

AN ABSTRACT OF THE THESIS OF

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Abstract approved: *Redacted for Privacy*  
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This study had two purposes: to determine solid waste management needs of residents and organizations of the San Xavier District Indian reservation near Tucson, Arizona; and to develop a solid waste management plan to be recommended to the San Xavier District Tribal Council.

A solid waste generation study compared the daily per capita solid waste generated over one week by 25 Indian households, 15 Adult non-Indian households and 15 Family-Adult non-Indian households on the district. An analysis of variance showed that the differences in daily per capita solid waste generation among the three groups were not statistically significant at the .05 level, and a t-test showed that differences between the Indian residents and the non-Indian residents considered as one group were not statistically significant at the .05 level. The overall daily per capita solid waste generated by all groups, 1.71

lbs/day, was less than half of the national average of 3.5 lbs/day. The Adult non-Indian households had the highest daily per capita solid waste generation (1.96 lbs), while the Indian and the Family-Adult non-Indian households generated a similar amount of solid waste daily per person (1.67 and 1.64 lbs respectively).

Four alternative solid waste management proposals were developed: (1) a tribal-operated solid waste management and disposal service serving all residents and most organizations on the San Xavier district and trucking solid wastes off the reservation; (2) the same as Alternative One except that disposal would be in an 8.24 acre landfill to be constructed by the tribe on the district; (3) contracting waste pickup and disposal to an outside waste management company; and (4) the same as Alternative One except that commercial organizations on the district would not be served.

Evaluation of the four proposals showed that Alternative One best fulfilled the objectives of the San Xavier District Tribal Council, and that alternative was chosen for recommendation to the San Xavier District Tribal Council. It was also recommended that a recycling proposal by U.S. Recycling Industries be accepted.

A Comprehensive Solid Waste Management Plan for  
San Xavier District, Tohono O'Odham Nation

by

Nathan Quiring

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A COMPREHENSIVE SOLID WASTE MANAGEMENT PLAN FOR  
SAN XAVIER DISTRICT, TOHONO O'ODHAM NATION

CHAPTER I

INTRODUCTION

Background of the Study

The San Xavier Indian District covers 71,095 acres in Pima County, Arizona, immediately southwest of Tucson (see Figure 1). The reservation is part of the Tohono O'Odham Nation and has a population that includes approximately 1,200 members of the Tohono O'Odham tribe. Also living on the reservation are almost 800 non-Indians, most of whom reside in the Mission View mobile home court in the northwest corner of the reservation. The size of the non-Indian population varies with the time of year, as a number of the residents are "snowbirds," i.e., individuals whose permanent residences are elsewhere but who come to the reservation to live during the winter months.

The San Xavier District and its Indian constituency have never developed a cohesive solid waste management plan. For the most part, individuals have themselves had the responsibility of disposing of solid wastes generated by their households. Although an outside solid waste collection and disposal company does have a pickup service on the reservation, the service is restricted to the Mission View mobile home court, as it has not obtained the



approval of the district council to serve tribe members. Indian residents and those non-Indians who do not subscribe to the pickup service have generally hauled their solid wastes to the district open burning dump. In many cases, however, Indian residents have developed the practice of burning the waste themselves, burying it on their own property, or disposing of it at some location on the open reservation.

There are several reasons for the lack of a coordinated solid waste management plan on the San Xavier District. Indian culture and the presence of allotted lands owned by non-Indians who are not subject to tribal laws both play a role. Another important reason is the fact that the district does not fall under federal, state or county jurisdiction. It is part of a sovereign nation which may or may not choose to develop and enforce a mandatory solid waste management program.

Recently, however, the district council has recognized that the continued existence of an open burning dump on the reservation is a hazard to health and is incompatible with county, state and federal laws and with stated district environmental goals and objectives. The council has also recognized that enactment of a solid waste management program is crucial to maintaining a healthy and agreeable reservation environment. As a result, in March of 1989, the San Xavier District and the Indian Health Service,

which provides health consultative services to the tribe, began preliminary discussions toward the development of a solid waste management plan for the district.

At the outset, the San Xavier District tribal leadership expressed its desire for a solid waste management system that is oriented to tribal autonomy, that operates as a tribal enterprise, and that contributes to a controlled reservation development consistent with an aesthetically pleasing environment. Out of these discussions the following goal and objectives were formulated.

#### Goal

The goal of the San Xavier District Solid Waste Management Plan is to help ensure the controlled development of a healthy and aesthetically pleasing environment. This is to be accomplished by the establishment of a solid waste management program to provide systematic management and control of the storage, collection, transfer, processing, recycling and disposal of solid waste.

#### Objectives

The objectives of the San Xavier District Solid Waste Management Plan are as follows:

1. Establish a district solid waste management program using qualified tribal personnel to administer and operate it.
2. Establish a convenient and efficient weekly refuse collection service for all reservation residents.

3. Provide for the disposal of solid wastes in a manner that is acceptable to the environment and in compliance with public health standards.
4. Promulgate regulations and enforcement procedures for compliance of acceptable solid waste management practices.
5. Conduct a program of public education to inform reservation residents of problems and needs related to solid waste management, with emphasis on home storage practices.
6. Close, cover and eliminate all dumps.
7. Promote the opportunity for the recovery of resources and energy from solid wastes.
8. Establish a self-sufficient solid waste management program by April 20, 1992.
9. Maintain flexibility in planning, implementation, and future development of the solid waste management system.

#### Statement of the Problem

Given the goal of the San Xavier District Solid Waste Management Plan, the problem was twofold. The first problem was to gather information about present solid waste management needs on the reservation and about attitudes of the constituents to be served by the plan. The most important information concerned present solid waste management needs on the district. This information consisted of two parts: (1) data on daily per capita solid waste generation by residents of the district and (2) information about the solid waste management needs of both non-profit and commercial organizations located on the district. This

information was important in deciding the resources, such as number of personnel and trucks, needed to carry out the plan.

The second problem was formulate, through utilization of the gathered information and other resources, a solid waste management plan that would fulfill the objectives listed above. To do this, it was necessary to develop several alternative plans first and then evaluate those options in terms of effectiveness, orientation to tribal autonomy, and cost. This allowed the most suitable plan for the San Xavier District to be chosen.

#### Purpose of the Study

There were two primary purposes for this study. The first purpose was to gather information needed for the development of a comprehensive solid waste management plan for the San Xavier District. The second purpose was to develop the plan itself.

#### Objectives of the Study

The objectives of the study were the following:

- 1) To determine the daily per capita solid waste generation of both Indian and non-Indian residents of the San Xavier District.

- 2) To determine the solid waste management needs for both non-profit and commercial organizations located on the district.
- 3) To determine the attitudes of both Indian and non-Indian residents toward various elements of a proposed San Xavier District Solid Waste Management Plan.
- 4) To develop several alternative solid waste management plans for the San Xavier District.
- 5) To choose from the alternative solid waste management plans one that is workable and self-sufficient, that takes into account the information gathered from this study, that fulfills the nine objectives of the plan which were listed above, and that best fits the needs of the San Xavier District.

#### Significance of the Study

Development of district lands by non-Indians, an expanding residential area, a growing number of non-Indian businesses and of allottee development projects, increasing traffic through the community, and an encroaching metropolitan area have all added to the problem of retaining the cultural and social way of life of the community of San Xavier. Without some formal guidance by the community and the governing body of the San Xavier District to help evaluate future land uses, development of land within the district would be uncontrolled and haphazard, with



consequent deterioration of the reservation environment as well as a possibly harmful environmental impact on identified sensitive areas such as the Santa Clara River Plain and desert plant life.

An integral part of a controlled land use policy is the development of a solid waste management plan, and the tribal council has recognized this. At present, an open burning dump is in operation on the reservation, resulting in air pollution, including hazardous fumes from burning plastic and dumped chemicals, and endangering ground water sources through seepage. The open burning dump also creates conditions in which bacteria and rats can proliferate in decomposing garbage and where both wild and domestic animals can feed, as well as creating other health hazards (see Appendix A). In addition, a number of individuals burn or bury their solid waste on their own land, and occasionally, individuals dump solid waste in open reservation areas. These practices are both environmentally unsound and unhealthy. In addition, with no regular solid waste pickup, some individuals tend to let their solid waste accumulate for several weeks in their houses, outbuildings, or yards before taking it for disposal. This is again an unsanitary practice that presents an opportunity for bacteria and vermin to breed.

This study provides the framework for a solid waste management system that will result in closing the open dump

and eliminating do-it-yourself waste disposal. In doing so, the plan will go far toward creating more sanitary conditions on the reservation overall as well as in many individual households. It will also bring the district into compliance with federal mandates pertaining to waste disposal. Further, the plan will add to the economic well-being of the district by providing new jobs for tribe members. Finally, the management plan will help ease the pressures of future growth within the district by managing the increased solid waste generated by that growth. By easing those pressures it will not only help the Tohono O'odham people maintain their culture in the face of development, it will help ensure a clean, healthy, aesthetically pleasing environment for all residents of the district.

### Research Questions

The following four research questions were asked in this study:

- 1) Are there any differences in the per capita daily generation of solid waste between Indian and non-Indian residents of the San Xavier District?
- 2) Are there any differences in the level of support for a solid waste management plan for the San Xavier District between Indian and non-Indian residents of the district?

- 3) Are there any differences in willingness to pay a fee for the collection and disposal of solid wastes between Indian and non-Indian residents of the San Xavier District?
- 4) Are there any differences in support for a San Xavier District recycling program between Indian and non-Indian residents of the district?

#### Limitations of the Study

Two limitations of this study should be noted:

- 1) This study pertained to the San Xavier Indian reservation only. Although results of the study may be useful to other reservations contemplating a solid waste management plan, it should be understood that results of the study, including daily per capita solid waste generation by residents and solid waste management needs of organizations, cannot be extended automatically to other reservations. In addition, the plan itself is intended only for the San Xavier District. Other reservations may face conditions that would call for a considerably different solid waste management plan.
- 2) It is important to note that the solid waste management plan developed here is subject to change as new, relevant information is obtained and as feedback from implementation of the plan warrants. This,

however, is a characteristic of any reasonable plan, and flexibility was in fact one of the objectives of the plan.

### Definition of Terms

CERCLA: Comprehensive Environmental Response, Compensation, and Liability act, also referred to as "Superfund."

CERCLIS: Comprehensive Environmental Response, Compensation, and Liability Information System. A list of abandoned and inactive or uncontrolled hazardous waste sites.

CWA: Clean Water Act, P.L. 95-217.

EIS: Environmental Impact Statement. A document required of federal agencies by NEPA for major projects and legislative proposals.

EPA: Environmental Protection Agency. An independent agency of the federal government formed in 1970 and responsible for pollution abatement and control programs.

Hazardous Waste. Any waste or combination of wastes which poses a substantial present or potential hazard to human health or living organisms because such wastes are non-biodegradable or persistent in nature.

HRS: Hazard Ranking System. A scoring system used to evaluate the relative potential for risks to public health and the environment from releases of hazardous substances through the air, surface water, or ground water.

IHS: Indian Health Service. An agency of the U.S. Department of Health and Human Services that provides health consultative services to Indian populations.

Indian Self-determination and Education Act of 1975. A law passed by Congress in 1975 which declared the federal government's commitment to the Indian people and the meaningful participation by Indian people in the administration of programs and services for Indian people.

NEPA: National Environmental Policy Act, 1969, P.L. 91-190.

Open Dump. Any facility or site where solid waste is disposed of which is not a sanitary landfill meeting the criteria promulgated under section 4004 of the ReCRA and which is not a facility for disposal of hazardous waste.

Open Burning. The uncontrolled burning of waste materials in the open, in outdoor incinerators, or in an open dump either intentionally or accidentally.

ReCRA: The Resource Conservation and Recovery Act of 1976, as amended by P.L. 95-609, 42 U.S.C. Section 6901.

Recycling. Converting solid waste into new products by using the resources contained in discarded materials.

SDWA: The Safe Drinking Water Act of 1974, P.L. 93-523.

Sanitary Landfill. A facility for the disposal of solid waste which meets the criteria published under section 4004 of the ReCRA. An engineered method of disposing of solid

wastes on land by providing a daily specified volume of earth cover.

Solid Waste. Any garbage, refuse, and/or sludge generated by a residence, a business, a municipality, a waste treatment plant or a water treatment plant. A substance as defined by the EPA as not being ignitable, corrosive, reactive or toxic.

Solid Waste Management. The systematic administration of activities which provide for the collection, source separation, and disposal of solid waste.

## CHAPTER II

## REVIEW OF RELATED LITERATURE

Regulation of Solid Waste Management  
Practices on Indian Lands

The Environmental Protection Agency (EPA) is the primary federal agency charged with regulation of solid waste management practices on Indian lands. Subtitle D of the Resource Conservation and Recovery Act of 1976 (ReCRA), which governs solid waste management, has been the primary statute under which this regulation has been undertaken. Inconsistencies related to defining the status of Indian tribes, however, have led to problems in enacting ReCRA on Indian lands. This section will review the nature and history of these problems.

The EPA's role in solid and hazardous waste management began when the agency assumed the Department of Health and Human Services' responsibilities for implementing the Solid Waste Disposal Act (SWDA, Public Law 89-272). This statute required the EPA to

... initiate and accelerate a national research and development program for new and improved methods of proper and economic solid-waste disposal and to provide technical and financial assistance to State and local governments and interstate agencies in planning, development, and conduct of solid-waste disposal methods.

The EPA's role in waste management was further defined in 1976 with the Resource Conservation and Recovery Act (ReCRA, Public Law 94-580), which added to the EPA's

mandate to regulate the management of both hazardous and non-hazardous waste.

In Section 1004 (13) (A), the ReCRA addresses tribal status by including Indian tribes, authorized tribal organizations and Alaska natives under the definition of "municipality." The result of this definition was to create a loophole in the congressional intent of ReCRA. Defining an Indian tribe as a "municipality" implied that tribes were political subdivisions of states, and this created considerable confusion regarding the roles of tribes, states, and the EPA such that full and consistent implementation of the ReCRA hazardous and solid waste management programs was difficult to achieve on Indian lands.

Difficulties were especially present in implementing Subtitle D of ReCRA, which governs solid waste management. The Subtitle D program was created to allow states to adopt state-specific solid waste management plans, based on a set of minimum criteria promulgated by the EPA. Specific criteria include minimum technical standards addressing surface water, ground water, disease transmission, air safety, food-chain crops, endangered species, and floodplains (EPA, Code of Federal Regulations 40, Part 257). Solid waste facilities must comply with the minimum criteria; facilities failing to comply with one or more criteria are classified as "open dumps" and must be closed or upgraded. States developing their own solid waste



management plans must submit these plans to the EPA for approval.

Difficulty in applying these regulations to Indian lands arose partly from the fact that, unlike the nationwide regulatory program established under Subtitle C (Hazardous Waste Management), Subtitle D was established not as a federally implemented and enforced program, but rather as a state-run program adopted on a voluntary basis. Subtitle D's objectives were to be accomplished

... through Federal technical and financial assistance to States or regional authorities for comprehensive planning pursuant to Federal guidelines designed to foster cooperation among Federal, State, and local governments and private industry (Public Law 94-580; p. 29).

With Subtitle D of the ReCRA being targeted to states and Indian tribes being defined as "municipalities," tribes appeared to be under the jurisdiction of states for the purposes of the ReCRA. Historically, however, Indian tribes had not been considered as under the jurisdiction of states; moreover, the year prior to the establishment of the ReCRA, Congress had passed the Indian Self-Determination and Education Act of 1975 (Public Law 93-638), which strongly supported the concept of the sovereignty of Indian tribes.

The Indian Self-Determination and Education Act declared the federal government's commitment to the maintenance of its continuing relationship with the Indian people through the establishment of a meaningful Indian

self-determination policy. The act provided for an orderly transition from federal control of programs of services to Indians to a policy of effective and meaningful participation by the Indian people in the planning, conduct, and administration of those programs and services.

Confusion thus arose in the late 1970's and early 1980's about how Subtitle D solid waste regulation provisions were to be enacted on Indian lands. In interpreting Subtitle C of the ReCRA (governing hazardous waste management), the EPA had taken the position that the federal hazardous waste management program applied on Indian lands, unless a state could demonstrate authority over Indian lands within the state (EPA, 40 Code of Federal Regulations 271.7(b)).

To date, no state has successfully made this demonstration. In 1982, the State of Washington claimed jurisdiction to regulate hazardous waste management on Indian lands within the state in its application for Subtitle C hazardous waste program delegation. The EPA denied Washington's claim on the grounds that the state had failed to adequately demonstrate legal authority and jurisdiction over the Indian lands. The state appealed this decision before the Ninth Circuit Court of Appeals (Washington Department of Ecology v. EPA, 752 F.2d 14;65 (9th Cir. 1985)). The Court of Appeals affirmed the Agency's decision, finding the following:

1. States are generally precluded from exercising jurisdiction over Indians in Indian Country unless Congress has clearly expressed an intention to permit regulation... (752 F.2d at 1466); and
2. ReCRA does not authorize the States to regulate Indians on Indian Lands (752 F.2d at 1467).

At the same time, the Court of Appeals emphasized the EPA's responsibility for seeing to it that the ReCRA provisions were carried out on Indian lands:

The absence of state enforcement power over reservation Indians, however, does not leave a vacuum in which hazardous wastes go unregulated. EPA remains responsible for ensuring that the federal standards are met on the reservations, (752 F.2d at 1472).

Some clarification of the status of Indian tribes for purposes of enactment of the ReCRA occurred in the mid 1980's. On January 24, 1983 President Reagan issued a federal Indian Policy supporting the primary role of tribal governments in matters affecting American Indian reservations. The policy is quite straightforward in its emphasis on two related themes: 1) that the federal government will pursue the principle of Indian self-government and 2) that it will work directly with tribal governments on a government-to-government basis. On November 8, 1984 the EPA became the first federal agency to issue a policy pursuant to the President's policy.

The EPA's Indian policy is based on a nine-point approach that emphasizes that the agency will work directly with tribes on a government-to-government basis in an attempt to ensure that the environmental protection

mandated by the EPA's statutes is provided for all people and geographic areas in the nation. The EPA nine-point policy for administration of environmental programs on Indian reservations is listed as follows (Popkin, 1987).

#### The Environmental Protection Agency

1. Stands ready to work directly with Indian tribal governments on a one-to-one basis rather than as subdivisions of other governments.
2. Will recognize tribal governments as the primary parties for setting standards, making environmental policy decisions and managing programs for reservations, consistent with agency standards and regulations.
3. Will take affirmative steps to encourage and assist tribes in assuming regulatory and program management responsibilities for reservation lands.
4. Will take appropriate steps to remove existing legal and procedural impediments to working directly and effectively with tribal governments on reservation programs.
5. In keeping with federal trust responsibility, will assure that tribal concerns and interests are considered whenever EPA's actions and/or decisions may affect reservation environments.
6. Will encourage cooperation between tribal, state and local governments to resolve environmental problems of mutual concern.
7. Will work with other federal agencies which have related responsibilities on Indian reservations to enlist their interest and support in cooperative efforts to help tribes assume environmental program responsibilities for reservations.
8. Will strive to assure compliance with environmental statutes and regulations on Indian reservations.
9. Will incorporate these Indian policy goals into its planning and management activities, including its budget, operating guidance, legislative initiatives, management accountability system and ongoing policy and regulation development processes.

This policy paved the way for the EPA to work more effectively with Indian tribes. At the same time, the EPA was beginning to pay more attention to the overall problem of solid waste management in the country. From the passage of the ReCRA until 1984, the agency's primary focus had been on implementation of the hazardous waste management program. However, the passage of the Hazardous and Solid Waste Amendments of 1984 reinforced and refocused the EPA's directive to address the growing problem of Subtitle D wastes (HSWA, Subtitle D). Section 302 of HSWA added section 4010 to ReCRA, which directs the EPA to evaluate the adequacy of its Subtitle D program, report the results to Congress, and revise the existing criteria for solid waste disposal facilities and practices for facilities generating hazardous waste. In accordance with Section 4010(c) these revised criteria must, at a minimum, include criteria for the acceptable location of such facilities and for locations of landfills, and requirements for groundwater monitoring and corrective action. In addition, Section 4005(c) requires states, within 18 months after the promulgation of the revised criteria, to adopt and implement a permit program or system of prior approval to assure that each solid waste management facility which may receive household or small quantity generator hazardous waste, complies with the revised criteria.

A major hindrance to the EPA's regulatory activities on Indian lands, however, continued to be its lack of enforcement authority for the minimum criteria. This lack of enforcement power was upheld in Mattie Blue Legs v. EPA et al. (Civ. No. 85-5097 Slip.OP. (W.D.S.D.) Sept. 3, 1987), where it was also demonstrated that the criteria are directly enforceable under the citizen suit provision of Section 7002 of ReCRA. In this case, the plaintiffs, members of the Oglala Sioux Tribe, sought an injunction against the Tribal Council, the EPA, the Indian Health Service (IHS) and the Bureau of Indian Affairs (BIA) to ensure that solid waste on the Pine Ridge Indian Reservation was disposed of in compliance with ReCRA. Open dumps existed in approximately a dozen communities on the reservation. Only one of the dumps was fenced, none were supervised, and covering of the waste in the dumps was irregular. In addition, many of the dumps were near housing, schools or surface water.

The Court found against the Oglala Sioux Tribe, the BIA, and the IHS, and in favor of the EPA. The court finding against the Oglala Sioux was based on the tribe's failure to enforce the tribal council's garbage and refuse disposal ordinance for the regulation of the collection and storage of solid waste. The court found that "the solution to open dumping on the Reservation is best left to the Indian people themselves through enforcement of tribal

ordinances enacted by the duly elected tribal council." The Court held the BIA and the IHS to be liable because a portion of the waste put into the open dumps by the Pine Ridge Village Garbage Service originated from facilities owned and operated by the BIA and the IHS. Because these agencies were found to have participated in disposal practices banned by the ReCRA, summary judgment against them was granted. The BIA and the tribal council were ordered to set forth a plan to bring the dump sites into compliance. The BIA and the IHS appealed the case to the 8th Circuit Court of Appeals which upheld the decision.

The original Court had found the EPA, however, to have fulfilled its mandates under the ReCRA, stating that,

1. EPA cannot regulate solid waste directly nor enforce Subtitle D standards on Indian land;
2. ReCRA requires EPA to issue guidelines and criteria for solid waste management to assist state and local governments in solid waste planning, including tribes;
3. ReCRA requires the EPA to provide financial assistance to implement solid waste regulations on the reservation; and
4. Primary responsibility under ReCRA, regarding open dumps, rests with the Tribe.

Therefore, according to the Court's decision, under ReCRA, the EPA does not have the congressionally granted authority over open dumping relating to discarded materials (non-hazardous solid waste) that it has relating to hazardous waste. The Court held that any enforcement by the EPA relating to the practice of open dumping on the Pine Ridge

Indian Reservation would be a violation of the inherent sovereignty of the Oglala Sioux Tribe.

Recently, the EPA has examined solid waste management activities on Indian lands pursuant to the ReCRA as amended by the Hazardous and Solid Waste Amendments of 1984. This effort has been in response to a growing concern regarding solid waste management in general, as well as Congressional concern regarding treatment of Indian tribes under environmental statutes. The Congressional concern was underscored by the fact that during the last several years, three environmental laws have been amended to allow tribes to be treated as states for the purposes of implementing the respective statutes. The Safe Drinking Water Amendments of 1986 (Public Law 99-339) and the Water Quality Act of 1987 (Public Law 100-4) both direct the EPA's Administrator to promulgate regulations outlining the process by which the Administrator can transfer programs to a federally recognized tribe with a governing body when the Administrator finds that the tribe is reasonably expected to be able to carry out the program. In 1986, the Superfund Amendments and Reauthorization Act of 1986 (Public Law 99-499) also amended the Comprehensive Response, Compensation, and Liability Act to treat tribes substantially as states. Thus, at present, the ReCRA remains one of the few environmental statutes that defines the status of Indian tribes in such a



way as to make implementation, particularly of Subtitle D, quite difficult on Indian lands.

The ReCRA, however, had not been changed. On August 30, 1988, the EPA proposed its revised municipal solid waste landfill criteria for public comment (53 Federal Regulation 33314, Federal Register, 1988), and in October 1988, the agency released its report to Congress on the adequacy of its Subtitle D program. The report made the following two conclusions specific to solid waste management on Indian lands (U.S. EPA, Report to Congress, 1988).

1. The definition of Indian Tribes should be changed under ReCRA, with provisions similar to those under section 1451 of the Safe Drinking Water Act. These provisions authorize EPA to treat Indian Tribes as States, while allowing EPA to define by regulation when Tribes will be treated as States and, where that is inappropriate or infeasible, how the goals of the Act will be met on Indian lands.
2. Coordination among Federal and State agencies and Indian Tribes is needed to develop an appropriate strategy for solid waste management on Indian Lands.

Yet even though the ReCRA had not been changed, the policy of the EPA continued to be to treat Indian tribes as states in accordance with its 9-point policy issued in 1984. That the EPA is currently doing so was confirmed during a seminar attended by this researcher in Albuquerque, New Mexico in January of 1990, in which the EPA government-to-government policy in relation to Indian tribes was reemphasized.

The overall scope and intent of ReCRA and its legal applications on Indian reservations is strongly debated

within the legal profession. As outlined above, in Washington Department of Ecology vs. EPA, the Ninth Circuit Court of Appeals upheld EPA's regulatory powers to deny a state (in this case the state of Washington) enforcement jurisdiction concerning hazardous wastes on Native American lands. But Allen (1987) argues that the doctrine the Supreme Court has developed to resolve state-federal jurisdictional disputes in Native American cases, which is sometimes referred to as the federal common law preemption analysis, supports state regulation of hazardous waste activity on reservation lands. Pope (1987), however, takes a different view. She points out that in the Washington case, the Ninth Circuit was confronted with an issue that had only recently become highly visible and somewhat controversial, the issue of jurisdictional environmental regulation on Indian reservations. Pope claims that in the Washington case, the Court identified correctly the principles needed to resolve such jurisdictional disputes, and accurately applied and interpreted them. The Court, she maintains, took into consideration the general principles of Indian law, the EPA's assessment of the issue and correctly reached a decision, with the decision based essentially upon the right of tribes to govern and regulate themselves without state interference.

At the present time, the EPA is working under Congressional deadlines towards establishing a variety of

work groups and advisory committees to determine what pollution control activities are feasible on Indian lands and what funding is available. The Office of Federal Activities has taken the lead role in coordinating the EPA's Indian program, while the EPA regional offices actually carry out the activities in the field with the cooperation of the tribes. In addition, in some cases the EPA is working in conjunction with the Indian Health Service, as is in the present study, for purposes of implementing solid waste management regulations.

The above discussion makes it clear that the concept of the sovereignty of Indian tribes in relation to solid waste management has been upheld by the federal government and by the courts. This is perhaps most clearly demonstrated by the Mattie Blue Legs case (see p. 21) in which the Court stated explicitly that the EPA had no enforcement power on the reservation even in the case of hazardous waste generation. From this it seems plain that the tribes themselves have the ultimate responsibility for ensuring that Subtitle D of the ReCRA is enacted on Indian lands, and this was also stated explicitly by the Court in the Mattie Blue Legs case. The willingness of Indian tribes to take on this responsibility and provide effective solid waste management on reservations thus becomes crucial. In the next section, the extent of that willingness will be briefly reviewed.

### The American Indian and Land Ethic Values

Many scholars have written about the land ethic extolled by Native American Indians. Although there seems to be no set definition for the term "land ethic," and the concept can mean different things to different groups of people, a number of writers have claimed that the American Indian viewpoint includes a strongly pervading special relationship to the land and nature; in addition, the idea that the earth is the mother of native peoples seems to be a consistently recurring theme in Indian culture.

Cornell (1985) relates how American Indians have been extolled as sages of the conservation movement throughout the 20th century, with the cosmology of the American Indian emphasizing that the earth is the mother of native peoples, nourishing its inhabitants. Cornell claims that out of these environmental perceptions and beliefs, the modern day environmental movement evolved. Hughes (1983) echoes these points, maintaining that nature is central to the Indians' world and that both nature and the existential relationship that Indians have with nature serve as the major cosmos of many Indian cultures.

Romeo (1985) presents a list of fundamental beliefs and moral imperatives of the Ute Indians relating to nature (see Figure 2). These beliefs emphasize that various aspects of the land, including water, wind, and mountains, are sources of power for the Ute people. Because they are

# RELATION TO NATURE

## WATER

### Fundamental Beliefs:

Water is Spirit and Power (God).

Water is spiritual power for man.

Water is life's spiritual and material sustenance.

Water is a gift from the Creator.

If a gift is abused, it will be lost.

### Moral Imperatives:

Water must be cared for, not lost, sold, or given away (water cannot be given; no person controls access to life itself.)

We must remain in this place and make sure the water is not abused (e.g. diverted, polluted) or we will lose it.

## ASPECTS OF NATURE: Wind, Mountains, Plants, Wildlife, etc.

### Fundamental Beliefs:

They are alive, with spirit.

They are sources of sacred power.

They are a part of religious practice, and must remain free in order to be so.

We are our spiritual power.

We are our life-ways.

Changes in any aspect of nature reverberate throughout the entire system.

If nature is abused, its support will be lost.

### Moral Imperatives:

They must not be abused, or we will lose our life-sustenance.

They must be free and respected, or we will lose our traditional life-way.

## LAND

### Fundamental Beliefs:

Land is a living body, part of nature; possessing spiritual properties.

The land is a part of us, and it contains the genealogy.

The tribe is past, present and future.

The living land (space and place) is part of nature's life process, and we protect that process, or it will be destroyed.

### Moral Imperatives:

The land must be guarded, kept in harmony, or it will be lost.

We must persist in this place, or the genealogy will be lost.

## OTHER INDIANS

### Fundamental Beliefs:

We must maintain communitarian values toward other Indians.

The persistence of the Tribe is the persistence of a way of life.

The tribe is past, present and future.

Relations to other Indians are part of the harmony of the universe.

### Moral Imperatives:

We must maintain proper relations to others, past, present and future.

We must not be greedy, but guard the reservation and its life-ways for past, present and future, or these will be lost.

### Moral Imperatives:

They must not be abused, or we will lose our life-sustenance.

They must be free and respected, or we will lose our traditional life-way.



Romeo, S. (1985, page 168)

Figure 2. Fundamental Beliefs of the Ute Indians.

the source of power, these aspects of nature must be kept in harmony. The land must be guarded, and the water cared for. According to Romeo, the result of not caring for the land and its various elements is, for the Ute Indians, the loss of power.

A different view of the relation of Native Americans to the land has developed recently, however. A number of environmentalists have become vocal critics of some Indian practices relating to the land. Williams (1986) claims that the environmental movement has developed an undercurrent of ill will toward Native Americans, and that some environmentalists have felt betrayed by Indian practices. Cases in point are the Inuit hunting of the bowhead whale, which is an endangered species, and the killing of bald eagles, presumably to obtain feathers for use in religious rituals.

Schwarz (1987) also recognizes the problems caused by Indian hunting practices in cases where endangered species are involved and in cases where Indians have unrestricted hunting and fishing rights by treaty. Schwarz recommends that rather than simply taking away rights to which Indians have been entitled for decades, environmentalists should be prepared to negotiate on such matters. He suggests that in exchange for the Indians' voluntary surrender of some of their treaty rights, environmentalists should seek to sponsor legislation opening national forest lands to Indians

who wish to live a subsistence lifestyle much as their forefathers did.

Regan (1982) maintains that there is an ambiguity in the American Indian's relationship with nature, concluding that there is no clear evidence for the existence of an Indian environmental ethic. Martin (1978) seems to agree. In investigating the reasons for the apparent respect for nature found in the traditional Eastern Algonkian culture, Martin concludes that, contrary to popular opinion, those people did not respect nature because of an environmental ethic inherent in their tradition. Rather, they were motivated primarily by the fear that nature would literally strike back at them if they did not show the proper respect. Martin refers to the American Indian as a "Miscast Ecologist."

The opening up of tribal reservation lands to non-Indian solid and hazardous waste disposal has also led to opposition by some environmentalists. Indian reservations are increasingly being looked at not only by municipalities but by county governments as well for solid and hazardous waste disposal. The reservations have been seen as inexpensive places to dump wastes and as being virtually free of government regulation. Concerning these practices, Susan Harjo, executive director of the National Congress of American Indians, says, "Non-Indians are using cash and

poverty politics on the reservations to make us once again a dumping ground" (Stommer & Sohagun, 1987). Yet opening the reservations to outside waste brings money to tribes, and overall unemployment on many reservations is presently well over 50%; thus some proponents of opening the reservation argue that tribal waste facilities, if properly designed, can be both safe and economically beneficial by providing revenue and employment (Stommer & Sohagun, 1987).

It can be argued that the important issue is not whether Native American Indians adhere, or their forefathers adhered, to "land ethic" values. The concept of land ethic is a non-Indian term and may have been applied to the Native American culture for self serving reasons. White (1985) maintains that defining Indians as environmentalists verges on "noble savagery." That is, it is a case where once again Indians have become merely a device for criticizing white mainstream society.

The exploitation of natural resources is a sensitive issue for many tribal members. Cultural subtleties sometimes are overlooked by white culture, and traditional tribal views of nature can often be missed by a casual observer. Some tribal members, however, go to great lengths to translate their thoughts into Anglicized concepts. One Indian who had served on a tribal business committee stated, "Taking oil out of the ground is like taking blood



from the veins in a person's body. But when people ask me, I just say I'm environmentalist minded" (Romeo, 1985).

Perhaps what is more at issue is the day-to-day practices of American Indians relative to the environment and to environmental health. A "Survey of American Indian Environmental Protection Needs on Reservation Lands: 1986," conducted by Americans for Indian Opportunity, surveyed reservations ranging from 33 acres with a population of 10 to the Navajo Nation of 149,000, living on 16 million acres and embracing 58% of the current nationwide reservation population (Popkin, 1987). Results of this survey showed that 92% of the reservations responding to the survey were participating in at least one environmental activity, such as ongoing solid waste management programs and vector control of prairie dogs that carry and could spread the plague (Popkin, 1987). The Navajo Nation has enacted an ordinance which establishes an Environmental Protection Commission with authority to adopt and enforce environmental regulations (Will, 1978).

Thus it may be a mistake either to attempt to classify American Indians as upholders of a special "land ethic" or to take an opposite view. They are, as we all are, individuals who are attempting to live in a complex world and to deal with the problems that result. It does seem clear that until the arrival of the white culture, Native American cultures lived close to the land, and in doing so,

they had to learn how to adapt to and live in harmony with nature in order to survive in a sometimes harsh world. With the arrival of white culture, much changed. Hoffman and Haskell (1984) claim that although the overall health of the American Indian prior to the arrival of whites in the New World is not clear, it is certain that the harsh environment of North America selected out only the hardest individuals. Hoffman and Haskell maintain that it was not until Europeans arrived that Indian populations began to be ravaged by diseases such as rubella, influenza, and smallpox. It seems clear that many Native American tribes have since suffered not only physically but also mentally, socially, and economically.

The Tohono O'Odham tribe of southern Arizona was traditionally an agrarian people long before the arrival of the white culture. With the influx of white settlers, however, their traditional farming lands were taken away from them, and perhaps more important, their traditional watering sources (deep dug wells with underground aquifers as a water source) were pumped dry by white farmers. Van Otten (1987) claims that only recently have the Tohono-O'Odham people, through commercial farming, been able to emphasize self-sufficiency while at the same time decreasing their reliance on assistance from the federal government.

The arrival of the white culture brought about many disruptive influences upon Native American tribes. The problem of solid waste is only one problem, but it is becoming more and more visible not only to the federal government but to the tribes themselves. An elderly Tohono O'Odham man related to the researcher how the problems of garbage and overall waste were but again a "white man's scourge" brought upon the Indian people, and that the Indian people did not have a solid waste problem until the white culture pervaded the reservation.

This may be an indication of bitterness among some Indians toward "white man's" regulations that require them to alter practices affecting health and the environment, including solid waste management. If so, that bitterness is possibly justified. Yet it is important for Indian peoples to understand that today they have the opportunity to deal with waste management problems largely through their own decision-making bodies and with relatively little outside encroachment on their sovereignty. This seems proper, for the best overall environmental protection on tribal reservations must originate from the tribes themselves.

Leaders should understand, however, that perhaps the most significant court ruling concerning solid and/or hazardous waste disposal on Native American lands was that of Mattie Blue Legs (see p. 21), where it was found that

the tribal government may be held accountable by tribal members under the ReCRA statute. The court determined that the Indian tribe had a duty under the Resource Conservation and Recovery Act to bring open dump sites into compliance with the Act and a responsibility to prohibit open dumps on tribal lands. The implications of this decision are that tribal governments have responsibility both for the collection and disposal of solid wastes on their respective reservations, and for maintaining solid waste disposal sites on the reservation in accordance with EPA regulations.

The courts have found that tribal governments are subject to the application of the ReCRA, and the United States government recognizes the sovereignty of Indian tribes. It is important for tribal leaders to understand that if tribes fail to recognize their inherent powers concerning the environment on Native American lands, then courts in the future may be reluctant to defend unexercised powers in the face of strong attacks by other governmental entities (Will, 1978).

In the instance of the San Xavier District in Arizona, tribal leaders have taken their responsibility and their power quite seriously. In the opinion of the researcher, the district tribal leaders of the Tohono O'Odham nation have demonstrated a strong desire to enact an efficient

solid waste management program that will help create a cleaner, healthier, and more environmentally sound reservation environment.

## CHAPTER III

### METHODS AND PROCEDURES

#### Introduction

This chapter presents the methods and procedures used in the investigation. The first section examines the survey instrument. The second section outlines the selection of subjects both for the per capita solid waste generation study and for the administration of the survey instrument. The third section reviews the procedures that were followed in collecting data, and the fourth section discusses analysis of the data. The final section outlines procedures and considerations used in developing a solid waste management plan.

#### The Survey Instrument

The survey instrument for this study was a researcher-developed 10-item questionnaire which sought information from respondents about attitudes toward a proposed tribal solid waste management plan and about their present solid waste management practices (see Appendix B). The original questionnaire was critically reviewed by Ms. Pam Bodenroeder of the Oregon State University Survey Research Center, and several suggestions concerning format and phrasing of questions were incorporated into the revised questionnaire.

Two of the 10 questions concerned present solid waste management practices of respondents. The other eight questions were intended to gauge the respondents' attitudes toward a tribal solid waste management plan and various aspects of the plan. Three of those eight questions concerned recycling and were designed to assess respondents' willingness to participate in a recycling program. Respondents were invited to circle their answer or answers to a question, and space was provided after each question for comments.

#### Selection of Subjects

In this investigation it was important to distinguish between Indian and non-Indian residents of the San Xavier District because it was judged that there might be differences between the two groups in per capita solid waste generation as well as in attitude toward a proposed solid waste management plan. The fact that non-Indian residents of the San Xavier District live in a mobile home park which has an adults-only section and an adult-family section made it a simple matter to further subdivide the non-Indian group into those two classifications. Therefore, prior to selection of the subjects, three distinct population groups living within the San Xavier District were identified. These three groups and their populations were as follows:

1. Indian Population

250 homes/mailing addresses  
Total population: approximately 1,200

2. Adult Non-Indian Population (snowbirds and permanent residents living on the adult side of the Mission View Mobile Home Court)

142 mobile homes/mailing addresses  
Total population: approximately 283

3. Adult-Family Non-Indian Population (residents living on the adult-family side of the Mission View Mobile Home Court)

141 mobile homes/mailing addresses  
Total population: approximately 507

Total population of the three groups:  
approximately 1,990

#### Selection for Per Capita Solid Waste Generation Study

Selection of subjects for the per capita solid waste generation study was done randomly. After obtaining a complete mailing list for each demographic group, the lists were cut into individual addresses. For each group, Indian, Adult non-Indian and Adult-Family non-Indian, the addresses were placed into a large bowl and shaken vigorously. Immediately afterwards, 10% of the addresses were selected: 25 for the Indian group (out of 250 households) and 15 each for the Adult Non-Indian and Adult-Family Non-Indian groups (out of 142 and 143 households respectively). For each group an additional five addresses were also chosen in the event that any of the individuals or families selected declined to participate in the study.



The actual drawing of names was done by key management personnel associated with the respective population groups. The 30 addresses for the Indian population were randomly drawn by Mr. Daniel Preston, District Vice-Chairman. The random selections of the non-Indian populations (20 Adult and 20 Adult-Family addresses) were conducted by the assistant manager of the Mission View Mobile Home Court, Mr. John Manson.

This method of random selection was chosen in order to achieve two objectives. First, it provided for the direct participation in the data gathering process of management personnel associated with the respective groups. Second, it was believed that such direct participation would help instill in these management personnel a sense that they too had a vested interest in the overall success of the study, and, by extension, in the solid waste management plan itself.

Following the selection, each household chosen was contacted personally by the researcher. The nature of the study and what would be required of participants was explained verbally to an adult representative of the household. All households contacted agreed to participate in the study except for three households in the Adult-Family non-Indian group. For this group, three of the five additional households that had been chosen were contacted, and all agreed to participate in the study. Upon agreeing

to participate, adult representatives of households were given a written set of instructions (see Appendix C) and a sufficient number of 60-gallon trash bags to accommodate the solid waste generated by the household for one week. This number ranged from four to 10, depending upon the number of members in the household. Also at this time, information was gathered about how many members were living in each participating household.

#### Selection for Administration of the Survey Instrument

The entire population of the San Xavier District was chosen for administration of the survey instrument. As noted above, this encompassed 250 Indian homes and 283 non-Indian homes (142 Adult non-Indian and 141 Adult-Family non-Indian).

#### Data Collection

##### Per Capita Solid Waste Generation Study

The per capita solid waste generation study was conducted during the week of Thursday, January 25 to Thursday, February 1, 1990. Indian households were instructed to place all household generated solid wastes into the provided trash bags from the afternoon of January 25 to the afternoon of February 1. Non-Indian households were instructed to place all household generated solid

wastes into the provided trash bags from the morning of January 25, following their regular Thursday morning trash pickup, to the morning of February 1.

Solid wastes generated by households were weighed for each groups twice, on January 29 and on February 1. Indian households were instructed to leave their accumulated bags of solid waste outside, either in front of their houses or in an easily accessible place, on the afternoon of January 29 and on the afternoon of February 1. They were also told that after each weighing the researcher would haul their waste bags to the district dump. Non-Indian households were instructed to leave their accumulated bags of solid waste at the curbside in front of their trailers on the morning of January 29 and again on the morning of February 1.

The weighing of solid wastes generated by the households was done by the researcher on both days. Weighing for the non-Indian households was done during the mornings of those days, and weighing for the Indian households was done during the afternoons. A Model PH150 flatbed scale manufactured by the Ohaus Company was used for both weighings, and weights were recorded for each household at each weighing. At the end of the study, the two weighings were totaled for each household.

### Survey Instrument

The survey instrument was mailed to all of the households on the San Xavier District, a total of 533, on January 26, 1990. Accompanying the questionnaire was a self-addressed prepaid envelope and an informational letter signed by Mr. Daniel Preston, Vice Chairman of the San Xavier District, and by the researcher (see Appendix B). Individuals were requested to return the questionnaire by February 9, 1990. Before mailing, questionnaires and return envelopes were both coded to indicate whether they were being sent to an Indian, an Adult non-Indian or an Adult-Family non-Indian household.

### Data Analysis

#### Per Capita Solid Waste Generation Study

Analysis of data from the per capita solid waste generation study began with dividing the total solid waste generated by each household by seven to give the daily solid waste generation of the household. This figure was then divided by the number of members in the household to give the daily per capita solid waste generation for the household.

The research question to be answered by the daily per capita solid waste generation study was the following:

Are there any differences in the daily per capita generation of solid waste between Indian and non-Indian residents of the San Xavier District?

To answer this question a t-test was performed using the SPSS PC package for personal computers. The .05 significance level was chosen as the level at which differences between the two groups would be indicated. In addition, since two non-Indian groups had been identified, a one-way analysis of variance (ANOVA) was performed in order to determine whether there were any statistically significant differences at the .05 level in per capita daily solid waste generation among all three groups.

### Survey Instrument

Although questionnaires were sent to all district residents, a total of 533, only 77 usable questionnaires were returned, for a response rate of 14%. This unexpectedly low response rate occurred despite the fact that when it became evident that the rate would be low, the researcher contacted both Mr. Daniel Preston, Vice Chairman of the San Xavier District, and Mr. John Manson, assistant manager of the Mission View Mobile Home Court, to request their assistance in promoting, among the Indian and non-Indian groups respectively, the importance of completing and returning the questionnaire. A second administration of the instrument could not be made because of stringent

time constraints on the investigation: this researcher had been directed by the Indian Health Service to complete the solid waste management study as soon as possible and by July 1, 1990 at the latest, as the open burning dump on the reservation created an imminent health hazard and was in violation of federal law. On the basis of the 14% response rate, no valid statistical inferences could be drawn, and thus no data analysis was done on the questionnaire results. The three research questions to be answered on the basis of questionnaire results could therefore not be answered.

#### Procedures and Considerations Used in Developing a Solid Waste Management Plan

It was necessary for the solid waste management plan developed in this study to fulfill several main criteria. First and foremost, it had to provide a reliable means of managing solid wastes generated by residents of the San Xavier District. In doing so, it had to provide convenient means for residents to dispose of their solid wastes in a sanitary, efficient manner, and thereby result in the closing of the presently operating open burning dump and the elimination of other unsanitary and ecologically unsound methods of storing and disposing of solid wastes presently being used by some residents.

Second, the plan had to be oriented to tribal autonomy. This is in keeping with the Indian Self Determination and Education Act of 1975 and the federal Indian Policy issued by President Reagan in 1983. If possible, enactment of the plan should result in employment of qualified tribe members, adding to the economic well-being of the reservation.

Third, it had to be cost effective, both for the tribe itself and for residents of the district. As federal regulations pertaining to solid waste disposal have increased over the past few decades, costs associated with disposal have also increased, with the result that some elements of a solid waste management plan could be cost-prohibitive for the Tohono O'Odham Nation. Furthermore, many of the residents of the San Xavier District, especially the Indian residents, live on small incomes. Since it is essential for the plan to have the support of residents of the district, it was deemed important to keep the cost to a household for pickup and disposal of solid wastes at \$10 or less per month.

To determine the plan that would best fulfill these criteria, four alternative solid waste management proposals were first developed. In developing the proposals, six main resources were used.

The first of these was a review of literature, primarily with respect to the element of cost. For each

proposal it was important to determine what the costs would be for the tribe as a whole and for residents of the district. In determining costs for Alternative Two, which included construction of a sanitary landfill, the EPA's (1988) document outlining estimated costs for constructing, maintaining, and closing sanitary landfills was especially important.

The second resource was information gathered from several waste management companies operating in the nearby area. This information was gained from responses to a letter sent by the researcher to four of those companies and through personal interviews with representatives of three of the companies.

The third resource was an investigation into the waste disposal needs of non-profit and commercial organizations operating on the district. This information was gathered by the researcher through visits to each of the organizations. Data was gathered both about present waste disposal practices and about waste disposal needs of the organizations.

The fourth resource was the information gathered from the daily per capita solid waste generation study. The results of the study were used to ensure that the alternatives developed reflected the needs of residents of the San Xavier District.



The fifth resource was personal interviews conducted by the researcher with the researcher's supervisor, Captain Gary L. Rothfus, Chief, Environmental Health Services section, Tucson area office, Indian Health Service. Captain Rothfus has served with the Indian Health Service for 20 years and is the co-author of two studies concerning solid waste management on two Indian reservations, the San Carlos Reservation and the Hopi Reservation, both in Arizona. Other than the present study, these are the only two such studies that have been done on Indian reservations during the past 20 years. Captain Rothfus's experience and his knowledge of needs, problems and possibilities pertaining to solid waste management on Indian reservations were invaluable in developing the four alternatives.

The sixth resource was personal interviews conducted by the researcher with residents of the San Xavier District, including members of the tribal council, and meetings with the council itself. Many of the interviews were quite casual, including brief conversations with individuals about their disposal practices, needs and expectations, often engaged in while the researcher was fulfilling assigned duties. Other interviews were more formal. All of them provided essential background information that allowed the researcher to become familiar with solid waste management problems on the district, with

what residents would like to see happen, and with what is suitable for the district.

Using these resources, the four solid waste management proposals were developed in some detail. They were then evaluated according to the three main criteria: effectiveness in managing solid waste in an efficient, sanitary, and ecologically sound manner; orientation to tribal autonomy; and cost effectiveness.

## CHAPTER IV

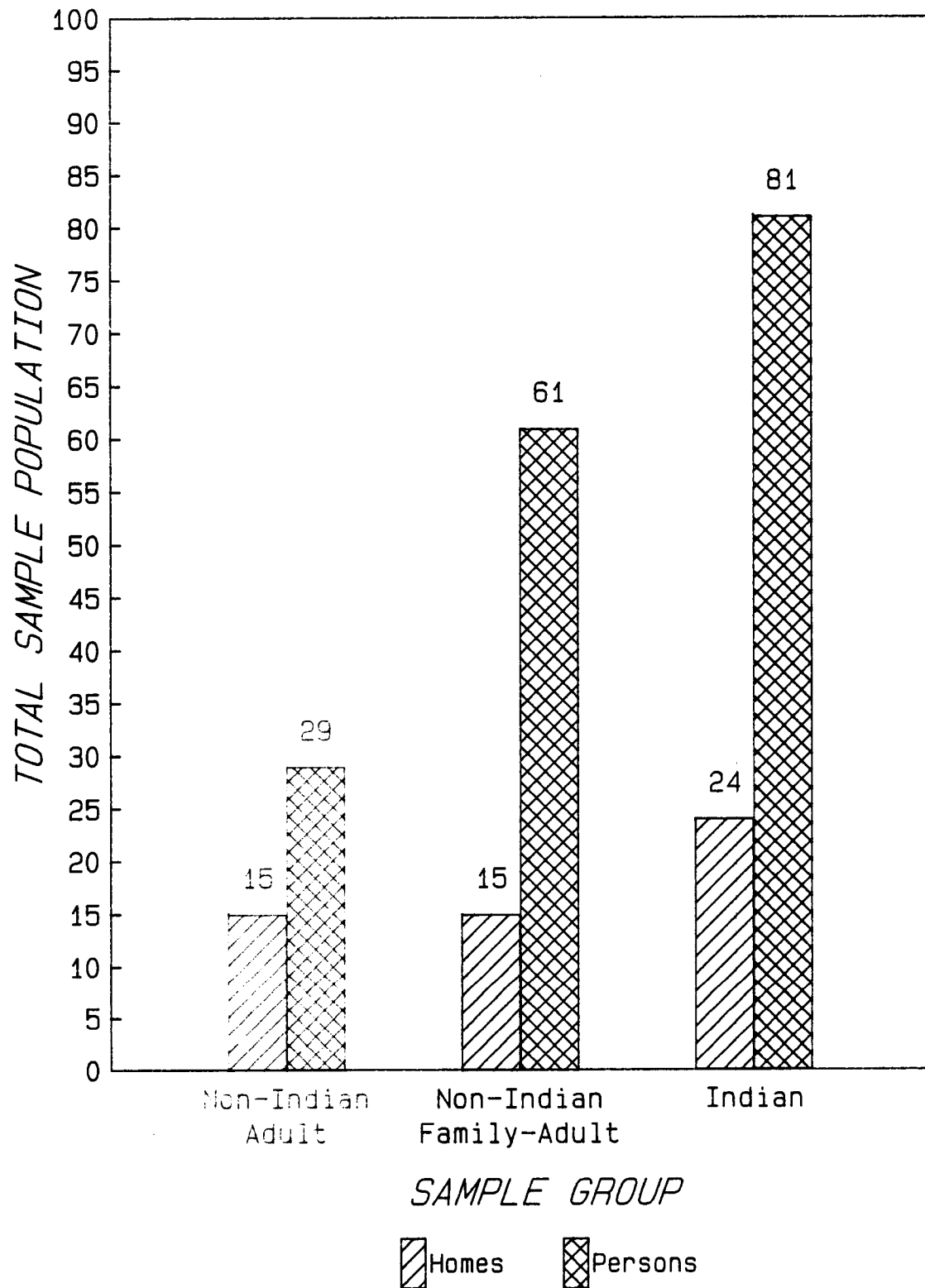
## RESULTS

This chapter presents the results of the research. The chapter is divided into two sections. The first section presents results of the per capita solid waste generation study. The second section presents results of the investigation into alternative solid waste management proposals.

Per Capita Solid Waste Generation

Of the 25 Indian households chosen for the per capita solid waste generation study, one household failed to leave its solid waste outside for weighing on the final day. Since the total solid waste generated by that household for the full one-week period could not be determined, the household was dropped from the study. Therefore, results of the solid waste generation study pertained to 24 Indian households and 30 non-Indian households.

Overall, 171 individuals resided in the 54 households surveyed, with a range of from one to six, and with a mean of 3.17 and a median of three individuals per household. Figures 3 and 4 show graphic representations of the total and mean number of persons in each group. A total of 81 individuals resided in the 24 Indian households, with a range of from one to six, and with a mean of 3.38 and a



Homes Sample Represented 10% of Total Demographic Housing Group

Figure 3. Total Number of Homes Surveyed Associated with Resident Sample Groups.

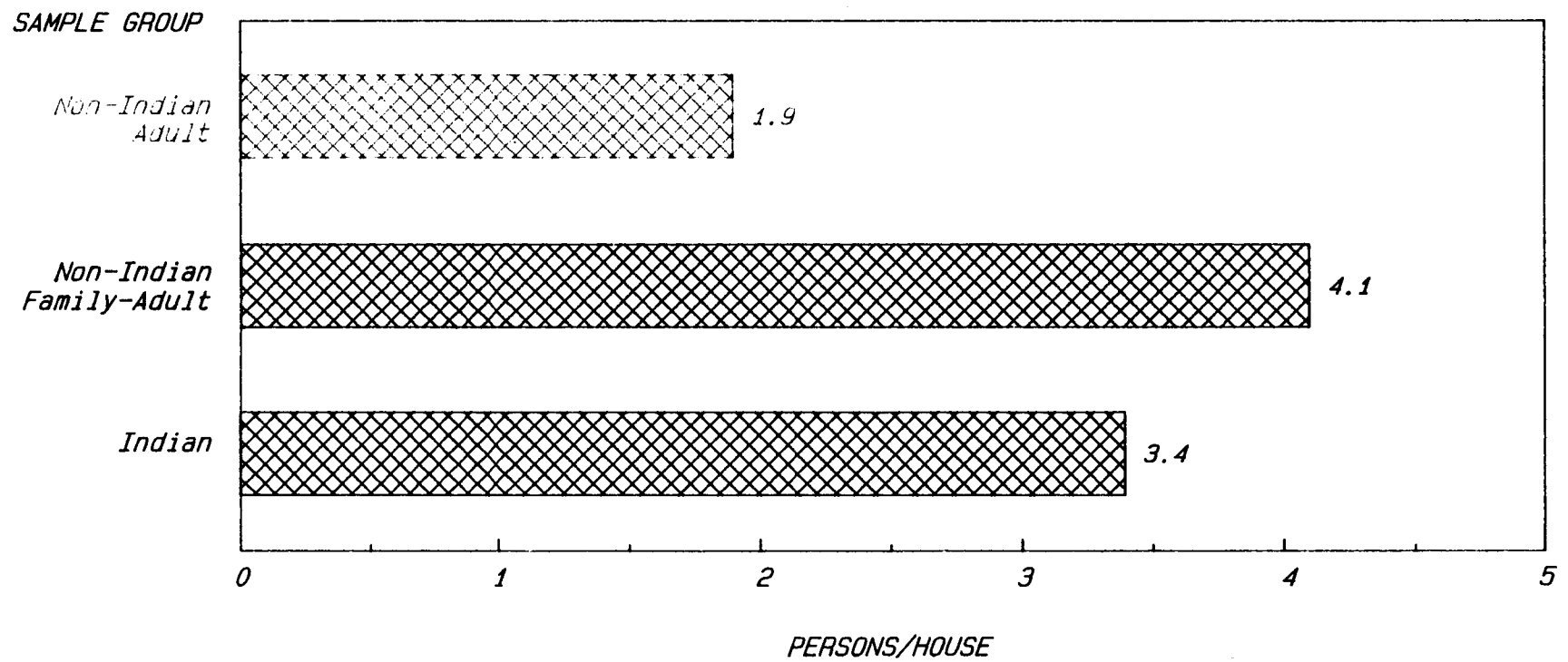


Figure 4. Mean Residents per Household of Sample Groups.

median of 3.5 persons per household. Twenty-nine individuals resided in the 15 Adult non-Indian households, with a range of from one to three, and with a mean of 1.93 and a median of two persons per household. Sixty-one individuals resided in the 15 Family-Adult non-Indian households, with a range of from two to six, and with a mean of 4.07 and a median of four persons per household. Grouping the non-Indian households together gave a total of 90 non-Indian residents, with a mean of 3.00 individuals per household, which was .38 fewer than the average number for the Indian households.

Table 1 presents the seven-day total and daily per capita solid waste generated for each group. Figures are shown for the Indian group, for the non-Indian groups separately and together, and for all groups combined. Daily per capita figures for each group are also shown in graphic form in Figure 5.

The solid waste generated over the one-week period by the 24 Indian households totaled 947.50 pounds. This group showed the widest range of the three, with a lower limit of 4.42 pounds being generated by one household with one member and an upper limit of 108.44 pounds generated by one household with five members. The 29 members of the 15 Adult non-Indian households generated 398.56 pounds of solid waste during the period, with a range of from 9.22 pounds for one three-member household to 57.60 pounds for

Table 1. Per Capita Daily Solid Waste Generation  
by Three Groups.\*

Group	Total Household Members	Median Per Household	Solid Waste (lbs.)	
			Total 7-day	Daily per capita
<b>Indian</b>	81	3.5	947.50	1.67
<b>Non-Indian</b>				
Adult	29	2	398.56	1.96
Family-Adult	61	4	700.86	1.64
Total non-Indian	90	3	1099.42	1.75
<b>All groups</b>	171	3	2046.92	1.71

\* N = 24 Indian households and 30 non-Indian households  
(15 Adult non-Indian; 15 Family-Adult non-Indian).

another three-member household. The 15 Family-Adult non-Indian households generated 700.86 pounds of solid waste during the period, with a range of from 26.68 pounds for one three-member household to 119.30 pounds for one household with six members.

The per capita daily solid waste generation for each group was determined by dividing the total solid waste generated by the group during the one-week period by seven, then dividing this result by the total number of individuals in the group's households. These calculations

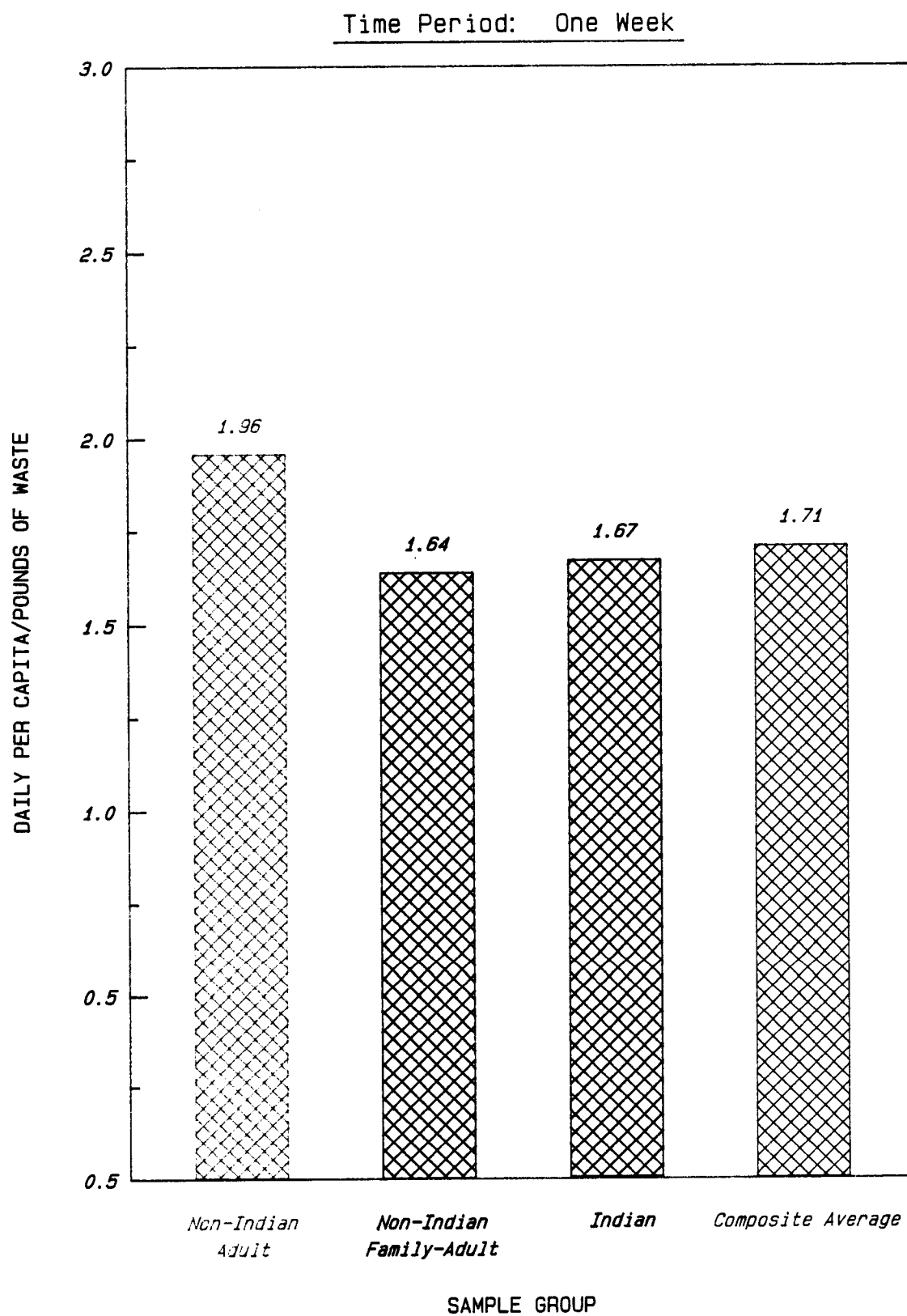


Figure 5. Per Capita Daily Solid Waste Generated by Resident Sample Groups.



showed that the highest per capita daily solid waste generation, 1.96 pounds, was by the Adult non-Indian group. The daily per capita amounts of solid waste generated by the Indian group and by the Family-Adult non-Indian group were similar, at 1.67 and 1.64 pounds respectively. Combining the two non-Indian groups showed a per capita solid waste generation of 1.75 pounds daily. Overall, the 171 individuals in all groups generated an average 1.71 pounds of solid waste per person per day.

The following research question was to be answered on the basis of results from the daily per capita solid waste generation study:

Are there any differences in the daily per capita generation of solid waste between Indian and non-Indian residents of the San Xavier District?

In order to answer this question, the two non-Indian samples were grouped together and a t-test was performed. The .05 significance level was chosen as the level at which differences between the two groups would be indicated.

Table 2 presents the results of the t-test. As shown, the 2-tail probability, also called the P-value, equaled .74. In order to indicate statistical significance at the .05 level, the P-value must be equal to or less than .05. Since this was not the case, no statistically significant difference between the two samples was found.

Table 2. Results of t-test Comparison of Indian and non-Indian Daily Per Capita Solid Waste Generation.

Group	House-holds	Mean	Standard Deviation	Degrees freedom	2-tail probability
Indian	24	1.67	.79		
Non-Indian	30	1.75	.82		
				52	.74

An analysis of variance (ANOVA) was also performed on the data in order to determine whether any significant differences existed among samples when the non-Indian group was divided into its two subgroups. Table 3 shows the results of the ANOVA.

As indicated in the table, the P-value was found to be .58. This was above the critical value of .05 that would have shown statistical significance. Therefore, no significant differences among the three samples with respect to per capita daily solid waste generation were found.

Table 3. Results of Analysis of Variance for Three Groups with Respect to Daily Per Capita Solid Waste Generation.

Source	Degrees of freedom	Sum of squares	Mean squares	F Ratio	P-value
Between groups	2	.72	.36	.56	.58
Within groups	51	32.95	.65		
Total	53	33.68			

#### Four Alternative Solid Waste Management Proposals

A important part of this study was the development of several solid waste management alternatives for the San Xavier District. A total of four alternatives were developed, enabling a comparison to be made in order to determine which was most suitable for the San Xavier District. The alternatives will be briefly described below. For all but the third alternative, a single recycling proposal has been developed and will be described following description of the four alternatives. Strengths and weaknesses of each alternative will be discussed in Chapter 5, where a recommendation will be made.

Tribe Operated Pickup from All District Residences and Organizations, Disposal off District

This alternative would serve the entire San Xavier District, including all residences, both Indian and non-Indian, most of the commercial organizations located on the district, and the six non-profit organizations (San Xavier Mission and Elementary School, which are located together; district offices; the district Head Start program; the day care center; and the OHPRD offices. The tribe would be totally responsible for day-to-day management of the program, and tribe members would be employed to pick up and transfer the solid wastes to the Tucson City Dump, which is located about 15 miles from the district.

Two trucks would be used for pickup, an 18-yard compactor truck with chassis and a 10-12 yard compactor truck with chassis. The larger of these would be the main truck used for daily pickups, while the smaller would be used for backup. Ninety-gallon wheeled curbside toters would be used for solid waste disposal by residents and by some of the non-profit organizations. These toters are constructed of durable plastic and have attached lids. Their compatibility with side-loading trucks enables the driver of the truck to unload the toter without leaving the cab. Commercial enterprises and some of the non-profit organizations would use three-cubic-yard side loading drop

box containers which can also be picked up and unloaded without the driver leaving the truck.

Solid wastes would be picked up from residences twice weekly on designated days. Each household would be provided with one of the 90-gallon wheeled toters, and household members would be responsible for transporting the toter to a designated site in front of or close to their home on collection days. For Indian households this would be on one of the main arterial roads where the household mailbox is located. For residents of the mobile home park, the toter would be transported to the curbside area directly in front of their residence.

A combination of ninety-gallon wheeled toters and three-cubic-yard side-loading drop box containers would be used for the six non-profit organizations. A survey of the waste management needs of these organizations was conducted by the researcher (see Figure 6). According to the data gathered, the containers and collections per week needed at each of the locations would be as follows:

1. San Xavier Mission and School: two 90-gallon toters and one three-yard container, twice a week.
2. San Xavier District Offices: one three-yard container, twice a week.
3. San Xavier District Head Start: one 90-gallon toter, twice a week.
4. San Xavier District Day Care Center: one three-yard container, once a week.
5. OHPRD offices: one three-yard container, twice a week.

NAME OF ESTABLISHMENT	POUNDS PER DAY	POUNDS PER WEEK	POUNDS PER YEAR	SIZE OF CONTAINER	NUMBER OF BARRELS	COLLECTIONS PER WEEK	MISCELLANEOUS ITEMS AND OTHER COLLECTIONS
San Xavier Mission and San Xavier School	150	1,048	54,496	55 gallon barrel	24	24 barrels/week	Hauled to the open dump
San Xavier District Office (s)	87	611	31,772	55 gallon barrel	7	Twice/Week	Hauled to the open dump
San Xavier District Headstart	12	87	4,526	55 gallon barrel	2	No particular schedule for pickup Would like to have it collected twice a week	Garbage, paper Cats/dogs frequently get into garbage barrels
San Xavier District Day Care Center	19	131	6,812	55 gallon barrel	3	Once/Week Would like to have it collected twice a week	Garbage, paper & diapers Cats/dogs frequently get into garbage barrels
OHPRD	125	877	45,600		Plastic Bags	Twice/Week	Hauled to City Landfill
TOTALS:	393	2,754	143,206				

One 55 gallon barrel will hold approximately 43.67 pounds of refuse.

Figure 6. Non-profit Organizations' Solid Waste Management Needs.

Information on the solid waste management needs of 13 commercial organizations located on the San Xavier District was gathered by this researcher during personal visits to each of the organizations (see Figure 7). Of these 13, the Westover Swap Meet, a large flea market, would not be served by the plan since solid waste produced by the Swap Meet includes many large items, such as old appliances, cars and farm machinery, that require special equipment and special handling not budgeted for in this plan. A fourteenth organization, ASARCO, Incorporated, a copper mining operation, would also not be served since it manages its own solid waste. (See Appendix D for a listing of all 14 organizations along with their main business activities). Excluding the Westover Swap Meet and ASARCO, Inc., and taking into account the expected needs of a restaurant currently under construction on the district and scheduled to open in the summer of 1990, an estimated 21 three-yard containers would be adequate for the waste management needs of commercial enterprises on the district. These would be picked up from one to three times a week, depending on the business, for an estimated total of 52 pickups per week.

Total startup costs for this alternative are estimated at \$290,000. This amount includes costs for 550 toters (including 15 to be held in reserve for replacement of toters that may become damaged), 25 three-yard containers, trucks, a small building to be used as an office, office

NAME OF ESTABLISHMENT	POUNDS PER DAY	POUNDS PER WEEK	POUNDS PER YEAR	SIZE OF CONTAINER	NUMBER OF CONTAINERS	COLLECTIONS PER WEEK	OTHER COLLECTIONS
Arizona Storage	137	960	49,920	3 cubic yards	1	2	
Bill Grahams Salvage	17	123	6,400	6 cubic yards	1 Trailer	N/A	30-50 Cubic Yards/Year - Average of 40 cubic yards
Desert Sands	210	1,476	76,800	40 cubic yards Roll Off	1		1 Per Month
Empire Caterpillar	1,208	8,480	440,960	53 cubic yards	3	1	
Foreign Trade Zone #48	34	240	12,480	3 cubic yards	1		Twice/Month
Jimmy's Diner	91	640	33,280	2 cubic yards	1	2	
Karl Peterson Salvage	42	295	15,360	4 cubic yards	2		Company calls Waste Management when dumpsters are full. Once/Month
Papago Bingo	422	2,954	153,600	40 cubic yards	1		Twice/Month
Rico Equipment	68	480	24,960	3 cubic yards	1	1	
Southwest Liquidators	137	960	49,920	6 cubic yards	1	1	
Tobacco Barn	91	640	33,280	4 cubic yards	1	1	
Westover Swap Meet	1,824	12,800	665,600	40 cubic yards	2	1	Major business and generation of solid waste from October through April.
Willard Trucking	68	480	24,960	3 cubic yards	1	1	
TOTALS:	4,349	30,528	1,587,520				

1 cubic yard = 160 pounds

Figure 7. Commercial and Industrial Waste Current Collection Information.



equipment, tools and spare parts, community education, a community cleanup campaign, and closing of the open dump. Two months of operating costs, estimated at \$17,400, are included in the startup costs. Capital costs would be provided through federal start-up grants and from the tribal treasury.

The estimated annual operating cost for this alternative would be \$104,150. These costs include wages, equipment maintenance, costs to use the city landfill, depreciation, and miscellaneous other costs.

The monthly fee for residences would be \$10.00, while the fee for commercial and non-profit organizations would be \$2.50 per pickup for 90-gallon toters and \$15.00 per pickup for the three-cubic-yard containers. Total annual revenue from operations would be about \$111,000, leaving an approximate \$6,850 surplus after operating costs. Appendix E gives an itemized breakdown of capital and operating costs for Alternative One, as well as for estimated annual income.

Tribe Operated Pickup from All District Residences and Organizations, Construction of District Sanitary Landfill

This plan would serve the same constituency as the first alternative. A major difference, however, would be the construction of a tribe-operated sanitary landfill on the district. This landfill would be located near the site

of the present open burning dump at the base of Black Mountain. It would be a 20-year landfill, i.e. one constructed to receive solid wastes generated by district residents for a period of 20 years. Projections of solid waste disposal needs for the district over the next 20 years (see Appendix F) indicate that an 8.24 acre landfill with an average operating depth of 10 feet would provide sufficient volume to dispose of wastes. The formula used to determine acre-feet required per year was the following (Rothfus & Dallapena, 1987):

$$Q = \frac{peck}{d}$$

where

Q = volume of land required per year in acre-feet  
 p = population served  
 e = ratio of earth to compacted fill (1.25)  
 c = pounds of refuse generated per capita per day  
 k = 0.226 (constant)  
 d = density of compacted fill (750 lbs/yd<sup>3</sup>)

The cost of constructing and operating the landfill would include costs for pre-construction studies, site and site access preparation, installation of utilities, a D-4 bulldozer, a service building, tools and spare parts, and office equipment. In addition, Environmental Protection Agency regulations for constructing, operating, and closing sanitary landfills would be followed in enacting this alternative, adding considerably to the costs. These regulations include gas and groundwater monitoring, a leachate collection and storage system, and run-on and run-

off controls (EPA, 1988). The single largest cost would be for the containment system, which is the liner at the bottom of the landfill. Two types of liner were reviewed, clay and synthetic. Since there is no clay present at or near the projected landfill site, clay would have to be trucked in, resulting in a cost for installing a clay liner for the 8.24 acre landfill of approximately \$946,000 (EPA, 1988). The synthetic liner would be considerably less expensive. It would consist of a geotextile support fabric, a 30-mil synthetic layer of high-density polyethylene, 12 inches of sand, a geotextile filter fabric, and 12 inches of fill to protect the liner, with installation costs of approximately \$765,000 (EPA, 1988). The total estimated cost for constructing the landfill, assuming installation of a synthetic liner, would be \$1,572,000, and total initial capital costs for Alternative Two would be about \$2,022,400. Again, capital costs would be provided through federal start-up grants and from the tribal treasury.

Yearly operating costs for this alternative would include expenditures involved in picking up, transporting, and covering the solid waste and for maintaining the landfill according to EPA regulations. These costs are estimated at \$116,432.

Income from operations would be somewhat more than for Alternative One, due to higher fees. The numbers and types

of receptacles needed and pickup schedules would remain the same as in the first alternative, but fees would be raised to cover the increased operations cost. Residential customers would be charged \$13.50 per month for twice-weekly pickup, non-profit customers would be charged \$5.00 per pickup, and commercial customers would be charged \$15.00 per pickup. This would result in an annual income of \$134,250, a surplus of about \$17,818 over operating costs. Out of this surplus, leachate treatment costs of an estimated \$660 per 20,000 gallons (EPA, 1988) would have to be paid. Appendix G provides a breakdown of capital and operating costs and of expected yearly income.

#### Outside Contracting for Storage, Collection, and Disposal of Solid Wastes

Four waste management companies operating in Tucson were contacted and requested to provide estimates for meeting the waste management needs of the San Xavier District. These were Waste Management of Tucson, Flyte's, Browning-Ferris Industries Waste Systems, and the Pascua Yaqui Tribal Health Department. Each organization was asked to provide information on monthly fees for twice-weekly collection and disposal of solid wastes, including provision of 90-gallon wheeled toters for 533 residences and five non-profit organizations. They were also asked to give an estimate for providing recycling services to the district.

All but the Pascua Yaqui Tribal Health Department responded to these requests. This organization had previously indicated an interest in submitting a cost estimate. The department's office in Tucson was contacted several times by the researcher, but the organization failed to submit a bid. Representatives of the three remaining companies were taken on tours of the district by the researcher, and the waste management needs of the district were explained in detail. Browning-Ferris Industries Waste Systems replied to the request for a proposal, but declined to offer a bid. Waste Management of Tucson and Flyte's both submitted proposals. Letters of reply from the three responding companies can be found in Appendix H.

Flyte's:

Flyte's monthly fee to residents for curbside service would be \$10.00 if the resident's barrels were used, and \$15.50 if Flyte's 90-gallon toters were used. Twice-weekly service for non-profit organizations using Flyte's 3-4 yard containers would be \$40.00 per month per unit. The company estimated that six units would be needed, for a total cost to non-profit organizations of \$240.00 per month.

An important aspect of Flyte's proposal was that the company indicated willingness to hire qualified tribe members to service the contract. In reply to the request

for a recycling proposal, however, the company stated that it was not economically feasible for it to provide such a service at the present time.

Waste Management of Tucson:

The proposal offered by Waste Management of Tucson distinguished between pickup from residences at the Mission View Mobile Home Park and from single homes on the district. For the mobile home park, the company bid \$6.50 per month for twice-weekly hand pick-up service and \$8.00 per month for twice-weekly service using their 95-gallon barrels. For single homes, the company bid \$16.00 per month for twice-weekly service using the company's 95-gallon barrels and \$13.25 per month for once-weekly service.

For the non-profit organizations, the company offered two alternatives, depending on whether 95-gallon barrels or larger containers were used. The first alternative quoted a total monthly fee of \$149.00 for twelve 95-gallon barrels picked up twice a week. In the second alternative, the monthly cost for two six-yard containers picked up twice a week at the San Xavier Mission and School was \$180, while the cost of three two-yard containers picked up at the other organizations was \$90.00 or \$165.00 per month, depending on whether they were picked up once or twice a week. The total cost to non-profit organizations for the larger containers therefore ranged from \$270.00 to \$345.00 per month.

Waste Management of Tucson also offered a bid on recycling services. Again, the bid differed for the Mission View Mobile Home Park and for the single-family residences. For the mobile home park the company offered curbside recycling at \$1.75 per month per home, and for single homes the company offered a centralized drop off bin to be rented at \$100.00 per month, with an additional \$100.00 fee each time the bin was taken to the recycling center. The company stated that any revenues from recycling would be returned to the Tohono O'Odham Nation.

Tribe Operated Pickup from All District Residences and Non-profit Organizations, Disposal off District

The fourth alternative for a solid waste management plan was similar to the first alternative. Pickup from residences and non-profit organizations would be on the same schedule as for Alternative One. The main difference in this alternative was that pickup and disposal of solid wastes would not be done for commercial organizations operating on the district. As a result of this difference, smaller trucks could be used to implement the plan. Instead of the 27-yard and 18-yard compactor trucks needed for Alternative One, an 18-yard compactor would be the main truck used in implementing this alternative, with a 10- to 12-yard compactor truck used as a backup. Also, to save on initial capital costs, no three-cubic-yard containers would

be purchased. Ninety-gallon wheeled toters would be used not only for residences but for all of the non-profit organizations.

The capital costs for enacting this alternative would be about \$77,000 less than for implementing Alternative One. This cost reduction would be due to the smaller trucks and the fewer number of containers needed. Estimated total capital costs would be \$213,000. Capital costs would again be provided through federal start-up grants and from the tribal treasury.

The estimated annual operating cost for Alternative Four would be about \$75,400, almost \$30,000 less than for the first alternative. Substantial savings would be seen in maintenance, fuel, and depreciation. However, because no income would be gained from commercial users in this alternative, user fees would have to be greater than in the first alternative. At \$12.00 per month for twice-weekly service to residents and \$5.00 per pickup for non-profit organizations, annual revenue would be about \$87,400, a \$12,000 surplus over operating costs. Appendix I provides breakdowns of capital and operating costs and of annual revenue.

#### Recycling Proposal for Alternatives One, Two, and Four

During the course of developing the four alternatives, this researcher investigated options for recycling. This



included requesting a recycling proposal from waste management companies for Alternative Three. For the other alternatives, the offerings of U.S. Recycling Industries, a local private recycling firm, were investigated in a personal interview with the general manager of the firm, Mr. Cliff Roberts.

U.S. Recycling Industries is willing to provide, at no cost to the tribe, centrally located containers for the purpose of recycling several types of items. A separate container would be provided for each of the following:

1. Newspapers and cardboard
2. Glass, sorted by color: clear, green and amber
3. Plastic milk, water and soft drink bottles
4. Aluminum cans

Revenues would be returned to the tribe at the rates of \$10.00 per ton for newspapers and cardboard and one cent per pound for glass. Deposits for returnable bottles and aluminum cans would also be returned.

For Alternatives One, Two and Four, this recycling option seemed workable and beneficial to the district and the tribe. It would require no investment from the tribe, and monies from recycling would be returned to the tribe. It should be noted, however, that the program would be on a trial basis. U.S. Recycling Industries would reserve the right to remove the containers if it determined that there was not a sufficient volume of recyclable items being

deposited in the containers to justify continuing to locate them on the district.

### Summary

Four solid waste management alternatives were developed for consideration in recommending a solid waste management plan for the San Xavier District. In Alternative One, solid wastes generated by residents, non-profit organizations, and commercial enterprises on the district would be picked up and disposed of at the Tucson city landfill. This would be a tribal enterprise employing tribe members. Alternative Two would also be a tribal operation. The same constituents would be served as in the first alternative, but disposal would be in a 20-year sanitary landfill constructed on the district and maintained by the tribe. In Alternative Three, waste pickup and disposal would be contracted to an outside company. Alternative Four would be substantially like Alternative One, except commercial organizations located on the district would not be served. A trial recycling program in conjunction with U.S. Recycling Industries was also included for Alternatives One, Two, and Four.

In the following chapter the four alternatives will be discussed. Following discussion, a recommendation to the tribal council will be made.

## CHAPTER V

### DISCUSSION AND RECOMMENDATIONS

This chapter is divided into three sections. In the first section results of the study will be discussed. This will include discussion of the solid waste generation study and the four alternative solid waste management plans. In the second section a recommendation to the San Xavier District tribal council will be made on what solid waste management plan to implement on the district, and steps toward implementation will be discussed. In the final section recommendations for further research will be made.

#### Discussion of Results

##### Solid Waste Generation Study

This was the third study of solid waste management systems on Indian reservations to be conducted during the last twenty years. To the researcher's knowledge, it is the first study to compare solid waste generation of Indian and non-Indian residents living on the same reservation. Such studies are of important for several reasons. They provide a comparative yardstick which the Indian Health Service can use in helping other reservations develop solid waste management plans. The information is also made available to the Centers for Disease Control in Atlanta and is potentially useful in its efforts to understand and deal

with environmental health problems, especially insofar as they involve solid waste disposal.

The study resulted in daily per capita solid waste generation figures considerably below the average for the U.S. population. Our society as a whole produces 3.5 lbs. of solid waste per person per day (EPA, 1989), whereas the overall daily per capita figure for residents surveyed in this study was 1.71 lbs, less than half the national average. A main reason for this low figure may be the modest incomes of many of the residents of the San Xavier District. Income seems to be related to waste generation, for as income rises, consumption generally rises, and with more items being purchased by the consumer, there is more packaging to be thrown away.

The idea that income is related to waste generation is also somewhat supported by the fact that the daily per capita solid waste generation was highest for the Adult non-Indian group (1.91 lbs/day compared to the average of 1.71 lbs/day). Although this difference was not statistically significant, it suggests that overall, the non-Indian group may produce more solid waste than the non-Indian group. If so, this might be partially explained by the fact that many of the members of the non-Indian group are "snowbirds," i.e. persons whose permanent residences are elsewhere. They are individuals who have two homes, with the means to travel from one home to another. They can

therefore be expected to have a greater disposable income than most permanent residents of the district, whether Indian or non-Indian.

The figures for the Indian group, which included many families, and for the Family-Adult non-Indian group were quite similar (1.67 and 1.64 lbs/day respectively). This is also understandable given that families often tend to purchase food items in larger unit quantities that are packaged more efficiently.

The low figures for solid waste generation on the district are a positive sign for the development of a solid waste management plan, since they indicate that considerably less solid waste will have to be dealt with in the future than would be the case if the figures were close to the national average. This is not to minimize the problem of solid waste disposal on the district, but the figures do suggest that whatever alternative is enacted by the tribal council, the amount of solid waste that must be managed will be considerably less than it would be for many other communities with a similar population.

#### The Four Solid Waste Management Alternatives

##### Alternative One:

The first alternative presented in Chapter IV was a tribe-operated solid waste disposal service that would pick up solid wastes twice a week from residences and from one

to three times a week from non-profit and commercial organizations. Wastes would be transported to the Tucson City Dump.

This alternative has three main strengths. First, it would be a wholly tribe-operated enterprise. Second, it would provide employment for tribe members. Third, by serving all residents and organizations on the district, fees to residents would be kept at \$10.00 per month.

Alternative One also has several drawbacks. The main drawback is the large capital cost of \$290,000 required to start the program. This would be a very substantial expenditure for the tribe, and the money would have to come from the tribal treasury and from federal start-up grants. A second weakness is the fact that there is at present no legal enforcement policy in place for collection of user fees. Both of these weaknesses are, however, weaknesses also of Alternatives Two and Four.

Alternative Two:

The second alternative is identical to the first in respect to being operated by the tribe and serving the same constituents, in schedules, and in trucks and containers needed. But one important difference is that instead of solid wastes being trucked off the reservation, a sanitary landfill would be constructed on the district and operated by the tribe.

This alternative has two of the main strengths that the first alternative has: it would be a wholly tribe-operated enterprise and it would provide employment for tribe members. An additional advantage of choosing this alternative would be that the tribe would have a dependable solid waste disposal site for the next 20 years. Transfer and dumping costs associated with disposal of district solid wastes at the Tucson City Dump would be eliminated. The tribe could also elect to accept some off-district solid wastes for disposal in the landfill, thereby generating additional revenue for the tribe.

The main disadvantage of this alternative is the large cost for constructing a sanitary landfill according to EPA guidelines. Startup costs would be over two million dollars, about seven times as much as for Alternative One. Again, this money would have to come from the tribal treasury and federal start-up grants. Yearly operating costs would also be greater than for the first alternative. The \$116,432 estimated annual operating cost would require raising resident fees by \$3.50 per month and non-profit fees by \$2.50 per pickup.

Accepting solid waste from off the district would help offset some of these expenses, but to be competitive with the Tucson City Dump, the tribe could charge no more than about \$10.00 per ton for outside wastes emptied into the landfill. For an amount of outside solid waste equivalent

to what would be generated by all residents and organizations on the district in one year, about 1,200 tons, the tribe would receive only \$12,000. At the same time, one year's worth of landfill space would have been used up by off-district waste. Thus accepting waste from off the district would add relatively little to the tribe's revenues and would defeat the purpose of building the landfill, which would be to provide a disposal site for district residents and organizations. In addition, opposition to the idea of becoming a "dumping ground" for off-district wastes could probably be expected from a number of tribe members and leaders, in the researcher's judgment.

An added disadvantage to building a landfill on the district would be the costs for closing the landfill. Environmental Protection Agency regulations require that the landfill be covered upon closure, and the least expensive of the types of cover, a synthetic cover, would cost the tribe an estimated \$27.23 per square meter (EPA, 1988). For 8.24 acres, the cost would be about \$908,000. Another \$7,500 would be added for a drainage pipe laid inside the cover perimeter. Post-closure care would include costs for continuing landscape and cover maintenance, including soil volume added after subsidence.

#### Alternative Three:

The third alternative is to contract with an outside waste management company to provide pickup and disposal



services to district residents and non-profit organizations. Four companies were contacted and two offered proposals, Waste Management of Tucson and Flyte's.

The main overall advantage of contracting with an outside waste management company is that no expenditure by the tribe would be required. The main overall disadvantages are that contracting with an outside company does not put control of solid waste management in the hands of the tribe and does not further the concept of tribal autonomy.

An apparent strength of the proposal from Waste Management of Tucson was the fact that the company offered a recycling plan. However, although the cost to residents of the Mission View area seemed reasonable, the cost to the tribe for enacting the plan for Indian residents (\$100 per month container rental and \$100 each time the container is taken to the recycling center) seems quite high. Although revenue from recycling would be returned to the tribe, it is not clear that this revenue would cover the tribe's expenses for container rental and transport.

The most notable feature of the proposal by Waste Management of Tucson was the different fee schedule for residents of the Mission View Mobile Home Park and for residents of single homes, both for solid waste pickup and for recycling. The difference in costs for recycling was noted above. For solid waste pickup, twice-weekly service using Waste Management's 95-gallon barrels would cost

mobile home residents \$8.00 per month, but residents of single homes would be charged \$16.00 per month for essentially the same service. Since residents of single homes on the district are tribe members, the effective result of the double fee schedule is discrimination against the Indian population. No satisfactory reason for submitting this double fee schedule can be seen by the researcher. Although it is recognized that there would be some cost increase in servicing the Indian population because their homes are farther apart than the homes in the mobile home court, the great variance in prices proposed by Waste Management of Tucson does not seem justified. It is worthwhile noting that the other waste management company offering a bid, Flyte's, did not propose a double fee schedule, but rather a single fee for all residents.

Waste Management of Tucson also provided three options for pickup of solid wastes from non-profit organizations. Total costs to the organizations for the option using 95-gallon barrels was \$149 per month, which was less than Flyte's offer which totaled \$240 per month for non-profit organizations.

Flyte's, as mentioned above, offered a single fee schedule for all residents, which was \$15.50 per month using their 90-gallon containers and \$10.00 per month using the resident's containers. In the light of the offer by Waste Management of Tucson, the equitable fee structure for

residents submitted by Flyte's can be considered a strength. Another strength of Flyte's proposal is the fact that the company offered to employ qualified tribe members to service the contract.

A weakness of the proposal is that no recycling alternative was given by Flyte's. However, the proposal offered by U.S. Recycling Industries to provide recycling containers at no charge to the tribe makes this weakness less serious.

A more important weakness is the fact that the monthly fee for residents using Flyte's 90-gallon toters would be \$15.50, which would be quite high for many of the district residents who have low incomes. The fee would only be \$10.00 per month if the resident's containers were used, but the use by residents of 90-gallon toters to store their solid wastes is highly desirable for sanitation reasons. This is because the toters hold a considerable amount of solid waste, are durable, and have attached lids. In comparison to smaller plastic and metal cans with removable lids, these features of the 90-gallon toter make it much less likely that a resident's solid wastes will overflow the container, that the container will be knocked over and spill its contents, or that animals will find their way to the contents. Flyte's offered to sell their toters to residents, bringing the monthly pickup fee down to \$10.00, but they did not quote a price. However, the researcher

obtained a price quote of \$68.00 apiece for the 90-gallon toters from ANCO Sanitation Systems of Tempe, Arizona. If Flyte's proposal were accepted, and considering the fact that owning one of the \$68.00 toters would save a resident \$66.00 per year in pickup fees, it would be worthwhile for the tribe to consider providing incentives for tribe members to buy the toters, perhaps in the form of rebates.

Alternative Four:

The fourth alternative was identical to the first except for two elements. First, commercial businesses would not be served. Second, as a result, the trucks purchased to implement the alternative could be smaller, and no three-yard containers would have to be purchased. Instead, 90-gallon toters would be used exclusively. The plan would still be totally operated by the tribe, and thus it shares two strengths with the first two alternatives: tribal operation and employment for tribe members.

This alternative was designed to save on capital and operating costs. Capital costs would be approximately \$77,000 less than for Alternative One, and yearly operating costs would be almost \$30,000 less. This savings in startup and operating costs constitutes the main additional advantage of Alternative Four.

A main weakness of the alternative is the reduction in revenue that would result from not servicing commercial enterprises on the district. This results in the second

main disadvantage, which is that fees to residents and non-profit organizations would have to be raised in order to make up for decreased revenues. Instead of the \$10.00 monthly fee to residents required by the first alternative, the fee would be \$12.00 per month. In addition, each pickup from a non-profit organization would be \$2.50 more than for Alternative One.

#### Recommendation to the Tribal Council

In the researcher's judgment, Alternative Two, which includes building a sanitary landfill on district lands, is far too expensive. Although constructing a sanitary landfill on district lands might add somewhat to tribal autonomy, no real advantage would be gained by doing so, and it would have a negative economic impact on the tribe itself and on individual residents and organizations. Startup fees would be over two million dollars, and the cost of operations would require higher fees for all constituents. In addition, a further large cost of over \$900,000 would be faced by the tribe 20 years from now when the landfill was full and had to be closed.

Alternative Four also offers no real advantage to the tribe, when compared to the first alternative. For the sake of saving on initial capital costs and yearly operating expenses, revenues would be cut so that higher fees would have to be charged to users. Over \$13,000 more per

year would be paid by the 2000 residents of the district to make up for decreased revenues.

Alternative Three has the advantage of requiring no expenditures by the tribe. However, the inequitable fee schedule offered by Waste Management of Tucson violates one of the main purposes of this study, which was to develop a solid waste management proposal to serve all residents of the district equally well, and it is recommended that the offer be rejected. The offer by Flyte's is equitable, and if the tribe could find a way to help individuals purchase the 90-gallon toters, monthly fees to residents could be kept at \$10.00. However, even though Flyte's has offered to hire any qualified tribe members to service the contract, the tribe would not have control of the waste management process, and the operation would not be oriented to tribal autonomy.

Therefore, it is recommended that the tribal council accept Alternative One for its solid waste management plan. This would be a wholly tribal-owned and operated waste management service serving all residents and organizations on the district.

The design and implementation of Alternative One would best meet the overall objectives set for a solid waste management plan for the district. Three advantages of the plan are that it would be oriented to tribal autonomy; it would be operated as a tribal enterprise, employing tribe

members; and user fees would be kept at \$10.00 per month for individual households. Another important consideration is that the main solid waste containment system for residents, 90-gallon wheeled toters, would provide sanitary, efficient, covered storage for their solid wastes, and the storage would be adequate given the twice-weekly pickup schedule. Overall, implementation of Alternative One would provide for a healthier, more sanitary, and more aesthetically pleasing environment on the district.

The startup costs for the plan, \$290,000, do not seem excessive, and in the researcher's opinion it is likely that federal startup grants can be obtained to considerably lessen the funds that would have to be expended by the tribe initially. It is recommended that all possible sources of funding, including grants, loans, contributions, and other services, be sought out. This should include investigation into the possibility of aid from the Environmental Protection Agency, the Indian Health Service, the Native American Association, the Tohono O'Odham Nation, and private foundations.

To provide initial operating funds for the program, two months of operating costs totaling \$17,400 were included in the capital costs. This would provide initial operating funds so that operations would not begin by incurring a large deficit. Financing of operating costs should be exclusively from user fees. An estimated yearly

surplus of \$6,850 after operating expenses should accrue to the tribe. In addition, \$36,000 for annual depreciation of equipment and the building was calculated for the first year's operating expenses. It is highly recommended that the tribe establish an account to save all surplus revenues over actual operating expenses for future replacement of equipment.

It is further recommended that the offer by U.S. Recycling Industries to place recycling containers at central locations on the district be accepted. Since these containers would be placed on the district only on a trial basis, provisions for public education should be made to inform residents of the value recycling would have for the tribe and the environment.

Expenditures for other public education about the program have been included in initial startup costs, and those provisions should be enacted. Results of the study suggest that there will be strong support for the solid waste management program among residents, yet the widest possible public understanding and backing is essential if the program is to succeed. Residents should be kept up to date. They should be informed about project implementation and progress, collection routes and fees, and closing of the open burning dump. This can also provide an opportunity to educate residents about sanitary home storage practices.



Costs for an annual reservation clean-up campaign have also been included in initial startup costs. Such a campaign will help create an awareness among residents of the importance of keeping their homes, lands, and the district itself free of pollution and health hazards associated with solid wastes. A strong effort should be made to publicize the cleanup campaign and to involve as many residents as possible.

During the initial years of the program, full-time management and supervision will be especially important to its success. Weekly solid waste collection will be a service that people will soon depend on, and residents will become keenly aware of it, especially if there are any problems. Thus the program must provide dependable service to gain the trust and respect of the people served. Not only will this promote full participation in the program, but residents will more readily accept paying for the service. A program manager will therefore be needed to direct activities such as facilities planning, equipment selection, collection route planning, and development of management guidelines. The present tribal manager may be able to undertake this program management function, but if so, it may be advisable to also use the services of an outside consultant with solid waste management experience.

Full participation in the program by all district residents must be encouraged, and if necessary, participation

should be made mandatory. The \$10.00 monthly user fee is based upon full or nearly full participation. Less participation would result in an increase in user fees to pay for operating costs. For example, if only 75% of the district residents participated in the plan, resident user fees would rise to \$13.25 per month.

The following schedule is recommended for implementation of the solid waste management plan.

June 27, 1990	Submit the solid waste management plan to the San Xavier District Council for approval.
June 27, 1990	Begin search for funding. Begin to develop a solid waste ordinance. Begin a village based solid waste educational program.
August 15, 1990	Submit and obtain Council approval of the solid waste ordinance.
October 17, 1990	Hire a solid waste Project Manager or obtain outside consulting as needed. Develop a plan of operations.
January 20, 1991	Begin purchasing equipment. Begin advertising for personnel.
March 15, 1991	Begin personnel training.
April 15, 1991	Begin collection system.
May 15, 1991	Begin closure and cleanup of the open dump.
June 20, 1991	Inspect the open dump to ensure that it has not been reopened.
April 20, 1992	Annual Solid Waste Management Project evaluation.
April 20, 1997	Five year Solid Waste Management Project evaluation.

### Recommendations for Further Study

The following recommendations are made for further study:

1. It is recommended that daily per capita solid waste generation studies be undertaken on other reservations that do not have a present solid waste management plan in order to help determine the waste management needs of the reservations.
2. It is recommended that any reservation considering a solid waste management plan conduct a survey of residents in order to help determine attitudes, needs, and desires pertaining to such a plan.
3. It is recommended that recycling options for the San Xavier District continue to be researched for the purpose of making it possible for residents to recycle a greater range of items.
4. It is recommended that an ongoing detailed record of the history of the implementation of the San Xavier District solid waste management plan be kept as a resource for other tribes to use in developing their own solid waste management plans.

## CHAPTER VI

## SUMMARY

This study concerned solid waste management on the San Xavier District of the Tohono O'Odham Nation near Tucson, Arizona. At present the district operates an open burning dump that constitutes a health hazard and is in violation of Environmental Protection Agency regulations. In addition, some individuals and families on the district engage in unsanitary and ecologically unsound waste management practices, including burying and/or burning solid wastes on their property and dumping solid wastes on open reservation lands. The San Xavier District Tribal Council has expressed its desire to implement a solid waste management plan to help eliminate these problems and to help create a healthier, more sanitary, and more aesthetically pleasing reservation environment.

The study had two main purposes. The first purpose was to gather information from residents of the San Xavier District about their solid waste needs and about their attitudes toward a proposed solid waste management program for the district. The second purpose was to develop four alternative solid waste management plans for the district and to make a recommendation to the district tribal council concerning which plan to implement.

To gather information about solid waste disposal needs among residents of the district, a solid waste generation

study was done comparing the daily per capita solid waste generated over one week by individuals residing in three randomly selected groups of district households. Daily per capita solid waste generation of 25 Indian households was compared to daily per capita solid waste generation of 30 non-Indian households situated in the Mission View Mobile Home Park on the district. The 30 non-Indian households included 15 Adult households (in the Adult section of the trailer park) and 15 Family-Adult households (in the Family-Adult section of the trailer park).

Results of the study showed that the Adult non-Indian households had the highest daily per capita solid waste generation (1.96 lbs), while the Indian and the Family-Adult non-Indian households generated a similar amount of solid waste daily per person (1.67 and 1.64 lbs respectively). The overall daily per capita solid waste generated by all groups, 1.71 lbs/day, was less than half of the national average of 3.5 lbs/day. An analysis of variance showed that the differences in daily per capita solid waste generation among the three groups were not statistically significant at the .05 level, and a t-test showed that differences between the Indian residents and the non-Indian residents considered as one group were not statistically significant at the .05 level.

A 10-item questionnaire meant to determine attitudes toward a district solid waste management plan was also

mailed to all residents of the district. A second administration of the questionnaire was impossible, however, and the 14% response rate was too low to make any valid statistical inferences.

Four alternative solid waste management proposals were developed. The first of these proposed a tribal-operated solid waste management and disposal service which served all residents and all organizations on the San Xavier district, trucking solid wastes off the reservation. The second alternative was much like the first except construction and operation of an 8.24 acre landfill on district lands was also proposed. The third alternative was to contract waste pickup and disposal to an outside waste management company. The fourth alternative was similar to the first alternative, except commercial organizations on the district would not be served.

Evaluation of the four proposals showed that the second alternative was too costly and that user fees would be too high. The fourth alternative would also lead to user fees that were too high. One proposal by one of the companies that submitted bids for Alternative Three was rejected largely on the grounds of inequitable fees for residents, while the other company's proposal was found to be reasonable and equitable. However, Alternative One was chosen as being the proposal that fulfilled the objectives of the San Xavier District Tribal Council most fully.

Alternative One was chosen for recommendation to the San Xavier District Tribal Council for several reasons. First, it would be oriented toward tribal autonomy and would be operated as a tribal enterprise, providing employment for tribe members. Second, it would require only a \$10.00 per month user fee per residence for twice-weekly pickup. Third, start-up costs required were considered to be not excessive. Overall, it fulfilled the objective of creating a healthier, more sanitary, and more aesthetically pleasing reservation environment.

Several further recommendations were made. It was recommended that a recycling proposal by U.S. Recycling Industries in which centrally located recycling containers would be placed on the district at no charge to the tribe be accepted. It was also recommended that the tribal council seek start-up grants to help fund the solid waste management plan. Finally, it was recommended that strong efforts be made to engage the participation of all residents and organizations on the district and that a program of public education and information about the solid waste management plan be enacted to gain the fullest support possible for the plan and to create a sense of the importance of maintaining a healthy and sanitary home and reservation environment.

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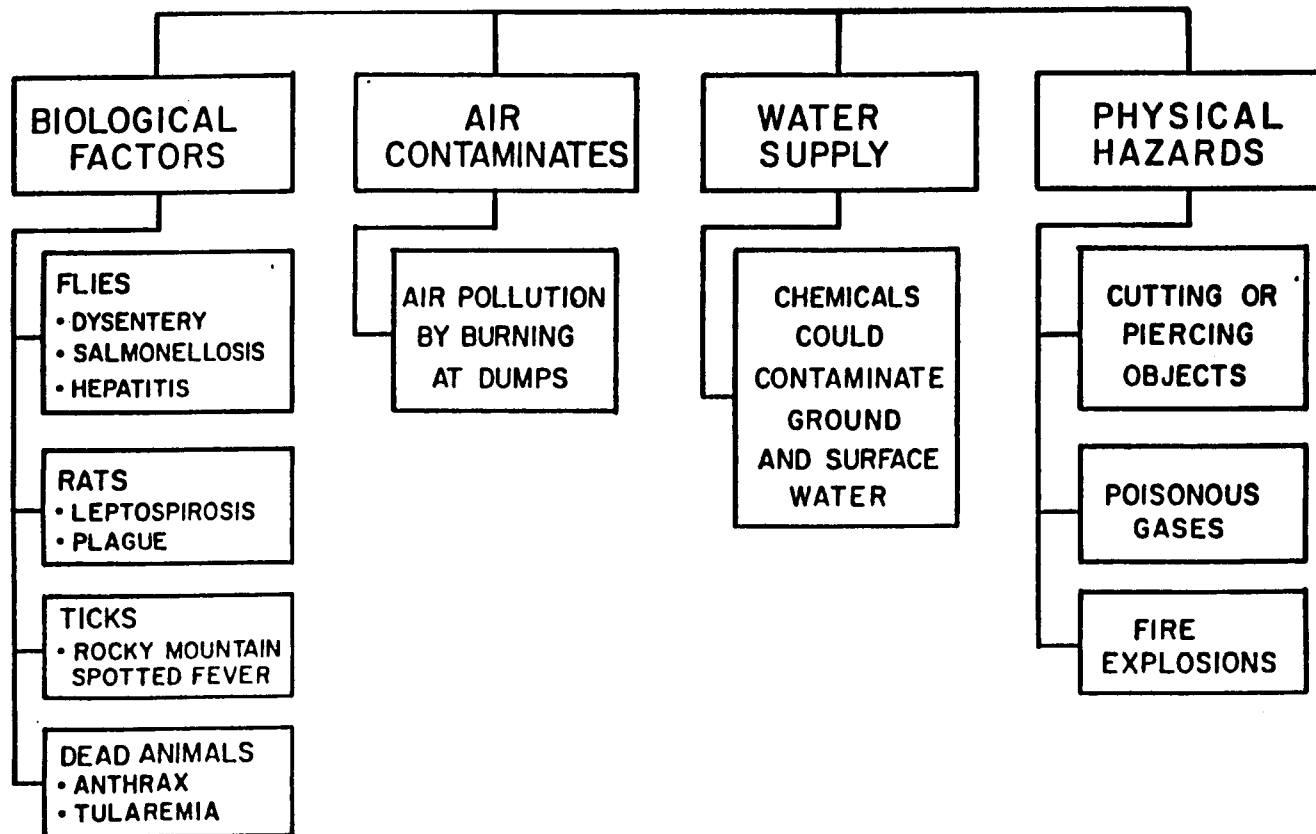


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## APPENDICES

APPENDIX A

HEALTH PROBLEMS ASSOCIATED WITH  
OPEN DUMPS



APPENDIX B

LETTER TO RESIDENTS EXPLAINING SURVEY QUESTIONNAIRE  
AND QUESTIONNAIRE

## SAN XAVIER DISTRICT SOLID WASTE QUESTIONNAIRE

TO THE RESIDENTS OF THE SAN XAVIER DISTRICT:

The San Xavier District Tribal Council is concerned about the increasing solid waste\* and garbage\* problems on the San Xavier Reservation. There is also concern about the continuing usage of the open burning dump at the base of Black Mountain. The District Council has directed the Indian Health Service to develop a Solid Waste Management Program for the reservation which would satisfy current and future federal environmental law, and provide a collection service to all residents of the district.

The existence and use of an open burning dump contributes to pollution of the air and land on the reservation. Presently, a solid waste collection service is available to only a few selected areas on the reservation. A majority of the people must haul their garbage to the open burning dump.

A successful Solid Waste Management Program must have the support of the community which it is designed to serve. The San Xavier District Council and the Indian Health Service would appreciate your answers and comments concerning what type of solid waste collection program you would support.

Would you please take the time to complete the following questionnaire and either return by mail utilizing the enclosed self-addressed envelope, or you may return it to the District Council office to the attention of Daniel Preston, District Vice Chairman. Please mail or return your completed questionnaire forms by February 9, 1990. If you have any questions please do not hesitate to contact the Indian Health Service, Environmental Services Branch at the following numbers, 670-5020 or 670-6664.

Thank you for your participation.

*Redacted for Privacy*

Daniel Preston, Vice Chairman  
San Xavier District  
Tohono O'Odham Nation

*Redacted for Privacy*

Nathan M. Quiring, M.S., R.S.  
Indian Health Service Sanitarian  
7900 South J. Stock Road  
Tucson, Arizona 85746

\*SOLID WASTE DEFINED AS: Paper, bottles, metals, plastics, et. al.

GARBAGE DEFINED AS: Food waste, waste materials that are likely to decompose or spoil.

RECYCLING DEFINED AS: Converting solid waste - garbage into new products by using the resources in throw away materials. (See attached questionnaire.)

SOLID WASTE MANAGEMENT GARBAGE COLLECTION SURVEY

1. Would you support or oppose a Tribal Solid Waste Management Plan for the San Xavier District? Please circle your answer.

- a. Support
- b. Oppose
- c. Does not matter

COMMENTS:

2. Would you be willing to pay a \$8 - \$10 fee for a collection service and proper disposal of your solid waste? Please circle your answer.

- a. Support
- b. Oppose
- c. Does not matter

COMMENTS:

3. Would you prefer to have your solid waste/garbage collected: Please circle your answer.

- a. Once a week
- b. More than once a week
- c. Twice a month
- d. Other (specify)

5. Please indicate whether or not you ever dispose of solid waste/garbage by using one or more of the methods listed below: You may circle as many items which apply to you and your household.

	<u>Yes</u>	<u>No</u>
a. Burning it somewhere on my property.	1	2
b. Burying it somewhere on my property.	1	2
c. Hauling it to the district open dump.	1	2
d. Hauling it somewhere out on the open reservation and dumping it.	1	2
e. Hauling it to the Pima County Landfill.	1	2
f. Having an outside waste collection company such as "Waste Management" collect it in front of my house.	1	2

- 2 -

6. Would you support or oppose a Solid Waste Management Program which collected and disposed of all solid waste/garbage off of the reservation/district? Please circle your answer.

- a. Support
- b. Oppose
- c. Does not matter

COMMENTS:

7. What kind of solid waste/garbage can/receptacle are you currently using? Please circle as many items as may apply to you and your household.

	<u>Using</u>	<u>Not Using</u>
a. Hard Plastic garbage cans on wheels with cover		2
b. Metal garbage cans		2
c. Cardboard boxes		2
d. Fifty-five (55) gallon barrels		2
e. Thirty (30) gallon plastic bags		2
f. Other (write in your answer)		

RECYCLING

8. Would you support or oppose a San Xavier District recycling program? Please circle your answer.

- a. Support
- b. Oppose
- c. Does not matter

COMMENTS:

9. Would you be willing to participate in the recycling of the following items? Please circle as many items as may apply to you and your household.

	<u>YES</u>	<u>NO</u>
a. Paper		2
b. Metals		2
c. Glass		2
d. Plastic		2
e. Used books		2
f. Auto batteries		2
g. Used oil		2
h. Tires		2
i. Used auto parts		2
j. Abandoned cars		2

- 3 -

10. Would you be willing to transport and deposit such recyclable items as paper, glass, and plastic to conveniently located "recycling dumpsters" within the district?  
Please circle your answer.

- a. Willing to transport.
- b. Would have to have it picked up.
- c. It does not matter.

COMMENTS:

11. Would you prefer that it be mandatory that all residents living within the district be required to participate in a district supported Solid Waste Management Program?  
Please circle your answer.

- a. Support
- b. Oppose
- c. Does not matter

COMMENTS:



APPENDIX C

LETTER TO INDIAN RESIDENTS AND LETTER TO NON-INDIAN  
RESIDENTS EXPLAINING DAILY PER CAPITA  
SOLID WASTE GENERATION STUDY



## DEPARTMENT OF HEALTH &amp; HUMAN SERVICES

Public Health Service

January 24, 1990

Indian Health Service  
Office of Health Program Research and Development  
Tucson Program Area  
7900 S. J Street Road  
Tucson, Arizona 85746-9352

DEAR SAN XAVIER DISTRICT RESIDENT:

Your name and address has been randomly selected to participate in a "Solid Waste Management" study for the San Xavier District. The San Xavier District Tribal Council has commissioned the Indian Health Service (IHS) to conduct a "blueprint study" concerning the implementation of a district wide solid waste garbage program. This program would include both Indian and non-Indian residents of the district.

A vital part of this study is the estimation of the amount of solid waste/garbage generated within the district. This is accomplished by the random selection of a certain number of homes within the district.

If you agree to participate in the "solid waste" study you will be asked to do the following:

The Indian Health Service would like to weigh the amount of solid waste/garbage your household would generate for one week.

STEP 1: Using the large trash bags given to you by the Indian Health Service Representative; place all of your household generated wastes from the afternoon of January 25, 1990, to the afternoon of January 29, 1990, in the bags. The IHS Representative will be stopping at your house during the afternoon (12:00 p.m. - 4:00 p.m.) hours of the 29th of January to weigh your solid waste/garbage. Please have your waste bags set out in front of your house or where they may easily be accessible to the IHS-San Xavier District Representative. AFTER WEIGHING YOUR SOLID WASTE/GARBAGE BAGS, THE IHS REPRESENTATIVE WILL HAUL YOUR WASTE BAGS TO THE DISTRICT DUMP.

STEP 2: Using the remaining trash bags; again place all generated household wastes from the afternoon of January 29, 1990, to the afternoon of February 1, 1990, in the appropriate number of bags. An IHS Representative will again be weighing your solid wastes/garbage during the afternoon (12:00 p.m. - 4:00 p.m.) hours of February 1, 1990. AFTER WEIGHING YOUR SOLID WASTES/GARBAGE BAGS, THE IHS REPRESENTATIVE WILL HAUL YOUR WASTE BAGS TO THE DISTRICT DUMP.

The San Xavier District Council and the Indian Health Service deeply appreciate your participation towards the successful completion of the San Xavier District Solid Waste Management Study.

Respectfully,

*Redacted for Privacy*

Nathan M. Quiring, M.S., R.S.  
United States Public Health Service  
Indian Health Service  
(602) 670-5020  
(602) 383-7336



## DEPARTMENT OF HEALTH &amp; HUMAN SERVICES

Public Health Service

January 24, 1990

Indian Health Service  
Office of Health Program Research and Development  
Tucson Program Area  
7900 S. J Street Road  
Tucson, Arizona 85746-9332

DEAR SAN XAVIER DISTRICT RESIDENT:

Your name and address has been randomly selected to participate in a "Solid Waste Management" study for the San Xavier District. The San Xavier District Tribal Council has commissioned the Indian Health Service (IHS) to conduct a "blueprint study" concerning the implementation of a district wide solid waste garbage program. This program would include both Indian and non-Indian residents of the district.

A vital part of this study is the estimation of the amount of solid waste/garbage generated within the district. This is accomplished by the random selection of a certain number of homes within the district.

If you agree to participate in the "solid waste" study you will be asked to do the following:

The Indian Health Service would like to weigh the amount of solid waste/garbage your household would generate for one week.

STEP 1: Using the large trash bags given to you by the Indian Health Service Representative; place all of your household generated wastes from the afternoon of January 25, 1990 to January 29, 1990, in the bags (waste generated after your normal January 25, 1990, waste management pickup). The IHS Representative will be stopping at your household during the early morning hours of the 29th of January to weigh your solid waste/garbage. (Please have your waste bags set out by the curb site no later than 8:00 a.m.)

STEP 2: Using the remaining trash bags; place all generated household wastes from the afternoon of January 29, 1990, to February 1, 1990, in the appropriate number of bags. An IHS Representative will again be dropping by your house during the early morning hours of February 1, 1990, to weigh your solid waste/garbage. (Please have your waste bags set out by the curb site no later than 8:00 a.m.)

The San Xavier District Council and the Indian Health Service deeply appreciate your participation towards the successful completion of the San Xavier District Solid Waste Management Study.

Respectfully,

*Redacted for Privacy*

Nathan M. Quiring, M.S., R.S.  
United States Public Health Service  
Indian Health Service  
(602) 670-5020  
(602) 383-7336

## APPENDIX D

COMMERCIAL-INDUSTRIAL ENTERPRISES WITH  
THE SAN XAVIER DISTRICT

1. ASARCO Incorporated  
P.O. Box 111  
Sahuarita, AZ 85629

ENTERPRISE: Copper mining

2. Arizona Storage Rental, Inc.  
Heavy Haul Division  
7400 S. Nogales Hwy  
Tucson, AZ 85706

ENTERPRISE: Provider of multi-use vans and ground storage units

3. Desert Sands  
7400 S. Nogales Hwy, #12  
Tucson, AZ 85706

ENTERPRISE: Sales and repair of mobile homes

4. Empire Machinery, Caterpillar Sales  
P.O. Box 11250  
Tucson, AZ 85734

ENTERPRISE: Heavy Equipment Sales

5. Foreign Trade Zone, #48  
North-Papago, Ltd.  
7800 S. Nogales Hwy  
Tucson, AZ 85706

ENTERPRISE: Export-import warehouse

6. Grahams Salvage Co.  
San Xavier Industrial Center  
Tucson, AZ 85706

ENTERPRISE: Salvage liquidators of machinery, tools, etc.

7. Jimmy's Diner  
P.O. Box 27281  
Tucson, AZ 85706

ENTERPRISE: Restaurant

8. Papago Bingo  
P.O. Box 22230  
Tucson, AZ 85734

ENTERPRISE: Bingo/gambling and food/beverage service

9. Petersons Salvage Co.  
San Xavier Industrial Park  
Tucson, AZ 85706

ENTERPRISE: Metal salvaging

10. Rico Equipment  
San Xavier Industrial Park  
Tucson, AZ 85706

ENTERPRISE: Heavy equipment repair

11. Southwest Liquidators, Inc.  
220 E. Los Reales  
Tucson, AZ 85706

ENTERPRISE: Equipment, furniture, and electronics  
salvage

12. Tobacco Barn  
San Xavier Industrial Park  
Tucson, AZ 85706

ENTERPRISE: Retail tobacco

13. Westover Swap Meet  
Tucson, AZ 85706

ENTERPRISE: Giant flea market

14. Willard Trucking and Brokerage  
P.O. Box 22433  
Tucson, AZ 85743

ENTERPRISE: Long and short haul trucking

APPENDIX E

ALTERNATIVE ONE

ITEMIZED COSTS AND FEE SCHEDULE

**Alternative One**  
**TRIBAL OPERATED: Serving All District Residential**  
**Groups, Commercial, and Non-Profit Organizations**  
**Capital Costs**

	UNIT COST	ESTIMATED COST	ANNUAL DEPRECIATION COST
I. STORAGE-RESIDENTIAL, COMMERCIAL AND NON-PROFIT STORAGE CONTAINERS			
550 each 90 gallon/Toters-Curbside	68	37,400	3,740 - 10 years
25 each 3 cubic yard Containers Side Load	380	9,500	950 - 10 years
II. COLLECTION-RESIDENTIAL, COMMERCIAL AND NON-PROFIT - TRIBAL OPERATED			
27 yard Compactor Truck Side Load	103,000	103,000	17,200 - 6 years
18 yard Compactor Truck Side Load with Chassis	75,000	75,000	12,500 - 6 years
III. 8' X 12' BUILDING	1,500	1,500	150 - 10 years
IV. OTHER EQUIPMENT			
Office Equipment		10,000	1,000 - 10 years
Tools and Spare Parts		5,000	500 - 10 years
V. COMMUNITY EDUCATION			
Advertising and Educational Materials		2,000	
Cleanup Campaign		1,000	
Closing of Open Dump		1,500	
VI. MISCELLANEOUS			
Two Months Start-up Cost		17,400	

Sub-Total: \$263,300

10% Contingency: \$26,330

TOTAL ESTIMATED CAPITAL COSTS: \$289,630 \$36,040

TOTAL ROUNDED COST: \$290,000

Capital Cost per Home: \$527

**Alternative One**  
**TRIBAL OPERATED: Serving All District Residential**  
**Groups, Commercial, and Non-Profit Organizations**  
**Operating Costs**

	ANNUAL COST
I. PERSONNEL	
1 - Refuse Collector	14,000
1 - Secretary/Bookkeeper	10,000
Fringe Benefits 15%	3,600
II. EQUIPMENT MAINTENANCE	
Refuse Collection Trucks	13,350
Containers	500
Diesel Fuel	2,850
III. MISCELLANEOUS	
Liability Insurance Trucks	4,000
Utilities	1,800
Office Supplies	6,000
IV. DISPOSAL COSTS	
City Landfill \$10.00/Ton	12,000
V. ANNUAL DEPRECIATION	36,040

TOTAL OPERATING COST: \$104,150



**Alternative One**  
**TRIBAL OPERATED: Serving All District Residential**  
**Groups, Commercial, and Non-Profit Organizations**  
**Fee Schedule**

<u>RESIDENTIAL</u>	<u>MONTHLY FEE PER 90 GALLONS</u>	<u>MONTHLY REVENUE</u>	<u>ANNUAL REVENUE</u>
535	\$10.00	\$5, 350	\$64, 200

<u>NON-PROFIT and COMMERCIAL</u>	<u>FEE PER COLLECTION</u>	<u>WEEKLY COLLECTION</u>	<u>WEEKLY REVENUE</u>	<u>ANNUAL REVENUE</u>
(3) 90 gallon	\$2.50	6	\$15.00	\$780
3 cubic yards	\$15.00	59	\$885.00	<u>\$46, 020</u>
				\$46, 800

TOTAL ANNUAL REVENUE

Residential	<u>\$64, 200</u>
Commercial - Non-Profit	<u>\$46, 800</u>
Sub-Total:	<u>\$111, 000</u>
Less Annual Operating Cost	<u>\$104, 150</u>
Surplus	<u>\$6, 850</u>

## APPENDIX F

**TWENTY YEAR SOLID WASTE GENERATION RATE PROJECTION AND  
LAND VOLUME REQUIREMENTS FOR A SANITARY LANDFILL**

	A	B	C	D	E	F	G
Year	2% Population Increase/Yr.	3% Increase in Pounds of Res. Solid Waste per Person/Yr.	Pounds of Residential Solid Waste Generated per Day	5% Increase in Pounds of Commercial Solid Waste Generated/Day	Total Pounds Solid Waste Generated/Day	Total Pounds per Person per Day: $\left( \frac{C + D}{A} \right)$	Acres/Year
1991	2,000	2.00	4,000	2,566	6,566	3.28	.25
1992	2,040	2.06	4,202	2,695	6,897	3.38	.26
1993	2,080	2.12	4,410	2,830	7,240	3.48	.27
1994	2,122	2.18	4,626	2,972	7,598	3.58	.29
1995	2,164	2.25	4,869	3,121	7,990	3.69	.30
1996	2,207	2.32	5,120	3,277	8,397	3.80	.32
1997	2,251	2.39	5,380	3,441	8,821	3.92	.33
1998	2,296	2.46	5,648	3,613	9,261	4.03	.35
1999	2,342	2.53	5,925	3,794	9,719	4.15	.37
2000	2,389	2.61	6,235	3,984	10,219	4.28	.39
2001	2,437	2.69	6,556	4,183	10,739	4.41	.41
2002	2,486	2.77	6,886	4,392	11,278	4.54	.43
2003	2,536	2.85	7,228	4,612	11,840	4.67	.45
2004	2,587	2.94	7,606	4,843	12,449	4.81	.47
2005	2,639	3.03	7,996	5,085	13,081	4.96	.49
2006	2,692	3.12	8,399	5,339	13,738	5.10	.52
2007	2,746	3.21	8,815	5,606	14,421	5.25	.54
2008	2,801	3.31	9,271	5,886	15,157	5.41	.57
2009	2,857	3.41	9,742	6,180	15,922	5.57	.60
2010	2,914	3.50	10,211	6,489	16,700	5.73	.63

Total Acres Needed for a Twenty Year Landfill: 8.24

Acreage based on average operating depth of 10 feet.

APPENDIX G

ALTERNATIVE TWO

ITEMIZED COSTS AND FEE SCHEDULE

**Alternative Two**  
**TRIBAL OPERATED: Serving All District Residential**  
**Groups, Commercial, and Non-Profit Organizations**  
**\*Tribal Operated and Maintained Sanitary Landfill**  
**Capital Costs**

	UNIT COST	ESTIMATED COST	ANNUAL DEPRECIATION COST
I. STORAGE-RESIDENTIAL, COMMERCIAL AND NON-PROFIT STORAGE CONTAINERS			
550 each 90 gallon/Toters-Curbside	68	37,400	3,740 - 10 years
25 each 3 cubic yard Containers Side Load	380	9,500	950 - 10 years
II. COLLECTION-RESIDENTIAL, COMMERCIAL AND NON-PROFIT - TRIBAL OPERATED			
27 yard Compactor Truck Side Load	103,000	103,000	17,200 - 6 years
18 yard Compactor Truck Side Load with Chassis	75,000	75,000	12,500 - 6 years
III. LANDFILL COSTS			
Cost Analysis 3 - Synthetic Liner		1,572,000	
IV. OTHER EQUIPMENT			
Office Equipment		10,000	1,000 - 10 years
Tools and Spare Parts		5,000	500 - 10 years
V. COMMUNITY EDUCATION			
Advertising and Educational Materials		2,000	
Cleanup Campaign		1,000	
Closing of Open Dump		1,500	
VI. MISCELLANEOUS			
Two Months Start-up Cost		22,113	

Sub-Total: \$1,838,513

10% Contingency: \$183,851

TOTAL ESTIMATED CAPITAL COSTS: \$2,022,364 \$35,890

TOTAL ROUNDED COST: \$2,022,000

Capital Cost per Home: \$3,676

**Alternative Two**  
**TRIBAL OPERATED: Serving All District Residential**  
**Groups, Commercial, and Non-Profit Organizations**  
**\*Tribal Operated and Maintained Sanitary Landfill**  
**Operating Costs**

	ANNUAL COST
I. PERSONNEL	
1 - Refuse Collector _____	14,000
1 - Secretary/Bookkeeper _____	10,000
1 - Landfill Operator _____	7,500
Fringe Benefits 15% _____	4,725
II. EQUIPMENT MAINTENANCE	
Refuse Collection Trucks _____	16,500
Landfill Dozer D-4 _____	7,682
Containers _____	500
Diesel Fuel	
Compactor Trucks _____	2,860
Landfill Dozer D-4 _____	4,875
III. MISCELLANEOUS	
Liability Insurance	
Compactor Trucks _____	2,500
Landfill Dozer D-4 _____	1,000
Utilities _____	2,400
Office Supplies _____	6,000
IV. ANNUAL DEPRECIATION _____	35,890

TOTAL OPERATING COST: \$116,432

**Alternative Two**  
**TRIBAL OPERATED: Serving All District Residential**  
**Groups, Commercial, and Non-Profit Organizations**  
**\*Tribal Operated and Maintained Sanitary Landfill**  
**Fee Schedule**

<u>RESIDENTIAL</u>	<u>MONTHLY FEE PER 90 GALLONS</u>	<u>MONTHLY REVENUE</u>	<u>ANNUAL REVENUE</u>
535	\$13.50	\$7, 222	\$86, 670

<u>NON-PROFIT and COMMERCIAL</u>	<u>FEE PER COLLECTION</u>	<u>WEEKLY COLLECTION</u>	<u>WEEKLY REVENUE</u>	<u>ANNUAL REVENUE</u>
90 gallons	\$5.00	6	\$30.00	\$1, 560
3 cubic yards	\$15.00	59	\$885.00	<u>\$46, 020</u>
				\$47, 580

TOTAL ANNUAL REVENUE

Residential	<u>\$86, 670</u>
Commercial - Non-Profit	<u>\$47, 580</u>
Sub-Total:	<u>\$134, 250</u>
Less Annual Operating Cost	<u>\$116, 432</u>
Surplus	<u>\$17, 818</u>

APPENDIX H

ALTERNATIVE THREE  
LETTERS OF PROPOSAL

Waste Management of Tucson  
 P.O. Box 50346  
 1901 W. Copper  
 Tucson, Arizona 85703  
 602/623-6396



A Waste Management Company

March 19, 1990

Nathan M. Quiring **MS**, R.S.  
 Indian Health Services  
 Office of Health Program Research and Development  
 7900 S. Stock Road  
 Tucson, Arizona 85746-9352

Dear Nathan:

Thank you for the opportunity to provide you with estimates for solid waste services for the San Xavier District, Tohono O'Odham Nation.

The service cost estimates provided were based on your written specifications, I have also offered other alternatives for your consideration.

1. RESIDENTIAL WASTE REMOVAL SERVICES

A. Mission View Mobile Home Park

Hand pick-up 2 times per week @ \$6.50 per month per home.

95 gallon barrel service 2 times per week @ \$8.00 per month per home.

B. Residential area - single homes

95 gallon barrel service 2 times per week @ \$16.00 per month per home.

95 gallon barrel service 1 time per week @ \$13.25 per month per home.

2. SERVICE TO NON-PROFIT ORGANIZATIONS

Your request for services to the Non-profit Organizations specifies 55 gallon barrels. We currently use 95 gallon barrels and have converted your figures to equivalent volumes.

Option A

A. San Xavier Mission  
 & San Xavier School

8 - 95 gallon barrels 2 times  
 per week \$96.00.



- B. San Xavier Dist. Office      2 - 95 gallon barrels 2 times  
per week \$26.50
- C. San Xavier Dist.              1 - 95 gallon barrel 2 times per  
Head Start                      week \$13.25
- D. San Xavier Dist.              1 - 95 gallon barrel 2 times per  
Day Care Center                week \$13.25

Option B

- A. San Xavier Mission      1-6 yd cont. 2 x's per week \$90  
& San Xavier School      1-6 yd 2 x's per week \$90
- B. San Xavier Dist              1-2 yd cont. 1 x per week \$30  
Office                              2 x's per week \$55.00
- C. San Xavier Dist.              1-2 yd cont. 1 x per week \$30  
Head Start                      2 x's per week \$55.00
- D. San Xavier Dist.              1-2 yd cont. 1 x per week \$30  
Day Care Center                2 x's per week \$55.00

3. RECYCLING ALTERNATIVES :

A. Mission View Area.

Curbside recycling service \$1.75 per month per home.

B. Residential area single homes.

Centralized drop off recycling bin to be serviced on call or on a schedule to be established by residents.

Container rental \$100.00 per month. \$100.00 each pull to recycling center.

Each of the proposed recycling alternatives provides for the return of any recyclable revenues to the Tohono O'odham Indian Nation.

4. SPECIAL RESIDENTIAL WASTE REMOVAL

Waste removal service (i.e. tree trimmings, old appliances, old furniture, construction materials, etc.).

Since many residents currently use a central dumping/burning area, we felt you may want to consider an additional service for larger and heavier materials.

We can provide large open top Roll Off containers to be placed at convenient locations where residents could dispose of their larger bulkier items which may be difficult to transport.

Fee: Open top Roll Off container \$90.00 per month rental plus \$100.00 per hauling to the landfill plus landfill costs. Please refer to the enclosed brochure for container description.

5. MEDICAL WASTES

Waste Management of Tucson does not currently provide medical waste removal service. This service is provided by Southwest S.T.A.T. Inc, a Waste Management, Inc. subsidiary. For more information on medical waste removal service please contact Eric Raphael at (602) 437-4010.

Please review our Solid Waste Removal & Recycling estimates and call if you have any questions. We look forward to an opportunity to work with you on your Solid Waste Management Plan for the San Xavier District.

Sincerely,

WASTE MANAGEMENT OF TUCSON

// . l .  
Veronica Sainz  
Recycling Coordinator 0

VS/gw



## FLYTE'S

(602) 574-0373

Roll-Off Containers  
Residential Trash Collection  
Interior & Exterior Demolition

4875 E. Cindrich St. • Tucson, AZ 85706

March 21, 1990

Indian Health Service  
Office of Health Program Research and Development  
Tucson Program Area  
7900 S. J Stock Rd.  
Tucson, Arizona 85746-9352

Attn: Nathan M. Quiring, Sanitarian

Dear Sir:

Since you have requested an estimate from Flyte's for refuse removal at San Xavier District, Tohono O'Odham Nation, Tucson, Arizona, I am pleased to provide the following:

The service provided would be on a twice weekly basis and would be curb-side except at the San Xavier District Offices and where dumpsters would be placed. These prices would be for a six (6) year contract ( 3 year plus 3 year option). For curb-side service using the customers @ \$10.00 per unit per month. For curb-side service using our barrels (90 gallon) @ \$15.50 per unit per month. For 3-4 yard dumpsters at 6 locations (4 at San Xavier Mission and San Xavier School, 1 at San Xavier District Headstart and 1 at San Xavier District Day Care Center) @ \$40.00 per month per unit for twice a week service.

These prices are contingent upon the landfill rates remaining at \$10.00 per ton. Should there be any increase (usually all increases are in \$2.00 increments) of \$2.00 or less per ton we would require a \$.35 per unit per month increase to cover these added costs.

If the San Xavier District, Tohono O'Odham Nation would wish to purchase the barrels, our price for service of these barrels would be @ \$10.00 per unit per month.


We would be willing to hire any qualified tribal members to service this contract.

At this time recycling is not economically feasible, however, should this change we would be happy to work out a program for you.

Sincerely,

*Redacted for Privacy*

James L. Flyte, Owner  
JLF/map

Recycled paper 

March 14, 1990

Nathan M. Quiring M.S., R.S.  
Indian Health Services Sanitarian  
7900 South J. Stock Road  
Tucson, Arizona 85746

Dear Nathan,

Thank you very much for the opportunity to submit a bid for  
the San Xavier District, Tohono O'Odham Nation.

Your interest in BFI's waste services is sincerely  
appreciated.

However, we are unable to provide you with a quotation for  
your waste management plan at this time.

Once again we appreciate your interest in BFI.

Sincerely,

*Redacted for Privacy*

Bobby Loya  
BFI Representative

BL/yb

APPENDIX I

ALTERNATIVE FOUR

ITEMIZED COSTS AND FEE SCHEDULE

**Alternative Four**  
**TRIBAL OPERATED: Serving Residential Indian and Non-Indian**  
**Populations Groups and District Non-Profit Organizations**  
**Capital Costs**

	UNIT COST	ESTIMATED COST	ANNUAL DEPRECIATION COST
I. STORAGE-RESIDENTIAL AND NON-PROFIT STORAGE CONTAINERS			
570 90 gallon/Toters-Curbside	68	38,760	3,876 - 10 years
II. COLLECTION-RESIDENTIAL AND NON-PROFIT - TRIBAL OPERATED			
18 yard Compactor Truck with Chassis		70,000	7,000 - 10 years
10-12 yard Compactor Truck with Chassis		50,000	5,000 - 10 years
III. 8' X 12' BUILDING		1,500	150 - 10 years
IV. OTHER EQUIPMENT			
Office Equipment		10,000	1,000
Tools and Spare Parts		5,000	500
V. COMMUNITY EDUCATION			
Advertising and Educational Materials		2,000	
Cleanup Campaign		1,000	
Closing of Open Dump		1,500	
VI. MISCELLANEOUS			
Two Months Start-up Cost		14,000	

Sub-Total: \$193,760

10% Contingency: \$19,376

TOTAL ESTIMATED CAPITAL COST: \$213,136 \$17,526

TOTAL ROUNDED COST: \$213,100

Capital Cost per Home: \$398

**Alternative Four**  
**TRIBAL OPERATED: Serving Residential Indian and Non-Indian**  
**Populations Groups and District Non-Profit Organizations**  
**Operating Costs**

	ANNUAL COST
I. PERSONNEL	
1 - Refuse Collector _____	14,000
1 - Secretary/Bookkeeper _____	10,000
Fringe Benefits 15% _____	3,600
II. EQUIPMENT MAINTENANCE	
Refuse Collection Trucks _____	9,000
Containers _____	500
Diesel Fuel _____	2,000
III. MISCELLANEOUS	
Liability Insurance Trucks _____	4,000
Utilities _____	1,800
Office Supplies _____	5,000
IV. DISPOSAL COSTS	
City Landfill \$10.00/Ton _____	8,000
V. ANNUAL DEPRECIATION _____	17,526

TOTAL OPERATING COST: \$75,426

**Alternative Four**  
**TRIBAL OPERATED: Serving Residential Indian and Non-Indian**  
**Populations Groups and District Non-Profit Organizations**  
**Fee Schedule**

<u>RESIDENTIAL</u>	<u>MONTHLY FEE PER 90 GALLONS</u>	<u>MONTHLY REVENUE</u>	<u>ANNUAL REVENUE</u>
535	\$12.00	\$6, 420	\$77, 040

<u>NON-PROFIT</u>	<u>FEE PER COLLECTION</u>	<u>WEEKLY COLLECTION</u>	<u>WEEKLY REVENUE</u>	<u>ANNUAL REVENUE</u>
(20) 90 gallon	\$5.00	40	\$200	\$10, 400

<u>TOTAL ANNUAL REVENUE</u>	
Residential	<u>\$77, 040</u>
Non-Profit	<u>\$10, 400</u>
Sub-Total:	<u>\$87, 440</u>
Less Annual Operating Cost	<u>\$75, 426</u>
Surplus	<u>\$12, 014</u>



## APPENDIX J

LETTER OF APPROVAL AND AUTHORIZATION FROM SAN XAVIER  
DISTRICT CONCERNING RESEARCH

April 19, 1990

Mrs. Eleanor Robertson  
7900 S. J. Stock Rd  
Tucson, AZ. 85748-9352

Dear Mrs. Robertson,

This letter is to confirm our approval and authorization for Mr. Nathan Guring to continue research and development of a Solid Waste Program for the San Xavier District.

Mr. Guring has been very cooperative with our verbal requests for investigations into the possibility of developing a Solid Waste Management Program at San Xavier. His efforts resulted in a survey of the quantity of household wastes on our district and is now in the process of completing a draft waste management plan for our review.

Your cooperation and support on this very important project under taken by Mr. Guring on behalf of the San Xavier District would be very much appreciated.

Thank you.

Sincerely,

*Redacted for Privacy*

Daniel L. Preston, Vice-Chairman  
San Xavier District of the  
Tohono O'odham Nation

cc: A. Nuñez, Chairman, San Xavier District  
J. Preston, Tohono O'odham Legislative Council  
E. Enia, Tohono O'odham Legislative Council  
Members of the San Xavier District Council

