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1999 Annual Report
Texas Nonpoint Source Pollution Management Program

A Joint Report of the Texas Natural Resource Conservation Commission
and the Texas State Soil and Water Conservation Board

SFR-66/99

October 2000

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Texas Nonpoint Source Pollution Management Program

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From the Directors

Water that is safe for its citizens to swim in, to fish from, to drink. Water that provides a healthy habitat for aquatic creatures and wildlife. Those are the goals of Texas' water quality programs. We all depend on clean water.

Water Pollution

Water can be polluted from a variety of sources, generally categorized as *point source* or *nonpoint source (NPS)*. A *point source* is a single, identifiable source of pollution, such as a discharge from a municipal or industrial wastewater treatment plant. Point sources are regulated under federal and Texas law and are subject to permit requirements that focus on water quality protection.

Nonpoint sources are largely unregulated. Nonpoint source pollution in surface water occurs when rainfall runoff transports contaminants on the surface of the land into adjacent water bodies. Groundwater can be contaminated by pollutants carried by water percolating through the soil or from stormwater flowing into recharge features. Residential and urban development, agricultural operations, and forestry are examples of nonpoint sources of pollutants.

As of 1999, Texas had identified 188 water bodies with threats or impairments due wholly or in part to nonpoint sources of pollution. That's 94 percent of all the threatened and impaired water bodies in the state. Water quality problems from nonpoint sources include pesticide residue in water and river bottoms, fecal coliform bacteria from animal and human waste, excess algal blooms from fertilizer and other nutrient sources, and oil, grease, metals, and other substances toxic to human or aquatic life.

Nonpoint Source Pollution:

Water pollution that results when rainfall runoff carries pollutants—such as fertilizers, herbicides, insecticides, oil, grease, sediments, and animal wastes—into streams, lakes, and bays. It is called nonpoint source pollution because it comes from many different places that are difficult to pinpoint or control (as opposed to point source pollution, which is discharged from a single, easily identifiable source).

Managing Water Quality

Texas manages water pollution from nonpoint sources primarily through voluntary programs, along with common-sense regulations at the state, regional, and local levels that are designed to prevent pollution. Because of the nature of NPS pollution, implementation of best management practices to control it is primarily the responsibility of regional and local authorities and landowners. State government agencies provide assistance to local governments, businesses, and landowners in identifying water quality problems, selecting and implementing the management practices that are best suited to control NPS pollution in their particular areas, directing funding to support those practices, and enforcing regulations.

Voluntary programs put control where it belongs—at the local level, where residents and water quality professionals understand what will work best in their areas. Local control is also consistent with Texas law, which puts most of the authority to regulate land uses at the regional, county, and municipal level. Time and again, the state's confidence in the responsibility and ingenuity of its citizens to address known threats and impairments to

water quality voluntarily has proven to be well founded, as will be shown in the success stories contained in this annual report.

In the last three years, Texas has successfully moved to a watershed management approach to protecting water quality and restoring polluted waters. Watershed management has now been integrated throughout the state in partnership with federal, state, and regional agencies. In 1999, after three years of development, the Environmental Protection Agency (EPA) approved Texas' updated *Nonpoint Source Pollution Assessment Report and Management Program* (TNRCC, SFR-068/99), which is based on the watershed management approach. The updated management program marks a shift in nonpoint source pollution management that includes a focus on local solutions and participation, along with increased coordination and cooperation among government agencies and private citizens to address water pollution from nonpoint sources.

That increased cooperation resulted in the first joint nonpoint source management program by the Texas State Soil and Water Conservation Board—the agency with primary responsibility for agricultural and silvicultural nonpoint source management, and the Texas Natural Resource Conservation Commission—the agency primarily responsible for managing all other nonpoint sources. The partnership has also resulted in another first: this joint annual report. More important, though, is the growing cooperation of these and other agencies at the state and watershed levels to protect and restore Texas' precious water resources.

The fruits of those labors are highlighted in this report. With the continued commitment of our citizens and the support of their government, Texas will have clean water for today and tomorrow.

Nonpoint Source Program Mission Statement

To protect the quality of water resources in Texas from adverse effects due to nonpoint sources of pollution through the cooperative implementation of a diverse range of strategies based upon common sense, good science, and fiscal responsibility, which emphasize pollution prevention, a watershed perspective, and community-based solutions.

James D. Thomas, Director
Technical Analysis Division
Texas Natural Resource Conservation Commission

James M. Moore, Director
Conservation Programs
Texas State Soil and Water Conservation Board

Chapter 1

Statewide Activities

Laying the groundwork with planning and coordination

Spreading the word through public education and outreach

Doing the job by implementing best management practices

Identifying the problems with monitoring and assessment

Laying the Groundwork

Planning, coordination, and grant management are essential elements of a successful NPS program. The watershed management approach, with its basin management cycle, is the framework for coordinating NPS activities in Texas. The major river basins are organized into planning area groups and follow an iterative process to manage surface water quality.

Under the state's basin management cycle, data are collected to characterize water quality conditions, to monitor changes in water quality, and to identify threats and impairments. An assessment of water quality conditions is published in the *State of Texas Water Quality Inventory* [Clean Water Act Section 305(b) report, TNRCC, SFR-050] and in reports prepared by the Clean Rivers Program regional agencies. The *Inventory* is used to plan future monitoring, pollution prevention activities, and other management activities. A list of water bodies that have been identified in the *Inventory* as threatened or impaired is published in the state's *Clean Water Act Section 303(d) List* (TNRCC, SFR-058). From that list, the state prioritizes specific water bodies or statewide issues for restoration.

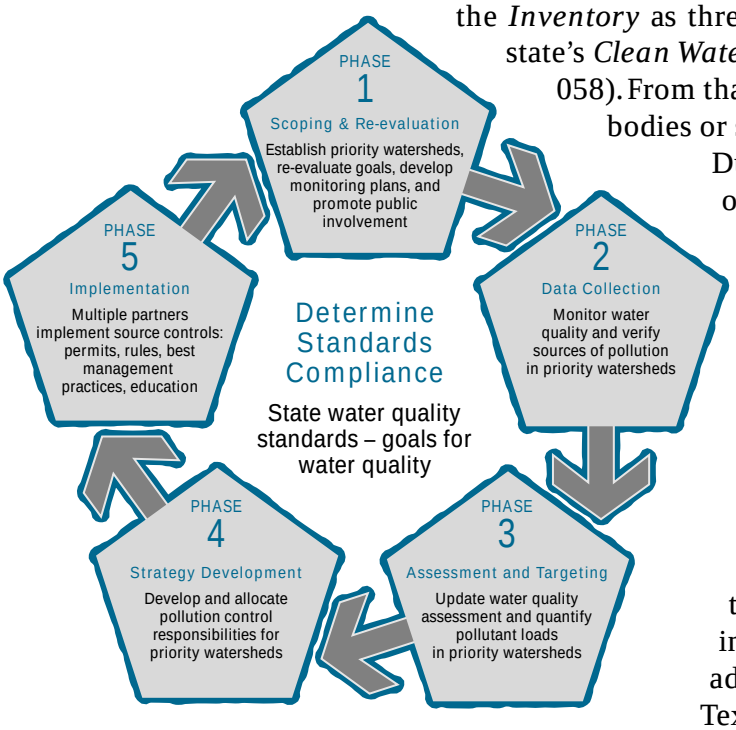


Figure 1. The Basin Management Cycle
The Basin Management Cycle supports planning, assessment, and action plans to protect and improve water quality.

During the assessment and strategy development phases of the basin management cycle, the state develops total maximum daily loads (TMDLs), or equivalent restoration plans, in concert with local stakeholders and appropriate federal, state, and regional agencies. These TMDLs are then used by local stakeholder groups to develop and implement watershed action plans that have the strong scientific basis necessary to effectively address NPS pollution problems. Each year, in implementing the federal Clean Water Action Plan to address nonpoint source pollution, the Texas Natural Resource Conservation Commission (TNRCC) and the Texas State Soil and Water Conservation Board (TSSWCB) choose projects that support statewide goals, and work with stakeholders in NPS-impacted watersheds to fund and implement projects that address high-priority problems. As more TMDLs are completed, grant funds will increasingly be directed to support watershed action plans developed under TMDL projects.

Bringing It All Together

Coordination is key in accomplishing water quality goals in Texas. In 1999, the state used interagency agreements and multi-agency task forces

Watershed Action Plans and Total Maximum Daily Loads

A watershed action plan consists of a quantitative assessment of water quality problems and contributing pollutant sources (total maximum daily load, or TMDL), along with an implementation plan that identifies responsible parties and specifies actions needed to restore and protect a water body. TMDLs are the scientific basis for watershed action plans. They provide the foundation necessary to identify appropriate management objectives and strategies.

Watershed action plans provide critical direction for managers at the local, regional, and state levels by establishing implementation schedules and identifying potential sources of funding.

to ensure this coordination happened. Texas has long-standing relationships with federal agencies like the Natural Resources Conservation Service (NRCS) and the United States Geological Survey (USGS). The NRCS is a very active partner in agricultural NPS management, and the USGS is an invaluable resource in water quality monitoring and assessment activities. EPA Region 6 provides technical assistance and program guidance.

Several state agencies are actively involved with the TNRCC and the TSSWCB in NPS management, including the Texas Department of Agriculture, the Texas Forest Service, the General Land Office, the Texas Railroad Commission, the Texas Department of Health, the Texas Water Development Board, and the Texas Parks and Wildlife Department. Key cooperators from academia include the Texas Agricultural Experiment Station and the Texas Agricultural Extension Service (which includes the Blackland Research Center) of Texas A&M University, the Texas Institute for Applied Environmental Research, the Center for Research in Water Resources at the University of Texas, and the Bureau of Economic Geology.

Representatives of all of these agencies serve on a number of committees that coordinate NPS management activities, such as the Texas Groundwater Protection Committee, the Clean Rivers Program Stakeholders Workgroup and its NPS Technical Workgroup, and the State Agricultural/Silvicultural Nonpoint Source Advisory and Coordinating Committee.

Regionally, nonpoint source pollution management is coordinated through the Clean Rivers Program (CRP) and the Soil and Water Conservation District offices (SWCDs) of the TSSWCB. The CRP is a partnership of the TNRCC, the TSSWCB, regional water authorities, other state and federal agencies, and the public. A regional agency—usually a river authority, water district, or council of government—heads up coordination for individual basins. A basin steering committee composed of a wide range of stakeholders is active in managing each river basin. The steering committees include representatives from:

- regional or local offices of the federal and state agencies that are members of the statewide steering committee,
- local government agencies,
- businesses and industries,
- agricultural producers,
- educational institutions, and
- environmental and civic groups.

Meetings of the basin steering committees are advertised in local media and are open to the public. Each basin steering committee may have several technical subcommittees to address various aspects of the management plan. In priority watersheds, stakeholders also come together as local watershed action committees to work on TMDL projects, source water protection plans, and other intensive management efforts.

Planning for the Long Term

The staff of the TNRCC and the TSSWCB worked hard in 1999 to finalize the *Texas Nonpoint Source Pollution Assessment Report and Management Program*, TNRCC publication SFR-068/99 (Management Program). The Management Program was developed with significant cooperation from the other federal, state, and regional authorities responsible for NPS management in Texas.

The Management Program reflects a new level of coordinated planning to achieve water quality goals. During development of the program, a statewide work group was organized to direct planning and priorities for water quality management, fully integrating NPS management into the process. At the same time, numerous stakeholder groups have been formed from the Clean Rivers Program basin steering committees to work with the state to develop TMDLs and watershed action plans that will identify best management practices (BMPs) for implementation now and in the years to come.

Best Management Practices

Best management practices (BMPs) are the most effective method or combination of methods identified to control nonpoint source pollution in a particular area. BMPs can be structural—such as sedimentation basins, retention ponds, or filter systems, or nonstructural—such as wetlands, vegetated buffer zones, or public education.

Managing nonpoint source pollution requires cooperation and coordination among many different agencies and groups at many different levels. Texas is working on water quality management from the top down *and* from the bottom up by combining a statewide work group to look at the big picture, at the same time that the Clean Rivers Program stakeholder groups and regional agencies take on the task at the grassroots.

The state's long-term goal is to implement watershed action plans in 139 surface water bodies that were identified in 1998 as having impacts from NPS pollution. The TMDL programs of the TNRCC and the TSSWCB are in full swing to develop those watershed action plans. At the end of 1999, there were 24 TMDL projects under way, addressing 82 impairments in 57 water bodies throughout the state. Several research projects were begun, such as construction of geospatial databases and modeling tools, that will support general TMDL development needs. Since the Management Program was completed in the fall of 1998, work or planning has begun for seven TMDL projects that will result directly in watershed action plans:

- Clear Fork of the Trinity River near Dallas, addressing low dissolved oxygen and lead;

- Urban lakes and Trinity River segments in the Dallas–Fort Worth area, addressing legacy pollutants;
- Urban bayous in Houston, addressing bacteria;
- the Houston Ship Channel and upper Galveston Bay, addressing dioxin;
- Dickinson Bayou in Houston, addressing low dissolved oxygen;
- Several lakes near Dallas and in northeast Texas that are threatened by atrazine pollution;
- Oso Bay and Oso Creek in Corpus Christi, addressing low dissolved oxygen.

Three of these projects are just getting started. Three of them will be discussed in more detail under "TMDLs" later in this section.

Planning for the Short Term

The federal Clean Water Act provides for a grant program under Section 319(h) to support state projects that prevent NPS pollution or restore impaired or threatened waters. Texas uses these funds to support institutionalized state programs for NPS management and to provide seed money to jumpstart local water-quality improvement initiatives. Grant funds are also used to demonstrate new BMPs, to implement BMPs in watersheds with NPS impacts, and to promote public awareness.

Urban Projects

In 1999, the TNRCC developed a work plan to implement BMPs for controlling NPS pollution from excess salinity in the Upper Colorado River basin. This project, coordinated with the Railroad Commission of Texas, will use grant funds to support plugging 171 abandoned oil field wells that are known to contribute to excess salinity in the E.V. Spence Reservoir. The Railroad Commission will plug another 1,000 abandoned wells throughout the state using state funding. Many of those wells are in the northwestern area of the state, where salinity is a concern in numerous watersheds.

The TNRCC also executed a work plan to address high levels of fecal coliform bacteria in water bodies in the southeastern region of the state, where inadequate or failing septic systems are known to be a problem. This project involves extensive cooperation among the TNRCC, the Texas Agricultural Experiment Station (TAES), and regional planning agencies (Southeast Texas Resource Conservation and Development and Pineywoods Resource Conservation and Development).

A third project addresses urban runoff that is impacting both surface water and groundwater resources in the Leon Creek watershed and the Edwards Aquifer in San Antonio. The San Antonio Water System will implement this project in coordination with the San Antonio River Authority. The project will locate sources of cadmium and fecal coliform bacteria problems in the watershed and the aquifer. The project will also identify appropriate BMPs to reduce pollution from urban sources.

Agriculture Projects

The TSSWCB completed two work plans to implement Water Quality Management Plans (WQMPs) in the Big Cypress Creek and Arroyo Colorado watersheds, both of which have TMDLs in development, and in which there are known NPS impacts from agricultural operations. WQMPs are site-specific plans developed for individual farms or ranches. Appropriate practices and techniques are tailored to the operation.

A third work plan is designed to implement alternative management practices for reducing impacts from poultry litter and manure in the Big Cypress Creek watershed. This innovative project will work to:

- develop and implement measures that organize the supply of litter and manure,
- stimulate demand for manure-derived products (both raw and processed),
- address logistical issues of bringing together the supply and the demand, and
- investigate policy and regulatory issues that can constrain or stimulate the marketing and application of litter as fertilizer.

Excess manure can cause water quality problems in watersheds where there are many dairy or poultry operations. However, when converted to compost, it can be transported outside the watershed for use as a soil amendment. The picture of the roadside shown here demonstrates the effectiveness of compost use. The area on the left was treated with compost; the area on the right was not.

Planning has also begun for implementation of the Clean Water Action Plan in 2000. Work plans are in development for projects that are expected to have positive impacts reaching far into the future. The TSSWCB and the TNRCC will jointly pursue a large-scale composting project to remove excess nutrient-rich manure from dairies in the Bosque and Leon River watersheds by developing a state market for composted manure. The composting process kills diseases, reduces odor, and results in a product that is easily stored and transported. The compost can be used in many different applications, including highway landscape work. An impressive amount of support and cooperation has already been developed among state legislators, dairy operators, state agencies, and compost facility operators during the planning process for this project.

The TNRCC will direct its project funds to provide incentives to state agencies that use the compost in their landscape practices. The TNRCC will also provide technical assistance on the proper production and application of composted manure. The TSSWCB's grant funds will be used to reimburse dairy operators for the cost of hauling manure to the composting facilities.

The Texas Department of Transportation will be the largest initial market for the compost, using it to restore grass cover on roadside landscapes. The market for compost will be expanded to other state agencies during the three-year project.

As a soil amendment, compost increases the soil's ability to retain water and decreases runoff. Compost adds nutrients that promote healthy plant

growth, and composted landscapes require less irrigation. Healthy roadside landscapes protect water quality by reducing erosion and acting as filtration zones for highway runoff. Both the TNRCC and the TSSWCB will monitor water quality in the Bosque and Leon watersheds to evaluate the effectiveness of the project in reducing nutrient problems in the area.

Forestry Projects

The Texas Forest Service (TFS) completed a work plan to address silvicultural impacts in the Cypress Creek Basin, where several stream segments have impairments to water quality. Past projects have developed and institutionalized numerous effective management practices for the forestry industry. As a first step, the TFS will evaluate the percentage of BMP compliance already in place in the watershed. One-to-one technical assistance to foresters, logging contractors, and landowners will be a major component of the project. The project will support voluntary implementation of forestry WQMPs, and will track implementation by conducting 150 assessments of recently logged tracts. Education and outreach will be integral parts of the project. The TFS will also continue to play an active role in the TMDL project in the Lake O' the Pines watershed in the Cypress Basin to ensure that forestry activities enhance and support the developing TMDL.

TMDLs

The TSSWCB is implementing activities for a TMDL project in the Lake Aquilla and Marlin City Lake System watersheds. Both of these areas have NPS impacts from the herbicide atrazine, while Lake Aquilla also has impacts from the herbicide alachlor. This cooperative project involves the TAES, the Texas Agricultural Extension Service (TAEX), and the NRCS, along with the TNRCC. The project educates local landowners about local water quality and agricultural BMPs, and assists local landowners to implement BMPs. Through tools such as the TSSWCB's Tex*A*Syst Groundwater Protection Program for rural landowners and the TNRCC's Source Water Protection Program, both urban and rural surface water and groundwater will be protected from herbicides and other forms of contamination. The lessons from these projects will be used in restoration activities in other watersheds with similar impacts. Success has already been realized through source water protection activities in the Marlin area, which will be described later in this report.

Planning and contract negotiation was carried out for three new TMDL projects that address problems in multiple watersheds. The first project addresses atrazine, an herbicide used for crops and lawn care, which is considered a threat to 11 drinking water supply reservoirs—five near Dallas–Fort Worth and two in northeast Texas. A cooperative project of the TNRCC and the TSSWCB to eliminate this threat was begun in 1999. The TNRCC and partner agencies will perform targeted monitoring of atrazine and three other herbicides to better characterize the threat to public drinking water. Project partners include the Trinity River Authority, the Sabine River Authority, North Texas Municipal Water District, the Tarrant Regional Water District, and the City of Waxahachie. Because crop lands are a known source of atrazine, the TSSWCB has begun working with agricultural producers in the affected areas to implement BMPs that reduce atrazine runoff.

Legacy pollutants, which are a problem in several water bodies, are the focus of the second TMDL project. The term "legacy pollutant" refers to certain chemical pollutants, the use of which has been banned or restricted since the 1970s, but which are still at detectable levels in sediment and fish tissue samples. The TNRCC, in cooperation with the USGS, is heading up a project that will examine this problem in urban lakes and Trinity River segments in the Dallas–Fort Worth area. The project will provide a comprehensive assessment of current and past contaminant loadings, establish historical trends, and evaluate mitigation strategies for each of the listed pollutants.

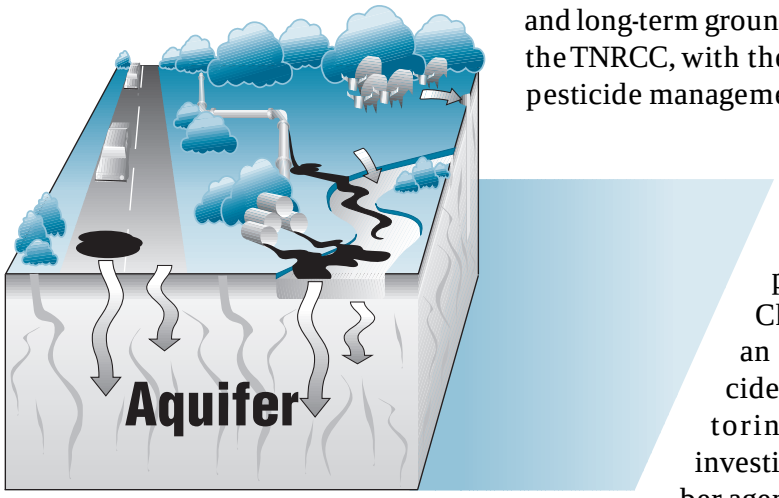
The third project will examine the tissue of edible fish in the same water bodies evaluated for the legacy pollutant project, and also in some East Texas waters in which the Texas Parks and Wildlife Department (TPWD) has found evidence of mercury contamination in fish tissue. This project will serve two purposes:

- to update older assessments that determine the risk to the public of consuming fish from the affected water bodies; and
- to assess the extent of fish tissue contamination for use in developing watershed action plans.

The Texas Department of Health (TDH) will collect the samples and perform the risk analyses.

Planning for Groundwater

The Texas Groundwater Protection Committee (TGWPC) is a multi-agency task force dedicated to coordinating groundwater protection activities in Texas. This group, which includes representatives from 10 government and educational agencies, plans for both short-term and long-term groundwater quality management. In 1999, the TNRCC, with the advice of the TGWPC, developed a pesticide management plan to protect groundwater and submitted it to the EPA for approval. The Texas Department of Agriculture (TDA) chaired the subcommittee that coordinated that plan. The TGWPC's Agricultural Chemicals Subcommittee conducted an investigation of possible NPS pesticide contamination and pesticide monitoring activities. The results of that investigation will be used by several member agencies in setting program priorities for the coming year.



Groundwater, which provides a little more than 40 percent of all municipal water used in Texas, is vulnerable to many pollutants.

Spreading the Word

Education is a critical aspect of managing nonpoint source pollution. Unless government agencies, educational institutions, and stakeholder groups spread the word to local communities and citizens about the water quality problems we face—and what works in preventing or solving those problems—people will not step forward to implement solutions.That's why public education—sometimes called public outreach to distinguish it from classroom education—is an implementation component of every NPS grant project,TMDL project, and watershed action plan.

Urban Programs

Texas has a variety of methods for spreading the word at the regional and statewide levels.The award-winning Texas Watch program trains volunteer monitors and promotes NPS pollution education activities in watersheds throughout the state. The program is operated by Southwest Texas State University under a cooperative agreement with the TNRCC. Local businesses, groups, and schools become partners by providing financial and other support to the volunteers. Texas Watch actively promotes water quality awareness and grassroots organization within local communities to address pollution problems. Data collected by volunteers have also been instrumental in filling gaps in government-conducted monitoring and in identifying land uses and pollution sources in the volunteers' watersheds.

The TNRCC's Clean Cities, Clean Industries, and Small Business and Environmental Assistance (SBEA) programs promote a variety of pollution prevention messages and activities in urban areas. For example, the Clean Industries Program offers members a free Web service called "Message of the Month," an informational packet that includes such items as sample payroll stuffers, educational fliers, and public service announcements. Topics in 1999 included proper disposal of used motor oil and other NPS pollution prevention tips. The SBEA conducted numerous, free site visits for small businesses to assist them in developing customized pollution prevention plans. Storm drain stenciling projects are carried out in cities throughout the state to make residents more aware of the relationship between urban runoff and the quality of local surface waters.

A new, statewide outreach project, planned for the next three years, will incorporate education and pollution prevention into the TMDL process. To engender public support and awareness in watersheds with active TMDL projects, the TNRCC will develop a public education campaign using various media. Radio and television public service announcements, brochures, advertisements, and fact sheets will be produced in both English and Spanish. Topics will include how nonpoint source pollution is assessed and accounted for in the TMDL process, stormwater issues, individual actions that can reduce NPS pollution, and BMPs.

Agriculture and Silviculture Programs

The Tex*A*Syst Groundwater Protection Program provides assistance to rural landowners in preventing nonpoint source pollution in groundwater. The program, which had initial funding under a federal NPS grant, uses a variety of media and activities for educating landowners. The TAES, the TAEX, and the TSSWCB developed the program and coordinate it. Messages are delivered over the Web and through Soil and Water Conservation District (SWCD) offices of the TSSWCB, County Agents of the TAEX, and NRCS district offices.

There are more than 100,000 abandoned wells in Texas—all of them potential avenues for NPS contaminants to reach groundwater.

Last year, the Tex*A*Syst Program produced and distributed five videos to introduce landowners to the concepts of wellhead protection. The video topics include an introduction to the program; proper storage and management of pesticides, fertilizers, petroleum products, and hazardous household chemicals; maintenance and construction of septic systems; and livestock waste management. Two of the videos in the series won the national Aegis Award for excellence in video editing. The videos were widely distributed to county extension offices, district extension offices, state extension specialists, regional SWCD and NRCS offices, the TNRCC, the EPA, the National Farm*A*Syst office, the Texas Department of Agriculture, the Lower Colorado River Authority, and the Brazos River Authority.

Recently, the TGWPC produced a sixth video on plugging abandoned water wells. Video production was supported with EPA grant funds administered by the TNRCC and by the Water Well Drillers Program of the Texas Department of Licensing and Regulation (TDLR). Copies are available from the TDLR (www.license.state.tx.us/MISC/office.htm).

Tex*A*Syst also produces and distributes 10 brochures that guide rural landowners through the steps necessary to protect groundwater from contamination. These brochures cover topics that assist all types of agricultural producers and rural landowners.

The Tex*A*Syst Internet site, called the "Waterhome" (http://waterhome.brc.tamus.edu), has been accessed over 459,000 times since its establishment in 1996. The site provides a valuable resource for the program staff and generates interest among landowners. In addition to information about the brochures and videos, the site offers slide presentations about agricultural BMPs and nonpoint source pollution projects.

The TSSWCB developed a new Web site for its agency in 1999 (www.tsswcb.state.tx.us). Users can find information about the mission and programs of the TSSWCB, along with helpful links to other agriculture-related sites. NPS project descriptions are also being developed for the site.

The Texas Forest Service produced and aired several radio and television campaigns, newsletters, and newspaper stories designed to inform forest landowners and citizens in forestry areas about water pollution preven-

tion in silvicultural activities. Staff conducted workshops, provided technical assistance, and formed an association of forest landowners who live in urban areas distant from the forests they manage. The project resulted in a voluntary implementation of BMP plans by 88 percent of the participants. The Texas Forest Service received two prestigious awards in 1998 for its innovative and successful education program—the state's Clean Texas 2000 Environmental Excellence Award and the federal Conservation Education Outstanding Achievement Award.

Continuing Education and Technical Assistance

Pesticide applicators, well drillers, water pump installers, non-agricultural irrigation system installers, and septic system installers are all required to take continuing education courses to ensure that they are up-to-date on BMPs for their respective activities. In 1999, the TSSWCB, the TDA, and the TNRCC conducted several workshops for these groups. Training centers for installers and inspectors of on-site sewage facilities were established at College Station, Weslaco, and El Paso under the auspices of the TAES and the On-Site Wastewater Treatment Research Council.

The Source Water Protection Program worked with 54 communities and water supply systems in 1999 to develop plans to protect surface water and groundwater sources of drinking water from NPS pollution. Volunteers were trained to perform inventories of contaminant sources in wellhead and source water protection areas. Program staff assisted local water supply managers in identifying BMPs for implementation. During the last two years, the program completed 108 new, local protection programs in collaboration with local agencies and volunteers.

SWCD offices provided technical assistance to rural landowners on BMPs that will work well in their operations, and how to implement them. TNRCC Field Office personnel provided technical assistance to operators and installers on proper application and BMPs for fertilization with wastewater treatment plant sludge, and on compliance with design and installation plans for on-site sewage facilities. TSSWCB District Office staff routinely work with area producers to give them the latest available information on BMPs and to find out what programs producers want from the Districts and the TSSWCB.

The TAES made numerous presentations on various aspects of irrigation management to protect water quality, and on wellhead protection practices to prevent groundwater contamination. A 10-county project called Water for Texans demonstrates the effect of current BMPs on water yield and quality.

Public Education in the TMDL Development Process

The TMDL process in Texas relies heavily on participation by stakeholders. Stakeholder work groups are formed early in the TMDL development process. In each of the basins, the CRP Basin Steering Committee—a diverse group of citizens who provide public input and assistance to the CRP regional agency—participates in the recruitment of the TMDL stakeholder work group.

Stakeholder work groups are involved in all aspects of TMDL and watershed action plan development. Information about NPS issues and BMPs is provided to the work group and to the local community at large through a variety of means. Presentations are made to work group committees, and at conferences, symposia, meetings, and workshops. Project managers and the stakeholders produce and distribute fact sheets, brochures, and news articles about local water quality problems and project progress. In addition, progress reports on TMDL projects are posted on the TNRCC's Web site (www.tnrcc.state.tx.us).

Other activities being planned for involving the public in watershed restoration include quarterly TMDL development information sent by e-mail to stakeholder groups, trade journal articles targeting select economic sectors, and training opportunities for TMDL project contractors.

In 1999, the TNRCC published a how-to manual, *Developing Total Maximum Daily Loads in Texas: A Guide for Lead Organizations* (TNRCC, GI-250), which was developed in cooperation with the Texas Institute for Applied Environmental Research (TIAER) and the Texas A & M University System. This guidance document gives step-by-step instructions for successful project development, including stakeholder participation requirements, TMDL allocation, model use and development, quality assurance, and action plan development. The manual has received national recognition for excellence and has been requested by several other states for their use in developing similar guidance. Texas will employ several contractors over the next several years to develop TMDLs and watershed action plans.

Identifying the Problems

Identifying actual and potential impacts from nonpoint source pollution is a vital aspect of NPS pollution management. A problem must be identified and well-defined before it can be addressed effectively. Monitoring and assessment has to occur at several levels:

- to routinely and systematically identify threats or impairments;
- to conduct detailed assessments of problems and identify their sources; and
- to monitor the effectiveness of BMPs implemented to protect or restore water quality.

Surface Water Assessment

Through the Clean Rivers Program, Texas coordinates the finite resources of state, federal, regional, and local monitoring organizations to obtain the best possible coverage at an effective cost. Each of the CRP planning agencies holds an annual meeting to bring all the parties together to determine its basin's monitoring needs for the upcoming year. The TNRCC's most recent *Water Quality Inventory* [Clean Water Act Section 305(b) assessment], the CRP summary assessments, and the 303(d) list are starting points for evaluating basin monitoring needs. Key participants in these meetings include the CRP partner agencies, representatives of the basin steering committees, surface water quality monitoring staff of the TNRCC central and regional offices, and the USGS. Numerous other qualified agencies may be involved in the actual monitoring through subcontracts.

Surface water quality monitoring staff routinely collect field measurements, such as water temperature, pH, dissolved oxygen, and specific conductance.

In addition to allocating resources, the annual meetings are used to ensure consistent quality assurance of the data collected. Each monitoring agency agrees to collect data under an approved quality-assurance plan.

Water quality data are collected at a network of fixed monitoring stations located at key points in the watershed to provide trend information and an overall assessment of the basin. Basins are delineated into subwatersheds, which are grouped and systematically monitored at a more intensive level. All subwatersheds are reviewed over a five-year period. Targeted monitoring, such as special studies and TMDLs, are carried out to provide information for developing and refining monitoring techniques, site-specific water quality standards, permit levels, and watershed action plans, and for assessing the success of implementation activities.

Resources available to address this wide array of monitoring needs are limited. For this reason, the Texas Legislature appropriated approximately $8 million in 1999 for TMDL development during the next two years. Mon-

ies allocated to Texas for assessment under the federal Clean Water Action Plan will also be used to support targeted monitoring.

Monitoring for protection of aquatic life and habitat is also carried out by the Texas Parks and Wildlife Department (TPWD). As part of its fisheries management plan, it routinely monitors fish populations, aquatic vegetation, and related water quality parameters. In addition, the TPWD investigates fish kills and any type of pollution event that may cause the loss of fish or wildlife resources. The TPWD also conducts instream flow studies to interpret various factors impacting aquatic life, and generally participates in fish sampling for watershed action projects.

Coastal Zone Assessment

The Texas General Land Office (GLO) heads up the Coastal Coordination Council to implement the state's Texas Coastal Nonpoint Source Control Program. The Council has provided funding for TMDL projects at Armand Bayou in Houston and Oso Bay in Corpus Christi. The Coastal Bend Bays and Estuaries Program and the Galveston Bay Program cooperate with the GLO and other regional agencies in assessing NPS pollution in heavily-developed urban areas on the Texas coast.

As part of their ongoing work to determine the influence of freshwater inflows on Texas bays and estuaries, the Texas Water Development Board (TWDB) calculates inputs to bays and estuaries from nonpoint sources in coastal watersheds. During 1999, compilations were completed for the Mission-Aransas Estuary. Nonpoint source loadings made up 94 percent of the total nitrogen loading from the coastal watersheds of the estuary. Local NPS sources accounted for 49 percent of the total nitrogen load, while the remainder came from river basins upstream. In conjunction with this effort, the TWDB funded studies to enhance methods of estimating rainfall runoff for use in modeling nonpoint source loadings. A project to estimate nonpoint source nutrient loadings to Sabine Lake was begun in 1999.

Currently, the GLO, the TNRCC, the TSSWCB, and other agencies are preparing amendments to the 1998 Texas Coastal Nonpoint Source Control Program in response to comments from the National Oceanic and Atmospheric Administration and the EPA. An additional effort is under way to prepare a five-year implementation plan and 15-year program strategies for the Coastal Program.

Groundwater Assessment

Groundwater contamination in Texas is documented in the annual *Joint Groundwater Monitoring and Contamination Report* (TNRCC, SFR-056/98), a collaboration by the member agencies of the TGWPC. According to this report, petroleum products are the most common contaminants, reflecting the large number of leaking underground storage tanks in the state. Some of the activities in place to address this problem include initiatives of the TNRCC's Office of Waste Management, and the state's urban and rural

wellhead protection programs. Less-common contaminants include pesticides, solvents, other organic compounds, heavy metals, and salts.

Source Water Assessment

Source waters are those surface water and groundwater resources that are used by public water supply systems to provide drinking water for Texas citizens. The TNRCC, in cooperation with the USGS, is assessing the susceptibility to contamination from NPS pollution of the more than 17,000 surface water and groundwater sources of public water supplies in Texas. This statewide investigation will develop statistical relationships between known occurrences of NPS contaminants with land uses and other environmental factors.

In addition to using existing data from the TNRCC, the CRP, and the USGS, the two agencies will sample 48 reservoirs and 160 wells used for public water supplies. The reservoirs selected are representative of the various hydrological conditions and land uses in the state. The selected wells are primarily in shallow, unconfined aquifers that are known to be most susceptible to NPS contamination, and to have other characteristics that may influence susceptibility, including land use, aquifer type, soil characteristics, depth to the water, and the amount of precipitation.

Staff are taking samples using specialized procedures that are capable of detecting pollutants at low levels. Pollutants being measured include soluble pesticides, volatile organic compounds, and nitrates (groundwater only).

Databases are also being developed to support the identification of statistical relationships between contamination and a wide variety of environmental variables that may affect water quality. These variables include such things as population density, land use, pesticide and nutrient usage, and selected natural factors.

Using the statistical relationships identified during the assessment, the TNRCC will develop threshold values, or measures of the correlation between the intensity of an environmental variable and the occurrence of contaminants in source water or in treated drinking water. These threshold values will then be used to determine threats to drinking water supplies.

Another important facet of the assessment will be the identification of the area of primary influence for source waters. The determination of the area of primary influence is based on the amount of distance and time it takes for pollutants to reach the water source. Potential sources of NPS pollution in areas of primary influence will be catalogued, along with the contaminants associated with them. Factors to be considered are proximity to major highways or pipelines (possible sources of chemical spills), since time is of the essence in preventing or reducing contamination from accidental releases of pollutants.

The information developed in this assessment will be of great value in developing source water protection plans to prevent pollution. It will also be helpful in designing watershed action plans to restore impaired source waters.

Special Studies

There are a number of special studies and TMDL projects under way around Texas to provide the scientific basis for watershed action plans. Many of those will be discussed in the "Regional Activities" section of this report.

Several studies are assessing NPS impacts at a regional level. Some also establish specialized procedures for NPS monitoring and assessment that address an existing problem and provide a model for the NPS assessment for future projects. The TSSWCB and the TNRCC have cooperative agreements for special studies with the USGS and research stations of Texas A&M University.

The Texas Agricultural Experiment Station (TAES) examined opportunities for effluent trading to meet TMDL allocations. Project staff analyzed economic and policy issues related to effluent trading to meet water quality goals. The TAES is also active in assessment projects that support TMDL development in several watersheds.

The TAES has several projects in progress to prevent NPS pollution from animal feeding operations. These include: developing and testing of BMPs to reduce phosphorus excretion from feedlot cattle through ration management; reducing ammonia volatilization loss through humate application to feedlots; devising land application practices for feedlot manure; and developing NPS dispersion models for odor and dust.

The Blackland Research Center (part of the TAES system) is using two models—the Soil and Water Assessment Tool (SWAT) and the Agricultural Productivity Extender (APEX)—to assess the aggregated effects of loadings in several subwatersheds of concern. The information from these models is used to improve understanding of flow, sediment, and nutrient relationships, and it is a valuable aid in locating new sites for effective monitoring stations. The SWAT model is also being used to simulate NPS pollution and BMP effectiveness in affected watersheds.

Pesticide and volatile organic compounds (VOCs) are major nonpoint source contaminants of concern. A USGS project examining this concern has two primary objectives:

- to determine the occurrence and distribution of pesticides and VOCs in surface water and groundwater supplies that are representative of the various land uses, hydrology, and geology found across Texas; and
- to develop a comprehensive contaminant occurrence database and to present this information by watershed, land use, and aquifer type.

Project staff are collecting data on the occurrence of these contaminants at low detection levels. These data will be used to determine what factors or activities may contribute to the contamination, which source waters are most vulnerable, and where and for which pollutants monitoring should be intensified or could be reduced. Project staff will also determine, to the extent possible, the statistical relationship between explanatory variables (such as land-use characteristics of the watershed) and the occurrence of a contaminant.

The TNRCC is directing a project to address a statewide problem with bacterial indicators of water quality. Roughly 45 percent of the impaired water bodies in Texas have concentrations of fecal coliform bacteria that exceed contact recreation standards. The sources of this bacteria include failing or inadequate on-site sewage facilities, agricultural operations, urban stormwater runoff, and in some instances, waterfowl and wildlife populations.

The bacteria project is evaluating various indicators to determine whether there may be a better indicator of contact recreation safety than fecal coliform bacteria, which is not highly correlated with actual disease outbreaks. The project is also investigating DNA-based technology for determining pollution sources.

In a related study, the Coastal Coordination Council has funded projects along the Texas coast to use DNA techniques to identify pollution sources. The relationship between in-stream bacteria and urban sources at various levels of density is being compared with the bacteria levels in a stream located in a natural, undeveloped area.

Doing the Job

Getting BMPs implemented to prevent and reduce pollution is the reason for all the coordination, monitoring, and education activities of state agencies and stakeholders. Much of the implementation takes place at the watershed level, as described in the "Regional Activities" section of this publication. However, local implementation efforts gain additional support from statewide and regional projects, common-sense regulations, and voluntary programs.

Reducing and Preventing Contamination from Bacteria

As previously noted, about 45 percent of the impaired water bodies in Texas have concentrations of fecal coliform bacteria that exceed contact recreation standards. Both the TNRCC and the TSSWCB have programs to prevent and remediate bacteria impacts.

The state's On-Site Wastewater Program regulates the design and installation of on-site sewage facilities (OSSF), or septic systems. Approximately one-third of the state's population relies on septic systems. Inadequate or improperly functioning septic systems are a primary source of fecal coliform bacteria. TNRCC field staff annually review OSSF installation plans and monitor to ensure compliance. In 1999, staff reviewed 128 plans and conducted 120 initial and follow-up inspections at new or expanded facilities, or in response to complaints. To achieve voluntary compliance, staff consulted with about 644 installers to assist them in proper planning and implementation techniques.

Constructed wetlands are an effective alternative for sewage treatment in some areas where traditional septic systems are impractical.

The state is also working to get septic systems installed in areas that do not have adequate service, and to develop innovative techniques for use in areas where traditional systems do not work. Building on the success of previous NPS 319(h) grant projects, several regional agencies are installing septic systems that use constructed wetlands in areas where traditional drain fields are not practical. The TWDB provided funding for development of water and wastewater plans for disadvantaged rural communities in the Texas-Mexico border area, and assisted in improving wastewater collection systems in several other regions where residential areas were dependent on septic systems.

Animal feeding operations (AFOs) are another possible source of fecal coliform bacteria in water. The TSSWCB's Water Quality Management Plan (WQMP) Program addresses this and other agricultural sources of pollution. BMPs for control of animal waste from dairies and poultry operations are instrumental in protecting water quality, especially in the central and eastern regions of the state, where AFOs are prevalent.

Water Quality Management Plans for Agricultural Operations

WQMPs address a wide variety of agricultural practices. Approximately 703 WQMPS were developed and implemented in 1999 to prevent or reduce NPS impacts to water quality from agricultural operations. Authorized and funded under State Senate Bill 503 in 1993, the WQMP program provides an institutional mechanism to specifically define what an agricultural producer needs to do to adequately control NPS pollution and to document compliance with the plan. This, in turn, makes it possible to identify and recognize the efforts of farmers, ranchers, and dairymen to protect local water quality.

WQMPs are site-specific plans developed for individual farms or ranches. Appropriate practices and techniques are tailored to the operation. They are developed in cooperation with the producer and the local SWCD, with assistance from the NRCS and the TSSWCB. The finished WQMP is certified and represents a voluntary agreement on the part of the landowner to carry out the plan. The TSSWCB conducts status reviews on a minimum of 10 percent of plans each year to ensure compliance.

Filter strips at the edges of fields use grass or other vegetation to filter runoff and remove sediment, preventing pollutants from reaching nearby water bodies.

The TSSWCB uses the criteria in the NRCS Field Office Technical Guide for designing WQMPs. These criteria are reviewed annually by the SWCDs and the TSSWCB, who work with the NRCS to develop and maintain the guide. The guide contains conservation considerations, criteria for quality and treatment levels, management guide sheets for various land uses, and BMP standards and specifications. It is tailored for the geographic area of each SWCD.

To assist agricultural producers in implementing WQMPs, the TSSWCB uses NPS 319(h) grant funds to support WQMP implementation in priority management areas. Financial assistance is awarded to producers in areas that have been given high priority for BMP implementation because of known NPS impacts to water quality. The TWDB also provided funding—primarily to local SWCDs through 12 grants—for water conservation practices to reduce runoff from irrigated lands.

Improving Water Quality through Brush Control

Though brush control is often considered to be simply a practice to conserve water, brush control projects can also have positive impacts on water quality, especially as envisioned by the TSSWCB and the Texas Legislature.

The TSSWCB's Brush Control Program is directed to those areas where brush consumes water to such a degree that it is detrimental to water conservation. In implementing the program, the Board provides financial assistance to those projects that:

- use methods proven to be effective and efficient,
- are cost-efficient,

- will have a beneficial impact on wildlife habitat,
- will maintain topsoil to prevent erosion or siltation, and
- allow for revegetation with beneficial plants.

Projects that satisfy these requirements can have significant water quality benefits by reducing soil erosion and silt build-up in streams and rivers. In many cases, brush control projects may result in the return of perennial flows to streams and springs that have been dry or intermittent for many years. Increased flows and reduced erosion have a positive impact on aquatic life by restoring or increasing the available habitat. Increased flow also enhances the availability and quality of water for other uses. The TSSWCB coordinates with the TPWD to evaluate the impacts of proposed brush control projects on fish and wildlife.

In 1998, a year-long study was completed on the 950,000-acre North Concho River watershed to determine potential impacts from a comprehensive brush control project. The study was conducted by the TSSWCB, the Texas A&M Research and Extension Center, and the Upper Colorado River Authority, with funding from the Texas Water Development Board. Based on the results of the study, the Legislature appropriated more than $8 million for the TSSWCB to implement a brush control project in the watershed. Another $1 million was designated for feasibility studies in eight other watersheds believed to be good candidates for the program—Frio, Nueces, Pedernales, Wichita, Canadian, Middle Concho, and Upper Colorado river basins and the Edwards Aquifer. The TSSWCB will be working closely with the NRCS, Texas A&M, and regional river authorities on these projects.

Managing Impacts from Herbicides and Pesticides

Atrazine and other herbicides have shown up at detectable levels in some drinking water sources around the state. Atrazine is commonly used on crop lands and is also used in urban areas for lawn care. In 10 watersheds, atrazine concentrations in finished drinking water are high enough to be considered a threat. In one other watershed, Lake Aquilla, atrazine concentrations have exceeded drinking water standards.

The state has a two-pronged approach to addressing NPS impacts from atrazine and other herbicides. In areas where atrazine is detected, but at low levels, the Surface Water Protection Committee (SWPC) mounts its Atrazine Action Plan to prevent and reduce further herbicide contamination. The SWPC is a coalition of the TNRCC, the TSSWCB, the TDA, several other regional, state, and federal agencies, and industry leaders. In areas where atrazine concentrations cause source waters to be identified as threatened or impaired on the state's 303(d) list, TMDL projects are initiated.

Preventing Herbicide Impairment in Source Waters

In the agricultural arena, SWPC members are working to identify key watersheds and the major producers within them. In consultation with regional basin steering committees, educational tools such as fact sheets

and brochures are being developed. Information on BMPs for herbicide and pesticide use are also being developed for use with the existing continuing education program. Educational items will also be distributed directly to individual growers and at workshops and industry organization meetings. Federal and state grant funds will be used, as appropriate, to provide incentives for BMP implementation. Key state and federal agencies involved in addressing surface and groundwater protection in agricultural areas include the Texas Department of Agriculture, the TAES, the TSSWCB, the NRCS, and the TNRCC.

In the priority areas, local professional teams are conducting research to identify possible industrial sources, such as highways, railroads, municipal maintenance areas, and lawn care companies. Activities will be coordinated with the Texas Department of Transportation, the Railroad Commission, and other state agencies, as needed.

For targeted urban areas, SWPC members prepared fact sheets about atrazine and integrated weed management for lawns. Through the Master Gardner program in cities and on TV gardening programs, the SWPC provides information about proper application and storage of herbicides and pesticides. Fact sheets and general articles are distributed to local papers, to feature columnists, and at local meetings.

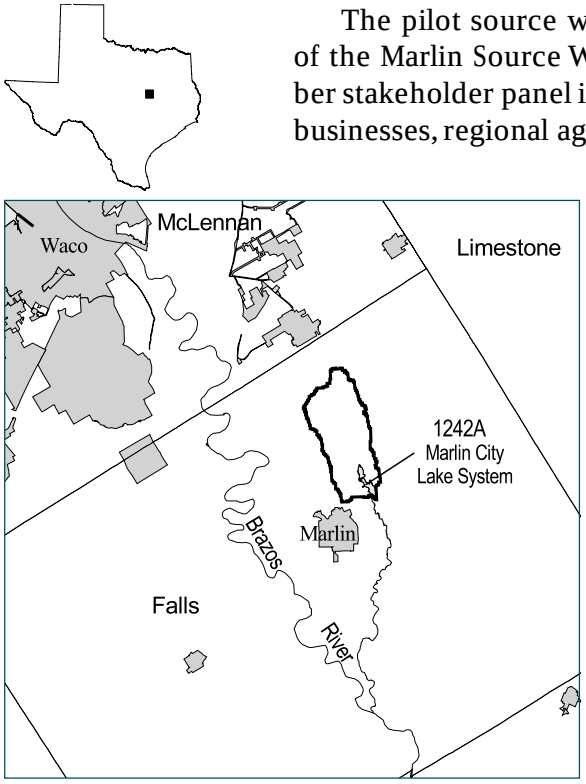
Restoring Water Quality in Impaired or Threatened Source Waters

In watersheds where atrazine concentrations threaten or impair drinking water, TMDL projects are initiated to restore water quality. As mentioned in the section "Identifying the Problems," a TMDL project is under way to address several threatened surface water bodies affected by atrazine.

Marlin City Lake System

The Marlin City Lake System watershed was the first TMDL project to address drinking water threats from atrazine. When the herbicide was first detected in the water supply system in 1995, the TNRCC Source Water Protection Program began work to identify sources of atrazine in the water and to work with local agricultural agencies, producers, and the City of Marlin to reduce atrazine levels in the watershed. The City of Marlin received a federal grant in 1996 to be a pilot city in the EPA Region 6 and Texas Source Water Protection Program. In 1998, a TMDL project began, building on the success of the source water protection project. The work of the stakeholders in this watershed has been so successful that Texas has recommended removing the Marlin City Lake System from the 303(d) list in 2000.

The Marlin City Lake System is located in the Brazos River Basin and includes Old Marlin City Lake and New Marlin Reservoir. These lakes are located roughly three miles northeast of Marlin on Big Sandy Creek. The lakes supply drinking water for over 6,000 city residents. The Lake System watershed is characterized by Blackland Prairies, generally considered to be high-quality crop land. The watershed includes about 12,500 acres, of which 5,000 are under cultivation for grain crops.



Marlin City Lake System Watershed

The pilot source water protection program began with the formation of the Marlin Source Water Protection Advisory Committee. This 13-member stakeholder panel included representatives from city government, local businesses, regional agricultural producers, community educators, agricultural chemical manufacturers, the Brazos River Authority, and county, state, and federal government agencies.

BMPs implemented by the Advisory Committee included delineation, mapping, and NPS contaminant inventories of the watershed, along with an intensive public education and outreach program. Materials were produced and distributed to agricultural producers, who in turn implemented new BMPs or improved their current practices for herbicide application and management.

In 1999, under the TMDL project, the TSSWCB and the Marlin Stakeholder Group continued the effort with local producers to improve agricultural practices for herbicide use in the watershed and to develop and implement WQMPs for area farms. The TMDL project funded an economic analysis of the "typical" farm in the watershed to assist in identifying the BMPs that are most feasible for immediate and future implementation in the area.

BMPs being used or considered in the watershed include:

- accurate herbicide application using calibrated sprayers and proper nozzles,
- reduced application rates,
- use of alternative herbicides that are less environmentally sensitive,
- timing application in relation to rain events,
- incorporation or shallow mixing of herbicides into the soil,
- integrated weed management practices,
- banded herbicide applications,
- light irrigation after application,
- contour farming and use of dikes and terraces,
- grass filter strips and grassed waterways,
- implementation of Tex*A*Syst wellhead protection practices, and
- agricultural chemical waste collection events.

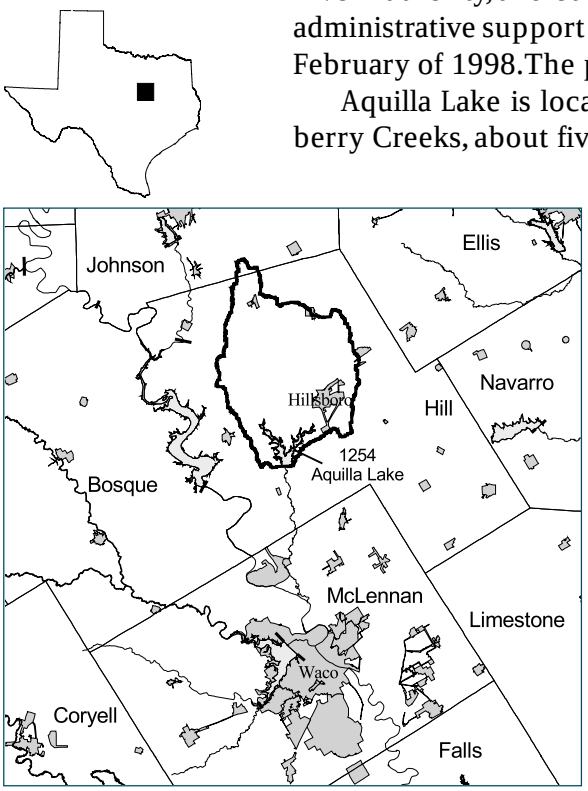
City officials and agricultural producers have worked quickly and effectively to address the atrazine threat in their watershed. Since 1995, atrazine concentrations in source water and finished water have been steadily declining to much lower levels measured in 1999. The BMPs in use by area farmers, along with implementation of the city of Marlin's Source Water Protection Plan and improvements to the water treatment facility, should

prevent any future threat to drinking water from atrazine. The ongoing drought probably also accounts for some part of the improvement in lake water quality. The TMDL project and the TNRCC public drinking water staff will continue to monitor atrazine concentrations in the lake and in treated drinking water over the next few years to ensure that water quality improvements are lasting.

Aquilla Lake

In the Aquilla Lake watershed—where atrazine concentrations exceeded drinking water standards in 1998, and alachlor concentrations are a threat to the drinking water use—a TMDL project is under way with the support of the local stakeholder committee. The TNRCC, the TSSWCB, the Brazos River Authority, and other state and federal agencies provide technical and administrative support to the project. The stakeholder group was formed in February of 1998. The project was initiated in January of 1999.

Aquilla Lake is located in the Brazos River Basin on Aquilla and Hackberry Creeks, about five miles southwest of Hillsboro. It supplies drinking water for more than 8,000 people in three towns and five water supply areas. The watershed is 255 square miles, characterized by Blackland Prairie and Cross Timbers.



Aquilla Lake Watershed

While monitoring and assessment modeling are under way, Aquilla stakeholders have already begun taking action to reduce atrazine concentrations. Area farmers have formed a Producers Atrazine Action Committee. The Producers Committee and the Stakeholder Group sponsored a public meeting in December 1999. The meeting featured speakers on water quality topics and training on pesticide application.

The Producers Committee developed a list of BMPs recommended for use in the watershed, and composed a questionnaire to document adoption of BMPs over time. In addition, the committee met with pesticide dealers to increase awareness and assistance in that arena. BMPs already being implemented include more setback areas and incorporating atrazine into the soil on application. Adoption of the incorporation practice among area producers was already at 33 percent at the end of the first year, and is expected to reach 100 percent by the third year of the project. In conjunction with the Marlin assessment, the TMDL project funded an economic analysis of the typical farm in the Aquilla watershed to assist in identifying the BMPs that are most feasible for immediate and future implementation in the area.

As in the Marlin watershed, awareness of groundwater quality has also increased as a result of the surface water project. Several county wells have been tested for various contaminants, and local landowners have been introduced to the Tex*A*Syst rural wellhead protection program.

The Aquilla water supply system is in its eighth consecutive quarter without a detection of atrazine above drinking water standards, due in part to the introduction of powdered, activated carbon treatment at the drinking water plant, and in part to reduced runoff associated with the ongoing drought. However, with local stakeholders participating at the level they have shown to date, water quality in Aquilla Lake and in the public water system should be fully protected.

Protecting Wetlands

Wetlands play an important role in the natural abatement of NPS pollutants. Therefore, certain permit requests are assessed for potential impacts on wetlands and removal of riparian vegetation—water rights use permits, U.S. Army Corps of Engineer dredge-and-fill permits, and permits for any development that results in the removal of wetlands. The TNRCC's Water Quality Assessment Section received an Environmental Excellence Award from EPA Region 6 in 1999 for its work in protecting wetlands in Texas. Section employees drafted a comprehensive regulatory guidance document to assist applicants for water rights permits. The document also clarifies the state's role in certifying federal dredge-and-fill projects, preventing unnecessary conflicts between the state and federal roles in issuing these permits. The EPA award recognized TNRCC staff for their high level of effort in protecting Texas wetlands.

The TPWD has numerous programs to protect or manage wetlands and coordinated development of the Texas Wetlands Conservation Plan. This plan focuses on non-regulatory, voluntary approaches to protecting wetlands, particularly through new incentives to encourage wetlands conservation on private lands, and through coordination and implementation of existing private, state, and federal wetlands protection incentives. Wetlands conservation—including acquisition, mitigation and restoration—is also an important component of the plan. Information transfer to landowners is another important component.

TPWD staff advise landowners on how to manage their properties for wildlife under the Private Lands Enhancement Program. These recommendations often involve wetlands conservation. The TPWD also coordinates the Private Lands Initiative, which offers cost-sharing opportunities to landowners interested in certain types of wetlands enhancement projects.

The TPWD has acquired lands in virtually every part of the state for the preservation, management, and study of wildlife species. These wildlife management areas typically include wetlands and open water for use by resident and migratory wildlife. The TPWD is also responsible for conducting research to determine management practices for waters and wetlands that promote and sustain fisheries.

In addition, TPWD staff review proposed U.S. Army Corps of Engineers dredge-and-fill permits. These reviews complement those of the TNRCC by focusing on protection of the state's fish and wildlife resources. The TPWD's comments are communicated to the U.S. Army Corps of Engineers, which issues the permits, and to the TNRCC, which certifies the permits.

Preventing NPS Pollution from Forestry Operations

East Texas, with nearly 12 million acres of timberland, contains the bulk of the state's timber resources. Much of this timberland is actively managed for the sustainable production of timber by forest industries, private forest landowners, and public agencies. Approximately 648,000 acres, or 6 percent, undergo some type of silvicultural treatment each year, such as timber harvesting, site preparation, temporary road construction, and prescribed burning.

Streamside management zones are vegetated buffer areas that are established along stream banks to prevent pollution from logging or other forestry operations.

Without the use of any BMPs, East Texas timberlands would lose approximately 561,000 tons of soil to erosion each year, according to available evidence. Without streamside management practices, approximately 27,931 tons of this soil would reach stream channels.

Through a comprehensive, award-winning management and education program, the Texas Forest Service and forest landowners annually prevent an estimated 11,707 tons of sediment from entering East Texas streams. This represents a 38 percent reduction in sediment since 1996. The same program prevented annual erosion of approximately 89,160 tons from forestry activities, reducing erosion by 20 percent since 1996.

The Texas Forest Service educates forest owners and managers about BMPs through a variety of means. They offer several workshops each year on forestry practices. As of 1999, they had reached 1,425 foresters and loggers with this information. Similar workshops on wetlands BMPs trained 1,125 people during the same time period. An attractive visual display has been exhibited at hundreds of locations, reaching an estimated 66,000 people. An interactive BMP presentation demonstrating the effectiveness of streamside management zone practices has been presented to numerous civic groups and at public events. Local SWCDs have been active in the project, helping to identify landowners, audit forestry management activities, and disseminate information.

This interactive model demonstrates the effectiveness of streamside management zone practices in preventing NPS pollution.

Newspaper articles and newsletters are also used to inform forest managers about BMPs. Articles appear in trade magazines and government newspapers and newsletters. The Forest Service also formed an association for forest landowners who live in urban areas in order to increase their participation in environmental issues at the local watershed level.

Of the forest owners and managers who participated in this program since 1996, 88 percent have voluntarily complied with the BMPs recommended for their operations. In recognition of this successful and innovative program, the Texas Forest Service received the state's Clean Texas 2000

Environmental Excellence Award and the federal Conservation Education Outstanding Achievement Award.

Preventing Pollution from Hazardous Wastes and Debris

In urban areas, the TNRCC sponsored Household Hazardous Waste Collection programs and events. Last year, the TNRCC sponsored 50 local Lake and River Cleanup events, with approximately 500 volunteers collecting debris from surface waters. In rural areas, the TNRCC sponsored several Texas Country Cleanups and Agricultural Waste Pesticide Collection events to provide rural residents with the opportunity to dispose of insecticides, pesticides, and other toxic chemicals and their containers safely. The General Land Office sponsors several Beach Cleanups with other agencies each year to remove trash from Texas shorelines.

Chapter 2

Regional Activities

Urban

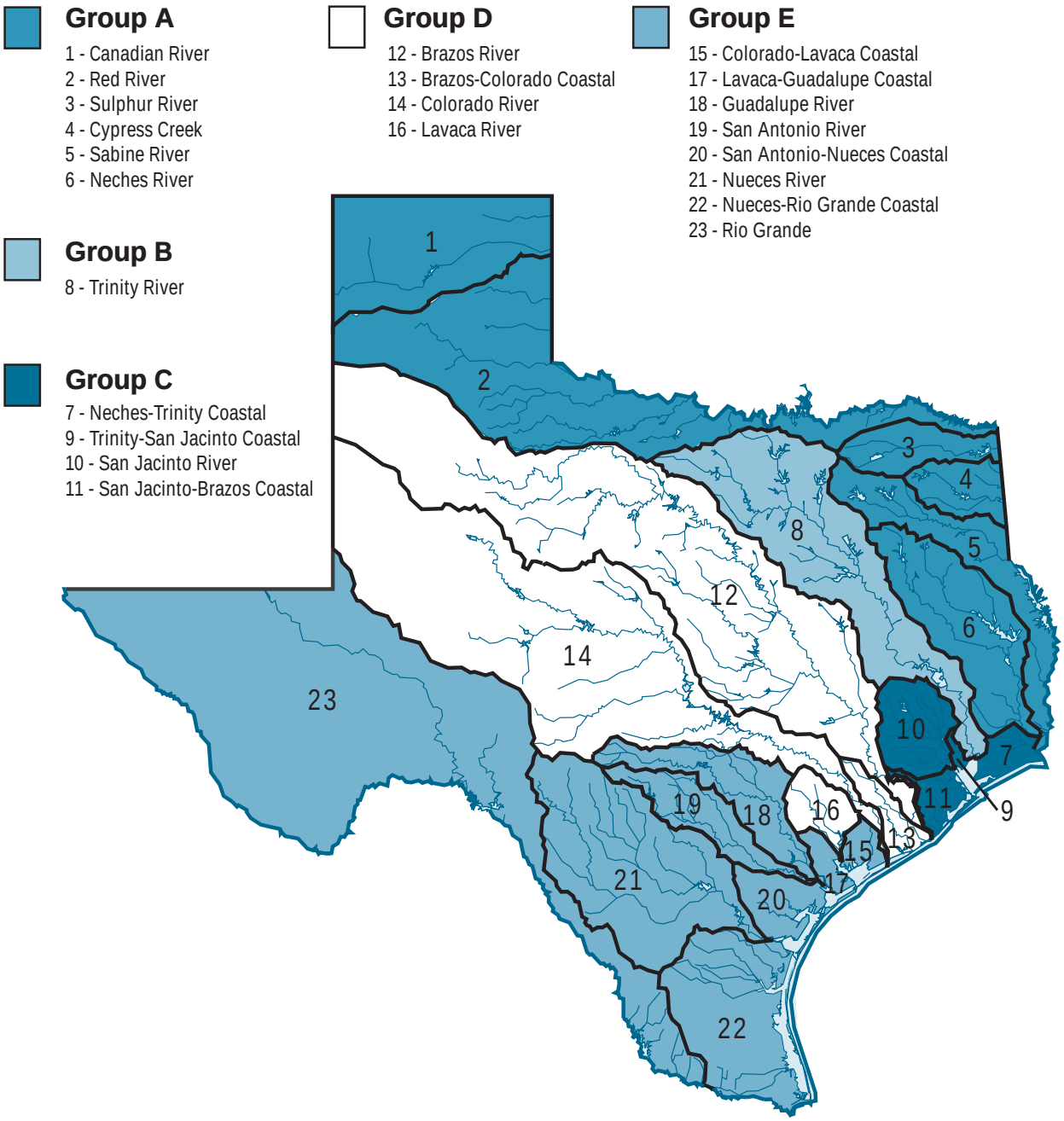
Agriculture

Silviculture

Regional Coordination

Because Texas is so large, the state's major river and coastal basins have been divided and grouped into five planning areas for purposes of statewide management. Each basin group follows the basin management cycle of scoping, data collection, assessment, strategy development, and implementation. This approach is consistent with the EPA's Watershed Restoration Action Strategy approach to NPS management.

CRP regional agencies, basin stakeholders, and TNRCC monitoring staff perform a large percentage of the routine, systematic, and targeted water qual-



ity monitoring and special studies conducted in Texas to identify water quality trends and problems. Monitoring data collected by the CRP agencies and their subcontractors are submitted to the TNRCC's central data repository and are used in preparing the statewide water quality inventory. Several other state or federal agencies are involved in monitoring and assessment as needed, such as the USGS, the TPWD, the TAES, the TDH, and the TDA.

Each CRP agency supports public outreach in its basin through its basin steering committee, public meetings, newspaper articles, and regular publication of Basin Highlight reports. Educational activities are also incorporated into special studies in watersheds of concern. Community events are another frequently used forum for outreach. Most of the CRP agencies provide support for Texas Watch programs within their basins. Each CRP agency has a Web site that offers information on water programs in the basins.

Basin Group A

The Clean Rivers Program agencies in Basin Group A include:

- the Red River Authority for the Canadian and Red River Basins (Basins 1 and 2),
- the Sulphur River Authority for the Sulphur River Basin (3),
- the Northeast Texas Municipal Water District for the Cypress Creek Basin (4),
- the Sabine River Authority for the Sabine River Basin (5), and
- the Angelina and Neches River Authority and the Lower Neches Valley Authority for the Neches River Basin (6).

Basin Group A has just completed the assessment phase of the basin management cycle and is moving into the strategy development phase, during which new or updated watershed action plans will be developed for each river basin.

A special study, *Bioaccumulation of Mercury in Selected East Texas Water Bodies* (TNRCC, AS-180), was recently published. Findings from this study and from the TDH's fish tissue analysis and risk assessment will be used to address concerns about mercury in several East Texas lakes.

Canadian and Red River Basins

In the Canadian and Red River Basins in the upper portion of Basin Group A, salinity is often a concern. Though only three water body segments are identified for salinity on the state's 1999 303(d) list, salinity concentrations are elevated in several other watersheds, especially in the Red River Basin. Low dissolved oxygen concentrations and fecal coliform bacteria are the other parameters identified for the seven water body segments on the 1999 303(d) list in these two basins.

Special studies of salinity have focused on subwatersheds of the Wichita River. Excess salinity limits the utility of regional water supplies. Salinity loads in the watershed are the result of natural brine discharges, runoff, and seepage from older oil fields that were not properly managed.

The U.S. Army Corps of Engineers constructed a chloride control project on the South Wichita River in the Red River Basin. Low flows were diverted from the river by a dam and directed via pipeline to the Truscott Brine Reservoir for management. A five-year study of monitoring data associated with the salinity control project indicates that the control structure is very effective. The structure is diverting approximately 80 percent of the chloride load in the South Wichita River at the low-flow diversion dam. Without this control project, it is estimated that chloride concentrations in Lake Kemp, downstream from the diversion dam, would increase by about 30 percent. Plans are under way to build similar structures at two other points on the Wichita River that will also divert salt loadings to the Truscott Brine Reservoir.

Monitoring by the Red River Authority indicates that significant salt loads are being introduced to the Wichita River from Beaver Creek. Studies are under way to identify the sources of the loading. The results of this study will be used to determine proper management strategies for further reducing salt loads into the river.

High concentrations of salt in Lake Meredith in the Canadian Basin continue to be a concern, because they affect the use of Lake Meredith as a potable water supply. A salinity control project was recently implemented to control the discharge from saline, artesian springs in New Mexico, which should result in a reduction of the salt load carried by the Canadian River.

The Major Rivers and Texas Rivers Programs sponsored by the Red River Authority bring environmental education to area secondary and elementary schools. Volunteer monitoring is also a component of the outreach program in the basins.

Sulphur River Basin

In the Sulphur River Basin, there are three water bodies identified on the 1999 303(d) list as impaired by nonpoint sources of pollution. The Sulphur River Basin Authority and TNRCC regional staff have begun targeted monitoring on these water bodies. General parameters of concern are low dissolved oxygen, aluminum, cadmium, and fecal coliform bacteria. Concentrations of atrazine are a concern in Big Creek Lake.

Of particular interest is Wright Patman Lake, the largest reservoir in the basin. Low dissolved oxygen concentrations and high pH values have been measured in the lake. The existing data on the lake are not conclusive regarding the cause of these concerns. A special study is in progress to further characterize water quality conditions in the lake.

Atrazine concentrations in Big Creek Lake will be addressed through the Atrazine TMDL Project. The TMDL is assessing herbicide loadings and sources in seven watersheds across the state in which atrazine concentrations are considered a threat to drinking water sources.

Cypress Creek Basin

There are six NPS-impaired water bodies identified on the 1999 303(d) list for the Cypress Creek Basin. Parameters of concern include low dissolved oxygen concentrations, high pH values, water temperature, mercury, cadmium, lead, zinc, and metals in fish tissue. The Northeast Texas Municipal Water District (NETMWD) is actively addressing these issues, with support from the TSSWCB and the TNRCC.

A special study related to agricultural NPS pollution is in progress in the Cypress Creek basin. Building on the work of a statewide special study of potential impacts from the poultry industry on water quality, the NETMWD is performing intensive monitoring in five subwatersheds that have varying concentrations of poultry operation. Although the statewide study in which the NETMWD was a participant showed no water quality degradation as a

result of poultry operations, measured values of some parameters in the study watersheds did indicate that nutrient loads could become a concern if poultry operations continued to grow without implementing better management practices.

In response to the study findings, NETMWD worked with SWCDs in the area to implement BMPs to prevent further impacts to water quality. Pilgrim's Pride operates the majority of the poultry facilities in the watershed and buys chickens from other smaller producers. In response to the study, Pilgrim's Pride entered into a voluntary agreement with the the NETMWD to address NPS pollution in the watershed. With input from the Basin Steering Committee, Pilgrim's Pride developed a program to ensure implementation of BMPs in area poultry operations, to provide funding for additional monitoring, and to allow access for inspection at any Pilgrim's Pride operation (including those of contractors). Under this program, site-specific nutrient plans are established prior to delivery of birds to any new facilities, and a phased program is establishing nutrient management plans at existing operations. Inspectors will verify implementation of the BMPs, and a database has been established to verify reductions in nutrient runoff from waste management practices.

A TMDL in the Lake O' the Pines watershed, which includes Big Cypress Creek, is under way to assess problems with low dissolved oxygen. This TMDL is a joint project of the TSSWCB, the TNRCC, and the NETMWD. Monitoring stations will be used to collect data on baseline water quality, stream flow, and wet weather influences on water quality. Intensive surveys during August of 1998 and 1999 captured data on extreme low-flow conditions. Monitoring in 2001 is planned to assess sources of oxygen-demanding materials in the watershed. The data will be used for assessment of the relative contributions of point and nonpoint sources of constituents of concern, their transport characteristics, and effects on water quality. The TSSWCB has been working with local poultry producers to educate them about the problem and to implement WQMPs.

The NETMWD and the Sulphur River Authority have formed a Sulphur River Task Force to address common issues in the adjacent basins. One outgrowth of that alliance is increased coordination in monitoring water quality conditions, resulting in more data collection and a more effective use of available funding. The Caddo Lake Institute has also cooperated with the NETMWD to monitor water quality in the basin.

Sabine River Basin

Six water bodies have been identified in the Sabine River Basin with use impairments due in part to nonpoint sources. Parameters of concern include low dissolved oxygen, fecal coliform bacteria, lead, aluminum, and mercury in fish tissue. Atrazine is considered a threat to the public drinking water use in the Lake Tawakoni watershed.

The Sabine River Authority (SRA) completed three special studies in 1999 on Adams Bayou, Cow Bayou, and Cowleech Fork. Biological screening was also carried out in targeted subwatersheds of the basin to identify areas where

aquatic life have been affected by nonpoint sources. Efforts are also under way to address atrazine, bacteria, and mercury pollution in the basin.

Mercury pollution is a problem in some of the area lakes. The SRA is working in conjunction with the state of Louisiana to evaluate the source of mercury pollution in Toledo Bend Reservoir. Texas Utilities is performing an independent study to measure mercury in lignite and coal sources, as well as from stack emissions. The SRA has also been working with the TDH and TPWD to collect samples of water, sediment, and fish tissue in water bodies with mercury impacts. All of this information will be used to develop action plans to remediate mercury pollution in the watershed and to protect consumers in areas where mercury is accumulating in fish tissue.

An intensive study and BMP implementation project was recently completed in the Lake Fork watershed. Nutrient contributions from dairy operations in the area were analyzed, and water quality was compared in subwatersheds with and without dairy operations. The SWCDs in the area worked with producers to implement WQMPs in area dairies. Training programs for dairy operators were also established in the affected watersheds.

In the Cow Bayou watershed, the special study focused on fecal coliform concentrations and associated nutrient enrichment. Many homes in the watershed depend on on-site sewage systems for wastewater treatment. Because of soil types in the area and high annual rainfalls, many of these systems are inadequate to meet needs. Regulations have been developed to require more appropriate systems for new homes and to require upgrades to systems at older homes when they are sold to new owners. In addition, plans have been made to serve significant portions of the populated areas of concern with new and existing wastewater treatment plants. Constructed wetlands have been shown to function well in southeast Texas, and are proposed for regional treatment of wastewater system effluent.

Fecal coliform bacteria is also a problem in Adams Bayou. However, unlike the Cow Bayou watershed, most of the population in the Adams Bayou area is being served by wastewater treatment plants. Infiltration from leaking collection system pipes in the sewer system is a likely source of contamination. Sources will be further identified by a special study. The SRA, with participation from stakeholders, will then develop a plan to remedy the situation.

Toxicity in ambient water appeared to be a concern in the Cowleech Fork watershed. However, an intensive study indicated that the problem may not be as severe as first believed. A total of 162 ambient toxicity tests were performed, with only 10 percent causing death of the test organisms.

The SRA is participating with the Surface Water Action Committee on atrazine to encourage implementation of BMPs for pesticide use in the Lake Tawakoni watershed and other agricultural use areas. The TSSWCB sponsored a Water Quality Conference in Mount Pleasant in March of 1999, attracting agricultural producers from the East Texas region. Topics included regulations and BMPs for pesticide use, NPS pollution control through the TMDL program, and other state and federal programs for protecting and enhancing water quality.

Neches River Basin

In the Neches River Basin, two listed water bodies have NPS impacts, including zinc, salinity, fecal coliform bacteria, low dissolved oxygen, and mercury in fish tissue. The Angelina–Neches River Authority (ANRA) manages the upper end of the basin, and the Lower Neches Valley Authority (LNVA) is responsible for the lower end.

The ANRA conducted special studies in 1999 on subwatersheds of the Angelina River above Lake Sam Rayburn and the Neches River below Lake Palestine to assess trends in fecal coliform bacteria concentrations. Both water bodies sometimes have high concentrations of fecal coliform bacteria. An intensive study of biological communities was conducted in the East Fork of the Angelina River watershed. These studies will assist in addressing water quality concerns in the upper Neches basin.

The LNVA is conducting special studies in the Pine Island and Village Creek watersheds to identify sources of water quality problems related to fecal coliform bacteria, pH values, and low dissolved oxygen. Initial results in the Pine Island study indicate that the low dissolved oxygen concentrations may be the result of naturally low flows and high temperatures in the summer months. The aquatic community seems well adapted to the environment of a low-flow, sluggish stream. It may be appropriate to revise the dissolved oxygen criterion for the bayou.

In the Village Creek watershed, pH values may also be the result of natural conditions. The watershed is heavily forested and has acidic soils. Fecal coliform densities, however, appear to be correlated with high flows, indicating nonpoint sources of the bacteria. Further targeted monitoring is under way to identify the sources of bacteria contamination.

There is a strong Texas Watch Program in the Neches River Basin, with eight active monitoring groups. Educational activities in the basin include the Major Rivers program for elementary students, river cleanups, and Earth Day events.

Basin Group B

The Trinity River Authority (TRA) is the lead agency for the Clean Rivers Program in Group B, which includes only the Trinity River Basin. The Trinity River Basin has 23 water bodies on the 1999 303(d) list with NPS impacts. Parameters of concern include lead, low dissolved oxygen, fecal coliform bacteria, high pH values, legacy pollutants, fish consumption advisories, salts, and atrazine.

A large-scale TMDL project is under way to address legacy pollutants in urban lakes and river segments in the Dallas–Fort Worth area. Elevated levels of one or more chemical pollutants (PCBs, chlordane, heptachlor epoxide, dieldrin, DDT, and DDE) have been measured in fish tissue. Though use of virtually all of these chemicals has been either restricted or banned since the 1970s, studies by the USGS and recent household chemical collections in Fort Worth have provided limited but significant evidence of continued use of some of the pesticides. The TMDL project will compile existing data collected by several agencies, including the USGS, the TRA, the TDH, and the city of Fort Worth. These agencies will also participate in the targeted monitoring conducted during the project. The study will document historical trends, identify current sources, and develop mitigation strategies.

In the meantime, the city of Fort Worth has mounted an intensive program for the collection and proper disposal of household chemicals. The city is also conducting a study to evaluate urban BMPs for mitigation of legacy pollutants, in addition to a feasibility study of remediation strategies for impacted urban lakes.

Several cities in the urban areas of the upper basin are actively involved in controlling NPS pollution from urban stormwater runoff through the national stormwater permit program. Dallas, Fort Worth, Arlington, Garland, Irving, Mesquite, and Plano are participants, with assistance from the North Central Texas Council of Governments, the Texas Department of Transportation, and the USGS.

The SWCDs, the NRCS, and the Tarrant Regional Water District have been active in NPS control programs with agricultural producers in the watershed. The Surface Water Protection Committee is addressing some atrazine concerns in area lakes, as is the Source Water Protection Program. The Atrazine Lakes TMDL Project is addressing the problem in this and other watersheds.

The TRA supports the Major Rivers educational program for elementary school students. Texas Watch volunteer programs are also active in the basin. The North Central Texas Council of Governments, the TRA, and cities in the watershed sponsor household hazardous waste collections, river cleanups, and educational events.

Basin Group C

The Clean Rivers Program agencies for Basin Group C are:

- the Houston–Galveston Area Council (H–GAC) for the San Jacinto River Basin (Basin 10), and the Trinity–San Jacinto (9), and San Jacinto–Brazos (11) Coastal Basins; and
- the Lower Neches Valley Authority for the Neches–Trinity Coastal Basin (7).

In the four basins comprising Basin Group C, 29 streams or reservoirs have impairments due in part to nonpoint sources of pollution. Parameters of concern include low dissolved oxygen, toxicity in ambient water and sediment, dioxin, fecal coliform bacteria, toxic chemicals, metals, and total dissolved solids. Nine bays and estuaries in the basin group have advisories limiting fish consumption or oyster harvesting, due in part to nonpoint sources of pollution.

Failing septic systems were identified as a significant nonpoint source of water quality contamination in the region. In response to this, the H–GAC requested and was awarded 319(h) grant assistance to identify and replace failing septic systems in 26 target communities across 13 counties.

Conventional septic tank/drain field systems do not function properly in the region, due in part to unsuitable soils and a high groundwater table. Contamination from fecal coliform bacteria and nutrients affect water quality in surface water bodies near communities with failing septic systems.

H–GAC is working with the TAEX, the TNRCC, and county officials to implement three alternative technologies for use in replacing failing systems.These systems have been shown to provide treatment quality rivaling that of municipal wastewater treatment plants, often at a lower cost. The three alternative technologies have been proven to be effective in demonstration projects within the region.

TMDL projects are in the planning stages to address bacteria in the Buffalo Bayou and White Oak Bayou watersheds, and dioxin in the Houston Ship Channel and Upper Galveston Bay. A third project will address toxicity in the Patrick Bayou.

A TMDL project is in progress to assess low dissolved oxygen in Armand Bayou. Preliminary data suggest that low dissolved oxygen concentrations may be a natural seasonal occurrence in the Bayou and its tributaries. The system has very subdued tide fluctuations, seasonally high water temperatures, and organic loading from riparian forests, as well as from other sources. An intensive study of hot-weather dissolved oxygen dynamics was conducted in the summer of 1999, the results of which are still being evaluated. Additional TMDL-related studies of Dickinson Bayou, Armand Bayou, and the San Bernard River are being implemented by the H–GAC in cooperation with the USGS.

A TMDL for nickel in several segments of the Houston Ship Channel System is near completion. Measured concentrations of nickel in the system are currently meeting water quality standards.

The USGS is conducting two special studies in the Houston area. The first project is designed to assess the status of aquatic communities and habitats at several stations where collection of chemical parameters has historically been the emphasis. Data gathered from these stations will be analyzed in relation to monitoring at several reference sites. The objective of the study is to gain a greater understanding of the impacts of various land uses and changes in land uses on aquatic communities.

The second USGS study focuses on the Lake Houston watershed. Physical and chemical parameters will be quantified from both a developed and a rural tributary to the lake. Staff will develop estimates of constituent loads to the lake from these subwatersheds, quantify conditions in the impounded area of the reservoir, and assess the effects of urbanization on water quality in Lake Houston and its tributaries.

Basin Group D

In Basin Group D, the Clean Rivers Program lead agencies are:

- the Brazos River Authority for the Brazos River Basin (Basin 12);
- the Lower Colorado River Authority for the Colorado River Basin (14), in cooperation with the Upper Colorado River Authority and the Colorado River Municipal Water District;
- the Lavaca–Navidad River Authority for the Lavaca River Basin (16); and
- the Houston–Galveston Area Council for the Brazos–Colorado Coastal Basin (13).

In the four basins in Group D, the state has identified 50 impaired or threatened streams or reservoirs that are impacted by nonpoint sources: 23 in the Brazos, five in the Brazos–Colorado, 20 in the Colorado, and two in the Lavaca–Navidad. Parameters of concern include low dissolved oxygen, fecal coliform bacteria, toxicity in ambient sediment, atrazine, alachlor, arsenic, metals, salts, and nutrients. Two bays and estuaries in the basin group have advisories limiting oyster harvesting, due in part to nonpoint sources of pollution.

Brazos River Basin

In the upper end of the Brazos Basin, salinity is a concern. Agricultural sources of bacteria and nutrients are the focus in the middle portion of the basin, where dairies and other agricultural producers are predominant. Metals are of concern in the lower basin.

The Brazos River Authority (BRA) has established a Watershed Protection Program to focus efforts in watersheds where NPS pollution has been identified. Several special studies are under way in this program, and BMPs have been demonstrated and tested. Several practical, cost-effective practices have been identified for controlling agricultural runoff, while still sustaining the economic viability of agricultural producers in the area.

Intensive efforts have been under way in the Brazos Basin since the early 1990s to address water quality problems resulting from excess nutrients and bacteria from agricultural sources. Several projects supported by Section 319(h) grants and state and local funding have explored various approaches to controlling animal wastes. The TSSWCB, the BRA, the NRCS, the TDA, the TAES, and producers in the basin have been very active in implementing WQMPs at operations throughout the affected watersheds in the basin. They have also explored ways to collect and compost animal waste, with the ultimate goal of marketing the compost to users in other watersheds where excess nutrients are not a concern.

A TMDL project is in progress with a stakeholder group, whose members formed the first coalition to address NPS impacts in the watershed—the Bosque River Advisory Committee. The Texas Institute for Applied Environmental Research (TIAER) is the lead agency responsible for develop-

ment and implementation of the TMDL. The project will address subwatersheds of two segments of the North Bosque River. Constituents being addressed include chlorophyll *a* and nutrients.

Substantial progress has been made in the TMDL project. The Sources and Contributions Subcommittee has reviewed and recommended acceptance of the TIAER's analysis of sources. Watershed models have been developed and are being used by the TIAER and the Blackland Research Center to simulate the effects of imposing various best management practices. The models will simulate water quality for an approximate 35-year historical period, taking into account population growth and weather variables. Numerous BMP implementation scenarios are being analyzed to determine the most effective and practical measures available to achieve the goals of improved water quality and sustainable economic development.

Other special projects under way in NPS-impacted watersheds include the Salado Creek Nutrient and Bacteriological Survey, the Leon River Survey, the Lower Brazos River Metals Survey, and the Lake Waco Watershed Intensive Survey.

In urban areas, the Household Hazardous Waste Seed Money project has succeeded in supporting several cities in the watershed with establishment of local household waste collections. Source water protection activities are in progress to assure safe drinking water for residents of the basin.

Treated drinking water supplies drawn from Aquilla Lake have contained concentrations of atrazine and alachlor in excess of drinking water standards. Source water protection and agricultural projects in the Marlin City Lake System watershed have successfully reduced atrazine contamination in the lakes. As detailed in the "Statewide Activities" chapter of this report, the TSSWCB and local stakeholders, with the support of several other state and federal agencies, are actively working to reduce herbicide loadings to the Aquilla and Marlin City lakes.

Colorado River Basin

The Colorado River Basin has a diverse mix of land uses, including numerous urban areas, petroleum operations, ranch lands, crop lands, and other agricultural operations. Salts are a concern in the upper reaches of the basin. Urban development and agricultural operations dominate the middle and lower areas of the basin.

The Lower Colorado River Authority (LCRA), the Upper Colorado River Authority (UCRA), and the Colorado River Municipal Water District (CRMWD) all work together to coordinate water quality management activities in this large basin.

TMDLs

In the upper end of the basin, a TMDL project is in progress under the leadership of the CRMWD. This project will address concentrations of sulfate and total dissolved solids in the E.V. Spence Reservoir. The problem definition and source analysis phases of the project have been completed. Abandoned wells from petroleum operations were identified as a source of

salinity in the lake. The Railroad Commission of Texas, with support from a Section 319(h) grant, will plug 171 abandoned wells in the watershed to reduce NPS pollution in the watershed. In the meantime, the E.V. Spence TMDL Steering Committee and project contractors are modeling impacts to the reservoir and evaluating other BMPs that may be effective in improving water quality in the E.V. Spence Reservoir.

Special Studies

Several special studies are being conducted in the large Colorado basin.

Upper Basin

In the upper end of the basin, the CRMWD and the UCRA are studying high nitrate levels in the Concho River. Various monitoring and management activities have been under way for several years to address the problem. Of six sampling stations on the Concho River, two stand out as problem areas. Nitrates are also elevated in two contributing tributaries, but because of low discharge rates, they have minimal impact on the river. The excessive nitrate loading to the Concho River and its tributaries is probably due to spring discharge from the Lipan Aquifer.

A parallel study conducted in that area by the Lipan–Kickapoo Water Conservation District confirmed that nitrates are also high in the Lipan Aquifer. One source of the nitrates is thought to be agricultural operations, which have been prevalent in the area for the last 50-75 years. Elevated nitrate concentrations in the soil zone from these operations may have leached into the groundwater. Other possible sources are concentrated animal feeding operations in the area or the Miles Wastewater Treatment Plant.

Based on these findings, the UCRA and the Lipan–Kickapoo Water Conservation District are cooperating to collect additional hydrogeological data. The UCRA will examine the existing data for trends and anomalies. With the additional data and assessment, staff hope to get a better idea of the sources of the pollutants and the dynamics involved in the aquifer.

Middle Basin

The USGS is conducting a study in the Colorado Basin to examine certain contaminants in urban creeks in Austin in relation to storm events. Under study are nutrients and sediment-related contaminants, such as legacy pollutants and other chemicals (polyaromatic hydrocarbons, or PAHs). The study is also developing a model to reliably estimate annual loads of traditional water quality parameters at each of the monitoring sites in the study area.

The LCRA collected data in 1999 on methyl tertiary butyl ether, or MTBE, which has gained a great deal of attention as a potential water pollutant in recent years, due in large part to contamination of drinking water wells in California. Originally developed to aid in the combustion of gasoline and thus to reduce air pollution, MTBE is highly soluble in water, is difficult to biodegrade, and is a possible human carcinogen. Because MTBE contamination in surface water is a somewhat new phenomenon, there is relatively little data on the behavior of MTBE as a water pollutant. There is also an increased potential for MTBE to enter surface water in the exhaust from

two-stroke water craft because their engines are usually very inefficient at burning fuel.

The LCRA designed a study to represent a worst-case scenario of MTBE contamination in the Highland Lakes. Staff collected samples on the busy Labor Day holiday weekend, when recreational boating use is high. Each of the lakes was sampled in areas of high use, such as marinas and public boat ramps. Detectable concentrations were measured in 18 of the 22 sampling sites. High concentrations correlated positively with areas where boating activity was highest. Initial follow-up sampling approximately six weeks later showed declines in the MTBE concentrations by approximately one-third of those found during the holiday weekend. Thirteen of the 22 sites had no detectable concentrations at the time of the follow-up sampling.

Lower Basin

Elevated bacteria concentrations are a concern in the Tres Palacios River, located in south central Texas in Wharton and Matagorda counties. The LCRA and a group of concerned volunteers designed a study to investigate when, where, and for how long after a rainfall bacteria levels remain elevated in the river. Ten sites were monitored—seven on the river and one on each of its major tributaries. The study found a positive correlation between bacteria concentrations and discharges from tributary streams. When the discharge was less than 60 cubic feet per second, regardless of weather conditions, the Tres Palacios River was suitable for contact recreation. Bacteria concentrations increased after storms, and it typically took at least four days after storm flow reached its peak before bacteria concentrations returned to background levels. Based on a limited set of data, the city of El Campo appeared to be a source of fecal coliform in the upstream areas of the river. It also seems that channel morphology may contribute to elevated concentrations in the upper part of the river. The sampled tributaries displayed patterns similar to those found in the river.

Education and Implementation

Monitoring by volunteers is very active in the basin under the auspices of the Colorado River Watch Network (CRWN). Volunteers report water quality information for 68 sites in 15 counties. Affiliated with the statewide Texas Watch program, the CRWN won two statewide awards for excellence last year.

Several cities in the Colorado Basin have been active in watershed protection and restoration projects. The cities of Smithville and San Angelo recently completed master plans for nonpoint source pollution control, and the city of Marble Falls is developing a regional plan. The city of Austin is also very active in planning for environmental protection. These plans use a balanced approach of reasonable local ordinances, installation of BMPs, and public education and awareness campaigns. The San Angelo project on the North Concho River, supported with seed money from a Section 319(h) grant, will be highlighted in Chapter 3, "Grant Program Success Stories."

Mid-basin, around the Highland Lakes, the LCRA has enacted an ordinance to control NPS pollution from development. Each development is required to implement on-site controls during construction. Permanent NPS control structures are required in some instances. The ordinance is expected

to prevent 70% of the NPS pollution that would be associated with development in the area without implementation of BMPs.

The Creekside Conservation program works directly with landowners and state and federal agencies to reduce sedimentation and pollution. Land treatments are designed to improve vegetative cover to prevent erosion, improve land productivity, and enhance wildlife habitat.

In agricultural areas, the LCRA, UCRA, CRMWD, and the TAES cooperated in the Agricultural Soil Testing Program. This program promoted awareness among producers on improving crop production and preventing NPS pollution through proper nutrient management. Soil testing was conducted in seven counties in the basin. An educational program was carried out in conjunction with the testing.

The TSSWCB and the UCRA are cooperating with federal, state, and regional agencies to implement an ambitious brush control project in the North Concho watershed. The project is expected to have significant water quality benefits by reducing soil erosion and silt build-up in streams of the North Concho watershed.

The TSSWCB held a water quality workshop in the Rockdale area for agricultural producers. Topics included regulations and BMPs for pesticide use, NPS pollution management through the TMDL program, and other state and federal programs for protecting and enhancing water quality. The Nolan County SWCD conducted a Conservation Tour in the Oak Creek/Lake Trammell watershed. The tour highlighted successful BMPs for area ranches.

Lavaca River Basin and Brazos–Colorado Coastal Basin

Lake Texana is the principal reservoir in the Lavaca Basin. The Lavaca–Navidad River Authority has implemented a Water Quality Management Plan for Lake Texana Project Lands. The plan was approved by the TSSWCB. SWCDs in the watershed have been active with local agricultural producers in implementing BMPs at area farms.

A special study is being conducted by the TNRCC on the San Bernard River in the Brazos–Colorado Coastal Basin. The study is designed to assess water quality impairments in the water body and to contribute to the development of NPS pollution evaluation procedures in surface waters throughout Texas. Assessments were conducted at nine study sites in the watershed. Six of the sites were located in streams with intensive agricultural activities on greater than 75 percent of the watershed. The other three sites served as references, with less than 25 percent of the watershed area above these sites used for agricultural purposes. Several pollutants all tended to increase as the proportion of intensive agriculture in the watershed increased. Bacteria, nutrients, and dissolved solids increased, while dissolved oxygen concentrations decreased. Biological data have been collected and are still being analyzed.

Basin Group E

The Clean Rivers Program is coordinated in Group E basins by:

- the Guadalupe–Blanco River Authority for the Guadalupe River Basin (Basin 18) and the Lavaca–Guadalupe Coastal Basin (17);
- the San Antonio River Authority for the San Antonio River Basin (19);
- the Nueces River Authority for the Nueces River Basin (21), and the San Antonio–Nueces (20) and Nueces–Rio Grande (22) Coastal Basins;
- the Lower Colorado River Authority for the Colorado–Lavaca Coastal Basin (15); and
- the International Boundary and Water Commission for the Rio Grande Basin (23).

The state has identified 33 impaired streams or reservoirs with NPS impacts in Basin Group E. Parameters of concern include low dissolved oxygen, fecal coliform bacteria, salts, legacy pollutants, metals, and toxicity in ambient water and sediment. Eighteen bays and estuaries in the basin group have advisories limiting fish consumption or oyster harvesting, due in part to nonpoint sources of pollution.

San Antonio River Basin

Most of the San Antonio River basin is rural, particularly the southern half. The heavily urbanized central portion of the watershed includes the city of San Antonio. The San Antonio River Authority (SARA) has been active with basin stakeholders in preventing NPS pollution and restoring impaired waters.

The San Antonio Water System (SAWS) is working actively to protect water resources in the city of San Antonio. In 1999, the city won the EPA Region 6 Environmental Excellence Award for its Source Water Protection Program, which protects surface water and groundwater sources of drinking water for 2.2 million residents. The program includes a well-organized public education component with brochures and other information about wellhead protection and proper pesticide application techniques. The city's efforts are supplemented by the TNRCC's Edwards Aquifer Protection Program, which works to prevent groundwater contamination from construction activities over the Edwards Aquifer underlying portions of the San Antonio, Colorado, Brazos, Guadalupe, and Nueces Basins.

The USGS is conducting a study in the San Antonio River Basin to examine the volume and quality of stormwater runoff over the recharge zone of the Edwards Aquifer in Bexar County. The Edwards Aquifer is the sole source of water for millions of central Texas residents. The quality of stormwater runoff will be correlated with various land uses in the area.

A TMDL project under the direction of SARA is addressing low dissolved oxygen from NPS impacts in the Salado Creek watershed. SARA has completed several technical components of the project, including source iden-

tification and preliminary modeling. Preliminary reports on the development of the TMDL and the Watershed Action Plan have been submitted to the TNRCC for review.

SWCDs and the TAES have been active in rural portions of the watersheds, working with producers to install BMPs for surface water and wellhead protection.

Rio Grande Basin

The Rio Grande Basin is quite large, forming the border between Texas and Mexico. Urban development is most concentrated in the Lower Rio Grande Valley, with other major urban areas at Del Rio, Laredo, and El Paso. Big Bend National Park, which is located on a large bend in the river, occupies a major portion of the watershed in west Texas.

Cities in the watershed sponsor a variety of pollution prevention activities, including river cleanups, recycling, storm drain stenciling, and programs for area schools. The cities of Brownsville and Harlingen have been particularly active in outreach programs. Most of the cities in the watershed have local ordinances to prevent pollution from construction and industrial activities.

The NRCS and the SWCDs in the watershed work with ranchers to the west and farmers in the Valley to implement BMPs and water conservation practices. Big Bend National Park actively monitors for contamination from fecal coliform bacteria and implements control measures to reduce bacteria contamination by park users.

Salinity impacts are being studied in the Rio Grande watershed from above Amistad Reservoir upstream to El Paso, and into the upper reaches of the Rio Grande in New Mexico and Colorado.

Guadalupe River Basin

The TNRCC is heading up an Instream Flow Study in the Guadalupe River Basin to determine appropriate dam release levels to protect aquatic habitat and to minimize NPS impacts. The TPWD, the TWDB, and the Guadalupe–Blanco River Authority are cooperating in this interdisciplinary project. Data will be used to model conditions under various flow rates in order to determine the best way to protect the existing instream uses in the basin. These include general uses, aquatic habitat, and recreation.

City and county governments are active in the watershed—managing on-site sewage facility installation and compliance, implementing ordinances to require BMPs for construction activities, and working with local industries to implement pollution prevention practices.

Nueces River Basin

The Coastal Bend area constitutes a large portion of the Nueces River Basin and is a center for urban development and tourism. The Coastal Bend

Bays and Estuaries Program (CBBEP) has several studies and activities in progress to assess and prevent NPS pollution in the area.

The CBBEP is working with small cities in the region to develop stormwater management practices.The CBBEP is also heading up a regional project to identify failing septic systems and to implement local solutions.

The city of Corpus Christi acquired property along Oso Creek to protect created and natural wetlands in Falcon Park. Native vegetation will be planted in the currently barren areas to filter urban runoff from adjacent neighborhoods.The city also recently completed a successful NPS demonstration project on Oso Creek, implementing and testing an innovative structure that combines a sedimentation and detention system with a constructed bioswale at the outfall of the structure.This project, which received 319(h) grant support, will be featured in Chapter 3,"Grant Program Success Stories."

Nueces–Rio Grande Coastal Basin

A TMDL project is in progress for the two segments of the Arroyo Colorado in the Lower Rio Grande Valley.The main parameters of concern are legacy pollutants in the non-tidal segment of the Arroyo Colorado watershed and dissolved oxygen in the tidal segment.The load allocation phase of the project is expected to begin in late 2000.

Chemicals (toxaphene, DDE, and chlordane) have been detected in the tissue of fish captured in the non-tidal segment, and PCBs have been found in fish from the Donna Canal and Reservoir system.The TDH has collected additional fish tissue samples to update information on fish consumption advisories in the watershed. Several important data sets have been completed with assistance from the USGS, the TDA, and the TAES.

The USGS, in cooperation with the TNRCC, has performed specialized, high-volume suspended sediment sampling along the Donna Canal to isolate the area of the source of the PCB contamination.The source has been narrowed from a seven-mile reach to a 700-foot reach just north of the Arroyo siphon, where the canal makes a 90-degree bend.This investigation also revealed leaks and seepages around an area of the canal previously believed to be hydraulically unconnected to the Arroyo Colorado.

To support development of the TMDL, the TNRCC is cooperating with the USGS to develop a watershed model of the non-tidal segment, and with the TIAER on a water quality model of the tidal segment.These models will be used to allocate point and nonpoint source loadings and to simulate flow and conditions under various future scenarios.

In 1999, the TSSWCB began work on a project to implement BMPs for agricultural operations that produce row crops.Through the project, producers are educated about water quality problems in the Arroyo Colorado watershed, and receive financial and technical assistance to implement WQMPs.

Chapter 3

Grant Program Success Stories

Composting Dairy Waste

North Concho River Project

Oso Parkway Project

On-Farm Composting of Dairy Cattle Solid Waste

This successful 319 grant project, conducted by Texas A & M University and sponsored by the TSSWCB, demonstrated that a dairy operator can economically convert solid animal waste into a value-added product for wholesale and retail markets. The composted waste of a 400-cow freestall dairy, when marketed outside the source watershed, annually removes 8,000 pounds of nitrogen and 3,000 pounds each of phosphorus and potassium. This prevents degradation of water quality in watersheds with intensive dairy operations and provides good fertilizer for use in watersheds that need the nutrient-rich material.

Demonstrations have shown that this product can be substituted with equal results for imported Canadian sphagnum peat moss in many applications, such as soil-free plant growing media in greenhouses and as an organic fertilizer for landscapes. The product may be marketed in bulk or bagged for retail sales. Potential markets include landscapers, commercial nurseries, home and garden centers, greenhouses, golf courses, developers, municipal land resource agencies, and road and highway contractors.

Although composting can be achieved using a variety of different processes, the following advantages were identified for the in-vessel composting technique used for this project:

Compost was produced in this commercial composter from animal wastes generated at a 400-cow dairy. Building on the success of this project, the TNRCC and the TSSWCB are working to develop markets for composted animal waste that will move nutrient-rich material out of watersheds impacted by intensive agricultural land use.

- Animal waste is retained on the farm until composted, eliminating the need to transport raw materials on public roads to a centralized facility.
- Composting can be completed rapidly, and with product stabilization and sanitation, in three to four days during any season of the year.
- The raw-waste material is isolated from the environment until the process is complete.
- The site manager has precise control of moisture, temperature, and aeration during the composting process, no matter what the ambient weather conditions.
- The raw waste loses all offensive odors within 12 hours after the composting process is begun.
- The composted product is of superior quality and competitive with other high-end soil amendments.

This technology, if fully implemented, is capable of removing 9 million pounds of nitrogen and 3 million pounds of phosphorus from watersheds impacted by dairy operations, while adding $15 million in income for dairy producers. The beneficial uses of the composted waste were demonstrated to numerous potential consumer markets.

Public outreach to inform producers, consumers, and other agencies about the success of this method was a major element of the project. Project staff from Texas A&M University made 27 presentations to industry and producer groups, highlighting the composting technology and the product quality. Over 30 demonstrations of the composting technique were conducted on the demonstration dairy or by transporting portable in-vessel composters to other sites. Project members also produced and distributed three brochures detailing the composting process, commercial uses of the composted product, and the economic benefits of composting.

Other media efforts included creation of 26 Internet sites; three full-length articles published in industry journals; a video on the composting and use of dairy cattle solid waste, which was widely distributed; and a table-top educational display that was used to advertise the technology at several events.

So successful was this project that it won the Governor's Environmental Excellence Award for Agriculture and the EPA Region 6 Environmental Excellence Award for Recycling, both in 1998.

North Concho River Project

The north fork of the Concho River, a subwatershed within the Colorado River Basin, winds through the city of San Angelo. Water quality in this portion of the river has been problematic for several years. The downtown portion of the stream is extensively developed for public use. The citizens of San Angelo enthusiastically embraced a project with the Upper Colorado River Authority (UCRA) to remediate nonpoint source impacts to the river and to prevent further pollution.

The project consisted of three phases:

- a master plan to identify and prioritize a multitude of NPS projects within the watershed,
- a public awareness campaign to educate members of the community and gain their support for this and future projects, and
- construction of a structural control to mitigate NPS pollution in the Concho River.

While all the environmental benefits from this project cannot yet be measured, it has been an unqualified success. The master plan has been completed and approved by the city. The plan includes delineation of watershed and subwatershed boundaries, an inventory of land uses, watershed models, and pollutant loadings. It also identifies structural and nonstructural controls and provides generalized BMP designs for future implementation. Additional structural controls are already under construction.

The public awareness campaign was resoundingly successful, with unexpectedly high participation from local stakeholders. A citizen group called The Friends of the Concho River formed several subcommittees, including a Public Education Committee. UCRA staff undertook an intensive effort to train the Friends about nonpoint source pollution and water quality. Out of this partnership, a four-pronged public information effort developed.

- A political arm undertook education and awareness activities with all levels of city government, including the City Council. This political group also cooperated with the San Angelo River Corridor Commission and the San Angelo Parks Board. Presentations to these political entities were usually covered in the local print, radio, and television media.
- A public presentation protocol was developed, with volunteers taking the lead in establishing contacts with civic groups and other interested parties. A member of the Friends group would pair with a member of the UCRA staff in most of these presentations.
- The Education Committee developed several products to raise public awareness. These included a video entitled *A River Runs Through It* and a booklet entitled *She Spoke of Her River*. The committee and the UCRA made several presentations at schools in the city, utilizing a "storm sewer in a suitcase" display that

effectively demonstrates the concepts and results of urban runoff. The educational efforts of this project won an Environmental Excellence Award in 1997, and UCRA staff were invited to speak at regional environmental conferences about the success of the outreach effort.

- A project advisory committee provided public input at key phases in the project planning and implementation.

Prior to this project, the term nonpoint source pollution was virtually unknown among the general public in San Angelo. Because of the high visibility of the project and the efforts of local stakeholders, many residents and city officials have a much greater understanding of stormwater runoff and the resulting adverse impacts to water quality. City officials have also become aware that structures to control urban flooding can readily and cost-effectively incorporate pollution controls.

The gabion structure between the wet pond and the river, near completion.

From a list of five top-priority projects identified in the planning stages, the city chose a project at Civic League Park for the first structural control. This site was selected because of its extreme visibility and the potential to improve water quality in one of the most impacted areas of the stream.

Project engineers modified an existing wet pond and constructed a gabion filtering structure along the river bank between the existing wet pond and the river. A concrete drainage culvert was installed through the embankment between the wet pond and the structure to aid in diverting stormwater into the filtering gabion. Space limitations at the site made it impossible to build a large retention and settling basin into the structure. A small retention pond was built behind the gabion walls.

Another gabion structure was built to bisect the existing wet pond and divert a major portion of storm flows into the new retention and filtration structure, while maintaining normal water levels in the wet pond. Initially, the porosity of the gabion in the retention structure was high, limiting the amount of pollutants cleaned by filtration.

The amount of debris reaching the river has been substantially and visibly reduced since completion of the Civic League Park structure.

However, water levels and retention time have steadily risen with each storm event, and project engineers estimate that the structure will reach optimum performance in two to three years, as void spaces in the gabion walls are filled in.

An immediate and visible benefit of the structure is a marked reduction in debris entering the river during storm events. In mid-October of 1999, an examination of the retention structure revealed a layer of floatable trash and light wooden thatch over about eight inches of dark sludge, or about 4,000 cubic feet. Estimates indicate that about 20,000 cubic feet of materials have been prevented from entering the river from the combination of structures built at the park.

Oso Parkway Demonstration Project

The Oso Parkway Drainage Channel provides drainage for approximately 42 acres on the south side of Corpus Christi in the Nueces–Rio Grande Coastal Basin. Stormwater runoff from the drainage channel drains to Oso Creek and then to Oso Bay.The watershed is currently under development, moving from agricultural use to urban residential use. At the time the control structure was built, the watershed was 60 percent residential and 15 percent agricultural, with 25 percent under construction. When the conversion to residential use is complete, about 35 percent of the area will have impervious cover.

The Oso Parkway site was chosen for this demonstration project in order to reduce the amount of silt entering the creek from construction in the watershed. A treatment structure designed to divert silt-bearing low flows was constructed adjacent to an existing drainage ditch. Pollutants, such as heavy metals, pesticides, and oil and grease, adhere to the soil particles that settle and are trapped in the structure.

The structure is a reinforced concrete diversion channel that diverts low flows from the drainage channel and allows excess flows to continue downstream. Once in the diversion channel, the flow is directed through a steel trash rack and then on to a sediment trap. From there, water spills in a sheet from a concrete weir and into a long bioswale, or vegetated area, planted with cattails.Water then exits the bioswale into a natural wetland that borders Oso Creek.

The concrete diversion channel diverts low flows from the drainage channel. The trash collection chamber traps large debris.

The structure was first cleaned about eight months after it was completed. Work crews removed about 15 gallons of trash and about 1,338 cubic feet of sediment.The sediment removed from the treatment basins had higher levels of metals and other pollutants than did the soil sample taken from the main drainage channel, indicating that the structure is preventing these pollutants from entering Oso Creek.

Based on the efficiency of the structure and a projected decline in sediment loads after construction is complete, the structure is predicted to remove about 2,025 cubic feet of sediment per year, and 2 cubic feet of loose trash. Considering the annual cost of cleaning the structure, the cost to remove this pollutant load is $2.63 to $3.95 per cubic foot.

Water samples were taken monthly and after each significant rain event during the monitoring phase of the project. Sample analysis showed several significant results. Concentrations of oil and grease were 17 times higher in the bioswale than in the water entering the structure, indicating that the treatment unit is capturing a significant amount of those pollutants. Total suspended solids increased from inflow to the bioswale, which may be due to the fact that the vegetated area is shallowly submerged. Concentrations of total dissolved solids were reduced, probably from minerals being taken up by the vegetation in the bioswale.

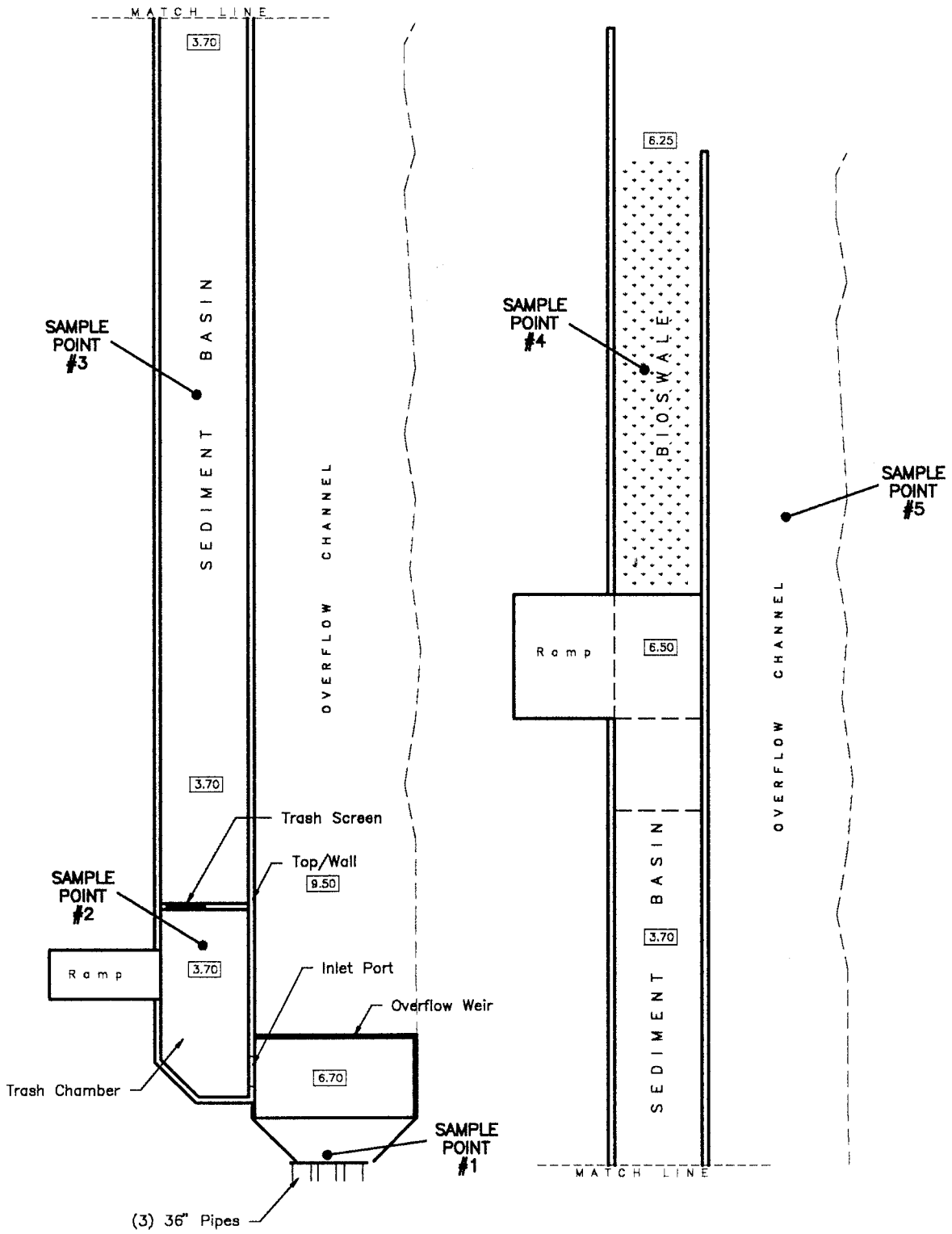


Diagram of the Oso Parkway stormwater treatment structure

The structure has good efficiency for its type, as compared with two similar treatment facilities in Austin. The cost to build and maintain the BMP, amortized over a 25-year life, is estimated at $44,400 per year. The structure is not as cost effective as some other structures, such as constructed wetlands or marsh systems, but it is a good application in developed areas where land for a larger treatment structure is scarce.

As construction on the BMP neared completion, a local Girl Scout troop spent a Saturday delivering information packets to 160 homes in the watershed. The packets included information about stormwater, pollution prevention, and the new water-quality improvement structure. The Girl Scouts also used stencils to paint storm drains in the watershed with a message reminding residents that anything that goes into the storm drain ends up in Oso Bay. The Scouts hoped that their efforts would make people more aware of the things they could do to keep pollutants out of the storm drains and the bay. As one Girl Scout said in the educational video that the city made about the project, "The more people that we can get to help with this, it can really change a lot of things."

Chapter 4

Program Administration and Financial Report

Program Administration

In September 1999, the TNRCC Nonpoint Source Program became the first state program in the nation to submit a 319(h) grant application electronically, ushering in a new era of electronic commerce between state and federal agencies. Texas is one of five pilot states in the EPA's innovative Partnership 2000 program to develop an electronic grant management system using Lotus Notes. The TNRCC Nonpoint Source Program staff received special recognition from the EPA for their efforts in pioneering the new system.

The EPA's mid-year review of the Texas program noted no significant issues of concern. In a significant new coordination step for the state program, the TNRCC is working with the Texas Water Development Fund to explore how State Revolving Loan Funds can be leveraged by local agencies to complement future NPS projects. This source of funding will be emphasized in presentations to solicit NPS projects for the coming year.

Other than the 1999 Performance Partnership Grant (PPG), no TNRCC grant awards were closed out in 1999. For those grants still active, a financial analysis was done for each project to determine whether leftover funds could be redirected to new projects. About $515,000 of unspent funds from the 1996 grant were augmented by smaller amounts left over from 1993 and 1994 to support new projects, including the Texas Watch volunteer monitoring program and construction of a BMP on the North Concho River. PPG funds are used to support internal NPS-related programs of the TNRCC. Traditional multi-year grants will be used to fund projects with local and regional agencies.

Several activities in 1999 improved grant administration. TNRCC quality assurance program staff developed a shell for Quality Assurance Project Plans associated with 319(h) projects. This shell should expedite the development and approval of these plans by contractors and the TNRCC. Fiscal monitoring staff continued oversight activities to ensure that NPS grant funds are being spent in accordance with federal requirements. With passage of the Prompt Payment Act by the 76th Texas Legislature, the TNRCC developed new procedures for ensuring that contractors are paid within 30 days of submitting properly completed payment vouchers. TNRCC staff attended two national EPA conferences on the Grant Reporting and Tracking System (GRTS) to learn about the enhancements and customized reporting features of the EPA's revamped database. The TNRCC plans to use GRTS to enhance future internal and external reports about the NPS grant program.

The TSSWCB conducted a financial analysis of the 1994 grant year and redirected unspent funds to new projects. One of those projects, "Texas State Boundary Areas: Watershed and Subwatershed Delineation," will update and delineate the boundaries of 11-digit watersheds and 14-digit subwatersheds for targeted river basins. The time frame for the 1994 grant was extended to allow for incorporation of the new projects. The 1997 and 1998 grants were also extended, due to concerns with some projects caused by continuing drought conditions in the state. The EPA's mid-year review of the TSSWCB noted no significant issues of concern.

Financial Report

TNRCC Grant Program Financial Report

Grant Fiscal Year	Grant Number	Total Grant	Cumulative Federal Expenses	Cumulative State Expenses	Grant Balance
1995	C9-96146-03	$3,614,167	$1,418,520	$914,559	$1,281,088
1996	C9-96146-04	$5,072,193	$1,996,787	$1,331,191	$1,744,215
1997	C9-96146-05	$1,757,166	$377,703	$251,802	$1,127,660
1998	BG-99627-97	$8,352,944	$3,945,266	$2,630,177	$1,777,501

TSSWCB Grant Program Financial Report

Grant Fiscal Year	Grant Number	Total Grant	Cumulative Federal Expenses	Cumulative State Expenses	Grant Balance
1994	C9-996236-01	$4,306,290	$2,353,734	$1,722,516	$230,040
1995	C9-996236-02	$4,122,201	$1,588,550	$1,260,138	$1,273,513
1996	C9-996236-03	$3,925,000	$1,476,187	$1,071,767	$1,377,046
1997	C9-996236-04	$3,925,000	$853,016	$665,311	$2,406,673
1998	C9-996236-05	$4,432,888	$493,501	$284,985	$3,654,402
1999	C9-996236-06	$7,879,500	$8,330	$16,727	$7,854,443

Appendix

Contacts and Acronyms

Contact Us

The views of those who live and work in Texas are important to the development of policies and programs. Comments about the state's nonpoint source management program are welcome. Call the TNRCC at 512-239-4416, the TSSWCB at 254-773-2250, or write to us at one of the addresses shown below.

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Acronyms Used in This Report

AFO - animal feeding operation
ANRA - Angelina–Neches River Authority
APEX - Agricultural Productivity Extender
BMP - best management practice
BRA - Brazos River Authority
CBBEP - Coastal Bend Bays Estuary Program
CRMWD - Colorado River Municipal Water District
CRWN - Colorado River Watch Network
CRP - Clean Rivers Program
DDE - dichlorodiphenyldichloroethylene
DDT - dichlorodiphenyltrichloroethane
EPA - Environmental Protection Agency
GBEP - Galveston Bay Estuary Program
GLO - General Land Office
GRTS - Grant Reporting and Tracking System
H-GAC - Houston–Galveston Area Council
LCRA - Lower Colorado River Authority
LNVA - Lower Neches Valley Authority
MTBE - methyl tertiary-butyl ether
NETMWD - Northeast Texas Municipal Water District
NRCS - United States Department of Agriculture–Natural Resource Conservation Service
NPS - nonpoint source
OSSF - on-site sewage facilities
PAHs - polyaromatic hydrocarbons
PCBs - polychlorinated biphenyls
PPG - Performance Partnership Grant
SARA - San Antonio River Authority
SAWS - San Antonio Water System
SBEA - Small Business and Environmental Assistance
SRA - Sabine River Authority
SWAT - Soil and Water Assessment Tool
SWCD - Soil and Water Conservation District
SWPC - Surface Water Protection Committee
TAES - Texas Agricultural Experiment Station
TAEX - Texas Agricultural Extension Service
TDA - Texas Department of Agriculture
TDH - Texas Department of Health
TDLR - Texas Department of Licensing and Regulation
TGWPC - Texas Groundwater Protection Committee
TIAER - Texas Institute for Applied Environmental Research
TMDL - total maximum daily load
TNRCC - Texas Natural Resource Conservation Commission
TPWD - Texas Parks and Wildlife Department
TRA - Trinity River Authority
TSSWCB - Texas State Soil and Water Conservation Board
TWDB - Texas Water Development Board
UCRA - Upper Colorado River Authority
USGS - United States Geologic Survey
VOCs - volatile organic compounds
WQMP - water quality management plan