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Abstract

Water inflow observed in trench 36 in the 218-E-12B burial ground was feared to occur in a much larger portion of the 218-E-12B burial ground and to possibly extend to the 218-E-12A burial ground. Emplacement of investigation trenches and wells were utilized to demonstrate that it is likely that water inflow occurred only in the southern most portion of trench 37.

The source of water was shown to be the B-2-3 ditch. An engineering study is evaluating the preferred alternative for eliminating leakage from the B-2-3 ditch. A pipeline to the south of the existing B-2-3 ditch is expected to be the preferred method. Addition of bentonite to the ditch and removal of obstructions to flow are interim corrective actions to allow time for the pipeline emplacement.

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DESCRIPTION OF CHANGE

EXECUTIVE SUMMARY

Water inflow was observed in unfilled burial trench 36 in the 218-E-12B burial ground. The source of the water was the 216-B-2-3 (B-2-3) ditch which flows about 200 ft south of trench 36. The 216-B-2-3 ditch conveys water about 4000 ft from the 207-B retention basins to a diversion structure, which can route water to B-Pond or Gable Mountain Pond.

A series of three end-to-end north to south trending investigation trenches were emplaced to determine the hydraulic gradient and the relationship of the hydraulic gradient to the geologic profile. The upper saturated elevation was found to decrease from 620 ft to 612 ft over a distance of 180 ft. This upper saturated system was found to be perched on thin silty sand layers. In all of the investigation trenches the saturated elevation was apparently controlled by a combination of the occurrence of low permeability thin silty sand layers and the leakage rate of water through these layers as the perched water flows away from the source.

A second group of investigation trenches were emplaced to determine if portions of the 218-E-12A and 218-E-12B burial grounds were unaffected by water inflow. A trench and a borehole were emplaced in the 218-E-12A burial grounds and no saturated sediments were found. It is likely that no water inflow occurs above the bottom of the burial trenches in the 218-E-12A burial ground.

Three investigation trenches were emplaced south and west of 218-E-12B burial ground for delineating the area that could possibly be affected by water inflow. A possible inflow affected area was found to be limited to the area encompassing burial trenches 28 to 37. This affected area represents about the western third of the burial ground.

Six boreholes were drilled in the vicinity of burial trenches 28 to 37 to delineate which trenches received water inflow within the possibly affected area. The initial borehole demonstrated that burial trenches to the east of trench 32 likely did not receive inflow. Only burial trenches 34, and 37 are filled with waste to the west of this initial well and were in a position to possibly have received water inflow. Trench 37 was found to have likely received water inflow in approximately its southern 65 ft based on an extrapolation of data from saturated sediment elevations in two adjacent boreholes. Trench 34 was found to be free of water inflow based on an extrapolation of data from saturated sediment elevations in two adjacent boreholes, in the area would be beneath the trench. The concentration of radioactivity in the perched water and sediment from two wells adjacent to trench 37 which likely received water inflow were measured. In addition the same parameters were measured for a well adjacent to trench 34 to provide a background value. No detectable radioactivity was found in trench 34 in the perched water. In contrast 2×10^{-3} µ Ci/L of total was initially found in a well adjacent to trench 37. Subsequent total levels were all less than background. Natural radioactivity is the likely source in the elevated sample.

Low but measurable levels of Eu-154 was measured in the sediments from all three boreholes near trenches 34 and 37. It is believed that the Eu-154 was sorbed from water released from B-2-3 ditch and unrelated to the inflow of water into the burial trenches.

A ground water monitoring well is located approximately 600 ft from the portion of trench 37 which likely received water inflow. Several radionuclide concentrations have been measured for an extended period of time. There has been no detectable increase in any of the monitored radioactive constituents over the last few years.

An interim remedial action was employed to allow time for final corrective action to be implemented. Bentonite clay was added to the ditch to reduce the permeability of the ditch perimeter. Additionally, vegetation and debris partially blocking the ditch was removed to enhance flow in B-2-3 ditch.

A second method of interim remedial action was attempted. Water interception wells were proposed between 216-B-2-3 ditch and the burial ground to percolate water to a depth below the bottom of the waste trenches. One well was installed and perforated at several depths from 20 ft to 50 ft below the surface to test the concept. Water could be heard cascading down the side of the well for a prolonged period. Ponded water in investigation trench 1a dropped in depth by more than a foot. However, the overall performance of the well is difficult to evaluate without several additional monitoring wells.

An engineering study is evaluating the preferred long-term alternative for eliminating leakage from B-2-3 ditch. A shallow depth pipeline to the south of the existing ditch is expected to be the preferred method.

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1.0 INTRODUCTION

1.1 Problem

Water inflow was observed in unfilled burial trench 36 in the 218-E-12B (E-12B) burial ground (Figure 1 and Figure 2). Water flows into the trench at the 612.5 ft elevation and runs for about 85 ft along the trench bottom before percolating into the sediments. The flow rate has been estimated to be about one gallon per minute but it has not been confirmed.

1.2 Water Inflow Source

The source of water is the unlined 216-B-2-3 (B-2-3) ditch which flows about 200 ft south of the south end of trench 36. The average discharge of B-Plant cooling water into the B-2-3 ditch is 2200 gal/min. The B-2-3 ditch receives wastewater from the 207-B retention basins which discharge approximately 500,000 gallons of water over a two hour time period, every four hours. The total daily discharge volume is roughly 3,000,000 gallons.

Other likely sources initially considered included the 216-B-63 (B-63) chemical ditch and three pipelines located to the west of trench 36. The headend of the B-63 ditch is located about 2000 ft west of trench 36. Wastewater currently flows about 200 ft from the head-end of the B-63 ditch before percolating into the ditch bottom. Furthermore the B-63 ditch flow is much less than the flow in the B-2-3 ditch. Three pipelines are located west of trench 36. All three pipelines are located about 2000 ft from trench 36.

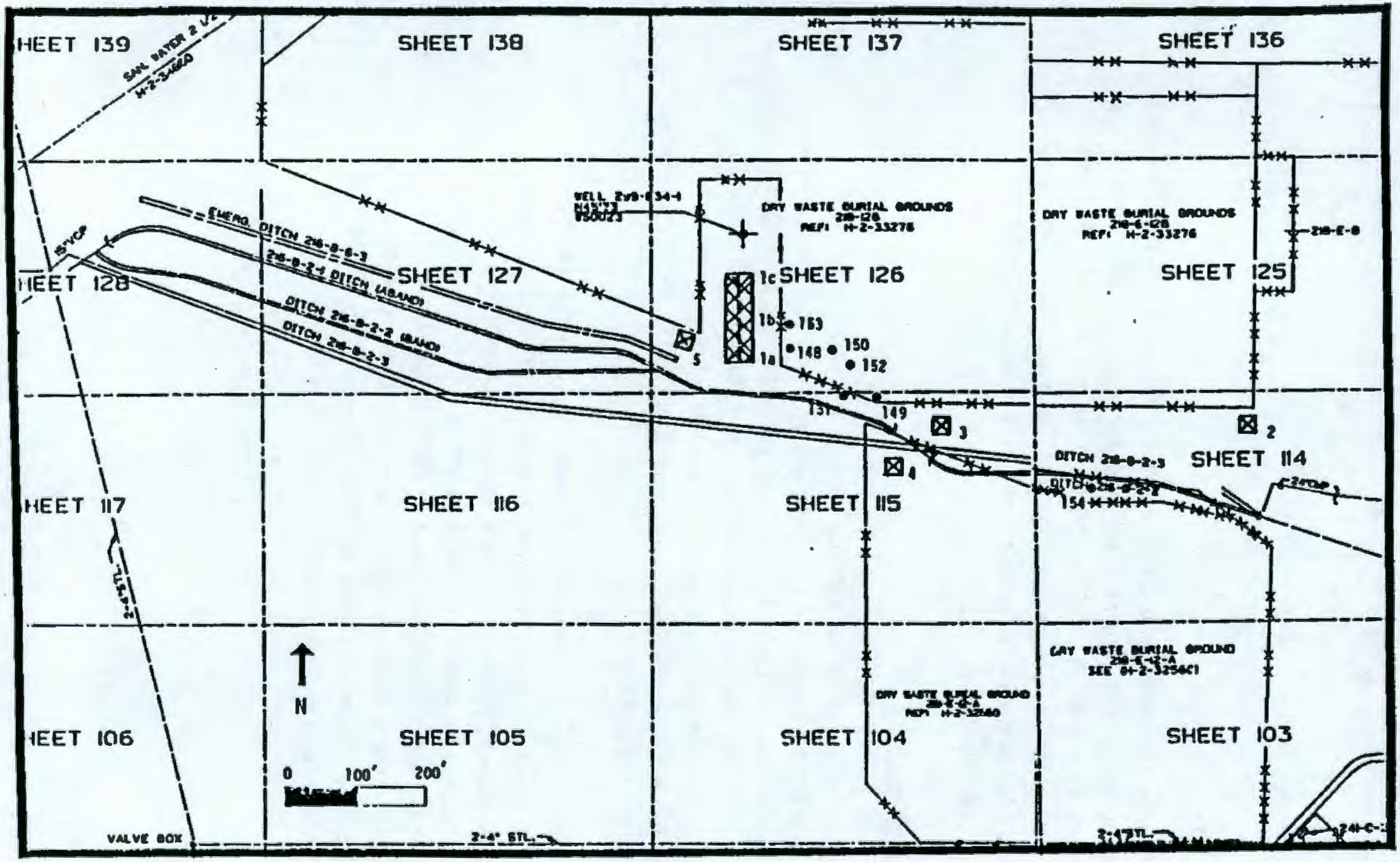

Figure 1: Location of 218-E-12B and 218-E-12A Burial Grounds and 216-B-2-3 Ditch Including Excavation, Trenches, and Well Locations.

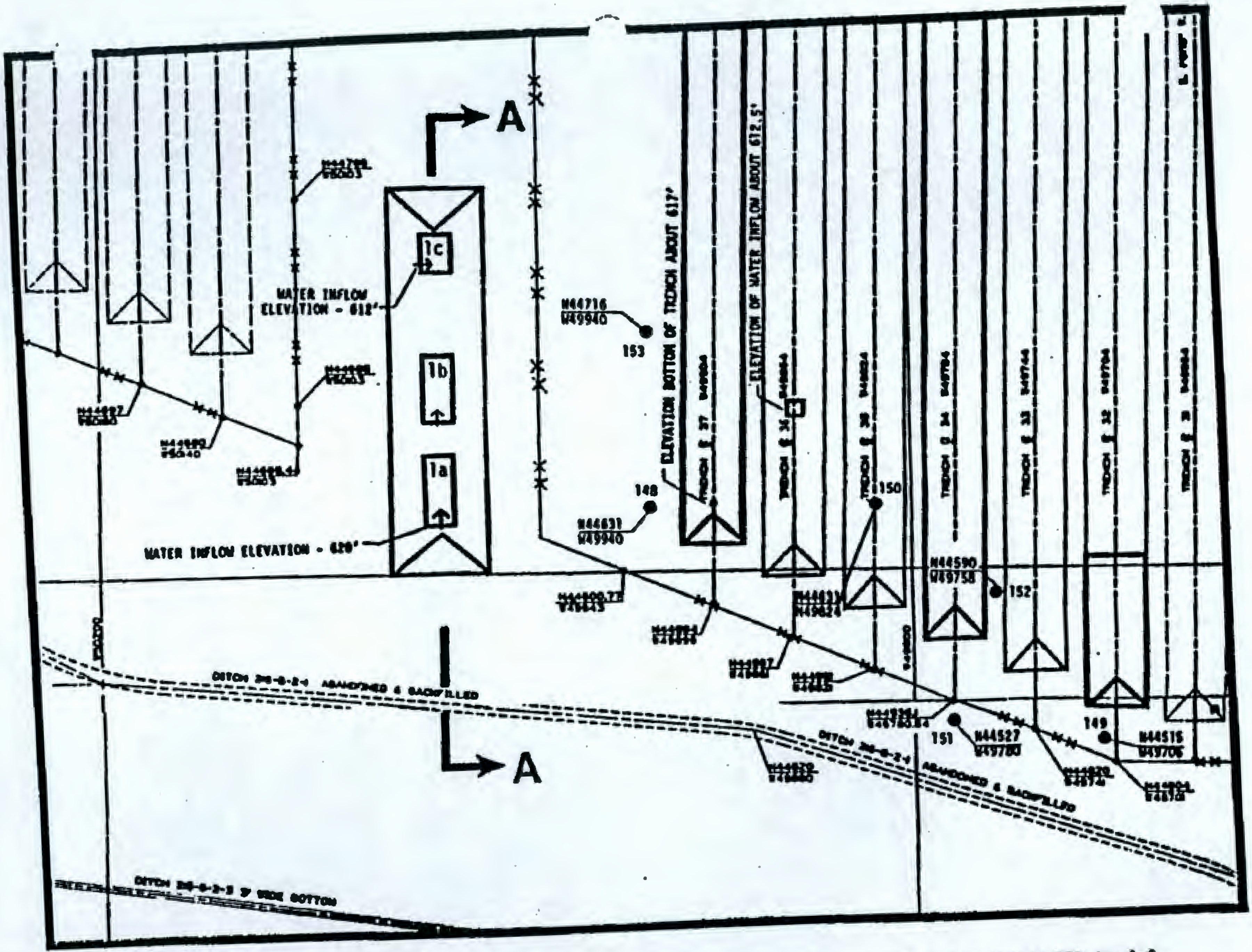

Figure 2. Location of burial trenches, boreholes and excavation trenched in the 218-E-12B burial ground near burial trench 36. Filled burial trenches are accented in black.

1.3 Investigative Phases

Three investigative phases were utilized to delineate the cause, the affected area, interim corrective actions, and to determine which burial trenches were receiving water inflow. In the initial phase a series of investigation trenches were excavated for determining the hydraulic gradient and the relationship of the hydraulic gradient to the geologic profile. In a second phase additional investigation trenches and one borehole were emplaced to delineate the general affected area(s) where perched water was above or near the bottom of the burial trenches. In the final phase boreholes were emplaced within the burial grounds to establish which burial trenches in the affected area received perched water inflow above the bottom of the burial trenches.

2.0 GEOLOGY AND HYDROLOGY

An initial series of investigation trenches were emplaced to determine the hydraulic gradient and the relationship of the hydraulic gradient to the sediments geologic profile. Three end-to-end trenches were excavated about 120 ft west of burial trench 37 (excavation trenches 1a, 1b, and 1c, Figure 2). These investigation trenches extend in a south to north direction for a distance of about 180 ft.

2.1 Geologic Profile

A geologic profile the length of the three investigation trenches is provided in Figure 3. The geology across the length of the excavations is complex and difficult to describe in detail. Cross-bedded, poorly sorted sand, gravel, and cobble extend to a depth of 10 or 12 ft. Nearly horizontally bedded dark grey sand and gravel, fining downward, occur from 12 to 16 ft. Nearly horizontally bedded dark brown fine

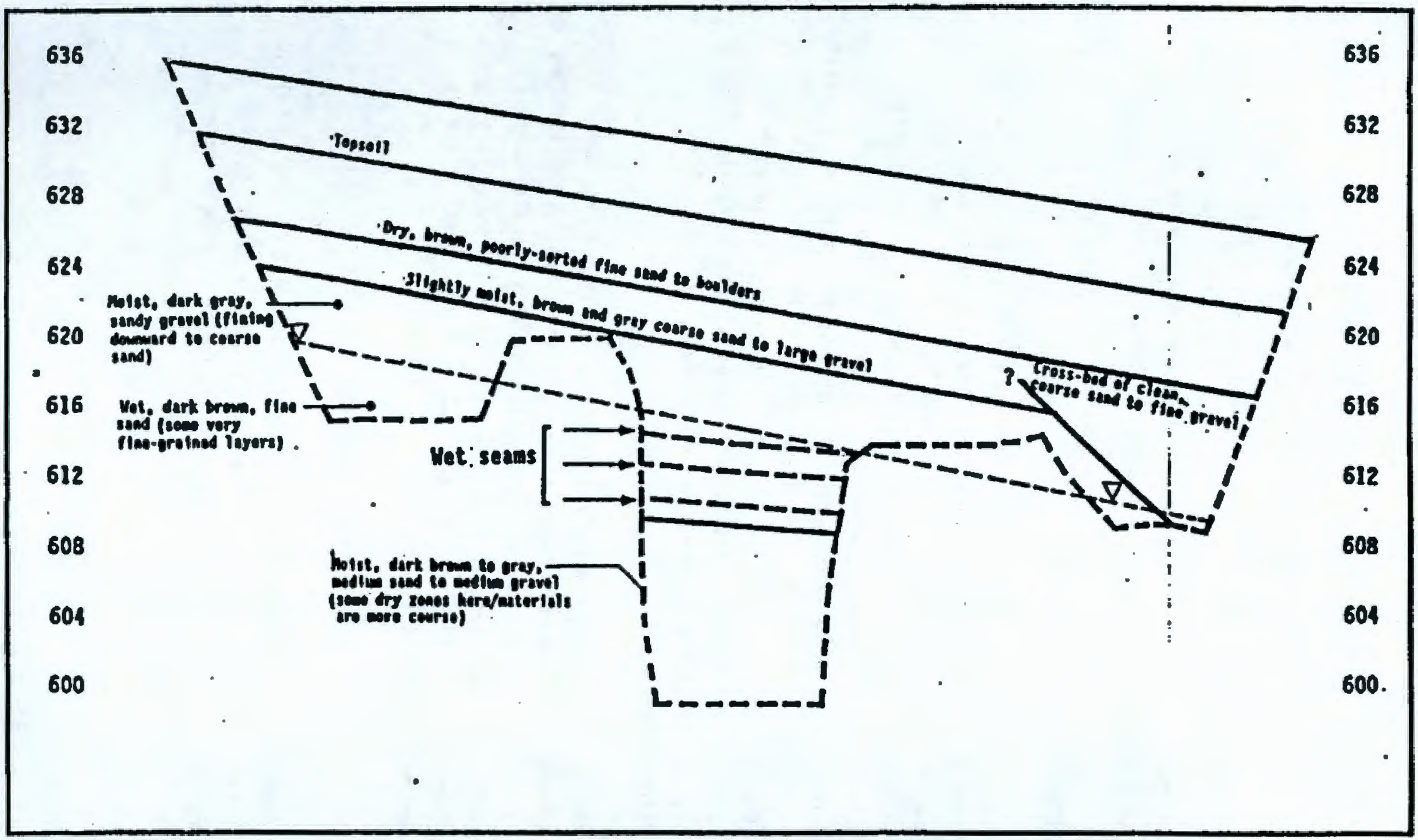

Figure 3. Geologic Profile of the Interceptor Trench Constructed West of the 218-E-12B Burial Grounds.

to medium sand occurs from 16 to 25 ft. Thin layers (<6 in.) of sandy silt to silty sand are present in the above sand sequence. These layers were extensive across the length of the excavation, however, they may not be extensive over the burial grounds.

2.2 Hydrology

Saturated materials were encountered at the 620 ft elevation in the southern most investigation trench (1a, Figure 3). Water readily flowed through coarse sand and gravel into the southern end of the excavation. This rapid inflow indicates a steep hydraulic gradient to the north. The water appeared to be perching above a thin silty sand layer. In the 1b investigation trench saturated sediments occurred at an elevation of 615 ft. Saturated sediments also occurred at the 613 and 611 ft elevation. Saturated sediments occurred at the 612 ft elevation in the 1c investigation trench. Water readily flowed through coarse sand and gravel and was perched above a thin layer of silty sand.

An initial generalized hydraulic gradient was estimated from the upper elevation where saturation occurred in the investigation trenches and trench 36. In all three investigation trenches the saturated elevation is likely controlled by a combination of the occurrence of thin layers of silty sand and the leakage through these layers as water flows from the B-2-3 ditch.

3.0 AFFECTED AREA

In addition to the E-12B burial ground, the 218-E-12A (E-12A) burial ground to the south of the B-2-3 ditch and the 218-E-12B expansion area to the west of the E-12B burial ground were considered to have a potential for water inflow (Figure 1). All of these areas are approximately equal distances from the B-2-3 ditch and have a potential for water inflow. However, the E-12A burial ground has a lesser likelihood of water inflow. The E-12A burial ground is topographically higher than the B-2-3 ditch. Furthermore, the B-2-3 ditch has been treated with bentonite adjacent to the E-12A burial ground, restricting water outflow from the ditch.

Four investigation trenches and borehole 299-E27-154 (154) were emplaced to identify and determine those portions of the E-12A and E-12B burial grounds that could be affected by water inflow at elevations above the bottom of the burial trenches.

3.1 218-E-12A Affected Area

An investigation trench and a borehole were emplaced in the E-12A burial ground to evaluate the extent of water inflow. Investigation trench 4 (Figure 1) which is located on the northwest edge of E-12A burial ground contained no saturated sediments above an elevation of 618 ft. The elevation of the bottom of the nearest burial trench is 624 ft. If the elevation of a burial trench bottom is higher than the saturated elevation no inflow of water is expected. The depth of a burial trench was estimated by subtracting 18 ft from the ground surface elevation at the trench. The burial ground specifications require that the trench depth be 16-18 ft below the surface elevation. Thus the western part of the E-12A burial has received no inflow.

Borehole 299-E27-154 (154, all boreholes are prefixed by 299-E27-) was emplaced on the north edge near the E-12A burial ground's east-west midpoint (Figure 1). No saturated sediments were encountered above an elevation of 613 ft in borehole 154. The elevation of the bottom of the nearest trench is at an elevation of 619 ft. No inflow of water is indicated into the surrounding burial trenches.

Considering that: (1) trench bottoms become rapidly higher in elevation with distance from B-2-3 ditch, (2) the B-2-3 ditch has been sealed with bentonite adjacent to the E-12A burial ground, and (3) no saturated sediments occurred in investigation trench 4 and borehole 154, it is likely that there is no inflow into the E-12A burial ground.

3.2 218-E-12B Affected Area

Three investigation trenches were emplaced around the E-12B burial ground to determine the potential extent of water inflow. Investigation trench 2 located on the southeastern edge of burial ground E-12B contained no saturated sediments above an elevation of 603 ft (Figure 1). The elevation of the bottom of nearest trench was 604 ft. This is an indication that at least some portion of the eastern part of the E-12B burial ground has no water inflow above the burial trench bottoms.

Investigation trench 5 was emplaced about 110 ft west of investigation trench 1b (Figure 1). Investigation trench 5 contained no saturated sediments above an elevation of 608 ft. This is a strong indication that water conditions found in investigation trenches 1a, 1b, and 1c do not exist for any appreciable distance to the west. Furthermore, the lack of any saturated sediments in trench 5 is a strong indication that the B-2-3 ditch is the source of water inflow to trench 36. Trench 5 would not be expected to lack saturated sediments above 608 ft elevation if the 216-B-63 trench or any of the pipelines to the west were the source of inflow to burial trench 36. The lack of saturated sediments in investigation trench 5 is also an indication that the E-12B expansion area likely contains no water inflow above the bottom of the planned trenches.

A final investigation trench was emplaced to determine how far to the east the inflow affected area might extend in the E-12B burial ground. Investigation trench 3 was emplaced to evaluate if more than the western third of the E-12B burial ground could be affected by water inflow (Figure 1). Investigation trench 3 contained no saturated sediments above an elevation of 616 ft. The elevation of the bottom of the nearest burial trench is 612 ft (burial trench 27). As was demonstrated in investigation trenches 1a, 1b, and 1c the hydraulic gradient drops about five ft per 100 ft from the south to the north in the E-12B burial ground. Investigation trench 3 is about 100 ft south of the nearest E-12B burial trench (trench 27). Thus it is likely that there is no inflow of water into the burial trenches to the east of investigation trench 3. A borehole drilled later in the investigation confirmed that these trenches received no water inflow (149).

From the above data it can be seen that the only probable inflow affected area in the E-12B burial ground is that area encompassing burial trenches 28 to 37.

4.0 WATER INFLOW IN 218-E-12B BURIAL TRENCHES

Once the affected area in the E-12B burial ground was delineated several boreholes (148-153) were drilled in the vicinity of trench 28 to trench 37 to determine if water inflow occurred into any of these trenches (Figure 2).

Borehole 149 was located approximately 50 ft south of trench 32 (Figure 2). Trench 32 is partially filled with dry solid waste. Saturated sediment was located at the 606 ft elevation in borehole 149. The elevation of the bottom of trench 32 is at 615 ft. Since the saturated sediments are located below the trench bottom, inflow into trench 32 did not occur. Furthermore, all of the trenches to the east of trench 32 likely have received no water inflow as was originally suggested by investigation trench 3.

On the opposite side of the affected area in E-12B burial ground borehole 148 was emplaced near the southeastern end of trench 37. In borehole 148 saturated sediments occurred at the 618 ft elevation. The bottom of trench 37 is located at 615 ft elevation adjacent to borehole 148 and water inflow likely occurred to a depth of about three ft.

Borehole 153 was emplaced about 85 ft north of borehole 148. Saturated sediments occurred at an elevation of 608 ft. The bottom of trench 37 adjacent to borehole 153 is at 611 ft. Saturated sediments occur three ft below the bottom of the trench 37. Thus water inflow is likely restricted to the southern 65 ft of trench 37.

Trench 34 is the only other closed burial trench which may have received water inflow (Figure 2). Boreholes 151 and 152 were emplaced for evaluating if burial trench 34 received water inflow. Borehole 152 is located about 30 ft north of the south end, and five ft to the east, of trench 34. Saturated sediments were present in borehole 152 at an elevation of 608 ft. The bottom of burial trench 34 is located at the 615 ft elevation adjacent to borehole 152. Thus water inflow did not occur in trench 34. Borehole 151 is located about 40 ft south of trench 34. Saturated sediments are present at the 609 ft elevation in borehole 151. The bottom of trench 34, adjacent to borehole 151, is at the 616 ft elevation. Thus water inflow into trench 34 is not indicated. The data from boreholes 151 and 152 are in good agreement.

5.0 RADIOACTIVITY IN BOREHOLES 148, 152, and 153

Radionuclide analysis were performed on perched water and sediment samples from boreholes 148, 152, and 153. Boreholes 148 and 153 are adjacent to burial trench 36 which was found to have water inflow within the trench bottom. Borehole 152 is adjacent to burial trench 34 which was found to have no water inflow. Radioactivity in borehole 152 provides background values for judging if there is movement of radioactivity from burial trench 37.

5.1 Radioactivity in Perched Water

Total beta, Sr-90, and Gamma Energy Analysis (GEA) evaluations were performed on perched water sampled from the 23 ft, 24 ft, and 50 ft depths of boreholes 148, 152, and 153, respectively. Total beta, Sr-90, and Cs-137 (GEA) values for borehole 152 were $<6 \times 20^{-5}$ μ Ci/L, $<2 \times 10^{-5}$ μ Ci/L and $<4 \times 10^{-5}$ μ Ci/L, respectively. Therefore, no measurable contamination is indicated in the perched water samples from borehole 152.

In contrast total beta, Sr-90, and Cs-137 (GEA) values in borehole 148 were 2×10^{-3} μ Ci/L, $<4 \times 10^{-5}$ μ Ci/L, and $<1 \times 10^{-5}$ μ Ci/L, respectively. The total beta value is above the table II value of 3×10^{-4} μ Ci/L, based on Sr-90 being the most restrictive radionuclide. However, Sr-90 was not detected in the sample. Furthermore, no gamma emitters were detected in the sample. This indicates that the radioactivity was due to a pure beta emitter. Sr-90 is the only pure beta emitter normally detected in significant concentrations in waste streams. Therefore, the beta activity is from some exotic pure beta emitter.

A second water sample from borehole 148 was analyzed for total beta. Its concentration was $<8 \times 10^{-5}$ μ Ci/L indicating no detectable beta radioactivity in the sample. The high initial concentration could have either been due to a transient radionuclide concentration in borehole 148, or due to contamination of the sample. A transient radionuclide occurrence is the more likely possibility. Total beta was measured in a perched water sample from borehole 153. Total beta concentration was 1.5 x 10^{-5} µ Ci/L. This value is elevated although of a much lower concentration than was initially observed in borehole 148. Natural radon daughter products are the likely source of the transient radioactivity in these wells.

5.2 Sediment Radionuclide Concentrations

Sediments from boreholes 148, 152, and 153 were analyzed for the presence of gamma emitting radionuclides by GEA and for Sr-90 by intrinsic germanium, phoswich detection. Table 5 is a listing of sediment concentrations of radionuclides as a function of depth. Radionuclide concentrations greater than 2 to 3 times background are likely significant. Sediment concentrations of Cs-137, Co-60, and Sr-90 are generally not significant. Sediment concentrations of Eu-154 are all above background by factors of from 1.8-8.6. There are measurable but low concentrations of Eu-154 in sediments from all three boreholes. The sediment concentration of Eu-154 is approximately the same in all three boreholes. This suggests that Eu-154 was sorbed from water that originated from the 216-B-2-3 ditch and not from any of the burial trenches. The Hanford surface soil contamination release limit for Eu-154 is 2 x 10^{-4} µ Ci/g (RHO-MA-139). Sediment Eu-154 concentrations for boreholes 148, 152, and 153 are nearly two orders of magnitude below the Hanford surface soil concentration limit.

TABLE 1. GEA of Sediments in Boreholes 299-E27-148, 299-E27-152 and 299-E27-153

Location	Depth feet	Eu-154	Cs-137	Co-60	Sr-90
		pCi/g			
Background Soil		0.60	0.56	0.28	25
E27-148	28.6	5.2	0.52	0.39	29
	32	2.1	0.54	0.27	0
	36	1.1	0.46	0.19	41
	38	1.6	0.40	0.39	8
	59	1.1	0.38	0.46	0
E27-152	21	2.1	0.47	0.26	41
	23	2.6	0.49	0.57	20
	24	1.0	0.38	0.56	0
	25.5	2.0	0.41	0.35	16
	28	2.6	0.34	0.45	5
	32	2.3	0.49	0.57	20
	34.5	1.0	0.41	0.40	15
	38	4.6	0.31	0.73	21
E27-153	19.5	1.2	0.40	0.58	0
	37	2.1	0.51	0.37	0
	40	1.1	0.48	0.44	12

6.0 GROUND WATER MONITORING WELL 299-E34-1 DATA

Ground water monitoring well 299-E34-1 is located about 600 ft north and 100 ft west of the southwest corner of the 218-E-12B burial ground. Total beta, total gamma, tritium, cobalt-60, Cesium-137, strontium-90, ruthenium-106 and nitrate have been monitored for several years and the data is provided in Figures 4-10. The well is a suitable downgradient monitoring well for burial trench 37. There has been no detectable increase in any of the monitored radioactive constituents over the last few years. The ground water concentration of all constituents are below the Hanford administrative control values (RHO-MA-139).

7.0 INSPECTION OF THE 216-B-2-3 DITCH

The average flow rate of the high- and low-risk cooling water from B Plant to the 207-B Retention Basins is 2200 GPM. The flow of cooling water is alternately retained in each of the retention basins for a four hour period and then discharged to the B-2-3 ditch. The flow is retained in the basins so a grab sample of the cooling water can be obtained. Approximately 500,000 gal. of cooling water is collected in four hours and then discharged to the B-2-3 ditch in less than two hours, so the B-2-3 ditch receives a discharge of 500,000 gal. once every four hours at a rate of approximately 4500 GPM.

A recent inspection of the condition of the B-2-3 ditch revealed that the ditch is severely plugged by a series of dams that are composed of tumbleweeds, reeds, silt and other debris that has accumulated in the ditch over the past few years. A total of twelve dams were found in the ditch. The inspection was conducted during the emptying of one of the retention basins and it was apparent that virtually all of the water was being retained in the ditch and allowed to percolate into the soil.

A trapezoidal weir at the discharge end of the B-2-3 ditch was put back into service and the discharge from the ditch was measured. As shown in Figure 11 less than 20% of the water entering the ditch was being discharged from the ditch. Conversely, 80% of the water, or 2,500,000 gal. per day was percolating into the coarse sands and gravels in the ditch, indicating that the B-2-3 ditch is the source of the water seeping into trenches 36 and 37 in the 218-E-12B burial ground.

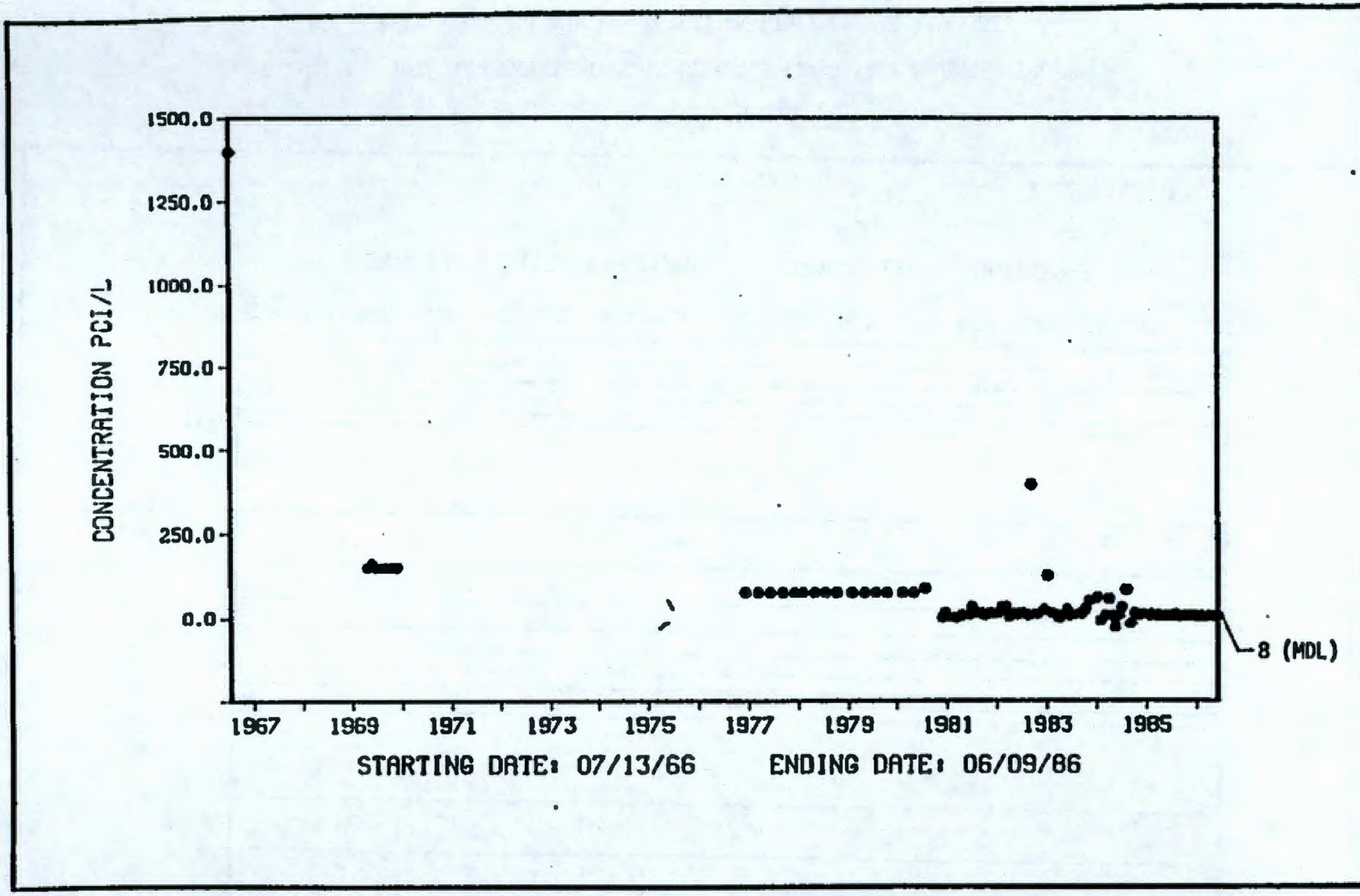

FIGURE 4 - TOTAL β CONCENTRATION IN WELL 299-E34-1 FROM 1967 TO 1986.

MDL - DESIGNATES THE MINIMUM DETECTION LIMIT OF THE ANALYSIS.

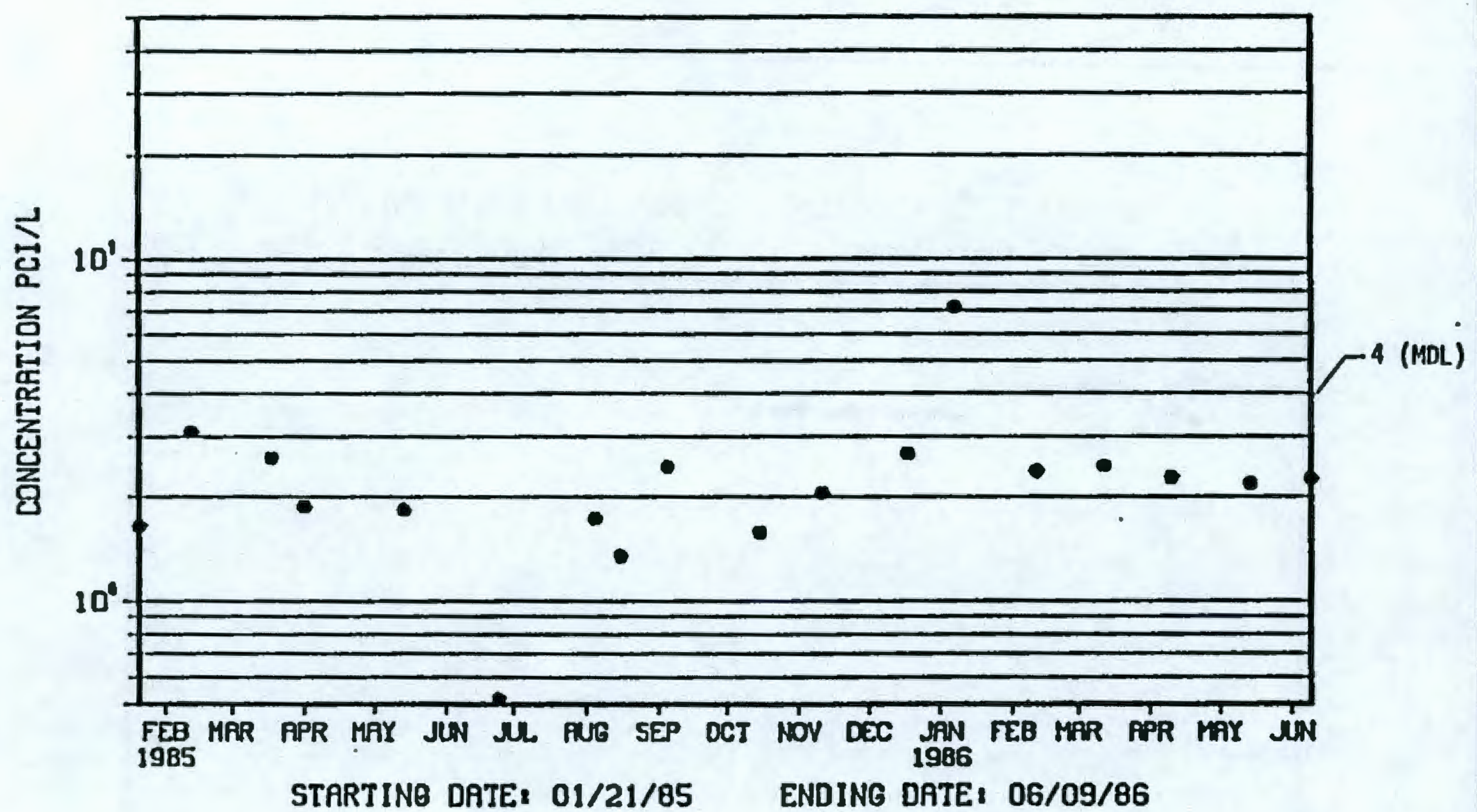

FIGURE 5 - TOTAL α CONCENTRATION IN WELL 299-E34-1 FROM 1985 TO 1986.

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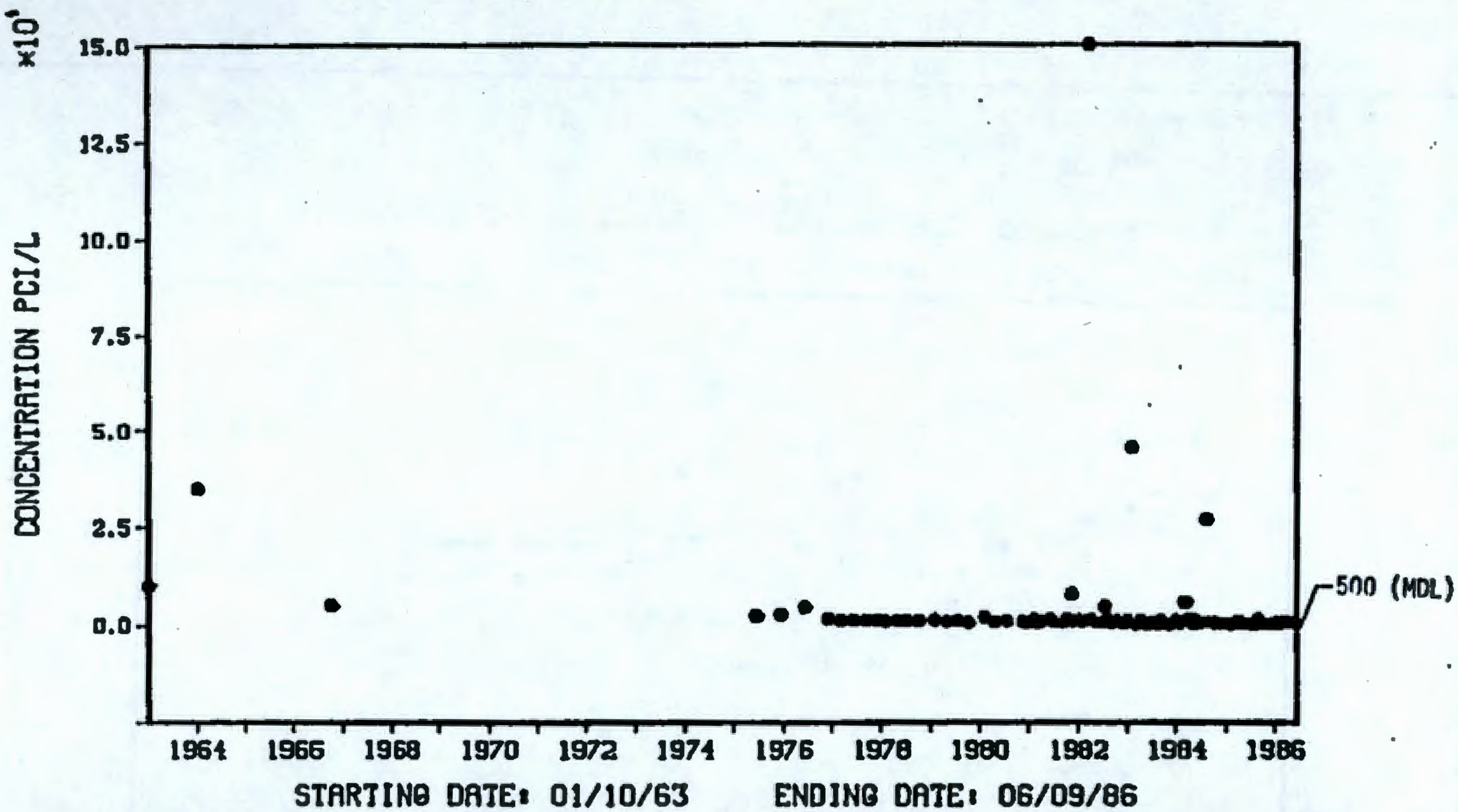

FIGURE 6 - TRITIUM (H-3) CONCENTRATION IN WELL 299-E34-1 FROM 1963 TO 1986.

MDL - DESIGNATES THE MINIMUM DETECTION LIMIT OF THE ANALYSIS.

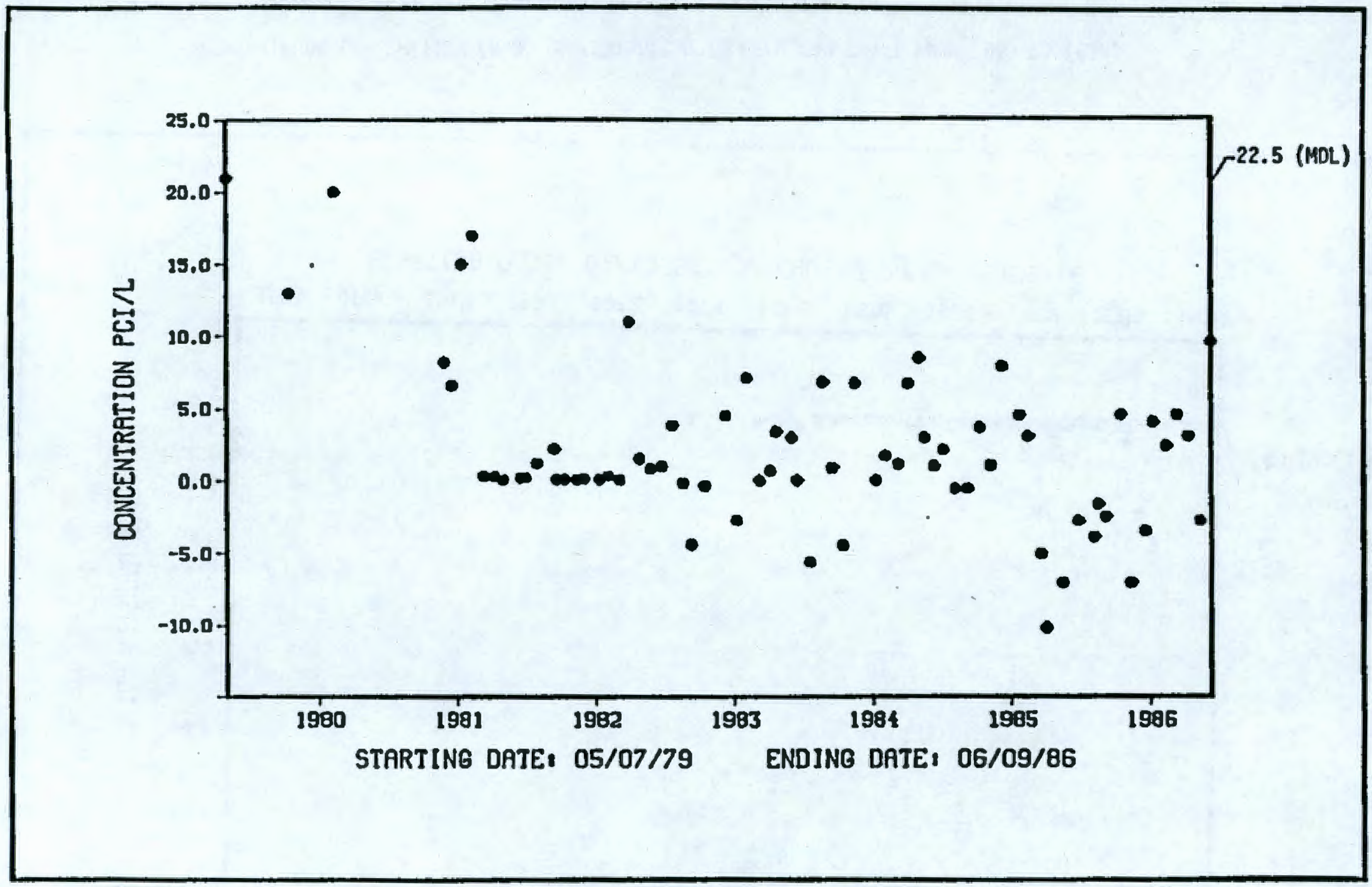

FIGURE 7 - Co-60 CONCENTRATION IN WELL 299-E34-1 FROM 1979 TO 1986.

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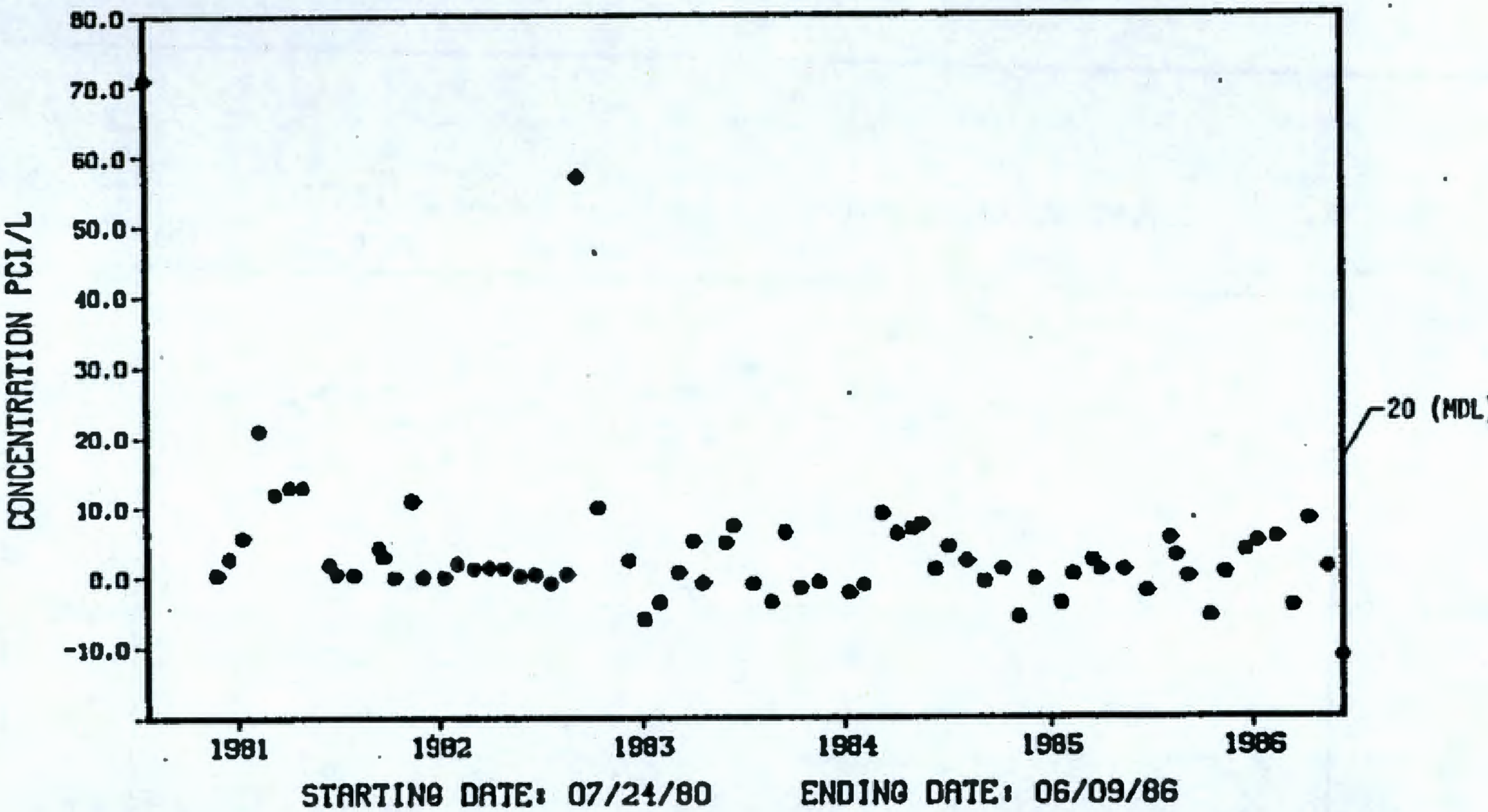

FIGURE 8 - Cs-137 CONCENTRATION IN WELL 299-E34-1 FROM 1980 TO 1986.

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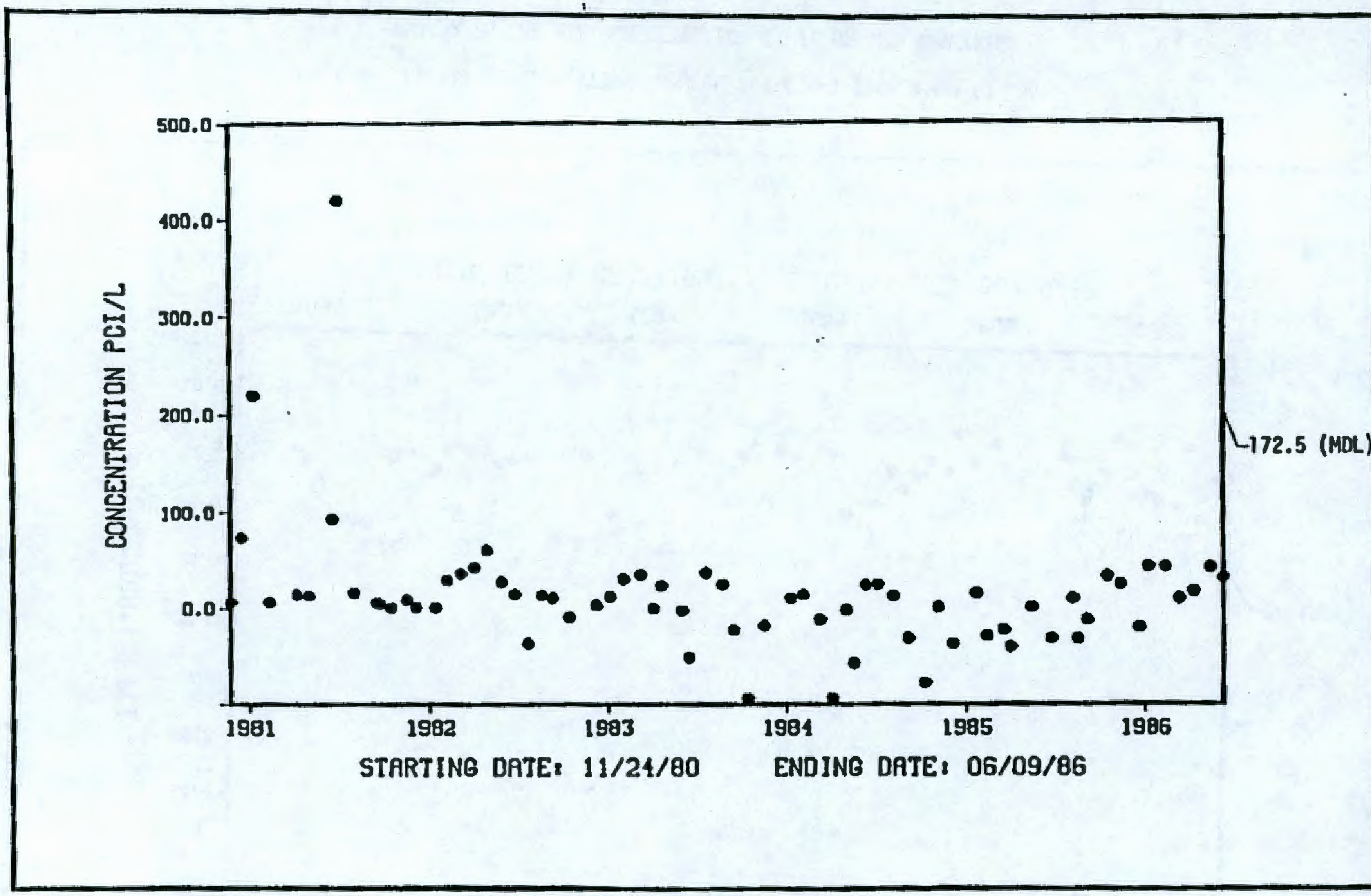

FIGURE 9 - Ru-106 CONCENTRATION IN WELL 299-E34-1 FROM 1980 TO 1986.

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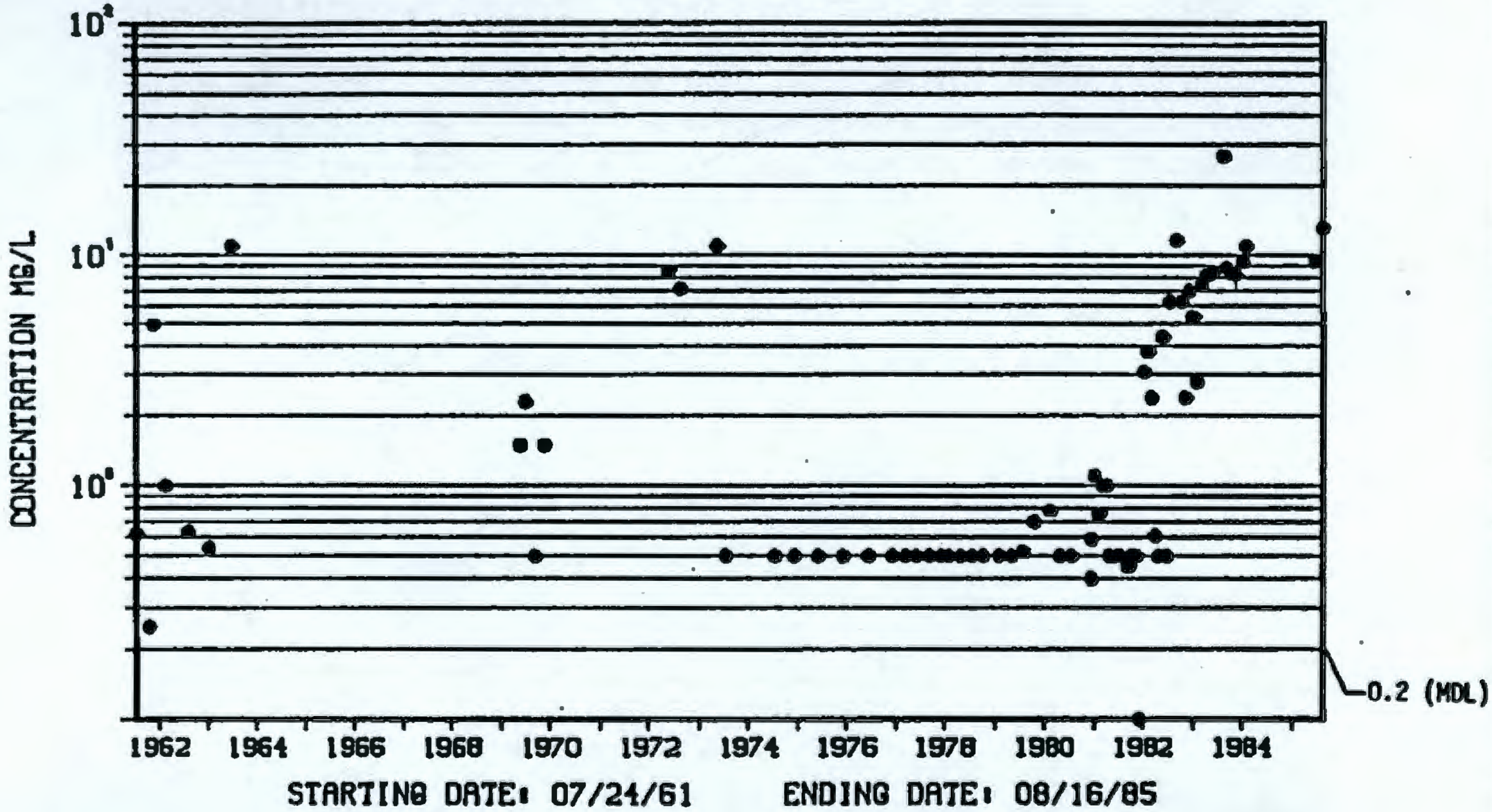

FIGURE 10 - NITRATE CONCENTRATION IN WELL 299-E34-1 FROM 1961 TO 1985.

MDL - DESIGNATES THE MINIMUM DETECTION LIMIT OF THE ANALYSIS.

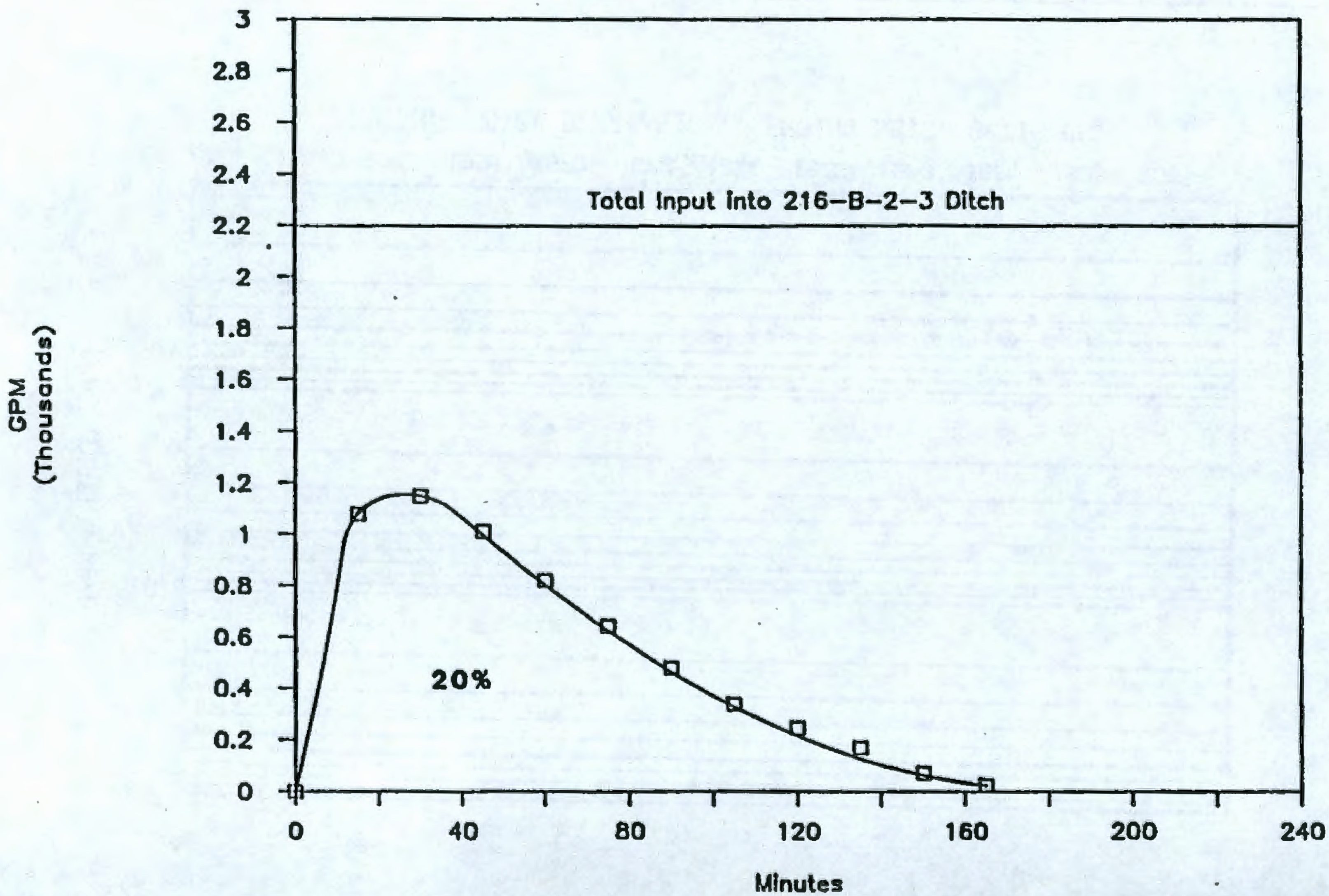

FIGURE 11. Discharge from 216-B-2-3 Ditch

8.0 REMEDIAL ACTION

Direct measurement of the flow in the B-2-3 ditch and hydrogeologic investigation have determined that the B-2-3 ditch is the source of the water causing problems in the 218-E-12B burial ground. Several possible interim corrective actions were considered: pumping from the 207-B retention basins to the end of the B-2-3 ditch, digging a new ditch and possibly installing temporary piping, install temporary piping in the existing ditch, using interceptor wells and/or interceptor trenches to redirect the movement of ground-water, sealing the existing ditch with bentonite and removing the obstructions to the flow of water, and dredging the existing ditch, removing and disposing of all vegetation. The purpose of the interim corrective action is to economically minimize the infiltration of water into the burial grounds until a permanent remedial action can be selected and implemented. Considering the condition of the ditch the best interim corrective action is to remove the obstructions to the flow of water, allowing the water to flow to the B-Pond Complex rather than retain the water thereby encouraging infiltration into the burial ground area. A decision was made to try to seal the bottom and sides of the ditch with bentonite clay prior to removing the dams so that the corrective action would be as effective as possible. The other interim corrective actions were not selected because: (1) pumping from the 207-B basins to the end of the B-2-3 ditch would cost more than $75,000 plus operating costs, (2) digging a new ditch would require a construction project, (3) temporary piping in the existing ditch would cost more than $75,000, (4) interceptor wells and/or trenches would cost more than $75,000 and would not affect the source of the water, and (5) dredging the existing ditch would be expensive due to burial costs and would aggrevate the infiltration rate in the ditch. The total estimated cost from applying bentonite and removing the dams and obstructions to the flow of water is $75,000.

Based on the manufacturer's recommendation, a granular bentonite was applied to 2400 feet of the B-2-3 ditch at a rate of two pounds per square foot. The bentonite was applied starting 400 feet from the beginning of the ditch and extending 2400 feet to the cross-over road in the burial grounds. A cement bucket and crane were used to apply the bentonite as evenly as possible to the bottom and sides of the ditch. Granular bentonite is the texture of coarse sand and is easily applied through standing vegetation and water. After being applied, the bentonite absorbs water, swells by up to a factor of ten and forms an impervious clay liner on the bottom and sides of the ditch. The flow rate at the trapezoidal weir was again monitored after the bentonite application. Approximately 40% of the water entering the ditch was being discharged from the ditch. The bentonite effectively doubled the amount of water being discharged, as shown in Figure 12.

Approximately one week after application of the bentonite was completed, work began to remove the tumbleweed dams and obstructions to the flow of water. The twelve dams were removed and disposed of using a smooth lip clam shell bucket, crane, loader and 10 yd. dump truck. Care was taken in removing the dams to minimize the disturbance to the ditch sides and bottom so the infiltration rate was not increased. The flow rate at the trapezoidal weir was again monitored after removal of the dams. The flow rate had increased such that 50% of the water entering the ditch was being discharged from the ditch. The flow rate is shown in Figure 13.

Inspection of the ditch and observation of the water flowing in the ditch indicates that several dense growths of reeds are still restricting the flow of water. Work is underway to clean the ditch and establish a flow channel through the reeds so the retention time of the water in the ditch is minimized. After the flow channel is established, additional bentonite will be applied to those areas which were disturbed by the removal

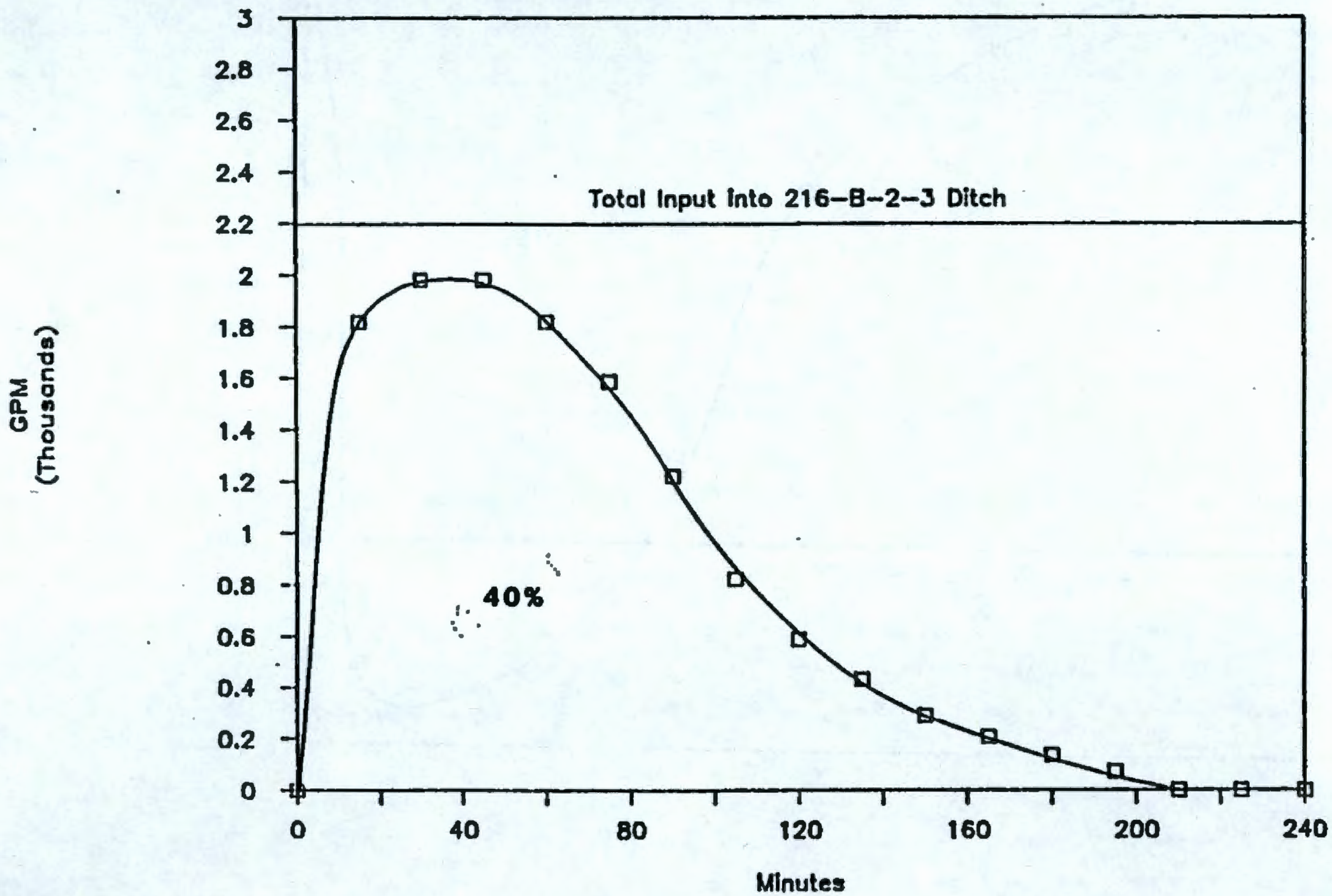

FIGURE 12. Discharge from 216-B-2-3 Ditch
After Bentonite Application

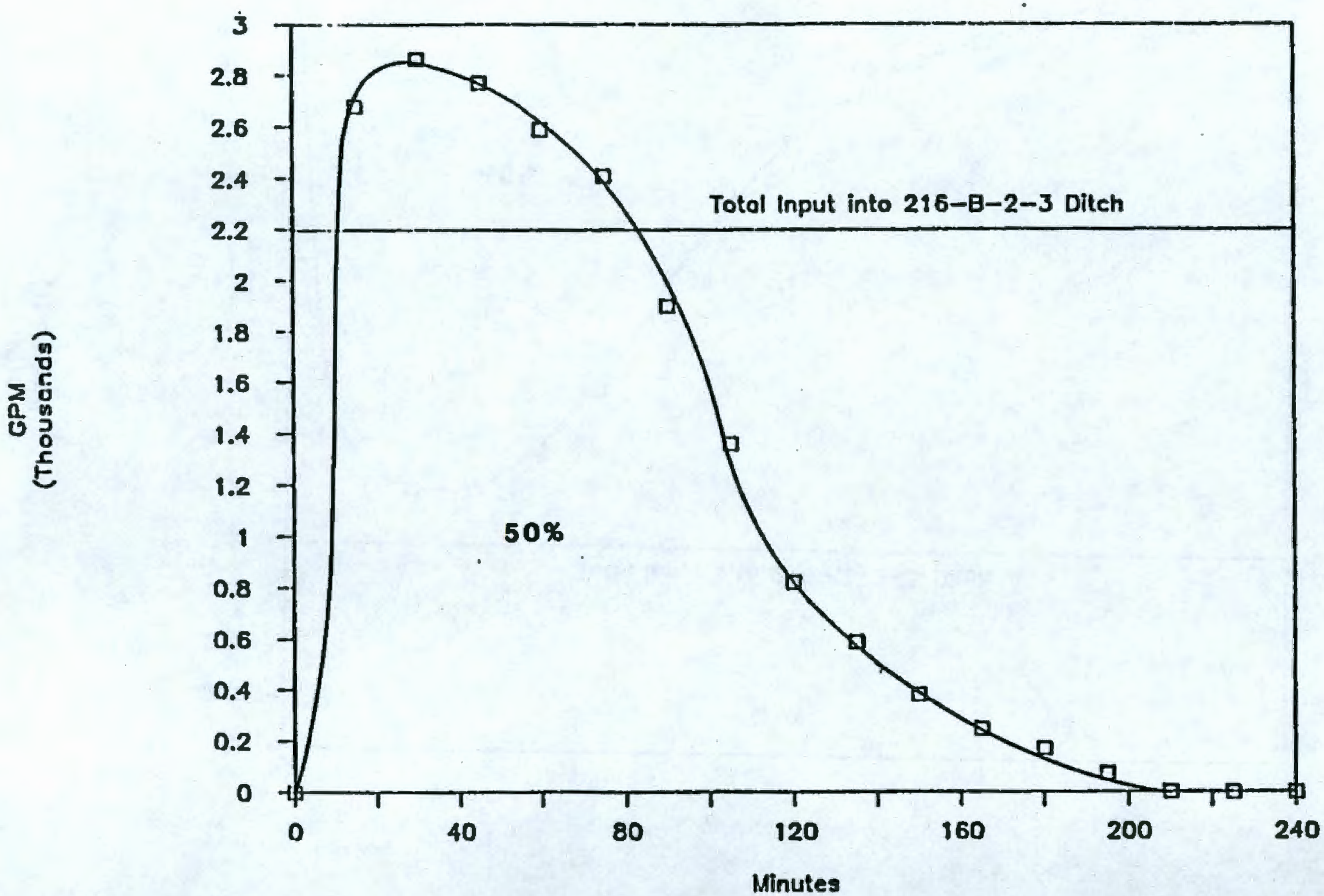

FIGURE 13. Discharge from 216-B-2-3 Ditch
Bentonite A   lcation and Dam Cleanout

of the dams and cleanout of a flow channel. The lower section of the B-2-3 ditch from the cross-over road to the weir will receive its first application of bentonite. After completion of the cleanout work and the final bentonite application, the flow rate will again be monitored. Substantial additional improvement in the flow rate is expected upon completion of this work.

Tangible improvements have been observed in trench 1a, well 148 and trench 36. The water in trench 1a has disappeared. The soil is damp, but there is no standing water. The flow of water in well 148 has been reduced to a trickle and the level of the standing water in the well has dropped a total of three feet. The flow of water in trench 36 has also been reduced to a trickle. The water enters at the very bottom of the trench and flows about two feet before disappearing.

9.0 FINAL CORRECTIVE ACTION

An engineering study is being completed to evaluate alternative methods of eliminating leakage from the B-2-3 ditch (B-475). Several possible methods are being evaluated and cost estimates developed. A shallow depth pipeline to the south of the existing ditch is expected to be the preferred method. The project will become a Fiscal Year 1987 General Plant Project (GPP).

10.0 CONCLUSIONS

Water inflow observed in trench 36 in the 218-E-12B burial ground was feared to occur in a much larger portion of the 218-E-12B burial ground and to possibly extend to the 218-E-12A burial ground. Emplacement of investigation trenches and wells were utilized to demonstrate that it is likely that water inflow occurred only in the southern most portion of trench 37.

The source of water was shown to be the B-2-3 ditch. An engineering study is evaluating the preferred alternative for eliminating leakage from the B-2-3 ditch. A pipeline to the south of the existing B-2-3 ditch is expected to be the preferred method. Addition of bentonite to the ditch and removal of obstruction to flow are interim corrective actions being taken. Preliminary indications are that the interim actions are effective.