INDUCED ALKALINE RECHARGE ZONES TO MITIGATE ACTIVE ACIDIC SEEPS

by

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Background

Although the production of acidic waters is influenced by many factors, two of the most critical are the occurrence of alkaline material and the hydrology of the site. Within the overburden the presence of pyrite coupled with calcareous material controls the quality of drainage. Obviously, the absence of alkaline material within the section precludes the generation of alkalinity. Further, even if the alkaline material were present, it must be positioned to intercept infiltrating waters to generate alkalinity prior to contacting the acid material. Additionally, the alkaline material must be capable of producing sufficient concentrations of alkalinity to neutralize large concentrations of acidity.

The amount of alkalinity generated by limestone or dolomite is constrained by the solubility of the mineral. Other materials are available which may be used to generate higher alkalinities such as lime, Na_2CO_3, $NaHCO_3$, etc. and although used primarily to treat acid discharge, these chemicals could be used in conjunction with limestone to provide a short-term, highly alkaline flow with a subsequent sustained low alkalinity flow. By strategically placing these materials in the recharge areas of a mine and inducing surface water flow into these areas, the alkaline load within the mine backfill will be increased to enhance neutralization and inhibit pyrite oxidation.

Our studies have shown that ground water flow through a backfill is highly channelized and the acidity is formed by the leaching of toxic rocks intercepted by these flow paths. By deliberately channelizing water into selected recharge zones which are loaded with alkaline material, the induced alkaline flow forms a greater percentage of the seeps emanating from the mine and should affect the quality accordingly.

Methodology

The induction of alkaline flow has been implemented at two sites, one active and one inactive site. At the former, the alkaline trenches were installed as the mining progressed and became part of the completed backfill. At the inactive site, a small completed, acid producing mine was used and the alkaline trenches were emplaced on the surface. At both sites, the created recharge trenches contain a thick layer of limestone overlying a veneer of sodium carbonate briquettes. A bromide or iodide salt incorporated in the limestone mixture during the application of the material serves as a tracer. Samples from seeps are collected routinely and measured for temperature, pH, acidity, alkalinity, specific conductance, sulfate and the tracer. The presence of the tracer in the water samples indicates that surface water has contacted and passed through the alkaline horizon and should be affecting seep quality.

Due to the variations in topography, geology and seep origins, control sites could not be established. However, because of the time lag, from the time of application to discharge events, samples collected several months before the seep is affected by the application should provide the necessary background data against which to make comparisons.

In addition to monitoring the seeps, the rainfall quality and quantity are measured. Percolation tests will be used to estimate the infiltration rates and to determine the approximate time required for flow and to estimate the volumes of water passing through the system.

Results

The mine plan of Job 8 of the ENOXY Coal Company, in addition to the selective handling and placement of overburden material, as outlined in the Task Force recommendations, contains a provision for the installation of an alkaline trench at the periphery of the clay cap. Potentially acidic material placed on top of a 20 foot pad is sealed and capped by a clay layer. The clay layer serves to divert the water away from the acidic material and toward an alkaline trench surrounding the mine. The trench is approximately 3 to 5 feet wide and 3 feet deep. The bottom is lined with sodium carbonate briquettes and the trench is filled with limestone, capped with coarse sandstone and tagged with iodide. Because the top of the trench is tapered slightly toward the body of the backfill, runoff will accumulate in the trench and infiltrate the backfill.

This site was completed during the Fall, 1983 and is currently being inspected for seep development. At the time of this writing, seeps had not developed.

Alternatively, at the Mercer Site, and with the cooperation of the DLM Coal Company, the alkaline trench concept was implemented at a mine completed approximately six years ago. Further, the four seeps emanating from the side and toe of the mine had been monitored by DLM for the past several years and by the AMDTAC study for the past year and a half. The small size of the mine (approximately 14 acres) provides good experimental control.

During January, 1982, approximately five depressions on the surface of the Mercer Mine were located and flagged for treatment. At that time, the depressions were tagged with bromide. It was believed that these depressions were major avenues of material would affect the quality February, 1982, Mr. Ray Williams to the schedule shown in Figure 1.

Although at this time of the year the ground was frozen, the seeps continued to flow and remained acidic. During the Spring thaw, however, bromide was picked up in Seep 2 with an attendant change in chemistry (Figure 2).

During the Summer of 1983, DLM proposed to recontour the Mercer site for the purpose of diverting water away from the highwall and affect runoff to the outslope. As part of this recontouring effort, AMDTAC agreed to identify the acidic/alkaline materials buried in the backfill so that selective material handling could be incorporated in the recontouring plan.

With a 30 foot backhoe, 16 large diameter holes were dug to pavement to collect samples for analysis and identify the configuration of the water table in the backfill. To our surprise, only 3 of the 16 holes encountered water (Figure 3). We further discovered that the zones below the depressions were generally dry. Thus, what we had earlier identified to be recharge areas, were in fact areas with perched water tables.

Significantly, in one of the "wet" holes, Hole 6, the water collected from the base of the pit had high alkalinity as well as increased conductivity. The bromide tracer was present which demonstrated that the alkaline trench had impacted this part of the mine. Of greater interest, laboratory weathering tests of the samples collected from this area leached alkaline with low levels of sulfate and continue to do so today. Although we do not have a control, relative to the general character and geology of the mine (with a stratigraphy which is predominantly acid producing), the assumption that samples collected from Hole 6 should be acid producing is a reasonable one. This observation, coupled with the major uncertainty of the hydrogeologic regime, prompted DLM to modify the recontouring effort and develop an alternative plan.

During active rain events, we often observed recharge taking place along the base of the highwall due to the slope of the backfill and the bouldery nature of the backfill (Figure 4). We would argue that this zone could be loaded with alkalinity which would significantly impact seep quality. We recommended to DLM that an alkaline trench along this zone be emplaced. In further discussion with DLM Coal Corporation, the alkaline trench concept was fully developed at the Mercer site. Figure 5 shows not only the configuration and locations of the alkaline trenches but the August 26, 1983 treatment schedule as well.

During the Fall recharge to the water table is at a minimum. The full impact of alkaline trenches and an assessment of this concept, will not be realized until at least the Spring thaw of 1984.

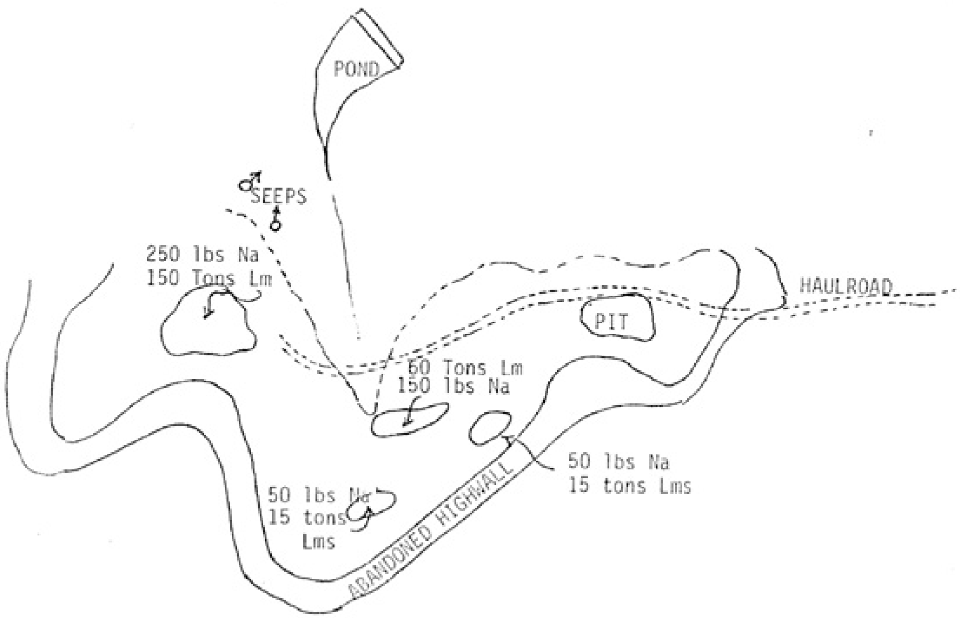


FIGURE 1- TREATMENTS OF DEPRESSIONS AT MERCER SITE (February, 1982)

Na= Sodium Carobante Briquettes
Lms= Limestone(reject)

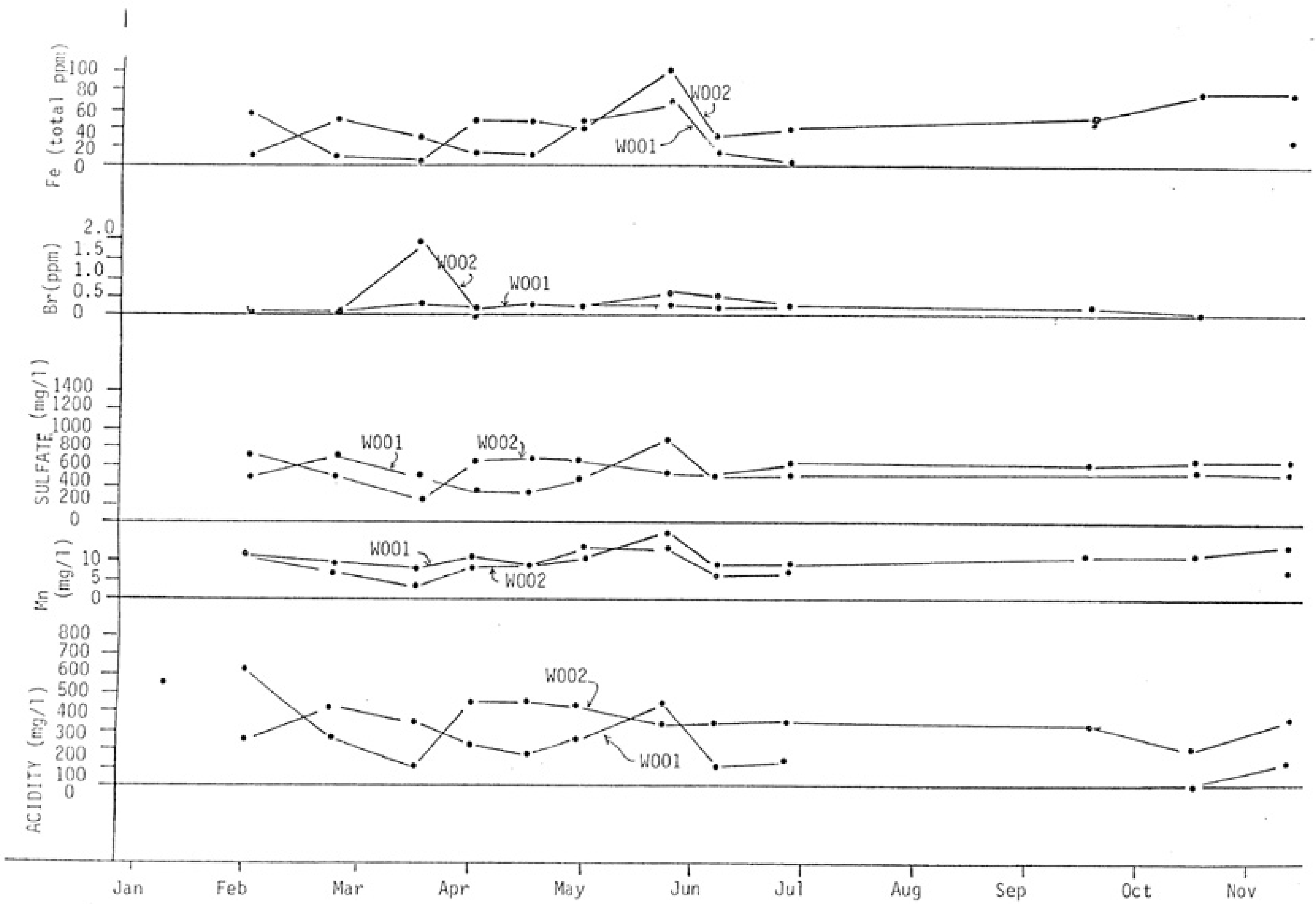
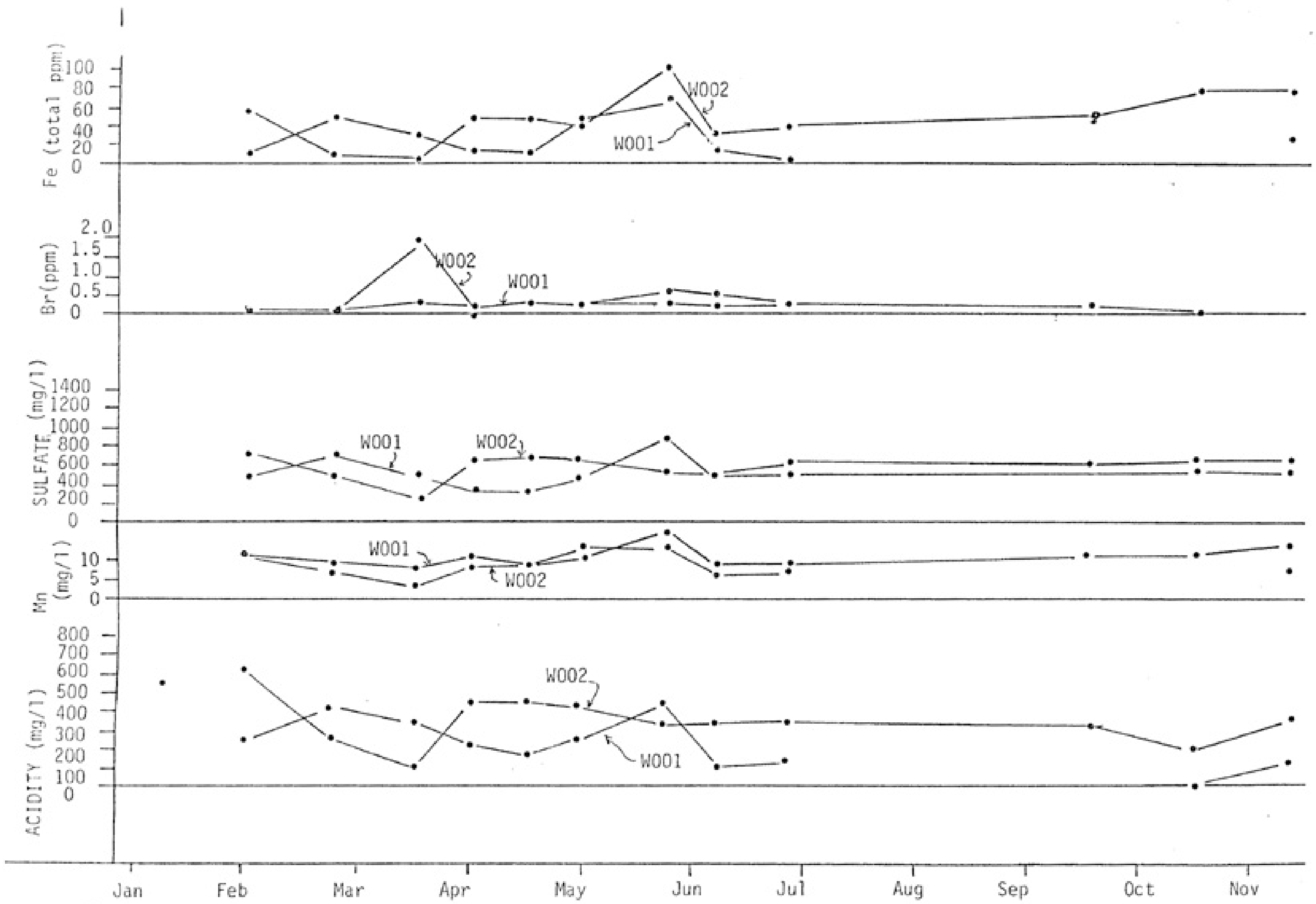


FIGURE 2- CHEMICAL CHARACTERISTICS OF SEEPS AT MERCER SITE IN RESPONSE TO ALKALINE TREATMENTS



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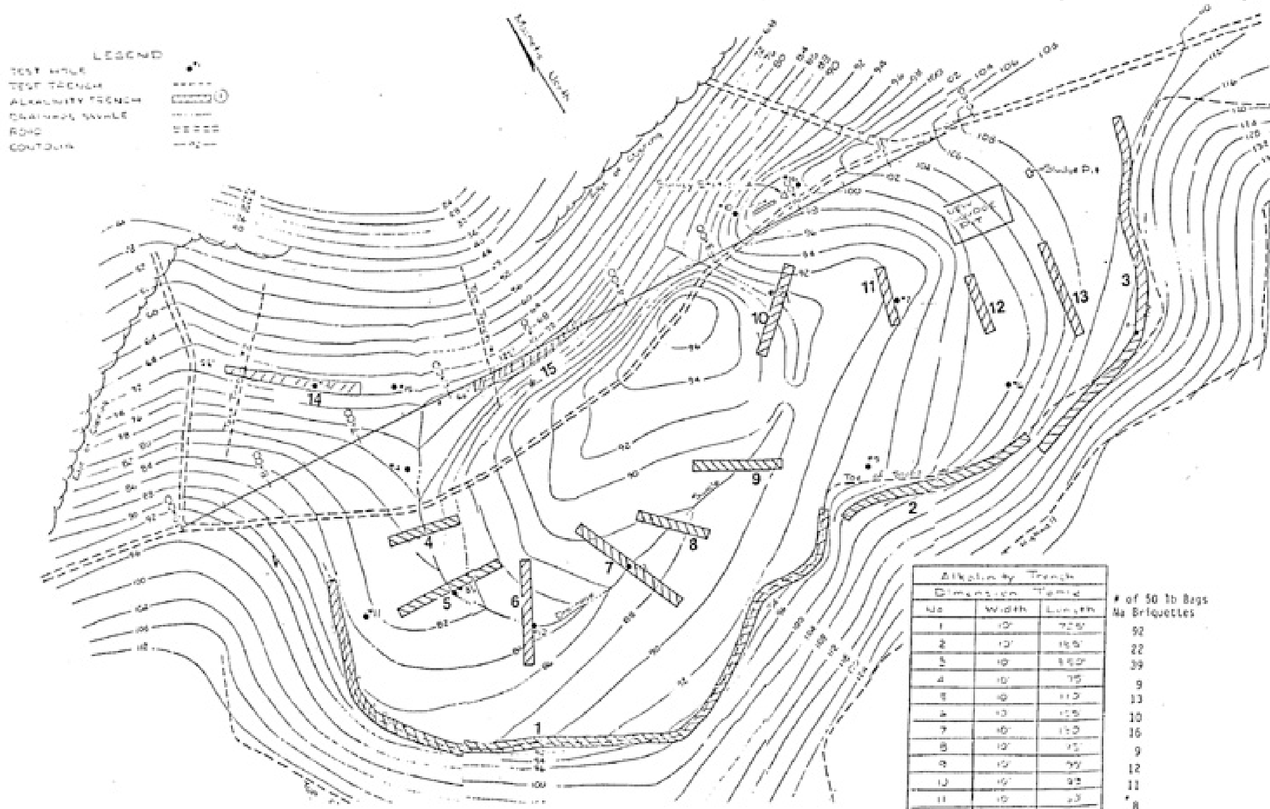

Alkalinity Trench Dimension Table			
No	Width	Length	# of 50 lb Bags Na Briquettes
1	10'	725'	92
2	10'	155'	22
3	10'	350'	39
4	10'	75'	9
5	10'	110'	13
6	10'	105'	10
7	10'	150'	16
8	10'	75'	9
9	10'	95'	12
10	10'	95'	11
11	10'	[illegible]	*8
12	10'	[illegible]	
13	10'	[illegible]	11

FIGURE - TOPOGRAPHY OF MERCER SITE AND APPLICATION SCHEDULE OF TRENCHES

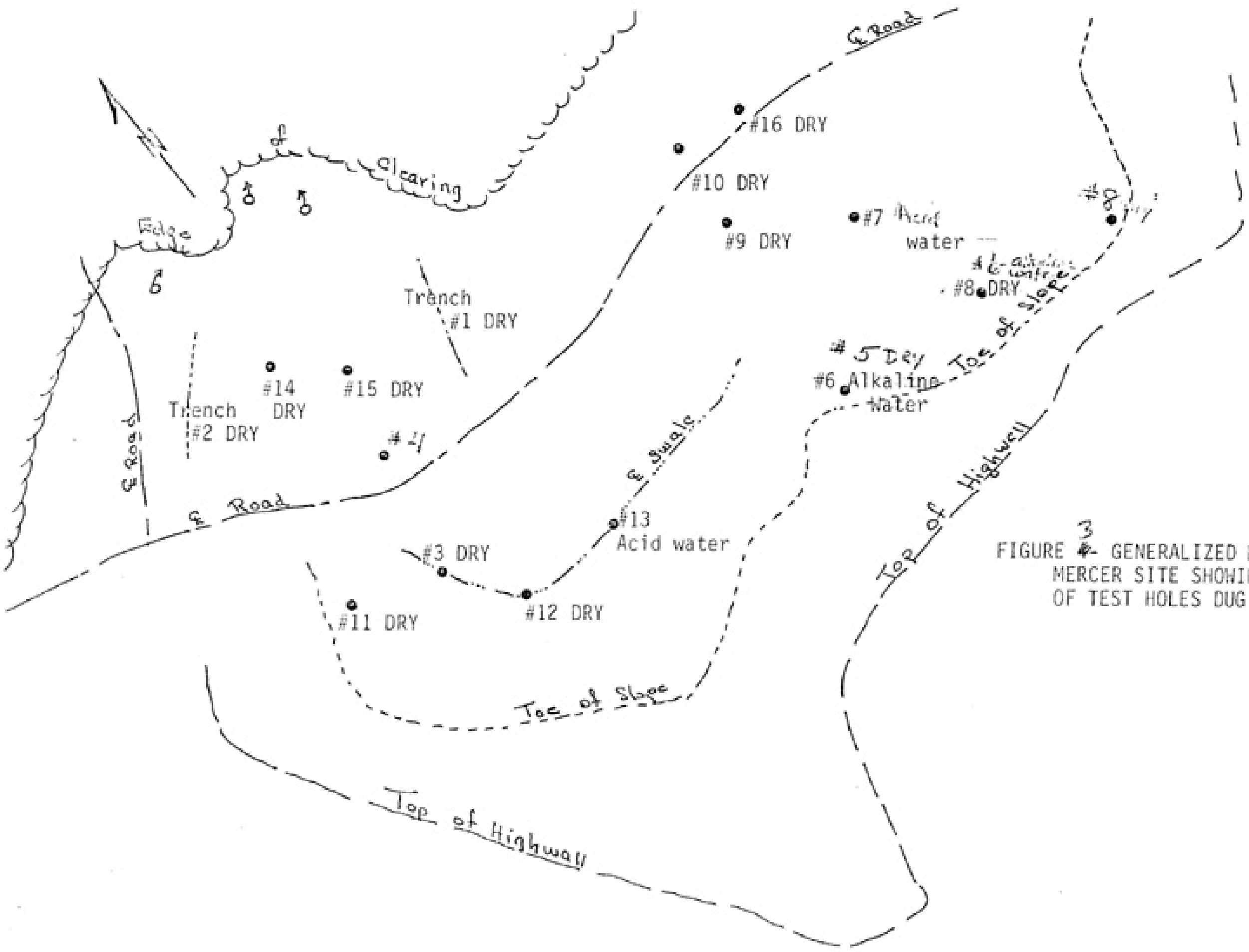

FIGURE 3 GENERALIZED MAP OF MERCER SITE SHOWING LOCATIONS OF TEST HOLES DUG WITH BACKHOE