STATE OF LOUISIANA

EDWIN W. EDWARDS, GOVERNOR

DEPARTMENT OF ENVIRONMENTAL QUALITY

Patricia L. Norton, Secretary

GROUND WATER PROTECTION IN LOUISIANA: PROBLEMS AND OPTIONS

REPORT BY THE SECRETARY'S

GROUND WATER ADVISORY GROUP

Baton Rouge, Louisiana
August 1985

PREFACE

The availability of clean potable water is a basic necessity of life that has long been taken for granted and is now threatened by our burgeoning society. Louisiana is ideally situated with its abundant resources of both ground and surface water. Problems and potential problems of contamination of our streams and lakes were recognized long ago and major programs were developed and now operate to ensure maintenance of surface water quality standards.

The vulnerability of ground water to contamination from human activities, particularly the disposal of waste products, has only recently been widely recognized. Widespread concerns about ground water protection have risen at local, state, and federal levels. The Department of Environmental Quality considers protecting ground water from contamination a paramount issue within its overall charge to protect the quality of our environment in Louisiana. Toward this end, I have appointed an Advisory Group of knowledgeable professionals in the fields of ground water and related environmental areas to aid the Department in developing a Ground Water Protection Strategy. This document represents the first report of the Advisory Group toward developing that objective.

The professionals who comprise the Ground Water Advisory Group have generously given their time and expertise to the development of this report. For all members this project was attended to largely after long hours at their regular positions. Each member's training and experience served to bring unique aspects of the ground water situation into focus. I am deeply grateful for their help with this project and for their personal and professional commitments to environmental quality for Louisiana. I look forward to continuing our work on developing ways to protect and enhance the quality of Louisiana's precious ground water resources.

The opinions, findings, conclusions or recommendations expressed in this report are those of the authors and do not necessarily reflect the views of any agency, department, or individual.

This report provides an inventory of the major sources ground water contamination. It is not intended to be exhaustive, but rather to provide a snapshot of what is presently known. It is hoped that this report will generate discussion among all affected interests and will bring us closer to the establishment of a long term protection strategy for our ground water.

Patricia L. Norton, Secretary

Department of Environmental Quality

LETTER OF TRANSMITTAL:

The Report of the Ground Water Advisory Group

This report is being submitted in response to a request from the Secretary of the Department of Environmental Quality to develop a framework for a strategy to protect ground water in Louisiana from contamination. The Advisory Group believes that the following information is necessary for the development of a framework:

* A definition of the problem and
* An enumeration of the measures available to deal with the problem.

After reviewing a large volume of information on the subject published by the State of Louisiana, the Environmental Protection Agency, the Office of Technology Assessment of the U.S. Congress, reports prepared in European countries, and other materials, the Advisory Group wished to organize and synthesize its findings to date. The group decided that the findings could best be issued as a report entitled "Ground Water Protection in Louisiana: Problems and Options." The report contains discussions of known sources of contamination, a description of the technical complexities of discovering ground water quality problems, the roles of public agencies and an outline which

TABLE OF CONTENTS

LIST OF ACRONYMS USED IN THIS REPORT

API - American Petroleum Institute

CERCLA - Comprehensive Environmental Response Compensation and Liability Act of 1980 by the U.S. Congress

DEQ - Louisiana Department of Environmental Quality

DHHR - Louisiana Department of Health and Human Resources

DNR - Louisiana Department of Natural Resources

DOA - Louisiana Department of Agriculture

DOTD - Louisiana Department of Transportation and Development

EPA - The U.S. Environmental Protection Agency

FIFRA - Federal Insecticide, Fungicide, and Rodenticide Act

LGS - Louisiana Geological Survey

LRS(RS) - Louisiana Revised Statutes

RCRA - Resource Conservation and Recovery Act of the U.S. Congress

SDWA - Safe Drinking Water Act of the U.S. Congress

USDW - Underground source of drinking water

USGS - U.S. Geological Survey, Water Resources Division

WL&F - Louisiana Department of Wildlife and Fisheries

WPCA - The Water Pollution Control Act of the U.S. Congress (The Clean Water Act)

GROUND WATER PROTECTION IN LOUISIANA: PROBLEMS AND OPTIONS

EXECUTIVE SUMMARY AND CONCLUSIONS

Until recent years our ground water resources were taken for granted--"out of sight, out of mind." Not only has there been a lack of appreciation of the importance of the resource (85 percent of public supply systems and over half of the state's population depend on ground water) but the mistaken notion that ground water is immune to contamination has prevailed. Recent experiences have demonstrated the vulnerability of our ground water supplies to contamination from many potential sources and through numerous pathways. Waste site investigations and cleanup of contaminated aquifers have proven to be costly and difficult and prevention of ground water contamination is obviously the solution to the problem.

At the federal level, the Environmental Protection Agency released a "National Ground Water Protection Strategy" in August 1984 intended to bolster the ability of state agencies to protect aquifers. In October 1984, the Office of Technology Assessment of the U.S. Congress released the report, "Protecting the Nation's Ground Water From Contamination", which concluded that the potential risks of contamination are significant and that laws and programs must be broadened to better protect the quality of our ground water. Congress recently amended RCRA to place emphasis on ground water protection activities and President Reagan has proposed a $4.7 billion EPA budget for

* Recommend a priority system for cleanup of waste sites that endanger drinking water.
* Review and recommend remedial plans for such sites.

The first undertaking of the advisory group was to investigate and document the major categories of <u>sources</u> of ground water contamination that must be considered in developing a ground water protection strategy. These were categorized as listed below and descriptive reports were prepared including description of the source, regulations, nature of problem, conclusions, and suggestions for future action.

1. <u>Inactive and abandoned hazardous waste sites.</u> DEQ and EPA are currently assessing a list of more than 300 sites. These are of serious concern and cleanup is mandatory to protect our ground water. Public awareness is important for identification of unknown sites. Adequate funding for investigations and cleanup will be difficult.

2. <u>Inactive hazardous waste sites at operating industrial facilities.</u> Detection of ground water contamination at inactive sites within operating facilities is difficult, because monitoring of the inactive sites is not required unless leakage has been detected. A mechanism for ensuring the integrity of these inactive waste sites is needed, including regulations for monitoring and any needed remedial action. Active hazardous waste sites were not addressed in this section because they do not represent as large a potential threat as cells constructed prior to current RCRA standards.

3. <u>In-plant sources of contamination.</u> Accidental spillage can create an insidious problem because of slow movement and delayed detection of contaminants. However, conduits to ground water can and have resulted in serious contamination. Plans need to be developed to obtain adequate assessment data, including background information on water quality.

4. <u>Leaking underground storage tanks and lines.</u> Storage tanks and lines are not presently regulated and no assessment of the problem or potential problem has been

past decade, considerable progress was made in ensuring that abandoned water wells were plugged properly, especially public supply and industrial water wells and water wells in and near waste sites. However, old (pre-1975) abandoned water wells may not be plugged properly and are considered a potential source of contamination. The licensing of water well contractors, the continued implementation of standards for water well construction and abandonment, along with a public awareness and education program, should encourage the plugging of these wells to minimize this potential source of contamination and encourage the reporting and plugging of newly abandoned water wells and holes. The adequacy of methods used to plug and seal seismic and cathodic-protection holes should be evaluated.

9. Agricultural sources. Major agricultural sources are pesticides, fertilizers, and barnyard or feedlot wastes. Some major pathways of concern are washout pits used by aerial applicators of pesticides, irrigation and domestic wells that are not adequately sealed, old dipping pits for farm animals, and downward leaching of pesticides to shallow aquifers in areas overlain by sandy soils. Regulations to outlaw washout pits and to mandate surface seals for wells are in progress. Old uncorrected situations, however, may cause future problems.

10. Septic tanks. Septic tanks are a potential source of widespread ground water pollution, and instances of contamination of shallow ground water have been documented. Fortunately, large areas of the state are afforded some protection from this source because low-permeability clay layers overlie aquifers. Planning is needed to: minimize the potential for exposure by ensuring adequate standards and enforcement; encourage use of adequate community sewer systems; and provide for disposal of home-generated hazardous wastes that might otherwise go into septic tanks. Areas of ground water recharge should be mapped, and the maps made available to the public.

Some well-known sources of contamination were not considered because they were outside of the scope of work assigned to the Advisory Group. Notable among these sources are contamination by encroachment of native saltwater (saltwater down deep within the aquifer), by radioactive waste sources,

TABLE 1

SUMMARY AND ASSESSMENT OF SOURCES OF CONTAMINATION AND PATHWAYS CONTRIBUTING TO GROUND WATER QUALITY PROBLEMS IN LOUISIANA
(Continued)

SOURCE OR PATHWAY	Agency having jurisdiction	Status of		Assessment
		Legislation	Regulation	
8(b) Seismic holes	WL&F	Inadequate	Inadequate	Should evaluate procedures for plugging seismic bore holes.
9. Agricultural sources	DOA	Adequate	Adequate	Old, pre-regulation situations such as buried pits and improperly constructed farm wells may cause problems.
10. Septic tanks	DHHR	Being revised	Being revised	Widespread potential sources that have caused ground water contamination locally. Need better planning and regulation.

Natural Resources (DNR), Transportation and Development (DOTD), Wildlife and Fisheries (DWL&F), and the Capital Area Ground Water Conservation Commission.

DEQ's programs and role as the state's environmental protection agency include broad concerns and responsibilities for ground water protection. DNR also has numerous responsibilities to protect ground water related to oil and gas production, injection wells, and exploration and development of other minerals. DOTD has responsibilities for ground water activities related to water well regulations and standards for water well construction, plugging and abandonment of all wells and bore holes not related to mineral extraction, licensing of water well drillers and control of free-flowing wells. DHHR's responsibilities relate to regulation of public water supplies to prevent contamination and assure the public of good drinking water quality. DOA's role in ground water protection is related to enforcement of regulations pertaining to the State Pesticide Law. The Department of Wildlife and Fisheries jurisdiction over ground water protection is limited to regulation of seismic bore holes.

The Capital Area Ground Water Conservation Commission has jurisdiction over a five-parish District surrounding Baton Rouge. The Commission , which is charged with conserving and protecting ground water, has the power to regulate ground water use.

Federal agencies involved in ground water issues include the U.S. Environmental Protection Agency (EPA) and the U.S.

Some conclusions are listed that may be drawn from the work of the Ground Water Advisory Committee to date:

* Ground water is a source of drinking water for more than two million Louisianians, over half of the state's population. It is a priceless and irreplaceable resource that should be protected.

* The ideal and ultimate solution to ground water contamination is <u>prevention.</u>

* Adequate funding of state regulatory programs is essential to ensure protection of ground water in the state.

* There is a need for trained personnel to carry out the environmental functions required to protect ground water. Funds should be provided for adequate training programs at state universities.

* Although Louisiana is less vulnerable to ground water contamination than many states with less favorable geology, many instances of local contamination continue to be detected on a regular basis.

* At least ten major categories of sources of contamination and pathways for contaminants to reach our drinking water presently exist.

* Although some of these sources are being addressed by existing regulation and laws, some of these programs should be strengthened and expanded to include all potential sources.

* There is a need for all state agencies with ground water protection jurisdiction to work together to develop a coordinated approach to long term ground water protection strategies.

1. INTRODUCTION

1.1 Background

Most of Louisiana is blessed with ground water of excellent quality that provides the source of drinking water for over two million Louisianians, more than one-half of the population. It is becoming increasingly clear that our ground water is highly vulnerable to contamination from a broad range of man-made sources.

We believe that it is of utmost importance that adequate measures are taken to protect the quality of this ground water from all types of contamination so that its use as a safe source of drinking water can be ensured for the future. We believe that ground water protection is preferable to the costly and unsatisfactory process of treating ground water that has become contaminated or developing alternative sources for drinking water supplies.

1.1.1 Federal concerns

At the federal level, Congress revised the Resource Conservation and Recovery Act (RCRA) in 1984 to address many issues related to ground water protection. In late 1984, the Environmental Protection Agency (EPA) issued a national "Ground Water Protection Strategy" for the purpose of"...bolstering the ability of state agencies to protect aquifers." Under this strategy, the level of protection afforded ground water will depend on its current or potential use. The plan outlines three requiring disposers to be financially responsible. In addition, laws have been passed to protect ground water, such as the prohibition of land disposal of hazardous waste by 1991. The responsible state regulatory agencies have been actively enforcing environmental regulations. The Governor recently established a Water Resources Advisory Committee. The Committee's responsibility is to study various aspects of water problems and to emphasize the need to protect ground water.

1.2 The Ground Water Advisory Group

The Louisiana Department of Environmental Quality has statutory responsibility for protecting the state's ground water resources. In May 1984, the Secretary of DEQ established a Ground Water Advisory Group comprised of professionals, from around the state, experienced in environmental areas related to ground water. The group was asked to pursue the following objectives:

* To establish a framework for and develop a ground water protection strategy for the state.
* To recommend a priority system for the cleanup of waste sites that endanger drinking water.
* To review and make recommendations on remedial plans for such sites.

This report furnishes background information related to the first objective. The second and third objectives will be

2. ASSESSMENT OF SOURCES CONTRIBUTING TO GROUND WATER QUALITY PROBLEMS IN LOUISIANA

2.1 INACTIVE AND ABANDONED HAZARDOUS WASTE SITES

2.1.1 Description

Inactive hazardous waste sites are broadly defined as those sites containing hazardous wastes, which are still owned or controlled by a responsible party, but where treating, storing, or disposing of hazardous wastes is not ongoing. Abandoned sites are similar, except that no responsible party has been found, and the Secretary of the Department of Environmental Quality has officially declared the site abandoned as provided by the Louisiana Environmental Quality Act.

2.1.2 Regulations

Regulations governing inactive and abandoned sites are authorized by both the state and federal government. The U.S. Congress passed the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly called Superfund, in 1980. The act provides for a fund to be administered by the Environmental Protection Agency (EPA) for the cleanup of inactive sites as well as a mechanism for federal and state oversight of the cleanup by responsible parties. CERCLA lists hazardous substances, including many chemicals not previously listed as hazardous wastes by the Resource Conservation and Recovery Act (RCRA). CERCLA has broader investigation may cost as much as a million dollars. If an average figure of $50,000 is used for site investigations at approximately 300 sites, the cost, in current dollars, to assess these sites would be 15 million dollars. Although cleanup costs vary greatly, an average figure can be placed at $1,000,000 per site. If wastes at only 50 of the 300 sites are found to be hazardous, the cost, in current dollars, to clean up these sites would be 50 million dollars. Louisiana therefore needs a minimum of 65 million dollars to address the existing, known problems.

Delays in obtaining adequate funding will drive these costs higher. Not only does inflation cause increases, the longer a site remains in the environment, the larger the problem. Wastes migrate through the soil by percolation. Once they enter the ground water, the problem is further compounded by the large volumes of liquids with low levels of contamination. Every year of delay in adequate funding for cleanup of these sites increases the cost of remediation.

The law is now in place, and soon to follow are the regulations that will enable the cleanup of these inactive or abandoned sites. While this is a major step, it does not address the problem of identifying these sites or the problem of tracing the generators of the wastes found at these sites. For instance, in the case of a site that was operated by a now defunct company, the records that would allow the identification of the generators of the wastes likely would not be available. The most significant problem is identification of sites because

2.1.5 Suggestions for future action

Three suggestions for future action are:

1. Promulgate the regulations required by Section 1149 of the Environmental Quality Act as soon as possible.
2. Continue to develop public awareness of efforts to identify inactive and abandoned hazardous waste sites. (An informed public is one of our most important environmental assets.)
3. Establish a larger, more predictable source of funding for the Abandoned Hazardous Waste Site Cleanup Fund.

2.2 INACTIVE HAZARDOUS WASTE SITES AT OPERATING FACILITIES

Active hazardous waste sites at operating facilities are not addressed in this section because they do not represent as large a potential threat as cells constructed prior to current RCRA standards.

2.2.1 Description

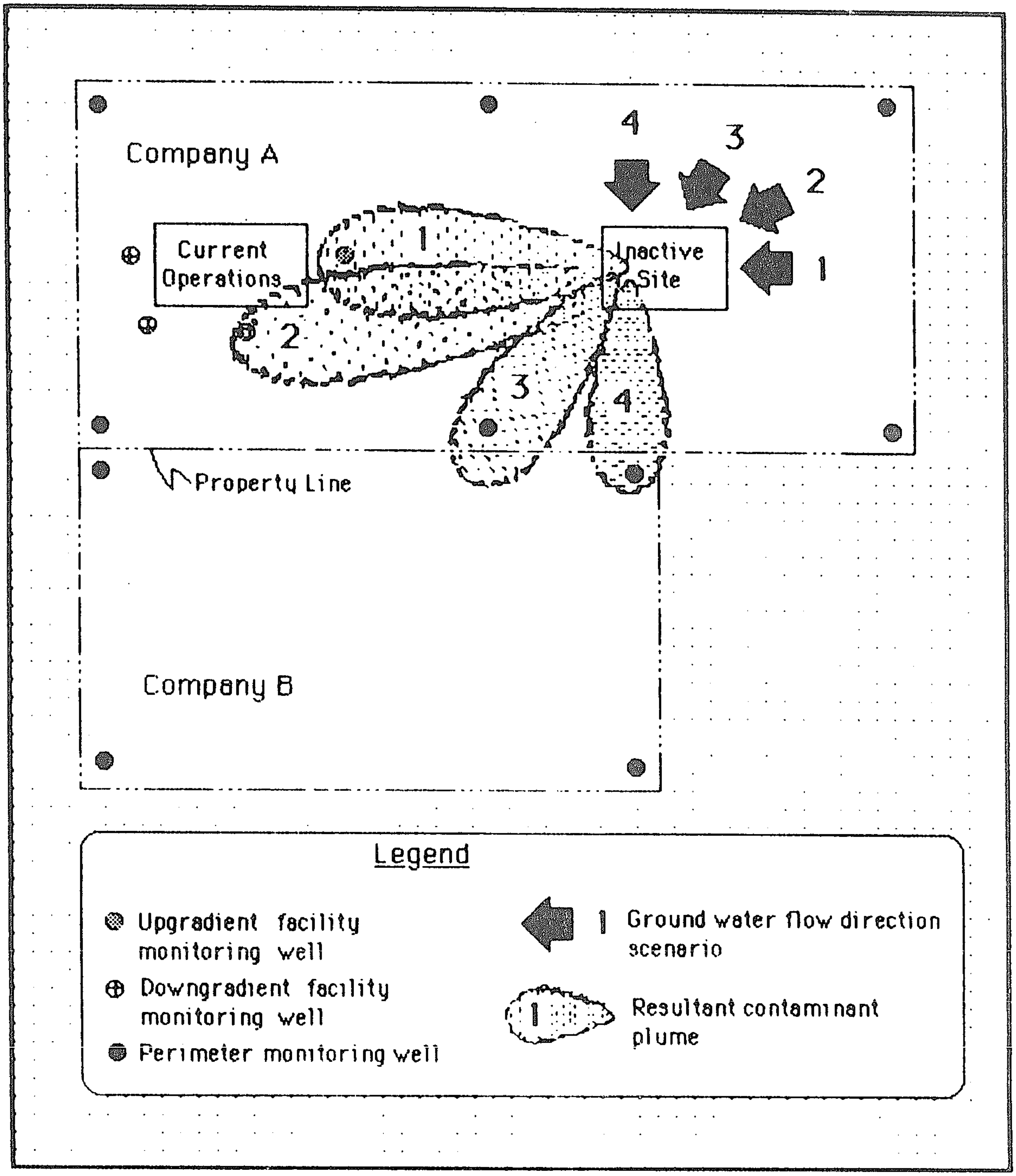
Many currently operating facilities or plants that produce hazardous wastes as a by-product have been in operation long enough to have one or more inactive hazardous waste landfill or other disposal site on their premises. The state and federal laws discussed in the previous section do not clearly address these old sites unless the Department of Environmental Quality demonstrates that the site is leaking. Once this has been demonstrated, the full extent of legal remedies is available to ensure a safe and adequate remedial action. However, until leakage is discovered, no clear requirement has been placed on generators of waste to monitor these sites to ensure that they are not leaking. The difficulties of detecting and demonstrating leakage are compounded by the lack of a requirement that inactive disposal areas have monitoring wells.

2.2.2 Regulations

The same regulations govern inactive sites at operating facilities as were discussed in section 2.1.2, page 17. Public Law 96-510 (CERCLA) is implemented through the National

FIGURE 1

Various Ground Water Contamination Scenarios



Source: Department of Environmental Quality, Office of Solid and Hazardous Waste.

contamination is greatly compounded.

If the chemical constituents are dissimilar to those of the active unit, it is unlikely that the contaminant plume would be recognized as such. In this case, other possible explanations for the increase in contaminants would appear to be the cause of the problem and the well could be plugged and abandoned.

In the situation depicted in scenario 4, the contaminant plume reaches the perimeter monitoring well of another facility. Here, if detected at all, it could be assumed to be an increase in the normal background, unless such a large concentration accumulates that it becomes obvious that a different source of contamination is causing the increase.

2.2.4 Conclusions

Under current law, monitoring and remedial action are not required at inactive hazardous waste sites at operating facilities unless the sites are demonstrated to be leaking. As the four scenarios indicated, the casual detection of such leaks is not assured. Even if a leak is detected, the inactive site would not automatically be suspected. A mechanism needs to be established to specifically assess these inactive sites and ensure their integrity.

2.2.5 Suggestions for future action

Legislation should be introduced, if required, and regulations should be promulgated to require industry to identify inactive hazardous waste sites at operating facilities

2.3 IN-PLANT SOURCES OF CONTAMINATION

2.3.1 Description of the problem

Since manufacturing plants utilizing or producing chemicals were first begun in Louisiana, there have been numerous events that have resulted in contamination of the soil beneath many of these sites. Although some contamination no doubt resulted from bad practices and (or) carelessness, most was probably due to accidental spillage during transport or leakage from process units, storage tanks, or pipelines. In some cases, ground water contamination has already occurred as a result of these events; many other cases are probably going unnoticed because the movement of the wastes through the soil and in ground water may be very slow and problems may go undetected. The movement of wastes downward into aquifers may be accelerated, however, by natural or man-made "conduits". Something as simple as the drilling of a water well may provide a conduit.

2.3.2 Regulations

Many environmental laws to control wastes, including the protection of ground water, have been passed at both federal and state levels. There are still some areas such as accidental spills, however, where either no control is specified or where a gray area exists, leaving doubt as to the regulatory authority. The Water Pollution Control Act, the Resource Conservation and Recovery Act (RCRA), and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) have each problem areas needs to be made and corrective action planned.

2.3.5 Suggestions for future action

For existing plants, new state legislation to require these plants to submit records, and (where necessary) to do needed site evaluation, is needed in order to be consistent with RCRA as it has been reauthorized. In addition, the Louisiana Hazardous Waste Regulations must be amended to reflect these changes. Finally, provisions should be made, both in the statutes and the regulations, to require the evaluation of ground water under process areas to ensure that past practices have not resulted in current contamination.

2.4 LEAKING UNDERGROUND STORAGE TANKS

2.4.1 Description of the problem

As stated in the June 1984 issue of "Ground Water Age", the acronym for leaking underground storage tanks, LUST, may elicit smiles but the problem it identifies is no laughing matter. As indicated by frequent newspaper items and television newscasts, gasoline and other hazardous materials that leak from underground tanks and lines and/or spillage of those materials pose a major threat to the nation's ground water. According to the Environmental Protection Agency gasoline leakage may be one of the most common causes of ground water pollution.

Louisiana's warm and moist climate is ideal for corrosion of unprotected steel tanks and may have already caused leakage from many old gasoline storage tanks. No studies have been conducted in Louisiana to determine the number of underground storage tanks or the number of leaking tanks and/or leaking lines. However, a report, "Leaking Underground Storage Tanks Containing Engine Fuels", prepared by Versar, Inc. for EPA (May 1984), estimates that more than 2,000,000 underground tanks in the United States are used to store engine fuels. Other EPA studies estimate that, in certain states, 10 to 25% of the tanks are leaking. Major oil companies are tackling the leakage problems with aggressive tank replacement programs. Operations to remove old steel tanks and to install new fiberglass replacements can be seen in several areas of Baton Rouge and

2) Although it is important to reduce all hazardous liquid leaks and spills, it is extremely important to reduce seepage into ground water for the following reasons:

* Once underground, most hazardous liquids are impossible to completely recover. Contaminants tend to remain in the ground water and adsorbed on soil particles, even after cleanup operations.
* Although some contaminants tend to flow with the ground water, the rate and direction of movement of contaminants in an aquifer is difficult to predict.
* It is usually very difficult and expensive to determine and prove who is responsible and liable for an underground spill.
* Even if a spiller admits responsibility for an underground spill, cleanup of a contaminated aquifer is very difficult.
* Cleanup and replacement of contaminated water sources are generally very expensive.
* In some cases there is no satisfactory answer. The source, cause, and magnitude of underground spills may remain unknown after years of work and enormous expense.

3) Because spills and leaks of hazardous materials frequently cause irreparable damage to ground water quality, <u>prevention is the ultimate solution to the problem</u>.

2.4.3 How other states address the problem

In 1983, the State of New York declared that spills and leaks of petroleum products from active and abandoned storage facilities are a threat to the public welfare. New York established regulations for the early detection of leaks, or potential leaks, by tank owners and operators and established minimum standards and schedules for testing and inspecting facilities that are over ten years old.

California has declared that no person shall own or operate an underground storage tank unless a permit for its operation has been issued (California Department of Health Services, 1983). Permits may not be issued or renewed if inspection by the local agency determines that the tank does not comply with applicable rules and regulations. California law requires that every underground storage tank installed after January 1, 1984, shall be designed and constructed to provide for the containment of the hazardous substances stored in them. For tanks installed on or before January 1, 1984, the regulations require that the owner shall outfit the facility with a monitoring system capable of detecting unauthorized release of any hazardous substance stored in the facility and shall monitor each facility, depending on the materials stored and the type of monitoring installed.

In Louisiana, underground storage tanks and lines are not regulated by current Louisiana Hazardous Waste Regulations because tanks and lines are not considered treatment, storage, or disposal facilities for hazardous waste as provided in the

c) The materials of the tank (or liner) are compatible with stored substances.

The maximum penalty for violating these provisions is $10,000 per day per tank.

2.4.5 Conclusions

Exactly how many underground storage tanks are in Louisiana is unknown. Using the criteria established by Versar, Inc., to predict the relative corrosion potential of various areas in the United States, it may be concluded that Louisiana, especially the South Louisiana parishes, has a very high corrosion ranking. As leaks occur most often where corrosion potential is high, it may be inferred that leaking underground steel tanks and lines are probably prevalent in Louisiana. At present, the state does not have any regulations to require the owners to monitor their tanks and lines and report leaks to the state.

2.4.6 Suggestions for future action

Because the lands and waters of this state constitute irreplaceable resources upon which the well-being of public health, economic vitality, and the state's environment is founded, and because these resources may be contaminated by spills and leaks from active and abandoned storage tanks containing petroleum products and other hazardous materials, it is recommended that: (1) The Department of Environmental Quality prepare appropriate legislation for consideration by the

2.5 WASTE IMPOUNDMENTS OF THE OIL AND GAS INDUSTRY

2.5.1 Description of surface impoundments

Surface impoundments are earthen basins (also referred to as pits, ponds, and lagoons) constructed to retain nonhazardous oilfield wastes generated during drilling, completion, and production of oil and gas wells. These wastes have been classified as nonhazardous by statutory definition. Some oilfield wastes do contain some hazardous constituents, although the concentration of inorganic constituents in most oilfield wastes and other parameters were less than established by EPA as being hazardous.

Classification of surface impoundments in Statewide Order 29-B is based on intended use as follows:

A) Production pits are either earthen or lined storage pits for collecting waste from a variety of sources. Included are sediments cleaned from tanks and other producing facilities, produced water, or other nonhazardous oilfield wastes produced from the operation of oil and gas facilities:

1) Burn pits are earthen pits intended for use as a place to store and burn nonhazardous oilfield waste (excluding produced water) collected from tanks and facilities.

2) Natural gas plant pits are earthen pits used for the storage of process waters or storm-water runoff.

3) Produced water pits are earthen or lined pits used

G) Non-hazardous natural gas plant processing waste which is comingled with produced formation water.

H) Produced formation freshwater.

I) Washout water generated from the cleaning of vessels (barges, tanks, etc.) that transport non-hazardous waste.

J) Rainwater from ring levees and pits at production and drilling facilities.

K) Pipeline test water which does not meet discharge limitations established by the appropriate state agency.

L) Pipeline pig water; i.e., waste fluids generated from cleaning of a pipeline.

M) Washout pit water from oilfield related carriers that are not permitted to haul hazardous waste.

N) Waste from approved salvage oil operators who only receive waste oil (basic sediment & waste) from oil and gas leases.

O) Material used in crude-oil spill cleanup operations.

P) Waste from permitted commercial facilities.

Constituents in these waste fluids commonly include bentonite clay, barite, organics, inorganics, soluble salts, and metals.

2.5.3 History and current status of drilling activities

Petroleum production in Louisiana began in 1901, with the impoundments at existing facilities to be in compliance with the order by July 1984, or to be closed and abandoned.

Recently proposed regulations, in the form of amendments to Section XV of SWO 29-B are designed to strengthen rules governing both onsite and offsite impoundments of oilfield waste. The final regulations are expected to be in effect by late 1985.

2.5.5 Discussion

The existence of more than 120,000 surface impoundments related to oil and gas activities, over the past 80 years, emphasizes the importance of establishing a mechanism to define the magnitude of the impact that these impoundments may have had in degrading the quality of the state's ground water.

In 1980, the Louisiana Geological Survey (LGS) completed a statewide study of surface impoundments for the EPA as part of a nationwide effort to get an overview of the magnitude of the problem (LGS, 1980). At least 20,000 industrial, municipal, and oil and gas impoundments were estimated to exist in Louisiana. Of this number, about 16,000 impoundments were estimated to be associated with oil and gas activity. The report concluded that "Significant areas of concentrated industrial and oil and gas impoundments exist. On an individual basis, many of these impoundments have low concentration potentials but their cumlative impact through time is poorly understood."

The lack of systematic studies makes ground water pollution oilfield wastes are not known. The impact of 80 years of surface impoundments associated with the oil and gas industry should be assessed.

C) Old and/or abandoned impoundments of oilfield wastes pose the greatest potential for contamination to shallow water-bearing sands. Many of these aquifers receive local recharge and are located at depths of less than 100 feet; thus, the potential for leachate migration into the saturated zone is great. These water bearing sands are, typically, a source of potable water for many rural, non-community water supplies and, in some areas, the sole source.

D) Production pits probably pose a greater threat to the state's aquifers than reserve pits for the following reasons:

   1) Production pits may have been in use over long periods of time. Reserve pits are generally in use only during drilling and completion operations.

   2) Production pits generally contain "mobile" fluids (brine, process water, etc.), which move through soil with relative ease. Reserve pits contain drilling fluids that are less mobile and of a self-sealing nature.

2.5.7 Suggestions for future action

The large number and wide distribution of impoundments

2.6 ACTIVE INJECTION WELLS

2.6.1 Description of injection wells

Five types (classes) of injection wells are regulated by the DNR, Office of Conservation, Injection and Mining Division. These represent all types of injection and are briefly described, as follows:

Class I - wells used for injection of hazardous wastes;

Class II - wells used for injection of produced oilfield brine;

Class III - wells used for injection of fluid for solution mining;

Class IV - wells used for injection of hazardous wastes into underground sources of drinking water (prohibited in Louisiana except for return of treated water to supply aquifer.);

Class V - wells used for injection of materials not included in Class I, II, III, or IV.

2.6.2 Non-hazardous waste injection wells

Non-hazardous waste injection wells include Class II, III, and V wells, which are described in detail as follows:

Class II wells - include wells that inject fluids (mainly saltwater, ranging from brackish water to brine) brought to the surface in connection with conventional oil or natural gas production. The fluid may be commingled with waste waters from gas plants that are an integral part of production operations, unless those waters are classified as a hazardous waste at the time of injection. Also, included in Class II are injection wells used for enhanced recovery of oil and natural gas and injection wells used for storage of hydrocarbons that are liquid at standard temperature and pressure.

Class II wells are regulated under Statewide Order 29-B (1943). There are currently (Nov. 1984) 4,465 Class II wells in the state. Annular disposal (disposal down the annulus between surface and production casings) may be temporarily allowed on a case-by-case basis, provided that the surface casing has been set and cemented below the lowermost underground source of drinking water (USDW). An aquifer (a) which supplies drinking water for human consumption or (b) in which the ground water contains fewer than 10,000 mg/L total dissolved solids. (See Fig. 2 for location of Class II wells.)

Class III wells - include wells that inject fluids for extraction of minerals or energy, including mining of sulphur by the Frasch process; in-situ production of uranium or other metals; and solution mining of salts or potash. Class III wells are regulated under Statewide Order 29-N-1 (1982). There are 249 Class III wells in the State (Nov. 1984). (See Fig.3 for location of Class III wells.)

Class V wells - include injection wells other than those included in Class I, II, III, and IV, such as air conditioning return flow wells used to return to the supply aquifer the water used for heating or cooling in a heat pump; cesspools; cooling water return flow wells; drainage wells used to drain surface fluid; "dry wells" used for the injection of wastes into subsurface formations; recharge wells; saltwater intrusion barrier wells; sand backfill and other backfill wells; septic wells; geothermal energy wells; radioactive disposal wells (other than Class IV); conventional solution mining; in-situ recovery of lignite, coal, tar sands, and oil shale; injection of spent brine after mineral extraction; and wells used in experimental technologies. Class V wells are provisionally regulated under Statewide Order 29-N-1 (1982) on a case-by-case basis. There are currently some three identified Class V wells in the state.

2.6.3 Hazardous waste injection wells

Hazardous waste injection wells include Class I and Class IV wells, described in detail as follows:

Class I wells - are wells used by generators of hazardous wastes or owners or operators of hazardous waste management facilities to inject hazardous waste beneath the lowermost formation containing, within a 1/4 mile radius of the well bore, an underground source of drinking water (USDW). An underground source of drinking water (USDW) means an aquifer or its portion which supplies any public water system or which contains a sufficient quantity of ground water to supply a public water system; and either currently supplies drinking water for human consumption or contains fewer than 10,000 mg/l total dissolved solids; and which is not an "exempted aquifer."

Class I also includes other industrial and municipal disposal wells that inject fluids beneath the lowermost formation containing an underground source of drinking water within a 1/4 mile radius of the well bore. Class I wells are regulated under Statewide Order 29-N-1 (1982) and are monitored continuously. There are currently 74 Class I wells in the state (Nov. 1984), of which two are operated by commercial waste-disposal operators. (See Figure 3 for location of Class I wells.) Surface facilities for Class I wells are regulated by DEQ. Facilities for other classes are under the jurisdiction of the Office of Conservation.

Class IV wells - are wells used by generators of hazardous wastes or of radioactive wastes, by owners or operators of hazardous waste management facilities, or by owners or operators of radioactive waste disposal sites. Class IV wells are for disposal of hazardous waste or radioactive waste into or above a formation, which within 1/4 mile of the well contains an underground source of drinking water. The wells are regulated under Statewide Order 29-N-1 (1982). These wells are prohibited in Louisiana, except for return of treated water to the aquifer from which it was withdrawn (amendment effective June 1, 1985). There are no such known Class IV wells within the State (6-85).

2.6.4 Other injection wells

All types of injection wells are presently included within one of the five "Classes" of injection wells. A particular type

2.7 ABANDONED WELLS (OTHER THAN WATER)

2.7.1 Oil and Gas Wells

Plugging and abandonment requirements for all wells drilled in search of oil and gas are included in Statewide Order 29-B, XIX (1943). In general, such wells are required to be plugged and abandoned within ninety (90) days after it has been determined that the well has no future utility.

The owner(s) of record is responsible for plugging wells for which the Office of Conservation has jurisdiction. In the event the responsible owner(s) fails to plug a well, and after a diligent effort has been made by the Office of Conservation to have the well plugged, then the Office of Conservation may call a public hearing to determine why the well was not plugged. Statewide Order 29-B authorizes the Office of Conservation to require the posting of a reasonable bond to secure the performance of proper abandonment; however, such a bond has never been required.

Act 98 of 1982 established a Natural Resources Conservation Fund for the purpose of plugging unplugged or improperly plugged and abandoned oil, gas, or injection wells where the owner(s) is unknown and the unplugged or improperly plugged and abandoned well may endanger underground sources of drinking water. No funds have yet been expended, although the Office of Conservation is currently evaluating candidate wells for future expenditures.

Many problem abandoned oil/gas wells are those that were

Since the early 1950's, the Office of Conservation has been controlling all types of injection/disposal well operations in the state. This control has been from an environmental viewpoint, with the primary objective being to protect underground sources of drinking water from contamination. Therefore, problems relating to the occurrence of improperly plugged injection wells should be significantly less than for improperly abandoned oil and gas wells.

During the normal course of their duties or through investigation of citizens' complaints, Office of Conservation inspectors occasionally discover improperly plugged and abandoned injection wells. Investigations of these wells are subsequently made and attempts to correct any problem conditions are instigated by the Office of Conservation. Certain of these abandoned wells may be eligible for plugging with funds from the Natural Resources Conservation Fund. (See 2.7.1.) As with oil and gas wells, more problems concerning improperly plugged and abandoned injection wells generally occur with the small, independent operators than with the major companies.

2.7.3 Lignite bore holes

Since July 14, 1976 the Office of Conservation has required all exploratory holes drilled for lignite to be properly plugged and abandoned. Records and locations are on file in that Office. Unlike operators of oil, gas, or injection wells, lignite operators must furnish a bond that will ensure proper plugging and abandonment of all lignite bore holes.

2.7.5 Conclusions

Most identified problems that have related to plugging and abandonment involve old, "pre-rule" wells.

2.7.6 Suggestions for future action

Although current rules are generally adequate, all regulatory agencies whose charges include environmental responsibilities should re-evaluate the adequacy of their existing rules from an environmental viewpoint. This should include oil or gas well construction and operating procedures, as well as plugging and abandonment procedures. The Office of Conservation is currently revising Statewide Order 29-B regarding rules for minimum surface casing.

For certain eligible oil, gas, or injection wells, the Natural Resources Conservation Fund (Act 98 of 1982) should be utilized for plugging and abandonment purposes. Inspectors should maintain careful vigilance to identify such wells. All underground source of drinking water (USDW) aquifers should be protected.

As provided under LRS:30, the Office of Conservation should consider requiring a performance bond on all new oil, gas, and injection wells to ensure proper plugging and abandonment.

The regulated industries should be provided access to informational seminars conducted by the regulatory agencies, emphasizing the need and importance of environmental regulations.

2.8 ABANDONED WATER WELLS AND BORE HOLES

2.8.1 Problems Related to Abandoned Water Wells

Unsealed, abandoned wells and holes constitute a hazard to public health, safety, and welfare and to the preservation of the state's ground water resources. According to an EPA report by scientists at the Robert S. Kerr Environmental Research Laboratory (1977), "Impact of Abandoned Wells on Ground Water", the leakage of contaminated or highly mineralized water through abandoned wells and unplugged holes has led to serious ground water pollution problems. Areas where ground water contamination has resulted from improper well abandonment are subject to economic and social hardships related to the loss or impairment of ground water resources.

Millions of dollars in damage can be directly attributed to the contamination of ground water by improperly abandoned water wells and improperly plugged holes drilled for various purposes. In one North Baton Rouge industrial site, where the ground water has been contaminated by organic wastes migrating from an unlined ditch to the shallow sands and then to the 400-foot aquifer, the company has, as of November 1984, spent $1.9 million to remove 1.7 million pounds of pure organic contaminants from the ground water. The company's findings indicated that the organic wastes had reached the 400-foot sand via old abandoned water wells, the annular spaces of which had never been fully grouted. The unsealed annular space provided a conduit that allowed the contaminants to travel quickly into the for installation of cathodic-protection devices, geotechnical bore holes and soil-boring activities. The regulations are now being revised (tentative release date, July 1985) to address plugging procedures for all wells and holes with the exception of oil and gas wells and injection and disposal wells, which are under the jurisdiction of the Office of Conservation, DNR, and seismic holes, which are under the jurisdiction of the Department of Wildlife and Fisheries. The plugging of seismic holes located near levees is also under the jurisdiction of local levee boards.

2.8.3 Plugging Procedures for Abandoned Water Wells and Bore Holes

Current plugging procedures for abandoned water wells and holes are described in "Water Well Rules, Regulations and Standards, State of Louisiana" (DOTD, 1975). Existing regulations adequately address the procedures for sealing the interior of the casings. However, procedures by which the unsealed annular spaces of abandoned water wells may be sealed are not addressed. It is anticipated that the forthcoming revised regulations for plugging of water wells located in areas having known or potential ground water contamination will require special provisions to provide increased protection from contamination. One provision which may be required is that the well casing be perforated or removed and cement slurry forced under pressure into the surrounding formation to prevent movement of contaminated water from the surface, from shallow

2.9 AGRICULTURAL SOURCES

2.9.1 Description

The probability of contamination of ground water from agricultural sources is much less than the probability for contamination of surface waters. However, pathways for travel of contaminants exist and agricultural sources have caused contamination in some instances. The principal sources of contamination are the various herbicides and insecticides utilized for the control of undesirable species of plants or insects.

The migration from surface pesticide applications to the uppermost aquifers is limited by absorption/adsorption onto surficial clays and the biodegradation of the pesticides. One other problem, which is not well documented, is the increase in nutrients, particularly nitrates, in shallow ground water from fertilizer use and animal feedlot wastes.

2.9.2 Regulations

Regulations governing agricultural sources exist at the state and federal level. The Louisiana Department of Agriculture has published regulations under La. R.S. 30:3201 to 3280. These regulations control the use, application, and disposal of agricultural chemicals. Few chlorinated herbicides and insecticides are allowed and then only for specific purposes. Those chemicals which are allowed demonstrate significant biodegradation within 24 to 48 hours.

The federal regulations governing pesticides are based on Public Law 92-516, the Federal Insecticides, Fungicide, and Rodenticide Act (FIFRA) published October 21, 1972. The act requires the registration of pesticides, the certification of applicators and governs disposal of pesticide wastes. It also requires inspections and provides for penalties for violations of the act.

2.9.3 Nature of the problem

The current and future use of persistent pesticides has been curtailed by the U.S. and Louisiana Departments of Agriculture. The problem that remains is to locate the pathways by which concentrations of persistent chemicals used in the past may migrate to ground water. The major pathways are generally restricted to washout pits from aerial pesticide applicators, agricultural wells with no surface seals, and downward leaching from areas containing heavy concentrations of these chemicals.

Washout pits are used by aerial pesticide applicators to rinse out airplane tanks between flights. These pits are prohibited under the latest Louisiana Department of Agriculture regulations, but many are not yet closed. In the northeastern part of the state, where pesticide use is heavy (See map, Figure 4), the soils are very silty and thus, relatively permeable. This increases the probability of leaching from these washout pits.

Another possible pathway to ground water is runoff from agricultural fields which may flow down the unprotected annular abandonment are being reconsidered to require sealing the annulus of agricultural wells. However, many existing situations remain uncorrected and could be introducing contaminants into ground water. Of the three major potential pathways identified, washout pits for aerial applicators may be of greatest concern as a source of contamination.

2.9.5 Suggestions for future action

An investigation should be initiated on a selected basis (prioritized by size of pit and type of chemical) to determine if aerial applicators' pits, even if closed, have contaminated ground water. The study need not be expensive if the most likely pits were selected. The depth of borings would be limited, and the chemical testing could be restricted to those chemicals known to have been contained in the pit.

2.10 SEPTIC TANK SYSTEMS

2.10.1 Description

Individual onsite sewage disposal systems are an alternative wastewater disposal treatment system to the conventional treatment plant. It is estimated that more than 1.3 million people in Louisiana utilize onsite disposal systems. Septic tank systems, the most common type of system used, condition wastewater so that it will percolate readily into the soil. Wastewater flows from the house to the settling tank, where solids are removed and changed into liquids or gases by bacterial decomposition. Pathogens are not removed in the settling tank, and the level of treatment achieved is primary. Secondary treatment is attained by the wastewater flowing to a subsurface soil-absorption field, oxidation pond, or sand filter bed where microbial action further breaks down the organic matter.

The performance of an onsite system is dependent upon: system design, construction, and maintenance; characteristics of the waste; rate of hydraulic loadings; climate; geology and topography; and the physical and chemical composition of the soil mantle.

2.10.2 Regulations

Private sewage disposal methods are regulated by the Department of Health and Human Resources under the State Sanitary Code. The Sanitary Code addresses the general addition to the Sanitary Code. While sixty-five percent of the sanitarians felt that enforcement of existing regulations is a major problem, sixty-two percent indicated that there is a need for additional regulations, preferably at the state level. The sanitarians expressed concern that much of the regulatory control is aimed at new septic tank systems with little control over the existing, older systems.

2.10.3 <u>Discussion</u>

Ground water contamination due to septic tank effluent is generally a localized problem occurring in areas where the density of septic tanks is greater than the subsurface environment's capacity to assimilate and purify the effluent. An area may be particularly susceptible to ground water contamination by septic effluent if one of the following conditions exist: a) shallow depth to ground water; b) highly permeable soils; or c) high density of septic tank systems. In local areas in Louisiana, shallow aquifers extend to the surface and may provide a pathway for effluent to travel to the ground water.

The Environmental Protection Agency (EPA) has cited the figure of 40 systems per square mile as being a threshold for potential contamination problems. In many areas of the state, the density of septic tanks exceeds forty systems per square mile. Additionally, the ground water table may be shallow, resulting in an ineffective soil filtering system and a potential public health hazard.

potential for ground water contamination increases if the contaminated surface water flows into a well or infiltrates an aquifer recharge area.

Lake Buhlow, located in Rapides Parish in central Louisiana, is an example of a waterbody experiencing sewage contamination. The lake was originally built as a multi-purpose recreational site. Due to health hazards from high fecal streptococci and fecal coliform bacteria, the lake was closed to water-contact recreation and was subsequently drained. It has since been allowed to refill with water. Seepage from septic tank systems appears to again be causing the high fecal bacterial concentrations in the lake. Approximately 75 percent of the soil associations in the watershed are rated poor for septic tank drain fields. The effluent may have moved into the lake through the near-surface ground water or by overland flow. Contamination of near-surface ground water may be a serious health hazard, especially where shallow wells are used near contaminated surface-water bodies.

2.10.4 Conclusions

Septic tank systems are the most common waste disposal system used in areas where a community sewerage system is not available. Private onsite disposal methods are regulated under the State Sanitary Code.

Septic tank systems are a potential source of ground water contamination, but surface waters are at a greater contamination risk due to the geology and soil associations found in the vicinity of septic tanks and other sources of contamination.

The recommendations of the APAI (1983) study are:

A) Evaluate the State Sanitary Code and local ordinances pertaining to the regulation of septic tank systems.

B) Assess the methodology used for permitting, installation inspection, maintenance requirements, and periodic inspection of onsite waste disposal systems conducted by local communities and make recommendations where necessary.

C) Provide guidelines for local communities to use in the establishment of special districts to regulate onsite waste disposal systems and/or construct and operate sewerage systems.

To accurately assess the areas in the state most susceptible to ground water contamination by septic tank effluent, the Soil Conservation Service (Bradley Spicer, oral commun.) recommends the construction of a detailed set of maps. The maps would consist of overlays correlating: a) soils with high percolation rates or excessive internal drainage, b) geology, c) depth to shallow aquifer, and d) aquifer recharge areas.

The EPA suggests that in addition to the hydrogeologic flow system, the long-range planning of the community be considered

3. PROBLEMS ASSOCIATED WITH GROUND WATER INVESTIGATIONS

3.1 MONITORING

The basic assumption of any monitoring program is that the information gathered at a point is representative of the conditions of a larger area. This assumption is carried into the third dimension because ground water systems are three-dimensional in nature. The design of a monitoring network is dependent upon the complexity of the aquifer system, and it is this fact that causes most problems. Monitoring networks are frequently established before a sufficient understanding is obtained of the hydrogeologic framework, ground water flow system, waste characterization, and pollutant movement. In order to have a valid monitoring network, it must be designed on the basis of an adequate understanding of the aquifer system, the native fluids, and the wastes involved. Many monitoring networks are inadequate because this understanding is lacking.

3.1.1 Hydrogeologic framework

The size, shape, and composition of the ground water reservoir (aquifer) determine the hydrologic properties, which control the water volume, water movement, and water quality within its boundaries. Therefore, it is very important that a good understanding of the three-dimensional distribution of geologic materials, and their physical and chemical characteristics, be obtained. Specific aquifer properties of materials.

A newer tool, which is proving to be very useful in ground water investigations, is three-dimensional mathematical models of the flow system. Models can be used to conceptualize the dynamics of the aquifer flow system. The more accurate the concept of the system and the knowledge of the fluids involved the more valid the monitoring network design. The model can also be used to guide data collection and as a predictive tool. However, in the latter use, predictions will be no better than the data input to the model.

3.1.3 Waste characterization

Contaminants may be chemically active; thus, when they move into the subsurface, they may begin to react with the surrounding environment. They may react with the geologic matrix, with other wastes that are already in the ground, and (or) with the ground water. Characterization of waste and its by-products is required to determine the manner in which the contaminant will move within the subsurface. For example, is the waste moving in the liquid or gaseous phase? Waste characterization is critical because the occurrence may be in the liquid, gaseous, or solid phase or multiple phases--each with a different rate and direction of movement.

3.1.4 Documentation of the occurrence and movement of contaminants

The main purpose of monitoring is to document the

3.2 TECHNIQUES FOR MONITORING AND SAMPLING

3.2.1 Design of monitoring networks

In order to have confidence in the data collected from a ground water monitoring system, it is imperative that the investigator understand the probability of data at a point representing the condition in the surrounding area. A good monitoring network is designed so as to maximize the probability of obtaining an accurate representation of the site and, thus, a clear understanding of the flow system. Therefore, ideally, the network design should be approved by a competent hydrogeologist. Criteria for approval should include evidence of an understanding of the hydrogeologic framework, ground water flow system, waste characterization, and the geochemical processes.

3.2.2 Monitoring well construction

Water and soil samples can be contaminated during the well construction and water sampling phases and, thus the monitoring wells may provide unreliable data. To lessen the probability of contamination and bad information, the following criteria should be used:

1) Use construction materials that will not contaminate the sample or deteriorate with time.
2) Use construction techniques that will not result in contamination of the strata of interest, either from above or from below.
3) Accurately determine well depth and alignment.

chemicals that cause concern in the environment are pervasive throughout our environment. At the levels of detection now possible (consistently in the low parts per billion range), it is difficult to determine which chemicals were in the sample of ground water, and which were introduced after sampling.

Although no regulations have been published governing sampling and testing, the EPA has published guidelines which are generally accepted and followed within the industry. These guidelines are contained in the publication, "Test Methods for Evaluating Waste", SW-846, July, 1982.

The first opportunity for contamination of a sample occurs when the sample is placed in a container. The sample jar or vial may have been contaminated, the technician may introduce contamination through handling, or the surrounding air may contain traces of contaminants. These hazards can be minimized by very careful sample-container preparation and use of good sampling techniques.

The second source of contamination is during transportation from the field to the laboratory. Samples in the same ice chest have been known to become cross-contaminated through improper or leaky seals on containers. Benzene and toluene from the fuel system of the transport vehicle can enter into the samples through the same mechanism.

During storage, another possible source of sample contamination is introduced. Freon used in the refrigeration system, as well as volatiles in the air from other sources, have been introduced to samples either during storage or sample

Everyone employed in sampling ground water for contamination must follow approved EPA procedures. This will minimize sampling and monitoring errors.

4. GROUND WATER ACTIVITIES IN GOVERNMENT AGENCIES

4.1 Government Agencies

The state of Louisiana has numerous agencies whose activities directly or peripherally affect ground water. However, the major ground water programs are found within five agencies. These agencies are the Departments of Environmental Quality (DEQ), Natural Resources (DNR), Health and Human Resources (DHHR), Agriculture (DOA), and Transportation and Development (DOTD). Table 2 summarizes the major ground water responsibilities within these agencies. A list of state laws and regulations affecting ground water and water in general may be found in Table 3, page 104, at the end of this section. A more detailed discussion of these agencies follows in the next section.

Of the federal agencies having programs affecting ground water in Louisiana, the Environmental Protection Agency (EPA) and the U.S. Geological Survey (USGS) play the major federal roles. The EPA funds specific activities and cooperates with DEQ, DHHR and DNR, working very closely with each department.

The USGS, Louisiana District Office, has cooperative ground water programs with several state agencies. These cooperative programs include: (1) the systematic collection of basic data to determine the quality, quantity, and use of ground and surface water, (2) interpretive water resource appraisals, (3) problem-oriented research in hydrology, and (4) collection of information on natural and man-induced hazards such as floods and land subsidence. The USGS disseminates data and findings through reports and other public contacts and provides technical assistance to state, other federal, and local agencies.

The Capital Area Ground Water Conservation Commission, a special purpose body created by state law, has regional ground water responsibilities and coordinates with both state and federal agency programs within a five-parish district. This regional agency has many unique powers to protect ground water resources. (See section 4.7.)

There are numerous special districts in the state whose activities may affect ground water quality. Each special district has a different jurisdiction within their local area. Some jurisdictions overlap with state agencies; however, the areas of overlap are often unclear. The following special districts exist within Louisiana law:

1. Levee districts.
2. Soil conservation districts.
3. Port, harbor, and terminal districts or commissions.
4. Offshore terminal authority.
5. Irrigation districts.
6. Water conservation, watershed, and recreation districts.

4.2 Department of Environmental Quality

The Department of Environmental Quality's programs were regulating the transportation, processing, resource recovery, and disposal of solid and hazardous waste on a statewide basis. The major thrust of solid and hazardous waste regulations is the prevention of ground water contamination. Under OSHW regulations, ground water monitoring is now required at approximately 75 facilities in Louisiana. All hazardous waste and solid waste facilities or they are permitted in the future will be required to install ground water monitoring programs, which will be approved and enforced by DSHW.

The OSHW contains three divisions, each with a defined role in ground water protection. The Solid Waste Division regulates the disposal of non-hazardous solid waste. The regulations of this division require monitoring of the shallow ground water to prevent contamination. The Inactive Sites Division administers the CERCLA (Superfund) program and has far reaching authority to require monitoring and cleanup of sites where the Secretary of DEQ has reason to believe that ground water contamination is occurring.

The Hazardous Waste Division administers the RCRA program which governs the transportation, treatment, storage, and disposal of all hazardous wastes. This program requires monitoring and cleanup of defined hazardous wastes if they are detected in the ground water. The RCRA program is currently the primary program within DEQ for the protection of ground water from contamination.

responsibility for hazardous waste disposal through underground injection wells.

The hazardous waste injection well program was originally authorized to the Office of Conservation in 1977, transferred to DEQ in 1983, and transferred back to the Office of Conservation in 1984. Although OC regulates the permitting and operating of oilfield waste disposal sites, any discharges of pollutants into the air and waters of the state are under the regulations of DEQ.

The Louisiana Geological Survey (LGS) provides technical assistance to other state agencies upon request. This assistance often entails aquifer research and subsurface geological mapping. Disposal-zone studies are aimed at deep well injection of hazardous waste.

The Coastal Management Division in DNR has duties and powers that relate indirectly to ground water resources. Through the Coastal Zone Management program, DNR issues coastal use permits for projects affecting state water bottoms, mineral activity, pipelines, jetties, breakwaters, bulkheads, and piers. The aim of this program is to ensure that water-related projects in the coastal zone do not damage or impede water flow, circulation, quantity and quality of water, and that the discharges of toxic or pollutant materials comply with other laws.

The Coastal Protection Task Force, established in 1983, was charged with making recommendations to the Governor on coastal protection projects. A special coastal environmental protection and as a cooperating state agency with the USGS in collecting water data and in sponsoring special investigations. The WRS is a member of various advisory groups and coordinating committees.

One program of special ground water interest within this agency is the Free Flowing Well Program. The agency can require the owners or lessees of free-flowing wells that are producing more than 25,000 gallons per day to install control devices on these wells. This is a significant measure to conserve the state's ground water resources.

4.5 Department of Health and Human Resources

The Department of Health and Human Resources, Office of Preventive and Public Health Services, has statutory authority for the regulation of public water supplies and sewage disposal. The agency's involvement in ground water protection generally relates to water quality monitoring of public water supplies and to the control of sources of pollution in the immediate vicinity of public water supply wells. Special studies of drinking water quality are conducted where pollution is suspected. This Office's sewage disposal regulation program is designed to provide guidelines for the design and operation of sewage collection and treatment facilities.

4.6 Department of Agriculture

The Department of Agriculture has an EPA grant for the enforcement of the Federal Insecticide, Fungicide, and hundred feet deep, those tapping the Mississippi River alluvial aquifer, and those wells used for agricultural or domestic purposes.

The Commissioners of the Capitol Area Groundwater Conservation District have not yet found it necessary to establish use priorities or to limit ground water pumping rates within the District. Rather, they have employed an educational approach to encourage water conservation. The District has been in existence since 1974 and pumping has declined in that time within the five-parish jurisdictional area. There have been discussions about establishing additional voluntary ground water conservation districts with similar powers at other places in the state where particularly serious ground water problems exist.

4.8 Discussion

Ground water resources in Louisiana are abundant. In many areas of the state, thick layers of clay inhibit ground water movement and have protected ground water from contamination, where it has been threatened from unsound human practices. However, as has been outlined in previous sections of this report, our ground water is vulnerable and numerous opportunities for ground water contamination exist throughout the state.

In this section, the preceding discussion has summarized the major ground water responsibilities within state agencies.

addresses all possible sources of ground water contamination.

The definition of water rights and management of water usage throughout the state are additional topics which may need to be addressed by state law.

The various state agencies having ground water protection responsibilities should enter into agreements to clarify and formalize each agency's role and responsibility for maintaining ground water quality and preventing contamination as well as resource management.

The Department of Enviromental Quality should develop regulations to set forth procedures to provide for remedial actions when ground water contamination is discovered. DEQ should develop a framework or model for evaluating and prioritizing ground water contamination problems so that the most pressing issues may be recognized and addressed.

Louisiana Hazardous Waste Regulations

Water Well Standards & Abandonment Procedures

L.R.S. 38:3091-3097

Water Well Drillers Licensing

L.R.S. 38:3098

Water Well Standards & Abandonment Procedures

5. WATER SUPPLIES, SEWAGE DISPOSAL

Sanitary Code

L.R.S. 40:4, 40:5, 45:951

6. OILFIELD WASTE STORAGE, DISPOSAL

Orders 29-B, 29-N-1, 29-0-1, 29-M, 29-P

L.R.S. 30:1 et. seq.

Amendment to Order 29-B

Off-site storage, treatment, and/or disposal of non-hazardous oilfield waste generated from drilling and production of oil and gas wells.

5. FRAMEWORK FOR A STRATEGY FOR PROTECTING GROUND WATER IN LOUISIANA FROM CONTAMINATION

This section is intended to serve as a framework suitable for use in development of the desired ground water protection strategy. Appropriate information is presented in a number of sections. These sections define the problems and enumerate the measures available to prevent contamination from new sources and to correct contamination of ground water from existing sources. The actual strategy (to be developed later) will propose approaches for authorizing the regulatory agencies to require that appropriate measures will be carried out by the regulated community in dealing with these problems.

The sections presented herein are summaries and, as such, are not necessarily complete and comprehensive.

The following list summarizes the steps outlined in this section. Areas of deficiency in these measures are identified.

<u>Sources of contamination: Step A</u>
The potential new and existing sources of contamination are listed. This list includes generalized types of sources rather than an exhaustive detailing of specific sources.

<u>Types of contamination: Step B</u>
The types of contamination that may be present in each source are listed. This list includes any generic contaminants rather than an exhaustive list of specific contaminants. Contaminants are not classified by the degree of hazard. (Steps A and B are addressed in the same tabulation.)

TABLE 4

Steps A and B - Listing of potential sources of contamination of ground water and types of contaminants.

(Step A) Types of potential sources (in approximate order of significance)	Types of Contaminants (Step B)			
	Chemical (Organic & Inorganic)			Biologic (Pathogens) and Viruses
	Soluble	Floaters	Sinkers	
(1) Waste Sites	X	X	X	X
(2) In-Plant	X	X	X	-
(3) Underground Storage Tanks	X	X	X	-
(4) Agricultural	X	X	X	X
(5) Septic Tanks	X	-	-	X
(6) Injection Wells	X	X	X	-
(7) Other Wells	X	X	X	X
(8) Oil Field Wastes	X	X	X	-
(9) Others (spills, etc.)	X	X	X	X

Conclusion: Chemical contaminants are present in most potential sources.

Notes:

(1) Waste sites involve all hazardous and non-hazardous waste sites (including surface impoundments, landfarms, landfills, waste pits, and dumps) whether active or inactive, in-plant or offsite.

(2) In-plant sources include all sources (other than waste sites) such as recent or old spills, and leaking tanks, lines, processing equipment.

(3) Underground storage tanks are listed separately because recent findings indiciate that significant ground water contamination can occur from underground fuel storage tanks, associated pipes and valves, and other tanks.

(4) Agricultural sources include pesticides, abandoned dipping vats, feed lot wastes, fertilizers, forestry sources, etc.

(5) Septic tanks are widespread potential sources of viruses and other pathogenic organisms. This source may also contain small amounts of chemical contamination.

(6) Injection wells are used for disposing of liquid wastes.

(7) Other wells may provide pathways for movement of contaminations, if improperly constructed or abandoned.

(8) Oil field wastes include brines and drilling fluids that are usually impounded near oil and gas drilling and production facilities.

(9) Others - includes such potential sources as spills from trucks, railroad cars, and miscellaneous sources.

TABLE 5

Step D Contamination prevention measures: Methods available for preventing contaminants from entering pathways to ground water for new potential sources

Types of potential sources (in approximate order of significance)	Operating Practices: Waste reduction	Operating Practices: Waste recycling and reuse	Operating Practices: Discontinue using certain pesticides	Operating Practices: Shutdown operations	Operating Practices: Construction practices	Operating Practices: Inspection and maintenance	Treatment: Incineration	Treatment: Chemical treatment	Treatment: Landfarming	Treatment: Composting	Disposal: Landfilling	(Other): Public awareness
(1) Waste Sites	X	X			X	X	X	X	X	X	X	X
(2) In-Plant	X			X	X	X	X					X
(3) Underground Storage Tanks				X	X	X						X
(4) Agricultural			X			X						X
(5) Septic Tanks				X	X	X		X		X		X
(6) Injection Wells	X			X	X	X						X
(7) Other Wells				X	X	X						X
(8) Oil Field Wastes	X	X		X	X	X	X	X	X	X	X	X
(9) Others* (*May be any category)	X											X

Step E-2- Potential contaminant assessment measures: Deep

Measures available to assess potential contamination sources - subsurface more than 20 feet below the surface.

1. Soils and Aquifer - extent of contamination laterally and vertically

   a. Direct methods

      - Test drilling: cores and cuttings

      - Monitor wells: water levels and water samples

      - Testing of soil and water samples for chemical properties

      - Testing of soil and water samples for physical properties

   b. Indirect methods

      - Laboratory tests
        Geotechnical
        Bulk density
        Grain-size
        Compressibility

      - Geohydrologic
        Hydrologic conductivity properties, including porosity
        Moisture content
        Compressibility

      - Field tests
        Geotechnical
        Borehole geophysics
        Geohydrologic
        Piezometer tests
        Pumping tests

2. Analyses of data obtained from direct and indirect methods

   - Flow nets
   - Aquifer test analyses
   - Water-level mapping
   - Aquifer geometry
   - Boundary conditions
   - Water budgets
   - Geologic mapping - stratigraphy and structure including faults, heterogeneity, geometry, etc.

Step F-2 - Remedial measures: Deep

Measures available to remediate subsurface contamination below 20-foot depth.

1. Direct recovery measures

   - Recovery wells - same methods as F-1
   - French drains - same methods as F-1
   - Excavation

2. Passive measures - isolation

   - Slurry trenches
   - Sheet piling
   - Declare aquifer "off limits" for certain uses

3. Areas of deficiency

   - Locating underground contaminants is difficult, time consuming and expensive
   - Removal with available techniques is also difficult. Consequently, there is no assurance that an aquifer can be cleaned up
   - Off limits declaration should be considered as a last resort
   - There may be times when the first attempt at remediation of a site is unsucessful because of inadequate assessment or inadequate application of remediation techniques

REFERENCES

American Petroleum Institute, 1984, Total Wells Drilled by States, 1859-1969 and United States Total Wells Drilled by State, 1967-1983: Washington, D.C.

Bennett, Gordon D., 1976, Introduction to Ground-Water Hydraulics: U.S. Geological Survey, Techniques of Water-Resources Investigations, Book 3, Chapter B2.

California Department of Health Services, Water Resources Control Board, 1983, California Hazardous Substance Storage Act: Sacramento, CA.

Crim, R. L., 1975, Model State Water Monitoring Program: Environmental Protection Agency, 440/9-74-002.

Dropkin, Robin, 1984, An Ounce of Prevention: In Ground Water Age, National Trade Publications, Inc., 8 Stanley Circle, Latham, NY, (June 1984).

Heath, R. C., 1976, Design of Ground-Water Level Observation Well Program: Ground Water, Volume 14, No. 2, p. 71-77.

Louisiana Department of Natural Resources, Office of Conservation, 1943, Statewide Order 29-B, as amended.

Louisiana Department of Natural Resources, Office of Conservation, 1979, Statewide Order 29-0-1.

Louisiana Department of Natural Resources, Office of of Water Resources, 1981, Bulk Storage of Hazardous Liquids: Problem Assessment Report, Paper No. 5, Albany, NY (April 1981).

Office of Technology Assessment, Congress of the United States, 1984, protecting the Nation's Ground-Water From Contamination: Washington, D.C.

Scalf, M. R., 1984, Sampling Procedures for Ground-Water Quality Investigations: National Technical Information Service, PB 84-194844.

Snider, J. L., 1981, Water Resources of the Terrace Aquifers, Central Louisiana: Department of Transportation and Development, Louisiana Office of Public Works, Water Resources Technical Report No. 25.

Task Force on Environmental Health, 1984, Environment and Health in Louisiana: The Cancer Problem: Louisiana State Planning Office, Baton Rouge, Louisiana (March 1984).

U.S. Environmental Protection Agency, 1977, Impact of Abandoned Wells on Ground Water: Robert S. Kerr Environmental Research Laboratory, Office of Research and Development, Ada, Oklahoma (August 1977).

----- (1984), Leaking Underground Storage Tanks Containing Engine Fuels: Prepared by Versar, Inc., Springfield, VA. (May 1984).