CLASS I

INJECTION WELL SURVEY

April, 1990

Updated from April, 1986

UNDERGROUND INJECTION

UIPC

PRACTICES COUNCIL

Prepared for the Underground Injection Practices Council

by Golder Associates, Inc.

PREFACE:

This survey of Class I injection wells has been conducted by Golder Associates Inc., Houston, Texas. Golder Associates Inc. is a group of consulting engineering companies specializing in geotechnical, groundwater and applied geoscience services. The company maintains 37 permanent offices in 7 countries and has a total of over 1,000 employees.

The collection of data for this survey occurred from January 1 to March 31, 1990 and therefore should not be construed as representing the status of Class I injection wells at any single point in time. Every attempt has been made to insure the accuracy of data presented in this report. The results of the survey will be provided to the Underground Injection Practices Council (UIPC) for internal use and dissemination to their members.

CLASS I INJECTION WELL SURVEY

INTRODUCTION:

Injection wells have been utilized in the disposal of fluids since the 1930's with their initial usage being the disposal of salt water associated with the production of oil and gas. Current United States Environmental Protection Agency (USEPA) inventories indicate that over 350,000 injection wells (all classes) exist in the United States. Class I injection wells are used to dispose of hazardous, non-hazardous and municipal wastes beneath the lowermost underground source of drinking water (USDW). Class I injection wells comprise less than one percent of the total number of injection wells, yet are an integral part of the waste disposal capacity in the United States with annual injection volumes measured in the billions of gallons. As concluded in the previous Class I Injection Well Survey (UIPC, 1987), this type of injection, as presently regulated, is a cost-effective yet environmentally sound method of liquid waste disposal when suitable hydrogeologic conditions exist.

PURPOSE AND SCOPE:

This nationwide survey of Class I injection wells was conducted to evaluate the changes in geographic distribution and usage patterns and to identify the major concerns of Class I injection operators. Initially, the appropriate regulatory agencies (EPA Region or State regulatory agencies) were contacted in order to compile a list of injection well operators under their jurisdiction. An attempt was made to contact each facility with Class I injection wells by phone or in writing in order to get direct information about their operations.

Each operator, in addition to general information, was asked:

- Number of wells at their facility;
- Status of wells;
- Classification of wells;
- Type of waste injected;
- Completion method;
- What type of monitoring was performed and whether the monitoring incorporated monitoring wells;
- If they had any major concerns for their operation; and
- If they planned to construct additional wells.

Operators with pending permits were asked about their construction plans in order to project future growth or decline in the number of injection wells.

In general, the injection well operators were extremely cooperative in responding to the survey. While some operators were not able to be contacted or declined to respond to the survey, 153 facilities representing 67% of all active Class I injection wells did respond to the survey.

The data received in the survey were broken down by State, classification of well, type of waste received and completion method. These results were compared to the "Report to Congress on Injection of Hazardous Waste" (USEPA 1985) and the "Class I Injection Well Survey" (UIPC, 1987).

RESULTS:

The results of this survey indicate significant changes in the geographic distribution, usage and construction methods of Class I injection wells. In general, the two factors which have contributed the most to these changes are the rapid increase in the numbers of non-hazardous wells used for disposal of treated municipal effluent in Florida and reclassification of wells as Class I.

As show in Figure 1, the total number of active Class I injection wells has increased significantly since the 1984 inventory by UIPC. Currently, there are 433 active Class I injection wells compared to approximately 300 at the end of 1984. The number of hazardous wells has continued to increase at approximately the same rate since 1978. The number of non-hazardous wells has increased at a higher rate and, for the first time, are more numerous than hazardous wells. The number of municipal effluent wells also continues to increase.

Figure 1 also shows a two-year projection based on the survey results. The projection indicates that the number of Class I injection wells will continue to grow with the greatest increases being in hazardous and municipal effluent disposal wells. The largest number of planned hazardous disposal wells are designed to emplace solidified waste into cavities excavated in salt domes. These systems will also utilize non-hazardous wells to dispose of brine produced in the salt cavity excavation.

The number of active Class I injection wells has decreased in nine states and increased in eleven since 1984 with inventories in two states remaining the same (Figure 2). The increases are generally due to the reclassification with the exception being Florida where new well construction has been rapid. Numerous wells have been reclassified to Class I due to changes in regulations defining the different waste categories. Currently, Texas has the highest number of active Class I injection wells followed by Florida, Louisiana and Kansas (Figure 3).

At this time, Florida has the greatest number of non-hazardous/non-commercial wells followed by Texas and Kansas (Figure 4). Texas has the highest number of hazardous/commercial and hazardous/non-commercial wells. Louisiana has the second highest number of hazardous/non-commercial wells and Ohio has the second highest number of hazardous/commercial wells.

The most common waste stream in non-hazardous/non-commercial wells is from manufacturing processes which represent 48.7% of this type of wells surveyed (Figure 5). The second most common non-hazardous/non-commercial waste stream is municipal effluent (28.0%) followed by mining wastes (6.2%) and cooling tower and air scrubber blowdown (5.7%).

As of December 1984, there were 30 active municipal effluent disposal wells located in Florida compared to the current number of 79. The reasons behind this rapid increase are the restrictions on surface discharges of effluent and the presence of a suitable hydrogeologic setting. A vast majority of the effluent is injected into the "boulder zone" which is a highly fractured dolomite capable of receiving large quantities of water under low injection pressures. These wells are generally constructed with large casing diameters (up to 30 inches) in order to accommodate large injection volumes (in excess of 10 million gallons per day). In order to deliver large volumes to the injection zone, most municipal effluent wells do not have tubing or packer. Also, the effluent wells are constructed with open hole completions which has increased the proportion of wells utilizing this completion method from 27.3% in 1984 to 41.9% (Figure 6).

As previously mentioned, construction of wells with open hole completions has increased in association with new municipal effluent well construction. The utilization of completion methods is not related to the waste stream characteristics but to hydrogeologic conditions. Open hole completions are utilized in areas with fractured carbonates (Florida and Mid-Continent) and low permeability injection zones (Great Lakes Region). Perforated completions are used primarily in relatively competent formations in the Gulf Coast Region and screened completion in less competent formations in the Gulf Coast Region to control sand problems (Figure 6). The type of waste is a controlling factor in the downhole tubulars which need to be compatible with the waste stream.

As part of the survey, Class I operators were asked to identify their major concerns. The most common response was concern over changing regulations (Figure 7). The second most common response was "no concern" (41.9%). Six operators expressed concerns over potential mechanical problems but most of these were concerns about the plugging of the injection zone or need for additional equipment to meet monitoring requirements. Only one respondent was concerned about their well leaking. In general, operators expressed confidence that their wells were safely delivering waste into the intended zone and that the waste would remain there.

Some proponents of stronger regulation of injection wells have suggested that monitoring wells be required. Of the facilities surveyed, 48% have monitoring wells associated with their injection operations. 93% of the facilities with monitoring wells have the lowermost USDW screened. The remaining 7% were screened in the injection zone. However, eight facilities contacted monitor both the lowermost USDW and the injection zone.

CONCLUSIONS

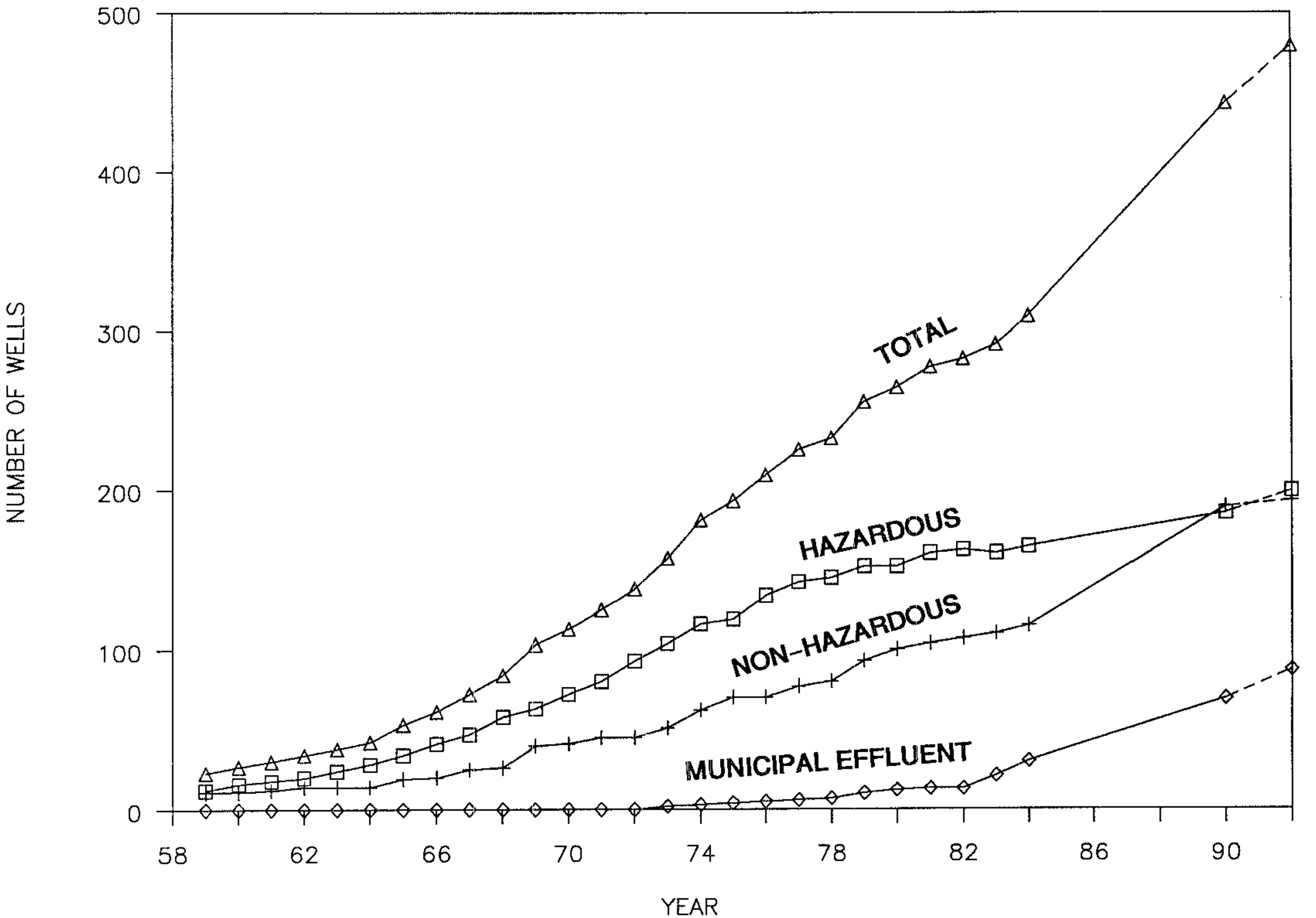
The data collected in this survey indicated that the utilization of Class I injection wells continues to be an important liquid disposal option. The number of Class I injection wells continues to grow despite increasingly stringent regulation. The geographic distribution and usage patterns of injection wells have been modified significantly by reclassification of wells and the construction of numerous municipal effluent disposal wells in Florida.

REFERENCES:

1. UIPC, A Class I Injection Well Survey, Phase II Report: Survey of Operations, 1987.

2. USEPA, Office of Drinking Water, Report to Congress on Injection of Hazardous Waste, 1985.

CLASS I INJECTION WELL
ANNUAL TOTALS WITH TWO YEAR PROJECTION



□= HAZARDOUS   += NON-HAZARDOUS   ◇= MUNICIPAL EFFLUENT   Δ= TOTAL

NOTE: Statistics Based On Data from Regulatory Agencies

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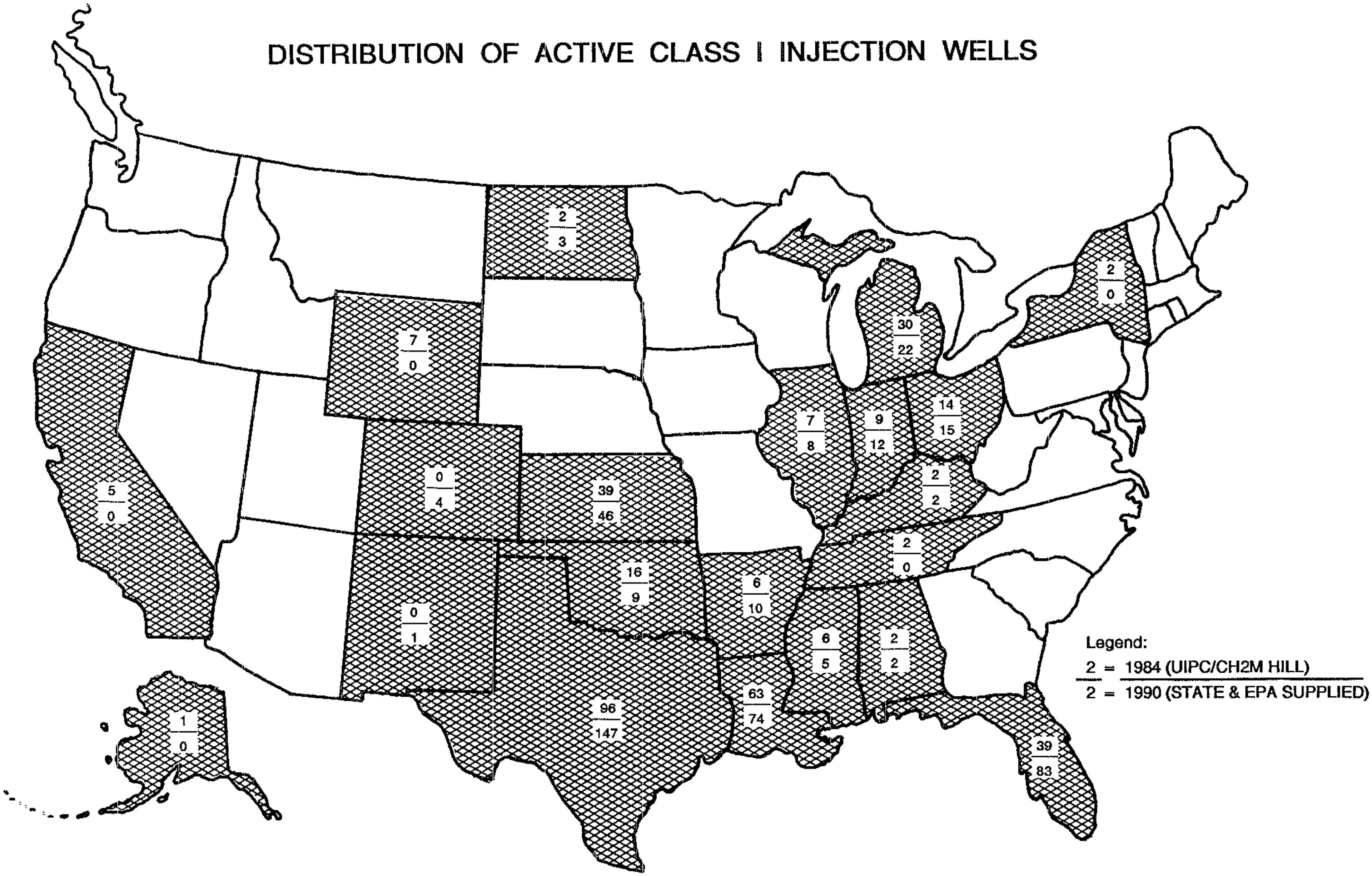
1992 Projections Based on Survey Results

FIGURE 1

DISTRIBUTION OF ACTIVE CLASS I INJECTION WELLS



NOTE: Statistics Based On Data from Regulatory Agencies

FIGURE 2

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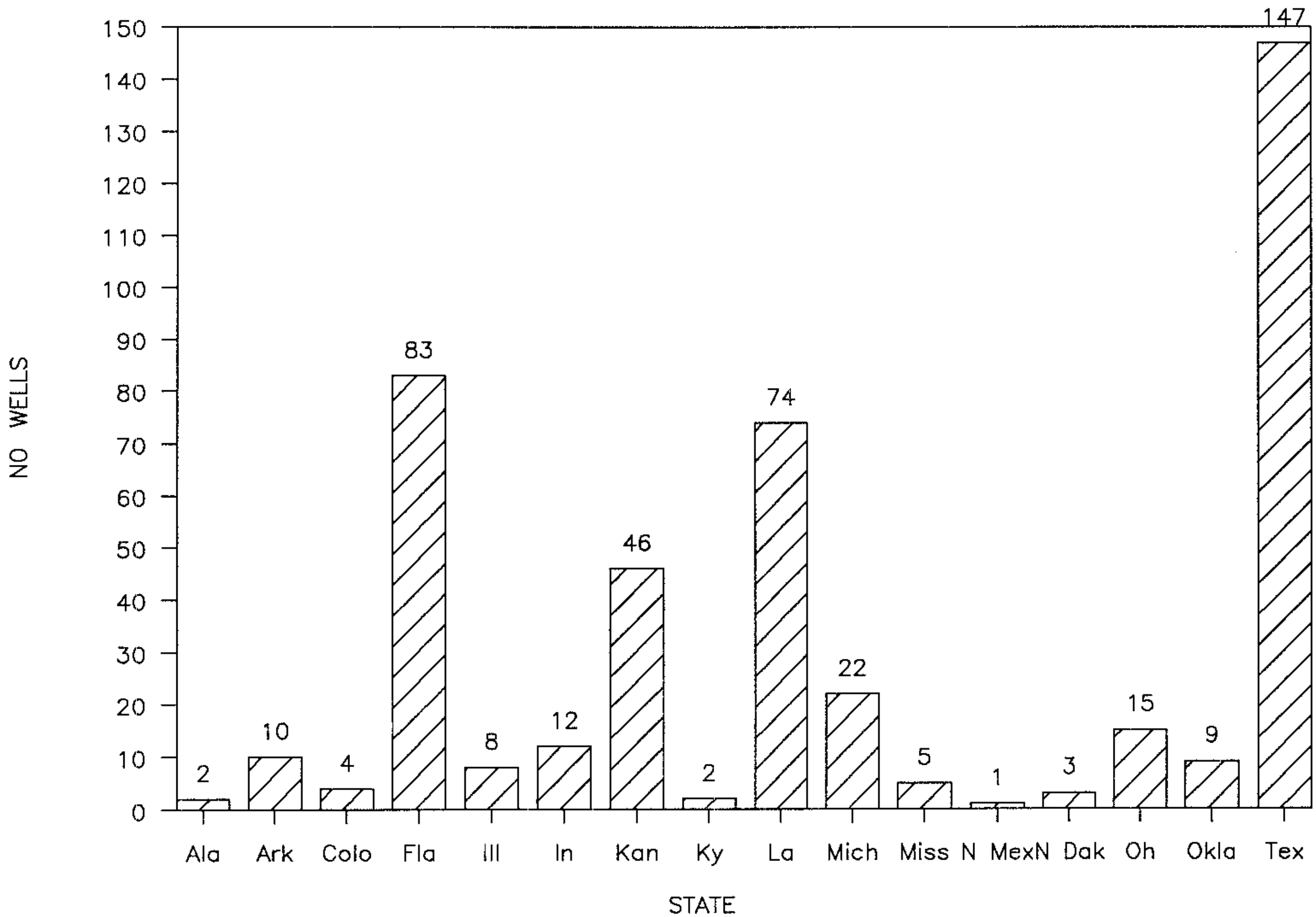
DISTRIBUTION OF ACTIVE CLASS I INJECTION WELLS



NOTE: Statistics Based On Data from Regulatory Agencies

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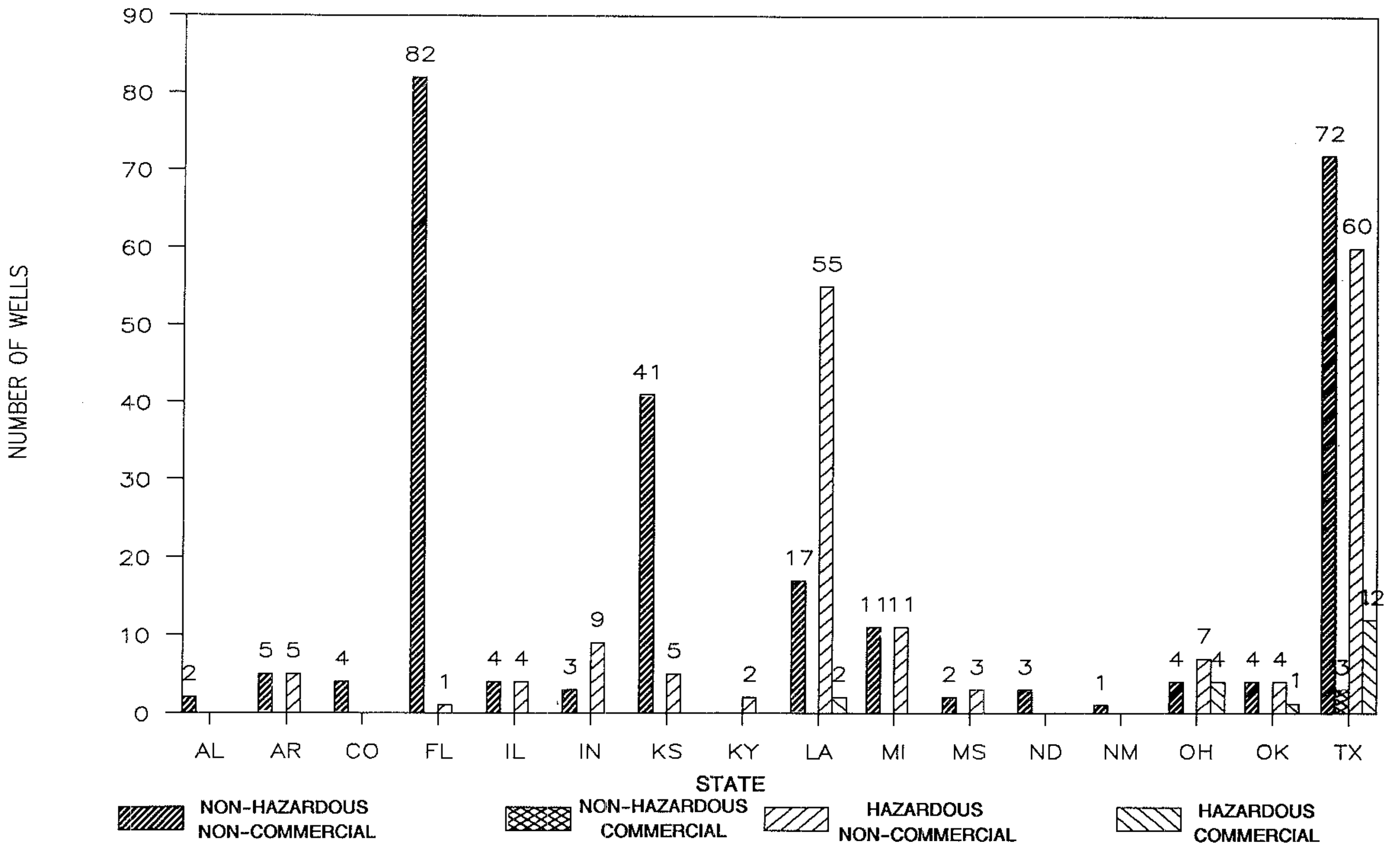
FIGURE 3

DISTRIBUTION OF ACTIVE CLASS I INJECTION WELL TYPES



NOTE: Statistics Based On Data from Regulatory Agencies

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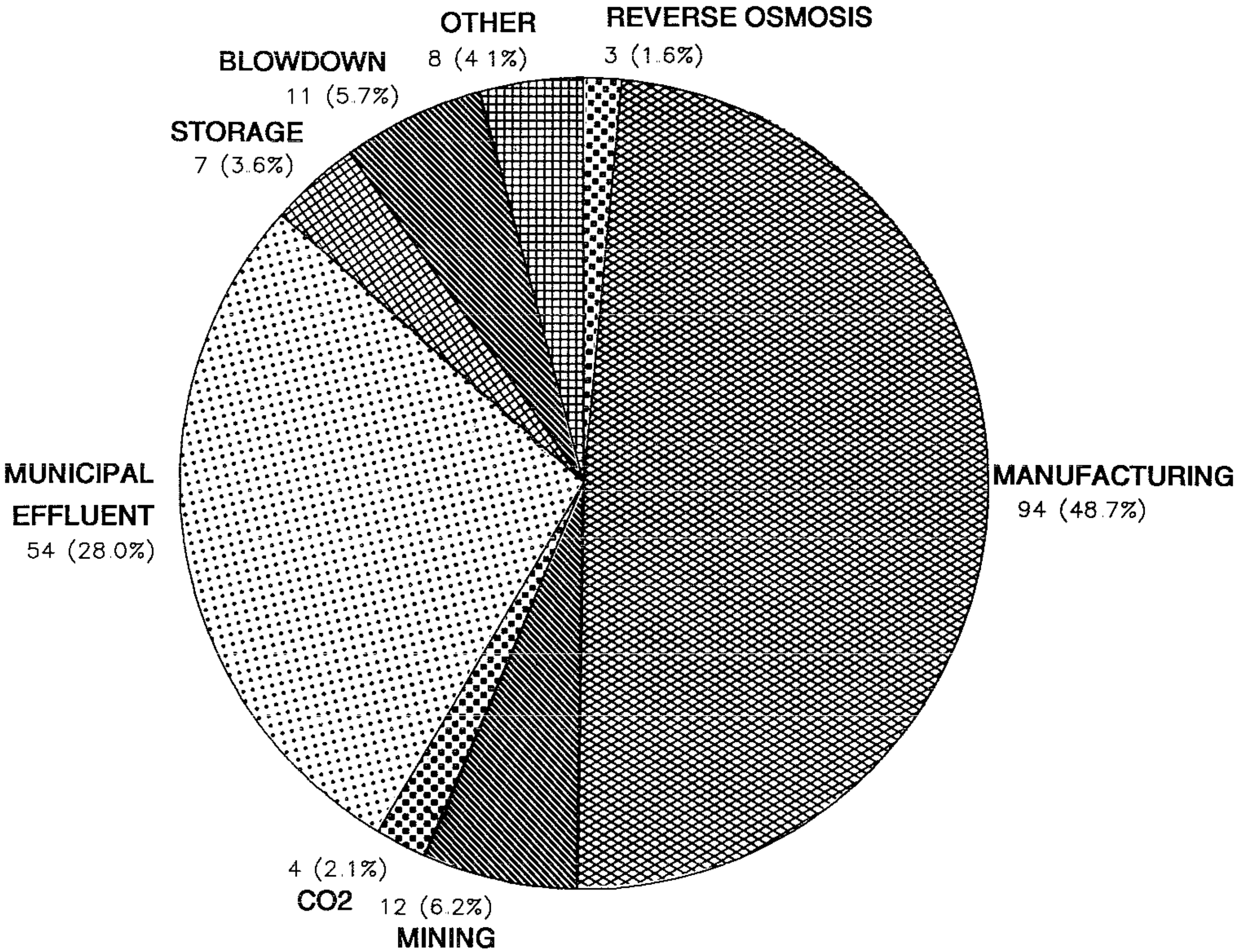
FIGURE 4

CLASS I INJECTION WELL
NON-HAZARDOUS / NON-COMMERCIAL
USAGE DISTRIBUTION



NOTE: Statistics Based On Survey Results

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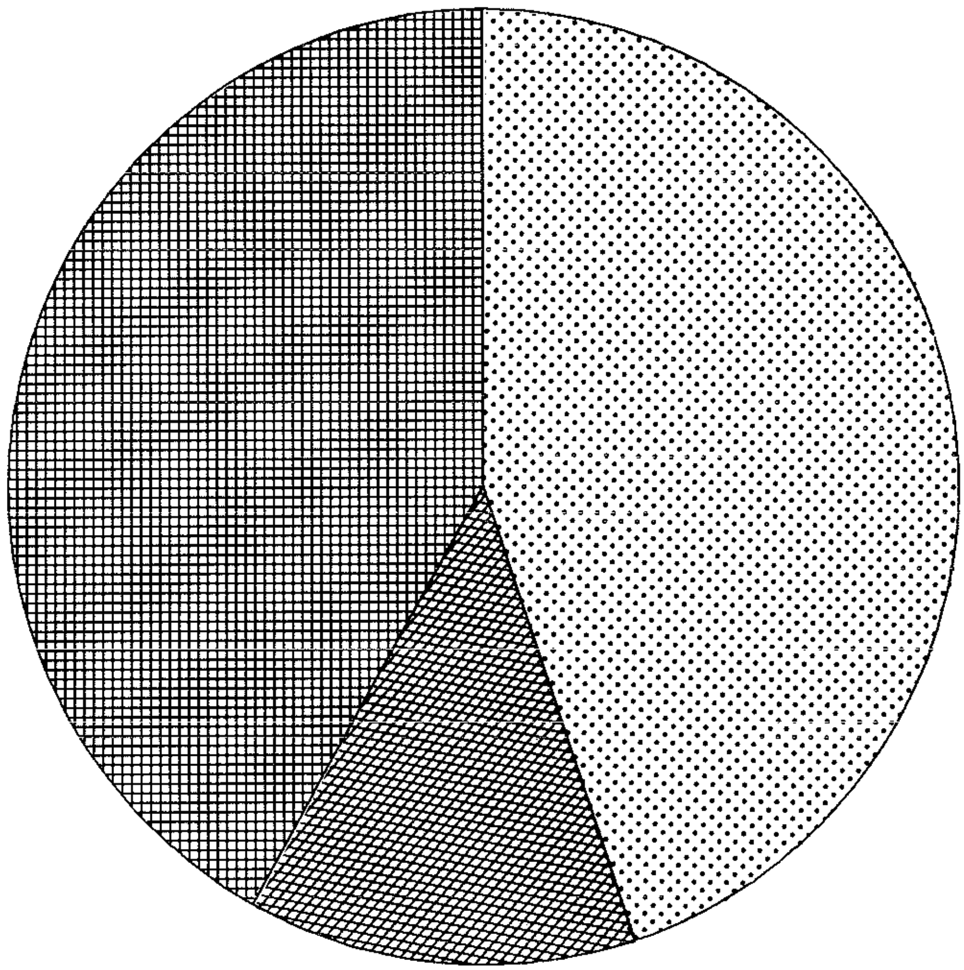
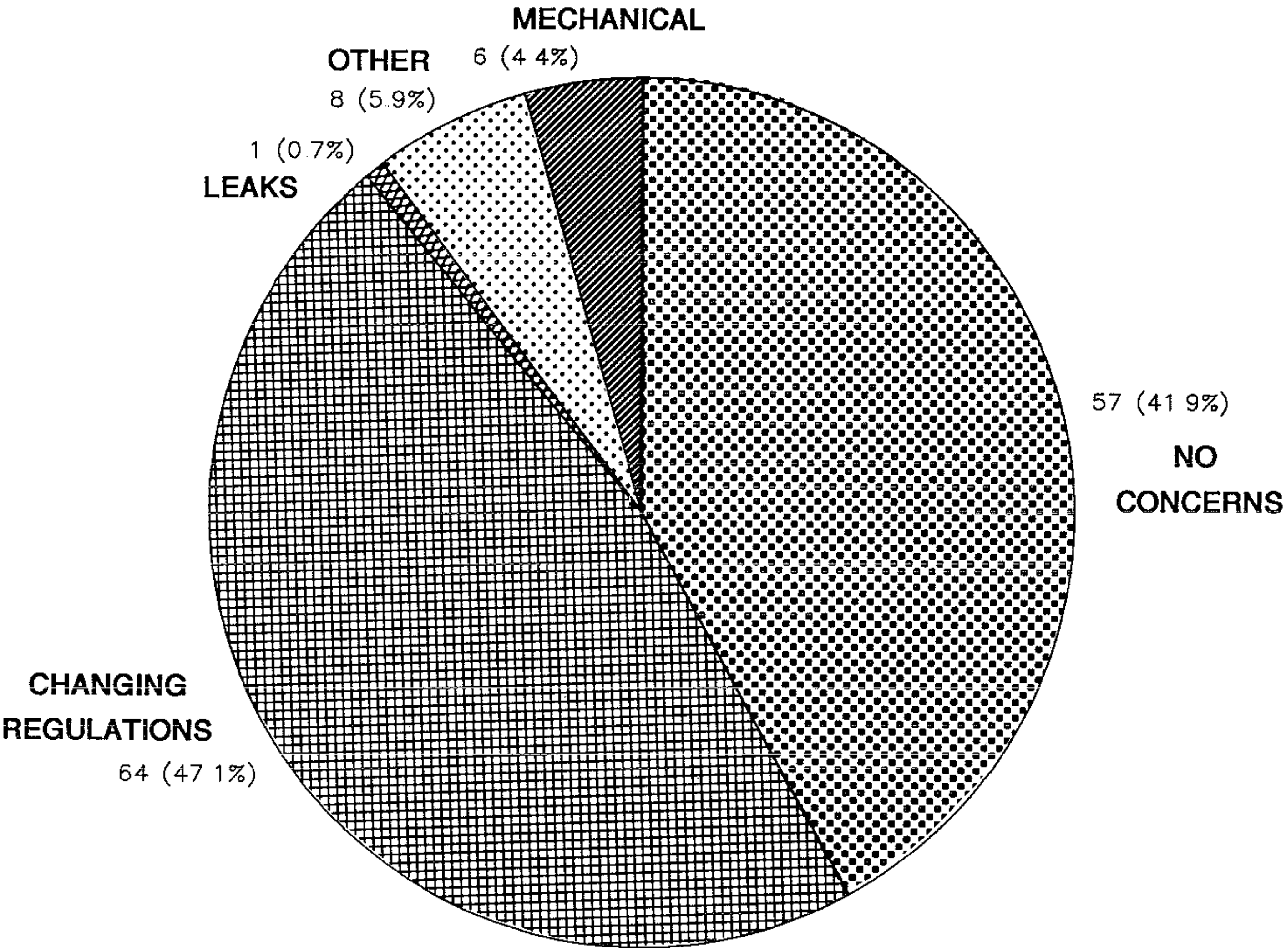
FIGURE 5

CLASS I INJECTION WELL COMPLETION METHODS



NOTE: Statistics Based On Survey Results

CLASS I INJECTION WELL OPERATORS MAJOR CONCERNS



NOTE: Statistics Based On Survey Results

Golder Associates
Houston, Texas

FIGURE 7

Prepared by:

Golder Associates Inc.
15603 West Hardy Rd., Suite 345
Houston, Texas 77060

Phone: (713) 931 - 8674

Fax: (713) 931 - 3246