JOB REPORT

Roy W. Spears
Marine Chemist

Project No. MP-2R-1 . Date August 12, 1959

Project Name: Pollution Abatement in Regions M-4 through M-9

Period Covered May 15, 1958 to May 15, 1959. Job No. F-3

An Investigation of the Existence of Pollution in Chiltipin Creek

Abstract: The Chiltipin Creek's main function at present is to serve as a route for disposal of oil field wastes from three fields. These wastes are high in total chlorides and oil content and are in sufficient amounts to deem the creek biologically dead.

Objectives: To determine the degree of pollution damage to the creek by the oil field wastes.

Procedure: Six stations were established on the creek. One at the beginning of the source and the others at the disposal point of each field (Fig.I). Each station was sampled approximately every two weeks and a chemical analysis determined on each sample.

Toxicity studies were conducted at each station to determine the concentration of wastes at which 50 percent of the test animals are able to survive for a specified period (48 hours). This is known as the mediam toxicity threshold (MTT) calculated by the graph method. (Fig. III).

Data on well location and discharge was obtained from the Railroad Commission office and operators of the wells.

Findings: The Chiltipin Creek is a twenty mile long tributary to the Aransas River, and it branches just before reaching the intersection at the river. The north branch reaches the river two miles upstream of the creek's mouth. The creek is fed by tributaries covering one hundred square miles. All tributaries join two miles east of Sinton, and these tributaries and the creek depend on rainfall to have a natural flow. However, the slope of the terrain is such that all the rainfall drains to the creek, and a light rain will keep the creek flowing for quite a while.

The creek meanders through three oilfields, collecting the wastes. From these three fields 330 wells dispose daily of approximately 16,600 barrels (697,000 gallons) of salt brine averaging 70 o/oo total chlorides. The measurements taken on movement of creek water versus waste disposal indicate the creek maintains its flow only through the oilfield brine and that natural flow occurred during rainfall only. This would indicate the creek has no biological or recreational value. However, reports from "old timers" said the creek was "always full of fresh water and catfish". This is possible since there are deep pot holes in the creek that stay full of water. Rainfall may also have been more abundant in the past.

The pollution effects in the creek are direct by specific physiological and toxic effects rather than indirectly through quantative alterations of dissolved oxygen, pH, etc. These specific effects are caused by the heavy concentration of total chlorides and oil.

The problems encountered in this study are involved. The study included more general rather than any specific data because a comparison of the creek in its natural and polluted condition was impossible. Artificial methods were used to try to compare this difference and establish a water suitable to aquatic organisms that might inhabit the area in its natural state. Toxicity studies using the bluegill sunfish as the indices were used. A portion of the creek has tidal effects, but not enough to render it brackish in its natural state. The ion ratio of the north branch of the creek was comparable to the river water, whereas the main branch was comparable to the Aransas Bay water. The intersection of the two branches one mile above the mouth was a mixture of the two (Fig.II). Theoretically, the tidal influence does not appear past this point, so no marine organisms were used in the study.

Figure III shows the water has a 11.2% median toxicity threshold value. This would indicate that for freshwater fish to inhabit the creek, there would have to be a natural flow of 23 million gallons of fresh water or maintain a flow of 30 cubic feet per second to dilute the present flow of waste sufficiently. This would dilute the sodium chloride content successfully.

The problem related with the salinity content in oilfield waste is crude oil, which has not been successfully recovered by the procedure used in these fields. This method of recovery utilizes earthen pits depending on gravity separation. In this process of separation, oil rises to the surface and any solids will settle to the bottom. When this milky water (oil in emulsion) is discharged into a body of water, the oil usually breaks as a result of dilution and rises to the surface. Thus, the creek usually stays full of oil.

Associated with the pollution problems of Chiltipin Creek is the Aransas River and Aransas Bay. The creek branches at the river and was presumed to empty into Aransas Bay via Aransas River. An analine dye was used to trace the route from the head of the creek to the Aransas River. This could only be accomplished by stations since the dilution effects by the creek were great enough to overcome a visible concentration of the dye. Fig. I shows the stations used in tracing the dye. The rate varied depending on the flow of the creek fed by rainfall and waste flow. From Station 1 to Station 2 the time interval of recovery was 35 minutes with the rate of flow of the creek at 5.0 cubic feet per second, using 1 gram/liter of dye. The dye was diluted sufficiently to reduce the color beyond visibility to Station 3. A liter of water with two grams of dye was placed in the creek at Station 2 and five hours later recovered at Station 3. The same amount of dye was placed in the creek at Station 3 and traced by plane to the mouth. At 20 cfs rate of flow the creek will empty its full contents into Aransas Bay. The rate of exchange was timed at 14 hours. The slowest flow of the creek was 1.5 cfs. Theoretically the longest interval for the exchange was calculated to be seven days.

Flow	Rate	Time
20 cfs	1.4 mph	14 hrs.
1.5 cfs	.11 mph	182 hrs. 48 mi.

Fields: There are three fields that empty waste into the Aransas Bay via Chiltipin Creek. From these fields a total of 16,595 barrels of oilfield brine from 330 wells empties a waste averaging 70 o/oo salinity. This high saline value is constant and is only reduced when diluted by rainfall. The creek water flows into Aransas River as a potential polluant. Associated with the brine is crude oil waste. It is always present in the creek, for each well contributes from 5.0 to 130.0 ppm oil. Toxicity studies on the brine wastes, using pin perch as the marine indices, had a tolerance equivalent to the salinity concentration of the oilfield waste. Fish avoided the oilfield brine, however.

Hydrogen ion (pH) measurements: The pH measurements were made with a Model M Beckman glass electrode pH meter and in the field with a p Hydrion paper. 91% of the samples from the outfall (Fig. IV) were in the range 6.5 - 7.1.

71% of the samples from the creek (Fig. IV) ranged from 6.5 - 7.1 and 27% were 7.2 - 8.9. However, the samples above 7.1 were taken after a rainfall and the salinity was below 10 o/oo. This is some indication that the creek is fed by oilfield wastes for the most part and obtains a natural flow by rainfall only.

Salinity: Station III (Fig. I) was established for the average monthly salinity value since it is located approximately half the distance between two fields. Fig. V shows the relationship of salinity vs rainfall. The peaks coincide except in May of 1959. There were 4.06 inches of rain, but the salinity was 3.7 o/oo. These 4.06 inches of rain fell in three days and the salinity measurement was taken previous to that. The salinity of the creek following mid May and all of June was 0.0 o/oo since 7.93 inches of rain fell in June. The salinity of this flow of water to the Aransas River coincided with the rainfall data.

Comments: The Chiltipin Creek's only value is as a route for disposal of oilfield wastes. The biological or sports value could probably never be restored. However, the wastes are emptied into a river and bay that has a sports and commercial value, and may effect the biological content if the wastes continue to flow at the present rate.

Prepared by Roy W. Spears . Approved by Howard T. Lee
Howard T. Lee

Marine Chemist . Date Approved 18 Aug. 1959

Figure I
Sampling Stations

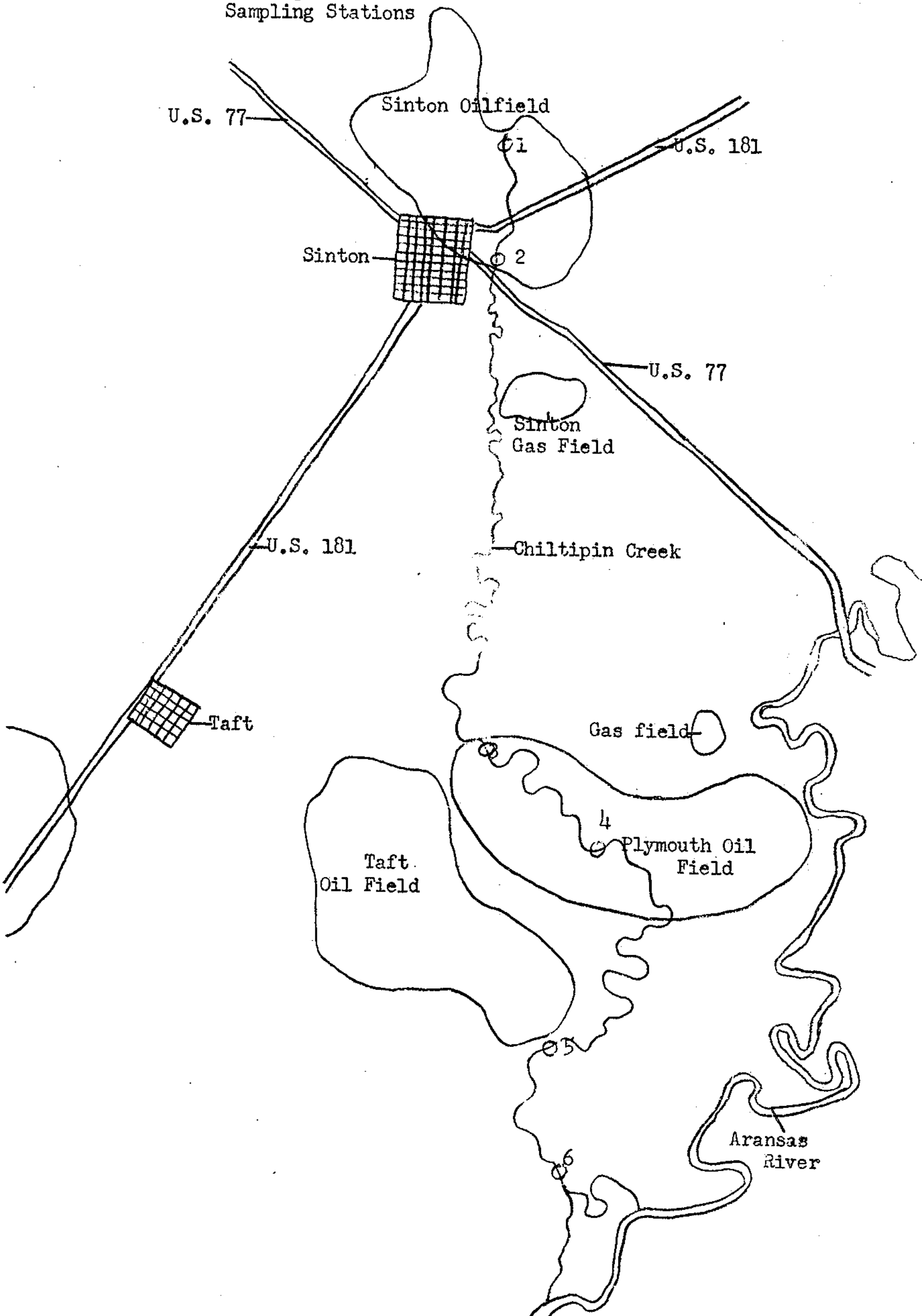

FIGURE II

A COMPARISON OF THE CHEMICAL COMPOSITION OF THE WATERS OF CHILTIPIN CREEK, ARANSAS RIVER, ARANSAS BAY AND OILFIELD BRINE

	Chiltipin Creek[1]	Oilfield Brine[2]	Aransas River[3]	Aransas Bay[4]
Bicarbonates	128.0 ppm	214.0 ppm	52.0 ppm	70.0 ppm
Sulphates	121.0	53.0	140.0	726.0
Chlorides	31,124.0	38,270.0	550.0	5200.0
Calcium	824.0	1,109.0	47.0	138.0
Magnesium	126.0	224.0	81.0	275.0
Sodium & Potassium	21,240.0	29,820.0	395.0	3020.0
Silica	29.0	21.0	10.0	15.0
Iron & Al. Oxides	31.0	42.0	1.0	2.0
Total Solids	53,623.0	69,753.0	1276.0	9446.0

1 - one composite of ten samples on separate days

2 - one composite of six samples from separate wells.

3 - one sample

4 - one composite of six samples on separate days.

Figure III

Median Toxicity Threshold Value
for Chiltipin Creek

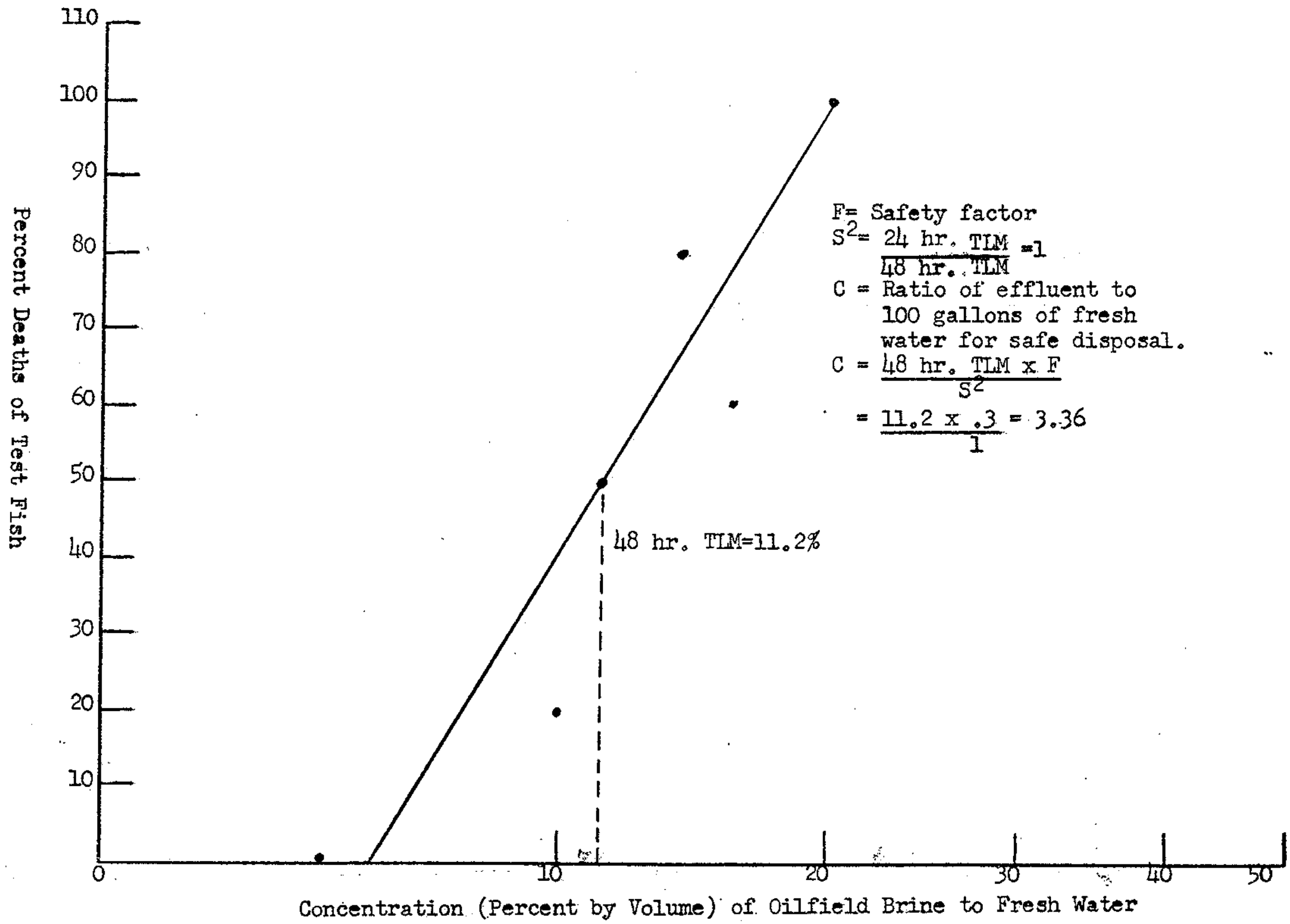

Figure IV

Hydrogen ion (pH) Limits of Chiltipin Creek and Oilfield Brine

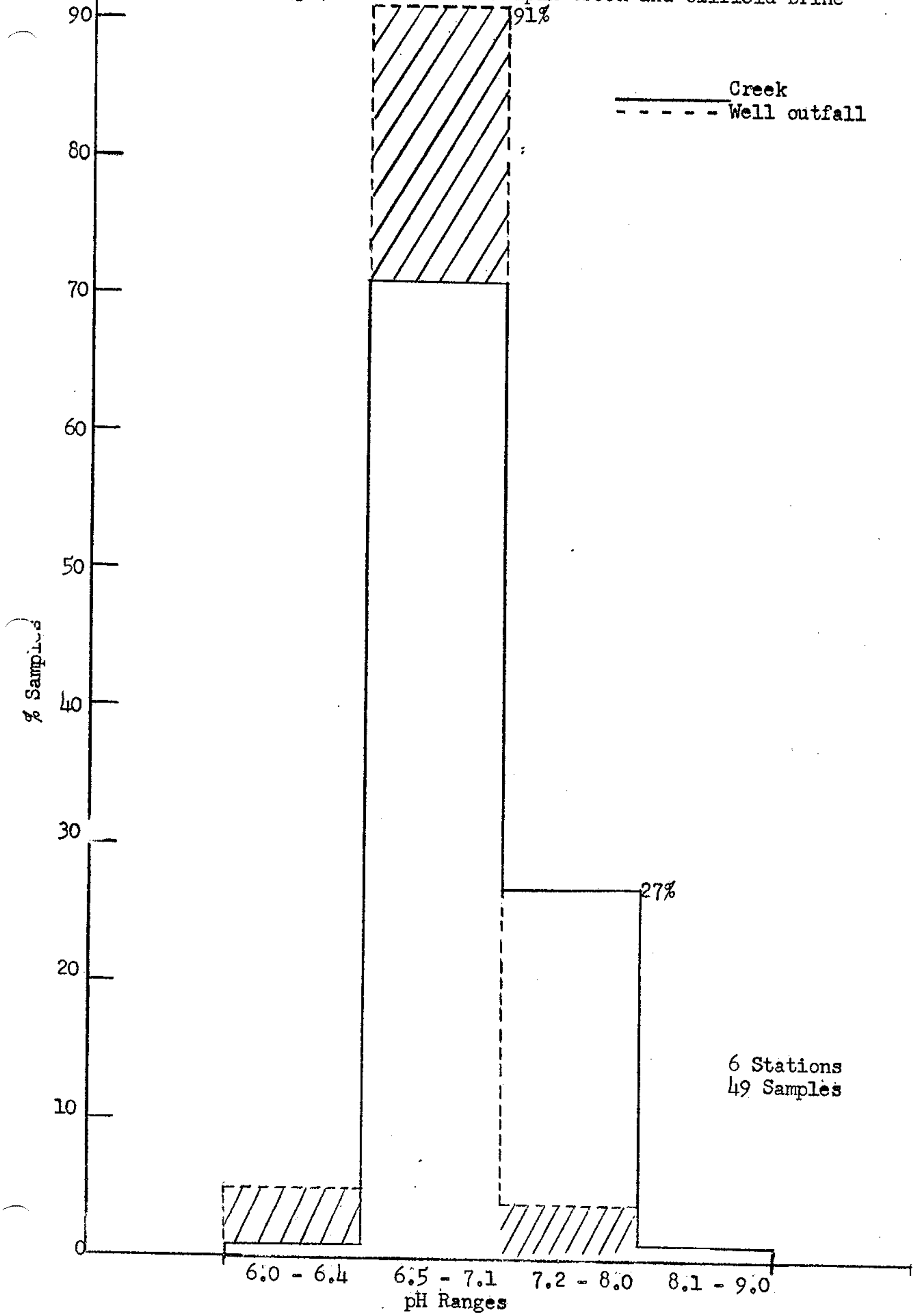

Figure V

Monthly Averages of Salinity versus Rainfall