SECTION 5
NONPOINT SOURCE POLLUTION

INTRODUCTION

Nonpoint source pollution results from a variety of activities that can lead to water quality pollution through stream runoff, seepage or percolation to aquifers. Nonpoint source activities such as agriculture, stormwater runoff, forestry and construction can create runoff that can carry pollution into receiving waters. This section of the WQMP deals with Nonpoint Source Pollution (NPS).

Nonpoint Source Pollution is defined differently in the state and federal programs; the federal definition being broader than the Arizona Environmental Quality Act (EQA) definition. In particular, the Environmental Protection Agency's (EPA's) definition includes (a) some categories that the EQA describes as nonpoint source discharges to aquifers and (b) discharges which do not originate from a specific single location such as a single pipe, or basically diffuse sources that do not require a National Pollutant Discharge Elimination System (NPDES) permit. Because of the diffuse nature of NPS, it has been more difficult to control than point source problems.

Not until the 1987 amendments to the Clean Water Act, was much emphasis place on nonpoint sources of pollution. The Clean Water Act (CWA) gives the responsibility to the states to prevent, reduce, and eliminate pollution, and to plan the development and use of land and water resources. Therefore, many local government entities will be directly affected by Sections 101, 319, and 402 of the CWA that specifically address maintaining water quality in their communities and controlling nonpoint source pollution. Section 319 of the CWA requires that each state develop a Nonpoint Source Management Program and Assessment Report. Such plans must identify waterbodies with NPS pollution problems, identify the causes of NPS pollution, identify existing programs at the state and local level which control NPS pollution, and identify the process for developing the overall NPS pollution control program, including institutional and technical factors.

Regulatory control programs for Nonpoint Source Pollution are generally designed on a categorical basis and are aimed at certain activities that cause the pollution. This section of the WQMP provides an overview of the regulatory programs that deal with NPS including stormwater runoff, dredge and fill (Section 404) program, and the Leaking Underground Storage Tank (LUSTS) programs; reviews the Arizona NPS Management Plan; discusses nonpoint source pollution occurrences by basin, and discusses the various categories of nonpoint source pollution.

NPS PERMIT PROGRAMS

NPDES Stormwater Runoff Program

One of the major objectives of the federal stormwater regulations is to ensure that urban runoff discharges into the navigable waters of the United States meet surface water standards. Section 402 (p) of the CWA requires a permit for stormwater discharges associated with industrial activity, construction activity or from a municipal separate storm sewer system.

The current program requires municipal stormwater permits for municipalities serving populations over 100,000 persons. CWA requirements include prohibiting non-stormwater discharges into storm sewers and requires controls to reduce the discharge of pollutants to the maximum extent practical. While EPA regulations published in November 1990 establish permit requirements, they do **not** establish stormwater quality standards or address specific stormwater controls. As stated, permit requirements for municipal storm sewer systems currently apply only to large municipalities (over 100,000 people) and so do not currently impact any communities in the SEAGO region. It is anticipated that they will be required for smaller communities in the near future.

Requirements for industrial stormwater permits may have more widespread impacts. Regulations identify facilities by SIC code which must apply for permits. These include lumber and papermills, chemical and

metal industries, landfills; hazardous waste treatment, storage or disposal facilities; vehicle maintenance and airport facilities; Wastewater Treatment Plants with a capacity greater than 1.0 mgd; and construction activities on areas of five acres or more.

In order to simplify permitting of these industrial facilities, regulations provide for issuing general and group permits as well as individual permits. General permits may be issued by the EPA or by states with NPDES primacy to cover industrial categories, such as construction. Applications for group permits may be submitted by "similar" facilities.

General permits require the applicant to file a notice of intent with the EPA and develop a pollution prevention plan. Plans for construction activities must be consistent with planning and zoning requirements and other local regulations. General permits also require the use of Best Management Practices, monitoring and recordkeeping.

The ADEQ does not have primacy for NPDES permits, so group and individual permits are written and administered by the EPA. The ADEQ must certify, under Section 401 of the CWA, that proposed activities will not violate water quality standards.

The EPA has issued a Notice of Proposed Action for a general NPDES permit for discharges of stormwater runoff associated with industrial activity in Arizona, as well as other areas. The EPA's draft general permit would authorize stormwater discharges associated with all types of industrial facilities requiring permits except (1) discharges for which an effluent limitation guideline has been established; (2) those for which an individual permit has already been issued; (3) stormwater discharges that may be expected to be contributing to a violation of water quality standards; and (4) stormwater discharges from inactive mining or inactive oil and gas operations occurring on federal lands where an operator cannot be identified. **Appendix 5-1** outlines the application procedures for a NPDES stormwater permit.

Recommendations, Stormwater Runoff

- Local governments need to develop and adopt ordinances to control stormwater runoff from permitted activities such as construction, parking lots, and various industries.

- Local governments should adopt guidelines or ordinances for new development to reduce or prevent urban runoff problems.

- The region should encourage ADEQ to incorporate local review and comment into the 401 certification process, especially in sensitive areas such as the riparian habitats.

Section 404 Dredge and Fill Permit Program

The congress of the United States has assigned responsibility for regulation of construction and other work in the waters of the United states to the U.S. Army Corps of Engineers (COE). Section 404 of the CWA authorizes the COE to issue permits for the discharge of dredged or fill materials into waters of the United States using EPA guidelines. Activities which could require a permit include channelization; road and bridge construction; dike, levee, and dam construction; dredging operations; and mining operations. The ADEQ must certify, under Section 401 of the CWA, that proposed activities will not result in a violation of state water quality standards.

The 404 program directly affects wetlands/riparian systems because placement of fill materials often occurs within these areas. The 404 program requires that special consideration be given to the protection of wetlands, sanctuaries and refuges, and other riparian areas. It does not, however, provide protection against the draining or dredging of wetlands nor full protection of all watercourses (i.e. 100-year floodplains).

These primary activities that are impacted by 404 regulations are mining, sand and gravel operations, and construction. The SEAGO region, as discussed previously, has a long history of mining, but due to the current world market for minerals, it plays a limited role in the region's economy today. According to the

1993 Directory of Active Mines in Arizona, there are now only seven active mine operations in the region; five in Cochise County, and one each in Graham and Greenlee Counties. A listing of these mines and the minerals excavated is included as **Table 5-2.**

Sand and gravel operations in the region are more numerous. The 1993 directory lists 13 sand and gravel operations in the region. A listing of the sand and gravel operations is included as **Table 5-3.**

Recommendations, Dredge and Fill Program

- Local governments should consider adopting zoning and floodplain ordinances that specifically address riparian areas/wetlands.

- The region should encourage ADEQ to incorporate local review and comment into 401 certification process, especially in sensitive areas such as the riparian habitats.

Aquifer Protection Permits (APPs) Program

The principal state management program for NPS pollution control for aquifer water quality protection is the Aquifer Protection Permit program. Any person responsible for the potential release of a pollutant to the land surface or to the vadoze zone, in such a manner that there is a reasonable probability that the pollutant will reach an aquifer, must obtain an Aquifer Protection Permit. Facilities which are assumed to be discharging to an aquifer are surface impoundments which include: holding, storage, settling, treatment or disposal pits, ponds, or lagoons; solid waste disposal facilities; injection wells; land treatment facilities, facilities which add a pollutant to a salt dome formation or salt bed formation, dry well or underground cave or mine; mine tailing piles and ponds; mine leaching operations, septic tank systems, groundwater recharge, and underground storage recovery projects; point source discharges to navigable waters; sewage or sludge ponds and wastewater treatment facilities.

Activities exempted in the EQA from Aquifer Protection Permit requirements include household and domestic activities such as: gardening, lawn watering, lawn care, landscape maintenance, the noncommercial use of consumer products generally available to the public, ponds for watering livestock and wildlife, mining overburden which has not been subjected to any chemical leaching or processing and which is returned to the excavation site, facilities for the transportation and storage of waters not containing effluent, discharge to a community sewer, facilities required to obtain a permit to rescue reclaimed wastewater, stormwater retention basins, facilities which ceased operation prior to January 1, 1986; and other activities regulated by programs which provide equal or better protection of aquifer water quality.

Both ADEQ and ADWR are required by statute to issue permits for artificial groundwater recharge. The ADEQ issues an Aquifer Protection Permit addressing aquifer water quality and ADWR issues a Recharge or Underground Storage and Recovery Permit which primarily addresses water rights. Aquifer recharge projects are reviewed jointly by the two agencies but permitted separately. The ADEQ and ADWR are required by law to maintain a statewide database of groundwater quality. The database will include water quality information collected by other state and federal agencies, including the ADWR and the U.S. Geological Survey. The exchange of this information will be facilitated by interagency agreements.

General Permits

The APP Program allows the issuance of "General Permits" in accordance with ARS 49-245 and 246 of the EQA for discharging activities that are similar in nature, large in number, and the Director is satisfied that appropriate conditions can be established in a general permit to be satisfied by Best Management Practices (BMPs). The conditions for a general permit are prescribed in the rule. Facilities which meet the statutory requirements for a general permit can operate under those conditions and are not required to obtain an individual Aquifer Protection Permit. Examples are: the application of sludge, recharge from water treatment plants of less than 1,000 gallons per day, hydrostatic pipeline testing, and regulated agricultural activities.

Agricultural General Permits

Certain regulated agricultural activities are subject to general Aquifer Protection Permit rules and require

implementation of BMPs. Regulated agricultural activities include: the application of nitrogen fertilizers and concentrated animal feeding operations.

NPS MANAGEMENT PROGRAM

To comply with the 1987 amendments to the Clean Water Act, the state has developed a Nonpoint Source Water Quality Management Program consisting of a: Nonpoint Source Assessment Report which identifies the nature and extent of NPS pollution in the state and a Nonpoint Source Water Quality Management Program outlining the actions which will be taken to manage identified nonpoint source problems. Categories of NPS are listed in **Table 5-1**.

Section 319 of the CWA requires that the state's management program be developed and implemented, to the maximum extent feasible, on a watershed-by-watershed basis. However, inconsistencies between the EQA and the CWA have made this impractical to date. The department is currently working on a watershed management zone concept which is a first step toward using a more holistic approach to controlling pollution sources.

NPS PREVENTION TOOLS

Section 319 of the Clean Water Act requires that the state identify those practices and measures which will be undertaken to reduce pollutant loadings from each NPS category identified as problems in the Arizona NPS Assessment Report. The Arizona Environmental Quality Act requires the implementation of Best Available Demonstrated Control Technologies (BADCT) for individual APP permits and may require implementation of Best Management Practices (BMPs) for certain General Permits.

Best Available Demonstrated Control Technologies (BADCT)

All facilities which require individual permits for aquifer protection must implement BADCT. The NPS categories which impact groundwater and require BADCT through the Arizona Aquifer Protection Permit Program include resource extraction (mining), and land disposal (landfills and septic tanks).

The BADCT requires determining "optimal" technologies as the first step, where optimal is defined as the most effective discharge controls independent of site conditions. Site characteristics may be substituted for design control technologies to arrive at a final design of BADCT for that facility and site. As a result, operators should be using state-of-the art design elements to eliminate discharges to groundwater, rather than using some minimum required control technology.

The BADCT guidance documents have been developed for municipal wastewater treatment facilities, landfills, mining, and industrial discharges in cooperation with the regulated community and other interested groups.

Best Management Practices (BMPs)

The EQA defines BMPs as the methods, measures or practices to prevent or reduce discharges and include structural and nonstructural controls and operations and maintenance procedures. The state's process for BMP development has been to identify the water quality problem for a certain category of NPS discharge; assemble an advisory committee to develop BMPs to protect water quality; and make a reasonable effort to notify persons conducting or managing the activity subject to requirements of the BMPs.

Advisory groups are composed of land managers, experts in the field, people whose activities generate nonpoint source pollution, and interested individuals (public).

The criteria for selecting and adopting BMPs for regulated agricultural activities include:

- Regional and hydrogeologic conditions;
- The source and mode of pollutant transport; and

- The effectiveness of management practices.

By definition BMPs for regulated agricultural activities are those practices or combination of practices which are the most effective practical means of preventing or reducing the contributions of defined pollutants generated by nonpoint sources to a level compatible to water quality goals.

NONPOINT POLLUTION SOURCES ANALYSIS

Nonpoint source pollution is not entirely dependent on the source. Evaluation of this problem is hampered by the lack of techniques to measure the amounts of NPS pollution. This section will review some of the potential pollutants and activities associated with nonpoint pollution sources. The following three terms will be used throughout the discussion:

> **Loading Factor:** is a mathematical expression used to determine the emission of a pollutant from a nonpoint source and discharge of the pollutant into surface or groundwater. A substance becomes a pollutant only when it is deposited in surface or groundwater.
>
> **Source:** is a land area devoted reasonably exclusive to a specific use, which therefore can be treated as a unit with respect to land use practices and potential for pollutant discharges.
>
> **Load:** a quantity of pollutant discharged to surface and groundwater from the source per unit of time. Load = kg BOD per source per day, etc.... The loading factor is the expression or equation which permits calculation of the load.

It may perhaps be construed that loading factors are straightforward expressions or equations, matched by precise, well documented data, and that calculations can be made by routine procedures with perhaps little discretionary input by the user. This is seldom the case. The loading factors assume that data can be procured by field and laboratory analysis or other onsite methods. Field sampling and analysis will be required when the data on record is inadequate.

<u>Sediment</u>

The sediment produced by erosion of sloping lands, gullies, and stream banks, and transported to surface water is generally recognized as the greatest single pollutant from nonpoint sources. More importantly, sediment, particularly that produced from eroded topsoil, produces other pollutants such as nitrogen, phosphorous, organic matter, pesticides, and pathogens. Erosion agents including water, wind and rain splash, work continuously to break down the earth's surface to produce sediment from cropland, forest, pasture, construction sites, mining sites, and road right-of-ways.

Flood flows in the basins cause extensive floodwater and sediment damage in the area. The quantity of runoff and resulting erosion occurring as a result of these storms depends on the amount and intensity of precipitation as well as on the condition of the watershed. The overall basin condition determines the effects of flooding and sedimentation. The proper management and the condition of the watershed can reduce runoff, erosion and the subsequent downstream damage by these storms and floods.

Damaging effects of stream sedimentation and related stream turbidity include a reduction of sunlight penetration into the body of water resulting in a hindrance to sight-feeding fish and decreased water recreational use. Similarly, stream sediment deposition has an adverse effect on fisheries in the form of reduced fish habitat. High stream sedimentation also adds an economic burden to agricultural, industrial and municipal users, due to water treatment costs.

Along its course through the Gila Basin, the Gila River receives major amounts of sediment by its tributary streams. The San Carlos Reservoir serves as a sediment collection structure. Other areas having high sedimentation rates include the Safford/San Simon area and the San Pedro River area. Flood control and

storage structures have been constructed to temporarily store flood waters and to provide downstream protection. They prevent downstream flood damage and release water later in non-damaging amounts.

Nutrients and Organic Matter

Nutrients from animal wastes and fertilizer are agricultural related pollutants that can contribute to the degradation of water quality. There is a wide variation in the quantity of nutrients entering waterways from agricultural activities and as many factors affect both the amount moved from agricultural lands and the amount on or applied to agricultural lands. Nutrients can cause an over enrichment of water and in turn an accelerated growth of aquatic plants.

The major potential for water contamination and health hazards are animals kept in confinement. The major cause of pollution from these sources is stream runoff from the area where the livestock is confined. This problem is minimal in the region because of low runoff due to low annual precipitation and because most of such facilities are located away in drainage contained rather than allowing it to flow through the facility. In addition, these facilities are required to have NPDES permits and must provide a means of containing the runoff from the facility during unusual climatic conditions.

Fertilizers are a source of the nitrogen and phosphorous that are found in surface water. They find wide agricultural use on the farms in the basins. The fertilizers can be transported to streams by irrigation return flows and the runoff from the infrequent thunderstorms. The major way agriculturally used phosphates reach waterways is by the erosion of soil containing them. Phosphates may also move with irrigation return flows.

Soil nitrogen is derived from several sources which include geologic weathering, microbial reactions, precipitation, and chemical fixation. While the complex interactions between these systems are reasonably well understood, methods for quantifying their movements within the system are still in the research stage.

Pesticides

Pesticides dissipate by several mechanisms: chemical degradation (hydrolysis, oxidation); biochemical degradation by soil organism and enzymatic systems; volatilization; absorption; leaching into subsurface soils, possibly into subsurface aquifers; and overland transport with surface runoff and eroded sediment.

Soluble pesticides are subject to leaching into subsurface soils and waters, solubilize in overland runoff water, and are also transported overland as sediment bound material.

Mineralization

Mineralized water is common throughout much of the United States, particularly in the groundwater of the eastern states, but is also a factor in some areas of the SEAGO region. Mineral content is measured by conductivity tests and recorded as Total Dissolved Solids (TDS).

A few springs in the basins produce water of such a high salinity that they are sources of chemical pollution to the streams they feed. These natural or geologic sources of mineralization pollution includes the Clifton Hot Springs, the largest such source, in the basins, which produces a salt load of about 21,500 tons per year. The Clifton Hot Springs yields water from the alluvium along the San Francisco River and the water it produces contains more than 9,000 mg per liter of dissolved solids. All natural water contains dissolved salts in various concentrations. High levels of dissolved mineral salts in surface and groundwaters may be a water quality problem in the basins.

Surface water in the planning area is expected to continue being used entirely for consumptive uses with additional water requirements to be met by pumping groundwater. Agriculture is the predominate consumptive use of the Gila River water at the present time. Because of the intense use of water, non-degradability of salts and absence of any significant irrigation return flows, the ultimate repository for salts appear to be the reaches of the basins and seems to deteriorate as it flows downstream. Much of the deterioration appears to be caused by salt seeps, mineral springs, and rangeland runoff during high flow periods.

Mineral springs in the San Francisco River contribute significant amounts of minerals which increases its TDS as well as the TDS of the Gila River. There are also several mineral springs in the area around Pima that discharge quantities of salts to the Gila River. The San Pedro River provides intermittent flows which empty into the Gila River at Winkelman.

Mining and milling processes in the basins produce highly mineralized water that may be toxic. The major source of the wastewater associated with the mining is the process waters used for concentrating the ores. The spent water from the mine process operation is piped to tailing ponds where the suspended material is allowed to settle. After settling, the water is reused. The water, while in these ponds, is subject to evaporation and percolation. While most of the water that percolates through the piles is captured at the base and reused; there is the potential of some waters reaching the aquifer and polluting the groundwater.

BASIN ASSESSMENTS

Land Use

Surface and groundwater contamination from NPS pollution is intimately related to land use, except a small percentage of cases due to naturally occurring constituents. The ADEQ has identified the predominant types of land use for the major surface water basins in the region, the San Pedro, the Santa Cruz, and the Upper Gila. Major types of land use for these basins is as follows:

SAN PEDRO BASIN

The San Pedro Basin, to include the sub-basins of the Willcox Playa, Whitewater Draw, and the Rios de Mexico, is characterized by its varied land uses and small towns. **Map 4A and 4B** show the San Pedro Basin. In most cases, the location and basic economies of these towns reflect a service or market relationship with the dominant varied land uses in their service areas. The one exception to this is Sierra Vista, the largest city in the basin. Sierra Vista's economy is based almost exclusively upon winter visitors, retirement, and service to Fort Huachuca.

Douglas, at the southern end of the Sulphur Springs Valley (Whitewater Draw Basin), serves as a market town and focus for trade and commerce across the international border. Bisbee, in the Mule Mountains, and Tombstone, on the western slopes of the Dragoon Mountains, are historic mining towns that have lost their economic support from that sector of industry and are now attempting to broaden their economies to include tourism and retirement services. St. David and Willcox are small agricultural market towns located where water resources or transport facilities are dictated.

Irrigated agriculture is limited to isolated locations along the San Pedro River (St. David, Benson, and Feldman) and to major areas in the Sulphur Springs Valley, north and south of the Willcox Playa. Grazing is widespread throughout the basin, where much of the natural vegetation is grasslands making the basin one of the most productive forage producing areas in the state.

Commercial silviculture is not a common activity in the San Pedro Basin. All forest resources are limited to the national forests and none of these are classified as commercial forests. Recreational activities and wood cutting are the most significant land uses in these forests.

Mining, along with agricultural land use, has had a major impact upon landscape. The present level of mining activity reflects the current market condition for precious metals and copper. However, there is a long history of copper, silver, and gold mining in this basin and Tombstone, Bisbee, and Douglas are communities once based upon a mining economy. Mining continues to be the economic base for Benson.

SANTA CRUZ BASIN

Development is concentrated in the basin's bottoms along the Santa Cruz River and in the Avra-altar sub-basin to the west. Tucson, the largest urban center in the basin, occupies much of that area. Less than 475 total square miles of the Santa Cruz Basin is urbanized. The only major city in the SEAGO region portion of the basin is Nogales at the international boundary. **Map 4D** shows the location of the Santa Cruz Basin.

Nogales is a population center supported economically by agriculture and border trade activities. Agricultural activities are confined to localized sites along the length of the Santa Cruz Valley. Although some of the agricultural land in the basin has been converted to urban use or retired because water rights have been purchased by mining or urban interests, pockets of active irrigated agriculture still flourish.

Like most of the lands situated in the Basin and Range Physiographic Province, the drainage area of Santa Cruz River and its tributaries is delineated by mountain ranges. These mountain ranges also support other activities such as mining, grazing, and recreation.

UPPER GILA BASIN

The use of land within the Upper Gila Basin follows patterns established in territorial days. There is significant public land ownership where agriculture, mining, and recreation are important land use activities.

The San Carlos Indian Reservation occupies the northern one-third of the basin, and is predominately used for livestock grazing, lumbering, and recreation. The majority of the federal land area in the Upper Gila Basin is managed by the U.S. Forest Service (USFS) and much of the remaining land is managed by the BLM. State Trust Lands account for the other public lands in the basin. The Apache/Sitgreaves and the Coronado National Forests are predominately used for recreation and livestock grazing by permit. Some portions of the national forests are managed for timber harvest and firewood production. Additionally, some areas of the national forests have been homesteaded and are now being subdivided for summer home use.

The majority of the public lands managed by the BLM are available for livestock grazing by lease. Mining also occurs on BLM managed lands; other areas are protected in their natural state. Portions of the State Trust Lands are also leased for grazing. The San Carlos Reservoir provides water-related recreation. **Map 4C** shows the location of the Upper Gila Basin.

NONPOINT SOURCE POLLUTION CATEGORIES ANALYSIS

Nonpoint Source (NPS) categories and subcategories which add significantly to the pollution of waters of the state of Arizona are described in **Table 5-1**.

Pollutants to surface water from nonpoint sources are often generated intermittently as a result of storm or snow melt incidents. The NPS pollution episodes in an arid setting are seasonal, less frequent, and short in duration, and NPS pollution to surface water is more difficult to quantify than continuous point source discharges. Groundwater contamination is even more difficult to identify because of the heterogeneous nature of the aquifers and the limited sampling locations. The impacts to groundwater are not differentiated as resulting from point sources or nonpoint sources.

The following is a more detailed description of each nonpoint source pollution category, NPS pollution elements for the state, and NPS pollutants for surface water basins in the SEAGO region.

Agricultural NPS (10)

The NPS pollutants from agricultural activities in Arizona include sediment, pesticides, nitrates from fertilizers, animal waste, and total dissolved solids. The majority of cultivated lands within the state are associated with the major river drainage systems in the Basin and Range Province of south central and southwestern Arizona. Pesticide contamination is associated with chemigation, irrigation water return flow, downward percolating agricultural waters, and direct disposal at landfills.

The 1976 Santa Cruz and San Pedro Basin Resource Inventory reported that limited surface and groundwater pollution are attributed to agricultural activities. Runoff from summer storms and grazing activity, especially in sensitive, erodible rangelands, contribute to erosion and sedimentation and has been reported for the northern two-thirds of the San Pedro Valley.

These agricultural sources contribute both directly and indirectly to the low dissolved oxygen and high sediments load in the San Pedro River. Groundwater withdrawal for irrigated agriculture in the Willcox Playa Basin, north and south of the dry lake, has been identified as a potential factor involved in salt water intrusion. Highly saline groundwater is believed to move from under the Willcox Playa and into the areas of withdrawal.

Grazing has a tremendous impact on the surface water resources of the SEAGO region due to the large acreages of rangeland. Grazing is the most widespread agricultural activity within the San Pedro Basin. Production of forage by natural vegetation in this region is as high as any area of the state. The 1976 Resource Inventory reported that grazing has resulted in moderately accelerated soil erosion for approximately 15 percent of the grazed rangelands. Much of the erosion impacted rangeland is concentrated along the San Pedro Valley in the area from St. David north and out of the region. This area also coincides with the reach of the San Pedro that does not meet standards due to low dissolved oxygen and high sediment loads which may be attributable to irrigated agriculture.

For the Santa Cruz Basin, grazing is a widespread land use which appears to contribute to the nonpoint source discharges in the basin. Sedimentation resulting from soil erosion is the major problem associated with grazed rangelands. Poor range management and grazing activities result in soil compaction, reduced vegetative cover, and an increase in surface runoff.

Since 1978 neither SEAGO, nor any state, or federal land management agency has identified water quality problems related to grazing other than sedimentation. Arroyo cutting within the Santa Cruz watershed may have been triggered by an imbalance between infiltration and runoff caused by a combination of climatic change and cattle grazing before 1895.

For the Upper Gila Basin, an identified impact on Arizona's water quality associated with agricultural

irrigation is caused by mineral or salt concentration due to evaporation and transpiration. Additional agricultural impacts upon water quality in the Safford area include nutrients from fertilizers and animal wastes and pesticides applied to carcasses and livestock. Management of grazing activities appears to have contributed to the identified poor rangeland conditions in some areas of the Upper Gila Basin. Overuse of riparian areas in the Upper Gila Basin by livestock is reported to have caused damage to the water resources.

Statewide NPS 10 Activity

In accordance with the EQA, ADEQ has developed a regulatory program to address two categories of agricultural related pollution: concentrated animal feeding operations (CAFOs) and application of nitrogen fertilizers. The BMPs to prevent pollution to both surface and groundwater have been adopted into rule. Staff has also developed technical guidance documents to outline activities that comply with the BMP goals. Public education, training, and technical assistance is provided by Soil Conservation Service (SCS) and the Cooperative Extension service.

The ADEQ is currently working on a similar regulatory program that would address grazing. The ADEQ's technical advisory group for grazing has met since 1989 to develop goals, identify issues, and develop BMPs for guidance practices. The group includes: USFS, BLM, ASLD, U of A, members of the state legislature, Cattleman's Association, Wool Growers Association and the Nature Conservancy. These BMPs have not been adopted into rule but some land managers are beginning to implement them.

Recommendations NPS (10)

- SEAGO should expand the membership of the Environmental Review Committee (ERC) to include National Resource Conservation District (NRCD), Soil Conservation Services (SCS), other state and federal agencies.

- ADEQ should consider designation of certain land managers as DMAs for NPS development of conservation plans incorporating BMPs for abatement of specified nonpoint sources of agricultural related water quality problems.

- SEAGO should include a NPS assessment for the region in the annual region report.

- SEAGO, through the ERC, should encourage all local governments to work with other agencies toward implementation of the conservation plans.

Silvicultural NPS (20)

Data provided by state, federal, and local forest management agencies indicates that grazing within forest areas is the primary cause of watershed degradation. The impact of timber harvesting and associated road construction is locally severe, but has a minimal overall impact on water quality within each basin.

Commercial silviculture is not practiced within the San Pedro Basin. Nonpoint source water quality problems from silvicultural activities have not been identified in the San Pedro Basin. The Coronado National Forest Plan lists fuel wood, posts, poles, and Christmas trees as the principal forest products. Recreation and forage production are the primary uses to the optimized in the USFS management programs.

In the Santa Cruz Basin, water quality impacts from silviculture activities are usually related to timber harvest processes. Sediment is the most significant pollutant associated with road building and timber cutting. Water temperature increases due to canopy reduction can also occur. None of the sources consulted for the latest ADEQ Nonpoint Source assessment cited groundwater or surface water quality problems from this activity.

In the Upper Gila surface water basin, of the 25 major watersheds in the Apache/Sitgreaves National Forest, 19 are rated as satisfactory or better and 6 are rated as unsatisfactory. Unsatisfactory watersheds are those where the vegetation protecting the soil surface has been removed to the point that accelerated

erosion is occurring and some peak flood flows are being affected.

Erosion on forested land is generally slight to moderate. Logging and road construction, associated with commercial timber operations on the San Carlos Indian Reservation and in the Apache-Sitgreaves National Forest, has resulted in soil loss. The most severe erosion from forest lands, and resulting sedimentation in streams, has occurred following forest fires.

Statewide NPS 20 Activity

Because most forestry activities in Arizona are under the control of the USFS, BMP development for the state program has been done in conjunction with this agency. The ADEQ and the USFS have signed a memorandum of understanding to cooperate in water quality management programs, under Sections 208 and 319 of the Clean Water Act on these federal lands. The Forest Service agrees, among other things, to ensure control of nonpoint source pollution from activities on forest lands, timber harvesting, grazing, recreation and controlled burns, through implementation of BMPs and to monitor both BMP implementation and effectiveness.

The USFS has proposed the use of a 13 step Integrated Resource Management process to decide which BMPs are applicable to a specific activity. The process describes the points where citizens can participate.

The ADEQ is working to develop a similar agreement with the Bureau of Land Management. Their primary concern is with grazing. Silviculture and grazing on State Trust Lands has not yet been addressed by any interagency agreement.

Recommendations NPS (20)

- Land management agencies should look at ways to address associated impacts of their implementation measures (i.e., air quality impacts from controlled burns). There are opportunities to do this through the Integrated Resource Management (IRM) process, forest planning and public education.

- Local governments and federal and state agencies should develop a process where the public has more input into the project development and planning stages. Also provide more opportunities for public information.

- State and federal agencies should recognize the cross media implications of these activities and provide for cross media coordination and evaluation of these projects.

Construction and Urban Runoff NPS (30) and (40)

Construction activity in the rapidly growing areas of Arizona has contributed to watershed degradation through vegetation removal and channelization which increases velocities of flow. Sediment, oil, and grease are the primary construction site pollutants. More rigorous erosion control by local jurisdictions will continue to improve this situation.

Urban stormwater runoff is a major contributor of pollution to receiving waters throughout the United states. Lead, iron, magnesium, manganese and hydrocarbons associated with plasticizer and paving materials have also been detected in elevated concentrations in urban runoff and therefore have the potential to impact groundwater quality.

Urban runoff in Arizona is frequently discharged into dry wells or retention basins. Many communities require that all runoff from storm events of less than a 10-year/24-hour event be retained on the property to prevent flooding of adjacent, off-site areas. These regulations result from a concern about controlling heavy regional runoff for short durations, which produce flash floods. Seasonal monitoring of dry wells commonly produces results in which variable levels of contaminants are encountered.

In the San Pedro River Basin, nonpoint source pollution from both construction and urban runoff have not been recorded. However, as this basin contains three of the five small metropolitan areas found in the

region, this category of NPS is under constant scrutiny. The City of Sierra Vista, because of its size and growth, is the priority city in the basin for urban and construction runoff evaluation. Current data is not available to assess the impact that Fort Huachuca has upon surface and/or groundwater quality.

In the Santa Cruz Basin, population growth has resulted in a significant increase in construction activities, causing soil loss and sedimentation. Construction in Nogales is reported to have produced some short-term, localized sedimentation problems which have not yet been reported or recorded as water quality violations. Soil may also be transported from construction sites and deposited along streets and gutters where it can become a source of particulate air pollution as well as a potential water quality problem. There is currently little information available as to the impact to the region attributable to urban runoff from the City of Nogales. The City of Nogales and a portion of Santa Cruz County are currently in violation of air quality standards for PM10.

Primarily due to the rural nature of the region, there are no reported problems with construction or associated urban runoff nonpoint source pollution in the Upper Gila Basin.

Statewide Construction and Urban Runoff NPS (30) and (40) Activities

Traditionally, urban runoff has been considered a nonpoint source of pollution. However EPA's new guidelines call for stormwater discharge to be regulated as a point source discharge and subject to the new NPDES stormwater discharge permits. The state NPS program will be based on a BMP program similar to the program developed for agriculture. The Urban Runoff Technical Advisory Group (URTAG) Committee began meeting in early 1993 and has developed draft BMPs. These BMPs will assist communities to reduce pollutants from urban runoff.

Construction activities in the state NPS plan are managed through a program similar to that for Urban Runoff, consisting of NPDES permits and BMPs. Where runoff from major construction sites occur, the NPDES program for urban runoff could be implemented.

Recommendations, NPS (30) and (40)

- Local governments, planning agencies and other agencies should develop and maintain public education programs regarding the impacts of these activities on private lands and things that individuals can do to prevent or reduce pollution from their activities. i.e. application of chemicals, trash, animal control, etc. on private lands subject to runoff.

- Local governments should develop ordinances to control runoff from construction activities and other development.

Resource Extraction NPS (50)

Historically, and to a lesser extent, current mining operations in Arizona have had adverse impacts on water quality. Early in Arizona's history, gold and silver were produced in more than 60 mining districts in Arizona. As a result of new technologies, many of the old districts, such as the historic City of Tombstone, are reopening using cyanide and sulfuric acid heap leaching methods. The waste products of precious metal processing contain elevated levels of cyanide, arsenic, cadmium, lead, and sometimes mercury and selenium. Seepage and runoff from tailing piles and heap leach piles are also nonpoint sources of pollution. Because sand and gravel extraction operations are usually associated with stream courses and floodplains, these operations are generally considered as hydrologic/habitat modification nonpoint sources of pollution.

There have been several copper mining operations that used in-situ leaching with sulfuric acid. Groundwater near the mining and milling sites show increased concentrations of sulfate as well as Total Dissolved Solids. Smelters have also been identified as major contributors of trace metals, sulfate and acidic precipitation falling in southeastern Arizona.

In the San Pedro Basin, the present level of mining activity reflects the current world market for precious metals and copper. Mining activities in the Bisbee and Tombstone areas are concentrated and the landscape has been significantly altered. Other mountainous areas also contain abandoned mining sites of varying size and age which contribute contaminates to water quality. Groundwater contamination of

cyanide and metals in the Tombstone area is attributable to both current and historic mining activities. Tailing deposits from the Lavender Pit operation in Bisbee have been identified as the source of TDS increases in groundwater south of the Mule Mountains. Copper Creek, a westward flowing tributary to the San Pedro south of Mammoth, has experienced documented violations for pH and metal standards for water quality.

In the Santa Cruz Basin, mining has had an historical presence. Because of the cyclic prices paid for copper, many of these mines which reduced or ceased operations are now reopening. Water quality studies and complaint investigations have documented water quality impacts due to mining in the following areas of the region:

1. Sonoita Creek, which drains the south flank of the Santa Rita Mountains and the north flanks of the Patagonia Mountains-surface water impacted by violations of metals and pH standards.

2. Harshaw Creek, a tributary of Sonoita Wash, surface water has been impacted by acid mine drainage from abandoned inactive mines.

In the Upper Gila Basin, mining is concentrated near Morenci and Clifton. Lower Chase Creek has been historically impacted by both point and nonpoint source pollution. As a result of state and federal enforcement actions, a major mine water control program was initiated to recover all runoff from mining operations and to bypass normal stream flows around the mine. Due to the highly mineralized geology of the Clifton-Morenci area, springs believed to be of natural origin continue to discharge elevated concentrations of copper, cadmium, selenium, zinc, and sulfate to the San Francisco River and Gold Gulch.

The EPA served Newmont Mining Corporation with a "Finding of Violation" (No. IX-FY 86-80). This order required Newmont, Magma Copper's parent company at that time, to cease all discharge of acid mine drainage, to remove any remaining mineral precipitates from Saloon Gulch and Copper Creek streambeds and to monitor the water quality of Copper Creek for approximately one year. As of the present, the mineral precipitates have been removed and surface water quality with respect to copper have improved.

Statewide Resource Extraction NPS (50) Activities

Active resource extraction activities fall under the state and federal permitting process. Mining discharges will require BADCT for protection of surface and groundwater quality. No state programs are currently in effect to control pollution from abandoned mines.

Recommendations NPS (50)

- SEAGO should expand the ERC membership to include state and federal agencies and industry representatives with interests in resource extraction.

- ADEQ should develop BMPs for both active and abandoned mining operations.

Land Disposal NPS (60)

Sludge disposal, wastewater reuse, recharge, on-site wastewater systems, landfills and hazardous waste disposal are subcategories of nonpoint source pollution in the land disposal category. Each of these, except the last two, are covered under the point source section of this plan. This discussion deals primarily with the landfilling of solid waste.

Before the 1970s, solid waste agencies were relatively unrestricted in the manner by which solid waste was disposed of. Consequently, sites for new landfills were often selected on the basis of convenience, rather than on concern for environmental consequences. For example, abandoned gravel pits along river channels were often used for waste disposal sites increasing the chance for groundwater contamination by landfill leachate.

Hazardous waste sites are contributors of nonpoint source pollution to groundwater. High technology-based industries and aviation facilities commonly use Volatile Organic Compounds (VOCs) as degreasing solvents. Improper disposal of these solvents has resulted in much of the VOC contaminated groundwater.

The most common VOCs detected in groundwater are trichloroethylene (TCE), tetrachlorethane (TEC) and chloroform. Chromium detected in groundwater is often associated with disposal of metal finishing operations. Modes of past disposal practices include injection of waste solvents into dry wells, disposal into surface impoundments, leachfields, dumping at unregulated landfields, and leaking underground storage tanks.

In the San Pedro Basin, ADEQ records identify an open dump in Benson; however, no violations of water quality standards have been shown to date. Hazardous waste sites and Superfund sites have been identified in this basin, specifically at Apache Nitrogen plant near St. David, but the full nature and extent of contamination has not been evaluated or determined.

In the Santa Cruz Basin, old gravel extraction sites have traditionally served as illegal landfills. The ADEQ records indicate possible problems with the Nogales landfill.

Statewide Land Disposal NPS (60) Activities

Land disposal, like mining activities, is regulated under the state permitting program and includes implementation of BMP and BADCT,where applicable.

Recommendations NPS (60)

- SEAGO and the ADEQ should assist local Governments to develop local waste disposal guidelines to ensure continued good management practices.
- ADEQ should encourage local governments to adopt recycling programs and ordinances.
- ADEQ should develop and implement a program to provide public outreach on waste disposal and impacts.

Hydrologic/Habitat Modification NPS (70)

Hydrologic/habitat modification, as a nonpoint source pollution category, has received little attention in the state of Arizona in the past. Concern for stream resources, wetlands, and riparian habitats has become a significant environmental issue within the last two years. This interest has culminated and Executive Order No. 89-16 issued by the Governor's office directing all state agencies to address polices, requirements, funding impacts, and implement changes to restore riparian habitats. It also established a riparian habitat task force composed of state agencies to develop a riparian classification system, inventory riparian habitats, identify key riparian areas, consult with the public and other entities, and make legislative recommendations.

Extensive diversion, impoundment, and use of surface and groundwater sources has been essential to economic and community development in the arid environment of Arizona, but in the process has had a profound effect on natural watercourses and habitat. Cienegas, which are mid-elevation wetlands that were once abundant in the San Pedro and Santa Cruz River Basins, have been substantially diminished in extent. Factors associated with the reduction include climatic change, rangeland grazing, vegetation change, woodcutting, mining diversions, groundwater exploitation, and artificial concentration of drainage by the construction of roads, ditches, bridges, and railroads.
Some of the larger sand and gravel operations have had a direct influence on wetlands and riparian habitats and are often responsible for a change in stream channel configurations. This aspect of nonpoint source will be covered in more detail in the section on 404, Dredge and Fill Permits.

Hydrologic modification is not a major nonpoint source pollution factor in the San Pedro Basin. However, because of extensive groundwater use throughout the Santa Cruz Basin, the Santa Cruz River has ceased perennial flows. Tributary streams still flow in the Nogales area and near some mountain ranges, but throughout the rest of the basin, surface water runoff results from wastewater discharges and major

precipitation events. Sand and gravel production could be expected to contribute to violations of the turbidity standards (sedimentation) for surface water. However, no violations of surface water quality standards have been attributed to sand and gravel operations within the Santa Cruz Basin. Except in the southernmost part of the basin, riparian habitats are impoverished. However, there are portions along the Santa Cruz River where a riparian community has developed, supported primarily by effluent disposal.

Statewide Hydrologic/Habitat Modification NPS (70) Activities

The ADEQ is developing a sand and gravel BMP programs similar to agriculture. The program is intended to complement the federal 404 permit program.

Hydrologic and habitat modification can result from a number of activities including grazing and rangeland management, agricultural activities, resource extraction and construction activities. Most nonpoint source pollution impacts should be addressed through BMP development in the specific program outlined above. Implementation of these and other activities can also have a dramatic affect on aquatic and riparian ecosystems in addition to state water quality standards.

Recommendations NPS (70)

- Local governments should adopt ordinances for protection of riparian areas within their jurisdictions.

- Local governments should encourage ADEQ to develop standards in conjunction with these ordinances.

Other NPS (80)

This category of NPS contains several subcategories on which little information was available for Arizona. However, natural sources affecting water quality are recognized as being substantial in Arizona. The predominately arid climate of the SEAGO region contributes to the restriction of the natural vegetative cover, and heavy precipitation events, characterized by desert thunderstorms, result in greater potential for natural erosion and sediment hazards to water quality.

Although natural sources of sediment, minerals, metals, and other substances may affect the use of waters for various purposes, their occurrence at natural background levels is not pollution. The term "pollution" generally means the man-made or man-induced alteration of the chemical, physical, biological, or radiological integrity of an aquatic ecosystem." A pollutant, according to the definition in the Arizona EQA, "means fluids, contaminates, toxic wastes, toxic pollutants, dredged spoil, solid waste, substances and chemicals, pesticides, herbicides, fertilizers and other agricultural chemicals, incineration residue, sewage, garbage, sewage sludge, munitions, petroleum products, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock sand, cellar dirt and mining, industries' waste or any other liquid, solid, gaseous or hazardous substances."

In natural aquatic ecosystems, natural background levels of substances in water, including their periodic highs and lows in concentration or amount following natural or episodic events, may be essential to the health of those ecosystems and the growth and reproduction of organisms. Man-induced changes in water quality occurring at periods both inside and outside of natural seasonal or episodic events, on the other hand, may adversely affect aquatic ecosystems.

Statewide Other NPS (80) Activities

The ADEQ currently has no program to address pollution of surface or groundwater. The remaining categories of NPS (80) are unassessed at this time.

Unknown NPS (90)

Several water quality violations have been documented in the state for which a source remains unknown. In some instances, sources can be identified based upon existing land uses in the contaminated area. However, a specific land use may not be solely responsible for the identified contamination. Since several potential land uses may be involved, it is difficult to designate a single source. In this respect, unknown sources will be undefined until specific monitoring efforts can identify the specific source and their relative contribution to the total contamination equation.

Recreation NPS (100)

Population growth in Arizona during the past 20 years, combined with a unique natural environment, has resulted in a substantial increase in outdoor recreation. Between 1970 and 1980, the population of the state increased by 53 percent. From 1970-1984, recreational visitor days on public lands in Arizona increased about 62 percent. Recreational uses on public lands and their respective order of importance are: camping, miscellaneous day use, hiking, hunting, boating, fishing, off-road vehicles, other recreation, and winter sports.

Recreational impacts on surface water quality have been documented in the uplands away from the main stem of the Santa Cruz Basin. Nutrients, fecal coliform bacteria, and solid waste are the common pollutants of concern. Water bodies impacted by this category of activity in the region include Patagonia Lake, the largest recreational lake in the Santa Cruz Basin, water quality problems relate to recreational use as well as sediment loss from grazing. Plasticizers and other organic chemicals have been a minor problem in this

lakes's immediate watershed.

Statewide Recreation NPS (100) Activities

The ADEQ currently has no programs in place for the development of recreational BMPs. The major opportunity for prevention pollution due to recreational activities is public education.

UNDERGROUND STORAGE TANKS ANALYSIS

Leaking Underground Storage Tanks can lead to contamination of groundwater from petroleum, industrial solvents, and or hazardous material, USTs are regulated under Subtitle D of and the Arizona Underground Storage Act of 1986. The basic program areas include: registration of tanks, installation of leak detecting systems, notification, reporting and corrective action in the event of a leak; closure plans for tank systems, design and technical standards for new tanks and financial responsibility requirements for owners.

Under the UST program, ADEQ works to locate and resolve Leaking Underground Storage Tanks (LUST), prevent future releases and ensure that the tank owners and operators are financially capable in the event of a release.

The ADEQ strongly encourages voluntary compliance for the regulated community and local government agencies, but has referred several cases to the Attorney General's office for enforcement.

During FY 1992, the program played a central role in cleanup efforts involving Underground Storage Tanks. Of the more than 22,200 USTs at nearly 7,600 locations in Arizona, 2,200 tanks were reported to have leaked. To date, approximately 500 LUSTs have been remediated.

In FY 1992, the LUST program received a $1.1 million EPA grant to support activities related to LUSTs. The grant helped the state pay for cleanups, enforcement action, cost of recovery actions against private parties, and administrative costs.

The ADEQ adopted State Assurance Fund (SAF) rules in mid-1992. The fund will assist UST owners who might not otherwise be able to demonstrate their ability to pay sums mandated by federal responsibility requirements. The fund will also be used to partially pay cleanup costs for LUSTS.

In brief, changes in federal regulations that will impact big and small operators alike include:

- All USTs installed after December 1988 must meet requirements for proper installation, spill and overflow prevention, corrosion protection, and leak detection prior to being installed.

- Tanks installed before December 1988 have similar requirements, but owners were given time to comply, with regulations being phased in according to the age of the UST. As of December 1993, all USTs must have leak protection devices installed. By December of 1998, all USTs must have corrosion protection and spill/overflow prevention safeguards in place, regardless of the year the tank was installed.

- The UST regulations also stipulate the type of corrective action that must be taken in response to leaking tanks, closure procedures for USTs whether it is on a permanent or temporary basis, and the requirement that owners demonstrate "financial responsibility" and ability to pay compensation costs in the event of a leak.

In the SEAGO region, there are numerous USTs already in place, and as the region grows, more storage facilities for petroleum and hazardous chemicals will need to be installed. All local agencies and officials need to be aware of the regulations governing USTs and the state programs in place to mitigate the possibilities of nonpoint source pollution.

Petroleum, diesel fuel, and hazardous chemicals in the region are commonly stored in tanks buried underground. In many cases, the tanks are old, and either the tanks or associated piping is leaking or may leak in the future. These leaks can cause fires or explosions, and can also result in contamination of

groundwater. Underground Storage Tanks are regulated by the EPA and the state, and ADEQ maintains a listing of tanks and reported releases, or leaks, from these tanks.

The ADEQ's Annual Report for Water Quality and Waste Programs reported releases from 1984-1993. Of the 2,246 leaks reported in Arizona during that period, 133, or about 6 percent, were in the SEAGO region. These leaking tanks and their location is listed in **Table 5-4 and 5-5**.

The ADEQ has also developed a database with information about Underground Storage Tanks (USTs), such as tank age, construction, and corrosion protection, which has been used to estimate the number of USTs that may leak. The USTs over 15 years old and constructed of uncoated, bare steel pose the highest risk for release, and one-third of USTs in the state (7,627 of 22,758) fall into this category.

Recommendations, USTs

- Local governments should adopt planning and zoning ordinances governing the siting of USTs and what actions are to be taken in the event of a release.

- Public outreach should be effected at all levels to ensure public awareness and involvement.

- The ADEQ should consider designation of certain agencies as DMAs for NPS pollution, in particular those agencies that deal with USTs and LUSTs on a routine basis. More information about DMA designation will be covered in Section 7, the Continuing Planning Process.

TABLE 5-1 ARIZONA NONPOINT SOURCE POLLUTION CATEGORIES

10. Agriculture Irrigated crop production/return flows Rangeland Concentrated animal feeding operations Aquaculture	60. Land Disposal Sludge Wastewater reuse Landfills Recharge On-site wastewater systems (septic tanks)
20. Silviculture Harvesting, reforestation, residue management Forest management Road construction and maintenance	70. Hydrologic/Habitat Modification Channelization/dredging Dam construction Flow regulation/hydrologic modification Riparian alteration Streambank modification/ destabilization Canals/irrigation systems Stock tanks Watershed yield/vegetation manipulation
30. Construction Highway/road/bridge Land development Military operations	80. Other Natural Waste storage/storage tank leaks Highway maintenance and runoff Spills In-place contaminants Utility corridors Motor transportation
40. Urban Runoff Surface runoff Dry wells, infiltration basins	90. Unknown
50. Resource Extraction Copper mining, milling and refining Precious metal mining and processing Placer mining Uranium mining, milling and refining Industrial minerals mining Sand and gravel mining	100. Recreation

Source: Arizona Department of Environmental Quality, Arizona Water Quality Assessment 1992, State of Ariozna Clean Water Act 305(b) Report.

TABLE 5-2
ACTIVE MINES IN SEAGO

COUNTY	MINE
COCHISE	ARMCO CUSTOM MILL, TOMBSTONE
COCHISE	ARIMTECO, DRAGOON
COCHISE	CHEMSTAR, DOUGLAS QUARRY AND PLANT
COCHISE	GSA RESOURCES, BOWIE
COCHISE	PHELPS DODGE, COPPER QUEEN
GRAHAM	UOP, BOWIE CHABAZITE
GREENLEE	PHELPS DODGE, MORENCI

TABLE 5-3
SAND AND GRAVEL OPERATIONS IN SEAGO

COUNTY	SAND AND GRAVEL OPERATION
COCHISE	ALLISON ROCK AND SAND CONSTRUCTION
COCHISE	DESERT CONCRETE COMPANY
COCHISE	EADS CONSTRUCTION COMPANY
COCHISE	HAMILTON'S SAND AND GRAVEL COMPANY
COCHISE	MADDUX AND SONS, INC. READY MIX
COCHISE	WILLCOX ROCK AND SAND
GRAHAM	CKC MATERIALS DIVISION
GRAHAM	SCARBOROUGH SAND AND GRAVEL
GRAHAM	W. A. MORRIS SAND, GRAVEL AND CONCRETE INC.
GREENLEE	OAKCREEK CONTRACTING INC.
SANTA CRUZ	J. D.'S SAND AND GRAVEL INC.
SANTA CRUZ	PADILLA SAND AND GRAVEL
SANTA CRUZ	UNITED METRO, OLD RUBY ROAD

TABLE 5-4
LEAKING UNDERGROUND STORAGE TANKS IN SEAGO

YEAR	84	85	86	87	88	89	90	TOTAL
COCHISE COUNTY								
BENSON	0	1	0	1	1	0	2	5
BISBEE	0	0	0	0	0	0	1	1
BOWIE	0	0	1	0	0	0	1	2
DOUGLAS	0	0	0	0	1	2	2	5
ELFRIDA	0	0	0	0	0	1	0	1
FT. HUACHUCA	0	1	2	0	0	3	13	19
HUACHUCA CITY	0	0	0	0	0	1	0	1
PORTAL	0	0	0	0	0	1	0	1
SIERRA VISTA	0	0	2	0	0	2	4	8
ST. DAVID	0	0	0	0	0	2	0	2
WILLCOX	0	0	0	1	1	0	3	5
GRAHAM COUNTY								
FT. GRANT	0	0	0	0	0	0	1	1
SAFFORD	0	0	1	1	2	0	4	8
THATCHER	0	0	0	0	0	0	2	2
GREENLEE COUNTY								
CLIFTON	0	0	0	0	0	0	1	1
DUNCAN	0	0	0	0	0	0	2	2
SANTA CRUZ COUNTY								
AMADO	0	0	0	0	0	0	1	1
NOGALES	0	0	0	0	1	3	2	6
PATAGONIA	0	0	0	0	0	0	1	1
SONOITA	0	0	0	0	0	0	1	1
TOTALS	**0**	**2**	**6**	**3**	**6**	**15**	**41**	**73**

TABLE 5-5
OPEN UST SITES IN SEAGO

COUNTY	OPEN UST SITES
COCHISE COUNTY	98
BENSON	9
BISBEE	6
BOWIE	1
DOUGLAS	15
ELFRIDA	2
FAIRBANK	1
FT. HUACHUCA	27
HEREFORD	1
HUACHUCA CITY	2
MCNEAL	1
PALOMINAS	1
PEARCE	1
SAN SIMON	1
SIERRA VISTA	13
ST. DAVID	1
SUNIZONA	1
TOMBSTONE	2
WILLCOX	13
GRAHAM COUNTY	16
PIMA	1
SAFFORD	10
SAN JOSE	2
THATCHER	3
GREENLEE COUNTY	5
CLIFTON	1
DUNCAN	3
MORENCI	1
SANTA CRUZ COUNTY	14
AMADO	1
ELGIN	1
NOGALES	9
PATAGONIA	2
SONOITA	1
REGION TOTAL	**133**