Memorandum regarding ground-water conditions in the vicinity of the South Houston oil field and need for protecting fresh-water sands from contamination.

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This memorandum was prepared for the Department of Utilities, City of Houston, Texas, at the request of Mr. F. N. Baldwin, Director. It concerns the gas blowout and fire which occurred on March 23, 1949, during the drilling of an oil well in the South Houston oil field, and the possibility of contamination of the fresh-water reservoirs in that area. The paper is a preliminary report subject to correction when additional data are available.

On Wednesday evening, March 23, 1949, a huge, rumbling gas fire broke out in the vicinity of an oil well being drilled in the northwest part of the South Houston oil field. According to reports of oil-company engineers, the well was down to 2,990 feet. The location was 85 feet from an abandoned and plugged oil well, and a second abandoned, plugged well was about 135 feet away. A pimple was formed beside the abandoned well nearest the drilling rig by gas pressure which soon caused a blowout, and in about an hour the fire started. The rumbling and explosive sounds caused considerable concern to many residents in the nearby community. Heavy drilling mud was pumped into the well being drilled and into the crater of the blowout for several days, until the gas was subdued and the fire extinguished. In addition, several thousand sacks of cement were required before the well was finally killed on March 27th. During this time five oil wells in the vicinity of the well which caught fire were killed by pumping mud into them as a safeguard against the possibility of their cratering and catching fire should gas be escaping from them.

It is not known precisely from where the gas was coming; whether from a fresh-water sand where it had gradually accumulated and become trapped over a period of years as a result of faulty well construction or from some stray shallow gas sand. Gas pressure was encountered at about 1,700 feet during the drilling and, in order to prevent the well from blowing out, the drilling mud had to be made heavier with a baroid material.

The South Houston oil field is over a deep-seated salt dome. The highest known salt occurs at about 4,400 feet below the land surface, near the center of the dome. According to Dr. J. Brian Eby, in a paper given in the Bulletin of the A.A.P.G., vol. 29, no. 2, February 1945, the salt plug is oval in outline, the long axis at the 6,000-foot sub-sea contour line being about 4,500 feet long, and the short axis a little more than 3,000 feet long. The dome is one of the steepest in the Gulf Coast. The center of the dome is in the H. T. & B. Survey No. 5. Most of the production lies on the northwest flank of the dome, a large part being in the M. A, Nichols Survey. A complicated fault pattern is associated with the structure. There are two principal oil-production zones; the Miocene sands from 3,800 to 4,100 feet and sands in the Frio clay at about 4,500 - 4,900 feet in depth.

In conducting the ground-water investigations in the Houston district for the past several years, the Geological Survey has collected many data including electrical surveys of oil tests and water wells. The generalized statements that follow are based upon a study of the field data at hand. For study purposes two generalized cross sections of the South Houston area have been constructed by use of the electrical logs. One of the sections extends for several miles in a down-dip direction from the City of Houston East End well field across the South Houston oil field. The other was constructed along the strike of the formations extending from an oil test located near the Pierce

Junction oil field through the City of Houston East End water well field, to the vicinity of Deepwater, on the Ship Channel. These sections, together with other data, indicate that large fresh-water reservoirs exist in the sands to depths of more than 2,500 feet adjacent to and possibly on the South Houston oil field structure.

About 1-1/2 miles northwest of the northern edge of the oil field the City of Houstonhas a well field for public water supply (see map). Water is produced from sands that range in depth from about 500 feet to 2,530 feet. An exploratory test well was sunk to a depth of 2,810 feet in this field last autumn,and drill-stem testing and water analyses of samples obtained showed that potable water exists to a depth of 2,550 feet.

A well that supplies water for the Meadowbrook subdivision (now within the City of Houston) draws water from sands screened between 720 and 1,157 feet. This well is less than half a mile from the oil well that blew out and caught fire. There was some change in chemical character of the water sample collected on March 25, 28, and 30, as shown by analyses made by chemists in the laboratory of the Water Department, City of Houston. The chloride and hardness on the 25th were 49 and 36 parts per million, and on the 28th they were 57 and 10, and on the 30th they were 55 and 14 parts, respectively. According to measurements made during the blowout and after the oil well was killed, the water level in the Meadowbrook well rose possibly 14 feet. No significant change was noted in the water levels in four other observation wells at distances from the gas well of from one to five miles. The water from the Meadowbrook well was first noticed to be muddy on March 25th and remained cloudy or turbid until the 28th, when it began clearing up. The amount of sand produced with the water increased to about three times the normal amount during this period.

The available data show that it has been the practice to set surface casing in the producing oil wells in the South Houston field at depths ranging from about 1,000 to 1,600 feet below the surface. It is understood that the Railroad Commission rule for this field is that 1,200 feet of surface casing be

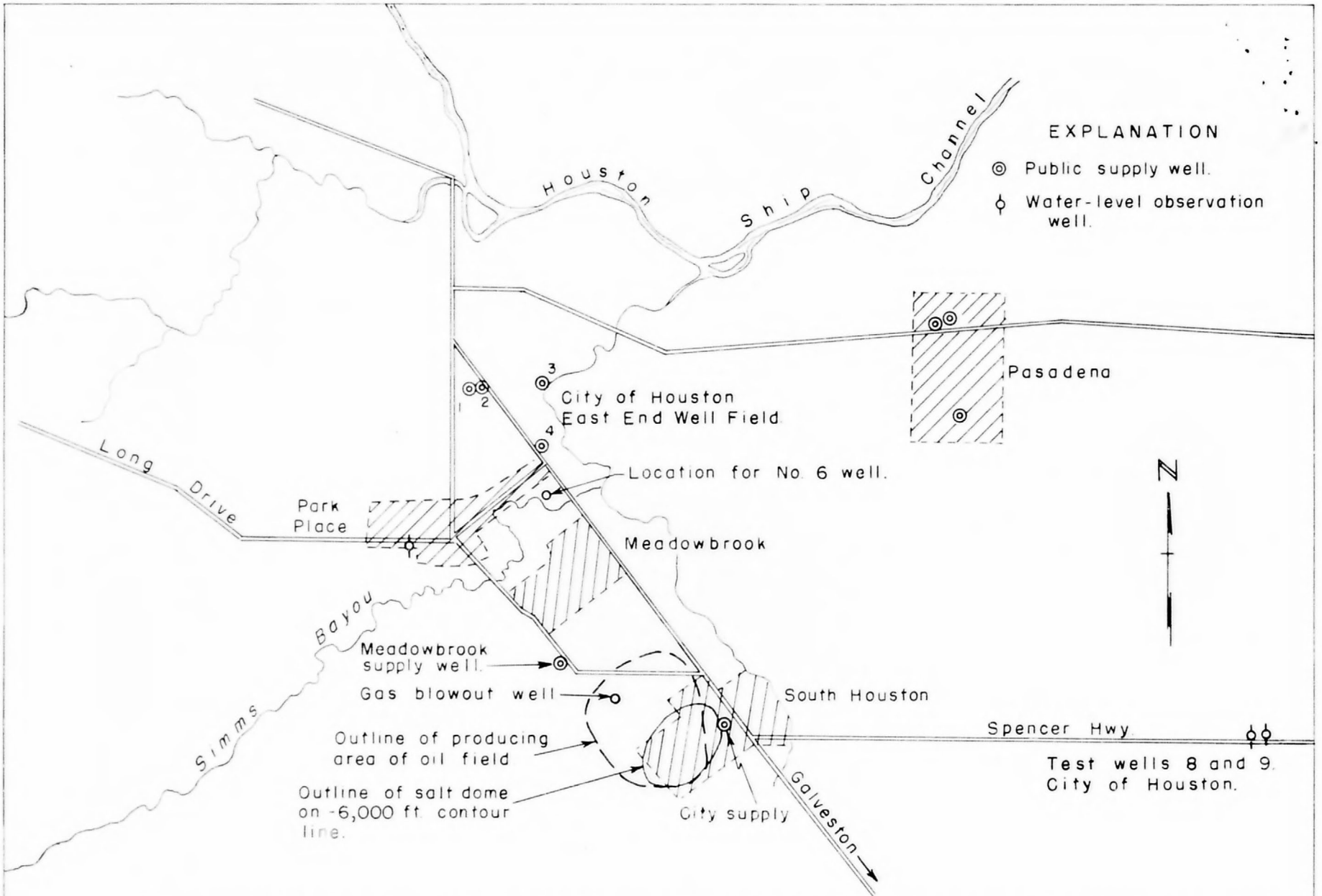
set. This is far short of an adequate depth for protection of the fresh-water sands.

It is not known what measures have been taken by the oil operators to protect the fresh-water reservoirs below the surface casing (assuming that the surface casing has been properly installed) from possible contamination from oil, gas, or salt-water zones. This general area gives promise of possibilities for important additional developments of ground-water supplies from sands down to depths of at least 2,400 to 2,600 feet, to supply the rapidly growing communities in the area. The City of Houston well-field development also is extending into that area. Should salt-water contamination occur on a large scale in the South Houston area, for instance, the contaminated water might migrate laterally and down the hydraulic or pressure gradient into the cones of influence of the City well fields and into the larger cone of depression developed in the Greater Houston-Pasadena area by the combined pumping in the area.

The experience gained from studies of the defective gas well in the Bammel field in 1944 shows that serious damage may be done to municipal and privately owned wells if gas wells become defective and the gas is discharged into the water-bearing sands in the locality of water-supply wells. In nearby water wells it is possible that the wells might blow out and crater, as happened in the Bammel area. Wells farther away might be damaged to the extent that sand would be produced with the water or the water would become turbid with a colloidal mixture of silt or clay, making it undesirable for public use. It is also possible that salt water in the deeper sand zones might enter the annular space between faulty casing (or no casing) and the production pipe in an oil well, together with gas, and be forced by gas pressure into the lower-pressure fresh-water sands.

Detailed studies are needed of the South Houston oil-field area in order to outline the structure, locate the salt-water sands and the oil and gas zones, and to find out whether the well construction adequately protects the fresh-water reservoirs. Present information is not sufficient for the Geological Survey to indicate exactly where surface casing should be set in the individual oil or gas wells in this field to protect the fresh-water sands. Limited data indicate that fresh-water sands extend at least to depths of 2,500 - 2,600 feet in some of the wells.

In view of the fact that the ground-water reservoirs are of such great value in the Houston district, as well as elsewhere on the Upper Gulf Coast, special attention should be given to provide for their protection from contamination in the oil fields by having all oil or gas wells properly cased.



SOUTH HOUSTON OIL FIELD AREA WHERE GAS BLOWOUT OCCURRED MAR. 23, 1949.

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