THE GEOPRESSURED GEOTHERMAL
RESOURCES OF TEXAS

REGULATORY CONTROLS OVER
WATER POLLUTION

By

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PREFACE

Two separate drafts of this report were distributed to various individuals, mostly in governmental agencies of the state of Texas, for review and any comment they desired to make. There was an opportunity for such review and comment between the beginning of April and the end of June, 1977. All comments received were given full consideration, and most were incorporated in the final report.

Specifically, the following agencies received two coordination drafts:

Railroad Commission of Texas —

Oil and Gas Division

Texas Water Quality Board —

Central Operations Division, Geological Services Section,

Comprehensive Planning Section, Special Studies Section

Texas Water Rights Commission —

Environmental Analyst

Texas Water Development Board —

Assistant Executive Director

Governor's Energy Advisory Council —

Executive Director

Texas Department of Health Resources —

Division of Waste Water Technology and Surveillance

Texas Parks and Wildlife Department —

Executive Director

Office of the Attorney General of Texas —

Environmental Protection Division, Houston

Central Power and Light Company —

Manager for Environmental Affairs

Environmental Protection Agency —

State Program Manager, Dallas

I. INTRODUCTION

The Gulf Coast of Texas is underlain by moderate temperature geothermal resources contained in overpressured sediments below depths of about 5,000-15,000 feet. Substantial evidence indicates that these geopressured zones contain saline fluids which are believed to be saturated with natural gas, largely methane. A broad-based interdisciplinary study of this potential energy resource is being conducted at the Center for Energy Studies of the University of Texas at Austin.⁽¹⁾

A. Characteristics of Geopressured-Geothermal Waste Fluids

The difficulty and cost of proper waste-fluid disposal will be major factors in determining the ultimate feasibility of any geopressured-geothermal development along the Texas Gulf Coast. Preliminary studies have indicated that a single geothermal resource well may produce as much as 30,000-40,000 barrels of superheated and pressurized salt water each day. The initial wellhead temperature of the fluids may approximate 300°F. The temperature of the effluent from a surface utilization facility may range between 160-212°F if the hydraulic and thermal energy of the produced fluids has been used for the generation of electricity⁽²⁾. Lower temperatures for the effluent may result from other uses for the energy of the fluids. In the absence of more reliable data, the salinity profile and the amount of total dissolved solids (TDS) of the geothermal fluids that will be produced have been estimated, based upon limited information from well logs obtained for other purposes. One report on such data shows a range from 35,000 to 300,000 parts per million (ppm) in TDS from fluid samples taken from various wells.⁽³⁾

Another estimate, based upon a more detailed examination of a particular geothermal resource field for which a test well is planned, suggests that 30,000-60,000 ppm should be expected.⁽⁴⁾

B. Uncertainties About Hazardous Trace Elements

Kreitler and Gustavson presented a chemical assessment of geothermal fluids, based upon oil and gas well logs from southern Texas, in the proceedings of a recent geothermal conference.⁽⁵⁾ This data came from twenty-two wells in several counties, and quantities of total dissolved solids, chlorides, and sodium-plus-potassium are given. However, it was noted that "[a]nalyzes for toxic trace elements such as boron are not available."⁽⁶⁾ Such trace elements could be critical for a decision to use surface or subsurface disposal for the spent fluids. As an illustration, in a recent California case involving the ownership of geothermal steam from The Geysers, the boron content of the steam was considered by the court in determining whether the steam condensate had utility for surface use. The court said:

A number of elements carried in the condensate exceed allowable limits. For example, 42 parts of boron per million parts of water would kill most vegetation and 380 ppm or more would be considered deadly. Most of the tests showed the presence of boron to be in excess of 34 ppm and a number of tests showed boron to be present in excess of 500 ppm . . . If costs were not a factor, processes presently exist by which the steam condensate could be filtered to make the condensed water safe for domestic and agricultural use. The cost of filtering, however, is prohibitive.⁽⁷⁾

Gustavson and Kreitler have indicated that a more recent analysis of some water samples from the Chapman Ranch area south of Corpus Christi shows a considerable quantity of boron in the fluids, varying between 19-42 ppm.⁽⁸⁾ Current regulations of the Texas Water Quality Board

(TWQB) indicate no particular concern about boron, although other trace elements, such as hazardous metals, are regulated.⁽⁹⁾ Presumably, a growing knowledge of the presence of specific trace elements in geopressured fluids, and a clearer recognition of their potentially hazardous nature, may limit surface disposal of effluent unless such trace elements are removed from the effluent prior to discharge. This is an area of uncertainty because of current data deficiencies and expected future changes in pollution standards.

C. Multiple Regulatory Agencies

The geothermal resource developer will be faced with an initial choice between surface or subsurface disposal of his fluid wastes. Of course, economic considerations may dictate the result of this choice. However, as will be discussed in detail later, there are also institutional and legal aspects to consider since different agencies, regulations, and laws govern each method of disposal. Several agencies have substantial regulatory authority for waste fluid disposal in general. These include: the TWQB, the Railroad Commission of Texas (TRRC), and the federal Environmental Protection Agency (EPA). One or more of these three agencies issues the permits necessary for either surface or subsurface disposal of waste fluids in Texas. However, other state, local, and federal agencies participate in the review of the permit applications, and comment upon them. Further, the statutes, rules, and regulations governing both permit granting and subsequent monitoring have been subject to substantial changes in recent years, and additional changes are an immediate prospect. Additionally, there are various unwritten, in-house procedures which can affect application of the rules. This

brief summary suggests the complexity of the regulatory problem for the developer or permittee who must operate within the limits of this complex and changing network for the control of water pollution.

D. Dual Levels of Control

Perhaps the most significant institutional problem arises from the existence of two separate levels of water pollution control, state and federal. The following quote from James A. Evans of Shell Oil Company's Corporate Law Department describes the frustrations these dual levels of control have caused:

Upon reviewing some of the candidates for the title of the most significant environmental law problem, it may be that no one law should receive such honor, but that title should be bestowed upon some of the parallel concepts that are found in each of these laws. One such concept is the state and federal relationship, which gives the Federal Government the dominant position with respect to these sets and the programs that they mandate, but allows the state to be a participant. The state does not appear to me to be a full fledged partner in this participation, but if it conducts itself in a manner that is agreeable to the federal agency, then the state is allowed to play the game. If it does not, the federal agency will then exclude the state. This results in a most difficult situation for the industrial citizen trying to identify the real source of authority. Many times, there is a need to have clarification of what is intended by regulations. The regulations in many instances, such as with the NPDES permit program, have been developed by the federal agency, but the state agency is in a position of attempting to administer such regulations. When a question arises as to the interpretation of these regulations and their application to a given fact situation, a question put to the state agency will receive either no answer or an answer so qualified that the citizen is in a position of thinking that he should not have asked the question in the first instance. On the other hand, a question put to the federal agency will not be answered on the basis that the state is administering the program and such questions should be directed to the state. In addition I have found instances

of a state agency being bold enough to come forth with a reasonable answer, only to find itself in the embarrassing position of being informed by the federal agency that such answer is not satisfactory. In that instance when the industrial citizen attempts to approach the federal agency to understand why the approach was not appropriate, the federal agency denies the audience on the basis that it is a program being administered by the state agency. Whom do you deal with, and how can you deal with such situations? ⁽¹⁰⁾

II. OVERVIEW OF CONTROL FRAMEWORK

The basic statutes and the principal agency responsibilities for water pollution control in Texas are summarized very briefly to afford an overview of the regulatory framework, which will be analyzed in detail in subsequent sections.

A. Surface Disposal

1. The Federal Water Pollution Control Act Amendments of 1972 ⁽¹¹⁾ [hereinafter referred to as FWPCAA] is the primary federal statute controlling the discharge of pollutants into "navigable waters". This last term has been interpreted as the waters of the United States, in the broadest constitutional sense, but essentially it is limited to surface waters. ⁽¹²⁾ The statute sets up a federal permitting program, and establishes federal water quality goals. The program is to be administered by the EPA. The statute also directs each state to establish its own water quality program in conformity with the federal standards and procedures. A state program requires EPA approval in its entirety in order to secure some degree of local autonomy. Such approval has not yet been secured for the Texas state program. ⁽¹³⁾
2. The Texas Water Quality Act of 1967, ⁽¹⁴⁾ with amendments, is

the controlling state legislation in regard to the discharge of waste into "water in the state," which includes both ground and surface water. The Water Quality Act has been incorporated into Chapter 21 of the Texas Water Code. The statute establishes the TWQB as the principal Texas authority on matters relating to the quality of the water in the state. All other state agencies engaged in water quality or water pollution control activities must coordinate those activities with the TWQB, pursuant to the Texas Water Code, Section 21.257.

3. In Texas, if the waste to be disposed of has been produced in association with the production of oil or gas, then the Water Code gives jurisdiction over disposal to the TRRC. However, discharge of the waste must meet the water quality standards of the TWQB. TRRC responsibility includes prevention of water pollution through both surface and subsurface disposal of waste, pursuant to Water Code Section 21.261.

B. Subsurface Disposal

1. The Texas Disposal Well Act of 1971⁽¹⁵⁾ is the controlling state legislation for the subsurface injection of waste. This act has been incorporated into Chapter 22 of the state water code. Under that chapter, the TWQB has authority to regulate subsurface injection wells which dispose of industrial and municipal waste, and any other type of waste which does not result from drilling for and producing oil or gas.
2. The TRRC has authority to regulate disposal wells for waste which does result from drilling for and producing oil or gas.
3. The federal Safe Drinking Water Act of 1974⁽¹⁶⁾ (SDWA) provides

in Part C, Section 1421, for protection of underground sources of drinking water through control over subsurface disposal of waste fluids by well injection. Federal regulations establishing minimum requirements for state underground injection control programs are currently being developed. These will bring about federal intervention into an area which heretofore has been controlled almost entirely by the states. The overall effect of these new federal underground injection control requirements upon the existing regulation of subsurface disposal wells in Texas will be substantial. A set of proposed federal regulations to implement the SDWA was published in August, 1976. According to present plans, an amended version of these regulations will be published in the summer of 1977, probably as interim regulations.

C. Ambiguity in Texas Law

Although the Texas Geothermal Resources Act of 1975⁽¹⁷⁾ gives the TRRC control over the development of geothermal resources, and directs the commission to protect the environment and the public, the Water Code was not amended to place geothermal waste disposal specifically under the jurisdiction of the TRRC. Arguably, the expected presence of methane gas in the geothermal fluids suggests that the waste fluids produced result from oil or gas production. On the other hand, the latest working draft of the new federal regulations under the SDWA groups geothermal wells with waste disposal wells, special process wells, and engineering wells, rather than with injection wells related to oil and gas production. The possible effect of such ambiguities will be considered in more detail in subsequent sections of this report.

III. FEDERAL POLLUTION CONTROL OF SURFACE WATERS

A. Overview of FWPCA

Despite earlier attempts dating back to the Refuse Act of 1899, the statutory origin of a federal system seeking major reductions in water pollution lies in the FWPCA. A very brief summary of the provisions of the FWPCA most significant to the waste disposal problems associated with geopressured-geothermal development is presented below.

1. Regulatory Scope

The amended act provides for a national permitting program to control the discharge of any "pollutant" into "navigable waters."⁽¹⁸⁾

Pollutant is defined⁽¹⁹⁾ to include most anything discharged into water, except certain sewage from vessels and materials associated with oil or gas production which are injected into or disposed of in wells, if the state in which the well is located determines that the injection or disposal will not degrade ground or surface water resources. In considering disposition of wastes from geopressured-geothermal resource development, it should be noted that the definition of pollutant in the FWPCA specifically includes solid waste, chemical wastes, sand, industrial waste, and heat discharged into water.

"Navigable waters" are defined⁽²⁰⁾ to mean "the waters of the United States, including the territorial seas." According to the statute, the territorial seas extend out to the three mile limit. While this definition of navigable waters is ambiguous, EPA and the courts seem to interpret it to give the broadest possible constitutional meaning and to embrace all significant surface waters into a cooperative federal-state system.⁽²¹⁾

While the FWPCA refers to protection of "surface and underground waters," a federal district court in Texas held in United States v. GAF Corp. (22) that an underground disposal of chemical wastes, which did not flow into or affect surface waters, did not constitute a discharge of a pollutant into water, as defined in the FWPCA. EPA apparently is continuing to resist the effect of that decision. (23)

Two national goals are established by the FWPCA: (1) elimination of the discharge of all pollutants into navigable waters by 1985, and (2) wherever attainable, what has been called "swimmable water" by July 1, 1983. The practicability of both of these goals is currently a matter of contention.

2. Basic Scheme of Control

The national permit system is called the National Pollutant Discharge Elimination System (NPDES) in Section 402 of the FWPCA. Federal discharge permits are granted by EPA under this system until such time as a state permit system has been approved in its entirety by the EPA Administrator.

Two complementary schemes of water pollution control are established. The historical control method of establishing water quality standards applicable to particular bodies of water continues to be used. The purpose is to limit total pollutant discharges into a specific body of water in order to raise its quality until it is suitable for a desired use. In the past, when this control method was used alone, it seemed to have little overall effect on reducing water pollution. Under the FWPCA, effluent standards have also been established for individual dischargers. These are keyed to available technology, and are generally uniform for each type of pollutant discharger. This is a control method

designed to prevent unnecessary degradation of water quality by requiring a discharge permit for each "point source" of pollution. A point source is defined in the act⁽²⁴⁾ as:

any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged.

Point sources are divided into two categories, (1) existing point sources, governed by Section 301 and other sections of the FWPCA, which do not appear to be relevant to geothermal development unless fluids are piped to an existing utilization facility, and (2) new point sources, governed by Section 306 of the act, which will apply to geothermal resource development according to the source standards published for the type of surface facility constructed to use the energy of the geothermal fluids.

3. Nonpoint Source Control

In addition to point sources, which must now be permitted and monitored, there are a great number of "nonpoint sources," such as runoff from construction sites, agricultural irrigation, and urban storm water, all of which contribute significantly to water pollution, but are more difficult to regulate. The FWPCA does not now require NPDES permits for nonpoint source discharges. However, under Sections 208 and 303, the states are charged with developing areawide waste treatment management plans. They are tasked to define which nonpoint sources in the state need to be controlled, and how to control them. Recently, EPA has promulgated revised regulations for guidance of these state planning programs. A new concept of "antidegradation" of water quality and the development of land use planning to achieve this goal are raised by 40

C.F.R. Parts 130 and 131, published in November, 1975.⁽²⁵⁾ This aspect of water pollution control may be most important for controlling new land uses in the future; thus, most significant for new geothermal development.

4. Special Controls of Possible Future Significance

A number of other pollution control aspects may have future significance to geopressured-geothermal development. Section 307 of the FWPCA requires the EPA Administrator to develop and publish a list of "toxic pollutants," and establish effluent standards for their control. According to the EPA-Dallas office,⁽²⁶⁾ no list of toxic pollutants has been promulgated, but one can expect such a list in the future which might affect geothermal fluid disposal. Another special category of pollutants is established under Section 311(b)(1) of the FWPCA. It is stated as national policy that there should be no discharge of "oil or hazardous substances" into the navigable waters of the United States, upon adjoining shorelines, or into the waters of the contiguous zone. The Administrator must designate those substances, other than oil, whose discharge would endanger public health or welfare, including a danger to fish, shellfish, wildlife, shorelines, and beaches. Future regulation in this category can certainly affect surface disposal options for geopressured-geothermal fluid wastes.

Section 316 of the FWPCA gives special recognition to "thermal discharges" which can affect shellfish, fish, and wildlife in a body of water. As mentioned above, "heat" itself is defined as a pollutant when discharged into water. This aspect will be very significant in the disposal of spent geothermal fluids, which will be hotter than the ambient temperatures when ready for release from a surface utilization facility.

As a carryover from the Refuse Act of 1899, the Army Corps of Engineers remains involved in permitting the discharge of dredged or fill material into navigable waters. This is covered by Section 404 of the FWPCA, and Section 402(a)(4) states that permits issued under the Refuse Act are permits under the NPDES, and vice versa. This results in a virtual consolidation of the two programs, but leads to very complex permitting requirements by another federal agency when construction associated with waste disposal is considered to involve "fill" material.

Section 403 requires the establishment of guidelines for discharges of pollutants into the territorial seas, the contiguous zone, and the oceans to avoid the degradation of their waters. No NPDES permits will be issued for such discharges except in accordance with these guidelines. This regulation would affect possible offshore discharge of geopressured-geothermal fluids.

B. Federal Versus State Permitting of Surface Disposal

In a declaration of goals and policy, the FWPCA says:

It is the policy of the Congress to recognize, preserve, and protect the primary responsibilities and rights of States to prevent, reduce, and eliminate pollution, to plan the development and use (including restoration, preservation, and enhancement) of land and water resources, and to consult with the Administrator in the exercise of his authority under this Act.⁽²⁷⁾
[Emphasis added].

Thus, Section 402(b) of the FWPCA says that a governor of a state desiring to administer its own permit program for controlling discharges of waste into navigable waters within its jurisdiction may submit a complete description of the proposed program to the Administrator who may approve it, or disapprove it under a broad list of reasons.

1. Requirements for Approval of State Permit Program

Under the FWPCAA, effluent limitations must be established for and applied to all point sources of pollutant discharge within a state, pursuant to Section 301. Under Section 303, the states must adopt water quality standards applicable to their intrastate waters. Further, they must establish a procedure for periodic review of these water quality standards, designate appropriate uses for specific water, and determine criteria required to accomodate these uses. They must identify effluent limitations not severe enough to achieve the water quality standards and establish maximum daily loads of pollutants, including thermal pollution, for waters identified as having water quality problems. All of these standards and procedures are subject to review by the Administrator. If he finds them unsatisfactory, he can prescribe his own standards or procedures.

Texas had a fairly advanced water pollution control program even before the passage of the FWPCAA in 1972. Under the Texas program, state laws and regulations were promulgated which are equally stringent, and perhaps just as procedurally demanding as those required by the FWPCAA. While some state laws, regulations, and procedures have been amended as a result of the 1972 federal statute, most existed before that time. Even so, Texas is not one of the 21 states that have been approved to supervise the issuance of their own permits in lieu of federal NPDES permits, pursuant to Section 402 of the FWPCAA. Texas submitted its state program to EPA for approval in April, 1973, but approval was not granted. Texas statutes and regulations for water pollution control, having been developed before the federal model existed, did not entirely conform to it. In particular, state civil and criminal

penalties were lower than those in the FWPCAA. In some instances, as for rangeland runoff and discharges from oil and gas wells, the Texas regulations were interpreted by EPA as requiring a showing of injury to receiving waters. EPA said that such differences, and others cited, would have to be removed by statutory or other adjustments before EPA could approve the Texas program. While discussions between EPA and Texas agencies have continued, the current prospects for state program approval are not well defined, even though the original Texas request for program approval was submitted to EPA more than four years ago. [See "Letter from EPA General Counsel to TWQB Concerning NPDES Certification," Appendix A].

2. Effect of Non-approval of Texas Program

Until and unless a Texas permit program is approved, the EPA will continue to control all discharges under the NPDES. Other than administrative complexity, the real effect of this is hard to determine. It should be noted that, even if a state program has been approved for issuance of state permits under the authority of Section 402(b), Section 402(d) requires the state to send the Administrator a copy of each permit application, and notice of every action contemplated under the request. Unless he waives certain options, the Administrator has 90 days in which to deny authority to issue the permit. On the other hand, under Section 401, even if an applicant applies directly to EPA for a federal permit, he is required to provide a certification from the state that the discharge complies with the applicable provisions of certain of the most significant sections of the FWPCAA as to effluent limitations and water quality standards. In essence, this gives the state a veto power over issuance of federal discharge permits.⁽²⁸⁾ Although the

entire Texas program has not been approved, it is significant that the substantive portions of it appear to be acceptable to EPA. Since November of 1973, there has existed a Memorandum of Understanding between the Regional Administrator, EPA-Dallas, and the TWQB that, insofar as practical, yet without actual delegation of permit authority, the TWQB "will assume the burden of the NPDES program" [See Memorandum, in Appendix B]. Thus, when an operator applies for an NPDES permit in Texas, he applies to EPA and fills out their application form; however, EPA has contracted with the TWQB to do about 90% of the actual modeling and technical research required on the application. Since this work is federally funded, the state is relieved of a financial burden it would have to assume if its own program were approved.

3. Overlapping Texas and Federal Permit Systems

A considerable overlap in federal and state administration appears inevitable as a result of the redundancy between federal and state laws and regulations. Under present rules, an operator who wishes to discharge fluid wastes into surface waters must apply to the EPA for an NPDES permit. Under the Texas Water Code, he must also apply for a permit from either the TRRC or the TWQB, depending on whether or not his waste fluids are related to oil or gas production. If he applies to the TWQB for "non-related" waste disposal, he is advised that he must also apply for a separate NPDES permit from the Region VI office of EPA in Dallas. As explained above, much of the technical evaluation will be done by a single agency, the TWQB, but this same evaluation will be used to support dual permits from two different governmental agencies, one federal and one state. Under the arrangement between EPA-Dallas and the TWQB, the TWQB will furnish EPA-Dallas with certified applications, fact

sheets, and TWQB approved state discharge permits in the "NPDES format."

For discharge of waste fluids resulting from oil or gas operations, Texas law requires a TRRC permit. The TRRC has the sole authority in Texas to issue such permits. (These statutory requirements are discussed fully in a subsequent section of this report). However, the permit cannot be granted by the TRRC unless it meets the state water quality standards which are established by the TWQB. As mentioned above, these water quality standards have been and will continue to be subject to EPA review. Nevertheless, a separate NPDES permit must be secured by the operator in addition to the TRRC permit to meet federal law requirements. The procedural details for handling oil or gas related disposal permits under the NPDES have not been resolved between the state regulatory agencies and EPA as they have been for all other waste discharges into surface waters. The Texas statutory requirement for two separate regulatory agencies has apparently complicated the problem for EPA. This is suggested in the EPA, Dallas-TWQB agreement by the statement that the agreement is "an interim step toward the ultimate designation" of the TWQB as the NPDES authority in Texas. No mention is made of TRRC exclusive authority and responsibility under Texas law. As will be discussed later, markedly different procedures for handling permits are being used by the two state agencies. Contrary to the practice of the TWQB, the TRRC has not made it a point to advise permit applicants that they need an NPDES permit as well as one from the TRRC.

4. Contradiction of National Policy

In summary, there is a current requirement for dual level permits for the discharge of waste fluids into the surface waters of Texas since Texas has not received approval to administer its own permit

program. Even if the state should revise its proposed program, and have it approved by the EPA Administrator, the FWPCA will still require a complete duplication of paperwork in order to permit a 100% review of state agency actions. Further, unless the Administrator exercises an option, there is a built-in delay of ninety days before a permittee could be assured that his state issued NPDES permit is valid.⁽²⁹⁾ These procedures seem inconsistent with the congressional policy to recognize primary state responsibility and right in this field, which was quoted at the start of this section. Additionally, the duplicate paperwork, the additional EPA regional manning required for one-for-one review even after state program approval, and the provision for reversing state agency decisions are clearly contradictory of the national policy stated in Section 101(f) of the FWPCA as follows:

It is the national policy that to the maximum extent possible the procedures utilized for implementing this Act shall encourage the drastic minimization of paperwork and interagency decision procedures, and the best use of available manpower and funds, so as to prevent needless duplication and unnecessary delays at all levels of government.

IV. STATE WATER POLLUTION CONTROL IN TEXAS

A. The Texas Water Quality Act

Under Chapter 21 of the Texas Water Code, which incorporates the Texas Water Quality Act of 1967, water pollution controls apply to "water in the state" which is defined to mean:

groundwater, percolating or otherwise, lakes, bays, ponds, impounding reservoirs, springs, rivers, streams, creeks, estuaries, marshes, inlets, canals, the Gulf of Mexico inside the territorial limits of the state, and all other bodies of surface water, natural or artificial, inland or coastal, fresh or salt,

navigable or non-navigable, and including the beds and banks of all watercourses and bodies of surface water, that are wholly or partially inside or bordering the state or inside the jurisdiction of the state.(30)

The legislative intent to embrace all kinds of water, both surface and underground, over which state authority extends, seems clear without court interpretation.

In comparison with the FWPCAA, the Texas Water Code also defines pollution broadly to mean:

the alteration of the physical, thermal, chemical, or biological quality of, or the contamination of, any water in the state that renders the water harmful, detrimental, or injurious to humans, animal life, vegetation, or property or to public health, safety, or welfare, or impairs the usefulness or the public enjoyment of the water for any lawful or reasonable purpose.(31)

1. Responsibilities of the TWQB

The TWQB is charged with administering the Texas Water Quality Act, establishing the level of quality to be maintained, and controlling the quality of the water in the state under the provisions of the code.(32) The TWQB has "exclusive authority to set water quality standards for all water in the state,"(33) and may issue permits for "the discharge of waste into or adjacent to water in the state."(34) Unauthorized discharges are prohibited under Section 21.251 of the Water Quality Act.

2. Responsibilities of Other State Agencies

The permitting authority of the TWQB is qualified by an exclusive assignment of certain permitting duties to the TRRC. That agency is:

solely responsible for the control and disposition of waste and the abatement and prevention of pollution of surface and subsurface water resulting from activities associated with the exploration, development, and production of oil or gas. The commission may issue permits for the discharge of waste resulting from these activities; and discharge of waste into water in this state resulting from these activities shall meet the water quality standards established by the board, [i.e., the TWQB].⁽³⁵⁾

Several other state agencies have specific water pollution control duties. They provide technical assistance, and must be consulted in appropriate cases by the principal permitting agencies, the TWQB and the TRRC. The Texas Water Development Board (TWDB) is concerned with the quality of groundwater in the state. The Texas Parks and Wildlife Department (TPWD) is concerned with the effects of pollutant discharges on aquatic life and wildlife. The Texas Department of Health Resources (TDHR) is concerned with the health aspects of water quality in the state.⁽³⁶⁾

B. Statutory Ambiguity in Geothermal Resources Waste Control

The delegation of permitting authority to the TRRC which was quoted above was not amended subsequent to passage of the Texas Geothermal Resources Act in 1975.⁽³⁷⁾ Section 4 of that act charges the TRRC with regulation of "the exploration, development, and production of geothermal energy and associated resources on public and private land." The TRRC is directed also to publish and enforce rules for protecting the environment against damage, and the general public against injury or damage, resulting from the exploration, development and production of these resources.

In the geopressured-geothermal resources along the Texas Gulf

Coast, there is substantial evidence that significant amounts of methane gas will be produced along with the geopressed waters in which the gas is now dissolved. Economic development of the geopressed resources will probably be critically dependent upon the value of the methane production, according to current analytical studies.⁽³⁸⁾ As a result, one could argue strongly that the spent fluid waste from geopressed-geothermal development and production is waste resulting from activities associated with the development and production of oil or gas. If this argument is accepted, the TRRC has permitting authority for the discharge of that waste, so long as the permits issued meet the water quality standards of the TWQB. TRRC authority would cover both surface discharge of the waste, or subsurface injection of the fluids into wells.

Following the passage of the Geothermal Resources Act, the TRRC amended its statewide oil and gas rules to incorporate geothermal resources. For example, Rule 8 covers water protection, and now reads "oil, gas, and geothermal resources" in describing all operations regulated by the rule. The same procedure was followed in Rule 9 which covers salt water disposal applications.

However, perhaps through oversight, the Texas legislature has never amended Section 21.261 of the Water Code to include geothermal resources specifically with the oil or gas associated waste permits issued by the TRRC. At present, the TRRC staff assumes that they will have jurisdiction over the disposal of geothermal waste fluids, since they have control over the development of the resources, and are charged with protection of the environment and the public in such development and production. However, the TWQB staff is not sure who would have jurisdiction over the disposal of geothermal resource waste. Although

it seems that the legislative intent was for the TRRC to have jurisdiction, since this would be most consistent with the overall pattern of the Geothermal Resources Act, the technicality has not yet been resolved, and probably will not be until such time as a geothermal developer approaches one agency or the other in search of a discharge permit for his waste fluids. One staff member of the TWQB strongly suggested that any potential operator should arrange an informal meeting as soon as possible with representatives from both agencies so that the problem could be settled quite early in the project.⁽³⁹⁾ Such a settlement would be only a willingness to abstain by one agency, and would still leave an ambiguity in the Water Code which must be resolved by the legislature or in the courts. Different sets of regulations and procedures exist for the two state agencies, as will be discussed below, although both are following the same water quality standards.

C. The Texas Disposal Well Act

State control over the injection of fluid wastes into sub-surface strata through disposal wells is prescribed by the Texas Disposal Well Act of 1971. This act amended an earlier statute and is now codified in Chapter 22 of the Texas Water Code. The provisions of this chapter establish a permitting control over disposal wells which divides state authority in a manner similar to the division of agency responsibilities for permitting the discharge of waste into water in the state under the Water Quality Act. No disposal well can be drilled, or an existing well converted into a disposal well, to dispose of industrial or municipal waste without first obtaining a permit from the TWQB. Wells for disposal of oil and gas waste require a permit from the TRRC. The TWDB, the TDHR, and the Texas Water Well Drillers Board (TWWDB) are the principal

coordinating state agencies on all such permits, and on rules and regulations proposed to be issued under authority of Chapter 22.

Industrial and municipal waste means any waste substance, other than oil or gas waste, which may cause "pollution of fresh water."⁽⁴⁰⁾ Oil and gas waste arises out of, or is incidental to drilling for or producing oil or gas.⁽⁴¹⁾ The same potential ambiguity as to geothermal resource waste mentioned in the preceding section relative to the Water Quality Act would seem to exist also for the Disposal Well Act.

The authority for and requirements placed upon the TWQB and the TRRC are entirely comparable. Each may require such information from an applicant as it considers necessary. Each must require that permits issued are in the public interest, do not impair existing rights, and that, with proper safeguards, both ground and surface fresh water can be adequately protected from pollution. Terms and conditions reasonably necessary to protect fresh water may be imposed on the applicant. For drilling a disposal well, the permitting agencies may require accurate records of the strata penetrated. For converting an existing well to a disposal well, an electric log or drilling log can be required with the application. Casing requirements for wells may be prescribed. Each agency can establish its own rules and procedures for notice and hearing on permit applications. Civil penalties are prescribed and may be sought, as well as injunctions, through suits brought by the Attorney General in the name of the state at the permitting agency's request.

Applicants who receive a disposal well permit from either agency must file a copy of it with the health authorities of the county, city, and town where the well is located before beginning injection operations.

D. Water Pollution Control by the TRRC

If the statutory ambiguity discussed above is resolved by placing geothermal-resource waste-fluid disposal under the TRRC, that agency would be charged by state law with the abatement and prevention of pollution of both surface and subsurface waters by such fluids. In accordance with state law, disposal of the waste fluids requires a TRRC permit for either surface or subsurface disposal.⁽⁴²⁾ Statewide rules (as distinguished from special field rules) have been published by the TRRC for general application to oil and gas operations within the state, and they have been amended to include regulation of geothermal resource operations. No special field rules have been established for geothermal resource fields, since no geothermal resource wells have been drilled.

Statewide Rule 8 of the TRRC deals with water protection in general, and states that:

Fresh water, whether above or below the surface, shall be protected from pollution whether in drilling, plugging, producing, or disposing of salt water already produced.

However, the rest of the rule is devoted generally to protection of surface waters, and Rule 9 covers salt water disposal wells. Considering the division of federal water pollution control into protection of surface waters under the FWPCA, and the protection of underground sources of drinking water through the SDWA, the same division will be retained in this discussion.

1. Protection of Surface Waters

a. Salt Water Disposal Pits

Rule 8 (C)(1) of the TRRC prohibits the use of salt water disposal pits for storage and evaporation of geothermal

resource waters, except for the use of impervious collecting pits in conjunction with approved salt water disposal operations. Furthermore, Rule 8(C)(1)(c) states:

Discharge of oil field brines, geothermal resource waters or other mineralized waters into a surface drainage water course, whether it be a dry creek, a flowing creek or a river, except where permitted by the Commission, is not an acceptable disposal operation and is prohibited.

TRRC personnel indicate that exceptions to these rules are rarely granted, and good and sufficient cause must be shown in order to receive such an exception.⁽⁴³⁾ Exceptions to Rule 8(C)(1) are usually granted only in emergency situations, when an approved disposal system breaks down for a period of 48 hours or less, and the operator must provide an emergency alternative, such as an earthen pit, to hold his salt water. Figures of how many or what sort of exceptions were granted last year were not readily available. When an exception to Rule 8(C) or (D) is requested by an oil or gas operator for surface disposition of brines, a letter of intent must be submitted to the Field Operations element of the TRRC.

b. Discharge into Tidal Waters

In addition to considering exceptions to Rule 8(C), the Field Operations staff oversees exceptions to Rule 8(D), which states, in part:

- (1) The operator shall not pollute the waters of the Texas offshore and adjacent estuarine zones (salt water bearing bays, inlets and estuaries) or damage the aquatic life therein.
- (2)
 - (a) The disposal of liquid waste material into the Texas offshore and adjacent estuarine zones shall be limited to salt water and other materials which

have been treated, when necessary, for the removal of constituents which may be harmful to aquatic life or injurious to life or property.

- (b) No oil or other hydrocarbons in any form or combination with other materials or constituent shall be disposed of into the Texas offshore and adjacent estuarine zones.

Permits for dumping liquid waste material into the offshore or estuarine areas under this provision are granted only after a careful case by case analysis of brine content. Information specific to a particular geothermal development would have to be supplied, including the chemical composition of the effluent and its temperature, to allow the TRRC to determine the permissibility of the discharge.

In the Gulf Coast area, where oil field brines sometimes approximate the salinity of the bay waters, discharge into the bays has been allowed from time to time. Cross consultation with the TWQB and the TPWD is required in such a case. If these interested agencies register objections, a hearing is usually held. The TPWD points out that "highly-mineralized, subsurface saltwater" is, in all cases they know, "chemically different from surface saltwater found in the bays, estuaries and Gulf of Mexico." Fish and wildlife can be and have been adversely affected by discharges of oil-field brine into tidal waters.⁽⁴⁴⁾ Once a TRRC permit is issued, either for surface or subsurface disposal of salt water produced in connection with the production of oil or gas, no separate permit from the TWQB is necessary.

For discharge of oil field brine into tidal waters, special instructions provide for skimming oil from the brine, a closed system for the discharge, marking of the discharge point, and a continuous program for sampling and analyzing the brine at random times. Quarterly

reports of the oil content must be made to the TRRC.⁽⁴⁵⁾ This concern for oil and other hydrocarbons in brine discharged into surface waters may indicate a need for special precautions to assure removal of all significant quantities of dissolved methane in geopressured-geothermal waters. Also, the FWPCA requirement in Section 311 that there be no discharge of "oil or hazardous substances" into navigable waters, or into the contiguous zone, demonstrates a similar federal concern. However, the federal and state permit requirements are probably not identical. As stated earlier, the EPA is required to designate hazardous substances other than oil whose discharge may endanger public health, fish, shellfish, wildlife, shorelines and beaches. No official list of such substances exists as yet.⁽⁴⁶⁾

2. Underground Injection Controls

Under the Oil and Gas Division in the Austin office of the TRRC, an engineering section grants all initial permits for disposal wells, and secondary-recovery, waterflooding wells associated with oil or gas production in the state of Texas. In 1975, 459 applications were processed for salt water disposal wells. In addition, 778 permits for waterflooding wells were processed.⁽⁴⁷⁾ A secondary recovery permit can cover several wells in a waterflooding project.

The number of salt water disposal wells rose sharply between 1967 and 1969. This was due largely to the prohibition of salt water disposal pits, under Rule 8, which went into effect in 1969. Prior to 1969, disposal pits had been in frequent use, and surface waters were being contaminated when these evaporation pits overflowed with a discharge of brines into water courses. Further, groundwater was

being contaminated by seepage from the evaporation pits. In connection with oil and gas operations, an immense volume of brines must be disposed of annually in Texas (in 1961, 95 billion gallons of brine were produced).⁽⁴⁸⁾

Between 1955 and 1975, approximately 10,744 salt water disposal wells have been permitted by the TRRC.⁽⁴⁹⁾ While the volume of applications is large, the TRRC staff tries to act upon an application as soon as possible after it is submitted to avoid interference with oil and gas production. If an application is submitted with complete data (See application form W-14 in Appendix C), it can sometimes be approved that same day. Two days is almost the maximum time that it will take to approve or reject an application. This should be contrasted with the TWQB process, which thoroughly reviews and processes only about thirteen applications for major municipal or industrial waste disposal wells per year. Of course, the procedures and requirements of the two agencies vary correspondingly.

a. TRRC Subsurface Injection Regulations

The basic requirements for salt water disposal well applications are contained in TRRC statewide Rule 9. The rule is quoted in part as follows:

(A) Salt water or other water containing minerals in such an amount as to be unfit for domestic, stock, irrigation, or other general uses, may be disposed of, upon application to and approval by the Commission, by injection into the following formations:

(1) All non-producing zones of oil, gas or geothermal resources bearing formations that contain water mineralized by processes of nature to such a degree that the water is unfit for domestic, stock, irrigation, or other general uses.

(B) Before such formations are approved for disposal use, the applicant shall ascertain whether or not the formations are separated from fresh water formations by impervious beds which will give adequate protection to such fresh water formations and must submit a letter from the Texas Water Quality Board, Austin, Texas, stating that the use of such formations will not endanger the fresh water strata in that area and that the formations to be used for salt water disposal are not fresh water bearing sands.

(C) Salt water disposal wells shall be cased and the casing cemented in such a manner that there will be no danger to oil, gas, geothermal resources or fresh water reservoirs.

(D) The application to dispose of salt water by injection into a porous formation not productive of oil, gas or geothermal resources shall be verified and filed with the Commission.

b. Assessment of TRRC Controls

The TRRC permit requirements for oil and gas waste disposal wells appear to be less demanding for substantiating data and monitoring requirements than either the TWQB rules and procedures for permitting industrial and municipal disposal wells, or the proposed EPA regulations for underground injection wells. The requirements of both the TWQB and EPA will be discussed further in later sections.

(1) TWQB Letter on Protection of Fresh Water

The TWQB letter described in Rule 9(B) is intended to satisfy a statutory requirement of the Disposal Well Act.⁽⁵⁰⁾ In practice, the letter is based upon an examination of the applicant's statements in his W-14 application form which he will submit to the TRRC. In the Geological Services Section of the TWQB, there is a single employee to review the TRRC disposal well applications. He reviews an average of 70 such applications per month. Only a cursory review is possible under these circumstances. The TRRC has control over

about 40,000 oil or gas related disposal or injection wells, whereas, the TWQB has permitted only 132 wells, and not all of these are active.⁽⁵¹⁾ When the TWQB staff reviews the TRRC salt water disposal well applications, they look primarily at the following:

(a) the top of the injection zone, making sure that there is at least 250 feet of clay or shale between that zone and the deepest usable fresh water stratum; b) the casing design for technical adequacy. The TWQB cannot verify independently the information provided in the application. As a result, their letter will state, if all abandoned wells in the area are cased and plugged, the well does not appear to pose any problems to any fresh water strata.

(2) TRRC Application Data

As an examination of the new W-14 application form in the appendix will show, the TRRC requires a full presentation of casing and tubing data by the applicant. Specific information is required as to the injection zone, type of injection (along with injection volumes and pressures), depth of deepest fresh water zone and shallowest zone productive of oil and gas in this field, need for treating waste fluid before injection, and other pertinent information. An area plat showing all wells within a half mile radius must be provided. The operator must state that the well is so cased and completed that the salt water can enter no other formation than the injection zone described. The application must be signed by an authorized representative of the operator, and he must certify that the data and facts are true, correct, and complete. The application must be accompanied by a complete electrical log of the well or of a nearby well, by the TWQB letter, and by waivers

or requests for them from all offset operators and the surface owners of land involved. If the waivers are not complete, the application will be suspended for ten days to permit protest or request for hearing.

(3) Monitoring and Inspection

The TRRC apparently depends to a large degree on the applicant's certified statements, and their own capability to recognize danger signs in an area of special expertise. Considering the possibly less harmful character of natural salt water produced with oil or gas, and the need to dispose of such large quantities with minimum interference with oil and gas production, this may be an appropriate system. The problem of interfering with oil or gas production has been recognized by the U. S. Congress, both in the FWPCA and in the SDWA.⁽⁵²⁾ Nevertheless, the TRRC staff says that any field inspection by them is sporadic. Further, they establish few monitoring and reporting requirements for the operator. However, the permit is granted subject to no substantial change in the operations set forth in the application. If the operator desires substantial changes, or if they should be necessitated, he must apply for a new permit.

(4) Notice and Hearing on Applications

Provision is made for notice of the application to be given to the surface owner and each offset operator. If complaints are received, a hearing will be held by the TRRC with notice to all interested persons. If no complaints are received, a permit will be issued without further notice or hearing.

E. Water Pollution Control by the TWQB

If the Texas legislature or the courts should resolve the existing statutory ambiguity discussed earlier by assigning water pollution controls over the disposition of geopressed-geothermal waste fluids to the TWQB, contrary to the apparent intent of the Geothermal Resources Act, an entirely different type of regulatory system would be applicable for state discharge permits. Additionally, because of the NPDES requirements, with or without a state permit program approval, it would appear that procedures similar to those of the TWQB are likely to be imposed on all surface disposal of pollutants, regardless of state law or desires.

1. Protection of Surface Waters

Section 21.079 of the Texas Water Quality Act states that:

- (a) The board may issue permits and amendments to permits for the discharge of waste into or adjacent to water in the state.
- (b) A person desiring to obtain or to amend a permit shall submit an application to the board containing all information reasonably required by the board or the executive director.

The act defines "waste" as sewage, industrial waste, municipal waste, recreational waste, agricultural waste, or other waste. Other waste means "garbage, refuse . . . sand, lime, cinders, ashes, . . . oil, . . . acids, chemicals, saltwater, or any other substance . . . that may cause impairment of the quality of water in the state".⁽⁵³⁾ [Emphasis added]. The "board" mentioned is the TWQB, which has seven members. These include representation from the TWDB, the TRRC, TPWD, and the TDHR.

It should be noted that a bill has passed the state legislature for consolidation of the three current state water agencies:

the TWQB, the TWDB, and the Texas Water Rights Commission (TWRC). The bill has been approved by the Governor. When the consolidation occurs, it must be presumed that water quality regulation will be largely unchanged, but the overall effect on administration cannot be predicted with confidence. The discussion which follows uses the current organizational titles and procedures.

The TWQB prescribes conditions of permits, including duration, location of point of discharge, maximum quantity of discharge, character and quality of waste, and any monitoring and reporting requirements. The permit may be later amended by the board and the permittee given reasonable time to conform to new or additional conditions. Once issued, a permit does not become a vested right in the permittee. After notice and public hearing, the board may revoke or suspend a permit for good cause.

Although the statutory board is composed of only seven members, the staff which reviews and researches permits fills several floors of state office buildings in Austin. Before a detailed application (see Appendix D) is ever seen by the "board" in the final hearing, it must go through a complex review, including a systematic, detailed, modeling process for determination of feasibility.

a. Point Discharge Permits

At present, the TWQB is concerned with getting all point source surface dischargers in the state permitted, pursuant to both the Texas Water Quality Act and the FWPCAA. The board estimates that 90% of all dischargers of effluents into or adjacent to state waters have been permitted.⁽⁵⁴⁾ This does not include the oil or gas related permittees which are handled now by the TRRC. Any potential

discharger required to apply to the TWQB for a permit should do so from eight months to one year prior to the proposed date of first discharge to allow normal processing time.

As stated earlier, EPA has contracted with the TWQB to draft 90% of the NPDES permits. The TWQB evaluates the permit request, goes through a modeling process using EPA guidelines, gives public notice of the permit application, conducts hearings, and mails a draft permit back to the EPA in Dallas, who then issues the NPDES permit. For this work, the TWQB gets federal money. Essentially, the TWQB writes the NPDES permit, but because of what seem to be rather minor technicalities, they cannot issue it. As a result, there is a dual permitting system, since the TWQB must also issue a state permit. However, under the EPA, Dallas-TWQB agreement mentioned earlier, the state permit is in the "NPDES format."

When a prospective discharger applies to EPA for a permit, he is assigned a number which is his identity for further dealings with his application, both at EPA and the TWQB. Although it does seem like a minor detail, this was mentioned by the two agencies as being a functional, important step in the permitting process. (55)

TWQB Rules of Practice and Procedure furnish guidelines to the applicant for a discharge permit. Specifically, Rules 130.01.31.001-.004 establish the procedure for obtaining a waste control order. The rules outline the forms, staff conferences, preparation, filing, fees, maps, and technical information required, and the procedures that will be followed. It is strongly recommended by the TWQB that an applicant confer with the staff before preparing design plans and specifications for any disposal system.

A public hearing is required by the TWQB for every application, except for an amendment to an existing permit. Notice must be given, pursuant to Rule 130.01.50.004, not less than 20 days prior to the hearing. This is accomplished by publication in newspapers in the counties affected, and by mail to numerous parties. These include, but are not limited to, the landowners named on the application map, the county judge and health authorities of the county in which the waste will be disposed, the TWDB, the TDHR, the TPWD, and the TRRC. The Texas Air Control Board is included if industrial waste is involved, and the Texas Water Well Drillers Board when an injection well is planned.

After notice and hearing, the board may grant the application in whole or in part, or deny it. A copy of the board order is sent to the applicant. If a permit is granted, quantity and quality of the allowable discharge are specified. Any granted permits are subject to amendment, appeal, rehearing, or revocation.

b. Water Quality Standards

Water quality standards have been established by the TWQB for particular areas, differing according to the specifics of the area, such as temperature, topography, desired uses, salinity levels, or a particular stream level. Such standards must be established by the states under Section 303 of the FWPCA. The Texas Water Quality Act also imposes this requirement on the TWQB. The surface waters of the state of Texas have been categorized as river basins, coastal basins, bay waters, and gulf waters. Each category is defined in a publication called the Texas Water Quality Standards.⁽⁵⁶⁾ In addition, river and coastal basins have been subdivided into water quality segments, each with its own parameters. A brief summary of some pertinent standards

follows.

(1) Usage Categories

Each water quality segment is designated as desirable for a particular usage, and this usage description reflects TWQB objectives for water quality in the segment. The usage categories are:

- Contact recreation waters
- Noncontact recreation waters
- Domestic raw water supply
- Propagation of fish and wildlife

Each usage category specifies an amount of coliform allowable, varying from 200/100 milliliters to 2000/100 milliliters. The recreation category description uses such broad terms as "swimmability," which is also used in FWPCA language and congressional reports reflecting desired uses of waters. Parameters are varied in their application to different water courses; i.e., the Houston Ship Channel will never be swimmable, although Lake Travis will be. Other criteria may be specified, which include:

- (a) limits for taste and odor producing substances; (b) surface waters kept essentially free of floating debris and settleable suspended solids;
- (c) the surface waters maintained in an aesthetically attractive condition;
- (d) no substantial change in the turbidity of streams due to waste discharge; (e) no foaming or frothing of a persistent nature; (f) no discharge of radioactive materials in excess of an amount regulated by statute; (g) surface waters maintained non-toxic to man, fish and wildlife; (h) no oil, grease or related residue which creates a visible film of oil or globules of grease on the water surface, or coats the banks and bottoms of the water course.

(2) Chemical Pollutant Limitations

Chemical concentration parameters, with the exception of dissolved oxygen and pH, apply to the approximate midpoint of the segment under consideration with reasonable gradients applying toward segment boundaries. Parameters limiting chemical pollutants include chlorides, sulfates and total dissolved solids. The limits are in terms of annual arithmetic mean concentrations. (57)

(3) Temperature Limitations

Temperature limitations may be specified in terms of maximum temperature, and maximum temperature differential attributable to heated effluents. The temperature requirements do not apply to offstream or privately owned reservoirs, constructed principally for industrial cooling purposes, and financed in whole or in part by the entity using, or proposing to use, the lake for cooling purposes. This applies to Jefferson Lake Sulfur, for instance, which has a 400 acre cooling pond as a part of a sulfur mining operation using the Frasch process. However, heated wastes cannot be discharged into certain designated state waters without an individual evaluation by the TWQB. The waters so designated are construed to be cool waters, which are potentially cool water fisheries.

Dissolved oxygen and temperature levels apply at all times when the daily flow of a surface stream exceeds a base flow condition. The base flow condition is defined as either a 7-day minimum average flow or 0.1 cubic feet per second, whichever value is higher. (58)

(4) Mixing Zones

Mixing zones may be established in an NPDES or

TWQB permit which allow special exceptions from normal quality standards for treated effluents discharged into the zone. Such mixing zones are designated where a reasonable discharge into a body of water cannot be made without exceeding the general water quality standards over a localized area. However, outside or downstream of the designated zone, the water quality must return to the proper standard level. Normally, mixing zones are limited to no more than 25% of the cross-sectional area of a stream or estuary, leaving at least 75% free for normal quality stream flow. Because of the varying physical, chemical and biological conditions of surface waters, no particular limitations are applicable in all cases. Occasionally, permission to discharge into a mixing zone may be limited by a condition that the discharge be made only during a flood level of the stream. Normal temperature standards remain applicable to waters outside the mixing zone. These are established over intervals from the surface to the bottom.

(5) Sulfur Operations (Frasch)

Water quality standards for temperature create difficulties in compliance for the sulfur industry using the Frasch process. Such installations along the Gulf Coast have thermal water disposal problems which appear similar to those a geothermal developer might have. The Frasch method of sulfur mining involves injecting superheated water under pressure, and at a temperature of 320 to 330 degrees F., into bore holes. The hot water melts the sulfur, which sinks to the bottom of the well in a molten state. It is then raised to the surface through an inner string of pipe. Part of the hot water percolating through the underground formation must be removed as it cools so that more can be injected. This "bleed" water, as it is called,

is removed through bleed wells at some distance from the operating wells, and is frequently pumped into holding reservoirs prior to discharge into ditches or canals. (59)

At the Boling Dome, Newgulf, Texas, the bleed water is discharged into a Lone Star Salt Water Company ditch where it flows for twenty miles, losing much of its solid burden, and cooling before it flows into the San Bernard River. This operation was permitted by the TWQB for an average discharge of 12,500,000 gallons per day. The original permit was for a point of discharge at the end of the disposal ditch. Since water is now being discharged from several places along the ditch, an amendment to the permit now establishes a new control point at the plant, where the bleed water is first put into the ditch. This loses the benefit of the twenty mile flow on the improvement of effluent quality.

Other sulfur operations using the Frasch process utilize large, 400 acre, cooling ponds, which are expensive to construct and maintain. The TRRC no-pit order would generally put these out of the question for oil, gas, or geothermal fluid waste disposal unless the cooling pond has an impervious lining. However, the TWQB discourages subsurface disposal of fluid wastes if surface disposal is feasible. (60)

(6) Salinity of Estuaries

Activities of any nature which might detrimentally affect salinity gradients in estuarine waters are scrutinized carefully. Although the mineral character of estuarine and marine waters is not included within the present Texas Water Quality Standards, other state and federal agencies are concerned with its effect on fish

and wildlife. Any TRRC or TWQB permit to discharge brines into the bays or estuaries of the Texas Gulf Coast must be reviewed by the TPWD before it is issued.

c. Meeting Water Quality Standards

In addition to meeting EPA prescribed effluent limitations, either for an existing or new point source of pollutants, a geothermal developer must meet the water quality standards of the TWQB which were outlined in part in the preceding section. The TWQB establishes waste load allocations into the various streams and coastal basins in order to satisfy usage criteria. The water quality standards are specific for particular stream segments. The stream or basin segments which are being considered for pollutant discharge can be identified from a TWQB publication, Texas River and Coastal Basins, Segment Identification Maps. The Texas Water Quality Standards, also published by the TWQB in February, 1976, must then be used to find usage criteria, and the various water quality standards applicable to each segment under consideration. In discussions with the TWQB staff, and these should be held as soon as possible, the developer must present reasonable evidence as to the physical and chemical character of his planned discharge. Special consideration may be given to discharge of effluent from a test well in a geothermal resources field, in order to get better data on the quantity and quality of waste flow expected from a surface utilization facility. Site planning should give major consideration to the requirements for effluent disposal, since water quality segments for surface disposal have varying standards to meet. Whether exceptions to the standards, particularly as to volume and temperature, can be granted will determine how much pre-treatment of the effluent will be needed prior to disposal.

d. Nonpoint Source Control Planning

As mentioned in the overview of the FWPCAA earlier, nonpoint sources of water pollution are a major problem in improving water quality in the United States. Nevertheless, because control of such pollution is so difficult to regulate, the NPDES permitting system is not applicable. The U. S. Congress chose to turn the problem over to the states, primarily by Section 208 of the FWPCAA, but also inherently in Section 303, where the states are charged to establish water quality standards and implementation plans for waters within the state.

The EPA was tasked to develop guidelines for identification of "areas which, as a result of urban-industrial concentrations or other factors, have substantial water quality control problems."⁽⁶¹⁾ The governor of each state was directed to identify such areas within his state, and then to establish area responsibility for an "areawide waste treatment management planning process." Plans developed and approved by a governor must be subsequently approved by EPA to secure federal funding assistance for their execution.

The TWQB Continuing Planning Program is now involved in a two year study pursuant to section 208 and 303 of the FWPCAA to identify geographical areas of concern, and categories of activities which may need to be monitored as nonpoint sources of pollution. Following this work, two other steps are needed. These are to assess the impact of the nonpoint sources, and then to develop and evaluate control alternatives. What effect this overall effort may have on geopressured-geothermal development is impossible to assess now.

New work is also being done on balancing the discharge into, and the pollutant load of river and coastal basins. This site

specific work is usually subcontracted out by the TWQB to the various river authorities, i.e., Trinity River Authority, Brazos River Authority. The work is then submitted to the TWQB in Austin for review and approval. New standards are being considered for the salinity level of streams, both as to the allowable salt content of discharges, and the maximum allowable salinity level for the stream.⁽⁶²⁾ The results of this work could certainly affect the possibilities for surface discharge of geothermal waste fluids.

As indicated earlier, new EPA regulations for guidance of state planning programs in 40 C.F.R. Parts 130 and 131 introduce a new concept of antidegradation of water quality which should be expected to create new problems for future geothermal developers. In order to comply with EPA direction,⁽⁶³⁾ the states must adopt a statewide policy on antidegradation. The TWQB published an antidegradation statement as its policy in the Texas Water Quality Standards.⁽⁶⁴⁾ The statement uses the very general "legislative policy expressed in the Texas Water Quality Act" as the basis for the TWQB antidegradation policy. What the evolution of this antidegradation concept will bring forth in the years ahead is impossible to forecast; however, some commentators are concerned that it is a "no-growth" policy, "requiring comprehensive land-use planning", but "solely from the perspective of water pollution." This antidegradation policy of EPA is currently being tested in a federal court.⁽⁶⁵⁾

2. Underground Injection Controls

If an operator wishes to make a subsurface disposal of geothermal waste fluids, and if it should be decided that a disposal

well for this purpose is under the jurisdiction of the TWQB, then the Geological Services division of that agency must be contacted. Last year, this division reviewed and modeled only thirteen disposal well permit applications of all kinds. As a result, the application process can be much more intricate than the disposal well application process at the TRRC.

As discussed earlier, the Texas Disposal Well Act established nearly identical authorities and requirements for permitting disposal wells by the TWQB and the TRRC for their respective waste fluid control responsibilities. Nevertheless, industrial waste fluids may be highly toxic, they may be corrosive to injection tubing in a disposal well, and they may react chemically with the soil material of the underground injection zone. Further, they may be more limited in quantity than brines from oil and gas production, and there is more opportunity for pre-treatment during the industrial process to adjust unfavorable characteristics prior to injection. Industrial wastes vary substantially from industry to industry, while oil and gas brines are more nearly uniform. However, many of the industrial injection well operations in Texas inject inorganic chemicals which are similar to oil field brines.⁽⁶⁶⁾

According to a TWQB staff member, municipal wastes injected into the subsurface in Texas are rather low in volume, and normally wells for injection of such wastes exist only in areas where little, if any, usable groundwater exists. Usually, these wells are in use for only a short time, and are discontinued when sewage service is offered to an area. Furthermore, these wells inject at low pressures, many by gravity alone, and all available studies indicate that bacteria

and virus will be filtered out within 200 feet of the well bore. For these reasons, municipal waste disposal by subsurface injection is not considered by the TWQB to be a major threat to underground drinking water sources, and such wells are not as stringently regulated as industrial waste disposal wells.⁽⁶⁷⁾

Oil and gas related brines can cause corrosion, and can erode well tubing, but the problems are generally less severe than with chemical wastes. However, for properly constructed and monitored injection wells, the TWQB staff believes that the true danger arising from injection may not be so much from what is being injected as it is from the pressure, depth, volume, and rate of injection.⁽⁶⁸⁾

Early regulation by the TWQB of disposal wells under a previous statute was less thorough than it is today, and the board found it necessary to send out a questionnaire to disposal well operators in order to acquire a comprehensive description of existing operations. Current permit applications must be prepared under the direction of a registered professional engineer or professional geologist (See Appendix D for details). The application must be accompanied by a justification for subsurface disposal in comparison with alternative disposal methods. In addition, a comprehensive technical report is required before an application will be considered.

a. Technical Report Requirements

The technical report must include location maps which show all artificial penetrations of the uppermost, proposed injection interval, within a radius of 2 1/2 miles of the proposed well site. A description of the local topography and geology pertinent to the program, and of the deepest fresh water strata in the area must be

provided. There are also detailed requirements for technical data which will permit an independent review of the proposal. These include:

(1) A detailed chemical and physical description of the waste fluid to be injected.

(2) The complete engineering design and operating plan for the proposed injection well.

(3) Geologic data and physical characteristics of the injection zone, compatibility of the injection waste with the zone, injectivity tests, and computations on the probable effects of the planned injection.

(4) Details of the injection program, including rates, pressures, annual volume, and anticipated life.

(5) Description of the associated surface installations.

b. Comparison of TWQB and TRRC Requirements

As should be expected from the greatly different work load, the time available for independent review, and the potentially more hazardous waste regulated by the TWQB, technical and procedural requirements of the two disposal well permitting agencies vary widely. The principal differences appear to be:

(1) Hearing Requirements

The Disposal Well Act permits hearings to be held by the permitting agency on applications. The TRRC holds hearings only when a dispute comes to their attention. The TWQB procedures provide for extensive notice and a public hearing on every application.

(2) Independent Technical Review of Injection Proposal

The extensive data specified for the technical

report accompanying an application for a permit allows an independent technical review and modeling of the disposal well proposal by the TWQB. The TRRC depends on the competence of the operator, and his certified statements as to the adequacy of his proposal, with only a limited review of the most significant design characteristics. The permit is granted with the requirement that the well be so cased and completed that injected water can enter no strata other than a specified depth interval.

(3) Monitoring, Reporting, and Inspection

The TWQB imposes extensive monitoring and reporting requirements on an applicant in the permit they issue. These vary according to the circumstances, but generally provide for well logs during drilling, injectivity tests, and bottom hole temperature and pressure recording. These are reported in drilling and cementing reports. Injection rates and permissible pressures are established, and pressure gauges on the injection tubing, and continuous recording devices are specified. Semi-annual reports are required on injection volumes and pressures, as well as a yearly report on the effects of injection on the injection stratum. Since there are only 66 active disposal wells under TWQB supervision, periodic inspections are possible.

For TRRC permits, there is a requirement that the well be equipped with an above ground bradenhead observation valve. This allows the operator to monitor pressure anomalies in the space between the surface casing and the injection tubing to detect signs of trouble. The permit limits maximum injection pressure, so the operator must install a gauge to measure that. There are no periodic reporting requirements, but the application form states a permit granted is valid

only so long as there is no substantial change in the operations set forth in the application. The local district office must be notified before running tubing and setting packer in the well. When a well is completed, or converted to a disposal well, the operator must file a complete record or log of the well with the district office. These monitoring and reporting requirements permit a local TRRC office, familiar with local operations, to inspect as appropriate according to the capabilities and experience of the operator, but no standard, periodic-inspection schedule seems to be maintained. Perhaps these procedures are appropriate for supervising on the order of 40,000 disposal or injection wells.

(4) Miscellaneous Technical Differences

The TWQB has not established any requirement for a fixed minimum injection depth for industrial waste wells, but most are over 3000 feet in depth. The TWQB does require that the surface casing be cemented all the way to the surface, and pays particular attention to the corrosion resistance of injection tubing to the particular fluid waste to be injected. The TRRC requires a minimum of 250 feet of impermeable strata between the highest injection zone level, and the lowest level of fresh water. The operator must report the top of the cement for the surface casing, and how this was determined, but there is no requirement to cement it all the way to the surface. Absent problems indicated in a specific case, no special requirements are established for corrosion resistance of tubing.

V. NEW FEDERAL STANDARDS FOR UNDERGROUND INJECTION CONTROL

A. The Safe Drinking Water Act

Prior to the passage of the Safe Drinking Water Act of 1974 (SDWA), subsurface injection of saltwater or waste fluids was an activity controlled almost entirely by the states. As stated previously, water pollution control under the FWPCA was limited to "navigable waters," but also referred to the protection of surface and underground waters. Nevertheless, based upon the legislative history, a federal district court, in United States v. GAF Corp.,⁽⁶⁹⁾ in 1975, held that underground waste disposal into non-tributary groundwater did not fall within the controls of the FWPCA. The EPA has resisted the effect of this decision, apparently because the penalties possible under the FWPCA are greater than those under the SDWA.⁽⁷⁰⁾ A very recent decision in another federal court, if it stands up under appeal, seems to make this EPA position completely untenable. In United States v. Earth Sciences, Inc.,⁽⁷¹⁾ a 1977 case, a federal district court in Colorado held that the activities listed in Section 304(e) of the FWPCA are a statutory exclusion from the definition of point sources regulated under the NPDES. After reviewing the legislative history extensively, the court found such activities to be legislatively defined as nonpoint sources, not subject to NPDES permit requirements, nor to EPA enforcement authority under the FWPCA. Most pertinent for the subsurface injection of geothermal wastes, Section 304(e) (2) (D) covers "the disposal of pollutants in wells or in subsurface excavations." However, the SDWA is now specific on the protection of underground drinking water, and instructs the EPA to promulgate regulations which will be guidelines for state underground

injection control programs. This is done "to provide broad protection to underground drinking water sources from endangerment by underground injection of contaminants."⁽⁷²⁾

B. Establishment of State Injection Control Programs

The SDWA is typical of federal environmental legislation which seeks to extend federal control into fields previously controlled by the states. In the text covering the proposed rules, EPA says that "Congress sought to leave primary enforcement responsibility to the States, and provided for grants from EPA to State programs meeting certain requirements,"⁽⁷³⁾ [emphasis added]. The governor of a state must apply for an initial grant, and indicate an intention to establish an underground injection control program for which the state will assume primary enforcement authority within two years. As will be shown below, this means that the state intends to develop a control program which meets federal standards within two years.

1. State or Federal Control

A state has no option. A list of states requiring underground injection control programs will be published by EPA, and all states will eventually be included.⁽⁷⁴⁾ When a state is listed, it must submit a state program to the Administrator within 270 days. The EPA proposed rules, drawing from the SDWA, say:

If the State program does not fully meet the requirements of the Act and applicable regulations, or if no State program is submitted, the Administrator must prescribe a program for the State within 90 days.

Further:

the State cannot assume overall "primary enforcement authority" unless all of its program is approved by the Administrator. If a State does not assume primary enforcement responsibility, . . . the Administrator will have direct enforcement authority in the State. (75)

2. Minimum State Program Requirements

The EPA regulations will establish minimum requirements for a state underground injection control program. Under the proposed rules, a state program must: (76)

- a. Prohibit almost all types of injections which do not have a state permit.
- b. Establish state permit requirements which comply with federal standards.
- c. Apply to almost all persons within the state.
- d. Establish an enforcement authority which includes:
a right for suit to enjoin violations, a right of entry and inspection, a requirement for operators to keep records and make reports, and provisions for civil or criminal penalties.
- e. Provide public availability of most information in state files.
- f. Include independent state inspection and surveillance procedures with supporting programs for systematic surveys and periodic inspections.
- g. Be adopted after reasonable notice and public hearings.

Under the proposed procedures, one state agency would be named by the state governor to be in charge of this program within the

state, administer the grant funds, and serve as coordinator with EPA. As discussed above, both the TWQB and the TRRC now have underground injection control responsibilities in Texas. Presumably, this can continue. Nevertheless, it is the EPA desire that one of these agencies must coordinate the work of the other, at least insofar as dealings with EPA are concerned, and administer any federal grant funds involved. Perhaps the FWPCA memorandum of understanding between the TWQB and EPA-Dallas (Appendix B) illustrates this EPA attitude.

3. Effect on Present Texas Injection Controls

The proposed federal regulations will impose stricter standards and substantially increased administrative requirements and time delays upon the operators of subsurface injection wells, especially salt water injection wells associated with oil or gas production, than has been the case under present Texas state rules. The federal regulations were apparently modeled after various state procedures, including the TWQB regulation of municipal and industrial waste injection wells,⁽⁷⁷⁾ but go beyond even those for monitoring and reporting requirements. For Texas, the result will be to impose what are essentially TWQB procedures on TRRC permitting of oil and gas related disposal wells, by far the larger part of the program numerically. Additionally, there are detailed, voluminous rules requiring broad notice and public hearings, not mandated by the Congress in the SDWA, on all permit applications. Extensive monitoring and five-year record keeping requirements are specified, and quarterly reports must be submitted.

This type of regulatory control would establish a new world for subsurface injection controls over oil, gas, or geothermal resource associated wastes. If such new federal regulations are imposed, regardless

of which state agency has regulatory responsibility, the extremely time consuming, and administratively burdensome procedures would apply to all disposal and injection wells.

Staff members of the TRRC have indicated that the new regulations will force them to enlarge their staff, install new and complex monitoring systems, and require a gross addition to their present budget. Based upon additions to the Austin staff, a large field operation staff increase, and a massive enlargement of data processing, the yearly cost of the new program is estimated to exceed two million dollars. (78)

C. Overall Effect on Oil and Gas Production

The chief oil and gas producing states will most probably be designated by EPA as requiring underground injection control programs. Oil and gas operators using salt water injection wells are very concerned about the impact of the proposed regulations on their production.

Proposed federal regulations pursuant to the Safe Water Drinking [sic] Act of 1974 could reduce Texas production of oil by 10%, according to George Singletary of the Texas Railroad Commission. Singletary says the estimate is "tentative, off-the-cuff and preliminary" and that the Commission staff is conducting a detailed survey to assess the situation. (79)

Worth noting is section 1421(b)(2) of the SDWA which states:

- (2) Regulation of the Administrator under this section for State underground injection control programs may not prescribe requirements which interfere with or impede —
 - (A) the underground injection of brine or other fluids which are brought to the surface in connection with oil or natural gas production. . . [Emphasis added].

When the proposed rules were published in 1976, representatives from the oil and gas industry, among others, cited this section as a basis for

opposition to the stringent regulations. Critics felt that the EPA requirements would interfere with and impede the production of oil and natural gas. The EPA referred them to the limiting phrase which follows the above cited section:

unless such requirements are essential to assure that underground sources of drinking water will not be endangered by such injection. [Emphasis added].

The House Report⁽⁸⁰⁾ which accompanied the Act defines the term "interfere with or impede" to mean "stop or substantially delay." The text accompanying the EPA proposed rules clearly places the burden upon an operator seeking an exception to the rules to show: 1) that the regulatory requirement applied to his operations would stop or substantially delay oil or natural gas production, and 2) the requirement is not necessary to assure the protection of an existing or potential source of underground drinking water. This second showing by the operator relieves EPA of any burden to show that the requirement they themselves established is essential to the protection of drinking water sources.

D. EPA Regulatory Ambiguity

The new EPA proposed regulations introduce an ambiguity with regard to the geopressured-geothermal resources of Texas and Louisiana. As stated earlier, the methane content expected in these resources is most significant for their economic development. The first draft of Subpart C of the proposed rules established requirements applicable to waste disposal wells and engineering wells. These requirements were stated to apply to "underground injection by industrial and municipal waste disposal wells, subsidence control wells, barrier wells, recharge wells, mining wells, storage wells, and geothermal wells,"⁽⁸¹⁾ [emphasis added]. A

draft working paper on revisions to the proposed regulations re-defines the wells under Subpart C as "waste disposal wells, special process wells, and engineering wells." While the final text is not decided, it is understood that the term "special process wells" will include geothermal wells, wells for gas and hydrocarbon storage, and wells involved in the in situ gasification of oil, shale coal, and tar sands.⁽⁸²⁾ Some of these wells in Subpart C, particularly the waste disposal wells, fall within the present TWQB responsibilities discussed earlier. Others have not been regulated in Texas in the past from the standpoint of water pollution. In Subpart D, the requirements applicable to injection wells related to oil and gas production are established. These requirements are for "underground injection of brine or other fluids which are brought to the surface in connection with oil or natural gas production; and underground injection for the secondary or tertiary recovery of oil or natural gas."⁽⁸³⁾ Clearly, Subpart D falls under current TRRC regulation, and some of the wells under Subpart C would also appear a TRRC responsibility. In particular, the Texas Geothermal Resources Act of 1975 charges the TRRC with regulation of geothermal resource development, and its statewide rules governing oil and gas operations have been amended to include regulation of geothermal resources. Presumably, as in most discussions of geothermal resources, the EPA has been influenced by The Geysers development in California without regard to resource differences, or the existing regulatory schemes of individual states. While the proposed regulatory requirements for Subpart D are still severe, according to present procedures, there has been an apparent attempt to reduce the regulatory impact on oil and gas operations to some small degree. Alternative methods of protection are considered only when the regulatory

requirements stop or substantially delay oil or gas production. These factors, together with the desirability of maintaining a coherent grouping of control functions under the TRRC, suggest that injection controls over geopressured-geothermal resources should be regulated under Subpart D, classifying them as injection wells related to oil and gas production. It is not at all clear that this can be done. If not, drilling a geopressured well will be controlled by the TRRC, but subsurface disposal of the geothermal effluent will be regulated by the TWQB, along with injection wells for disposal of industrial and municipal wastes.

E. Program Costs

Although the Office of Water Supply of the EPA regional office in Dallas estimates that the only costs imposed upon geothermal wells by the proposed regulations will be permit application costs of about \$500, this estimate assumes that all information required is readily available.⁽⁸⁴⁾ On the contrary, the federal regulations now proposed to govern geothermal wells, along with waste disposal wells under Subpart C, are quite similar to the present TWQB rules regarding industrial and municipal waste disposal well permits. A TWQB staff member in the permitting section has estimated that on a large project, disposal well estimates and modeling for a TWQB permit can cost up to several thousand dollars.⁽⁸⁵⁾

The EPA has subcontracted the engineering firm of Garrity & Miller to analyse the cost factor of these regulations. They are presently surveying all potentially affected industries to discern projected cost burdens and also sampling industry feelings toward the new program. Information on this analysis can be obtained through the Office of Water Supply, EPA Regional Office, Dallas, Texas.

As stated earlier, an amended version of the regulations is expected

to be published during the summer of 1977, and will theoretically incorporate changes suggested at public hearings held in the fall of 1976, and written comments submitted until January 15, 1977.

VI. SUMMARY ASSESSMENT

A. Geopressured-Geothermal Waste Fluids

Successful development of the geopressured-geothermal resources underlying the Gulf Coast of Texas could result in very large volumes of waste salt water requiring disposal in an environmentally permissible manner. It would be highly advantageous if this salt water effluent could be desalinated sufficiently to make it suitable for general water uses. While the physical and chemical characteristics of the geopressured waters after utilization of their energy cannot be predicted now with requisite accuracy, preliminary analyses suggest that the total dissolved solids expected will be too high for economical recovery of the water for general use. This water recovery potential deserves continued study by Texas agencies, particularly the TWDB, in light of future water requirements, improvements in desalination technology, and changing economic factors.

Regardless of the potential for saving waste fluids for general or limited water uses, some treatment of the geopressured waters may be necessary to reduce undesirable characteristics for flow through a surface energy-recovery facility. Moreover, treatment of the fluids to remove certain trace elements, which may be declared toxic or hazardous in future EPA regulations, might be required in order to secure a permit, at least for surface disposal of the effluent. Statutory duties of the EPA under the FWPCA of 1972 require promulgation of lists of such pollutants. Several attempts by EPA to execute this task have been

unsuccessful, and no official listing of such toxic or hazardous substances exists today.

B. Classification of Geopressured-Geothermal Resource Wastes

In water pollution control legislation, there is generally an exceptional treatment for wastes (not including oil itself) associated with oil or gas production. This exceptional treatment seems to arise because of several factors: (1) the need to avoid interference with production of these important energy resources; (2) an underlying assumption, which may or may not be correct in a particular case, that natural salt water, the primary oil and gas waste, has less potential for environmental damage or danger to public health than industrial-chemical, or municipal-sanitary waste; and (3) the generally greater opportunity for process adjustment or pre-treatment of industrial or municipal waste fluids to reduce harmful chemical, physical, and biological properties prior to surface discharge or underground injection.

The U. S. Congress in both the FWPCA and the SDWA requires special consideration in regulating the underground injection of salt water brought to the surface in connection with oil or gas production. Under the Texas Water Quality Act of 1967, both surface and subsurface disposal of such fluids is excepted from the general permitting authority of the TWQB in controlling water pollution, and made the sole responsibility of the TRRC.

The highly important methane content expected in geopressured-geothermal resources suggests that waste fluids resulting from development of these resources should be classified as salt water brought to the surface in connection with oil or gas production. The waste fluids will have the same characteristics as oil and gas wastes from comparable

horizons, and will be different in character from most industrial and municipal wastes. Nevertheless, the Texas Water Code has not been amended specifically to conform to the apparent intent of the Texas Geothermal Resources Act, to regulate all aspects of geothermal resource development and production under the TRRC. Consequently, it is not yet clear whether the TRRC or the TWQB is responsible for permitting either surface or subsurface disposal of waste geothermal resource fluids. The classification of geopressured-geothermal waste fluids is complicated further by proposed EPA regulations under the SDWA. These regulations group "geothermal wells" with waste disposal wells, and with other miscellaneous well types, rather than with injection wells related to oil and gas production.

C. Disposal of Geothermal Waste into Surface Waters

Presumably, the most severe problems for disposal of geothermal waste into surface waters will be the relatively high thermal content of the effluent, and its natural salinity level. In the future, particular trace elements in the geothermal fluids may require removal prior to surface disposal. For the thermal pollution problem, large cooling ponds lined with impervious material would probably be required in connection with an approved salt water disposal operation. After necessary cooling, the point source discharges of the fluids into surface waters must satisfy the requirements of the TWQB as to quality and quantity of the effluent, and mixing zone conditions for the particular discharge area.

The permissibility of a discharge of any effluent into surface waters is dependent to a significant degree on the standards for the particular water quality segment which will receive the discharge.

Current water quality standards for any segment can be expected to be raised to more severe requirements in the future. Antidegradation concepts may complicate the problem further. Protection of fish, shellfish, and wildlife will be a major consideration for any surface discharge permit.

Even if the TRRC is given permitting authority for surface disposal of geothermal waste fluids, changes in their current procedures for oil and gas waste discharges should be anticipated in order to conform to federal NPDES requirements. Changes needed would be both substantive and procedural. Current TWQB control methods might be expected as the model, since they have EPA approval now. Under the NPDES system, it may take eight months to a year to secure an unopposed surface disposal permit. Moreover, it is always possible that a citizen's civil action may be brought to complicate and delay permit issuance. Extensive public notice and hearing procedures are mandatory for all NPDES surface discharge permits. Such procedural delays do not provide the capability to meet the emergency disposal requirements for short periods which have arisen in the oil and gas industry, and presumably will also arise in geothermal resource development.

At present, dual state and federal permits are required for surface discharge of all pollutants into or adjacent to water in the state. Even after approval of a Texas permit program by EPA, and authority for the state to assume responsibility for administering its own program, the FWPCA requires the state to send EPA a copy of each permit application, and notice of every action contemplated under the request. With his residual authority, the EPA Administrator can still review and reject any permit application which the responsible state agency may

decide to approve.

D. Disposal of Geothermal Waste by Subsurface Injection

Under the Texas Disposal Well Act of 1971, subsurface injection of waste through disposal wells permitted by the TRRC is the principal means used to dispose of massive quantities of salt water brought to the surface in connection with oil and gas production. In Texas, perhaps 40,000 disposal or injection wells associated with the oil and gas industry are in current use. In contrast, only 66 disposal wells for the subsurface injection of industrial and municipal waste fluids are now active under permits by the TWQB. As could be expected, considering the generally different characteristics of the two types of waste and the gross difference in work load, permit procedures established by the two Texas permitting agencies differ in many ways. The requirements for substantiating data to justify a permit, independent modeling and analysis by the permitting agency, monitoring and reporting duties of the permittee, agency inspection frequency, procedures for public notice and hearing, and the time required to secure a permit vary greatly for the two agencies, with the TWQB having the more severe requirements in each case. Again, the authority to regulate underground disposal of geopressured-geothermal resource waste in Texas probably lies with the TRRC, but this is not certain.

Under the federal SDWA of 1974, major changes can be expected in the regulation of disposal or injection wells for salt water associated with oil and gas production. While the U. S. Congress directed non-interference with oil or natural gas recovery, the qualification, unless requirements established are essential for protection of underground sources of drinking water, left the door open for an extensive regulatory

expansion into salt water disposal well operations. The proposed EPA regulations to implement the SDWA seem patterned to a substantial degree on the TWQB procedures for regulating industrial and municipal waste disposal wells. While oil and gas waste disposal is regulated under a separate section of the proposed regulations, only relatively minor differences exist in the regulatory requirements for the two types of waste.

As under the FWPCAA for surface discharge, federal permits for subsurface injection will be issued by EPA until a Texas program is approved in its entirety. Dual permit requirements would exist until it is. Unless major changes are made in the proposed regulations for oil and gas waste disposal, and unless geopressured-geothermal wells can be regulated under that classification, procedures similar to those now used under the TWQB rules for industrial and municipal waste disposal well permits will apply for geothermal resource wastes.

FOOTNOTES

1. See generally Proceedings, Second Geopressured Geothermal Energy Conference (M. Dorfman & R. Deller eds.) (Center for Energy Studies, University of Texas at Austin) (February 23-25, 1976) [hereinafter cited as Proceedings, Second].
2. 160 degrees -- IV Proceedings, Second, at 12.
212 degrees -- V Proceedings, Second, Environmental at 9.
3. Gustavson & Kreitler, Geological Circular 76-7, Environmental Concerns Arising from the Production and Disposal of Geothermal Waters (Bureau of Economic Geology, University of Texas at Austin) (1976).
4. Presentation by D. G. Bebout, Bureau of Economic Geology, at University of Texas at Austin (May 4, 1977).
5. V Proceedings, Second, Environmental at 3.
6. Id at 5. However, analyses for 15 additional wells have been studied more recently. Supra note 3.
7. Geothermal Kinetics, Inc. v. Union Oil Co. of California, et al, No. 75,314 (Super. Ct., Sonoma County, Calif., Intended Decision filed June 1, 1976, at 8. Finding of Fact and Conclusions of Law, and Judgment filed August 31, 1976). See 4 GEOTHERMAL ENERGY MAGAZINE No. 7, at 12 (July, 1976).
8. Supra note 3.
9. Telephone interview with C. B. Kincannon, TWQB, in Austin (January 17, 1977); TWQB Order No. 75-1125-5 (November 25, 1975).
10. 27 INSTITUTE ON OIL AND GAS LAW AND TAXATION 48 (1976).

11. Federal Water Pollution Control Act Amendments of 1972, 33 U.S.C.A. sec. 1251 (Supp. 1976) [hereinafter cited as FWPCAA].
12. Infra at 8-9.
13. Infra at 13-14.
14. Texas Water Quality Act, TEX. WATER CODE ANN., Chap. 21 (1972).
15. TEX. WATER CODE ANN., Chap. 22 (1972).
16. Safe Drinking Water Act of 1974, P.L. 93-523, 42 U.S.C.A. sec. 300f (Supp. 1976) [hereinafter cited as SDWA].
17. Geothermal Resources Act of 1975, TEX. REV. CIV. STAT. ANN. art. 5421s (1975).
18. FWPCAA, sec. 402.
19. FWPCAA, sec. 502(6).
20. FWPCAA, sec. 502(7).
21. FEDERAL ENVIRONMENTAL LAW 687-693, (Dolgin & Guilbert eds. 1974).
22. 389 F. Supp. 1379 (S.D. Tex. 1975).
23. Head, Underground Injection Under the Safe Drinking Water Act, Part N at 5, Texas Environmental Law, State Bar of Texas, Austin, Texas [February, 1977].
24. FWPCAA, sec. 502(14).
25. See generally M. Miscovsky & M. Van Hook, Regulation of Forestry Related Nonpoint Source Pollution, IX, 4 NATURAL RESOURCES LAW. 645 (1976).
26. Telephone interview, Tony Anthony, EPA, in Dallas (March 1, 1977).
27. FWPCAA, sec. 101(b).
28. Supra note 21 at 734.
29. FWPCAA sec. 402(d).
30. TEX. WATER CODE ANN. 21.002(3).

31. TEX. WATER CODE ANN. 21.002(11).
32. TEX. WATER CODE ANN. 21.061.
33. TEX. WATER CODE ANN. 21.075.
34. TEX. WATER CODE ANN. 21.079.
35. TEX. WATER CODE ANN. 21.261.
36. TEX. WATER CODE ANN. 21.258-21.260.
37. TEX. REV. CIV. STAT. ANN. art. 5421s (1975).
38. IV Proceedings, Second, at 47, 50.
39. Interview with Bob Kent, TWQB, in Austin (November 9, 1976).
40. TEX. WATER CODE ANN. 22.002(4).
41. TEX. WATER CODE ANN. 22.002(5).
42. Rules 8 and 9 (051.02.02.008-009), RULES HAVING STATEWIDE GENERAL APPLICATION TO OIL, GAS AND GEOTHERMAL RESOURCE OPERATIONS WITHIN THE STATE OF TEXAS (re-adopted January 1, 1976).
43. Telephone interview with Phil Russell, TRRC, in Austin (January 21, 1977); interview with George Singletary, TRRC, in Austin (November 12, 1976).
44. Comment from C. T. Garrison, Executive Director, TPWD, in Austin (June 27, 1977).
45. Requirements for Leases Disposing of Produced Oil Field Brine Into Tidal Waters, TRRC.
46. Telephone interview with David Curtis, EPA, Dallas (March 15, 1977).
47. Telephone interview, Charles Rowton, Information Service, TRRC, in Austin (February 28, 1977).

48. TEXAS WATER COMMISSION, SUMMARY OF STATISTICAL ANALYSIS OF DATA ON OIL FIELD BRINE PRODUCTION AND DISPOSAL IN TEXAS FOR THE YEAR 1961, at 4 (1961).
49. Interview with George Singletary, TRRC, in Austin (November 12, 1976).
50. TEX. WATER CODE ANN. 22.033.
51. Telephone interview with Fred Young, TRRC, in Austin (May 24, 1977); and telephone interview with Bob Kent, TWQB, in Austin (March 15, 1977).
52. FWPCA sec. 502(6)(B); SDWA sec. 1421(b)(2), sec. 1422(c).
53. TEX. WATER CODE ANN. 21.003(4) and (10).
54. Interview with Dr. Peggy Glass, TWQB, in Austin (October 29, 1976).
55. Telephone interview, Terry Maddox, Permit Section, TWQB, in Austin (January 17, 1977).
56. TEXAS WATER QUALITY BOARD, TEXAS WATER QUALITY STANDARDS (February 1976).
57. Id at 8.
58. Id at 13.
59. IV Proceedings, Second, at 150-153.
60. Telephone interview with C. B. Kincannon, TWQB, in Austin (January 17, 1977).
61. FWPCA sec. 208(a)(1).
62. Interview with Dr. Peggy Glass, TWQB, in Austin (October 29, 1976).
63. 40 C.F.R. Part 130, Sec. 130.10(b)(2) (November 28, 1975).
64. Supra note 56 at 1.
65. Supra note 25 at 661-663; also at 656, note 41 in cited article,

- which cites Commonwealth Edison v. Train, Civil Action File No. 75 C 4127. An order in this case dated February 2, 1977, denied defendant's motion to dismiss. On a subsequent motion, case was dismissed but is on appeal as of June 7, 1977.
66. Comment from J. W. Mullican, Chief, Geological Services, TWQB, in Austin, April 4, 1977.
 67. Id.
 68. Id.
 69. 389 F. Supp. 1379 (S.D. Tex. 1975).
 70. SDWA sec. 1423(b); also, supra note 23 at N-3 to N-7.
 71. United States of America v. Earth Sciences, Inc., reported in 9 ERC 2137 (Colo. D. 1977).
 72. 41 Fed. Reg. 36,726 (August 31, 1976) (proposed to be codified in 40 C.F.R. part 35); also, a draft working paper from EPA to a working committee on revisions to the proposed rules (April 19, 1977).
 73. Id.
 74. Id. at 36,731.
 75. Id.
 76. Id. at 36,737-36,738.
 77. Id. at 36,731.
 78. Interview with George Singletary, TRRC, in Austin (November 12, 1976).
 79. Governor's Energy Advisory Committee, Energy Policy Monitor (October 22, 1976).
 80. Draft Environmental Impact Statement, State Underground Injection

Control Program, Proposed Regulations (40 C.F.R. 146), Office of
Water Supply, EPA, Proposed Reg. at 4.

81. 41 Fed. Reg. 36,739 (August 31, 1976) (proposed to be codified as
40 C.F.R. Part 146).
82. Supra note 72, working paper.
83. Supra note 72 at 36,742, sec. 146.40.
84. Supra note 80, Economic Analyses at 11 (1976).
85. Interview with Bob Kent, TWQB, in Austin (November 9, 1976).

Appendix A

LETTER FROM EPA GENERAL COUNSEL TO TWQB
CONCERNING NPDES CERTIFICATION

NOTE: The text of this letter was reproduced from a copy included as Exhibit 1, I GENERAL LAND OFFICE OF TEXAS, TEXAS COASTAL MANAGEMENT PROGRAM, Part I, at 16-18 (June, 1976).

**LETTER FROM EPA GENERAL COUNSEL TO TWQB
CONCERNING NPDES CERTIFICATION**

Mr. Hugh C. Yantis, Jr.
Executive Director
Texas Water Quality Board
P.O. Box 13246, Capitol Station
Austin, Texas 78711

Dear Hugh:

As you requested, my office has reviewed the statement dated April 20, 1973, submitted by the Attorney General of Texas in support of the State's authority to carry out the NPDES. Generally, Texas statutes provide the Texas Water Quality Board with authority to operate a strong, effective permit program. Not all of the authorities required by Section 402(b) of the Federal Water Pollution Control Act Amendments of 1972 (FWPCA), however, are supplied by the Texas statutes in their present form. Following are some areas—some major and some less significant—for which statutory or other adjustments would have to be made before the Administrator lawfully could approve the Texas program under the NPDES.

1. **Civil Penalties.** Section 21.252 of the Texas Water Quality Act (TWQA) provides civil penalties for violations of permits and permit program requirements. However, the maximum civil penalty is \$1,000 per day of violation. The minimum allowable civil penalty as set forth in May 31, 1973, memorandum is \$5,000 per day, under special circumstances. In Texas' case, the full \$10,000 maximum civil penalty for each violation should be provided as an enforcement backup to one of the country's most important industrial and agribusiness States.

2. **Criminal Penalties.** A criminal penalty is not provided for a discharge without a permit, unless such discharge will cause "water pollution." TWQA, Section 21.553. "Water pollution" is, in turn, defined to require a showing of injury to receiving waters. Section 21.551(2). Criminal penalties do not apply to violations of pretreatment standards or user charge requirements, or inspection, entry, or monitoring requirements, unless such requirements are embodied in permit conditions. No criminal penalties are provided for making false statements in NPDES and other forms, as required by Section 124.73(g) of the State Guidelines. Finally, the maximum criminal penalty is \$1,000 per day, as compared to the minimum required \$10,000 per day. These deficiencies should be corrected and a maximum criminal penalty of \$25,000 per violation should be established.

3. **Confidential Information.** Texas lacks the authority to obtain from any discharger, or to disclose to the public, "confidential information relating to secret processes or economics of operation." TWQA, Sections 21.033, 21.064. There is no exclusion from this restriction for effluent data. Moreover, the State may need certain production and other data in order to establish permit conditions, which data a company might argue are protected because they are related to "secret processes or economics of operation." These provisions preclude the State from obtaining such data and should be amended, limited, or repealed.

4. **Industrial User Requirements.** Section 402(b)(9) of the FWPCA and Section 124.42 of the State Guidelines require the State to have procedures for establishing permit conditions requiring compliance with, among other things, user charge require-

ments of Section 204(b) and toxic and pretreatment standards under Section 307 of the FWPCA. Although the Board has broad powers to set permit conditions and to promulgate rules and regulations (Sections 21.031, 21.069 of the TWQA), these powers are not cited by the Attorney General. That section authorizes the required range of authorities to be exercised, but only by local governmental units, not by the State. The Attorney General must show that the State has such authority, either by rules compelling action by, or limiting the discretion of, local governments, or independently by permit conditions which would supersede conflicting local requirements.

5. **Well Disposals.** Although authority is present for the regulation of disposals of pollutants into wells, it extends only to new wells or conversions of old wells. There does not appear to be authority to regulate disposals into wells used for waste disposal prior to enactment of the Disposal Well Act or its predecessor. See TWQA, Sections 21.001, 21.031. Authority must be provided for the regulation of existing, ongoing well disposal operations, as required by Section 402(b)(1)(D) of the FWPCA and Section 124.80 of the State Guidelines.

6. **Rangeland Return Flow and Runoff.** The TWQA does not prohibit discharges without a permit of irrigation return flow or rainwater runoff from cultivated or uncultivated rangeland, unless such flows, alone or with other discharges, will cause "pollution." Again, injury to receiving waters must be shown. TWQA, Sections 21.251, 21.003(8), (1). Such injury ought not be a prerequisite for application of FWPCA requirements under Sections 301, 302, 306, 307, and 403. Texas authority must be modified to allow application of these requirements, as required by Section 402(b)(1)(A) of the FWPCA.

7. **Oil and Gas Well Permits.** The Texas Railroad Commission, which alone is authorized to issue permits for discharges of pollutants associated with oil and gas wells, does not appear to have authority to apply Federal effluent standards. Discharges from oil and gas wells must meet water quality standards (TWQA, Section 21.261), and the Commission may make rules "to prevent pollution" from such activities (Art. 6029, Texas Rev. Civ. Stat.). Section 402(b)(1)(A) of the FWPCA requires application of the Federal requirements unencumbered by the requirement of proving "pollution."

8. **Civil and Criminal Penalties for Violation of Oil and Gas Well Permits.** No criminal penalties are provided for violations of requirements established by the Texas Railroad Commission. The maximum civil penalty, \$1,000 a day, is inadequate. Authority must be provided to make Texas Railroad Commission permit violations subject to the same civil and criminal penalties as all other NPDES permit violations.

9. **Regulations Implementing Section 402(b) Authority Requirements.** Among the documents which were submitted by our Regional Office was a draft letter from the Governor stating that the State's regulations are being revised to conform to the State Guidelines and that revision will be completed prior to January 1, 1974. Several required authorities (such as the authority to apply Federal effluent limitations) appear to be authorized by a broad statutory delegation of authority. However, regulations specifically establishing such authorities apparently have not been promulgated. Such regulations must, of course, be in force before EPA can approve the program.

10. **Texas Railroad Commission Regulations.** The statutory authority of the Texas Railroad Commission derives from broadly worded statutes. These statutes must be supplemented by detailed regulations specifically establishing the required authorities and supported by a statement of their legality by the Attorney General. Without the regulations, and a detailed Attorney General's Statement, the authority of the Texas Railroad Commission to carry out the NPDES cannot be adequately examined.

11. **Cause for Revocation of Permits.** The State lacks specific authority to revoke permits where obtained by misrepresentation or where required by a change in conditions requiring elimination of the discharge. However, this defect could be remedied by specific permit conditions authorizing termination under such conditions.

Although some of the above authorities could be supplied by regulation, others, such as the civil and criminal penalty provisions, require legislative action. We hope that until the Texas Legislature has a chance to act, you will consider a joint program for issuance

of NPDES permits. Under such an arrangement, Texas would maintain her leadership role in water pollution control in Texas, minimize duplication resulting from two uncoordinated permit programs, and gain valuable experience and momentum for final take over of the NPDES program in Texas.

Our staff, both in Dallas and here in Washington, is available to work with you in the development of any of the necessary legislation or regulations, if you should so request. We look forward to working with you and your staff, both before and following NPDES approval, in order to check and conquer degradation of our country's waters.

Sincerely yours,

Alan G. Kirk II
Acting Assistant Administrator for
Enforcement and General Counsel

Appendix B

MEMORANDUM OF UNDERSTANDING BETWEEN
THE TEXAS WATER QUALITY BOARD
AND THE
REGIONAL ADMINISTRATOR, REGION VI,
ENVIRONMENTAL PROTECTION AGENCY

NOTE: The text of this memorandum
was reproduced from a copy
included as Exhibit 2, I
GENERAL LAND OFFICE OF TEXAS,
TEXAS COASTAL MANAGEMENT
PROGRAM, Part I, at 18-20
(June, 1976).

**MEMORANDUM OF UNDERSTANDING BETWEEN THE
TEXAS WATER QUALITY BOARD
AND THE
REGIONAL ADMINISTRATOR, REGION VI,
ENVIRONMENTAL PROTECTION AGENCY**

The Texas Water Quality Board (Board) and the Regional Administrator, Region VI, Environmental Protection Agency (EPA-Dallas), as an interim step toward the ultimate designation of the Texas Water Quality Board as the National Pollutant Discharge Elimination System (NPDES) authority in Texas do hereby agree as follows:

I. GENERAL UNDERSTANDING

A. Burden Assumed by Board

Insofar as practical without actual delegation of permit authority, the Board will assume the burden of the NPDES program.

B. Program Grant Adjustment

EPA-Dallas will adjust the Program Grant made available to the Texas Water Quality Board in accord with its evaluation of the services rendered.

C. Validity of July 1973 Understanding

To the degree the attached Memorandum of Agreement between the Texas Water Quality Board and EPA-Dallas adopted by the Board and EPA-Dallas in July 1973 is appropriate, since delegation of NPDES authority has not been given to the Board; the agreements reached and the procedures enumerated therein are hereby adopted.

D. Actual Issuance of NPDES Permits

Since actual delegation has not occurred, EPA-Dallas will necessarily issue the actual NPDES permits.

E. Continuation of State Permit System

The Board will continue to issue waste discharge permits pursuant to State law.

F. Equivalent Permits

To the degree it is possible and appropriate, the TWQB will insure that State waste discharge permits are identical in requirements to the NPDES permits issued by EPA-Dallas.

Similarly, to the degree it is possible and appropriate where the Board issued in accord with the procedures set forth herein a State waste discharge permit in advance of the issuance of an NPDES permit. EPA-Dallas will insure that NPDES permits are identical in requirements to State waste discharge permits. It is specifically understood that this provision does not apply to existing TWQB waste control orders.

II. SPECIFIC AGREEMENTS

A. Board Responsibility

The TWQB will follow the procedures set forth in Section 645 of the Rules and the flow sheet in issuing and reissuing State waste discharge permits and in certifying NPDES applications.

The TWQB will furnish to EPA-Dallas certified applications, fact sheets, and Board-approved State waste discharge permits in the NPDES format. The TWQB will hold appropriate public hearings as set forth in Section 645 of the Rules.

B. EPA Responsibility

EPA-Dallas will be responsible for:

- 1) numbering NPDES applications
- 2) preparing and processing
 - a) Notice of Intent to Issue NPDES permits
 - b) Fact sheets (mailing only)
 - c) NPDES permits (typing and reviewing)

- 3) conducting PL 92-500 public hearings, if any
- 4) transmitting issued NPDES permits to the National Data Bank.

In this connection, the State public hearing process will in all likelihood negate the need for an EPA public hearing in most instances.

C. Board's Defense of Its Decisions

Should a public hearing in a particular application be required under Public Law 92-500, State personnel will be made available to participate in such hearings as might be appropriate. The Board will defend and support its decisions and documents furnished by it to EPA, i.e., fact sheets, certifications, and NPDES format State waste discharge permits.

D. EPA Review

The Board will undertake to provide a smooth transition from the issuance of strictly State waste discharge permits to NPDES-format waste discharge permits suitable for issuance by EPA as NPDES permits, and to subject future NPDES-format waste discharge permits to the EPA review process envisioned in Attachments A and B. Under this section, a smooth transition means and includes the avoidance of undue delays in the issuance of State waste discharge permits.

E. Priority for Issuance

The Board will issue NPDES-format waste discharge permits and certifications to EPA such that, to the degree possible with available resources, applications in the following three categories will be available each month:

- 1) new applications,
- 2) noncontroversial applications, and
- 3) applications high on the waste discharge issuance list provided EPA under Section 303(e) of the Act and as may be agreed upon by both parties from time to time.

To the degree consistent with the timing constraints for the issuance of NPDES permits, existing State waste control orders for discharges to water quality segments will not be undertaken until waste load allocations pursuant to PL 92-500 have been made.

When applications for new or significantly increased discharges of magnitude are received for waste discharge to water quality segments, such permits will only be issued after an appropriate investigation of its impact has been made and a preliminary waste load allocation made. Such preliminary waste load allocation will not be subjected to public hearing other than the hearing on the waste discharge permit—the formal public hearing on the waste load allocation will be held as a part of the Basin Plan under Section 303(e) of the Act.

III. TERM

This Memorandum of Understanding will take effect upon approval by the Regional Administrator of EPA and the Board.

This Memorandum shall remain in effect for the duration of such approved program or until the Memorandum is rescinded by mutual agreement of the parties. This Memorandum may be modified from time to time as the parties may agree in order to simplify the procedures and refine the methods contained herein.

IV. APPROVAL

This Memorandum of Understanding was approved as to form and content by the Texas Water Quality Board assembled in regular meeting on the 23rd day of October, 1973.

Dated November 12, 1973

by s/J. Douglass Toole
Chairman
Texas Water Quality Board

Dated November 29, 1973

by s/Arthur W. Busch
Regional Administrator
Environmental Protection Agency

Appendix C

RAILROAD COMMISSION OF TEXAS
OIL AND GAS DIVISION

FORM W-14

**RAILROAD COMMISSION OF TEXAS
OIL AND GAS DIVISION**

C-1

Form W-14
Rev. 1-1-77
Eff. 7-1-77

**APPLICATION TO DISPOSE OF SALT WATER BY INJECTION INTO A POROUS FORMATION
NOT PRODUCTIVE OF OIL OR GAS**

1. Operator Name				2. Operator No.			
3. Address (Street, City, State and Zip Code)				4. RRC Dist.			
5. Lease Name		6. RRC Lease Identification No.		7. Well No.			
8. Field Name		9. RRC Field No.		10. County			
11. Location (Sec. -Twp-Rge or Block and Survey)							
CASING AND TUBING DATA							
NAME OF STRING	SIZE	SETTING DEPTH	SACKS CEMENT	TOP OF CEMENT	TOP DETERMINED BY	HOLE SIZE	CASING WEIGHT
12. Surface Casing							
13. Intermediate							
14. Long String							
15. Tubing			16. Name, Model and Depth of Tubing Packer				
17. Depth to Top of Injection Zone		18. Depth to Bottom of Injection Zone		19. Is Injection through Tubing or Casing? ☐ Tubing ☐ Casing		20. Total Depth of Well	
21. Perforation or Open Hole? ☐ Perforation ☐ Open Hole		22. Date Well Drilled		23. API No.		24. Ground Surface Elevation	
25. List All Cement Squeeze Operations, Giving Interval and Number Sacks of Cement							
26. Depth of Deepest Fresh Water Zone		27. Depth of Shallowest Zone Productive of Oil or Gas in this Field			28. Anticipated Daily Injection Volume (Bbls) Minimum Maximum		
29. Open or Closed System? ☐ Open ☐ Closed		30. Is Injection by Gravity or Pressure? ☐ Gravity ☐ Pressure			31. Approximate Pressure (Psi)		
32. Will it be necessary for water to be filtered or chemically treated? ☐ Yes ☐ No				33. Is this well so cased and completed that water can enter no other formation than the above set out injection zone? ☐ Yes ☐ No			
34. NAME AND ADDRESS OF SURFACE OWNER							
35. List Name and Addresses of All Offset Operators							
				36. Source of Fluids (Geological Name of Formation and Depth)			
37. Have notices of this application been mailed or given to all Offset Operators? ☐ Yes ☐ No				38. Are there any other Salt Water Disposal Wells using this same Zone in this Field? ☐ Yes ☐ No			
39. If answer is Yes to Question 38, name one such well.							
Name of Operator		Lease Name		Lease or I.D. No.		Well No.	
<p align="center"><u>CERTIFICATE</u></p> <p>I declare under penalties prescribed in Article 6036c, R.C.S., that I am authorized to make this report, that this report was prepared by me or under my supervision and direction, and that data and facts stated therein are true, correct, and complete, to the best of my knowledge.</p>							
				Signature			
				Name of Person (type or print)		Title	
				Telephone Area Code Number		Date	
FOR RRC USE ONLY							

APPLICANTS MUST COMPLY WITH THE INSTRUCTIONS ON REVERSE SIDE HEREOF (OVER)

INSTRUCTIONS

1. File the original application and supporting documents in the Austin Office. Mail to: P. O. Drawer 12967, Capitol Station, Austin, Texas 78711.
2. Attach complete electrical log of this well or log of a nearby well.
3. Attach letter from the Texas Water Quality Board. Submit two copies of Form W-14 to the Texas Water Quality Board, P. O. Box 13246, Capitol Station, Austin, Texas 78711.
4. Area Plat showing location of all wells within a half ($\frac{1}{2}$) mile radius with surveys marked.
5. Attach waivers from all offset operators or a letter from operator to offset operator explaining application and requesting waiver.
6. Attach waivers from surface owner(s) of land on which well is located or a letter from company making application to the surface owner explaining said application and requesting waiver.
7. No application will be processed until INSTRUCTIONS 1, 2, 3, 4, 5 and 6 have been complied with. Should all waivers in INSTRUCTIONS 5 and 6 not accompany application, the Engineering Department of the Commission shall hold such application for a period of ten (10) days from date of receipt in the Austin Office. If, after said ten (10) day period, no protest or request for hearing is received in the Austin Office, the application will then be processed.
8. Approval of this application, if granted, is valid only so long as there is no substantial change in the operations set forth in such application. A substantial operation change requires the approval of a new application.

Appendix D

TEXAS WATER QUALITY BOARD
APPLICATION FOR PERMIT FOR SUBSURFACE
INJECTION OF INDUSTRIAL WASTE

Note: Page D-1 of this appendix is a reduced size reproduction of the application form. Page D-2 is a reduced size reproduction of the accompanying instructions for the application.

TEXAS WATER QUALITY BOARD
APPLICATION FOR PERMIT FOR SUBSURFACE
INJECTION OF INDUSTRIAL WASTE

I. Applicant

1. Name _____ Plant Name _____

2. Address _____

3. City _____ Zip Code _____

II. Location of Proposed Injection Well

1. County _____ Lease _____ Well No. _____

2. Section _____ TWP-RGE or
Block No. _____

3. Survey Abstract

4. Name and address of surface owner _____

5. Distance (in feet) and direction from adjacent original survey lines _____

III. Proposed Injection Program

1. New Well _____ Convert existing well _____
(Yes) (No) (Yes) (No)

2. Type of waste _____

3. Depth of well

4. Depth(s) of injection interval(s) _____

IV. Submit with Application

1. \$25.00 Fee (Please remit by Check or Money Order.)

2. Technical Report: (See reverse side for instructions)

3. Prepared by _____

Under direction of _____
(Registered Professional Engineer, or Professional Geologist)

AFFIDAVIT

I, _____, _____

(Title)

Being first duly sworn on oath state that I have knowledge of the facts herein set forth and that the same are true and correct.

(Signature)

Subscribed and sworn to before me this _____ day of _____, 19____

Notary Public in and for

County, Texas

FOR TEXAS WATER QUALITY BOARD USE ONLY:

Technical Report Received _____ (Date) _____ (Review by - Signature)

Field Inspection _____ (Date) _____ (Field Inspection by - Signature)

Permit Issued _____ Permit No. _____

INSTRUCTIONS

1. Application form in quintuplicate, all accompanying data, and the required \$25.00 filing fee shall be sent to the Texas Water Quality Board, P.O. Box 13246 Capitol Station, Austin, Texas 78711. The Board's staff is available for consultation should questions arise in completing the application.
2. Justification for subsurface disposal must accompany the application by submitting treatability studies of alternate methods of waste disposal. Explain in detail why each method is considered to be less satisfactory in terms of environmental protection than the proposed subsurface disposal method. Indicate whether this waste is presently being produced, and if so, what method is used in disposal. Briefly describe the manufacturing process(es) and product(s) from which waste will arise.
3. A technical report is required before an application can be processed. This report should include, but not necessarily be limited to the following information:
 - a. An accurate plat showing location of proposed injection well relative to both state land survey and plant boundaries.
 - b. A map indicating location and depth of water wells on and adjacent to plant property. This map or a supplementary map must show location of all artificial penetrations (oil and gas wells, exploratory tests, etc.) of the uppermost proposed injection interval(s) within $2\frac{1}{2}$ miles of the injection well site. (The technical staff may adjust this distance as the situation warrants.)
 - c. Description of local topography and geology pertinent to injection program. Depth of deepest strata containing fresh water or water of suitable quality for potential beneficial development as determined by well development and/or electrical logs.
 - d. A detailed description of the chemical and physical characteristics of the waste to be injected. Complete chemical analyses of all inorganic constituents should be reported in ppm or mg/l. If organic fractions are present, all such constituents should be reported in ppm or mg/l, as individual percentages by weight, or in other appropriate terms. Give analysis of each waste stream and its percentage of total waste.
 - e. The anticipated average and maximum rate of injection in gallons per minute. Estimated yearly volume of injected waste and anticipated life of project.
 - f. Data on construction, completion and operation of proposed injection well.
 - (1) Total depth
 - (2) Casing—size, grade, type, weight and setting depth of all strings; size and type of tubing; name, model, and depth of tubing packer setting.
 - (3) Cement—type and volume of cement to be used on each casing string and calculated top of cement behind each string. Describe and give percent of all cement additives.
 - (4) Proposed injection interval(s) and perforations or screen setting depths. This should include the interval(s) to be utilized initially and the entire zone requested for future development.
 - (5) Diagrammatic sketch of proposed wells including the wellhead.
 - (6) Anticipated maximum and average wellhead injection pressures.
 - (7) Description of possible hydraulic fracturing and/or acidizing programs, if anticipated.
 - (8) Description of proposed injectivity tests.
 - (9) Proposed logging, bottom-hole testing, coring, etc.
 - g. Characteristics of injection interval(s):
 - (1) Lithology, porosity, permeability, temperature.
 - (2) Natural reservoir fluid pressure or hydrostatic head; fluid saturation and chemical characteristics; and fracture gradient or critical input pressure.
 - h. Compatibility of injected waste and formation fluids.
 - i. Calculated formation pressure increase by injected waste and directions of dispersion.
 - j. Surface installations.
 - (1) Detailed description of pretreatment process and facilities to be used (include flow diagram).
 - (2) Description of type of materials to be used in pretreatment facilities and transmission lines.
 - (3) Description and location of all waste retention facilities, if such are to be used in conjunction with the injection well.
4. In the event an existing well is to be converted to an injection well, applicant should submit a complete electrical log, all other logs or surveys performed on the well, and complete casing and cementing data.
5. Submit a list of adjacent landowners, their addresses, and a map indicating location of their property. (See Rules and Regulations, TWQB, Rule 305.1 (d))

Appendix E

GLOSSARY OF ABBREVIATIONS

GLOSSARY OF ABBREVIATIONS

TWQB	— Texas Water Quality Board
TRRC	— Texas Railroad Commission
EPA	— Environmental Protection Agency
FWPCAA	— Federal Water Pollution Control Act Amendments of 1972
SDWA	— Safe Drinking Water Act of 1974
NPDES	— National Pollutant Discharge Elimination System
TWDB	— Texas Water Development Board
TPWD	— Texas Parks and Wildlife Department
TDHR	— Texas Department of Health Resources
TWWDB	— Texas Water Well Drillers Board
TWRC	— Texas Water Rights Commission
pH	— usual measure of acidity and alkalinity
ppm	— parts per million
TDS	— total dissolved solids