I. INTRODUCTION AND SUMMARY

A. Effective Water Quality Protection Requires Good Scientific Data

The quality of our water—whether it is for drinking, fishing, recreation or other uses—is an extremely important issue to most Texans.[1] Our federal, state and local governments spend millions of dollars and thousands of man hours each year carrying out programs designed to protect and improve water quality. Providers of drinking water must run expensive water quality tests and install treatment systems to make sure that the tap water is safe to drink. Industrial operations must comply with various levels of mandatory regulations to reduce their discharge of pollutants to surface water and ground water. Federal and state governments have intensified efforts to reduce water pollution from agricultural operations and many farmers are now involved in voluntary programs to reduce contaminated run-off from crops and other agricultural operations.

In general, these programs have done much to alleviate the most obvious water pollution problems and to protect the quality of surface and ground water in the state of Texas. But, more remains to be done to guarantee that all Texans have clean water for drinking, fishing, recreation and other uses. The need for further action is evidenced by the 1996 amendments that strengthened the federal Safe Drinking Water Act; by new efforts at the state level to remedy water pollution in those streams, rivers, lakes and bays that are not meeting state water quality standards; and by a state-led effort to address and prevent contamination of ground water by agricultural chemicals.

Water quality protection programs, however, are generally only as effective as the data on which they are based. Without good data on which pollutants are reaching rivers, lakes or aquifers, water quality protection programs can miss their target and result in inefficient and, ultimately, unproductive expenditures. In the absence of good data it is difficult to: (1) know

[1] For example, the 1996 biennial Texas Environmental Survey conducted by professors at Rice University found that 75 % of those polled believed that water pollution was a serious issue in Texas. Thirty-four percent thought it was “very serious” and 41 % thought it was “somewhat serious”. Fifty-three percent of those polled thought water pollution was a serious issue in their own local community. Dept. of Sociology, Rice University, 1996 Texas Environmental Survey (February 1997; Houston, TX).

which pollutants to monitor for in testing the quality of surface water or ground water; (2) decide where to target more aggressive pollution reduction efforts; or (3) measure the effectiveness of pollution reduction efforts..

B. Water Quality and Pesticide Data in Texas

Over the past 30 years, the state and federal governments have developed fairly detailed data on the presence of "conventional" pollutants in surface water. "Conventional" pollutants include fecal coliform bacteria, organic materials that create biological oxygen demand (BOD)[2], nutrients such as nitrogen and phosphorus which increase algal growth, and suspended and dissolved solids. There is a wealth of data on the health of our water in relation to these conventional pollutants. There is also quite a bit of information on how and where these types of pollutants enter our waterways and aquifers, though more information on some types of sources -- such as storm water run-off, septic tanks, sewage spills and abandoned wells -- is necessary for a complete picture.[3]

Much less information is available on "toxic" water pollutants, however.[4] A program introduced in 1986 called the "Toxic Release Inventory" (TRI)[5] requires many types of manufacturing plants to report their releases of toxic pollutants into the water, air and land. This program has been an important step in getting better scientific information on toxic water pollution from industrial operations and has allowed state and local government agencies to better target monitoring and pollution control efforts for this sector. The TRI program, however, does not apply to non-manufacturing sources of toxic water pollution.

One potentially important source of non-industrial toxic water pollution is the use of pesticides—on farms, golf

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[2] Oxygen-demanding pollutants are most frequently associated with sewage. Discharges high in BOD can reduce the in-stream dissolved oxygen (DO) levels. Reduced DO levels can adversely affect aquatic life.

[3] See Texas Center for Policy Studies, Texas Environmental Almanac, Chapter 2, Water Quality (Austin, 1995). Also available on the internet at http://www.tec.org.

[4] Texas Clean Rivers Program/TNRCC, Texas Water Quality: A Summary of River Basin Assessments (Austin: 1994), p. 38.

[5] For the most recent Texas TRI trends, see www.trncc.state.tx.us/exec/media/press/06-98tri.html.

courses, parks, highway right-of-way and lawns and gardens. Pesticides can reach surface waters through storm water and other run-off from these types of sites and some may leach into the ground water.[6] In some areas, herbicides are being purposefully introduced into lakes and streams to kill hydrilla and other aquatic weeds.

Once they reach water, pesticides pose potential risks to human health and the environment. They can be carried through drinking water systems to the tap, if the drinking water provider does not have special treatment technology in place. They can fall out into the sediment of waterways and be taken up by fish or other aquatic life, posing potential problems for humans and animals that consume the fish.

The present report, which is based on a review of over 50 reports on Texas water quality, demonstrates that data on the presence of pesticides in ambient surface water systems or ground water is greatly lacking, though there is more information available on whether pesticides are being found in the drinking water provided to the tap. Table 1 provides a brief summary of the results of this review.

1. Pesticides in Surface and Ground Water

In summarizing the 1994 assessments of 15 river basins and 8 coastal basins, TNRCC concluded: "In general, the screening analysis of ten and a half years of data for toxic substances in water reveals that, in most cases, there were insufficient data to make any conclusion of concern, possible concern or no concern. This is especially true of toxic organic substances, i.e. pesticides."

As discussed in Sections II and III of this report, testing for the presence of pesticides in ambient surface water, fish and ground water has been extremely limited in Texas, as in most other states. For example, in 1996, only 2 TNRCC fixed surface water quality monitoring stations were tested for pesticides in water (compared with 27 stations tested in 1985). The Texas Department of Health has no designated funds for testing fish tissue for pesticides, and can generally only respond to fish kills or other situations where a problem has already been identified. The Texas Clean Rivers Program Basin Assessments, conducted by river authorities and other entities, almost uniformly state that very little data are available to evaluate water quality with respect to pesticides.

[6] U.S. Geological Survey, Pesticides in Surface Waters: U.S.G.S. Fact Sheet FS-039-97 (1997).

TABLE 1. SUMMARY OF REVIEW

DATA SOURCE	SUMMARY
SURFACE WATER / DRINKING WATER	
1996 State Water Quality Inventory and STORET Water Quality Data Base (1984 – 1997)	10 years of limited data on about 38 pesticides in water, sediment and fish tissue. Most frequently detected pesticides include banned products such as chlordane, dieldrin, silvex and DDT and its breakdown products and currently used pesticides such as diazinon and 2,4-D. There were no results above the detection limit for 22 of the 32 pesticides tested in water samples. There are no data for many of the most widely used pesticides. TNRCC has identified twelve water body segments "of concern" due to pesticides in sediments and three "of concern" for pesticides in fish (mostly chlordane, DDT and breakdown products).
TNRCC, March 1998 § 303 (d) list of Waters Failing to meet Aquatic life use (1990 – 1994 data)	Three river segments not meeting aquatic life use due to elevated diazinon levels.
Texas Department of Health, Fish Advisories and Bans, 1997.	Eleven river segments / lakes have fish consumption advisories or bans due to high pesticide levels in fish tissue (primarily banned pesticides such as chlordane, toxaphene and DDT breakdown products).
Texas Department of Health, Fish Tissue Sampling Data (1970 – 1997).	Limited and sporadic fish tissue sampling data shows several pesticides detected in fish tissue above detection limits in water bodies across the state – primarily, but not exclusively, highly persistent banned pesticides (chlordane, DDT & breakdown products, toxaphene, dieldrin, endrin).
Public Drinking Water Sampling Database, TNRCC (1/93 – 3/98); includes quarterly sampling data for approximately 5000 systems.	Nine Public Water Systems (PWS) exceeded atrazine maximum contaminant level (MCL) standards for drinking water at least once since monitoring began in 1993. One of these systems was in violation of standard (average of quarterly samples above MCL). In 1997, sixty four systems had 107 detections of atrazine in finished water. Pesticides were detected in over 90 PWS systems, including simazine, alachlor, metolachlor, and others. (Appendix B)
TNRCC, March 1998, § 303 (d) threatened list of waters.	Nine lakes / reservoirs listed because atrazine found in drinking water from these water bodies.

Table 1. SUMMARY OF REVIEW, CONT.

1992, 1994 and 1996 Clean Rivers Programs Assessments for Texas (15 River Basins and 8 Bays).	Virtually all of the assessments note a lack of sufficient pesticide water quality data, even though land use patterns in some basins indicated potential concerns. Clean Rivers Program targeted monitoring does not generally include pesticides, due to limited resources. Basin assessments identifying potential pesticide concerns included: Upper Neches River (1994); Brazos River from Lake Whitney to Possum Kingdom (endosulfan – 1994); Canadian River basin playa lakes (triazine herbicides, aldicarb – 1993); Lower Neches (Taylor Bayou – mosquito control program, 1992); Nueces / Rio Grande Coastal Basins (1987 study by NOAA indicating Nueces coastal basins at "high risk" for contamination); Rio Grande (Arroyo Colorado, mainstem of Rio Grande); Sabine River (1994-malathion in one segment); San Antonio River(Medina River below Medina Lake – aldrin, 1994); Trinity (chlordane, endrin, 2,45 TP (silvex), 2,4D-1994).
U.S. Geological Survey National Water Quality Assessment Program (NADWA)(1993 – 1995).	Trinity River studies found urban and agricultural use pesticides (atrazine, metolachlor, prometon, simazine, diazinon); Trinity River coastal prairie area studies found atrazine, metolachlor, molinate and 26 other pesticides; peak concentrations coinciding with peak use periods.
U.S. Geological Survey Special Studies	Rio Grande sediments (1997) – DDT, DDE, and chlordane found frequently in historical data (1970s – 1994); Comal Springs (diazinon, 1993 – 1994); Lake Texana (picloram, 2,4-D and methyl parathion most frequently detected of the sixteen pesticides analyzed for during 1992 – 1997 period.)
Corpus Christi Bay N.E.P.	Lack of water quality data for pesticides; some sediment data available.
Galveston Bay N.E.P.	Lack of sufficient data for analysis; urban land uses <u>estimated</u> to contribute 50% of annual pesticide loadings to the Bay; agriculture (mainly rice farming) thought to be relatively smaller contributor.
Texas Parks & Wildlife Spills and Kills – analysis of fish & wildlife investigation reports from 1960 - present	Estimated 11% of fish and wildlife kills over last 15 years due to pesticides, resulting in over 2.5 million fish killed.
GROUNDWATER	
Texas Groundwater Protection Committee, 1996 Annual Report	Thirteen confirmed cases of groundwater contamination due to pesticides.
Texas Department of Agriculture, Howard & Martin Counties Study, 1988	Arsenic contamination of water wells in the Ogallala aquifer, related to arsenic-based pesticide use on cotton and poor management of cotton gin waste.
Texas Department of Agriculture – West Texas and South Texas Counties Study, 1988 - 1990	Pesticides confirmed in ground water included arsenic, atrazine, dicamba, prometon, bromacil, picloram, metolachlor, 2,4,5-T and 2,4-D.

Number of fixed TNRCC surface water quality monitoring stations where water tested for pesticides in 1996: 2.

Number of fixed state surface water quality monitoring stations where water tested for pesticides in 1985: 27.

Ground water has been tested for pesticides in only a few areas of the state, mostly in the late 1980s.

One reason for the lack of pesticide water quality data is that laboratory analyses for pesticides are very expensive. Determining the level of just one particular pesticide in just one water sample can easily cost $ 100 or more, and a screening of one sample for the full range of pesticides for which water quality criteria have been established could cost up to $2000. Fish tissue sampling is similarly expensive. A scatter-shot approach—i.e., analyzing for many types of pesticides—is prohibitively expensive in most cases. Most entities that are conducting water quality testing are looking at the general health of the water body, and are thus not prepared financially or technically to test and analyze for particular pesticides that could be of concern in that area. Most ambient water quality testing for pesticides is generally done without information on whether those pesticides are used within the watershed or near the water well being tested or when the pesticides are being used.

A few special studies—particularly those conducted by the U.S. Geological Survey—were designed considering available data on what pesticides were likely to be used nearby and were carried out during the time of year when pesticide use was likely to be at its peak level. Many of these studies did find the targeted pesticides present in the water and sediment, sometimes in excess of levels considered safe by the regulatory agencies.[7] These types of targeted studies, however, are the exception, not the rule, in Texas.

The lack of data for pesticides in the ambient waters of the state make it extremely difficult to assess the extent to which pesticides may be affecting aquatic life, other in-stream uses of surface water or sources of ground water that are not currently being used as public drinking water supply sources.

[7] See Section II of the report for discussion of the USGS and other special studies.

2. Pesticides in Drinking Water

Pesticides most frequently detected in Texas drinking water systems: atrazine, metolachlor, simazine, alachlor. Of these, atrazine is by far the most frequently detected. Only one system, however, has been found to be in violation of the federal drinking water standard for atrazine since 1993, and that system is now back in compliance.

Some drinking water systems, primarily those using ground water, have waivers from pesticide testing requirements. These waivers are granted only after a "vulnerability assessment" by TNRCC staff determines that the water source is not nor is it likely to become contaminated. TNRCC has one of the most comprehensive vulnerability assessment programs in the U.S.

We know more about the quality of our drinking water in relation to pesticides. Through implementation of federal and state drinking water protection requirements, many water supply systems have been testing finished drinking water (i.e. water that is provided to the tap) for 33 pesticides for which monitoring is required. As discussed in more detail in this report, only a limited number of those systems conducting quarterly[8] monitoring have detected pesticides in the drinking water being provided to customers (at least 90 of over 5500 systems). The fact that a pesticide is detected in the tap water, however, is not the only consideration. Many of the pesticide detections have been at levels below the "maximum contaminant level" (MCL). In fact, to date only one system has been found to have violated the federal drinking water standard (for atrazine). A violation of the standard occurs when the average of four quarterly samples in exceeds the MCL.

Atrazine—one of the herbicides most widely-used in Texas—is the most frequently detected pesticide in drinking water. TNRCC data indicate that between 1996 and the first quarter of 1998, in 1,350 tests of public drinking water, atrazine was detected in 318 of the tests (about 25%). In the last few years, atrazine has been detected in over 60 public water supply systems, serving at least 4 million people. In about 10% of the samples, atrazine exceeded the federal drinking water standard of 3 parts per billion.

As described in Appendix A, several systems in Texas have been granted "waivers" from the quarterly monitoring requirements for pesticides or other contaminants. Most waivers are granted for ground water systems, as ground water systems are often less vulnerable to contamination than surface water systems. These waivers are given after an analysis by TNRCC staff of factors that affect the system's vulnerability to contamination—including well design and construction (for systems using ground water), geology and soils, land use in the "zone of contribution" and prior drinking water monitoring results.

[8] I.e. monitoring once per quarter.

The TNRCC has also issued "statewide" monitoring waivers for four pesticides—endothall, diquat, glyphosate and dibromochloropropane (DBCP).

C. Ramifications of the Lack of Water Quality Information for Pesticides

The lack of water quality data for pesticides, combined with the general lack of location- and time-specific data on pesticide use poses barriers to effective implementation of new water quality protection efforts. As discussed in Section IV of this report, effective implementation of these new programs will require more extensive and accurate data on pesticide use and the potential for that use to adversely affect water quality.

Assessments for Public Drinking Water Supply Sources

First, the new source water assessments to be conducted under the 1996 amendments to the federal Safe Drinking Water Act will be an important tool for protecting drinking water quality and possibly relieving some public water supply systems of high monitoring costs. ***Nevertheless, without better, site-specific information on agricultural and non-agricultural pesticide use, the source water assessments cannot effectively address potential pesticide contamination of drinking water sources.*** This data gap could have implications for both the adequacy of the state's overall source water assessment program and for whether the assessments can be used to reduce water quality testing burdens on public water supply systems, as contemplated by the federal Safe Drinking Water Act amendments.

Total Maximum Daily Loads

Second, Texas is gearing up a significant effort to implement the requirements of Section 303(d) of the federal Clean Water Act, which requires analysis and allocation of pollutant loading in water bodies that are not meeting water quality standards. ***Without better data on pesticide use, however, these efforts will be hampered for those segments where pesticides are threatening designated water uses.***

Groundwater Management Plans for Pesticides

Finally, the state's ***efforts to develop adequate plans for protecting ground water from agricultural chemicals, particularly regarding the widely-used pesticides (atrazine, simazine, cyanazine, propazine metolachlor and alachlor) are going to depend on gathering and***

making available better pesticide use data. Ultimately, if the state plan is not adequate, the U.S. Environmental Protection Agency could move to ban the use of the pesticides, which could have significant economic consequences for Texas farmers.

D. Solution: Pesticide Use Reporting

Because it is too expensive to test for all pesticides in each water body, state regulators, local governments and drinking water suppliers must carefully target the limited resources available for testing and analysis efforts. Pesticide use data is the key to being able to target and track the effectiveness of water quality monitoring, source water protection and water pollution reduction programs.

Pesticide use data will: (1) allow better targeting of the very limited resources available for testing for pesticides in surface water, fish and ground water; (2) allow for more scientifically-sound source water assessments to protect drinking water and to evaluate monitoring waiver decisions; and (3) provide scientifically-sound data for the state's groundwater management plans for pesticides. Pesticide use data would also help water protection authorities more quickly identify and remedy any uses that are posing potential risks to surface water or ground water.

A pesticide use reporting system for both agricultural and non-agricultural uses of pesticides would provide agencies and the public with information on when, where, what types and in what quantities pesticides are used in Texas. This information, in turn, could be used by TNRCC and other agencies, public water supply systems and others to greatly enhance the implementation and effectiveness of those water quality protection programs. The availability of pesticide use reporting data would have the following specific benefits for water quality protection in Texas[9].

- Provide site-specific information on pesticide use for drinking water source assessments and

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[9] PUR also has many other benefits. See TCPS, Realm of the Unknown: Pesticide Use in Texas (TCPS: Austin, 1998).

related monitoring waivers under the federal Safe Drinking Water Act;

- Provide site-specific information needed for allocation of pollutants loadings in water bodies not meeting water quality standards, thus allowing the state to successfully implement Section 303(d) of the federal Clean Water Act;

- Provide site-specific data necessary for preparation of adequate state management plans to protect groundwater from contamination by widely used herbicides, thereby reducing the possibility of stringent use restrictions or bans on these herbicides; and

- Provide state and local governments, river authorities and others with site-specific data necessary to appropriately target limited resources for monitoring for pesticides in ground water and surface water, thus avoiding waste of money and manpower.

Whatever the specific design elements, Texas should move quickly to establish an efficient pesticide use reporting system. Not only will such a system greatly enhance water quality protection programs, it will avoid wasted resources by providing sound scientific data upon which to base decisions and target limited resources.

As discussed in Section V, several other states have pesticide use reporting systems, some of which have been in place for several years. These systems are a viable mechanism for collecting important pesticide use information, and the experience in these other states can be used to help Texas design an efficient, useful and workable program. Texas can also draw on its decade-long experience with the industrial toxics release inventory (TRI), which was put in place by the 1986 amendments to the federal Superfund law.

The TRI program basically requires manufacturing industries using greater than certain threshold amounts of any of 650 toxics to report on their discharge of these compounds to the air, water, and land. The TRI data, which is also available to the public, has greatly enhanced state environmental programs and pollution prevention efforts.

A pesticide use reporting system for Texas should take advantage of advances in electronic reporting and, to the extent practicable, be consistent with existing record-keeping requirements and practices.

Reporting of some types of non-agricultural uses of pesticides--such as individual homeowner use--may not be feasible. Nevertheless, because several of the pesticide water quality problems being detected relate to urban use of pesticides such as diazinon, it is critical to have some level of information on urban use. One alternative for providing at least some useful data on homeowner use is reporting of retail pesticide sales by zip code or other geographical basis. Reporting for other urban uses – such as pesticide use on golf courses, parks and soccer fields, rights-of-way, etc. is more feasible than individual homeowner use, and should be included in the use reporting system.

KEY DATA ELEMENTS OF A PESTICIDE USE REPORTING SYSTEM

- Location and date of pesticide application;
- Amount of active ingredient applied and target pest;
- Application method;
- Applicator license/certification identification;
- Sales reporting to capture urban use patterns.

II. PESTICIDES IN SURFACE WATER

This chapter presents an evaluation of all readily available reports on the presence of pesticides in Texas surface water and fish tissue. Parts II.A-E focus on overall state efforts, while Part II.F examines the results of studies for particular river basins and of various federal agency studies.

A. Introduction

The State of Texas monitors water for contaminants, including pesticides, in the course of implementing two different federal laws: the Clean Water Act and the Safe Drinking Water Act. The Texas Natural Resource Conservation Commission has primary responsibility for protecting water quality in Texas, pursuant to state law and the federal Clean Water Act. In order to implement these responsibilities, TNRCC has designated specific uses--such as drinking water, fish consumption, contact recreation (swimming) and aquatic life use--for major water bodies and has established water quality criteria designed to protect those uses. In order to determine whether specific water bodies meet their designated uses, the state monitors for a variety of pollutants, including pesticides, in the water, sediment and fish tissue.

One of the uses designated by TNRCC under the Water Quality Standards is fish or shellfish consumption. Although TNRCC conducts some monitoring of contaminants in fish tissue, the Texas Department of Health determines whether the fish in a river, stream, bay or the Gulf of Mexico is safe to eat, using both TNRCC data and its own monitoring.

Under the federal Safe Water Drinking Act--last amended in 1996--and applicable state drinking water regulations, TNRCC is also charged with assuring that public water systems provide safe water to their customers. The TNRCC has adopted drinking water standards for a number of chemicals, including pesticides. Drinking water systems which serve more than 25 persons or have more than 15 connections must monitor the quality of their water for these compounds. Many Texas systems using ground water have obtained waivers from the monitoring requirements for some or all pesticides. The TNRCC bases these waivers on an assessment of whether the source water for the system is "vulnerable" to contamination. Criteria used in the waiver decision include location of the water source, well construction, geology and soils, history of land use and potential sources of pollution. Texas has also issued statewide monitoring waivers for four pesticides—endothall, diquat, glyphosate and dibromochloropropane (DBCP), based on either limited use and/or low potential to persist in drinking water. (See Appendix A for further discussion of the waiver issue).

These water quality and drinking water programs, however, do not necessarily monitor for the same pesticides. For example, only 13 of the 33 pesticides which TNRCC requires public water supply systems to monitor are also monitored by TNRCC in the ambient water of lakes, rivers, streams and bays. Similarly, TDH monitors for pesticides likely to show up in fish, but not necessarily for pesticides likely to show up in drinking water (see Table 2). Moreover, as discussed in Section II(B), TNRCC's surface water monitoring is quite limited in geographic scope, and monitoring of pesticides in surface water has decreased dramatically over the last few years.

In a practical sense, this means that it is often difficult to assess the full effect of pesticides on water quality because the data is fragmented and inconsistent. This especially presents a problem when trying to determine the possible sources of any pesticide contamination that is found in drinking water, since TNRCC is often not monitoring for those same pesticides in the surface water source.

Section II.B discusses the state's overall surface water quality monitoring for pesticides; fish tissue sampling is discussed in Section II.C; and drinking water monitoring is discussed in Section II.D.

Table 2. Pesticides Monitored by the TNRCC Water Quality Monitoring Program, Drinking Water Utilities and Texas Department of Health Fish Tissue Program

TNRCC Surface Water Quality Program	Drinking Water Quality Program	TDH Fish and Shellfish Testing Program
2,4 –D	2,4 – D	
	1,2 - Dichloropropane*	1,2 –Dichloropropane*
2,4,5-T		
2,4,5 -TP (Silvex)	2,4,5-TP (Silvex)	
	Alachlor	Alachlor
	Aldicarb**	
Aldrin	Aldrin**	Aldrin
	Atrazine	
	Butachlor**	
alpha-Hexachlorocyclohexane		alpha-Hexachlorocyclohexane
beta-Hexachlorocyclohexane		beta-Hexachlorocyclohexane
delta-Hexachlorocylohexane		delta-Hexachlorocylohexane
gamma-Hexachlorocylohexane (Lindane)	Gamma-Hexachlorocylohexane (Lindane)	gamma-Hexachlorocylohexane (Lindane)
	Carbofuran	
Carbaryl (Sevin)	Carbaryl (Sevin)**	
Chlordane	Chlordane	Chlordane
Chlorpyrifos (Dursban)		Chlorpyrifos (Dursban)
DDD, total		DDD
DDE, total		DDE
DDT, total		DDT
Demeton		
		Dacthal
	Dalapon	
Diazinon		Diazinon
	Dibromochloropropane* (DBCP)	
	Dicamba	
Dicofol (Kelthane)		
Dieldrin	Dieldrin**	Dieldrin
	Dinoseb	
	Diquat	
Diuron (Karmex)		
Endothall	Endothall	
Endosulfan I and II		Endosulfan I and II
Endosulfan Sulfate		Endosulfan Sulfate
	Ethylene dibromide (EDB)*	
Endrin	Endrin	Endrin
		Endrin Aldehyde
	Glyphosate	
Guthion		
Heptachlor	Heptachlor	

TNRCC Surface Water Quality Program	**Drinking Water Quality Program**	**TDH Fish and Shellfish Testing Program**
Heptachlor epoxide	Heptachlor epoxide	
Malathion		Malathion
Methoxychlor	Methoxychlor	Methoxychlor
	Methomyl**	
	Metribuzin**	
Mirex		Mirex
	Metolachlor**	
Parathion		Parathion
	Oxamyl (Vydate)	
	Picloram	
	Propachlor**	
Pentachlorobenzene		
	Simazine	
Toxaphene	Toxaphene	Toxaphene
Total = 32	**Total = 33**	**Total = 25**

Notes: *Volatile or semi-volatile organics that have been used as pesticides.
**Unregulated (no Maximum Contaminant Levels), but monitored under Safe Drinking Water Act.
Source: For column one, Texas Natural Resource Conservation Commission, The State of Texas Water Quality Inventory -- 1996, Volume 1 (Austin: TNRCC, 1996), 210; for column two, EPA website (http://www.epa.gov/OGDW); for column three, Seafood Safety Division, Texas Department of Health, Fish Tissue Sampling Data, 1970 - 1997 (Austin: TDH, 1998).

B. Surface Water Quality Monitoring

1. Scope of Monitoring for Pesticides. This section describes the statewide monitoring conducted by the Texas Natural Resource Conservation Commission for pesticides in surface water (including sediment and fish tissue). The first part of the section looks at the monitoring itself, while the second examines the overall results of monitoring for pesticides. Finally, a third section discusses which streams, reservoirs and bays have been found to have pesticide-related problems.

As part of its Surface Water Quality Monitoring Program (SWQMP), TNRCC 's Water Planning and Assessment Division and regional offices operate about 450 fixed SWQMP sites.[10] In addition, TNRCC conducts intensive surveys on specific water bodies to evaluate water quality under low-flow conditions, as well as special studies to improve understanding of specific constituents in water bodies. Results of all of the special studies, intensive surveys, and fixed monitoring stations' data are stored in the TNRCC SWQMP database.[11]

The number of TNRCC fixed monitoring stations has been reduced from nearly 700 in 1994 to 446 in 1996, although the number of overall sampling events--around 1700--has reportedly remained constant.[12] While field measurements like dissolved oxygen, water chemistry and fecal coliform densities were taken at all 446 sites in 1996, only 2 stations were monitored for pesticides in water. (Table 3a and Map 1a). As shown in Table 3a, there has been a steep decline in the number of fixed monitoring stations where water is tested for pesticides. For comparison purposes, Map 1b shows the number of sites sampled for pesticides in 1985. With such limited monitoring of pesticides, it is difficult if not impossible to assess

[10]Texas Natural Resource Conservation Commission, The State of Texas Water Quality Inventory -- 1996, Volume 1 (Austin: TNRCC, 1996), 27.
[11]Ibid, 38-39.
[12]Ibid.

whether Texas water bodies are experiencing contamination problems. This is reflected in the review of the Clean Rivers Program watershed assessments, discussed in Section II((F)(2) of this report. Virtually all of the assessments concluded that pesticide water quality data for their respective basins were insufficient.

It should also be emphasized that monitoring for pesticides at the fixed stations in the TNRCC network is not keyed to when and what types of pesticides are being used in the upstream watershed, nor is it keyed to rainfall related events that might increase pesticide run-off from agricultural or urban areas. By contrast, the special targeted studies performed by the U.S. Geological Survey (described in Section II(F)(6)) in the Trinity River, which were more closely tied to at least general information about pesticide use in the basin, resulted in substantially more pesticide detections than generally found at most of the TNRCC fixed sampling stations.

One further caveat about the TNRCC statewide monitoring network: in general, the TNRCC fixed monitoring stations are located only on “classified” water bodies, those for which particular uses have been designated (usually major perennial streams and rivers, reservoirs and bays). Classified stream segments cover only 14,350 miles of the total 191,228 total stream miles in Texas (7.5%).[13] There is very little year-to-year monitoring of water quality in the unclassified streams.

Table 3a. Pesticide Sampling (Water Column) at Fixed TNRCC Monitoring Stations (1983-first quarter 1997)

Year	**# Stations Sampled**	**# of Sampling Events***
1983	16	20
1984	15	24
1985	27	47
1986	23	57
1987	12	21
1988	18	23
1989	23	30
1990	16	23
1991	15	17
1992	2	3
1993	8	19
1994	2	2
1995	5	6
1996	2	2
1997 (1st quarter)	1	1

* Sampling event may include analysis for up to 40 different pesticides.
Source: TNRCC Storet database, from information request to TNRCC.

Monitoring of toxic pollutant levels in ambient water is necessary to determine whether or not streams, bays and reservoirs are meeting their designated aquatic life use. However, TNRCC has only developed acute and chronic water quality criteria to protect aquatic life for 12 metals and 23 organics, including 18 pesticides. Human health numeric criteria have been developed for 61 organics and metals to ensure that public consumption of water and fish is safe. These criteria include 22 pesticides.[14] (See Table 3b). TNRCC has also developed some internal aquatic life criteria, as well as screening levels not yet adopted as part of the Texas Water Quality Standards, to assist its evaluation of monitoring results. In essence, however, TNRCC monitors mainly for those pesticides for which it has established numerical water quality criteria.

[13] Ibid., 23. The classified stream miles account for about 36% of the total perennial stream miles in the state.
[14]Ibid, 209.

Table 3b. Comparison of Texas Surface Water Quality Program Monitoring and Criteria for Pesticides with Drinking Water Quality Standards

Pesticides in TNRCC surface water quality monitoring program	Drinking Water Monitoring Required?	Aquatic Life Water Quality Criteria?	Human Health Water Quality Criteria?
2,4-D	Yes	No	Yes
2,4,5-T	No	No	No
2,4,5-TP (Silvex)	Yes	No	Yes
Aldrin	Yes	Yes	Yes
Alpha-hexachlorocyclohexane	No	No	Yes
Beta-hexachlorocyclohexane	No	No	Yes
Gamma-hexachlorocyclohexane (Lindane)	Yes	Yes	Yes
Carbaryl (Sevin)	Yes	Yes	No
Chlordane, total	Yes	Yes	Yes
Chlorpyrifos (Dursban)	No	Yes	No
DDD, total	No	No	Yes
DDE, total	No	No	Yes
DDT,total	No	Yes	Yes
Danitol	No	No	Yes
Demeton	No	Yes	No
Diazinon	No	No	No
Dicofol (Kelthane)	No	No	Yes
Dieldrin	Yes	Yes	Yes
Diuron (Karmex)	No	No	No
Endosulfan I and II	No	Yes	No
Endosulfan sulfate	No	No	No
Endrin	Yes	Yes	Yes
Guthion	No	Yes	No
Heptachlor	Yes	Yes	Yes
Heptachlor epoxide	Yes	No	Yes
Hexachlorobenzene	No	No	Yes
Malathion	No	Yes	No
Methoxychlor	Yes	Yes	Yes
Mirex	No	Yes	Yes
Parathion	No	Yes	No
Pentachlorobenzene	No	No	Yes
Toxaphene	Yes	Yes	Yes
Total 32		17	21

Sources: for column 2, Texas Natural Resource Conservation Commission, The State of Texas Water Quality Inventory—1996, Volume 1 (Austin: TNRCC, 1996); for columns 3 and 4: Texas Surface Water Quality Standards, 30 Tex. Admin. Code Sec. 307.6, Table I.

TNRCC has also developed screening levels for organics and metals in sediments and fish tissue. These criteria are not enforceable standards, however, but rather are used internally by TNRCC to assist in its evaluation of monitoring results. No aquatic life numeric criteria have been developed for toxics in sediment. Instead, TNRCC determines where repeated evidence of these toxics are cause for potential concern (11 to 25% of values exceed screening levels) or concern (more than 25 % of values above screening levels) for fish tissue and sediment. The Texas Department of Health (TDH) may issue fish consumption advisories or bans based upon measurements of toxics in fish tissue above human health criteria. Human health criteria for fish tissue are generally higher than the screening levels in fish tissue used by TNRCC for purposes of identifying segments of concern.

In 1996, 67 stations were monitored for organics in sediments, while 48 SWQMP fixed stations were monitored for metals and organics in fish tissue.[15] As shown in Tables 3c and 3d, however, the number of fixed stations at which monitoring for pesticides in fish tissue and sediment is conducted has also generally decreased. For example, in 1983, 48 stations were sampled for pesticides in sediment, while in 1996 only 13 stations were sampled, and in 1997 only 20 stations were tested for pesticides in sediment.

Table 3c. Pesticide Sampling (Fish Tissue) at Fixed TNRCC Monitoring Stations (1983-third quarter 1997)

Year	# Stations Sampled	# of Samples*
1983	15	25
1984	16	21
1985	18	20
1986	16	17
1987	13	15
1988	13	16
1989	33	39
1990	32	45
1991	16	17
1992	17	21
1993	30	39
1994	23	41
1995	21	47
1996	12	33
1997 (3rd quarter)	8	19

* Sampling event may include analysis for up to 40 different pesticides.
Source: TNRCC Storet database, from information request to TNRCC.

The state also monitors water and sediment "total toxicity" at a limited number of sites. Total toxicity is measured in relation to the toxic effects of the water or sediment on certain indicator aquatic species. "Total toxicity" is a measure of the combination of toxic effects of pollutants in water or sediment. In 1996, 31 SWQMP stations were monitored for either ambient water and/or sediment total toxicity.[16] The TNRCC records those water bodies which have shown instream toxicity in two or more samples. The TNRCC identified 18 water bodies between 1990 and 1994 which showed instream toxicity in two or more tests. This instream toxicity could be related to pesticides, among other toxics.[17]

[15] Ibid. at 35-38.
[16] Ibid. at 35.
[17] Ibid. at 218.

Table 3d. Pesticide Sampling (Sediment) at Fixed TNRCC Monitoring Stations (1983-1997)

Year	**# Stations Sampled**	**# of Samples***
1983	48	54
1984	47	51
1985	48	62
1986	46	48
1987	52	60
1988	46	50
1989	29	29
1990	10	12
1991	10	10
1992	11	12
1993	20	22
1994	22	23
1995	14	16
1996	13	15
1997	20	28

* Sampling event may include analysis for up to 40 different pesticides.
Source: TNRCC Storet database, from information request to TNRCC.

2. Statewide SWQMP Results. Of the 32 pesticides generally tested at SWQMP stations between September 1984 and August 1994, 22 have never been detected in water above detection limits and only three (2,4-D, 2,4,5-TP and diazinon) have been detected above detection limits in water more than ten times (Table 4).[18] It should be noted, however, that the SWQMP station testing is not geared to when or where pesticides are being used within the stream segment. The samples thus reflect essentially random tests at a very limited number of fixed sampling stations.

Table 4. Results of Individual Measurements of Pesticides in Water, Sediment and Fish Tissue, (1984-1994)

Medium	**Total individual pesticide samples**	**Total individual pesticide detections above detection limit**	**% detection rate**	**Number of pesticides with more than 10 detections above detection limit**
Water	18,189	125	0.7%	3
Sediment	21,900	564	2.6%	8
Fish Tissue	11,432	917	8.0%	6
TOTAL	51,521	1,606	3.1%	10

Notes: First three columns include PCB samples and detections.
Source: Texas Natural Resource Conservation Commission, The State of Texas Water Quality Inventory-1996, Volume 1 (Austin: TNRCC, 1996), 214.

Pesticides have been found more frequently in sediment and fish tissue than in the ambient water itself. Eight pesticides have been detected in sediment samples more than 10 times over the 10-year period, while six pesticides have been detected more than 10 times in fish tissue samples (Table 5).[19] In fact, about eight percent of all measurements for pesticides in fish tissue detected at least one pesticide. Still, many of the pesticides for which this random sampling is conducted have not been found above detection limits by TNRCC's SWQMP monitoring in either fish tissue or sediments.[20] Many of the frequently

[18] Ibid at 208.
[19] Ibid. at 215.
[20] Ibid.

detected pesticides have been banned for many years, but continue to persist in the environment. For example, chemicals like chlordane, DDT and its byproducts (DDE, DDD) continue to show up in water, sediments and fish. Many of the pesticides in use today, like diazinon, are not as highly persistent as these older pesticides. Thus, the repeated detection of diazinon, which is mostly used in the home and garden setting, may indicate that excessive amounts are being used without proper controls.[21]

Table 5. Pesticides with More than 10 Detections in Surface Water, Sediment and Fish Tissue Samples at TNRCC SWQMP Stations (1984-1994)

Medium	Number of Pesticides with More than 10 detections above detection limit	Pesticides
Water	3	2,4-D, 2,4,5-TP, Diazinon
Sediment	8	2,4,5-T, chlordane, DDD, DDE,DDT, diazinon, dieldrin, hexachlorobenzene
Fish Tissue	6	DDD, DDE, DDT, dieldrin, gamma-hexachlorocyclohexane (Lindane), hexachlorobenzene

Source: *Texas Natural Resource Conservation Commission, The State of Texas Water Quality Inventory-1996, Volume 1 (Austin: TNRCC, 1996), 215.*

The Texas Center for Policy Studies requested data from the TNRCC STORET Water Quality Monitoring Database on pesticide monitoring from 1984-1997. An analysis of these data found results similar to those reported by TNRCC in its 1996 Water Quality Inventory (summarized above). The only pesticides detected with some frequency in water were 2,4-D, 2,4,5-TP (Silvex), diazinon and atrazine. Atrazine is not regularly monitored by the TNRCC, but was detected by the United States Geological Survey sampling in nine out of 17 samples taken in 1993—mainly in Harris County (Table 6). These USGS data are included in the STORET system.

It is important to note that the pesticides for which TNRCC regularly monitors are generally those for which human health and aquatic life criteria have been established. Thus, TNRCC and other state and federal agencies do not necessarily monitor for those pesticides which are estimated to be among the most highly used in Texas. Table 7 shows monitoring results for some of the pesticides that are widely used in Texas.

[21] See Section II.F(4) for a discussion of diazinon-related problems for city wastewater treatment plants.

Table 6. Number of Pesticides with Positive Detections in Texas Surface Waters, 1984 - 1997

Pesticide	No. of Samples*	No. Above Detection Limit **	% of Samples Above Detection Limit
Endosulfan	70	1	1%
Heptachlor Epoxide	153	1	<1%
Methoxychlor	163	1	<1%
Malathion	147	2	1%
Aldrin	224	2	1%
Endrin	165	2	1%
2,4,5-T	139	3	2%
Lindane	164	3	2%
Hexachlorobenzene	119	5	4%
Diazinon	151	9	6%
Atrazine	17	9	53%
Silvex	117	19	16%
2,4-D	167	28	17%
TOTAL*	3368	85	2.5%

*Notes: * Includes all pesticides sampled, not just those listed above with positive detections. ** The detection limit depends on the chemical, methodology, instruments, lab technique and other factors. Source: TNRCC Storet database.*

Table 7. TNRCC Surface Water Monitoring Data for Widely Used Pesticides, 1984 - 1997

Pesticide	No. of Samples	No. of Detections Above Detection Limit
Malathion	147	2
Trifluralin	0	0
Glyphosate	0	0
Metolachlor	0	0
Atrazine	17	9
Carbaryl	0	0
Alachlor	0	0
Picloram	0	0

Source: Based upon data request by Texas Center for Policy Studies of TNRCC STORET Database, March 1998; high-use pesticide list based on data compiled by the National Center for Food & Agricultural Policy, Washington, D.C. 1995.

3. SWQMP Monitoring Results for Specific Water Bodies. Every two years, TNRCC publishes a Water Quality Inventory--also known as the 305 (b) report--as required under the Federal Clean Water Act. The Water Quality Inventory uses monitoring data from the SWQMP stations to determine whether streams, rivers, reservoirs and bays are meeting water quality criteria for their designated uses such as aquatic life, public drinking water, contact and non-contact recreation and fish consumption. Beginning in 1994, the Water Quality Inventory began to consider the effects of toxics on whether designated uses are being achieved, although it wasn't until the 1996 inventory that enough data were available to fully consider these impacts.

One of the major uses of streams, rivers, reservoirs and bays is the aquatic life use. There are two primary ways in which a segment of a river, reservoir or bay can fail to meet its designated aquatic life use: (1) low dissolved oxygen levels--too little oxygen—or (2) elevated levels of toxic pollutants. In 1996, TNRCC analyzed four years of data (1990-1994) to determine if samples collected evidenced ambient water toxic levels above chronic and/or acute levels. If the median of samples taken was above the chronic aquatic life criteria or if over 25% of the samples were above the acute aquatic life levels, that section of a segment was considered as impaired and unable to fully support the aquatic life use. In 1996, there were 780 miles of streams and rivers which did not meet the aquatic life use. About 55% of this total did not meet the aquatic life use due to elevated toxics; however, only two segments did not meet the aquatic life use due to pesticides (diazinon in Medina River and Salado Creek).[22] In addition, two lakes -- Lake Houston and Caddo Lake-- and one bay -- Corpus Christi Inner Harbor -- did not meet their aquatic life use due to elevated toxics in the water. Only Lake Houston was impacted by pesticides; again, diazinon was the problem (Table 8). The Upper San Antonio River has also exceeded the aquatic life criteria for diazinon at times and is on TNRCC's 1998 303(d) list of impaired water bodies, in part because of these elevated levels.[23]

Table 8. Segments Which Did Not Meet the Aquatic Life Use Due to Elevated Pesticide Levels in Ambient Water, Based on 1990-1994 Data from SWQMP Stations

Segment Number	Water Body	Type	Pollutant
1002	Lake Houston	Lake	Diazinon (C)
1903	Medina Creek below Medina Diversion Reservoir	Stream	Diazinon (A, C)
1910	Salado Creek	Stream	Diazinon (A, C)
1911	Upper San Antonio River	River	Diazinon (A,C)

Notes: C=Chronic Criteria; A=Acute Criteria.
Source: Texas Natural Resource Conservation Commission, Draft State of Texas 1998 303(d) List, March 13, 1998 and Texas Natural Resource Conservation Commission, Texas Natural Resource Conservation Commission, The State of Texas Water Quality Inventory -- 1996, Volume 1 (Austin: TNRCC, 1996), 217.

Approximately 228 miles of monitored streams and rivers did not support their designated fish consumption use, based on advisories or bans issued by the Texas Department of Health. About 170 of these miles had fish consumption bans due to high levels of pesticides in fish tissue, mostly chlordane, DDE (a breakdown component of DDT) and toxaphene, all of which have banned for use, but are highly persistent in the environment.[24] In addition, four reservoirs were closed to fishing because of the presence of pesticides or pesticide by-products in fish tissue. A full list can be found in Table 11.

For the water quality inventory, TNRCC also reviewed ten years of data (1984-1994) to identify segments in which elevated levels of toxics in sediment or fish tissue might be a concern, even if the overall use was supported. If more than 25% of the samples for a chemical were above screening levels, the segment was listed as a "segment of concern." TNRCC identified 50 out of 222 monitored stream and river segments, encompassing 1,028 miles; 31 out of 99 monitored reservoirs; and 18 out of 44 monitored bay segments with sediments which contained elevated levels of metals or organics.[25] Ten of these river and stream segments and two of the reservoirs had elevated levels of pesticides in the sediment (Table 9).

[22]Texas Natural Resource Conservation Commission, The State of Texas Water Quality Inventory -- 1996, Volume 1 (Austin: TNRCC, 1996), p. 217.
[23]Texas Natural Resource Conservation Commission, Draft State of Texas 1998 303(d) List, March 13, 1998.
[24]Texas Natural Resource Conservation Commission, The State of Texas Water Quality Inventory -- 1996, Volume 1 (Austin: TNRCC, 1996), 219-221.
[25]Ibid, 187.

Table 9. Segments of Concern for Pesticides in Sediment

Segment Number	Water Body	Type	Pesticide or Pesticide by-product
0805	Upper Trinity River	River	Chlordane
0806	West Fork Trinity River	River	Chlordane, Diazinon
0827	White Rock Lake	Reservoir	Chlordane
1007	Houston Ship Channel	River	Chlordane, Dieldrin
1201	Brazos River Tidal	River	Hexachloro-benzene
1242	Brazos River below Whitney Lake	River	DDD, DDE, Chlordane
1428	Colorado River below Town Lake	River	DDE
1429	Town Lake	Reservoir	Chlordane, DDD, DDE, DDT
1801	Guadalupe tidal	River	DDT
1906	Lower Leon Creek	River	DDD, DDE, DDT
2202	Arroyo Colorado above Tidal	River	DDE
2306	Rio Grande above Amistad Reservoir	River	DDE

Source: Texas Natural Resource Conservation Commission, The State of Texas Water Quality Inventory -- 1996, Volume 1 (Austin: TNRCC, 1996), 231-233.

Whole fish from five of 222 monitored river and stream segments--covering 383 miles--contained elevated levels of metals or organics.[26] Two of these segments as well as one reservoir were identified as segments of concern due to elevated pesticide levels in fish in 1996 (Table 10).

Table 10. Segments of Concern for Pesticides in Fish Tissue

Segment Number	Water Body	Type	Pesticide
0806	West Fork Trinity River below Lake Worth	River	Chlordane
0827	White Rock Lake	Reservoir	Dieldrin, DDD, DDE
1007	Houston Ship Channel	River	Chlordane, Dieldrin

Source: Texas Natural Resource Conservation Commission, The State of Texas Water Quality Inventory -- 1996, Volume 1 (Austin: TNRCC, 1996), 222.

C. Fish Tissue and Shellfish Sampling

This section examines the Texas Department of Health's fish and shellfish testing program. The Texas Department of Health’s Seafood Safety Division is charged with surveillance of oyster-harvesting areas along the Gulf Coast and has the authority to close bays and estuaries based upon testing shellfish and finding levels of toxics or other pollutants in excess of human health criteria for consumption. This program is funded in part by a $1-per-sack fee paid by oyster fishermen.

No comparable revenue source is available for testing inland fish. Like most states, Texas has no comprehensive inland fish monitoring program. The state does test fish tissue for contaminants when a report of a chemical spill or some other information leads state health officials to believe human health may be threatened. But no systematic monitoring is done in the absence of these reports. Testing fish is expensive: a detailed tissue sampling of one fish might cost $500, and a full scan,

[26] Ibid, 222.

which examines the liver and reproductive organs to pinpoint sources of dangerous contaminants, might exceed $1,000 per sample.[27]

Currently, TDH has a contract with EPA to conduct testing in the Galveston Bay area as part of the Galveston Bay Estuary Program and in the San Antonio Bay area as part of the Corpus Christi Bay Plan. TDH also has a pending contract with TNRCC to conduct additional fish tissue testing in segments listed on the state's TMDL 303(d) list because of confirmed or possible fish contamination problems. Under this contract, for example, TDH will test fish in the Arroyo Colorado and Donna Irrigation System for pesticides and PCBs previously documented to determine if a problem still exists.[28]

There is evidence that a more comprehensive inland fish testing program may be warranted. In 1993, for example, the Environmental Protection Agency conducted a study on the types of environmental problems to which Texas families living along the border are exposed. As part of the study, EPA tested a carp caught by a Brownsville family from the Donna Reservoir. The tests of the fish's tissue revealed PCB levels of 400 parts per million, or 200 times the recommended limit for human consumption.[29] When further tests of Donna Reservoir fish identified eight more fish contaminated by PCBs, TDH issued a fish consumption advisory for the reservoir and its connecting canals. Ten more PCB-contaminated fish caught from an irrigation canal between the reservoir and the Rio Grande River were found in January 1994. Following this study, TDH banned any taking or consumption of fish in the area.[30]

While startling, the problems at Donna with PCBs are not unique. In 1995, TDH prohibited the possession of any species of fish caught in Lake Como or Fosdic Lake in Tarrant County because of the presence of high levels of chlordane, PCBs, dieldrin and DDE in fish tissue.[31] A full list of TDH-issued fish consumption advisories and bans due to pesticides can be found in Table 11. All of these advisories and bans are based on the persistent presence of pesticides that are no longer legally authorized for use.

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[27]Texas Center for Policy Studies, Texas Environmental Almanac (Austin: Texas Center for Policy Studies, 1995), 64.
[28]Phone interview with Kirk Wiles, Seafood Safety Division, Texas Department of Health, March 1998.
[29]US Environmental Protection Agency, Lower Rio Grande Valley: Environmental Monitoring Study (Washington: EPA, June 1994), 20.
[30]Texas Center for Policy Studies, Texas Environmental Almanac (Austin: Texas Center for Policy Studies, 1995), 64.
[31]Ibid.

Table 11. Fish/Shellfish Consumption Advisories and Aquatic Life Closures Due to Pesticides in Fish Tissue

Segment Number	Water Body	Date Issued	Size Affected	Pollutant
0805 0806 0829 0841	Upper Trinity River West Fork Trinity River Clear Fork Trinity River Lower West Fork Trinity River	01/04/90	19 miles 22 Miles 1 mile 27 miles	Chlordane
0829 0806	Lake Como Fosdic Lake	12/05/95 04/05/95	15 acres 6 acres	Chlordane, Dieldrin, DDE (and PCBs)
0841	Mountain Creek Lake	04/25/96	2,710 acres	Chlordane, Heptachlor Epoxide, Dieldrin, DDE, DDT, DDD (and PCBs)
1429	Town Lake	07/10/87	500 acres	Chlordane
2202	Arroyo Colorado Upstream of Port of Harlingen	06/24/93	63 miles	Chlordane, Toxaphene, DDE
1101 1102	Clear Creek, tidal Clear Creek, above tidal	09/18/93	8.4 miles 30.3 miles	Chlordane (and Volatile organic Substances)

Source: Seafood Safety Division, Texas Department of Health, Fish Advisories and Bans, 1997 (Austin: TDH, 1997) (Segment Nos. from TNRCC classifications).

TDH has sampled for pesticides in fish tissue in several water bodies in addition to those water bodies already under fish consumption closures and advisories. The TDH fish tissue testing generally focuses on a small standard set of pesticides, many of which are no longer authorized for use, but are highly persistent in the environment. The TDH fish tissue testing is not related to location, timing or type of pesticides being used in the watershed. According to TDH fish tissue sampling data collected between 1970 and 1997, fish or shellfish in some 54 water bodies were sampled for evidence of pesticides (Table 12). These data also demonstrate, however, that fish tissue pesticide sampling has been extremely limited and sporadic, except in those cases where a clear pattern of elevated pesticide levels has been found. While it is reasonable to concentrate resources on areas with obvious problems--like the coastal areas of South Texas and the Trinity River Basin in the Fort Worth area--some areas of the state have been completely ignored, while others have been sampled only occasionally. Some of the sampling showed detectable levels of pesticides in the early 1980s, with no follow-up sampling since. Sampling has tended to flow to those areas where special problems and the resulting funding has made it possible.

Table 12. Water Bodies Where Fish or Shellfish Sampled for Pesticides or PCBs by Texas Department of Health, 1970 - 1997.

Water Body	Year of Sample	Pesticides* Above Detection Limit**
Adams Bayou	1985	DDE, DDD, Chlordane
Sabine Lake	1981	DDE
	1982	Dibutyl Phthalate, DEHP
	1994	DDE
San Jacinto River	1990	None
Tabbs Bay	1983	DDE, Chlordane

Water Body	**Year of Sample**	**Pesticides* Above Detection Limit****
	1990	None
Galveston Bay	1977	Chlordane, Malathion
	1980	PCBs, DDE, Dieldrin, Dacthal
	1981	DDE, Dacthal
	1982	Dibutyl Phthalate, DEHP, DDE, DCPA, Chlordane, Dieldrin
	1983	Chlordane, DCPA, DDE, Dieldrin
	1984	Dacthal, DDE
	1986	Chlordane
	1990	Chlordane, Dacthal
	1994	DDD, DDE, Dacthal, Carbon Disulfide
Trinity Bay	1981	None
	1982	DDE
	1984	Dacthal
	1990	None
East Galveston Bay	1981	None
	1982	None
	1983	None
Carancahua Lake	1979	None
West Galveston Bay	1980	None
	1981	None
	1982	DDE, DDD, DDT, Toxaphene, HCB, Dibutyl Phthalate, DEHP
	1983	DDE, PeB, HeB
	1984	DDE
Bastrop Bay	1983	DDE, HeB, PeB
Freeport Area	1982	DDE, Dibutyl Phthalate, DEHP
East Matagorda Bay	1982	None
	1983	DDE
Matagorda Bay	1982	DDE
Tres Palacios Bay	1982	DDE
	1983	DDE
Lavaca Bay	1980	None
	1981	DDE
	1982	None
	1983	Dibutyl Phthalate, DDE
	1984	DDE
Powderhorn Lake	1981	None
	1984	DDE
Espiritu Santo Bay	1982	DDE
	1983	None
	1984	DDT, DDE
San Antonio Bay	1982	DDE
	1983	None
	1984	DDE, DDT
	1985	None
Mesquite Bay	1982	None
	1983	None
Copano Bay	1982	DDE
Copano Bay (cont.)	1983	None

Water Body	Year of Sample	Pesticides* Above Detection Limit**
	1984	DDE
Aransas Bay	1982	DDE
	1983	Dibutyl Phthalate, DDE
	1984	DDE
Nueces Bay	1980	DDE
	1982	DDE, Dibutyl Phthalate
	1983	DDE
	1984	None
Corpus Christi Bay	1984	None
Baffin Bay	1984	Chlordane, DDE
Laguna Madre	1980	DDE, DEHP, Dibutyl Phthalate
	1981	DDE, DDD, DDT, Chlordane, Toxaphene , DCPA
	1984	None
	1986	DDE
	1987	DDE, Chlordane, DDT, Dieldrin
	1989	DDE, Chlordane, Dieldrin, Dacthal
Arroyo Colorado	1980	Chlordane, Trans-nonachlor, DDD, DDE, DDT, Dieldrin, Endrin, Dibutyl Phthalate, Toxaphene
	1981	DDE
	1989	DDE, Chlordane, Dacthal, Dieldrin, Dacthal
	1993	DDE
Llano Grande Lake	1980	Chlordane, DDD, DDT, DDE, Dieldrin, Endrin, Dibutyl Phthalate, Toxaphene, Trans Nonachlor
	1981	Chlordane, DDD, DDT, DDE, Dieldrin, Endrin, Dibutyl Phthalate, Toxaphene, Dacthal
	1983	Chlordane, DDE, Dieldrin, T-Nonachlor, Toxaphene, Endrin, DCPA
	1985	DDE, Chlordane, Toxaphene, Dacthal, Dieldrin, Endrin
	1987	DDE, Chlordane, Toxaphene, Dacthal, Dieldrin, Endrin
	1993	Endosulfan, Endosulfan Sulfate, Dacthal, DDT, DDD, DDE, Dieldrin, Endrin
Port of Harlingen	1981	Toxaphene, DDE, Dacthal, Dieldrin, Endrin, Chlordane, DCPA, DDD
	1983	Dieldrin, DCPA, DDD, T-Nonachlor, DDE, Toxaphene, Endrin, Chlordane
	1984	DDE, Dieldrin
	1985	DDE, Chlordane, Toxaphene, Dacthal, DDT, Dieldrin, Endrin
	1986	DDE, Dacthal
	1987	DDE, Chlordane, Dieldrin, Endrin, Dacthal
	1989	Chlordane, DDE, Dieldrin, Dacthal
Donna Irrigation Canal	1993	DDE, Endosulfan Sulfate, Dacthal
	1994	DDD, DDE, Endosulfan I, Hexachlorobenzene, Alachlor, Malathion, Dacthal, Aldrin
Mercedes Main Canal and Settling Basin	1993	DDE, Endosulfan, Endosulfan Sulfate
Hidalgo Settling Basin	1993	DDE, Endosulfan Sulfate, Dacthal
Brownsville Resacas	1996	Chlordane, DDD, DDE

Water Body	Year of Sample	Pesticides* Above Detection Limit**
Brownsville Ship Channel	1997	DDE
Rio Grande River	1994	DDD, DDE, Aldrin, Dieldrin, Chlordane, Hexachlorobenzene, Endosulfan, Dacthal, Lindane, DDD, DDT
Delta Lake	1993	DDE
South Bay	1981	DDE
	1982	DDE
	1984	None
Brazos River (mouth)	1990	Hexachlorobenzene, DDE, Nonachlor-Trans
Brazos River near Freeport	1996	DDE, Hexachlorobenzene, Pentachlorobenzene, DBCP
Martin Creek Lake	1997	DDE
Neches River near Ten Mile Creek and Rainbow Bridge	1993	DDE
	1994	Carbon Disulfide
Brakes Bayou	1993	DDE, DDD
	1995	Chlordane, Dieldrin, Heptachlor Epoxide, DDT
Sulphur River	1993	DDE
Town Lake	1985	Chlordane, DDE, DDT, DDE, Dieldrin
	1995	DDD, DDT, DDE, Dieldrin, Chlordane, Hexachlorobenzene
Trinity River, Middle Region, Various Locations	1987	Chlordane, DDE, DDT, Dieldrin
	1988	DDE, Chlordane, DDT, Dieldrin,
	1990	Chlordane, DDE,
	1994	DDE, Dieldrin, Endosulfan II, DDD, Chlordane,
Clear Creek (Brio Superfund Site)	1993	Carbon Disulfide, DDE, Chlordane, Hexachlorobenzene, Heptachlor Epoxide, Dacthal, Lindane, DDD, alpha-Hexachlorocyclohexane, delta-Hexachlorocyclohexane
Millwood Lake	1986	None
Brandy Branch Reservoir	1997	DDE
Lake Livingston	1994	DDE, Dieldrin, DDD, Chlordane, , Dibutyl Phthalate
Fosdic Lake	1994	DDE, Dieldrin, Chlordane
Lake Como	1994	DDT, DDD, DDE, Chlordane
Echo Lake	1995	DDE, Dieldrin, Endrin, Heptachlor Epoxide, Carbon Disulfide
French Lake	1995	DDE, , Carbon Disulfide
Cement Creek Reservoir	1995	DDE, Carbon Disulfide
Twin Lakes	1997	DDD, DDE

*Note: *Pesticides listed include some Volatile Organic Compounds such as carbon disulfide, which can also be used in industrial processes.*
***The Table shows all pesticides found over detection limits. Detection limits have changed over time as fish tissue sampling has improved, depending upon the type of sampling conducted.*
Source: Texas Department of Health, Fish Tissue Sampling Data, 1970 - 1997 (Austin: TDH, 1998).

D. Drinking Water Monitoring

This section reviews pesticide monitoring data for drinking water supply systems. Water utilities serving at least 25 persons or 15 connections at least 60 days a year are required to monitor for a number of organics, including pesticides. (Many of these systems, however, can apply for waivers from these requirements). Toxic pollutant monitoring requirements for drinking water systems began as a result of the 1986 Safe Drinking Water Act. Currently, there are 54 organic chemicals for which Maximum Contaminant Levels, or MCLs exist, and 33 additional organic compounds that must be monitored for, even though no MCL currently exists. Of these organics, 23 of the regulated MCL and 10 monitored contaminants are used or have been used as pesticide active ingredients.[32] If the average of four consecutive quarterly samples of these chemicals is above the MCL, then it is considered to be a violation of both state and federal drinking water standards. TNRCC implements the requirements of the federal SDWA and related Texas law.

As described in more detail in Appendix A, some systems have waivers from pesticide monitoring requirements. These waivers are granted after TNRCC conducts a "vulnerability assessment", an evaluation of various factors to determine whether the water source is "vulnerable" to contamination. The vast majority of waivers are granted to systems relying on ground water. About one-half of the over 5,700 community and non-transient, non-community water systems in Texas have received waivers from all pesticide monitoring based on TNRCC determinations that they are not "vulnerable" to contamination.[33] In addition, TNRCC has granted statewide waivers for four pesticides: endothall and diquat (primarily used as aquatic herbicides), glyphosate (a widely used herbicide)[34] and dibromochloropropane.

In those systems conducting sampling for pesticides, atrazine is the most frequently detected pesticide. A number of Texas systems have detected atrazine in finished drinking water (i.e. drinking water that goes to the tap) and a few have had individual quarterly samples above the MCL for atrazine (see Map 3 and Appendix B, Table B-1). In 1997 alone, for example, atrazine was detected in the tap water provided over 60 public water supply systems.[35] These systems served at least four million people. Between 1995 and 1997, over 80 public water supply systems detected atrazine in finished drinking water one or more times. Overall, nine water systems have exceeded the atrazine MCL at least once since drinking water monitoring for organics began in 1993. In addition, the Aquilla Water Supply District in Hillsboro, Hill County was in violation of the atrazine MCL and has exceeded the alachlor MCL on two occasions (Table 13).[36] Statewide, most of the MCL exceedences have been found in the spring, when atrazine use is higher and when rains are most likely to wash it into surface waters.[37]

In addition to the detections and exceedences of the MCL for alachlor and atrazine in some systems, many drinking water systems have detected other pesticides with frequency. Other pesticides that have

[32] Does not include two aldicarb breakdown products on unregulated contaminants monitoring list.

[33] Texas Natural Resource Conservation Commission, "Vulnerability Assessments", www.tnrcc.state.tx.us / water/wu/swap/vapp.html, May 19, 1998. These systems still must sample once every three years for pesticides and other contaminants.

[34] TNRCC's waiver for glyphosate is based on (1) glyphosate being reduced or eliminated by chlorination or ozonation and (2) that the MCL for glyphosate is very high.

[35] Texas Natural Resource Conservation Commission, TNRCC Executive Management Briefing Paper Subject: Atrazine Occurrence in Public Drinking Water (Austin: TNRCC, August 19, 1997).

[36] Information from Organic Drinking Water Sampling Database, Water Quality Division, Texas Natural Resource Conservation Commission.

[37] Texas Natural Resource Conservation Commission, TNRCC Executive Management Briefing Paper Subject: Atrazine Occurrence in Public Drinking Water (Austin: TNRCC, August 19, 1997).

been detected in Texas public drinking water systems include simazine, metolachlor, heptachlor, lindane and dieldrin.[38] (Map 4 and Appendix B, Table B-2).

Other pesticides for which monitoring is required have not been detected in tap water. For example, the SOC3 group includes the herbicides 2,4-D, 2,4,5-TP (Silvex—banned), dalapon, dinoseb, picloram and dicamba. Testing of 2,190 water systems between 1993 and September 1998 did not show any confirmed detections of any of the chemicals in this group (one detection of picloram was not confirmed upon re-testing). This sampling represents quarterly sampling once every three years in surface water systems and a "handful of very vulnerable" ground water system and sampling once every three years in "vulnerable" ground water systems.[39]

The SOC4 group includes eight carbamates: aldicarb, aldicarb sulfone, aldicarb sulfoxide, carbofuran, oxamyl, carbaryl, hydroxycarbofuran and methomyl. Similar sampling of 2,190 systems for the SOC$ pesticides did show any detects for any of the pesticides.[40]

TNRCC is currently considering issuing a statewide monitoring waiver for 1999-2001 for all of the pesticides in groups known as SOC3 and SOC4, based on the lack of positive detections. As part of this decision, TNRCC will require the use of Method 525 (gas chromatograph/mass spectrometer)—a method which can detect compounds at low levels—for the other pesticides.

Because of the detection of atrazine in public drinking water systems, the TNRCC has proposed listing nine water bodies where there were at least two detections of atrazine over 50% of the MCL as part of the TMDL Section 303(d) list of threatened streams or reservoirs (Table 14).

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[38] Information from Organic Drinking Water Sampling Database, Water Quality Division, Texas Natural Resource Conservation Commission.

[39] Data from Texas Natural Resource Conservation Commission, Overview of Drinking Water System Monitoring Results for Pesticides (1993-9/29/98), December, 1998.

[40] Id.

Table 13. Samples in Drinking Water Systems Exceeding MCLs for Pesticides, January 1993 - March 1998

System Name	Date of Sample	Chemical Name	PPB
Aquilla Water Supply District	2/3/98	Atrazine	5.4
	5/15/97	Atrazine	10.5
	5/15/97	Alachlor	5.8
	4/30/97	Atrazine	8.9
	4/30/97	Alachlor	5.5
Sagemeadow Municipal Utility	6/16/97	Atrazine	8.8
	6/16/97	Atrazine	8.8
City of Dawson	4/15/97	Atrazine	3.9
Friona Municipal Water Supply	4/16/97	Atrazine	3.3
City of Robinson	4/24/96	Atrazine	3.7
City of Marlin	4/4/95	Atrazine	9.6
	5/15/95	Atrazine	3.6
City of Ft. Worth	5/5/97	Atrazine	3.1
City of Midlothian	4/15/97	Atrazine	3.2
Combined Water Supply Corporation	5/27/97	Atrazine	3.7
	4/15/97	Atrazine	4.0

Notes: MCL for Alachlor is 4.0 ppb; MCL for Atrazine is 3.0 ppb (parts per billion). One of the samples that exceeded the MCL for atrazine was obtained by Sagemeadow Municipal Utility from the City of Houston, while the other was obtained from a well in the Gulf Coast Aquifer; Friona obtains its water from groundwater.
Source: Information from Organic Sampling Database, Water Utilities Section, Water Quality Division, Texas Natural Resource Conservation Commission.

Table 14. Water Bodies on the State of Texas 1998 303(d) Threatened Waters List Because of Elevated Levels of Atrazine and/or Alachlor in Drinking Water

Segment Number	Segment Name
0303-A	Big Creek Lake
0507	Lake Tawakoni
0815	Bardwell Reservoir
0816	Lake Waxahachie
0821	Lake Lavon
0836	Richland-Chambers Reservoir
0838	Joe Pool Lake
1242-A	Marlin City Lake System
1254	Aquilla Lake

Source: Texas Natural Resource Conservation Commission, Draft State of Texas 1998 303(d) List, March 13, 1998.

E. Summary of Statewide Data

The failure to meet surface water quality standards for aquatic life or fish consumption due to elevated pesticide levels, concerns about pesticides in fish tissue or sediment and the threat to drinking water from pesticides has led to a number of water bodies being proposed for inclusion on the 303(d) List in 1998. In all, there are 21 water bodies listed in part because of contamination caused by pesticides (Table 15). Despite this well-documented statewide list of water bodies affected by pesticides, there is still a great lack of monitoring data. Because the TNRCC Surface Water Quality Monitoring Program and Drinking Water Program only monitor for 13 of the same pesticides, the links between pesticides in drinking water and in surface water bodies can not be readily established, making prevention more difficult. In addition, the under-funded fish tissue sampling program of the Texas Department of Health has resulted in scattered monitoring for pesticides in only 54 water bodies throughout the state, most of which occurred between 1980 and 1984.[41]

Table 15. Water Bodies on the State of Texas 1998 303(d) Lists due to the Presence of Pesticides in Fish Tissue, Surface Water or Drinking Water

Segment Number	Water Body	Chemical of Concern	Affected or Threatened Use
0303-A	Big Creek Lake	Atrazine	Drinking Water
0507	Lake Tawakoni	Atrazine	Drinking Water
0815	Bardwell Reservoir	Atrazine	Drinking Water
0816	Lake Waxahachie	Atrazine	Drinking Water
0821	Lake Lavon	Atrazine	Drinking Water
0836	Richland-Chambers Reservoir	Atrazine	Drinking Water
0838	Joe Pool Lake	Atrazine	Drinking Water
1242-A	Marlin City Lake System	Atrazine	Drinking Water
1254	Aquilla Lake	Atrazine, Alachlor	Drinking Water
0805	Upper Trinity River	Chlordane	Fish Consumption Ban
0806 0806-A	West Fork Trinity River Fosdic Lake	Chlordane Chlordane, , Dieldrin, DDE	Fish Consumption Ban
0829 0829-A	Clear Fork, Trinity River Lake Como	Chlordane Chlordane, Dieldrin, DDE	Fish Consumption Ban
0841	Lower West Fork, Trinity River	Chlordane	Fish Consumption Ban
1101	Clear Creek, tidal	Chlordane, Carbon Disulfide	Fish Consumption Advisory

[41]Seafood Safety Division, Texas Department of Health, Fish Tissue Sampling Data, 1970 - 1997 (Austin: TDH, 1998).

Segment Number	Water Body	Chemical of Concern	Affected or Threatened Use
1102	Clear Creek, above tidal	Chlordane Carbon Disulfide	Fish Consumption Advisory
1429	Town Lake	Chlordane	Fish Consumption Ban
2202	Arroyo Colorado Above Tidal	Chlordane, Toxaphene, DDE	Fish Consumption Ban
1903	Medina Creek below Medina Diversion Reservoir	Diazinon	Aquatic Life Use Impaired
1910	Salado Creek	Diazinon	Aquatic Life Use Impaired
1911	Upper San Antonio River	Diazinon	Aquatic Life Use Impaired

Notes: Lake Houston (Segment 1002) has also had elevated levels of diazinon exceeding aquatic life criteria but is not listed on the 303(d) because the aquatic life standards are not considered attainable. The Arroyo Colorado tidal (2201), while not in violation of any pesticide-related standard, is being evaluated to determine if the fish consumption ban should be extended. Source: TNRCC, Draft State of Texas 1998 303(d) List, March 13, 1998.

F. Other Surface Water Quality Data for Pesticides

The purpose of this section is to provide an overview of the findings of various reports conducted to assess surface water quality in Texas and in particular to summarize their findings and recommendations related to pesticides. The following reports were reviewed: the 1992, 1994 and 1996 River Basin Assessments of the eight coastal basins and 15 river basins prepared for the Texas Clean Rivers Program; special reports prepared by the U.S. Geological Survey's National Water Quality Assessment Program (NAWQA) and selected studies under USGS's Biomonitoring of Environmental Status and Trends Program (BEST); special reports and/or studies prepared by the United States Fish and Wildlife Service; reports and analysis of the Texas Parks and Wildlife's Fish Kill Program; and the Corpus Christi Bay National Estuary Program and Galveston Bay National Estuary Program reports. In addition to the review of the above-mentioned water quality studies and reports, the authors interviewed biologists and water quality program directors with the USFWS, the USGS, the Texas Parks and Wildlife Department and TNRCC's Clean Rivers Program.

1. Texas Clean Rivers Program River Basin Assessments

In 1991, the Texas Legislature passed the Texas Clean Rivers Act in response to concerns that water resource issues were not being addressed in a holistic manner. This legislation required that, beginning in 1992, ongoing water quality assessments be conducted for each of the 15 river basins and eight coastal basins. The Texas Natural Resource Conservation Commission administers the Clean Rivers Program. The program is funded from fees assessed on wastewater and water permit holders. The program budget is capped at five million dollars a year. TNRCC contracts with river authorities, municipal authorities and Councils of Governments to conduct the biennial water quality assessment reports. Where there is no lead contractor, such as for the Rio Grande, TNRCC has conducted the assessments itself.

Though the river basin assessment process has changed over time, each assessment incorporated a process that gathered historical water quality data, analyzed the data to determine where water quality problems existed and identified possible causes and sources of pollution. The historical data evaluation encompassed studies conducted by universities, federal agencies--such as the USFW and/or the USGS--and other sources. Many of the river basin contractors have also conducted some independent water sampling and analysis. Map 5 shows the river basins and coastal basins of the Clean Rivers Program.

The Clean Rivers Program also has a public participation component. Each river authority or contractor must establish a Citizen Advisory Committee to help determine possible water quality issues within various geographical areas of the basin. Several of the contractors have conducted citizen surveys to help identify possible water quality issues. Beyond the water quality data collection and evaluation, water sampling and analysis, each assessment also includes recommendations for improving or preserving the basin's water resources.

Though the authors of this report reviewed all of the 1992 assessments, these assessments cannot be considered significant. The 1992 Assessments were conducted in three months and, therefore, as TNRCC recognized, "contained only basic analyses of existing data and lacked significant evaluation."[42] On the other hand, the 1994 watershed assessments and the 1996 assessments have more reliable data and evaluations. The emphasis of the Clean Rivers Program has evolved from the collection and analysis of historical data to the development and implementation of basin-wide monitoring efforts. It should be noted, however, that no pesticides are on the target list for monitoring procedures under the Clean Rivers Program; and there is no standard list of pesticides in the Clean Rivers Program. Therefore, under the Clean Rivers Program's monitoring, if the public has informed river authorities (contractors) of a possible concern for pesticides, monitoring might be pursued. At the same time, pesticide monitoring studies and analysis are very costly and time-consuming and river authorities and the Clean River Program have limited financial resources. In addition, some pesticides have no screening standards. According to the TNRCC, the lower portions of the river basins are beginning to be tested for pesticides to investigate the need to conduct more detailed monitoring in the upper portion of the basin.[43]

2. Findings of the 1994 and 1996 Texas Water Quality River and Coastal Basin Assessments

In preparing the 1994 Water Quality Assessments, each regional entity relied on the same approach and methodology. Each regional entity collected and analyzed ten years of available water quality data, for both point and non-point source pollution, for its respective basin.

In summarizing the 1994 assessments of 15 river basins and eight coastal basins, TNRCC concluded: "In general, the screening analysis of ten and a half years of data for toxic substances in water reveals that, in most cases, there were insufficient data to make any conclusion of concern, possible concern or no concern. This is especially true of toxic organic substances, i.e., pesticides and herbicides."[44] The literature review and screening of available data, however, did reveal the presence of pesticides in many basins.

Angelina and Neches River Basin

For the 1994 Assessment of this basin, there were eight classified stream segments. There was a lack of data for organic substances for seven of these segments. Two segments of the Upper Neches River basin study area were included in TNRCC's statewide list of non-point source impacted waters for concerns about nutrients and sediment from agriculture and silviculture activities.[45]

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[42] Texas Clean Rivers Program, TNRCC, Texas Water Quality: A Summary of River Basin Assessment (Austin: Texas Clean Rivers Program/ TNRCC, December 1996), 15.
[43] Clyde Bohmfalk, Texas Clean Rivers Program/TNRCC, interview with author, 3/23/98.
[44] Texas Clean Rivers Program/ TNRCC, Texas Water Quality: A Summary of River Basin Assessments (Austin: Clean Rivers Program/TNRCC, 1994), 38.
[45] Angelina and Neches River Authority, Regional Assessment of Water Quality Neches River Basin Executive Summary, (Lufkin: ANRA,1994), ES-6

Within the Upper Neches River Basin specific non-point sources of pollution were identified, including silviculture activities and potential contamination from the use of herbicides. Approximately 75 percent of the Upper Neches River basin study area is involved in forestry and forestry-related activities. The 1994 assessment report recommended that a specific water quality monitoring program aimed at determining impact from silviculture activities be developed. In addition, the report concluded that agricultural and urban applications of fertilizers and pesticides might be impacting water quality in the basin, but that more monitoring and evaluation was needed to assess actual impacts.[46]

The 1996 Regional Assessment of the Upper Neches River basin did not identify any concerns for pesticides in the eight segments studied.

The 1996 Assessment recommended that continued support be given to the Texas State Soil and Water Conservation Board's efforts to implement Best Management Practices for control of agricultural and silvicultural non-point source pollution.[47]

Brazos River Basin

The 1994 Regional Water Quality Assessment of the Brazos River Basin concluded that pesticide water quality data was not available for most major watersheds in the basin.[48] The Assessment recommended that more sampling be conducted to support water quality standards, including the collection of more organic constituent data. The pesticide endosulfan was detected at levels high enough to be considered a possible concern in the Brazos River from Lake Whitney to Possum Kingdom Lake, but the data were limited.[49] The 1994 Assessment listed Segment 1242 (Lower Brazos River) as having the second highest number of fish kills reported within the Brazos River Basin, but did not identify the cause of the incidents.

The 1996 Assessment of the Lower Brazos River Basin identified non-point source pollution as a potential problem for some segments of the study area, but the assessment screening process did not identify any specific problems with pesticides.[50]

The 1996 Assessment of the Middle Brazos River Basin did not identify any specific concerns for pesticides, though the study noted that the area had potentially significant non-point source discharges from row crop agriculture and CAFOs.[51]

The 1996 Assessment of the Upper Brazos River Basin did not identify any specific potential problems with pesticides.

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[46] Angelina and Neches River Authority, Regional Assessment of Water Quality Upper Neches River Basin Area (Lufkin: ANRA, 1994), RPT-37.

[47] Angelina and Neches River Authority, Regional Assessment of Water Quality Neches River Basin Vol. 1 Upper Neches River Basin Study Area, October 1996 (Lufkin: ANRA, 1996), ii. The Angelina and Neches River Authority and Stephen F. Austin University did conduct a Poultry Litter Land Application Rate Study to determine the water quality and soil impacts from land application of poultry litter.

[48] Brazos River Authority, 1994 Final Report Regional Assessment of Water Quality of the Brazos River Basin (Waco: Brazos River Authority, 1994), 16.

[49] Ibid.

[50] Brazos River Authority, 1996 Final Report Regional Assessment of Water Quality Brazos River Basin, 1996 (Waco: Brazos River Authority, 1996), ES-12.

[51] Ibid.

Brazos/Colorado Coastal Basin

During the 1994 Assessment process, no data were collected for organics in any segment in the basin.[52] The 1996 Assessment made no mention of pesticides in the Brazos/Colorado Coastal Basin.[53]

The Texas State Soil and Water Conservation Board in 1993 reported on selected rice fields in the Colorado, Wharton and Matagorda area. The Board concluded that proper water retention on rice fields following application of fertilizers and pesticides significantly reduced non-point source loading in receiving waters.[54]

Canadian River Basin

Though not included in the screening, pesticides are used throughout this basin for crop and fiber production. Historical data from the Texas Parks and Wildlife Pollution and Fish Kill program reported that in November 13, 1988, 44 Lesser Canada Geese were killed by the pesticides parathion and sigon in the Wolf Creek water body in Ochiltree County, but the responsible party was unknown.[55]

The 1994 Assessment pointed out that there has been no systematic monitoring of non-point source pollution in the basin, though some of the available water quality data have been used in an attempt to assess the extent of non-point source pollution. For example, Texas Tech University, in cooperation with the High Plains Underground Water Conservation District and the Brazos River Authority, conducted a water quality assessment of 100 playa lakes on agricultural lands in 1993. This assessment found that detectable levels of residues of triazine herbicides and aldicarb insecticides were cause for possible concern in virtually every playa basin in the study. Though the report stated that the levels did not appear to be sufficiently high to present a risk to human or environmental health, there were indications of a strong potential for these pesticides to reach groundwater through recharge from the playa basins.[56]

The 1994 Assessment recommended more monitoring for the playa basins for non-point source pollution, but did not specify which pollutants should be targeted.

The 1996 Assessment reiterated previous conclusions about data gaps and inconsistencies.

Colorado River Basin

The 1994 Assessment recommended that the implementation of a boll weevil eradication program for cotton in the Concho River sub-watershed be accompanied by increased monitoring of the chemical and biological health of streams that could be impacted by the widespread use of pesticides (mostly malathion) in the eradication program.[57] The 1994 Assessment also recommended additional studies to evaluate any impacts from agricultural production on groundwater or wildlife in the non-contributing area of the Colorado basin.[58]

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[52] Houston Galveston Area Council, Houston Galveston Area Regional Assessment of Water Quality (Houston: HGAC, 1994), BC.2.
[53] Houston Galveston Area Council, Houston Galveston Area Regional Assessment of Water Quality (Houston: HGAC, 1996)
[54] Houston Galveston Area Council, Houston Galveston Area Council Regional Assessment of Water Quality (Houston: HGAC, 1994), BC.4.
[55] Red River Authority, Canadian River Basin Water Quality Assessment (Wichita Falls: Red River Authority, 1994), Table 3.3-4.
[56] Ibid., 3-32
[57] Lower Colorado River Authority, 1994 Water Quality Assessment of the Colorado River Basin (Austin: LCRA, 1994), ES-3.
[58] Ibid., ES-5.

The 1996 Assessment concluded that data on organics, including pesticides, are very limited within the Colorado River basin. In fact, for all 45 segments studied, the data were insufficient to draw any conclusions.[59] A fish consumption advisory is in effect for Segment 1429 (Town Lake in Austin) due to past applications of chlordane.[60]

The 1996 Assessment also questioned the "conventional wisdom which holds that agricultural practices are the biggest single contributor to water quality problems."[61] To that end, the LCRA conducted studies of runoff from various agricultural sites below Austin in the lower sub-basin. The key findings of those studies were that: 1) two years is insufficient to reach many quantifiable conclusions; 2) total suspended solid levels were dramatically higher from row crop production compared to improved pasture land; 3) nitrogen levels were generally elevated during the first runoff event following fertilizer application, but then reached background levels; and 4) pesticides could only be detected in the runoff for about one month after application, indicative of the short half-life of many pesticides currently in use, such as metolachlor and atrazine.[62] (The Assessments did not mention any studies or water monitoring data that indicated that indicated the presence of either metolachlor or atrazine in the Colorado River Basin.)

The 1996 Summary of the Water Quality Assessments prepared by the TNRCC stated that the "effects of agricultural/rural non-point source pollution are currently being studied" for the Colorado River basin segment running from Austin to Bay City.[63]

Cypress River Basin

The Cypress River Basin includes Caddo Lake, which is at the base of the Cypress Creek Basin watershed. The 1996 Assessment report for this basin did not mention the collection of data or analysis for any pesticides.

Guadalupe River Basin and the Lavaca/Guadalupe Coastal Basin

The 1994 report concluded that there was insufficient data for a complete assessment, particularly on organics, though pesticides are used in the basin. The 1996 reports had no conclusive data on pesticides.

Lavaca-Navidad River Basin

The 1994 Assessment for this basin concluded that water quality data on metals, toxics and pesticides were not sufficient to draw any conclusions. For the last five years, the USGS has been sampling for pesticides and other pollutants in Lake Texana and more recently at four tributary sites. For more information, refer to the Section on Special Studies conducted by USGS.

Lower Neches River Basin and Trinity Coastal Basin

The 1992 Regional Assessment of the Lower Neches River Basin identified some possible concerns for pesticides. A 1987 Neches River study by the Texas Water Commission showed that dieldrin occurred in excess of the human health criteria for ambient water. A 1992 Lower Neches Valley Authority questionnaire also stated that pesticides could be a problem in Segment 0701 (Taylor Bayou) due to a

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[59] Lower Colorado River Authority, Regional Assessment of Water Quality Colorado River Basin and Colorado/Lavaca Coastal Basin. Technical Report (Austin: LCRA, 1996), 5.
[60] Ibid., Chapter B, Sub-watershed Issues, Austin-2.
[61] Lower Colorado River Authority, Regional Assessment of Water Quality Colorado River Basin and Colorado/Lavaca Coastal Basin, Executive Summary (Austin: LCRA, 1996), 3.
[62] Ibid., 3.
[63] TNRCC, Texas Water Quality: A Summary of River Basin Assessments (Austin: TNRCC, 1996), 78.

mosquito control program conducted by Jefferson County and due to rice farming in the area. Responses to a 1992 citizen questionnaire demonstrated concern about biocide applications to crops in the Segment 0607 (Pine Island Bayou).

The 1994 Assessment of the Lower Neches River Basin concluded that toxic water quality data were generally lacking for this basin. With regard to pesticides, the 1994 Assessment did refer to several findings from the 1992 Assessment.

The Texas State Soil and Water Conservation Board and Texas A&M carried out a two year study from 1992-1993 funded by the Environmental Protection Agency on the impact of rice irrigation practices on water quality. The study was conducted by Garry Macauley of the Texas A &M Experiment Station. According to Macauley, the study was conducted in two of the wetter years in the Texas rice belt. For those pesticides reviewed (five total), ninety-eight percent of the chemicals stayed in the field. Macauley said that in a dry year, even lower concentrations would leave the field.[64]

The 1996 Assessment did not make any conclusions regarding cause of concerns for pesticides.

Neches-Trinity Coastal Basin

There was no mention of any pesticide data collected in the 1996 Assessment.[65]

Nueces River Basin

The combined drainage area of the Nueces River Basin is 16,950 square miles and includes all or parts of 23 counties. According to the 1994 Assessment, ten of the 17 river segments in this basin either have no data available for organic compounds such as pesticides or do not have any available data after 1988.[66] Four of the segments had data available for aldrin, but the data did not demonstrate water quality concerns.[67] The 1996 Assessment did not mention pesticides.[68]

Nueces/Rio Grande Coastal Basin

This area includes Corpus Christi Bay, Oso Bay, Upper Laguna Madre and Baffin Bay. The 1994 Assessment noted that only “very limited” water quality data were available for pesticides.[69] The Assessment did discuss a 1987 study by the National Oceanic and Atmosphere Administration (NOAA), which found the Nueces Coastal Basins to be at a “high or very high level of risk from [contamination by] agricultural chemicals,” primarily due to the extensive agricultural operations in these basins and the relatively high toxicity of trifluralin used on cotton.[70] Estimates were apparently based on the types of crops grown and typical pesticide use patterns rather than actual use data, however.

The 1996 Assessment did not discuss any pesticide water quality problems.

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[64] Garry Macauley, Texas A & M Experiment Station, Eagle Lake, Texas, interview with author 4.17. 98. Unfortunately, neither Macauley nor the Texas Soil and Water Conservation Board could provide copies of the study.
[65] Lower Neches Valley River Authority, Regional Assessment of Water Quality Lower Neches River Basin and Neches-Trinity Coastal Basin (Beaumont: LNVRA, 1996)
[66] Nueces River Authority, Regional Assessment of Water Quality, 1992 (Corpus Christi: Nueces River Authority, 1992), ES-2.
[67] Ibid., III-5.
[68] Nueces River Authority, Nueces River Basin Regional Assessment (Corpus Christi: NRA,1996)
[69] Texas Natural Resource Conservation Commission, 1994 Regional Assessment of Water Quality in the Nueces Coastal Basins (Austin: TNRCC, 1994), 139-144.
[70] Ibid at 178.

Red River Basin

There has been no systematic monitoring for non-point source pollution in this basin. Potential sources for non-point source pollution are cities, industries, agriculture, silviculture and on-site wastewater. The 1994 Assessment Report recommended that non-point source pollution and attendant monitoring remain a high priority for the basin.[71]

The 1996 Assessment states: "There has been …limited monitoring of herbicides, pesticides and PCB's in the Red River Basin over the past 30 years. Although cultivation of food and fiber crops occurs in many parts of the basin, there are insufficient water quality data available in the TNRCC records on chemicals used in crop production to make an assessment using the screening criteria."[72]

Rio Grande River Basin

For the purposes of this report, the authors paid special attention to the 1996 Regional Assessment of Water Quality in the Rio Grande River Basin. This 1996 Assessment stated that little information exists on toxic substances, particularly pesticides and heavy metals. The study further stated that information about types of land use, pesticide use, population growth, soil conditions, climate and other factors that influence water quality must also be compiled.[73] The Rio Grande Basin study pointed out that in the Arroyo Colorado upstream of the Port of Harlingen, the Texas Department of Health has advised people not to consume any fish from the waters. The Health Department is concerned with the presence of the pesticides DDE, toxaphene and chlordane. Use of all three of these pesticides have been banned in the U.S., but persist in the environment.[74] In addition to the analysis of fish tissue, biological methods were used to assess toxicity levels in the river system**.** According to the study, "the occurrence of pesticides is more widespread. Seven different pesticides (out of 50 tested) exceeded criteria at about a third of the sites. [DDT, lindane, dieldrin, DDE, chlordane, chlorpyrifos, diazinon]. The most frequent occurrences were in the Lower Rio Grande Valley, an intensively farmed area, and in the Laredo/Nuevo Laredo area. Three of these pesticides are (or were) used for home and garden use, suggesting urban as well as agricultural sources."[75]

Sabine River Basin

The 1994 Assessment for the Sabine River Basin found a possible pesticide concern (for malathion) in one segment out of 14 total segments. However, the Report stated that "this should not be taken to mean that there are no problems with organics in the Sabine Basin, it is simply a reflection of the fact that we lack sufficient data to assess the situation."[76] In the 1996 Assessment, preliminary results indicated ambient toxicity in one segment, and pesticides were identified as a possible cause. One of the recommendations of the Assessment report was that the Sabine River Authority sub-watershed inventory should continue collecting additional information on land use and other activities which can influence water quality.[77]

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[71] Red River Authority, Red River Basin Water Quality Assessment (Wichita Falls: Red River Authority, 1994), 3-40.
[72] Red River Authority, Red River Authority of Texas Regional Assessment (Wichita Falls: RRA, 1996), 85.
[73] Texas Natural Resource Conservation Commission, 1996 Regional Assessment of Water Quality in the Rio Grande Basin (Austin: TNRCC, 1996), 6.
[74] Ibid., 30.
[75] Ibid., 41.
[76] Sabine River Authority, Sabine River Basin Assessment of Water Quality (Orange: Sabine River Authority, 1994), 41.
[77] Sabine River Authority, Sabine River Basin Assessment of Water Quality (Orange: SRA, 1996), 7.

San Antonio River Basin

The 1994 Assessment for this basin concluded: “Of all the data reviewed during the 1994 assessment only organics (insecticides and herbicides) were found to have been analyzed less often than metals.”[78] There was a concern indicated for the pesticide aldrin in the Medina River below Medina Lake. The Assessment also stated that for “All other waters that are not designated segments, there is almost no toxic organic data.”[79] The 1996 Assessment stated that a plan to identify agricultural non-point source contribution to waters in the basin is being developed. The Assessment specifically mentions that this was “an important component of overall pollution problems and the effects occur in most streams in the basin. Considerable effort and expense will be required to isolate components and identify sources of pollution."[80]

San Antonio-Nueces Coastal Basin

The 1994 and 1996 Assessments concluded that the water quality data on toxic substances in the study segments of these coastal basins were not sufficient to draw any conclusions.

Sulphur River Basin

The 1994 Water Quality Assessment concluded that toxic organics data are lacking for all segments of the Sulphur River Basin.[81] The 1996 Assessment did not report any data on pesticides.[82]

Trinity River Basin

The 1994 Water Quality Assessment reported that the following organic parameters were found to be of no detectable concern in the 41 designated river segments of this basin: aldrin in Segment 804 (Richland-Chambers Reservoir); and lindane, 2,4,5-TP and 2,4-D in Segment 828. However, the report noted that there were insufficient data to determine water quality concerns for any other toxic organic compounds in all of the river segments.[83]

The 1994 Assessment did recommend that chlordane, endrin, PCBs, hexachlorobenzene, 1,1,1, trichloroethane, 2,4,5-TP and 2,4-D be designated for “Step 4 screening.” The only criteria for Step 4 screening of a toxic organic compound is that it be reported present in water in detectable concentrations. The other 54 organic parameters were either not present at detectable concentrations or there was no data for them in the existing database.[84]

The 1996 Assessment prepared by the Trinity River Authority recommended that because state and federal support for water quality monitoring has declined steadily for almost 20 years, the TRA should perform targeted sampling and analyses to prioritize pollution control efforts.[85] The Report also states

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[78] San Antonio River Authority, San Antonio River Water Quality Assessment (San Antonio: San Antonio River Authority, 1994), 4.
[79] Ibid., 120.
[80] San Antonio River Authority, 1996 Regional Assessment of Water Quality of San Antonio River Basin (San Antonio: San Antonio River Authority, 1996), Chapter IX, p. 1 of 3.
[81] Sulphur River Basin Authority, Regional Assessment of Water Quality (Texarkana: Sulphur River Basin Authority and Texas Natural Resource Conservation Commission, 1994), IV-2.
[82] TNRCC, Texas Water Quality: A Summary of River Basin Assessments (Austin: TNRCC, 1996), 30.
[83] Trinity River Basin Authority, Trinity River Basin Regional Assessment of Water Quality (Arlington: Trinity River Basin Authority and TNRCC, 1994), III-32.
[84] Ibid., III-25.
[85] Trinity River Basin Authority, Trinity River Basin Regional Assessment of Water Quality (Arlington: TRBA, 1996), 6.

that water quality has improved in the last 20 years, with point source treatment reaching a point of diminished returns and most of the remaining pollutant loadings are from non-point sources.[86]

San Jacinto River Basin, Trinity-San Jacinto Coastal Basin, San Jacinto Brazos Coastal Basin, Trinity-San Jacinto Coastal Basin

In the 1994 Assessment there was no data collected for organics except for trichloroethane. There was a recommendation that water quality monitoring and analysis of metals and organics should be a part of future actions.

In 1993, the Texas Department of Health issued a consumption advisory for fish and shellfish in portions of Clear Lake due in part to chlordane in fish tissue.[87]

The 1994 Assessment recommended that "small area studies should be developed as part of the Clean Rivers Program to investigate water quality issues, pollution sources, and management solutions for priority areas and parameters of concern within the basin."[88] Of the five river segments examined for the 1996 Assessment, there was no mention of any data on pesticides.

3. Conclusions Drawn from Review of Clean River Regional Water Quality Assessments

The main objective of the Clean Rivers Program is to provide a structure for on-going assessments of water quality, including, when feasible, additional water quality monitoring. Because fees from water and wastewater providers fund this program, the focus is not on detecting non-point source pollutants, such as pesticides. There are no standard parameters for evaluation or sampling for pesticides in the Clean Rivers Program. The Clean Rivers Program budget is too limited to support such expensive testing.

Nevertheless, several of the river authorities involved in the Clean Rivers Program Water Quality Assessments have reported that additional information on land use and other activities which can influence water quality would be most helpful in pinpointing geographic areas of the basin for water quality studies. With limited funds and resources, the River Authorities want to be able to focus on priority issues and identify pollutant sources in order to prevent and reduce pollution.

The historical pesticide data collected in the assessments were generally found to insufficient to draw conclusions, though some of the data did point to possible problems within a given basin. At the same time, the resources required to extensively monitor water quality of the basins for pesticides are beyond the financial capabilities of most, if not all, the river authorities.

4. Diazinon Problems for Wastewater Treatment Plants

Eight large municipal wastewater treatment plans in Texas have had difficulty meeting overall toxicity limitations on wastewater treatment plant discharges due to persistent problems with diazinon. Diazinon is causing wastewater treatment effluent to fail toxicity tests because the diazinon is not removed in the treatment process. Diazinon is an organophosphate pesticide, with widespread home and garden use. Cities and wastewater service providers with this problem include:[89]

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[86] Ibid., 15.
[87] Houston Galveston Area Council, HG Area Council Regional Assessment of Water Quality (Houston: HGAC, 1994), SJB.6.
[88] Houston Galveston Area Council, Houston Galveston Area Council Regional Assessment of Water Quality (Houston: HGAC, 1994), SJB.2.
[89] Letter from Kelly Holligan, TNRCC to Mary Sanger, TCPS, May 11, 1998, in response to request for information.

- Cibolo Creek Municipal Authority
- City of Denton
- City of Big Spring
- City of Greenville
- City of Fort Worth
- City of Temple
- City of Tyler
- Trinity River Authority

5. Special Studies Conducted by United States Fish and Wildlife Service

In Texas, the U.S. Fish and Wildlife Service conducts water quality-related activities from its regional offices in Austin, Arlington, Clear Lake, and Corpus Christi. A few of these activities relate to pesticides.

The USFW's Contaminant Study program was started in 1990. According to the biologist in the Austin regional office, the program is not geared up to do sustained long-term water quality studies, and what they are able to do is fairly haphazard because of lack of funding.[90] The Austin office is conducting two studies that might relate to pesticides. One study is looking at bat guano and how pesticides are carried into bat colonies. This study is not completed. The other study is looking at water quality in Barton Springs in conjunction with the endangered species listing of the Barton Springs salamander.

The USFWS Clear Lake office reports that several years ago it began a small pilot project to see if dieldrin, aldrin, chlordane, DDT, and toxaphene were in the water in the Anahuac National Wildlife Refuge, which is located in the Trinity River Basin on Trinity Bay. The study did not produce definitive conclusions regarding the presence or absence of these pesticides. USFWS has requested funding to conduct a more in-depth study of the presence and effects of pesticides on amphibians and reptiles in the Anahuac Refuge. According to a USWF biologist in the Clear Lake office, because of the short life span of many pesticides, scientists need to know what chemicals are used on crops in a timely manner in order to better understand possible effects on water quality and aquatic organisms. He also pointed out that farmers who contract with crop dusters do not always know what pesticides are being used. The sprayer might mix a concoction, rather than use a ready-made chemical. In addition, the biologist said that farmers might buy a different product each year due to price or what pesticide the salesperson might recommend at any given time.[91]

6. Department of Interior's U.S. Geological Survey National Water Quality Assessment Program (NAWQA).

In 1991, the USGS began to refine its National Water Quality Assessment Program through ongoing investigations of 59 of the Nation's important river basins and aquifer systems. The objectives of the NAWQA are to describe water quality conditions of the freshwater streams, aquifers and rivers of the United States; describe how water quality is changing over time and improve understanding of the natural and human factors that effect water quality conditions.[92] The Trinity River Basin in Texas was chosen as one of the 59 study areas.

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[90] Alan White, USFWS, Contaminant Specialist, Austin, Texas, interview with author, March 1998.
[91] Brian Cain, USFWS, Contaminant Specialist, Clear Lake, Texas, interview with author, March 1998. Also, see USGS, Water Quality Assessment of the Trinity River Basin, Texas, Pesticides in a Coastal Prairie Agricultural Area, 1994-1995, Open File Report 96-124.
[92] USGS, Water- Quality Assessment of the Trinity River Basin, Texas—Nutrients and Pesticides in the Watersheds of Richland and Chambers Creeks, 1993-95.

The USGS Trinity River Basin study analyzed pesticides in urban and agricultural streams. The USGS team collected and analyzed water samples throughout the Basin from March 1993 through September 1995.

Twenty-four herbicides were detected in urban streams and 19 in the agricultural streams. Fifteen herbicides were detected in both areas. Atrazine was the most commonly detected herbicide, occurring in all samples from both areas. Metolachlor was detected in about 80 percent of the samples from urban streams and in all samples from the agricultural streams. Prometon and simazine were two other commonly detected herbicides. These two occurred in about 90 percent of the urban samples and in about 60 percent of the agricultural samples. Ten insecticides were detected in the urban steams and 10 in agricultural streams. Other than diazinon, all insecticides in agricultural streams occurred in less than ten percent of the samples. Atrazine was the only herbicide with concentrations greater than applicable water quality standards. In the agricultural streams, approximately 20 percent of the samplings exceeded the MCL (maximum contaminant level) and HA (health advisory) for atrazine. Diazinon was the only insecticide with concentrations greater than applicable water quality standards.[93]

The USGS also conducted a specific study of pesticides from 1994-95 in the Coastal Prairie Agricultural Area of the Trinity River Basin. This coastal prairie area is upstream from Trinity Bay and the only area within the Trinity River Basin where rice is grown. A complex system of irrigation canals and drainage canals for return flows is required for rice farming in this area.[94] Water quality samples were collected from three watersheds in the coastal area. Twenty-nine pesticides were detected in one or more of about 60 surface-water samples from the three coastal prairie streams. The most frequently detected compounds were the herbicides atrazine, metolachlor and molinate. Concentrations and loads of atrazine, metolachlor, and molinate were highest in the watersheds where more had been applied to rice, sorghum, and soybeans and peak concentrations of atrazine, metolachlor, and molinate occurred in the spring, around the time of their application. Maximum concentrations of atrazine and metolachlor were almost always below drinking water standards set by EPA; no standards are available for molinate.[95]

The NAWQA Program is also conducting a South Central Texas study, which will look at the Guadalupe, San Antonio and Nueces River Basins. This study will analyze pesticides in fish tissues in the basin.[96] A full report should be available in early 1999.

7. USGS Special Studies

The USGS conducted a study on the Rio Grande/Rio Bravo to assess selected historical data for trace elements and organic compounds (including pesticides) in the riverbed sediments of the Rio Grande/Rio Bravo, the Pecos River and the Arroyo Colorado in Texas.[97] The study evaluated historical (early 1970s-1994) sediment quality data from 59 sites. Only 19 sites were sampled annually and had "relatively complete" analyses of data. The pesticides DDT, DDE and chlordane were found above detection/screening levels:[98]

[93] USGS, Water-Quality Assessment of the Trinity River Basin, Texas: Pesticides in Urban and Agricultural Streams, 1993-95, Fact Sheet-178-96 . (Austin: USGS, July 1996), 1-2.
[94] USGS, Water Quality Assessment of the Trinity River Basin, Texas Pesticides in a Coastal Prairies Agricultural Area, 1994-95, Open-File Report 96-124 (Austin: USGS, February 1996), 1.
[95] Ibid., 6.
[96] Evan Hornig, biologist with USGS office in Austin, interview with author, March 1998.
[97] USGS, Trace Elements and Organic Compounds Associated with Riverbed Sediments in the Rio Grande/Rio Bravo River Basin, Mexico and Texas, Fact Sheet FS-098-97 (Austin: USGS, 1997) 1-6.
[98] Id. at 5.

Compound	No. of Sites	Detections	Non-Detections
DDT	32	1	66
DDE	32	24	44
Chlordane	59	23	271

Chlordane concentrations were reported to "show a decreasing trend" with time at one site on the Arroyo Colorado where data were sufficient to analyze for such trends.[99] No detections were reported for 15 or so other pesticides for which some sediment sampling had been conducted.

The USGS conducted a water quality assessment of the Comal Springs System in New Braunfels, Texas from 1993-1994. These artesian springs are the largest in the southwestern United States and are an important recreational, economic and environmental resource for the region.[100] The springs are home to unique aquatic species such as the endangered fountain darter. As a part of a larger study conducted by the USFWS to understand the environmental needs of endangered and threatened species, USGS monitored selected water-quality parameters and collected water samples at selected sites along the Comal Springs river system. Of the 29 pesticides for which samples were analyzed only diazinon was detected during the summer, not in the winter, at two sites, in concentrations of 0.01 and 0.02 ug/L, respectively.[101]

The USGS office in San Antonio conducted a special study of Lake Texana and its contributing creeks. Lake Texana is located in Jackson County on the Lavaca River. Between 1992 and 1997, USGS took 535 samples, analyzing for 16 pesticides in water and/or bottom sediments at six sites on Lake Texana. In addition, the USGS took 29 total samples for the same 16 pesticides during 1996 and 1997 in four Lake Texana contributing streams. There were relatively few positive detections of pesticides in water samples and virtually none in sediments. The pesticides which occurred with the most frequency were picloram, 2,4-D and methyl parathion. The occurrence of pesticide detections was much higher in the contributing streams than in the lake itself.[102]

8. Corpus Christi Bay National Estuary Program

The Corpus Christi Bay area has been designated by Congress as an estuary of national significance. To help protect, restore and enhance the quality of the Bay, a community-based program was established to identify problems and develop a long-range plan for the Bay system. The Corpus Christi Bay National Estuary Program began in 1992. The CCBNEP has been gathering new and historical data on the bay ecosystem to identify and evaluate water pollution sources. A number of studies have resulted from CCBNEP's activities.

One CCBNEP report is a compilation of water quality, sediment quality and tissue quality data from 30 data collection programs carried out in the Corpus Christi Bay area.[103] The study concluded that "no definitive statements can be made about water-phase semi-volatile organics such as pesticides and PAHs, because data is sparse, and very few measurements are uncensored, most being simply reported as below detection limits. For example, the best-monitored pesticide is DDT, for which most areas of the bay do

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[99] Id. at 6.
[100] USGS, Water Quality Assessment of the Comal Springs Riverine System, New Braunfels, Texas, 1993-94 Fact Sheet FS-099-97 (San Antonio: USGS, 1997),1. The long-term average flow of the Comal River, which essentially is the flow from Comal Springs, is 284 cubic feet per second.
[101] USGS, Water Quality Assessment of the Comal Springs Riverine System, New Braunfels, Texas, 1993-94
[102] USGS, database provided by the USGS Regional Office in San Antonio to authors on May 1, 1998, in response to request for information.
[103] Corpus Christi Bay National Estuary Program, Current Status and Historical Trends of Ambient Water, Sediment, Fish and Shellfish Tissue Quality in the Corpus Christi Bay National Estuary Program Study Area (Corpus Christi: CCBNEP, 1997)

not have data."[104] The report did find that there was a bit more sediment-phase data, though most of the study area has not been sampled, and much of the data that exist are is below detection limits. The study found that the highest concentrations of the common pesticides were in Baffin Bay and Copano Bay.[105]

An additional work product of the Corpus Christi Bay National Estuary Program is a study of non-point source pollution in the bay system. Non-point source activities affecting the bays and estuaries include urban development, agricultural activities, septic tanks, runoff from landfills, and industrial and residential developments. Land use in the study area is dominated by agricultural and ranching activities. Most of the agricultural production is dryland crops such as cotton, corn, grain, sorghum and these are the crops that also often receive applications of nutrients and pesticides. This non-point source study states that "a substantial data gap exists on specific agricultural practices such as tillage practices, fertilizer, and pesticide applications and how they relate to NPS [non-point source pollution]."[106] A separate study is being conducted by the Texas Agriculture Experiment Station to help fill this data gap. The TAES study will include analysis of water quality data on runoff collected following rain events and is to be completed in 1999.[107] The University of Texas Marine Science Institute is also conducting a study that will collect data on rainfall and runoff within the King Ranch area.

The Corpus Christi Bay program study on non-point sources further stated that "data on urban and agricultural pesticide concentration in the CCBNEP study area is extremely limited. Although the NPDES sampling did not indicate the presence of pesticides, the earlier study by Oppenheimer in 1980 indicated the presence of diazinon and malathion (not sampled for by NPDES) in runoff samples. If possible, the NPDES sampling should be enhanced to include analysis for urban and residential pesticides used in the area. Other sampling efforts should be enhanced to include analysis for urban and residential pesticides used in the area. Available information indicates that pesticides occur in small (or trace) amounts and probably do not constitute a concern with biotics."[108] As noted above, however, the "available information" is extremely limited.

9. Galveston Bay National Estuary Program

Like Corpus Christi Bay, the Galveston Bay Estuary System has been named as an estuary of national significance. Land use in the Galveston Bay Estuary Program five county study area is very diverse: high density urban areas (10%), residential (9%), agricultural lands (22%), open/pasture land (23%), wetlands (15%), forests (18%), barren (1%), and water (1%).[109] The Galveston Bay National Estuary Program study of non-point sources and loadings in Galveston Bay noted that "The precise sources of NPS loadings are relatively difficult to determine due to their widespread, diffuse nature."[110] In regard to pesticides, the study found that "… the analysis of the metals and pesticides data was hampered by the presence of a high percentage of "non-detect" values." It was suggested that future studies use a better statistical technique such as probit analysis.[111] A 1993 study of the Bay system concluded, "High density

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[104] Ibid., xiv.
[105] Ibid., xiv-xv
[106] Corpus Christi Bay National Estuary Program, Characterization of Nonpoint Sources and Loadings to the Corpus Christi Bay National Estuary Program Study Area (Corpus Christi: CCBNEP, 1996), 31.
[107] The study is entitled " Action Plan Demonstration Project: Assessment of Surface Runoff Water for Sediment, Nutrients, and Chemicals from a set of Best Management Practices on Agricultural Croplands." The principal investigator is Bobby Eddleman, Texas Agricultural Experiment Station.
[108] CCBNEP, Characterization of Nonpoint Sources and Loadings to the Corpus Christi Bay National Estuary Program Study Area (Corpus Christi: CCBNEP, 1996), 81.
[109] Charles J. Newell, Hanadi S. Rifai, Philip B.Bedient, Galveston Bay Environmental Characterization Report (Webster: Galveston Bay Estuary Program, September 1993), 41.
[110] Charles J. Newall, Hanadi S. Rifai, Philip B. Bedient, Characterization of Non-point Sources and Loadings to Galveston Bay, vol.1 (Webster: Galveston Bay National Estuary Program, 1992)
[111] Ibid., 153.

urban land use areas were the main contributor of non-point source loads. For example, high density urban land uses contributed approximately 50% of the annual pesticide loadings."[112] The study further pointed out that "Agriculture was a relatively smaller contributor, as much of the local watershed is devoted to rice production, which hydrologically segregates the field from the watershed, detains water, and permits some settling prior to discharge."[113]

10. Texas Parks and Wildlife's Kills and Spills Report

For 30 years, the Texas Parks and Wildlife Department has been investigating mass kills of fish and wildlife in the state. Scientists at TPWD have also been examining "spills" of contaminants that threaten fish and wildlife. The Kills and Spills team has primarily focused on human activities that cause mass kills of fish and wildlife, rather than kills caused by natural phenomena. If the Department determines that a particular kill has been caused by human activity, the Department will seek restitution from the responsible party or parties. In October 1997, the TPWD's Kills and Spills Team issued an analysis of all their investigation reports going back to 1960.[114] In identifying the numbers of fish and wildlife killed by type of pollution, the Department's analysis concluded that 11 percent of the fish and wildlife kills were due to pesticides. Of the over 2.5 million fish killed by pesticides since 1960, about 40 percent were killed by agriculture pesticides; about 40 percent by urban runoff; 6 percent by industrial discharges; about 5 percent by illegal fishing (rotenone) and 1 percent by unknown causes.[115]

SAMPLE INCIDENT REPORTS FROM TEXAS PARKS & WILDLIFE DEPARTMENT FISH KILLS DATABASE

- *Lake near Leroy has a fish kill every time it rains . . . TX Ag Department found herbicides from neighboring cotton and wheat fields. # 19902M3*
- *Stressed fish were seen Friday after rainfall [in White Rock Lake]. The fish were all dead Saturday. The City of Dallas tested the water and found diazinon. # 19952M388*
- *Estimated total kill 4240 . . . A fish kill occurred in [Williamson] creek following a heavy rain. Suspected cause was a recent pesticide treatment for fire ants at an apartment complex adjacent to the creek . . Lab reports from water samples . . . show chlorpyrifos at 4ug/l. #19961A826*
- *Large crayfish dying all over Lake McQueeny . . . it is possible that the die-off was related to aquatic vegetation treatment earlier that fall resulting in habitat destruction. # 19971A863*
- *Losses of fish in 2 private ponds. The landowner had sprayed ethyl parathion on the field the week before the losses. The field is next to the Hagerman Wildlife Management Area of Lake Texoma. Ethyl parathion is toxic at 1.6 parts per million and can last up to 690 days in water at 20 degrees Centigrade. Normal breakdown is 60 to 70 days on land. Since this a rainfall season . . notification of the management area was necessary. No clean-up was performed, but some diking was done. # 19912M113*
- *The fish kill of approximately 600 mullet, sunfish and gar occurred in the Bay of Palacios and Matagorda Island Slough . . .The section of the bay where the kill occurred is adjacent to rice fields that are sprayed with pesticide for insects. The game warden reported a pesticide odor during the initial survey of the area. # 1993M281*
- *A late fish kill was reported in the Arroyo Colorado. Red drum were the only reported species affected. No official counts were taken. The cause of the kill is suspected [pesticide] aerial drift. # 19975A802*
- *A partial fish kill involving 100 minnows, sunfish and yellow bullheads occurred. Investigation by Ft. Worth personnel revealed contamination by organophosphates. # 19952M400.*

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[112] Charles J. Newall, Hanadi S. Rifai, Philip B. Bedient, Galveston Bay Environmental Characterization Report (Webster: Galveston Bay National Estuary Program, 1993), 189.
[113] Ibid.
[114] In preparing this analysis, TPWD concluded that adequate data was really only available for the last 15 years and therefore the analysis only reflects that period, rather than the last 30 years of reporting.
[115] Cindy Contreras, Texas Parks and Wildlife Department, Water Quality Coordinator, Kills and Spills Team, Kills and Spills Report Memorandum dated March 10, 1998, information provided to Texas Center for Policy Studies, in response to request for information.

III. PESTICIDES IN TEXAS GROUND WATER

A. Introduction

When first introduced into widespread use, pesticides were not deemed to be a threat to ground water. Early pesticides, such as arsenic, and the post-World War II synthetic pesticides, such as DBCP[116], were thought either to be captured in soils or to degrade quickly. That theory was shattered in the 1960s and 1970s, with proof that many pesticides were very persistent in the environment, and that some pesticides were showing up in aquifers which provided drinking water to rural and urban residents.

As in most states with significant agricultural production, Texas has found pesticides in a number of its aquifers. Unlike some states, such as Ohio and Wisconsin, Texas has not pursued a comprehensive process for detecting or reporting pesticides in ground water or for evaluating the significance of the problem. Even with the creation of an inter-agency ground water protection committee by the Texas Legislature in 1989, collection of data and the evaluation of risks have been slow.

As this inter-agency committee has pointed out, however, "data gaps" (such as the lack of pesticide use and fate data) are barriers to an effective program.[117] As discussed in a previous TCPS report,[118] Texas does not have a program for systematic reporting or collecting of pesticide use data, even in areas of the state with very vulnerable groundwater systems, such as the recharge zone for the Edwards Aquifer.

In addition, rural landowners have been reluctant to allow voluntary sampling of their water wells by representatives of state regulatory agencies. Thus, Texas agencies have not been able to evaluate the extent of the contamination problem, even for high-profile pesticides like atrazine.[119] For example, the Texas Groundwater Protection Committee (TGPC) identified an area along the Brazos River Alluvium in southeast Texas[120] as a region where atrazine is likely used and ground water is vulnerable to contamination. The TGPC designed a study program for the area, but could not carry it out. Farmers in the area would not allow their wells to be sampled for atrazine by representatives of the state agencies. While the members of the TGPC have the authority to go on the lands to sample the wells, they are reluctant to do so if farmers or ranchers object. Thus, TGPC only took samples from a few public wells, leaving the study with little scientific value.

The Brazos River landowners, like others in Texas, are concerned that if they allow government agencies to sample their water wells and the tests indicate contamination, these agencies will seek penalties from the landowners, even if the landowners have always used the pesticides in accordance with the label.

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[116]Dibromochloropropane was banned in the late 1970s. It had been widely used to kill nematodes in soils. It is suspected to cause sterility in men, as well as cancer. It is also suspected of being a testicular toxin. It has been found in wells in a number of states and foreign countries. The Leaching Fields: A Non-Point Threat to Groundwater, prepared by the Assembly Office of Research for the California Legislature, March 1985, pp. 84-87.

[117]See, for example, the draft report of the Data Evaluation Task Force of the Texas Groundwater Protection Committee of May 6, 1997. The Task Force found "that the current data are insufficient to conclude that all ground water susceptible areas of the state are unaffected by non-point source contamination by atrazine.... The present data base contains information of variable quality collected for various purposes."

[118] Texas Center for Policy Studies, Realm of the Unknown: Pesticide Use in Texas (Texas Center for Policy Studies: Austin 1999).

[119] Id.

[120]These alluvial or bolson deposits range from one to seven miles wide along 350 miles of the River. They provide a significant amount of water for irrigation. See, Texas Department of Water Resources, Ground Water Availability In Texas, Report No. 238, (TWDB: Austin, September 1979).

These rural landowners are reportedly also concerned that neighbors might sue them if the contamination migrated onto the neighbors' properties.

B. <u>Sources of Ground Water Contamination</u>

Risks to ground water are associated with use of pesticides by farmers and ranchers, urban pest control companies, homeowners and governments. Groundwater contamination can result from the use of pesticides in accordance with the restrictions on the labels, as well as misuse of the product.

In addition to normal use of pesticides, possible sources of pesticide contamination in ground water include:

1. Migration of pesticides through abandoned wells, unplugged wells, improperly completed wells and wells used to drain water from fields;

2. Spills of pesticides at facilities, such as airports, used by aerial applicators of pesticides;

3. Spills of pesticides at processing facilities such as cotton gins;

4. Spills of pesticides at manufacturing, formulation and distributing facilities;

5. Disposal of pesticides in landfills;

6. Back-flow of pesticides used in irrigation systems;

7. Treatment of road and railroad right-of ways with herbicides; and

8. Treatment of soils in urban settings, such as injection of pesticides to treat for termites.

Of the several known cases of pesticide contamination of ground water, many involve the presence of improperly completed or improperly plugged wells or spills of pesticides. Without a comprehensive evaluation of Texas ground water, however, Texas agencies cannot identify or evaluate the most significant potential sources of pesticide contamination for ground water, thus making it difficult to prioritize monitoring and prevention strategies.

C. <u>Survey of Reported Contamination Data</u>

Data on pesticide contamination of ground water are generally collected in one of three types of activities:

- Evaluation of known incidents of contamination;
- Routine testing by water supply systems; or
- Limited periodic sampling by government agencies.

1. Evaluation of Known Incidents

a. Investigation of arsenic contamination in the Ogallala Aquifer in Howard and Martin Counties: In the early 1980s, arsenic and nitrates were discovered in the Ogallala Aquifer in cotton production areas near Knott, Texas. Reports of cattle deaths in the area resulted in studies demonstrating that the deaths were the result of ingestion of arsenic by the cows.

Further investigation by TDA concluded that the contamination was the result of historic use of arsenic on cotton and poor management practices for cotton gin waste.[121] Movement of arsenic pesticides through uncemented or uncased wells was also identified as one possible source of the problem. One hundred rural water wells were sampled, and arsenic was found above the drinking water standard in 34 wells.[122]

As a result, many farms in Howard and Martin Counties installed their own water treatment systems. Farmers in the area agreed to a temporary prohibition on use of arsenic-based pesticides.

A more recent report suggests that the arsenic contamination in Howard and Martin Counties should be attributed to "point sources," e.g., cotton gins and gin trash.[123] The report does not, however, explain how this conclusion was reached. Moreover, the report does not explain the source of the nitrate contamination that was found along with the arsenic contamination in the earlier TDA study. Thus, leaching from the locations of the arsenic applications would still appear to be one of the likely sources.

b. Investigation of contamination in Dawson, Comanche, El Paso, Haskell, Hidalgo, Knox, Lynn, Stonewall, and Terry Counties: Because of the contamination found in Howard and Martin Counties, TDA began a more comprehensive evaluation of potential pesticide contamination of ground water in selected West Texas counties. As a result, a number of pesticides and fertilizers were identified in the ground water in these counties between 1988 and 1990. The agency apparently stopped testing in 1990. Pesticides confirmed in the ground water were arsenic, atrazine, dicamba, prometon, bromacil, picloram, triclopyr, metolachlor, 2,4,5-T, and 2,4-D.[124]

c. Investigation of contamination at pesticide applicator sites: In the 1980s, a number of studies were done to evaluate pesticide contamination at aerial and ground applicator sites. In one study, about 1000 sites were examined. At a number of the sites, ground water was found to be contaminated with pesticides, including ethyl and methyl parathion, pydrin, arsenic, 2,4-D, chlorpyrifos, atrazine, cypermethrin, permethrin, trifluralin, molinate and DDT.[125]

2. Testing by Water Supply Systems

a. Periodic testing of drinking water: Every supplier of drinking water to the public with 15 or more connections has to test periodically for contaminants. The frequency and number of contaminants evaluated depends on the size of the system. Of the almost 90 water systems which are monitoring and have had detections of pesticides in treated water between 1995 and 1997, (§II D), 9 get all or part of their water from ground water sources. Ground water-based systems detecting pesticides in finished drinking

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[121] Texas Department of Agriculture, Investigation of Arsenic Contamination of Groundwater Occurring Near Knott, Texas, (Texas Department of Agriculture: Austin, 1988).

[122] Many of these wells also exceeded the drinking water standard for nitrates, suggesting movement of fertilizers into the ground water.

[123] Texas Ground Water Protection Committee, Joint Groundwater Monitoring and Contamination Report – 1996, SFR-56, (Texas Natural Resource Conservation Commission: Austin, 1997), p. 65.

[124] Rick Piltz and Lea Aurelius, "TDA Analyzes Rural Water Wells for Pesticides,", in Grassroots, (Texas Department of Agriculture: Austin, Spring 1988), p.3.

[125] See letter report of Engineering Science, Inc. to the Texas Water Commission dated July 20, 1987 (TCPS files).

water include the Tulia and Friona municipal water systems (both with wells in the Ogallala aquifer) and Sagemeadow Municipal Utility District and the City of Huntsville (both getting some water from wells in the Gulf Coast Aquifer). Pesticides found include atrazine, alachlor and metolachlor.

b. Investigation of atrazine contamination in Friona, Texas: The City of Friona has repeatedly detected atrazine in one of the City's water supply wells. Atrazine was first detected in 1996, and the concentration of atrazine in the water in the well has increased steadily, with levels up to 6 ppb now detected. The drinking water standard for atrazine is 3 ppb. The other city wells are not showing any contamination. The source of the contamination has not been determined, partly due to the lack of any information on nearby use patterns of atrazine.

3. Limited Periodic Sampling

In addition to the data discussed above, the Texas Groundwater Protection Committee has reported that the state has also confirmed pesticides in ground water at several industrial and pesticide applicator sites.[126]

OTHER SITES WITH CONFIRMED GROUND WATER CONTAMINATION FROM PESTICIDES

Lonestar Army Ammunition Plant in Bowie County;
Fish Engineering and Construction in Brazoria County;
Atochem North America (Penwalt) in Brazos County;
Niagara Chemical (State Superfund site) in Cameron County;
Pharr Plantations, Munoz Borrow pits, and Hall Acre Road in Hidalgo County;
High Yield (State Superfund site) in Hunt County;
Texas Electric Cooperatives in Jasper County;
High Plains Underground Water District No. 1 in Lamb County;
TH Agriculture and Nutrition in Llano County;
Hale Dusting in Nueces County;
Chemical Enterprises (W.R. Grace) in Parmer County;
Greenway Aviation, Wrightway Spraying Service and County land in San Patricio County; and
City of Laredo Cattle Dipping in Webb County.

There are many other cases where pesticides have been found in limited groundwater tests, but not confirmed adequately for the state report. Nitrates, likely related to uses of fertilizers, have also been found and reported in the ground water of many other counties. For example, a survey by TDA in the 1970s and 1980s found extensive nitrate contamination in the region around Stephenville. [127]

D. Texas Response: Texas Groundwater Protection Committee and Texas State Management Plans

Texas has had informal inter-agency committees on groundwater protection since the early 1980s. In 1989, the more formal Texas Groundwater Protection Committee (TGPC) was created by the Texas Legislature to gather information on groundwater pollution, encourage better management practices and develop cooperative state responses to contamination problems.

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[126] Texas Ground Water Protection Committee, Joint Groundwater Monitoring and Contamination Report – 1996 , SFR-56 (Texas Natural Resource Conservation Commission: Austin, 1997).

[127] Lea Aurelius , Testing for Pesticide Residues in Texas Well Water, (Texas Department of Agriculture: Austin, 1989), pp. 25-26.

Participants in TGPC include agencies with the responsibility over pesticide use (Texas Department of Agriculture (TDA) and Structural Pest Control Board (SPCB)), protection of water resources (TNRCC, Texas Water Development Board (TWDB) and Texas Railroad Commission (TRC)), and protection of the public health (TDH). In addition, the Bureau of Economic Geology at the University of Texas, the Texas Agricultural Experiment Station and the Texas State Soil and Water Conservation Board have been invited to participate as members of the Committee.

In 1991, EPA initiated a program to encourage states to respond to the discovery that certain pesticides were being detected in ground water throughout the country[128]. EPA determined that atrazine and four other pesticides (simazine, cyanazine, metolachlor and alachlor) had a high potential to contaminate ground water. To avoid the need to ban the use of these pesticides, states were encouraged to prepare management plans. These plans are required to provide for ongoing programs that gather and evaluate basic information on ground water in relation to "pesticide usage patterns" and other factors[129]. TGPC was given the responsibility for preparing the plans.

The first plan to be prepared was a generic plan that could be used for any pesticide. This Texas State Management Plan for Prevention of Pesticide Contamination of Groundwater (SMP) is now in draft form and has been submitted to EPA for approval.

The Committee is also working on pesticide-specific plans that could be used to deal with specific occurrences of groundwater contamination. The first of these plans will focus on atrazine. The committee is, however, facing serious data gaps. First, current data on the use of atrazine is not available to allow the state to identify likely areas of risk. Some data is available from surveys done by the Texas Agriculture Extension Service in the early 1990s. Texas A&M officials, however, have been reluctant to provide detailed data to TGPC, arguing that if they did, farmers would not cooperate in the future with their surveys.

Since TGPC does not have current data on the use of atrazine, it has proposed an approach that focuses on vulnerable aquifers. With the assistance of the Blackland Research Center, TGPC is developing maps for areas vulnerable to groundwater contamination. Based on an early evaluation of vulnerable areas, the TGPC began examining areas where it believes that atrazine is used over vulnerable aquifers. TGPC attempted to verify its approach, but has not been able to do so.

TGPC initially picked an area of San Patricio County and obtained permission from farmers to test their wells. The farmers were, however, generally using water from a deep aquifer, not the shallow aquifer that the Committee believed was at risk. Thus, groundwater samples from the deeper aquifer did not provide useful information about potential contamination in the shallow aquifer. TGPC then turned to the Brazos River Valley, but, as was discussed above, TGPC was frustrated there by refusal of the local landowners to give the agencies' staff access to sample water wells. Thus, site specific pesticide use data will likely be needed to carry out the vulnerability assessments.

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[128] U.S. Environmental Protection Agency, Pesticides and Ground-Water Strategy, Report No. 21T-1022 (Washington, D.C.: 1991); U.S. Environmental Protection Agency, Guidance for Pesticides and Ground Water State Management Plans: Implementation Document for the Pesticides and Ground Water Strategy, EPA 735-B-93-005a (Washington, D.C.: 1993); Proposed Rule for Pesticides and Ground Water State Management Plan, Federal Register, vol. 61, No. 124, pp 33259-33301, June 26, 1996.

[129] See, e.g., Proposed Rule for Pesticides and Ground Water Strategy at 33269 (basis for assessment and planning).

IV. ENHANCING WATER QUALITY PROTECTION THROUGH BETTER DATA ON PESTICIDE USE

Given that water quality testing and analysis for the full range of pesticides that are of concern could be prohibitively expensive, state agencies, local governments and drinking water providers must look for ways to build a useful base of scientific information on pesticides and water quality in Texas. There are three relatively new water quality protection programs that are going to require much better data on pesticides if they are to be effective and efficient.

The first is the ***Source Water Assessment Program***. This program, which was put in place by the 1996 amendments to the federal Safe Drinking Water Act, is designed to help state and local agencies better assess contamination threats to drinking water supplies and to provide a mechanism by which drinking water suppliers can, when certain conditions are met, reduce expenditures for expensive chemical-by-chemical monitoring.

The second is the program for preparing what are know as Total Maximum Daily Loads (TMDLs) under Section 303(d) of the federal Clean Water Act. The state is responsible for preparing TMDLs for pollutants that are causing violation of applicable water quality standards. In Texas, the TNRCC has identified approximately 20 segments that may need TMDLs for various pesticides. Most involve concerns about atrazine, diazinon or chlordane.

The third program relates specifically to the protecting groundwater from contamination by pesticides. Under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), the U.S. Environmental Protection Agency is requiring states to develop plans to protect groundwater from contamination by agricultural chemicals, particularly those which have been shown to have a high potential for leaching into groundwater systems. The EPA will be reviewing state plans to determine whether they are adequate and the stakes are high: if the plan is not adequate, EPA could take steps to ban the use of certain chemicals. Some agricultural economists have estimated that use bans could cost Texas farmers millions of dollars in lower yields or higher costs for substitute pesticides.[130]

This section reviews these three programs, with an eye toward how the collection of better data on pesticide use is essential to their effective implementation in Texas.

A. Source Water Assessment Program[131]

In 1996, the U.S. Congress overwhelmingly approved amendments to the federal Safe Drinking Water Act. These amendments are designed to supplement the traditional approach of reliance on water treatment with strong efforts to better protect water quality at the source. At the heart of this approach is a program which requires states—in cooperation with drinking water providers, consumers and other interests—to undertake more complete analyses of the sources of contamination that could be affecting drinking water supplies and then take action to remedy those sources of contamination. The approach is designed primarily to enhance water quality protection at the source, thus reducing vulnerability of public water supply systems to contamination.

The amendments, however, also provide some incentives, many of which were necessary to secure full support for the legislation. One of these incentives is funding: federal monies can be used to help cover

[130] See, for example, Kelly Bryant et al., Economic Impact of Withdrawing Specific Agricultural Pesticides in the Lower Rio Grande Valley, Report No. TR-157, Texas Water Resources Institute, Texas A&M University (College Station, 1997).

[131] This discussion is based on: U.S. Environmental Protection Agency, State Source Water Assessment and Protection Programs: Final Guidance, EPA 816-R-97-009, August 1997.

the costs of conducting the source water assessments. Texas has elected, through the TNRCC, to use $2.5 million of its FY 1997 allocation from the federal Drinking Water State Revolving Fund, to fund source water assessment activities over a three-year period. Texas could have elected to use as much as $8.5 million.[132] The TNRCC will conduct the source water assessments in partnership with the U.S. Geological Survey (USGS).

The second major incentive relates to the extent of monitoring required for public water supply systems. If the state has an approved source water assessment program, it can provide flexibility to public water systems with regard to the extent of monitoring required for specific contaminants, potentially saving these systems thousands of dollars in monitoring costs.[133] The state's legal ability to provide this flexibility, however, will depend on having accurate source water assessments that can be used to demonstrate that the particular contaminant is not of concern for that water system because it is not likely to be present in the source water supply at any significant level. Under the EPA guidance, factors that the state must consider in making this determination include "patterns of contaminant use" and the location of potential contaminant sources within the source water review area. (See Appendix A for more discussion of the waiver procedures.)

A third major incentive relates to a heavy emphasis on public participation and public access to information. Guidance developed by EPA requires that the state provide for meaningful input from consumers, drinking water providers and many other interests in the development of the Source Water Assessments. It also requires that the information gathered in the assessment be summarized for the public in an understandable form and that all the information collected for the assessment be made available to the public upon request.

The new law and EPA's implementation guidance require that states develop a program to prepare Source Water Assessments for each public drinking water supply system in the state. A Source Water Assessment must be designed to define the boundaries of the land area within which sources of pollution could affect the quality of surface water or ground water used to supply public drinking water systems. The assessment must also be designed to determine whether and how much those pollution sources are affecting the quality of the drinking water supply.

By February 1999, Texas must submit to EPA the state's plan for conducting the required source water assessments. This submittal must describe: (1) how the state achieved public participation in developing the plan; (2) the details of the approach the state will take to conducting the source water assessments; (3) how the results of the assessment will be used in the state's efforts to protect source water quality; and (4) how the state will make the results of the assessments available to the public. The EPA has nine months to approve or disapprove the state's plan. If EPA does not act within the nine-month period, the state's plan will be automatically approved.

All the source water assessments are required to be completed within two years of the EPA approval of the state's program, unless the state request and receives an approved extension of up to no more than three and a half years after program approval. Each completed source water assessment must include:

1. A delineation of the source water protection area;
2. An inventory of the significant potential sources of regulated and certain unregulated contaminants found within the source water protection area; and

[132] See TNRCC Meeting Record from November 20, 1997 meeting of the interagency Texas Groundwater Protection Committee, p. 6.

[133] For a full description of the procedures for alternative monitoring, see U.S. Environmental Protection Agency, Alternative Monitoring Guidelines, August 8, 1997. Available on the Internet at http://www.epa.gov/ogwdw000/regs/pmrfin.html.

3. A determination of the public water supply system's susceptibility to contamination by sources inventoried within the source water protection area.

The assessments can be done on a "area-wide" basis involving more than one public water supply system. For example, if one reservoir was used to supply drinking water to several public water supply systems, the source water assessment for that reservoir and its contributing watershed would cover each system.

For purposes of this report, one of the most important requirements of the source water assessments is the inventory of--to use the exact regulatory phrase--"significant potential contaminants of concern". The "contaminants of concern" include, at a minimum, all the compounds for which EPA has developed drinking water standards under the federal Safe Drinking Water Act. This list includes the pesticides shown in Table 16.

Table 16. Pesticides That Are "Contaminants of Concern"

Pesticide	**Health Effects***
Alachlor	Cancer
Atrazine	Mammary gland tumors
Carbofuran (Furadan)	Nervous, reproductive system effects
Chlordane**	Cancer
Dalapon	Liver and kidney effects
Dibromochloropropane	Cancer
1,2-Dichloropropane	Liver, kidney effects; cancer
Dinsoseb	Thyroid, reproductive organ damage
Dioxin—impurity in herbicides	Cancer
Diquat	Liver, kidney, eye effects
2,4-D	Liver and kidney damage
Endrin	
Ethylene dibromide	Cancer
Glyphosate (Round Up)	Liver and kidney damage
Heptachlor***	Cancer
Lindane	Liver, kidney, nervous, immune and circulatory systems
Methoxychlor	Growth, liver, kidney, nerve effects
Oxamyl (Vydate)	Kidney damage
Picloram	Kidney, liver damage
Simazine	Cancer
Toxaphene**	Cancer
2,4,5-TP**	Liver and kidney damage

** Health effects indications from U.S. Environmental Protection Agency table on National Primary Drinking Water Standards; available on the Internet at http://www.epa.gov/OGWDW/wot/appa.html.*
*** Use banned.*
**** Drinking water standards also include heptachlor epoxide, a biodegradation product of heptachlor.*

In addition, under the 1996 amendments to the federal Safe Drinking Water Act, EPA is evaluating whether it should develop drinking water standards for several other pesticides, including those shown in Table 17. The agency is scheduled to decide by 2001 whether to develop standards for no more than 30 chemicals. If EPA determines new standards are necessary, the regulations must be proposed by August 2003 and adopted by February 2005.[134] Five of the pesticides on the candidate contaminant list are being

[134] See Drinking Water Contaminant Candidate list, *Federal Register*, 63:10273, March 2, 1998 and http://www.epa.gov/OGWDW/ccl.cclfs.html.

evaluated from the perspective of whether new drinking water regulations are needed: aldrin, dieldrin, metolachlor, metribuzin, and the triazines and their degradation products.

Table 17. Pesticides on Candidate List

Pesticides on Candidate Contaminant List for Possible New Drinking Water Standards
Alachlor ESA and other degradation products of acetanilide pesticides
Aldrin
DDE
Diazinon
Dieldrin
Disulfoton
Diuron
EPTC
Fonofos
Linuron
Methyl Bromide
Metolachlor
Metribuzin
Molinate
Prometon
Terbacil

States may also include in their Source Water Assessments those contaminants that are not federally-regulated under the Safe Drinking Water Act but which the state has determined may present a threat to public health. As shown in **Table 2** (Section II), there are several pesticides for which Texas has adopted water quality standards, but for which there are no drinking water standards. It is not yet clear whether Texas will include these contaminants in its source water assessments.

The EPA's guidance for the source water assessments requires that the inventory include a clear description of the sources of contamination (or categories of sources) by either specific location or area. Appendices to the Guidance list agricultural, landscaping or golf course activities as factors to consider when "doing an adequate contamination source inventory and adequate susceptibility analysis." The Guidance also notes that other factors, such as likelihood of the contaminants reaching the waterbody, the amount of contaminants being used, location of the public water supply intake relative to the source of contamination, etc. that should be considered in determining the significance of the potential source of contamination. Finally, the Guidance notes that as the analysis for any particular source water body becomes more detailed, the state may want to have the inventory be very location-specific "so that protection actions can focus on specific facilities or areas within a source water protection area."

In its initial efforts to plan its approach to source water assessments, TNRCC has identified agricultural chemical activities as one area where the agency is greatly lacking in the data necessary to complete source water assessments**.** (See Figure 1)**.** Although not specifically addressed in the TNRCC analysis, even less data are available for non-agricultural use of pesticides, which can also be a source of contamination.

The bottom line: source water assessments will be an important tool for protecting drinking water quality and possibly relieving some public water supply systems of high monitoring costs. Nevertheless, without better, site-specific information on agricultural and non-agricultural pesticide

use, the source water assessments cannot effectively address potential pesticide contamination of drinking water sources. This data gap could have implications for both the adequacy of the state's overall source water assessment program and for whether the assessments can be used to reduce water quality testing burdens on public water supply systems, as contemplated by the federal Safe Drinking Water Act amendments.

B. Total Maximum Daily Loads

The federal Clean Water Act requires states to set water quality standards. These standards include both "designated uses" (i.e. drinking water, recreation, aquatic life, etc.) for segments of streams, rivers, lakes and estuaries and ambient water quality criteria that must be met if the water body is to support the designated use. If water quality data show that a water body is not meeting its designated use because the water quality criteria are being exceeded, Section 303(d) of the federal Clean Water Act requires that the state perform an analysis designed to find out why the standards are not being met and to determine what additional water pollution controls might be necessary to clean up the water body to the point where it fully supports the designated uses. This type of analysis is referred to as a "total maximum daily load" or TMDL.[135] Within an individual watershed, it may be necessary to develop a separate TMDL for each different pollutant that is causing a violation of the water quality standards.

The TNRCC's 1998 TMDL draft list, released for public comment on March 13, 1998, lists 22 water bodies in Texas where pesticides are causing water quality violations and which may be candidates for TMDLs. Nine of these water bodies were listed as threatened because of public water supply system sampling that showed atrazine concentrations in the treated drinking water to be violating or approaching violation of the federal drinking water standard. Seven of the segments were listed due to fish consumption bans that had been issued because of chlordane contamination in fish tissue, though use of chlordane has now been banned. Three segments were listed due to diazinon exceeding limits set to protect aquatic life. The other segments were listed due to a combination of pesticide problems, some resulting from historical use of highly-persistent pesticides.

Because the state will have to identify and implement appropriate control actions to reduce the amount of these pesticides that enter the surface waters, successful completion of TMDLs to address these pesticide problems—particularly for widely used pesticides such as atrazine and diazinon—will require good data on pesticide use.

C. Groundwater Management Plans for Agricultural Chemicals

Although it has been slow to develop, EPA's program to protect groundwater, including drinking water sources, from pesticide contamination is now reaching an important stage. This program has significant implications for the state, as well as users of the targeted pesticides.

EPA first announced its approach to pesticides and ground water in 1991.[136] The approach centers around the "development and use of State Management Plans (SMPs) . . . to restrict the use of certain pesticides by providing the States with the flexibility to protect groundwater in the most appropriate way for local conditions."[137] EPA issued guidance for the SMPs in 1992, and after four more years of discussion with states, pesticide users and manufacturers, and other interested parties, it proposed rules for

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[135] See Texas Natural Resource Conservation Commission, Clean Water for Texas: Solving Water Quality Problems, Publication No. GI-229a (Austin, 1997) for an overview description of the TMDL process as it is being implemented by TNRCC.
[136] U.S. Environmental Protection Agency, Pesticides and Ground-Water Strategy, Report No. 21T-1022 (Washington, D.C.: 1991).
[137] Proposed Rule, *Pesticides, GWSMP*, Federal Register, Vol. 61, No. 124, p 33260, June 26, 1996.

implementation of the SMP.[138] This rule has yet to be finalized, but it is illustrative of what are likely to be the basic SMP requirements, applicable to five pesticides with high potential to contaminate groundwater: atrazine, simazine, cyanazine[139], alachlor and metolachlor, all of which are widely used herbicides.

As noted in the proposed rule,[140] information on “pesticide usage patterns” will be essential for the development of an adequate SMP, particularly if the state hopes to have a plan that is more flexible than just an overall statewide stringent use restriction. Given that these herbicides are so widely used and given that the EPA rule will likely require aquifer vulnerability assessments on a “sub-county level for the geographic area in which the State intends to allow continued use”[141] of the herbicides, fairly site-specific data on use patterns would seem to be essential for adequate, flexible SMPs.

[138] Id.
[139] Pursuant to a voluntary agreement between EPA and DuPont Agricultural Products, Inc. cyanazine will not be manufactured after 1999, and use is scheduled to phase out by 2002. Id at 33292.
[140] Id. at 33269.

[141] Id. at 33292.

V. CONCLUSION:

TEXAS NEEDS A PESTICIDE USE REPORTING SYSTEM

In order to provide better scientific data on pesticide use in Texas, the state should establish a pesticide use reporting system for both agricultural and non-agricultural uses of pesticides. Depending on available resources, it may be necessary to phase-in such a program over a 2 to 4 year period.

A pesticide use reporting system would provide agencies and the public with information on when, where, what types and in what quantities pesticides are being used in Texas. As discussed in previous sections, this information would greatly enhance the implementation of several important water quality protection programs. In addition, there are other clear benefits of pesticide use reporting, including:[142]

- a more accurate picture of pesticide use patterns in Texas;
- better information upon which to base pesticide registration decisions, especially for emergency exemptions or "special local needs" exemptions;
- better information with which to track the effectiveness of Integrated Pest Management initiatives and other pesticide use reduction efforts;
- better information to help understand and prevent pest resistance problems; and
- increased scientifically-valid information upon which to base pesticide regulatory decisions related to protection of water quality, food safety, worker health and public health.

A pesticide use reporting system, properly designed and implemented to avoid undue burdens on those required to report, would provide a viable mechanism for collecting important pesticide use information. Experience in other states with pesticide use reporting, such as California, New York and others, can be used to help Texas design an efficient, useful and workable program. Texas can also draw on its decade-long experience with the industrial toxics release inventory (TRI), which was put into place by the 1986 amendments to the federal Superfund law.

The TRI program basically requires manufacturing industries using greater than certain threshold amounts of any of about 650 toxics to publicly report their discharge of these compounds to the air, water and land. The TRI data is reported to TNRCC and the U.S. Environmental Protection Agency and is also available to the public. The availability of such data has allowed TNRCC to sensibly target pollution prevention efforts, many of which are voluntary in nature. In Texas, these efforts have allowed the state to document a 41 % reduction in releases and disposal of toxics between 1988 and 1996, even though there was a 30% increase in Texas manufacturing activity over that same period.[143]

Given the large number of farms in Texas (205,000) and the numerous and widespread non-agricultural uses of pesticides, full pesticide use reporting may not be possible immediately. Instead, priority could be placed on certain areas, such as the need for information on uses of pesticides that are of concern because of their potential to contaminate drinking water sources.

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[142] All the benefits listed, and more, have been identified by the California Department of Pesticide Regulation in relation to California's comprehensive pesticide use reporting system. See California Department of Pesticide Regulation, *Full Use Reporting: A Successful Partnership* (Consumer Fact Sheet; May 1995). See also Leonard P. Gianessi , "Has U.S. pesticide use really increased since 1993?" in *Agrichemical and Environmental News* (June 1996), identifying problems with EPA Market and Sales estimates and stating that "accurate, comprehensive, publicly available pesticide use data are needed in order to make informed and fair public policy decisions."

[143] Texas Natural Resource Conservation Commission, "Texas Leads Nation in Pollution Reduction: Clean Industries 2000, Pollution Prevention Efforts Cited", Press Release, June 18, 1998.

RECOGNIZED BENEFITS OF
PESTICIDE USE INFORMATION

*"Determinations of the types and quantities of pesticides applied in agricultural and non-agricultural settings are beneficial for monitoring usage trends and to predict potential exposure hazards…To monitor potentially hazardous situations, improved state and national systems are also needed for the reporting of pesticide usage…*AMERICAN MEDICAL ASSN., COUNCIL ON SCIENTIFIC AFFAIRS[144]

"Use reporting also provides documentation of farmers' efforts to adopt reduced-risk pest management practices, which helps increase consumer confidence in the safety of the food supply" CALIFORNIA DEPT. OF PESTICIDE REGULATION[145]

The new pesticide use reporting system in New York, even in the first year, has "provided invaluable information to the Department in the enhancement of the Pesticide Management Program." NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION[146]

"*The FQPA requirements are strict, but they are attainable, provided that EPA allows development of the best scientific methodology and data to meet the new safety standards and revised objectives for protecting children's health. They must secure data on non-food uses of pesticides. . . . Decisions must be based on actual pesticide use."* ARTICLE IN PEST CONTROL TECHNOLOGY MAGAZINE[147]

A pesticide use reporting system in Texas should take advantage of advances in electronic reporting and, to the extent practicable, be consistent with existing record-keeping requirements and practices of those who use pesticides.

KEY DATA ELEMENTS OF
PESTICIDE USE REPORTING SYSTEM

*****Location and date of pesticide application
*Amount of active ingredient applied and target pest
*Application method
*Applicator license/certification identification
*Sales reporting to capture urban use patterns

[144] Council on Scientific Affairs, American Medical Association, "Educational and Informational Strategies to Reduce Pesticide Risks", in Preventative Medicine 26:191-200 (1997).
[145] California Department of Pesticide Regulation, Pesticide Use Reporting: A Successful Partnership (May 1995).
[146] New York State Department of Environmental Conservation, Annual Report on New York State 1997 Pesticide Sales and Applications (Albany, NY:NYS Department of Environmental Conservation, July 1, 1998), p. 20
[147] Josof, L., "The Food Quality Protection Act sets a strict new standard that revolutionizes the way pesticides are registered. But is it realistic?", Pest Control Technology Magazine Online (June 1998); http://www.pctonline.com/inetpubpct/jun98/f60198f.htm.

DRINKING WATER MONITORING WAIVERS FOR PESTICIDES

Under both federal and state law, public drinking water systems must monitor for a variety of pollutants to ensure that there are no exceedances of drinking water standards in the water that reaches the tap. Table B-1 lists the pesticides to which these monitoring requirements currently apply and to which they might apply in the near future. Both federal and state law, however, provide opportunities for drinking water systems to seek waivers from monitoring requirements, if certain conditions are met. These monitoring waivers can save a significant amount of money, due to the high costs of laboratory testing for most pesticides. For example, the waivers granted by TNRCC since 1993 are estimated by the agency to have saved $ 49 million in monitoring costs statewide.[148] *(Table B-3 provides data on pesticide analysis costs).*

Table B-1. Pesticides for Which Drinking Water Monitoring Required[149]

2,4-D	***1,2 Dichloropropane****	***2,4,5-TP (Silvex)+***
Alachlor	***Aldicarb*****	***Aldrin*****
Atrazine	***Butachlor*****	***Lindane (Gamma-HCH)***
Carbofuran	***Carbaryl (Sevin)*****	***Chlordane+***
Dalapon	***DBCP*+***	***Dicamba***
Dieldrin**	***Dinoseb***	***Diquat***
EDB*+	***Endrin***	***Glyphosate***
Heptachlor	***Heptachlor expoxide***	***Methoxychlor***
Methomyl**	***Metribuzin*****	***Metolachlor*****
Oxamyl (Vydate)	***Picloram***	***Propochlor*****
Simazine	***Toxaphene+***	

*Volatile or semi-volatile organics that have been used as pesticides.
*Unregulated, but monitoring required.
+All or most uses banned.

As described in more detail below, these conditions generally relate to past monitoring history (i.e. whether the pollutant has been detected in previous monitoring) and the "vulnerability" of the drinking water source to contamination. The Texas Natural Resource Conservation Commission (TNRCC) has also granted broad state-wide monitoring waivers for three pesticides: endothall, diquat and glyphosate.

The following discussion explores the monitoring waiver provisions in more detail, especially with respect to pesticides. It explores what specific information on pesticide use and fate has been necessary under previous law in order to grant monitoring waivers and what type of relief those waivers have provided. It also explores what pesticide use and fate information will be necessary to grant monitoring waivers under the 1996 amendments to the federal Safe Drinking Water Act. Section B-1 focuses on federal requirements and Section B-2 discusses how TNRCC has implemented those requirements at the state level.

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[148] TNRCC, Chemical Monitoring Waiver Benefits, available at http://www.tnrcc.state.tx.us/water/wu/swap/benefit.html.

[149] Pesticides on EPA's Candidate Contaminant List for possible new drinking water standards in 2003 include aldrin, dieldrin, metolachlor, metribuzin and the triazines and their degradation products. Drinking Water Contaminant Candidate List, *Federal Register*, 63:10273, March 2, 1998 and http://www.epa.gov/OGWDW/ccl.cclfs.html.

Briefly, the analysis shows clearly that pesticide use data would greatly enhance the scientific validity of monitoring waiver decisions, making these decisions less vulnerable to question or challenge. In addition, the analysis shows that pesticide use data will likely be required for some pesticides if drinking water systems are to obtain the broad new monitoring relief potentially available under the 1996 amendments to the Safe Drinking Water Act.

B-1. Federal Law Requirements

1. Monitoring Waivers Prior to 1996 Amendments.

Prior to the 1996 amendments, the federal Safe Drinking Water Act did provide some limited options for monitoring relief, and the U.S. Environmental Protection Agency (EPA)—in consultation with drinking water providers, states and others—was developing a more detailed proposal for "Chemical Monitoring Reform" (CMR).[150] The CMR proposal was targeted toward allowing drinking water systems to monitor for specific chemicals only once during a five-year period, if certain conditions were met. The CMR proposal was not completed before the 1996 amendments, however. Nevertheless, EPA decided to include the CMR option in its August 1997 proposed rules for implementing the "Permanent Monitoring Relief" (PMR—now referred to as "alternative monitoring") provisions of the 1996 amendments.[151] The provisions of CMR and alternative monitoring under the new amendments are discussed below.

Even without the CMR proposal, however, some states, including Texas, had initiated a monitoring waiver program. These programs were based on 42 U.S.C. Sec. 300j-4 (Sec. 1445 of the SDWA, prior to '96 amendments), which provided, in pertinent part:

> *In requiring a public water supply system to monitor . . . the Administrator may take into consideration the system size and the contaminants likely to be found in the system's drinking water.* Sec. 300j-4(a)(1).

The Act imposed a minimal requirement to monitor at least once every 5 years. Sec. 300j-4(a)(2). It also allowed states with primacy enforcement authority, such as Texas, the ability to delete monitoring requirements for individual systems "after obtaining approval [by EPA] of assessment of the contaminants potentially to be found in the system." Sec. 300j-4(a)(3). In developing standards and monitoring requirements for organic pollutants—including pesticides—EPA basically required quarterly monitoring for an initial 3-year compliance period.[152] The regulations, however, also provided that monitoring frequency could be decreased to annual or less if the contaminant was not detected and the system received a waiver because it was not found to be "vulnerable" to contamination. Vulnerability assessments must be updated a minimum of once every three years.

2. Monitoring Waivers After the 1996 Amendments.

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[150] See Advanced Notice of Proposed Rulemaking for Drinking Water Monitoring, Federal Register, July 3, 1997, Vol. 62, p. 36100, 36117-18.
[151] Id.
[152] See generally 40 CFR Part 141.

At the time this report was being prepared, it was not possible to determine exactly what will be required for monitoring waivers under the 1996 amendments. EPA proposed rules for CMR and alternative monitoring in July 1997,[153] but, as of this writing those rules had not yet been finalized. EPA has stated that it expects to finalize the rules in August 1998. Nevertheless, the proposed rules, as well as EPA's final guidance for alternative monitoring[154] and its final guidance for implementation of the source water assessment and protection requirements,[155] give some idea of:

1. What monitoring relief will likely be provided with respect to pesticides and
2. What type of information with respect to pesticides will likely be required to justify monitoring waivers.

a. Potential Monitoring Relief.

Table B-2 provides a general comparison of monitoring requirements and relief available under the current system, under EPA's proposed CMR relief and under the more permanent monitoring relief that could be granted under the 1996 SDWA amendments. It is important to note that in Section 1418 of the 1996 SDWA amendments, Congress expressly provided that completion of a source water assessment, pursuant to an approved State Source Water Assessment Program (SWAP), was a prerequisite to granting "permanent monitoring relief" to any public water supply system.[156] These assessments are not formally required under the current waiver process, but, as discussed below, many of the factors considered in the current waiver process, at least as implemented by TNRCC are similar to the factors required to be assessed in a more rigorous manner under the source water assessment program.

Under EPA's proposed regulations for implementing CMR and alternative monitoring relief, a state could choose to retain its current waiver procedures until the expiration of the state's timetable for completing source water assessments.[157] EPA is considering whether to allow states to renew waivers for any public water system for which the state has failed to complete a source water assessment.[158]

Under EPA's proposed rules, a state could also adopt CMR provisions in place of its existing waiver procedure. This option, however, might prevent the state from granting any waivers until all source water assessments are complete.[159] Therefore, EPA is considering a proposal to allow states that adopt CMR to also retain their current waiver system, at least until the expiration of

[153] Id.
[154] U.S. Environmental Protection Agency, Alternative Monitoring Guidelines, August 6, 1997, http://www.epa.gov/ogwdw000/regs/pmrfin.html.
[155] U.S. Environmental Protection Agency, State Source Water Assessment and Protection Programs, EPA 816-R-97-009, August 1997.
[156] 62 FR 36120.
[157] 62 FR 36117.
[158] TNRCC has issued 3-year statewide waivers (1996-1998) for endothall, diquat and glyphosate. Under the state's proposed source water assessment schedule, source water assessments for all systems would not be complete until the end of 2001. Waivers for other pesticides for individual systems are also generally issued for a period of 3 years with the current waivers in place until 1998. See: http://www.state.tx.us/ water/wu/swap/vapp.html.
[159] 62 FR 36117.

the state's timetable for completing the source water assessment. States will not be able to make this decision, however, until EPA issues its final rules, which is anticipated to occur in August 1998 or later.

After the state has completed its source water assessments, it could adopt the alternative monitoring framework for granting systems more permanent monitoring relief. Under the final alternative monitoring guidelines published by EPA last summer, drinking water systems could be allowed **to forgo any monitoring of specific contaminants during the 5-year monitoring period**, if various conditions are met. In addition, the alternative monitoring framework could be used to allow public water supply systems to conduct "surrogate sampling from sampling points within a system or among two or more systems, in lieu of sampling every entry point into the [water] distribution system."[160] Surrogate sampling could greatly reduce the number of monitoring points and thus greatly reduce monitoring costs, especially for large systems.

[160] 62 FR 36121; Alternative Monitoring Guidelines, Sec. B.

Table B.2. Summary of Monitoring Requirements/Waiver Provisions

Feature	Current (TX-based on current federal requirements)[161]	Proposed CMR[162]	Alternative Monitoring Under SDWA Amendments[163]
Usual Monitoring Frequency	Quarterly as baseline. Reduction in frequency available if no detects and system not "vulnerable" to contamination.	Varies with system vulnerability	Varies with system vulnerability.
Waiver Provisions	Statewide 3-yr waivers for three pesticides; other 3-yr waivers for individual systems can reduce monitoring frequency or waive monitoring requirement.	State to develop targeting plan to screen systems to allow once/5-year monitoring, based on previous monitoring during period of "greatest vulnerability"; more vulnerable systems can be required to monitor more frequently.	Based on source water assessments, waive monitoring requirement for full 5-yr period (and can be renewed with renewal of assessment); also allow surrogate sampling within and between systems.
Considerations for waivers for specific contaminants	Previous monitoring data; previous use of contaminant within the watershed or zone of influence of well; proximity to potential source of contamination; environmental persistence and transport of the contaminant; how well the watershed is "protected from contamination"; nitrate levels.	Period of "greatest vulnerability" determined considering "local pesticide application practices"; previous monitoring data; fate and transport of contaminant; the "agricultural, commercial or industrial activities" within source water review area; susceptibility of water source to contamination.	Sampling point free of contamination based on previous data for source water review area; contaminant will remain reliably and consistently below MCL b/c all sources identified and under control and water treatment properly operated and maintained; fate and transport of contaminant; patterns of contaminant use; location of sources; results of source water assessments; efficacy of source water protection measures; and other factors

b. Information required for alternative monitoring waivers.

Under the 1996 amendments to the Safe Drinking Water Act and EPA guidance implementing those amendments, it is the source water assessments that will "generate the information to

161 30 Tex. Admin. Code Section 290.
162 62 FR 36000 et seq; proposed 40 CFR 142.16.
163 EPA, Alternative Monitoring Guidelines.

enable states to offer alternative monitoring to water systems in appropriate circumstances."[164] To grant monitoring relief for a particular pesticide, for example, the state must find, at a minimum:

> *(a) the sampling point is free of contamination and there is a high probability that it will remain so during the term of the waiver. A state may not make this determination if the contaminant has been detected within the* <u>*source water review area*</u> *of the sampling point within the last five years; or*
>
> *(b) the contaminant level will remain reliably and consistently below the MCL during the sampling period based on a finding that:*
>
> > *(i) the natural occurrence levels are stable and the contaminant does not occur because of human activity; or*
> >
> > *(ii) all the sources of potential contamination within the* <u>*source water review area*</u>*: have been identified, brought under control, and will pose no increased or additional risk of contamination to the source water withdrawal point during the sampling period; and the contaminant levels have peaked based on the history of sampling results and the duration of the contaminant in the environment; or*
> >
> > *(iii) the treatment at the sampling point is property operated and maintained, and is working reliably and effectively; and*
> >
> > *(iv) the highest levels are < MCL.*[165]

Under EPA guidance, the source water review area for systems supplied by surface water is the "watershed upstream of the source water withdrawal point."[166] For systems relying on groundwater, the source water review area is the source water protection area for the system (usually established by the state under the Wellhead Protection Program provisions of the Safe Drinking Water Act), where the area is based on a time of travel delineation "consistent with the sampling period" (i.e. 5 years). That is, the review area must include all sources from which contaminants can reach the supply well over a 5-year period.[167]

The foregoing provisions indicate that one avenue for granting a 5-year monitoring waivers for pesticides will be having a sufficient baseline of data showing affirmatively that the pesticide is not present. If, however, there is any showing that the contaminant has been detected within the source water review area (which can be the entire watershed for a system at the bottom of the watershed), a waiver cannot be granted unless the state can make a determination that the contaminant level will remain reliably and consistently below the MCL. This determination will necessarily involve identifying "all the sources of potential contamination within the source water review area." **The only way to make this determination for pesticides on a scientifically valid basis is to have pesticide use data.** Any other approach—i.e. assumptions based on cropping patterns or aggregated state/national pesticide sales[168]—is unlikely to provide a scientifically defensible basis for the determination.

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[164] EPA, Alternative Monitoring Guidelines, page 2.
[165] Id. Section A(1); emphasis in original.
[166] Id. , Section D(3).
[167] TNRCC generally uses a 20-year time of travel period for analyzing contaminant travel for non-point sources affecting <u>vulnerable</u> aquifers and a 40-year time of travel for contaminants from point sources.
[168] In lieu of pesticide use data, this is the approach TNRCC has been using to implement its current waiver provisions. See Section B-2.

The need for reasonably location-specific pesticide use data is reinforced by the other factors that the state must, at a minimum, consider in the contaminant specific waivers. These factors include:

(a) *the fate and transport of the contaminant;*
(b) *the patterns of contaminant use;*
(c) *the location of potential contamination sources within the source water review area;*
(d) *the hydrogeologic features within the source water review area;*
(e) *the integrity of the structures delivering source water to the sampling point;*
(f) *the results of all source water assessments that have been completed within the source water review area;*
(g) *the efficacy of any source water protection measures that have been enacted; and*
(h) *for waivers based on the contaminant remaining reliably and consistently below the MCL for the sampling period, the relationship of the sampling results to the MCL, the variability of the sampling results over time and the trend of the sampling results.*[169]

Pesticide use data is necessary for scientifically-defensible consideration of many of these factors, particularly "patterns of contaminant use" and "location of potential contamination sources", both of which are required to be considered in source water assessments. In addition, pesticide use data could help show the efficacy of voluntary best management practices being implemented to, for example, reduce pesticide run-off. That is, if the data show that pesticides are being used at a particular site or group of sites, but those pesticides are not showing up in either the surface water or in the drinking water monitoring results, a stronger case can be made for the efficacy of the management practices.

Finally, pesticide use data is necessary for the type of determinations that the state must make to allow "surrogate sampling points" for intra-system and inter-system sampling. To support these waivers, the state must determine that "the source water serving the surrogate sampling points is drawn from the most vulnerable portion of the same contiguous source water."[170] *"Vulnerability" with respect to pesticides is going to depend largely on local pesticide use practices, as EPA has recognized in its proposed definition of "greatest vulnerability" for the purposes of the CMR program.*[171]

In sum, pesticide use data is effectively required to ensure the scientific validity and defensibility of the determinations that must be made by the states in order to grant the broad, permanent monitoring relief under the 1996 amendments to the Safe Drinking Water Act (i.e. no monitoring for five-year period, with renewal option, plus surrogate sampling) for specific pesticides for which monitoring is otherwise required on a quarterly basis.

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[169] EPA, Alternative Monitoring Guidelines, Section A(2), emphasis in original.
[170] EPA, Alternative Monitoring Guidelines, Section B.
[171] 62 FR 36134, proposed addition to 40 CFR 141.2; definition of "periods of greatest vulnerability".

B-2. Texas Implementation and Waiver Requirements

1. *Current System.*

The current Texas system for granting drinking water monitoring waivers for pesticides and other compounds is based on the law as it existed prior to the 1996 amendments. Essentially, TNRCC has since 1991, implemented a "Vulnerability Assessment Program" (VAP) for Phases II and IV of the National Primary Drinking Water Regulations, which include standards for several pesticides (Table B-1).[172] TNRCC reports that the VAP has a staff of three full-time technical experts, a part-time data processing clerk and two part-time student interns.[173] According to TNRCC, Texas has over 5,700 community and non-transient, non-community (NTNC) public water supply systems, with a total of 7,600 entry points. There are 460 surface water intakes and over 11,800 wells and springs that supply drinking water.[174]

In 1997, the VAP team reportedly conducted over 5,000 assessments of public drinking water sources. The most recent round of vulnerability waiver evaluations, issued for the 1996-1998 period, resulted in state-wide waivers for endothall, diquat, glyphosate and dibromochloropropane (DBCP). Endothall and diquat are both used as aquatic herbicides, as well as for other purposes. Glyphosate is the active ingredient in the widely used herbicides RoundUp and Rodeo, among others. Use of DBCP is now banned due to links to sterility in men and other adverse effects.

*According to TNRCC, these waivers saved more than $ 5,300 for each sampling point.[175] TNRCC also reports that for the 1996-1998 period, almost half of the community and NTNC systems received waivers from quarterly monitoring for all organic chemicals. Most waivers are given to systems relying on groundwater, where it is theoretically easier to define the area of influence on the supply source.[** TNRCC data base being analyzed to provide more specific #s] The waivers granted by TNRCC since 1993 are estimated by the agency to have saved $ 49 million in monitoring costs statewide.[176] Table B-3 contains information from TNRCC on pesticide analysis costs.*

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[172] TNRCC, <u>Vulnerability Assessment Program</u>, October 3, 1996. Available at http://home.tnrcc.state.tx.us/water/wu/mon/vap.html.
[173] http://www.tnrcc.state.tx.us/water/wu/swap/process.html.
[174] Id. at p. 2.
[175] Id.
[176] TNRCC, Chemical Monitoring Waiver Benefits, available at http://www.tnrcc.state.tx.us/water/wu/swap/benefit.html.

Table B-3. Pesticide Analysis Costs

Pesticides	*Cost at TDH Lab**
SOC Group 3 (2,4-D;2,4,5TP, dalapon, dinoseb, picloram, dicamba.)	***$ 180***
SOC Group 4 (aldicarb, aldicarb sulfone aldicarb sulfoxide, carbofuran, oxamyl, carbaryl, hydroxy-carbofuran, methomyl)	***$ 164***
SOC Group 5 (alachlor, atrazine, chlordane, endrin, heptachlor, heptachlor epoxide, lindane, methoxychlor, simazine, toxaphene, aldrin, butachlor, dieldrin, metolachlor, metribuzin, propachlor, prometon, trifluralin)	***$ 236***
Endothall	***$ 293***
Diquat	***$ 198***
Glyphosate	***$ 139***

Source: Information provided by TNRCC Drinking Water Section in response to request for information; cost estimates effective 3/1/98; information provided June 17, 1998.

The TNRCC regulations set out several factors for consideration in granting monitoring waivers.[177] *If there is determination of no previous use (including transport, storage or disposal) of the contaminant within the watershed or zone of influence of the water source, a waiver may be granted. If "previous use of the contaminant is unknown or it has been used previously", then factors such as the following are to be considered in whether to grant waivers:*

- previous analytical results;[178]
- the proximity of the system to a potential point or non-point source of contamination . . . non-point sources include the use of pesticides to control insects, weeds, or pests on agricultural areas, forest lands, home and garden property, or other land application uses;
- the environmental persistence and transport of the pesticide, herbicide or contaminant;
- how well the water source is protected against contamination due to such factors as depth of the well, type of soil and the integrity of well construction. Surface water vulnerability determinations must consider watershed vulnerability and protection; and
- elevated nitrate levels.[179]

The description of the TNRCC VAP program implementation, however, indicates that for pesticides, TNRCC does not have site-specific, scientifically valid data on which to evaluate the proximity of potential sources of pesticide contamination.[180] *The basic data used by TNRCC for "use determinations" with respect to pesticides are: (1) surveys of crop types on irrigated land coordinated by the Texas Water Development Board; (2) a "county-level" database from Resources for the Future, which is based on 1987 Census of Agriculture and on consultation with Texas Agricultural Extension personnel; (3) crop statistics from Texas Agricultural Extension Service; and (4) a 1990 county-level survey conducted by the Texas Agricultural Extension Service.*[181] *This information is combined with information on the legally-registered uses of pesticides on crops. Information on silvicultural pesticide use is based on "telephone interviews" with the staff of the Texas Forest Service, along with forest land distribution information from the U.S. Forest Service (from 1992). For non-agricultural use, TNRCC relies on unspecified 1991 data from the Texas Department of Transportation; "telephone interviews" with major utility companies; a 1985 "urban pesticide use survey"(actually conducted in 1981); information on legally-registered uses for pesticides on turfgrass and ornamental plants; information from the Texas Parks and Wildlife Department on aquatic pesticide use; and a U.S. Army Corps of Engineers guide on aquatic herbicide use.*

None of these sources provide the reasonably site-specific, verifiable pesticide use data that are needed to identify the location of particular pesticide uses in relation to source water intakes. The Resources for the Future database is dated and is based on sales and marketing data and some survey data, not actual use patterns on specific sites in Texas. At best, it represents average

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[177] 30 Tex. Admin. Code Sec. 290.109(a)(5).
[178] For pesticides, TNRCC seems to take the position that "prior monitoring results" can consist of "one sample in aquifers where short-term fluctuations in water chemistry do not occur." VAP Program Description, p. 7 of 18.
[179] 30 Tex. Admin. Code Sec. 290.109(a)(5)(A-E).
[180] TNRCC, Vulnerability Assessment Program, full description, p. 5 of 18.
http://home.tnrcc.state.tx.us/water/wu/mon./vap.html. TNRCC states that it has focused on pesticide waivers in part because the analytical costs for pesticides are 2 to 10 times greater than for volatile organic compounds.
[181] Id.

application and treatment rates, all of which could vary significantly with location, weather and other factors. Information on legally-registered uses and cropping patterns can give only theoretical use patterns, as they do not necessarily represent what is actually being used by a particular farm, in what amounts or, importantly, when the pesticide is being used. Credible pesticide use data are especially scarce for non-agricultural uses.

On the other hand, site-specific pesticide use data for agricultural and non-agricultural uses would provide a sound scientific basis for waiver decisions for individual pesticides. The availability of such data would likely greatly facilitate and simplify the waiver decision process, saving money for both TNRCC and water systems.

2. *TNRCC Procedures Under 1996 Amendments to SDWA.*

In recent waiver evaluations, TNRCC staff have noted that "advanced source water assessments" could be used to better target sampling times and sites.[182] *This is particularly true for staff waiver recommendations that are based on "lack of detects indicating short environmental half-lives or not sampling at the period of greatest vulnerability at the correct locations."* [183] *Without reasonably location-specific and verifiable pesticide use data, however, it is hard to see how advanced source water assessments would really enhance the scientific validity of the waiver determinations for all systems across the state.*

The Source Water Assessment program—and the broad monitoring relief that can be linked to it—establishes the need for pesticide use data, at least for those pesticides on the drinking water monitoring list used in quantities and locations that present a significant potential source of contamination. The few states that have pesticide use data should be far ahead of the game. Texas can join this group by enacting a reasonable, targeted pesticide use reporting system which can be in place before the source water assessments must be completed (2001).

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[182] TNRCC InterOffice Memo and attachments—Waiver Determinations for 1998; dated November 5, 1997; obtained through Open Records Act Request.
[183] Id.