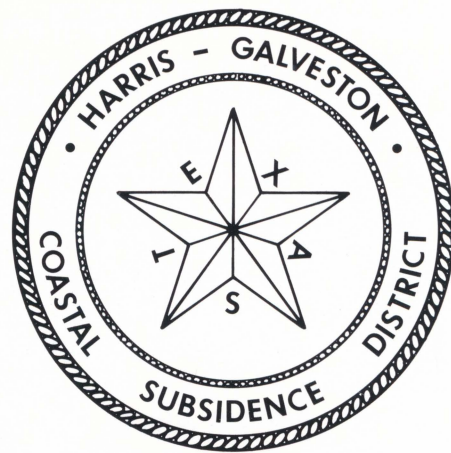
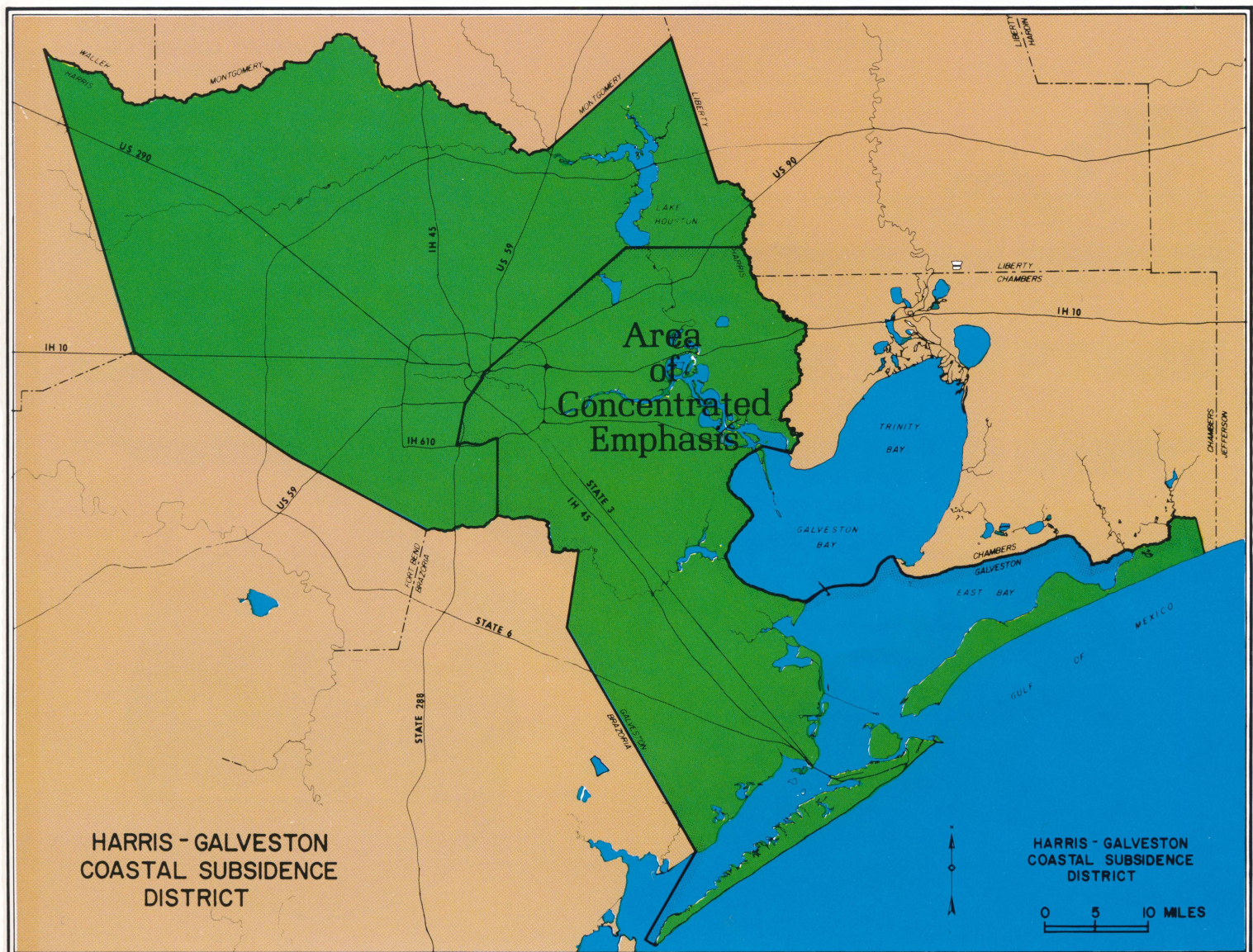


Harris-Galveston Coastal Subsidence District

Created by the Texas Legislature in May, 1975, by passage of H.B. 552 which states that "...this act is to provide for the regulation of the withdrawal of ground-water...for the purpose of ending subsidence..."



Harris-Galveston Coastal
Subsidence District



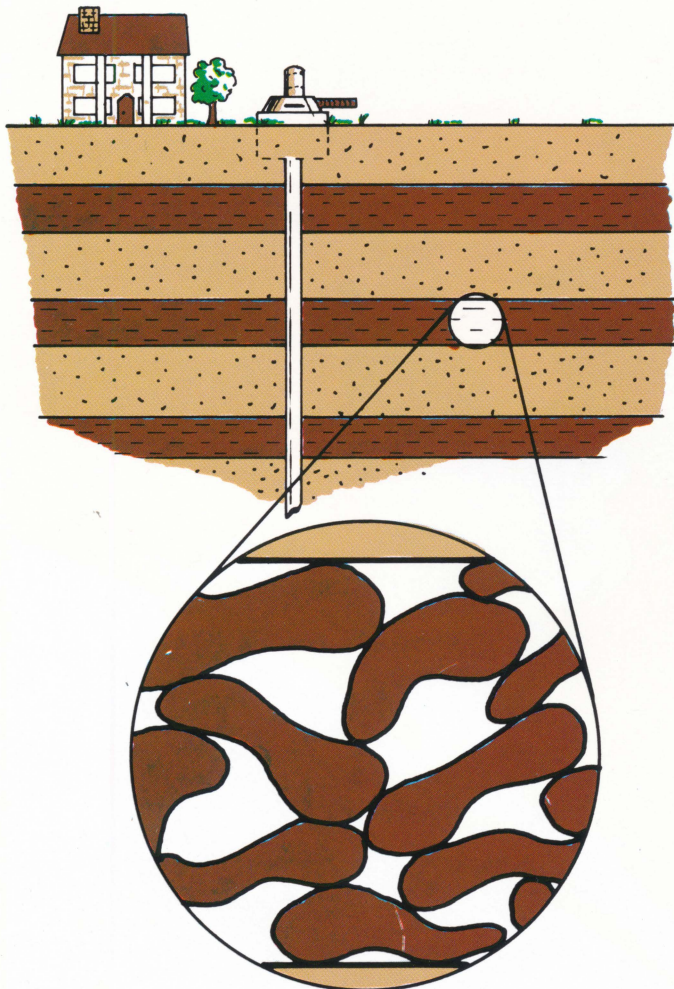
WHAT CAUSES SUBSIDENCE

The soil underlying the Houston-Galveston region consists primarily of alternating beds of sand and clay which contain fresh water at depths of up to 3,000 feet. The fresh water is contained in the small spaces between the sand and clay particles. When the underground strata contain enough water to be able to supply usable amounts to wells they are called an aquifer. The first illustration below shows a well which has been drilled into the aquifer below the Houston-Galveston area. When water is withdrawn from

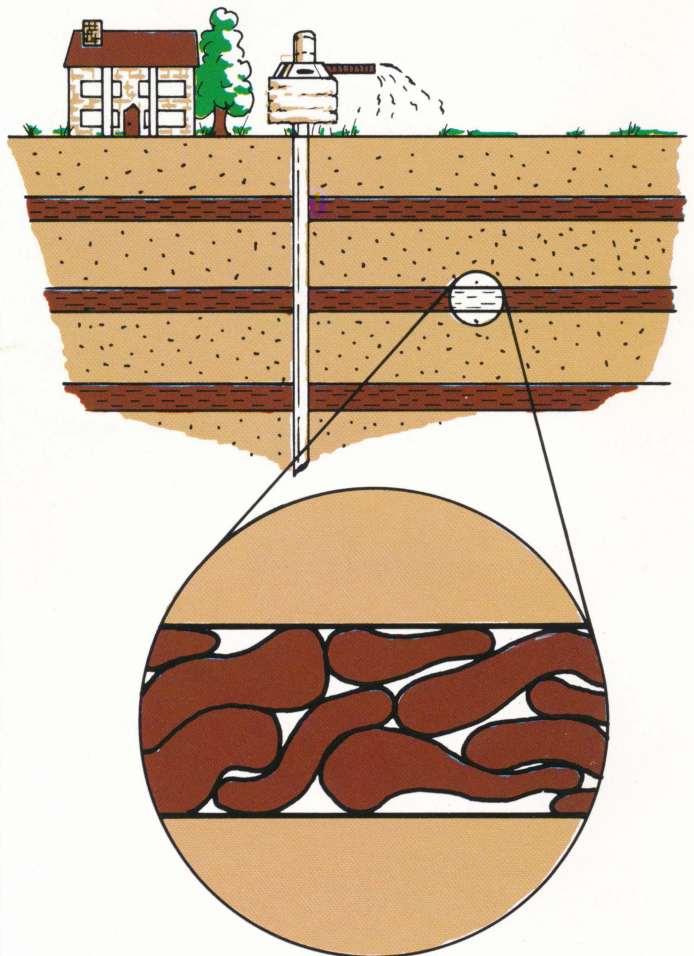
that well, it is withdrawn primarily from the sand beds (shown as a dotted pattern). However, because clay beds are interspersed between the sand beds, water withdrawn from the sand beds will eventually also be withdrawn from the clay beds. In the first picture below, the blowup shows a magnified picture of what the particles in the clay beds might look like. Notice that they are randomly arranged, some particles bridging over other particles.

The second picture below shows the same scene after many years of groundwater with-

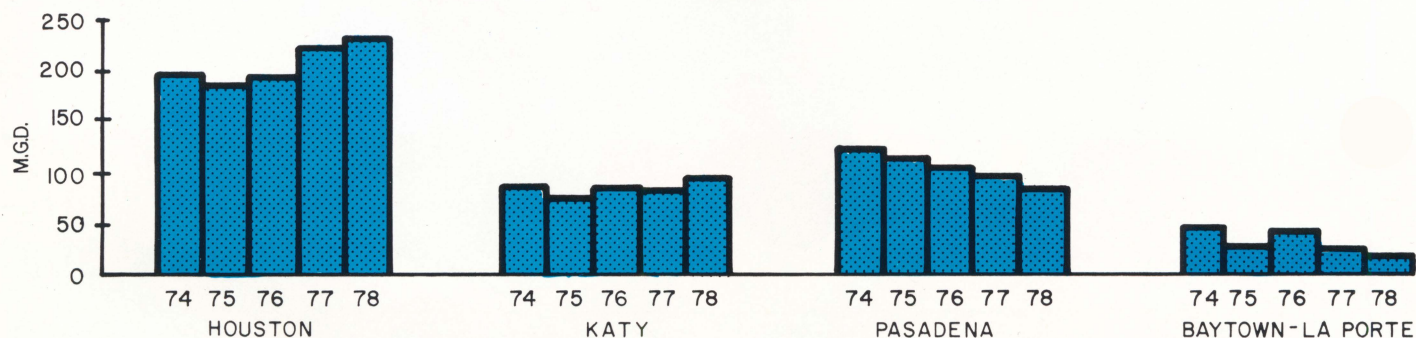
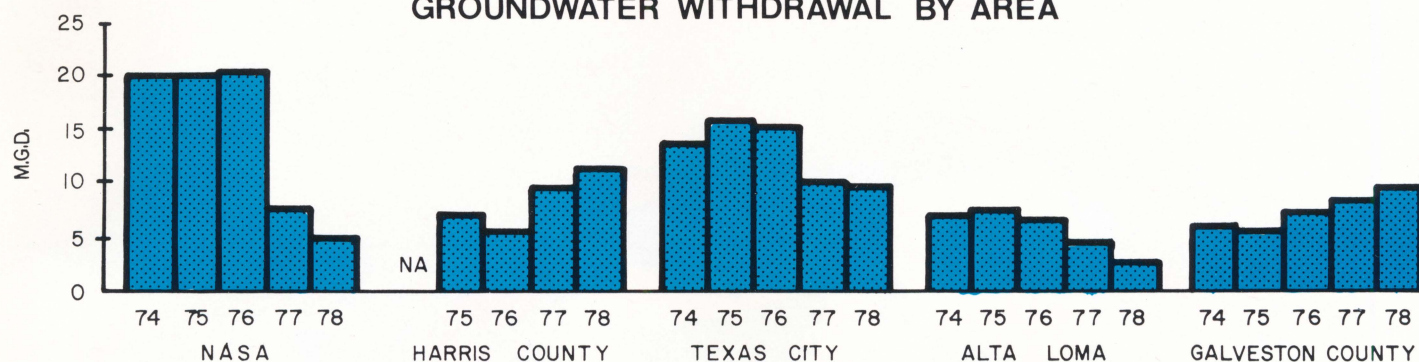
TYPICAL, WATER-BEARING
CLAY AND SAND STRATA
CONFIGURATION.



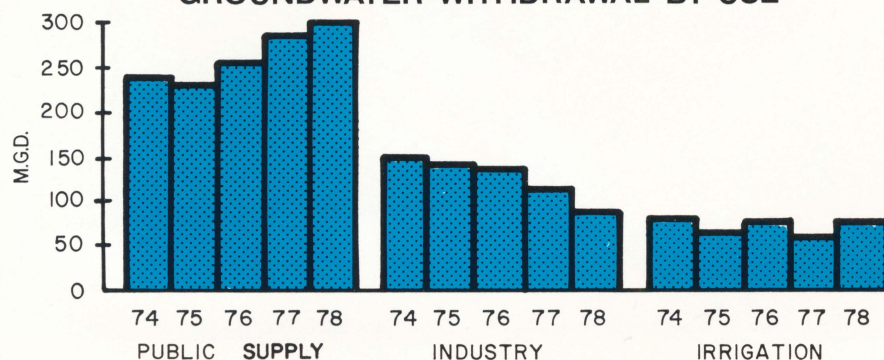
AFTER GROUNDWATER
WITHDRAWAL CAUSES
CLAY COMPACTION.
(SUBSIDENCE)



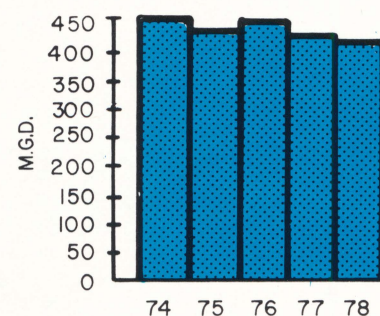
GROUNDWATER WITHDRAWAL BY AREA



GROUNDWATER WITHDRAWAL BY USE



TOTAL



drawal. As water was withdrawn from the aquifer, water pressure in the clays decreased and allowed the clay particles to collapse on each other, thus becoming more compact. There are hundreds of clay beds varying from five to fifty feet thick. Although each of these beds may compact only slightly, the effect of having each of these hundreds of beds compacting slightly is to produce land subsidence on the order of many feet. Subsidence is a slow process and the result of the withdrawal of ground water in one year may take many years before the total amount of related subsidence is completed. Unfortunately,

the clay layers are inelastic, i.e., even if we allowed groundwater levels to return to their old levels the clay layers would not regain their lost water and would not expand to their previous thicknesses. Once subsidence has occurred it is essentially permanent.

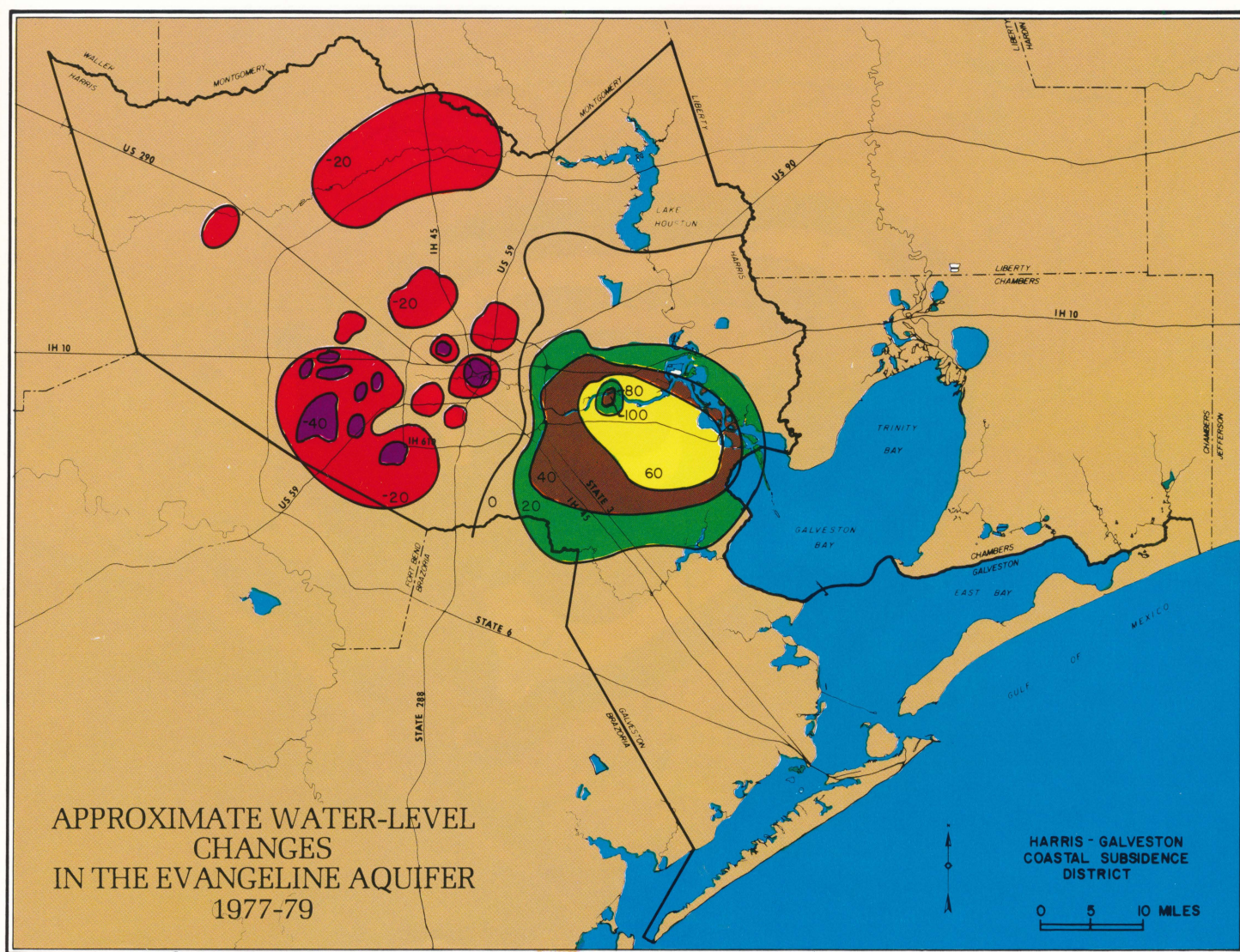
Historically, the major areas of heavy groundwater withdrawal have been southeast Harris County and Galveston County. Keeping in mind that it is excessive groundwater withdrawal that is the primary cause of subsidence in our area, it is easier to understand the map "Subsidence,

1906-1978" on Page 5. It is because these two areas have suffered the most subsidence that they were designated as the area where the Subsidence District would first concentrate its efforts to cut back on pumpage to ease the subsidence problem. It thus became known as the area of Concentrated Emphasis (see map on Page 1).

On January 12, 1979, the National Geodetic Survey completed the field work for the ninth regional releveing survey of the Harris-Galveston area. Previous levelings occurred in 1906, 1936, 1944, 1951, 1954, 1959, 1963, and 1973. The purpose of the leveling was to determine the

elevation of various points (bench marks) in Harris and Galveston Counties.

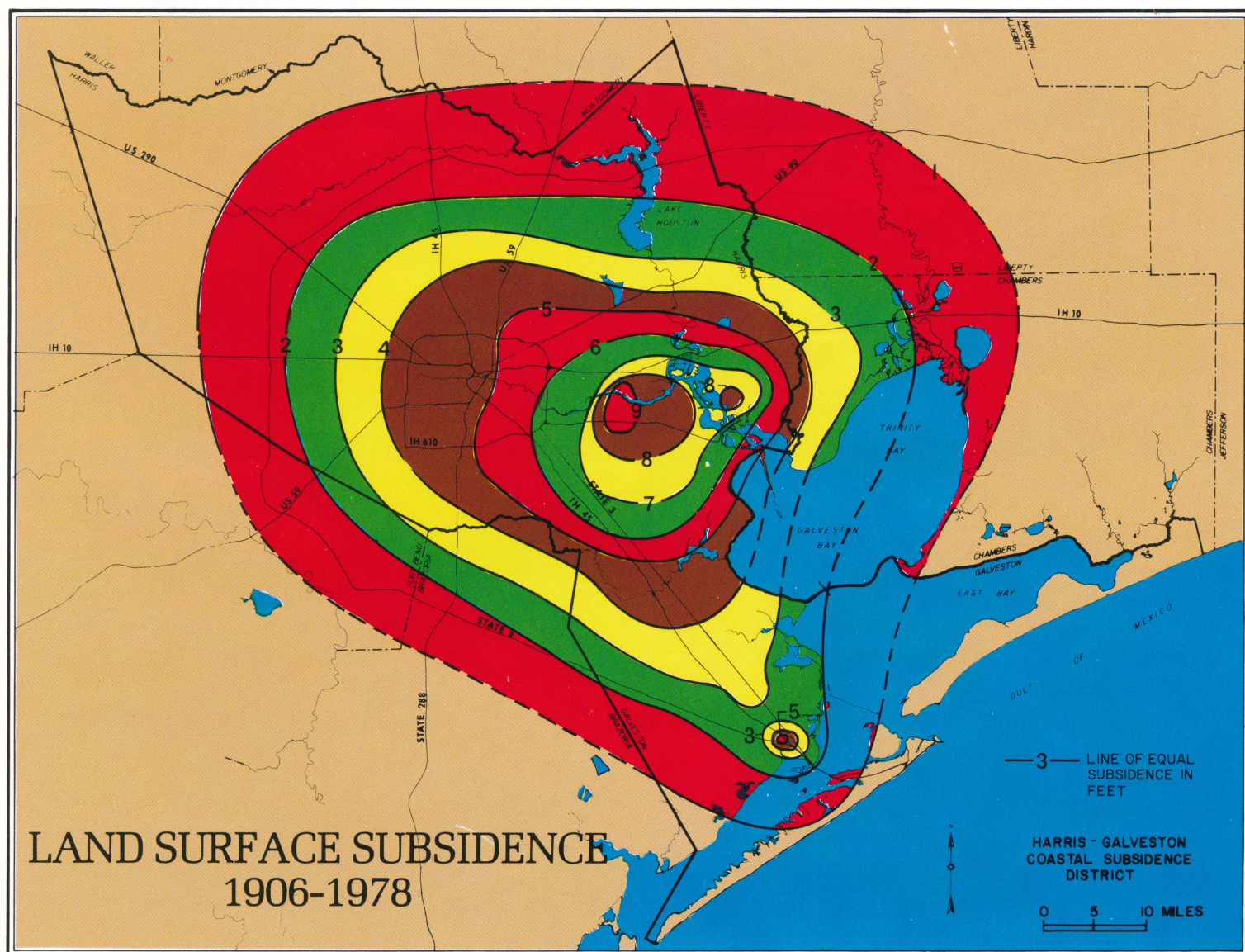
Subsidence District staff members have compared the elevations of bench marks, as determined in 1973, with elevations of the same bench marks as determined in 1978. This change in elevation or subsidence is shown on the map on Page 6. It is important to remember that the changes shown reflect the total difference, or total subsidence, which occurred from 1973 to 1978 and do not reflect the changes which have occurred in the last year or two where, in some areas, the reduction of groundwater withdrawal

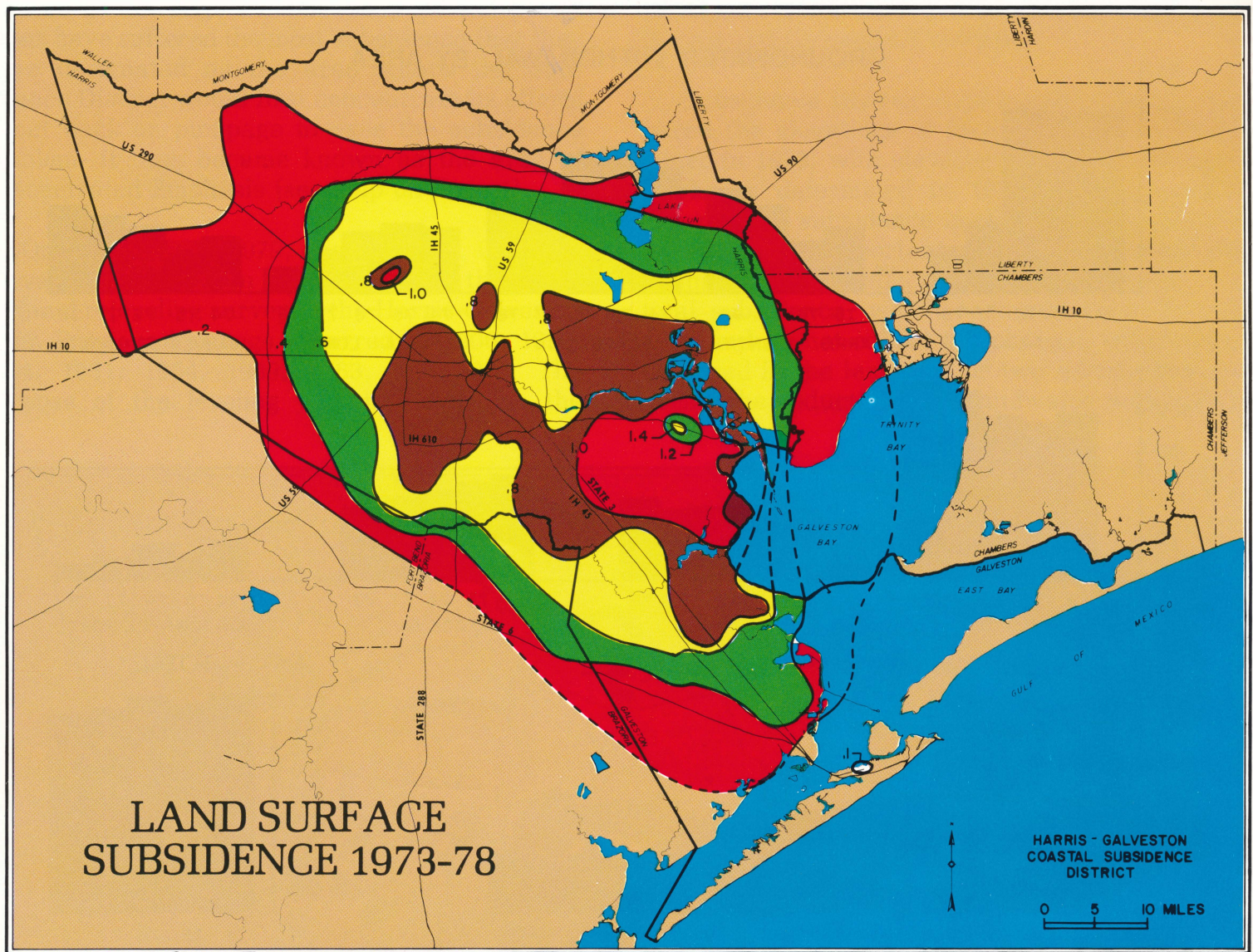


has been significant. You will note that, in the five-year interval from 1973 to 1978, the amount of subsidence ranged from less than a tenth of a foot on parts of Galveston Island to a foot and four-tenths in the Deer Park area. When figured annually, the rates range from a low of a quarter of an inch per year to slightly over three and one-quarter inches per year.

Although the greatest amount of total subsidence has occurred in the Ship Channel-NASA area, the District has data which causes it to believe that the majority of the subsidence in that area occurred in the first several years of the

1973-1978 interval and that the rate of subsidence during the last few years of that interval was much less. Significant decreases in groundwater withdrawal occurred in the NASA and Ship Channel areas during the years 1976 and 1977. (See the Chart on Page 3.) The elevation of water levels in wells in these areas was also shown to increase dramatically during the same period (see map on Page 4). However, in the area to the west and southwest of Houston, annual reports of pumpage have shown that groundwater withdrawals are increasing. This is corroborated by records of water levels in wells in that area which have decreased significantly. It is suspected that





the annual rate of subsidence in the areas to the west of Houston has been greater in the last few years of the 1973-1978 interval and is still increasing.

Although the 1973-1978 subsidence map shows the greatest total subsidence has occurred on the east side of Houston, if we were able to prepare a subsidence map for the years 1977 through 1978, we would probably see the reverse situation--that the majority of the subsidence had occurred not to the east of Houston but, rather, to the west of Houston. Housing and commercial developments, which are rapidly being built in the area to the

west of Houston, are causing the formation of municipal utility districts dependent on groundwater. As groundwater withdrawal increases, the rate of subsidence increases.

The reduction and ultimate cessation of subsidence can only be accomplished by the reduction of groundwater withdrawal. The future development and maintenance of surface water supplies appears to be the only practical solution to our subsidence problem.

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1980

