construction costs are for materials.

TABLE 5-10

Action	Cost	Construction Employees	Additional Operations Employment
Transfer lines to new plant	$16.73	50 for 1 year	0
		50 for 2 years	
		50 for 2-5 years	
New Plant }	62.79	200 for 3 years	42
Salado Expansion }		50 for 1 year	16
Leon Expansion }		50 for 1 year	13
	$79.52		71

Source: BA-583

5.2.2.4 Indirect Effect of the Treatment Plants and Transfer Lines

As with indirect impacts on population, the proposed action will not serve to induce industrial or commercial expansion beyond that which can normally be expected. As noted earlier, the treatment capacity of the system will not be greatly changed because of the projected flow reductions by removal of a significant fraction of the infiltration and inflow. Thus, the treatment processes *per se* should neither promote nor discourage industrial discharges to the municipal system.

5.2.3 Land Use

Direct impacts on land use are related to the land which actually changes use at or near a particular site. These impacts are usually obvious and quantifiable. Less obvious are the indirect, long-term changes in land use which are related to residential, commercial, and industrial growth.

5.2.3.1 Direct Effects of Extended Collection System

In the very short term, some land will be temporarily lost to its existing use during the construction period. However, in the long term, this activity does not represent direct change in land use since the pipes will be covered and former uses usually reestablished.

As noted in Chapter 4, the expanded collection system will eliminate some of the small, city-owned, existing treatment plants. When this occurs, the beneficial impact of a change in land use at these sites to something were aesthetically pleasing should occur.

5.2.3.2 Indirect Effects of Extended Collection System

There is an ever-growing body of literature examining the long-term, indirect effects of expanded sewer collection systems (e.g., UR-013 or TA-149). One of the most difficult questions which must be addressed is whether the sewer system should lead (in time) or follow residential development. If it leads the development, a very strong land use control device will have been employed. If it follows, there will probably have been "leapfrog" development with package treatment plants, low-density development using septic tanks, and combinations of these two.

The collection system being developed in San Antonio will serve as an effective land use control device. Because of uncertainty about the environmental impact of residential development on the Edwards Recharge Zone, it appears wise to stop or limit "leapfrog" development in that area, at least temporarily. If the collection system were composed of lines running to unpopulated portions of the recharge zone, it would be encouraging leapfrogging. However, the system will be extended only to areas adjacent to the currently developed land. Furthermore, these areas will receive the great bulk of the anticipated growth between now and 2000 according to the San Antonio Growth Sketch (SA-304). San Antonio is planning for its future land use pattern and the collection system is being recognized as an effective tool to implement that plan. In general, the collector system will have a beneficial impact on the land use plan being implemented by San Antonio.

5.2.3.3 Direct Effects of the Treatment Plants and Transfer Lines

Approximately 100 acres will be required to build the new facility at the confluence of the Medina and San Antonio Rivers. That land is presently agricultural in use, and most of the site is classed as "prime agricultural" land.

The expansions at the Leon Creek and Salado Creek plants will take place on lands which are now part of the treatment facilities. Therefore, no new land will be required.

The three sewage transfer lines will temporarily disrupt current land use along 300 acres of right-of-way. This will be a temporary impact since approximately 75 feet of pipe can be laid per day and the land will revert to its current use.

5.2.3.4 Indirect Effects of the Treatment Plants and Transfer Lines

A beneficial effect of the proposed action will be the closing of the Rilling Road plant. This closing encourages some development in that southern portion of San Antonio near that plant. This aspect will be examined in more detail in Section 5.2.4.

The selected alternative may stimulate some development, both residential and commercial/industrial in southern San Antonio because of the increased service area of the new Confluence plant south of Loop 410. This should be considered as a beneficial impact because it may relieve some of the pressure in the northern portion of San Antonio. The less pressure there is in the north, the better will be the chances of protecting the Edwards Recharge Zone from unnecessary development.

5.2.4 Archaeological and Historical Resources

The archaeological and historical resources of Bexar County area are not self-sustaining and must be identified and evaluated in the 201 planning process. Measures, including a preliminary reconnaissance survey (PO-131), have been taken to protect these resources. Further work will be done in the remaining portion of Steps 1 as well as in Step 2 of the planning process to insure the protection of significant resources. The following sections highlight what is now known about the archaeological and historical resources that could be affected by the San Antonio 201 planning process.

5.2.4.1 Direct Effects of Expanded Collection System

A preliminary survey (FO-131) indicates that the potential for archaeological resources occurring along a number of the collection system routes is very high. The areas where these sites are located were presented in Section 2.2.4. Some of these sites may be important and will require further analysis before construction can proceed. San Antonio has already allocated funds and retained the Center for Archaeological Research at the University of Texas at San Antonio to perform this analysis.

5.2.4.2 Indirect Effects of Expanded Collection System

It is difficult to assess the archaeological significance of upland areas whose development will be supported by the collection system extensions. However, most resources of this type are found along the creeks already surveyed by the Center for Archaeological Research. While there may be resources exposed to risk as a result of the expansions, the probability is not as high as in the lowland areas.

5.2.4.3 Direct Effects of the Treatment Plants and Transfer Lines

Since little is known about the southern portion of Bexar County from an archaeological perspective, some adverse impact may occur. This is especially true of the site selected for the new plant at the confluence of the Medina and San Antonio Rivers. Furthermore, the sewage transfer lines from the Leon and Salado Creek plants may expose heretofore undetected resources. Finally, the entire area may contain historic remnants since it is part of the Jose de la Garza land grant. Thus, some further historical research will be required.

On the beneficial impact side, the proposed action will include the eventual closing of the Rilling Road plant. This plant is adjacent to the proposed Mission National Historic Park, and the plant serves as a deterrent to tourist activity at the Mission Espada and Espada Aqueduct. It would certainly be a very beneficial effect for San Antonio and Texas for this plant to be closed (see Chapter 3 and Appendix 1).

5.2.4.4 Indirect Effects of the Treatment Plants and Transfer Lines

As with the indirect effects of the extended collection system, little can be predicted with respect to resources endangered by urban growth. Southern Bexar County has not historically been attractive for growth and probably will not become a highly developed area in the near future. Hence, existing resources will probably remain unaffected.

5.2.4.5 Summary

Extensive archaeological surveys will be conducted in all archaeologically sensitive areas which will be affected by construction of the wastewater treatment and collection system. These surveys will be conducted as soon as specific locations of portions of the system are identified in Step 2 of the planning process. A condition will be placed on the Step 2 grant which will require the completion of all surveys to the satisfaction of EPA, the State Historic Preservation Officer (SHPO), the Advisory Council on Historic Preservation (ACHP), and the National Park Service. If the surveys identify any resources eligible for inclusion on the National Register of Historic Places, the SHPO will be advised and the ACHP will be afforded an opportunity to comment in accordance with its procedures (36 CRP Part 800) prior to any action being taken which might affect the resources. If any significant resources are discovered during Step 3 (construction), work will be halted, the SHPO will be contacted and the ACHP will be allowed to comment if appropriate.

5.2.5 Resource Use

In terms of direct impact, both the expanded collection system and the selected alternative will be costly (30 percent) for construction materials (steel, stone, cement, etc.). Yet, these materials are not in short supply in San Antonio and their provision will represent an economic stimulus to local business. From a power perspective, the selected alternative will require considerable amounts of electricity (10,000 MW-hours per year for the new plant). However, this should not have a significant impact on the total San Antonio power supply, especially in light of the construction activities (South Texas Nuclear and Deely Plant) now underway.

Residential, commercial, and industrial expansion will represent an indirect impact on resources. However, to minimize resource waste, a concentrated city should be encouraged. The selected alternative and the expanded collector system are planning tools being used by the city to promote this type of growth as much as possible. Since urban sprawl and "scatterization" are so expensive (RE-118), any measure which might limit that type of development should be encouraged from a resource conservation perspective.

5.2.6 Transportation

Any construction activity such as sewer line installation will have a detrimental effect on the normal flow of highway traffic. In the peripheral areas, collector system construction will cause minor problems. New lines or enlarged lines in already urbanized areas will be more serious in their disruption. However, since the construction activity progresses geographically and is relatively short-term in nature, it should not be considered as a severe impact.

The selected alternative will cause an increase in traffic volume to the Confluence site for the three-year construction period. However, the increase will be small relative to the total volume of traffic in that area. Also, the roads in that area can accommodate the growth increment.

The growth of San Antonio will require expanded transportation services and facilities. However, it has been assumed that a certain amount of growth (as set forth in the Growth Sketch, SA-304) will occur with or without the selected alternative. Hence, indirect effects brought about by to the selected alternative will be minimal.

5.2.7 Sensitive Man-Made Areas

Clearly, the collector expansions and the selected alternative are not going to be unnoticed by the people of San Antonio. There will be some inconveniences during construction. Also, care will be necessary to protect archaeological resources which are yet to be discovered. The sensitive historic sites in the proposed Mission National Historic Park will be enhanced by the removal of the Rilling Road treatment plant, as noted above. The planning process for the Section 201 activities has been extensive, including citizen participation and the input of various planning experts in government. There does not appear to be a conflict between the activities under consideration and important features of the cultural environment.

6.0 HIGHER-ORDER EFFECTS OF THE PROPOSED ACTION

Not all environmental impacts of the proposed program to upgrade the wastewater treatment facilities for the City of San Antonio are addressed in Chapter 5. Some of the impacts are too broad in scope or too interdisciplinary to be covered adequately in the various disciplines. Some impacts are covered in part in different disciplines, but need to be discussed *in toto* to provide an overall perspective. The main purpose of this chapter is to bring out impacts not previously identified and to give an overall view of topics discussed only piecemeal in earlier chapters.

One of the most significant effects of the proposed project is its potential impact on the water quality planning efforts being conducted by the Alamo Area Council of Governments under the provisions of Section 208 of the FWPCAA. However, as noted in Chapter 1, a series of coordination meetings were held between representatives of the 201 and 208 water-quality planning efforts to ensure that the goals and methodologies of the two remain in line with each other and to prevent conflicts between the two programs. Also, continuous contact between 201 and 208 representatives has been maintained. As a result of this coordination, the proposed action is consonant with the 208 planning efforts, and it does not foreclose any of the options under consideration by the Alamo Area Council of Governments.

6.1 Irreversible and Irretrievable Commitment of Resources

Several resources that will be consumed during construction and operation of the wastewater treatment facilities additions have been identified in earlier sections. During construction and emplacement of pipelines for the sewage transfer lines, several acres of soil, including considerable quantities of prime farmland soil, will be removed from productivity. However, this loss of productivity will be temporary and will last for no longer than a single growing season at most. Construction for the new Confluence treatment plant and the additions to the Leon Creek and Salado Creek treatment plants will result in permanent removal of about 100 acres of prime farmland soil from productivity. However, this loss is not excessive in consideration of the thousands of acres of prime farmland soils available in southern Bexar and adjoining counties. Much of this acreage is not used intensively for cash crop production, but is used only as hayland. Some of this hayland acreage could be put into crop production to make up for the losses at the Confluence site.

The construction material resources that will be consumed for the new plant and plant additions are readily available in the San Antonio area. This consumption is probably better viewed as a positive stimulus to the economy rather than as a serious loss of resource.

After the treatment facilities are constructed and in operation, the primary resource that will be required is energy, particularly electrical energy. This demand will contribute to the gas shortage problem in Texas, at least for the short term, inasmuch as most of the city's power plants are gas-fired at present. As the two new power plants (one of which is nuclear-powered and one of which is lignite-fired) are brought on line, the stress on the gas resources will be alleviated. Also, the power consumed by the wastewater treatment plants is small in the total San Antonio power consumption picture.

The population growth that will occur during the design period of the proposed project will consume much larger quantities of resources than the project will require directly. The major resources consumed will include:

- Land and soil resources, including at least some prime farmlands, required for urban development;
- ground-water (and possibly surface water at a later date) for municipal water supplies;
- energy resources for both home and commercial uses and for transportation; and
- food resources for the populace.

These resources, and other less significant resources as well, are not quantified at this time. It should be noted that the objective of the proposed project is to support population growth that is expected regardless if the project is actually constructed. Thus the proposed project should not be viewed as contributing to excessive urban growth of San Antonio.

The Edwards aquifer and the abundant ground water that it contains is a topic of great concern to the citizens of San Antonio and Bexar County. The almost total reliance of the city and the military installations on the aquifer as a water source, the increasing withdrawals from the aquifer for municipal needs as the city's population grows, the wide perception of the aquifer's susceptibility to contamination by urbanization, the encroachment of San Antonio urban growth over the recharge zone of the aquifer, and the presence of interest groups who wish to protect the aquifer have all combined to bring the issues of the aquifer to the forefront of public attention. Recent city attempts to temporarily prevent urban growth over the recharge zone, and the continuing city policy to discourage intensive urban development over the zone (through subdivision control in the city's zone of extraterritorial jurisdiction), are the result of the widespread public concern for its municipal water supply. It is imperative that the recommendations from ongoing studies of the type and amount of urban development that can be sustained over the recharge zone without damage to the water quality of the aquifer be instituted as city policy as soon as the results of the studies are known. These studies are in progress under the city's auspices at present. Also, steps should be taken as soon as practicable to derive an aquifer management plan in order to protect the aquifer from depletion, particularly during droughts, in order to ensure a continuing supply of water for the city. It is likely that at some time in the future consideration will again have to be given to using surface-water sources to supplement the water supply from the Edwards aquifer.

6.2 Relation of Short-Term Use to Maintenance of Long-Term Productivity

The primary objective of the proposed project is to upgrade the quality of wastewater effluent from the city of San Antonio so as to improve the water quality of the receiving streams. Once the stream quality has attained the standards established in the San Antonio River Basin Plan (prepared under the provisions of Section 303e of FWCPCAA), then the streams should be able to sustain the water uses deemed desirable for them. These uses include domestic raw water supply, propagation of fish and wildlife, and noncontact recreation (TE-263).

The upgrading of the stream quality to meet standards may not be totally achieved in all stream segments and at all times as a result of this project, largely because of other point sources (such as military installations) and non-point sources of pollution, notably urban runoff. Pollution control efforts by the Alamo Area Council of Governments under the provisions of Section 208 of the FWPCAA should help alleviate non-point sources of pollution. Federal efforts to bring the Federal installations into the same type of effluent limitation compliance as is being imposed on municipalities should reduce the pollutant loads from military installations.

The proposed project is nevertheless the most effective measure that can be taken to upgrade the streams at present because municipal effluent is the largest single source of pollution to area streams. A notable improvement in stream quality, and an attendant improvement in biological productivity, should occur after the project is built. A price must be paid in peripheral adverse environmental effects, as noted in Chapter 5 of this EIS, but the long-term enhancement of stream quality and biological productivity should greatly outweigh these peripheral effects.

7.0 COORDINATION WITH OTHERS

CONTACT	PURPOSE
U.S. Geological Survey Texas District Office Austin, Texas	Obtain various information on surface water records, open file reports and flood maps.
U.S. Department of Agriculture Soil Conservation Service Field Office San Antonio, Texas	Obtain Bexar County soil survey.
U.S. Department of Agriculture Soil Conservation Service State Office Temple, Texas	Determine "prime farmland" status of soils in Bexar County.
National Park Service Southwest Regional Office Santa Fe, New Mexico	Verify status of proposed San Antonio Missions National Historical Park.
Texas Air Control Board Austin, Texas	Obtain air quality data for study area.
Texas Air Control Board San Antonio, Texas	Obtain air quality data for study area.
Texas Department of Water Resources Austin, Texas	Obtain permits and board orders for Mitchell Lake clean-up.
Texas Parks & Wildlife Dept. Austin, Texas	Obtain data on aquatic macrophytes.
Texas Parks & Wildlife Dept. Austin, Texas	Determine regional status of big and small game species.
Texas Department of Water Resources Austin, Texas	Coordinate archaeological survey.
Texas Archaeological Research Lab Balcones Research Center Austin, Texas	Obtain baseline archaeological and historical data.

CONTACT	PURPOSE
Texas Department of Water Resources Austin, Texas	Obtain Qual II model results for proposed action and discuss implications of those results.
City of San Antonio Engineering Department San Antonio, Texas	Determine status of any city drainage policy.
City of San Antonio Metropolitan Health District San Antonio, Texas	Obtain air quality data and odor complaint records.
City of San Antonio Metropolitan Health District San Antonio, Texas	Determine fish kills in areas lakes.
City of San Antonio Dept. of Public Works San Antonio, Texas	Discuss status of Edwards aquifer study.
Chamber of Commerce San Antonio, Texas	Obtain economic indicators.
City of San Antonio City Public Service San Antonio, Texas	Determine acceptability of discharges treated wastewater to CPS cooling lake.
City of San Antonio City Public Service San Antonio, Texas	Obtain air quality data for coal-fired power station.
San Antonio River Authority San Antonio, Texas	Obtain data on benthic macroinvertebrates.
San Marcos Fish Hatchery San Marcos, Texas	Obtain data on aquatic macrophytes.
The University of Texas at San Antonio Center for Archaeological Research San Antonio, Texas	Coordination of archaeological survey.
City of San Antonio Historic Preservation Officer San Antonio, Texas	Collect data concerning historical resources.

CONTACT	PURPOSE
City of San Antonio Department of Planning San Antonio, Texas	Procure land use data, economic and demographic data, and Growth Sketch information.
Alamo Area Council of Governments San Antonio, Texas	Obtain regional, social, and economic data.
San Antonio River Authority San Antonio, Texas	Obtain planning data.
Alamo Area Council of Governments Water Resources Consultant Blanco, Texas	Obtain water quality information concerning direct discharge of treated wastewater CPS cooling lakes.
Alamo Area Council of Governments Water Quality Specialist San Antonio, Texas	Review status of 208 activities to coordinate with EIS efforts.
Alamo Area Council of Governments 208 System Manager San Antonio, Texas	Obtain description of AACOG's proposed planning efforts in area wide planning.
Alamo Area Council of Governments 208 Project Director San Antonio, Texas	Obtain copy of water quality modeling data of the San Antonio River Basin.
San Antonio River Authority San Antonio, Texas	Discuss water quality modeling data developed by SARA.

BIBLIOGRAPHY

AL-144 Alamo Area Council of Governments, Preliminary Analysis of Nutrient Loads to Lake Calaveras and Lake Braunig, San Antonio, Texas, December 1969.

BA-494 Baker, Joe M., Private Communication: "Summary of Preliminary Effluent Disposal Alternatives, San Antonio 201 Planning Area", Joint Venture, October, 1976.

BA-583 Baker, Joe M., Private Communication, City of San Antonio, Department of Public Works, July 29, 1977.

BA-A-626 Baker, Joe M., Private Communication, Pape-Dawson, Inc., Vickrey and Associates, Inc., and Lockwood, Andrews, and Newnam, Inc., Austin, Texas, 27 December 1977.

BA-A-647 Baker, Joe M., Private Communication, Pape-Dawson, Inc., Vickrey and Associates, Inc., and Lockwood, Andrews, and Newnam, Inc., Austin, Texas, March 6, 1978.

BA-A-648 Baker, Joe M., Private Communication, Pape-Dawson, Inc., Vickrey and Associates, Inc., and Lockwood, Andrews, and Newnam, Inc., Austin, Texas, March 14, 1978.

BL-118 Blair, Frank, "The Biotic Provinces of Texas", Reprint, Tx. J. Sci. 2(1), (1950).

BO-054 Bolt, Beranek, and Newman, Noise From Construction Equipment and Operations, Building Equipment, and Home Appliances, PB 206 717, Cambridge, Masschussetts, 1971.

BR-333 Brune, G., Recharge of the Edwards Limestone Reservoir, Texas, Fort Worth, Texas, U.S. Soil Conservation Service, South Regional Technical Service Center, 1966.

CH-196 Cheremisinoff, Paul N. and Richard A. Yound, eds., Pollution Engineering Practice Handbook, Ann Arbor, Michigan, Ann Arbor Science, 1975.

CO-RF-547 Code of Federal Regulations 40, Protection of the Environment Pts. 50-59, Revised Edition, Washington, D.C., General Services Administration, Office of the Federal Register, July 1976.

DE-221 DePree, Jeff, Russell L. Masters, and Roy Quiroga, Water Quality Modeling Data, San Antonio Planning Region, Summary Report, San Antonio River Authority, August, 1976.

DI-123 Dietz, Elgin M.C., Statewide Noxious Vegetation Control, Job No. 15a 16, Chemical Control of Water Hyacinths (Eichornia crassipes) on the San Antonio River and Its Tributaries in Bexar and Wilson Counties, Texas, Texas Parks and Wildlife Department, May 1964.

EN-071 Environmental Protection Agency, Compilation of Air Pollutant Emission Factors, 2nd Edition with Supplements, AP-42, Research Triangle Park, North Carolina, Feb. 1972, April 1973, July 1973, September 1973, July 1974, January 1975, December 1975, February 1976, April 1977.

EN-108 Environmental Protection Agency, Office of Noise Abatement and Control, Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare With an Adequate Margin of Safety, EPA 550/9-74-004, Washington, D.C., 1974.

EN-483 Environmental Science and Engineering, Inc., Evaluation of Potential Odor and Noise Production from the Proposed Arlington East Sewage Treatment Plant, 2 vols., EPA Contract Order No. 68-01-2384, Task 1, Gainesville, Florida, September, 1975.

EN-485 Engineering-Science, Inc., North Carolina Air Quality Maintenance Area Anlaysis, Final Report, Vol. 1., EPA Contract No. 68-02-1380, Task 7, McLean, Virginia, April, 1976.

EN-502 Environmental Protection Agency, "Proposed Amendments to the Texas Hydrocarbon/Photochemical Oxidant Strategy", Preliminary, 40 CFR Pt. 52.

EN-609 Environmental Protection Agency, "Texas, Required Revision to Implementation Plan for Particulate Matter", Fed. Reg. 41(138), 29488 (1976).

FO-131 Fox, Anne A., An Archaeological Assessment of the San Antonio 201 Wastewater Treatment Project, Draft Report, San Antonio, Texas, University of Texas, Center for Archaeological Research, undated.

FO-145 Fox, Anne A., An Archaeological Assessment of the San Antonio 201 Wastewater Treatment Project, Final Report, Archaeologic Survey Report No. 41, San Antonio, Texas, The University of Texas at San Antonio, Center for Archaeological Research, 1978.

FU-065 Fulton, Joe, Private Communication, City Public Service, San Antonio, Texas, September 10, 1976.

GA-195 Garza, Sergio, Ground-Water Resources of the San Antonio Area, Texas. A Progress Report on Studies, 1960-64. TXWDB Report 34, U.S. Geological Survey, November, 1966.

GE-147 Gehlbach, F.R., Clark Hubbs, and Robert A. Thomas, Summary Statements on Rare, Endangered and Peripheral Fishes, Amphibians and Reptiles in Texas, May 1973.

GL-070 Glass, Peggy W., Private Communication: "Coordination Meeting on 208/201 Planning Between City of San Antonio and Alamo Area Council of Governments, Nov. 17, 1976, Meeting Summary", Texas Water Quality Board, November 24, 1976.

GO-190 Gould, F.W., Texas Plants, A Checklist and Ecological Summary, MP-585/Revised, College Station, Texas, Texas A&M University System, Texas Agricultural Experiment Station, January 1975.

GR-348 Grauvogel, Larry, Private Communication, City of San Antonio, Public Works Department, August 8, 1977.

HA-515 Hansen, Harry, ed., Texas. A Guide to the Lone Star State, Revised Edition, New York, Hastings House, 1969.

HE-163 Hershfield, David M., Rainfall Frequency Atlas of the United States for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years, Technical Paper No. 40, Washington, D.C., U.S. Weather Bureau, May 1961.

HI-196 Higby, Richard, Private Communication, City of San Antonio, Comprehensive Planning Department, June 23, 1977.

HO-049 Holzworth, George C., Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States, AP-101, Research Triangle Park, North Carolina, EPA, 1972.

JA-149 James, Stephen N. and James M. Wiersema, An Ecological Survey and Assessment of the Proposed Environmental Development Plant for San Antonio Ranch-Title VII New Town, Tracor Project 077-020-01, Document No. T72-AU-9539-U, Austin, Texas, Tracor, June 1972.

KE-186 Keeter, Tom, Private Communication, City of San Antonio, Parks and Recreation Department, August 1976.

KL-042 Klemt, William B., et al., Ground-Water Resources and Model Applications for the Edwards (Balcones Fault Zone) Aquifer, Austin, Texas, Texas Water Development Board, March 1975.

LE-309 Leopold, Luna B., Hydrology for Urban Land Planning - A Guidebook on the Hydrologic Effects of Urban Land Use, USGS Circular 554, Washington, D.C., GPO, 1968.

LO-228 Lockwood, Andrews & Newnam, Inc., San Antonio 201 Facility Plan Salado Creek Wastewater Treatment Plant Preliminary Engineering Information for EIS - Alternative 3B, Austin, Texas, October 1977.

LO-229 Lockwood, Andrews & Newnam, Inc., San Antonio 201 Facility Plan Leon Creek Wastewater Treatment Plant Preliminary Engineering Information for EIS-Alternative 3B, Austin, Texas, October 1977.

LO-230 Lockwood, Andrews & Newnam, Inc., San Antonio 201 Facility Plan Transfer Lines for Alternative 3B, Austin, Texas, October 1977.

LO-231 Lockwood, Andrew & Newnam, Inc., San Antonio 201 Facility Plan Confluence Site Wastewater Treatment Plant Preliminary Engineering Information for EIS-Alternative 3B, Austin, Texas, November 1977.

MA-581 Maclay, R.W. and P.C. Rettman, Hydrologic Investigations of the Edwards and Associated Limestones in the San Antonio Area, Texas-Progress Report, 1970-71, Edwards Underground Water District, 1972.

ME-050 Memphis State University, Effects of Noise on Wildlife and Other Animals, PB 206 720, 1971.

ME-222 Menke, James, Private Communication, Texas Air Control Board, San Antonio, Texas, December 6, 1977.

NA-273 National Climatic Center, Local Climatological Data, Asheville, North Carolina, (1973-1975).

OL-046 Oliver, J., et al., Seismology, Responsibilities and Requirements of a Growing Science, Pt. 1, Washington, D.C., National Academy of Science, 1969.

OR-021 Orton, Robert, Climatography of Texas, Austin, Texas, National Weather Service.

PA-193 Patterson, W.L. and R.F. Banker, Estimating Costs and Manpower Requirements for Conventional Wastewater Treatment Facilities, Kansas City, Missouri, Black & Veatch, October 1971.

PA-237 Painter, Dean E., Algae Ecology Related to Phosphate Reduction in Mitchell Lake, Thesis, Trinity University, 1968.

PA-254 Pape-Dawson, Inc., Vickrey & Associates, Inc., and Lockwood, Andrews & Newnam, Inc., Waste Treatment Study, San Antonio 201 Facility Planning Areas, Interim Report, November 1976.

PA-275 Pape-Dawson, Inc., Vickrey & Associates, Inc., and Lockwood, Andrews & Newnam, Inc., Planning Area and Collection System Studies, Interim Report, San Antonio 201 Facility Planning Areas, C-48-1211-01-0/C-48-1279-01-0, February 1977.

PO-167 Pound, Charles E., Ronald W. Crites, and Douglas A. Griffes, Cost of Wastewater Treatment by Land Application, Technical Report, EPA-430/9-75-003, EPA Contract No. 68-01-9066, Washington, D.C., EPA, Office of Water Program Operations, June 1975.

PO-210 Porter, Roy W., et al., Drainage Criteria Manual, 1st Edition, U.R.S./Forrest & Cotton, Inc., Espey, Huston & Associates, Inc., and City of Austin, Engineering Department, January 1977.

PR-133 Pritchard, David L., Statewide Fishery Management Recommendations. Job A: Existing Reservoir and Stream Management Recommendations, Texas Parks and Wildlife Department, Inland Fisheries Management Program, April 1976.

PU-065 Pulich, Warren, M., The Golden-Cheeked Warbler, Austin, Texas, Texas Parks and Wildlife Department, 1976.

RA-304 Rathburn, Dwayne, Intensive Surface Water Monitoring Survey for Segment No. 1906, Leon Creek, Texas Water Quality Board, Field Operations Division, 1974.

RA-310 Ramsdell, Charles, San Antonio, A Historical and Pictorial Guide, Revised Edition by Carmen Perry, Austin, Texas, University of Texas Press, 1976.

RA-R-420 Technical Reference Document Prepared for San Antonio Wastewater Treatment Facilities, EIS, Austin, Texas, Unpublished.

RE-118 Real Estate Research Corporation, The Costs of Sprawl. Environmental and Economic Costs of Alternative Residential Development Patterns at the Urban Fringe, 1974.

SA-244 San Antonio, City of, Texas, Community Development Office, Comprehensive Planning Division, A Report on Population: San Antonio and Bexar County, San Antonio, Texas, May 1973.

SA-245 San Antonio, City of, Texas, Comprehensive Planning Division, Planning and Community Development Department, A Report on Population: San Antonio and Bexar County. Population Projections Updated September 1975, San Antonio, Texas, September 1975.

SA-246 San Antonio, City of, Texas, City Planning Department, Community Renewal Program, San Antonio Historic Survey, 1972. Historic Resource Data Cards and Instruction Manual, San Antonio, Texas, Undated.

SA-259 San Antonio, City of, Texas, Water Pollution Control, San Antonio, Texas, San Antonio, Texas, Undated.

SA-261 San Antonio, City of, Texas, Planning and Community Development Department, Community Analysis Division, *San Antonio Housing Plan, Phase I: 1975-1980*, San Antonio, Texas, 1975.

SA-263 San Antonio, City of, Texas, Planning and Community Development Department, *Short Range Major Thoroughfare Plan*, San Antonio, Texas, October 1974.

SA-264 San Antonio, City of, Texas, *Alternative Growth Study*, San Antonio, Texas, June 1975.

SA-265 San Antonio, City of, Texas, *Growth Sketches for San Antonio*, San Antonio, Texas, January 1976.

SA-267 *San Antonio, City Public Service Thirty-Fourth Annual Report, Fiscal Year Ended January 31, 1976*, San Antonio, Texas, 1976.

SA-304 San Antonio, City of, Texas, Department of Planning, *San Antonio Growth Sketch*, January 1977.

SA-M-307 San Antonio, City of, Texas Planning Department, *Generalized Land Use (Existing Land Use, January, 1975)*, Map, May 1976.

SA-310 San Antonio, City of, Texas Planning Department, *Existing Land Use in Acres*, 1976

SA-329 San Antonio, City of, Texas, *Wastewater Treatment City of San Antonio, Annual Report, 1976*, San Antonio, Texas, Undated.

SU-100 Suhm, Dee Ann, "A Review of Central Texas Archeology", Tx. Archeol. Paleontol. Soc. Bull. 29, 63-107 (1958).

TA-111 Taylor, F.B., Soil Survey-Bexar County, Texas, Series 1962, No. 12, U.S. Department of Agriculture, Soil Conservation Service With the Texas Agricultural Experiment Station, June 1966.

TA-114 Taylor, Ron, Effect of Direct Wastewater Discharge on the Cooling Water and Recreational Uses of Lake Braunig and Lake Calaveras, Austin, Texas, University of Texas, Environmental Health Engineering, June 1975.

TA-149 Tabors, Richard D., Land Use and the Pipe, Lexington, MA, D.C. Heath & Company, 1976

TE-254 Texas Water Quality Board and U.S. Geological Survey, Salado Creek Sampling Data Station 1901.1, 5-10-74 to 5-7-76 and Station 1901, 005, 7-23-74 to 7-27-76.

TE-256 Texas Parks and Wildlife Department, Fish Data for Medina River and Its Diversion Lakes, and Woodlawn, Elmendorf, and Esquivel Lakes on the San Antonio River, 1963.

TE-RF-257 Texas Almanac, 1976-1977, Dallas Morning News.

TE-259 Texas Organization for Endangered Species, Plant Classification, October, 1975.

TE-263 Texas Water Quality Board, Texas Water Quality Standards, Austin, Texas, February 1976.

TE-322 Texas Air Control Board, Information for Listing Areas in the State of Texas That Do/Do Not Meet the National Ambient Air Quality Standards, Austin, Texas, October 1977.

TE-325 Texas Water Rights Commission, Notice of the Preliminary Determination by the Texas Water Rights Commission of All Claims to Water Rights in the Medina River Watershed of the San Antonio River Basin, September 1976.

TE-326 Texas Water Rights Commission, Notice of the Preliminary Determination by the Texas Water Rights Commission of All Claims to Water Rights in the San Antonio River Basin Excluding the Medina River and Cibolo Creek Watersheds, October 1976.

TE-328 Texas Water Commission, Permit for City of San Antonio, Texas, To Dispose of Wastes from Lake Mitchell, Permit No. 10137-04, Austin, Texas, November 1977.

TE-331 Texas Water Development Board, Intensive Surface Water Monitoring Survey for Segment No. 1906, Leon Creek, Draft Report, Austin, Texas, 1974.

TH-136 Thomas, Robert A., A Checklist of Texas Amphibians and Reptiles, Tech. Series #17, Texas Parks and Wildlife Department, 1974.

TH-138 Thurber, Marlys Franc, Proposed San Antonio Missions National Historical Park: Alternatives for Implementation, Santa Fe, New Mexico, National Park Service, Division of Cultural Resources, 1975.

TH-188 Thompson, Charles, Private Communication, Texas Soil Conservation Service, 13 December 1977.

TU-001 Turner, D. Bruse, Workbook of Atmospheric Dispersion Estimates, Revised, AP-26, Air Resources Field Research Office, Environmental Science Services Administration, 1969.

TW-005 Twidwell, Steve R., Intensive Surface Water Monitoring Survey for Segment No. 1901, San Antonio River, Report No. IMS30, Texas Water Quality Board, Field Operations Division, 1975.

UR-013 Urban Systems Research and Engineering, Inc., Interceptor Sewers and Suburban Sprawl: The Impact of Construction Grants on Residential Land Use, Final Report, 2 vols., PB 236-871, Cambridge, MA., July 1974.

US-043 U.S. Army Medical Research Lab., The Effects of Noise On Work Output and Physiological Activation, Fort Knox, Kentucky, 1956.

US-054 U.S. Department of Commerce, Bureau of the Census, _General Social and Economic Characteristics, Texas_, Washington, D.C., 1972.

US-122 U.S. Department of Commerce, Social and Economic Statistics Admin., Regional Economic Analysis Division, _1972 OBERS Projections. Economic Activity in the U.S. 1929-2020_, 7 vols., Statistics by Economic Area, Water Resources Region and Subarea, State, and SMSA and Non-SMSA Portions of the Areas, Historical and Projected, Washington, D.C., U.S. Water Resources Council, 1974.

US-155 U.S. Geological Survey, _The National Atlas of the United States of America_, Washington, D.C., 1970.

US-308 U.S. Department of Commerce, Environmental Data Service, _Climatic Atlas of the United States_, June 1968.

US-343 U.S. Department of Commerce, Social and Economic Statistics Administration, _County and City Data Book, 1972_, Washington, D.C. GPO, 1973.

US-398 U.S. Geological Survey, _Surface Water Supply of the U.S., 1961-65. Part 8, Western Gulf of Mexico Basin, Volume 2, Basins from Lavaco River to Rio Grande_, Survey Water-Supply Paper 1923, Washington, GPO, 1970.

US-793 U.S. Geological Survey, Water Resources Division, Water Resources Data for Texas, 1976, 3 vols., USGS/WRD/HD-77/034, Austin, Texas, July 1977.

US-845 U.S. Army, Corps of Engineers, Forth Worth, Texas, District, Floodplain Information, San Antonio River, Interstate 410 to County Line, Bexar County, Texas, June 1975.

VA-123 Van Note, Robert H., et al., A Guide to the Selection of Cost-Effective Wastewater Treatment Systems, EPA-430/9-75-002, EPA Contract No. 68-01-1973 and 68-01-1276, San Francisco, Bechtel, Inc., July 1975.

WH-131 White, Carl, Private Communication, City of San Antonio, Texas, 8 December 1977.

WI-217 Winkler, C.K., Private Communication, Texas Parks and Wildlife Department, August 1976.

YO-044 Young, Willard C., et al., The Guadalupe-San Antonio-Nueces River Basins Project, Phase I: Review of Existing Biological Data, Texas Water Development Board, January 1973.

APPENDIX #1

U.S. DEPARTMENT OF INTERIOR NATIONAL PARK SERVICE LETTER ADVOCATING ABANDONMENT OF RILLING ROAD SEWAGE TREATMENT PLANT

United States Department of the Interior
NATIONAL PARK SERVICE
SOUTHWEST REGION
P.O. Box 728
Santa Fe, New Mexico 87501

IN REPLY REFER TO:
L58-(SWR)CRH

DEC 15 1977

Mr. Dennis Harner
Environmental Planner
Radian Corporation
8500 Shoal Creek Boulevard
Austin, Texas 78758

Dear Mr. Harner:

I am writing you with regard to the possible removal of the Rilling Road Wastewater Plant in San Antonio. As noted in our suitability/feasibility study for the proposed San Antonio Missions National Historical Park (see pages 80-81) we feel that the Rilling Road Wastewater Plant has adverse effects on the air quality and water quality in the vicinity of the Espada Mission and Aqueduct, and the lower portions of the Espada Acequia. In particular, the odors frequently emitted from the plant are quite detrimental to the visitor's enjoyment of the historical features of the area. Whether or not a national park is established, the removal of the plant would be of substantial benefit in preserving and restoring the historical integrity of these very significant historic sites.

Sincerely yours,

Douglas G Warnock

~~Acting~~ Regional Director
Southwest Region

APPENDIX #2

CITY COUNCIL OF SAN ANTONIO RESOLUTIONS FAVORING ALTERNATIVE 3B

KC:amt
8/24/77

A RESOLUTION

77-45-56 A

ADVOCATING AND PROMOTING THE ABANDONMENT OF THE RILLING ROAD SEWAGE TREATMENT PLANT, THE CONSTRUCTION OF A LARGE NEW SEWAGE TREATMENT FACILITY AT THE CONFLUENCE OF THE SAN ANTONIO AND MEDINA RIVERS AND THE UPGRADING OF THE SALADO AND LEON CREEK PLANTS.

* * * * *

WHEREAS, the Congress of the United States enacted the Clean Water Act of 1972, Public Law 92-500, with a goal toward making all of the nation's streams "swimmable and fishable" by 1983; and

WHEREAS, the State of Texas has adopted similar mandatory guidelines now being implemented by the Texas Water Quality Board; and

WHEREAS, the City of San Antonio has entered into a planning grant with the Environmental Protection Agency under Section 201 of said Act; and

WHEREAS, the Public Advisory Committee, appointed by the City Council, has studied numerous alternatives toward achieving the goals of said Act, with respect to available technical hardware, environmental and economic impacts on citizens, and costs; and

WHEREAS, after due consideration, the Advisory Committee reduced the options to three possible sites for location of needed sewage treatment facilities: Site 1, requiring the remodeling of the Rilling Road Wastewater Treatment Plant, and the upgrading of the existing Salado and Leon Creek Plants; Site 2-B, requiring the abandoning of the Rilling Road Plant, the expansion of the Salado Creek Plant, and the upgrading of the Leon Creek Plant; and, Site 3-B, requiring the elimination of the Rilling Road Plant, the upgrading of the Salado and Leon Creek Plants, and the construction of a large new facility at the confluence of the San Antonio and Medina Rivers; and

WHEREAS, the Advisory Committee has found that abandoning the Rilling Road Plant would definitely be in the best interest of all of the citizens of San Antonio, and be conducive to balanced growth, which is vital to the environmental enhancement of that sector; and

WHEREAS, the Advisory Committee has gone on record in high favor of Site 3-B as meeting the long range goals and remedies necessary to comply with the mandatory state and federal water quality standards and the City's strong desire for the balanced development of the City, while meeting the needs of all citizens for general upgrading of neighborhoods, parks, historical areas and other aesthetics; NOW THEREFORE:

BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF SAN ANTONIO:

SECTION 1. The City Council hereby officially endorses and supports the recommendations of the Public Advisory Committee, and hereby goes on public record as advocating and promoting the Site 3-B option (requiring the abandonment of the Rilling Road Sewage Treatment Plant, the construction of a new sewage treatment facility at the confluence of the San Antonio and Medina Rivers and the upgrading of the Salado and Leon Creek Plants), as an integral part of the City's long range goals to meet the mandatory standards by 1983.

SECTION 2. The City Council hereby recognizes that while Site 3-B has a possible higher initial cost to the City, nevertheless in the opinion of the Council, such Site holds a distinctive advantage to all the Citizens of San Antonio regarding their needs for preserving and improving their quality of life, promoting the balanced growth of the City, and adding greatly to the general amenities of the City.

PASSED AND APPROVED this 25th day of August, 1977.

Lila Cockrell

M A Y O R

ATTEST: G. V. Jackson Jr.
City Clerk

APPROVED AS TO FORM: for Tom Finlay
City Attorney

77-45

TF:lm
11/9/77

A RESOLUTION

NO. 77-57-82

INDICATING THE CITY'S INTENT TO ASSUME THE ADDITIONAL COST FOR UPGRADING THE CITY'S SEWAGE TREATMENT FACILITIES, ALTERNATIVE 3B, OVER THE COST OF ALTERNATIVE 2B.

*   *   *   *

WHEREAS, the City Council by Resolution 77-45-56-A went on public record as advocating and promoting the Site 3B (option requiring the abandonment of the Rilling Road Sewage Treatment Plant, the construction of a new sewage treatment facility at the confluence of the San Antonio and Medina Rivers and the upgrading of the Salado and Leon Creek Plants) and recognized a possible higher initial cost, and at the request of the EPA as to a firm intent to assume the additional cost of Alternate 3B over those costs for Alternate 2B (requiring the abandoning of the Rilling Road Plant, the expansion of the Salado Creek Plant, and the upgrading of the Leon Creek Plant); NOW THEREFORE:

BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF SAN ANTONIO:

The City Council hereby indicates its intent to assume the additional costs for Alternate 3B over the cost of Alternate 2B and recommends proceeding with the Draft Environmental Impact Statement and subsequent Public Hearing.

PASSED AND APPROVED this 10th day of Nov., 1977.

Lila Cockrell

MAYOR

ATTEST: G. V. Jackson Jr.
City Clerk

APPROVED AS TO FORM: ____________________
City Attorney

77-57