N62604.AR.000383
NCBC GULFPORT
5090.3a

TECHNICAL BULLETIN REGARDING FREE PHASE PRODUCT ASSESSMENT SITE 6 NCBC GULFPORT MS

2/1/1994

ABB

NCBC Gulfport Administrative Record
Document Index Number

39501 - IRP
18.02.06.0004

ABB
ASEA BROWN BOVERI

TECHNICAL BULLETIN

FREE-PHASE PRODUCT ASSESSMENT
SITE 6 FORMER FIRE-FIGHTING TRAINING AREA
NCBC GULFPORT, MISSISSIPPI

SUBJECT

Pumping test conducted in GPT-6-RW (Field Effort #3).

SUMMARY

The discovery of free-phase floating product in monitoring well GPT-6-1 initiated a Free-Phase Product Assessment (FPPA). The first field effort (November 1993) focused on evaluating the horizontal and vertical extent of the free-phase product at Site 6, as well as the hydraulic conductivity and grain sizes of the surficial formation. Based on this data, five monitoring wells and one recovery well were installed within the free-phase product during the second field effort (December 1993). During the third field effort, a stepped pumping test was conducted on the recovery well. Six other monitoring wells were instrumented with pressure transducers, and their water levels were monitored with an In-Situ SE200 datalogger. This technical bulletin discusses the third field effort. Data obtained during this pumping test will aid the design of a remediation system for the site.

The pumping test consisted of several steps. First, background water level readings were monitored for 14.5 hours prior to any pumping. Phase 1 (2.33 hours duration) of the pumping test included the extraction of free-phase product with a Masterflex peristaltic pump. During the second phase (8.0 hours duration), free-phase product/emulsified product was removed by a Masterflex pump, and groundwater was removed at 3.04 gallons per minute (gpm) with a Grundfos submersible pump. The Grundfos pump induced a cone of depression of 1.5 feet, which influenced the flow of free-phase product into the recovery well. During Phase 3 (5.66 hours), the flow rate of the submersible pump was increased to 7.1 gpm. The cone of depression increased to 3.5 feet. Phase 3 ended when the Baker tank on site was full. After the pumps were shut off, Phase 4 began. Water level recovery was monitored for 9.33 hours. Water levels in GPT-6-8 and GPT-6-2 were manually checked during the pumping test.

Several significant observations were observed during the evaluation of the pumping test data. First, the response of water levels in the monitoring wells indicates a good hydraulic connection between the recovery well and the surficial aquifer. Second, free-phase product thickness levels apparently increased during the second and third phases of the pumping test in response to the gradient created by the submersible pump. Third, the water level response in all of the shallow wells suggests a rather large radius of influence for the recovery well, even at

The data and interpretation contained in this technical bulletin are derived from preliminary field data and are subject to revision as additional data become available.

pumping rates as low as 3.04 gpm. Finally, well GPT-6-7 did not respond to either 3.04 gpm or 7.1 gpm withdrawal rates from the recovery well. This may be attributed to the depth (39.4 to 44.4 feet below ground surface [bgs]) of the screen, which may be below the vertical zone influenced by pumping from the recovery well at these flow rates.

ATTACHMENTS

Attachment 1: Chronology of Events at Site 6
Attachment 2: Site Map
Attachment 3: Hydrographs from Instrumented Wells
Attachment 4: Drum Inventory

DISCUSSION

The following discussion presents the methods and the results of the field activities conducted from 10 January to 14 January 1994. These activities included assembling the Masterflex peristaltic pumping system for free-phase product removal, and the 4-inch Grundfos submersible pumping system for groundwater extraction. A 16-hour stepped pumping test was preceded by 14.5 hours of background water level monitoring and followed by 9.25 hours monitoring the recovery. A chronology of events during the second field effort at Site 6 is provided in Attachment 1.

Equipment and Preparation for the Pumping Test

Equipment and supplies were staged to Site 6 and to Building 420 on 10 January and 11 January 1994. A Keck oil/water interface probe was employed to determine depth to, and thickness of, free-phase product. Depths to water were measured with a SINCO water level indicator. The pH, conductivity, and temperature of the groundwater were measured using the YSI Salinity-Conductivity-Temperature Meter and the HyDAC 910 Conductivity-Temperature-pH Tester.

Two different pumps were utilized to withdraw free-phase product and groundwater during the pumping test. A Masterflex peristaltic pump withdrew the free-phase product through a polyethylene tube. The free-phase product was discharged to 55-gallon drums. Groundwater withdrawal was accomplished with the Grundfos Model 10E submersible pump. Groundwater was discharged through polyethylene tubing that was connected to a ball valve and totalizing flow meter assembly. The rate of groundwater discharge was regulated by adjusting the amount of back pressure asserted by the ball valve. Groundwater discharge from the recovery well (GPT-6-RW) was conveyed to a 6,500-gallon-capacity Baker tank.

Transducers were installed in wells GPT-6-RW, GPT-6-1, GPT-6-3, GPT-6-4, GPT-6-5, GPT-6-6, and GPT-6-7 on 11 January 1994 and allowed to equilibrate to the ambient groundwater temperature as well as monitoring background water levels until 0900 hours on 12 January.

Barometric observations were monitored throughout the test using a barometric pressure transducer linked to the Hermit SE 2000 datalogger.

Water levels in wells GPT-6-RW, GPT-6-1, GPT-6-3, GPT-6-4, GPT-6-5, GPT-6-6, and GPT-6-7 (Attachment 2) were monitored using pressure transducers linked to a Hermit SE 2000 datalogger. Water levels were manually observed using the SINCO water level indicator and the Keck oil/water interface probe.

Pumping Test: Background Readings

Background water level readings were monitored for 14.5 hours from 11 January to 12 January 1994, except in the recovery well which was not linked to the datalogger until 0800 hours on 12 January.

Pumping Test: Phase 1 - Free-Phase Product Only

Phase I of the pumping test involved removal of free-phase product at a pumping rate of 0.16 gpm using only the Masterflex peristaltic pump. Teflon tubing was lowered into the free-phase product layer, which was 0.27 feet thick, just prior to the start of the pumping test at 0900 hours on 12 January 1994. Product thickness was monitored manually during Phase 1, which lasted 140 minutes. Table 1 presents the results of these measurements as well as product thickness observations made during Phase 2, Phase 3, and Phase 4 (recovery).

Table 1: Product Thickness at Recovery Well GPT-6-RW Measurements During Pumping Test

Time (hours)	Phase	Depth to Product (feet)	Depth to Water (feet)	Product Thickness (feet)
0736	Background	8.31	8.58	0.27
0926	Phase 1	8.39	8.52	0.13
1107	Phase 1	8.44	8.47	0.03
1149	Phase 2	9.81	9.86	0.05
1210	Phase 2	9.81	9.87	0.06

Table 1: (Cont.) Product Thickness at Recovery Well GPT-6-RW Measurements During Pumping Test

Time (hours)	Phase	Depth to Product (feet)	Depth to Water (feet)	Product Thickness (feet)
1540	Phase 2	9.82	9.92	0.10
2146	Phase 3	11.91	12.85	0.94
0950	Recovery	8.34	8.57	0.23

At the beginning of Phase 1, product thickness was 0.27 feet, and the effluent from the peristaltic pump was 40 percent free-phase product. Product thicknesses decreased by half in the first hour of Phase 1. By 1107 hours, only 0.03 feet of free-phase product remained, while the pumping rate of the peristaltic pump was reduced to 0.11 gpm. At 1117 hours, the peristaltic pump was adjusted to 0.29 gallons per minute. At 1120 hours, Phase 1 was terminated based on product thickness and the lowered percent of recovery. Approximately 30 gallons of free-phase product and groundwater were removed during this phase.

Pumping Test: Phase 2 - Free-Phase Product and Groundwater Depression

Phase 2 of the pumping test began at 1130 hours. The initial flow rate of 9.6 gpm was adjusted to 3.7 gpm. This flow rate adjustment is discernible on the hydrographs (Attachment 3) for the recovery well and the nearest monitoring wells (GPT-6-1 and GPT-6-3). A flow rate of 3.04 gpm was established at 1144 hours and maintained until the end of Phase 2.

Product levels apparently thickened throughout the second phase from 0.03 foot to 0.10 foot possibly in response to the gradient created by the Grundfos (groundwater depression) pump. Pumping at 3.04 gpm during the second phase induced a drawdown of 1.5 feet in the recovery well.

Phase 2 (3.04 gpm) ended at 1930 hours, when the drawdown in the recovery well reached a static level. Approximately 1,526 gallons of groundwater were removed during this phase.

Pumping Test: Phase 3 - Free-Phase Product and Groundwater Depression

Phase 3 of the pumping test immediately followed Phase 2. A flow rate of 7.1 gpm was maintained until the pumping test ended at 0120 hours on 13 January 1994. Apparently product levels thickened during this phase also, although the product was emulsified. Removal of groundwater at a rate of 7.1 gpm from the recovery well induced 3.5 feet of drawdown during this pumping phase.

Phase 3 of the pumping test ended when the Baker tank was full. Both pumps were shut off, and the recovery phase began. Approximately 2,486 gallons of groundwater were removed during this third phase. Approximately 4,010 gallons of groundwater were removed during all phases of the pumping test.

Samples were collected at 2300 hours on 12 January 1994 to be analyzed for engineering and treatability parameters.

Pumping Test: Phase 4 - Recovery

The recovery of groundwater levels were monitored from the end of Phase 3 until 1100 hours on 13 January 1994. Groundwater levels had fully recovered in all monitoring wells before monitoring ceased. The product thickness in the recovery well at 0950 hours on 13 January was 0.23 feet. Levels of groundwater in all wells recovered above those observed during background readings. This pattern reflects an overall recharge of groundwater levels in the surficial aquifer, which may be attributed to several recent rainfall events.

HYDROGRAPHS OF WATER LEVEL FLUCTUATIONS DURING THE PUMPING TEST

Hydrographs of water level fluctuations are provided for all instrumented wells in Attachment 3. Barometric fluctuations during the pumping test are also provided in Attachment 3.

Background Readings

Increasing water levels were observed in all instrumented wells during background readings. Water level fluctuations were not observed in the recovery well during background readings. In general, water levels in the shallow wells (GPT-6-1, GPT-6-3, GPT-6-4, GPT-6-6, and GPT-6-RW) (water levels in GPT-6-RW were manually measured during the background phase) increased approximately 0.04 foot, and water levels in the deep wells (GPT-6-5 and GPT-6-7) increased approximately 0.02 foot.

Phase 1 - Free-Phase Product Only

During Phase 1 of the pumping test, free-phase product and dissolved-phase product was removed from the recovery well. As expected, the response of fluid levels was the most distinct in the recovery well (0.01 foot). Decreases of approximately 0.01 foot were observed in wells GPT-6-1 and GPT-6-6.

Phase 2- Free-Phase Product Removal/Pumping at 3.04 GPM

The second phase of the pumping test began when the Grundfos submersible pump was brought on line. Initial pumping rates during this phase were as high as 9.6 gpm, until the flow rate was throttled back to 3.04 gpm. The period of adjusting the flow rate is reflected in the hydrographs (Attachment 3) as a downward spike. As expected, the spike is most pronounced in the recovery well (1.8 feet), and the closest monitoring well (GPT-6-1) exhibits a pronounced spike of 0.26 feet (Attachment 3).

Table 2 Water Level Drawdowns

Well Number	Drawdown Phase 1 (feet)	Drawdown Phase 2 (feet)	Drawdown Phase 3 (feet)	Total Drawdown (feet)
GPT-6-RW	0.04	1.35	2.05	3.4
GPT-6-1	0.01	0.34	0.52	0.87
GPT-6-2	NR	0.09	0.23	0.32
GPT-6-3	NR	0.10	0.14	0.24
GPT-6-4	NR	0.12	0.16	0.28
GPT-6-5	NR	0.11	0.18	0.29
GPT-6-6	0.01	0.19	0.28	0.48
GPT-6-7	NR	NR	NR	NR

NR No Response

Every well except GPT-6-7 responded to the pumping of 3.04 gpm from the recovery well. The response observed in the monitoring wells was influenced by two variables: the distance from the recovery well and the depth of the screened interval. The wells closer to the recovery well exhibited the most drawdown, but depth was also a factor. GPT-6-4 and GPT-6-5 are a well pair with GPT-6-4 screened across the water table, and GPT-6-5 screened from 26.6 to 31.6 feet below ground surface (bgs). Water levels in GPT-6-4 decreased more rapidly than in GPT-6-5 (even though it is 7 feet further away), but GPT-6-5 had more total drawdown by the end of the test. GPT-6-6 and GPT-6-7 are a well pair 35 and 30 feet respectively west of the recovery well. GPT-6-6 has a screen that intercepts the water table, and GPT-6-7 has a screen from 39.4 to 44.4 feet bgs. Water levels in GPT-6-6 responded almost immediately after the groundwater depression pump became operational, while the deeper GPT-6-7 did not respond at all during the test. Apparently the screened interval of GPT-6-7 was below the vertical zone of influence created by the pumping in the recovery well.

Product thickness in the recovery well increased (Table 1) during this phase in response to the gradient created when the groundwater depression pump was engaged.

Phase 3 - Pumping at 7.1 GPM

The flow rate of the Grundfos submersible pump was increased to 7.1 gpm at the beginning of Phase 3. Water levels in all instrumented monitoring wells responded almost immediately, except GPT-6-7. Water levels again stabilized in all monitoring wells, but increased distance and depth of the screened intervals caused a delay in stabilization.

Pumping Test: Phase 4 - Recovery

The recovery phase of the pumping test began at 1820 minutes into the pumping test, when the Grundfos pump was turned off. Recovery of water levels to pre-pumping levels occurred rapidly in all wells. In fact, the groundwater levels recovered above pre-pumping test levels, which indicates a general trend of groundwater recharge. This is consistent with the increasing trend noted during background monitoring.

Barometric Readings During the Pumping Test

Barometric pressure fluctuations during the pumping test are plotted and presented in Attachment 3. A general trend towards lower pressure is observed throughout the test with one anomaly. A sharp increase in barometric pressure is indicated at 1850 minutes after the start of the test (including the background test phase). This apparent increase in barometric pressure may be attributable to the rapid influx of rainwater in the container in which the barometric transducer was housed. An intense rain event was noted prior to the sharp increase in barometric pressure readings. The barometric pressure transducer was observed to be submerged in approximately 2 inches of rainwater when it was removed from the container. If the rainwater entered the container beginning at about 1850 minutes, this would account for the sudden increase of 0.15 foot in pressure readings. A phone call was placed to In-Situ (maker of the barometric pressure transducer) regarding the submerged transducer. In-Situ estimated a 0.8 foot to 0.2 foot increase in pressure readings from 2 inches of water.

Drum Inventory

An inventory of drums and the associated investigation derived waste (IDW) is included as Attachment 4. The amount and source of the waste is also included.

IMPLICATIONS OF RESULTS

Several significant observations were made after initial evaluation of the pumping test; they are,

- the response of water levels in the hydrographs which indicate good hydraulic connection between the recovery well and the surficial aquifer;

- the increase in the free-phase product thickness during the second and third phases of the pumping test are possible in response to the gradient created by the submersible pump and product emulsification;

- the water level response in all the shallow wells suggests a rather large radius of influence of the recovery well, even at pumping rates as low as 3.04 gpm; and

- well GPT-6-7 which did not respond to either 3.04 gpm or 7.1 gpm withdrawal from the recovery well. This may be attributable to the depth (39.4 to 44.4 feet bgs) of the screen, which may be below the vertical zone influenced by pumping at those flow rates from the recovery well.

ATTACHMENT 1

Chronology of Events at Site 6

ATTACHMENT 1

Chronology of Events at Site 6

10 January 1994

- Arrive at Airport
- Mobilize and stage equipment and supplies to Building 420
- Take round of water level measurements and well soundings

11 January 1994

- Remove sand/silt from sump of recovery well
- Take one round of water level measurements
- Install transducers in wells and set-up datalogger
- Prepare pump for test
- Begin background water level monitoring

12 January 1994

- Start pumping test
- Take 6 rounds of water level measurements
- Collect engineering treatability parameters

13 January 1994

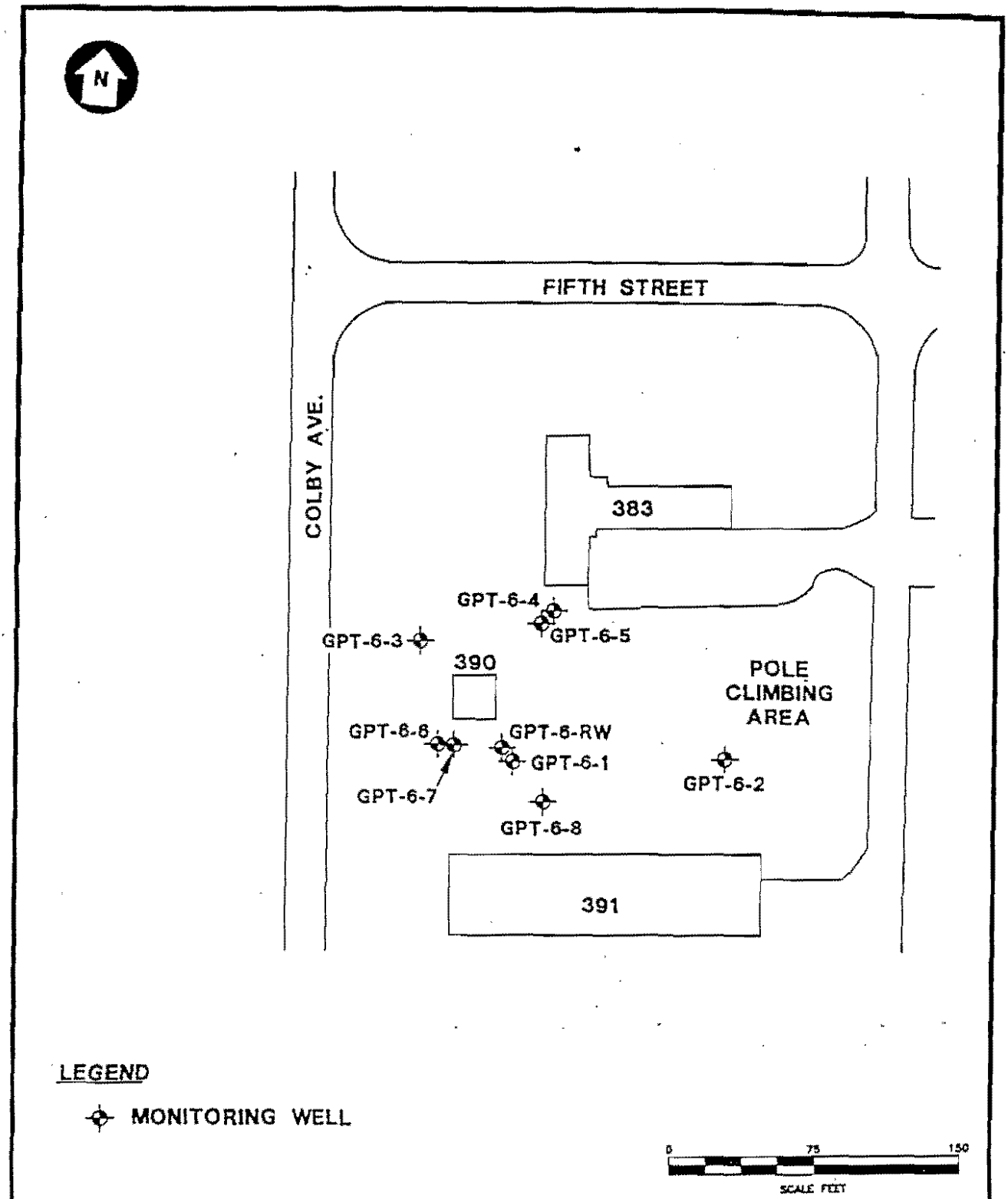
- Finish pumping test
- Start recovery phase
- Take 2 rounds of water level measurements
- Download pumping test data to diskette and print a hard copy
- Take drum inventory

14 January 1994

- Demobilize supplies and equipment from Building 420
- Ship samples to CH2M Hill
- Return to Knoxville

ATTACHMENT 2

Site Map



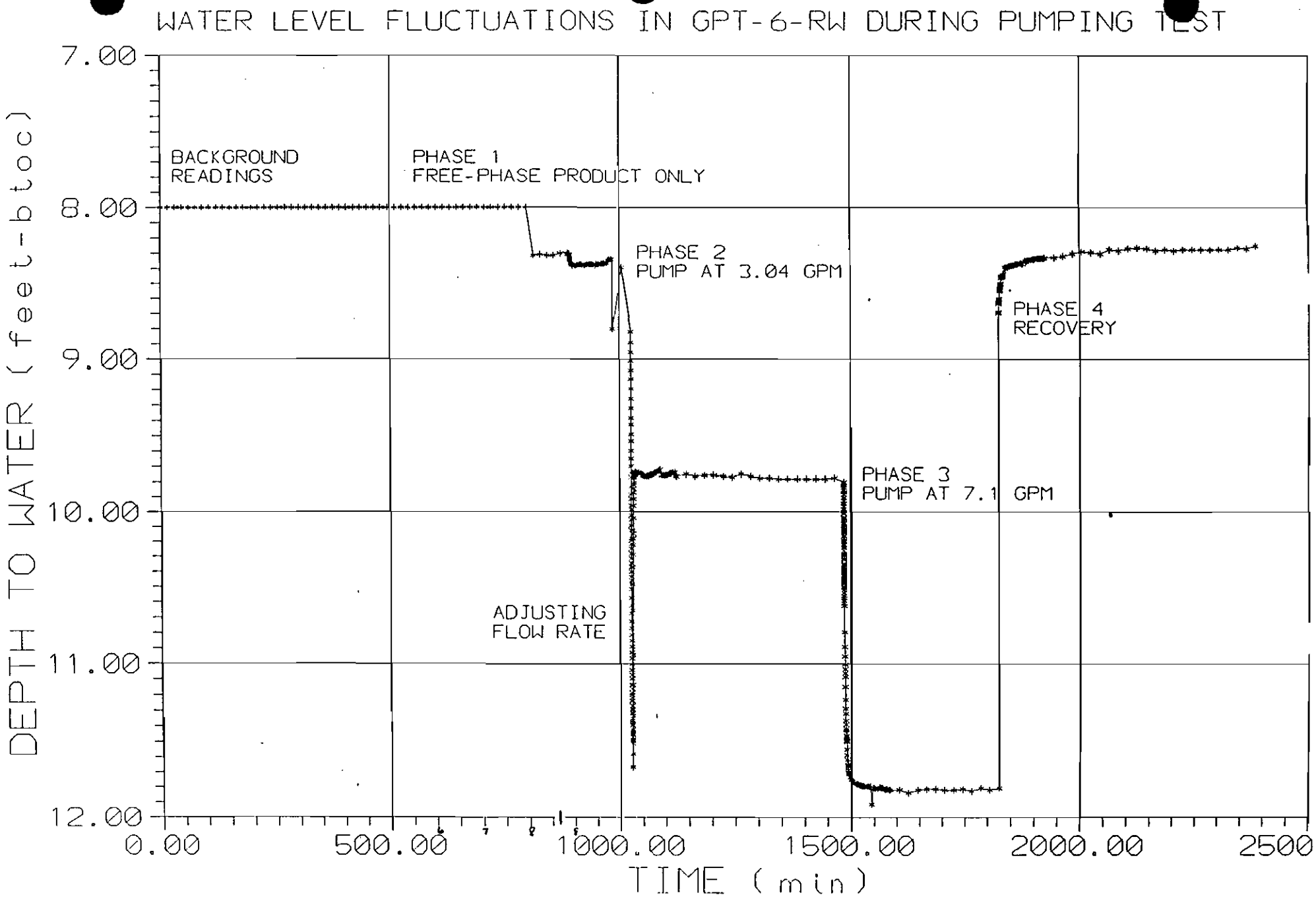
SITE 6 - FIRE FIGHTING TRAINING AREA

F-PPA/IAD WORK PLAN

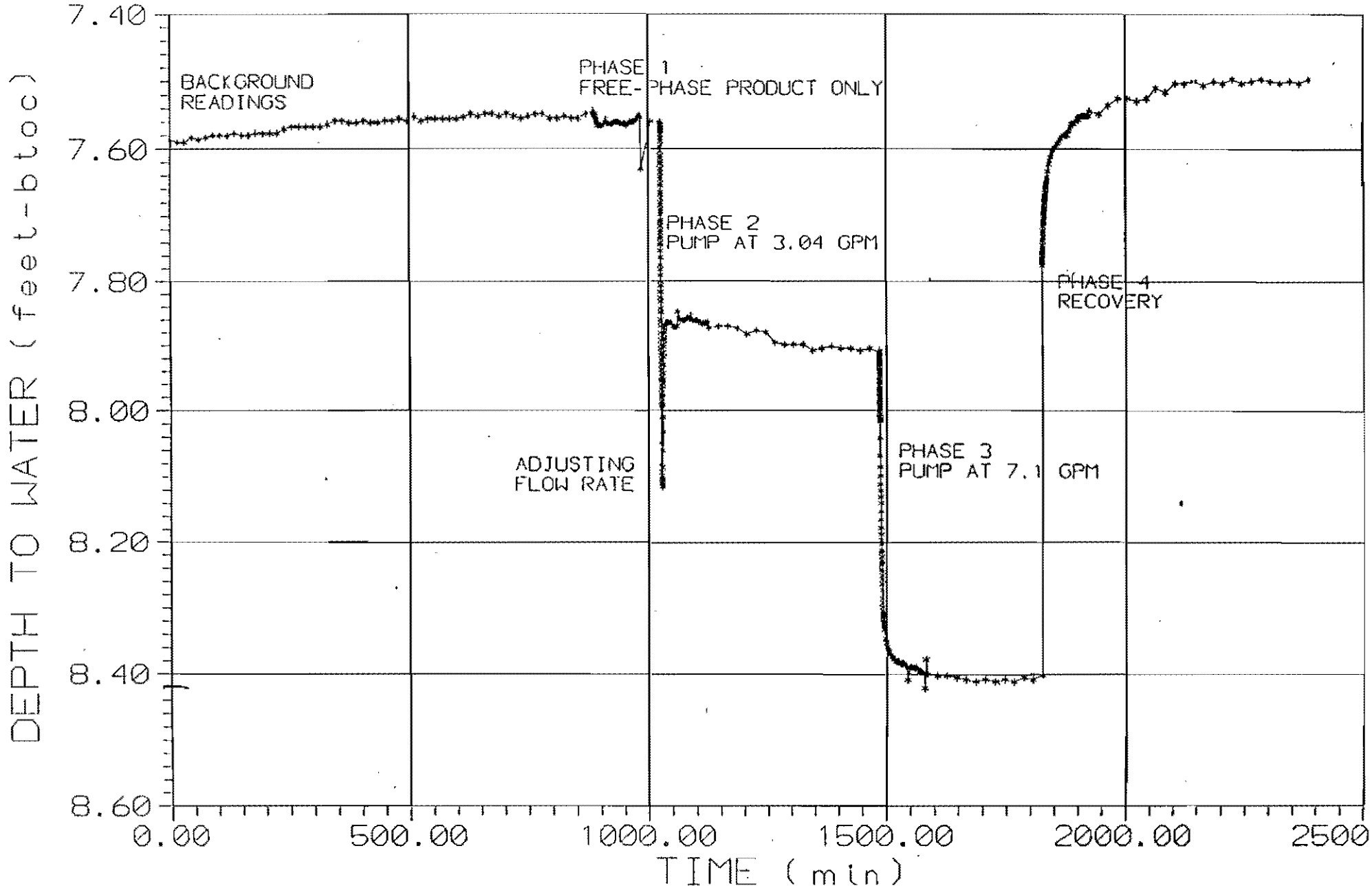
NCBC GULFPORT
GULFPORT, MISSISSIPPI

ATTACHMENT 3

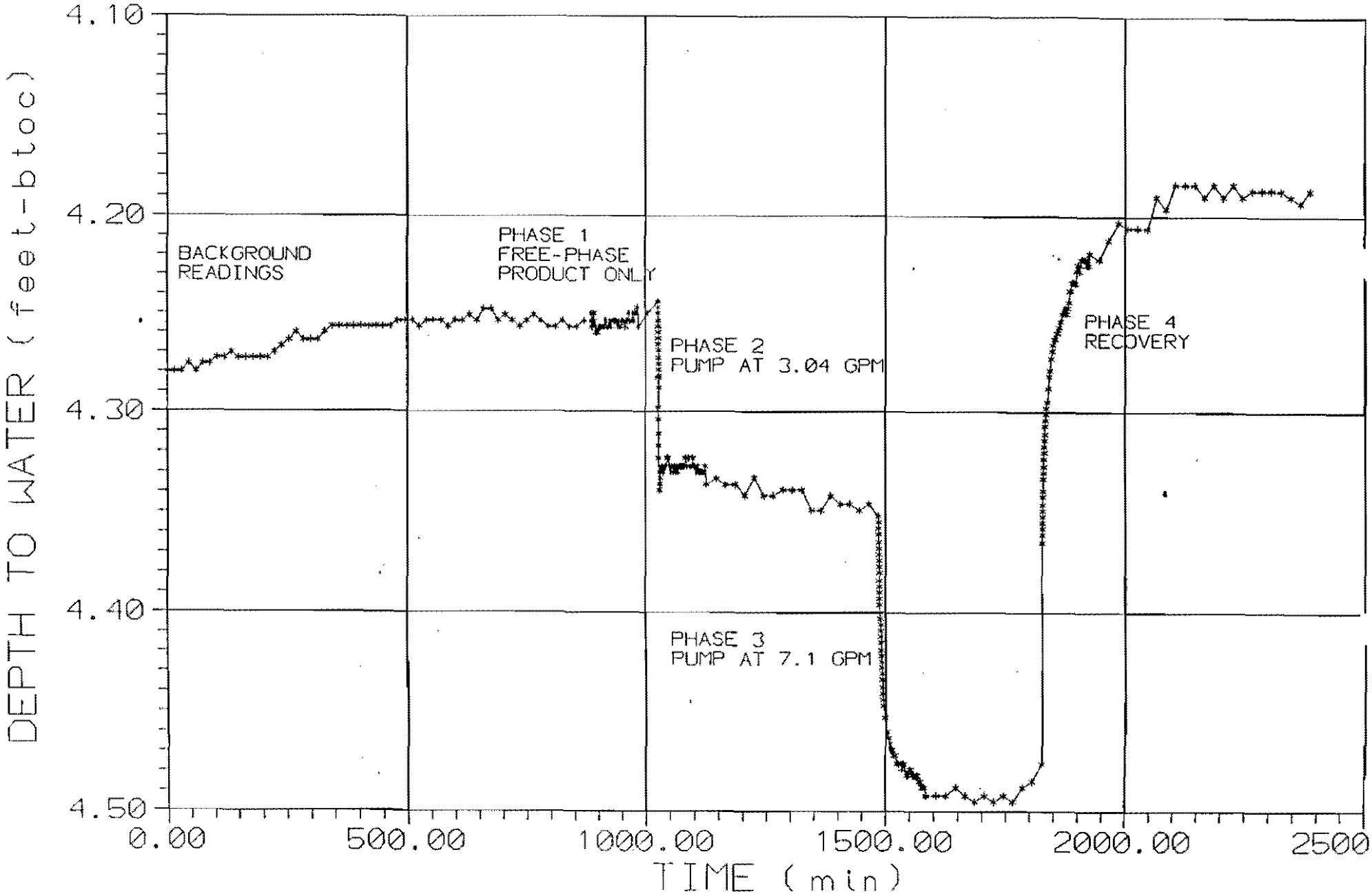
Hydrographs of Pumping Test Data

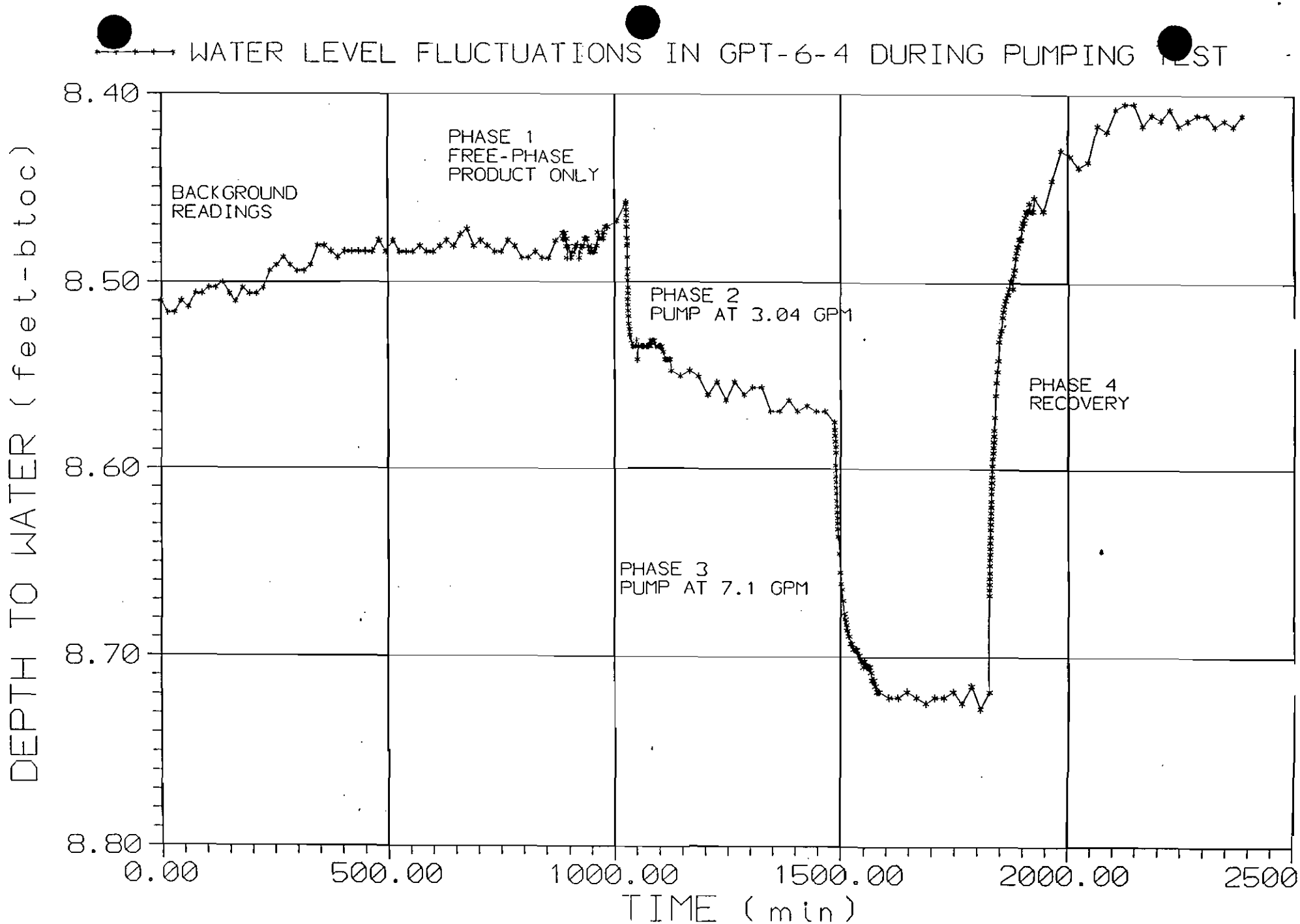

WATER LEVEL FLUCTUATIONS IN GPT-6-RW DURING PUMPING TEST
DEPTH TO WATER (feet-btoc)
7.00
8.00
9.00
10.00
11.00
12.00
0.00
500.00
1000.00
1500.00
2000.00
2500
TIME (min)
BACKGROUND READINGS
PHASE 1 FREE-PHASE PRODUCT ONLY
PHASE 2 PUMP AT 3.04 GPM
ADJUSTING FLOW RATE
PHASE 3 PUMP AT 7.1 GPM
PHASE 4 RECOVERY

WATER LEVEL FLUCTUATIONS IN GPT-6-1 DURING PUMPING TEST

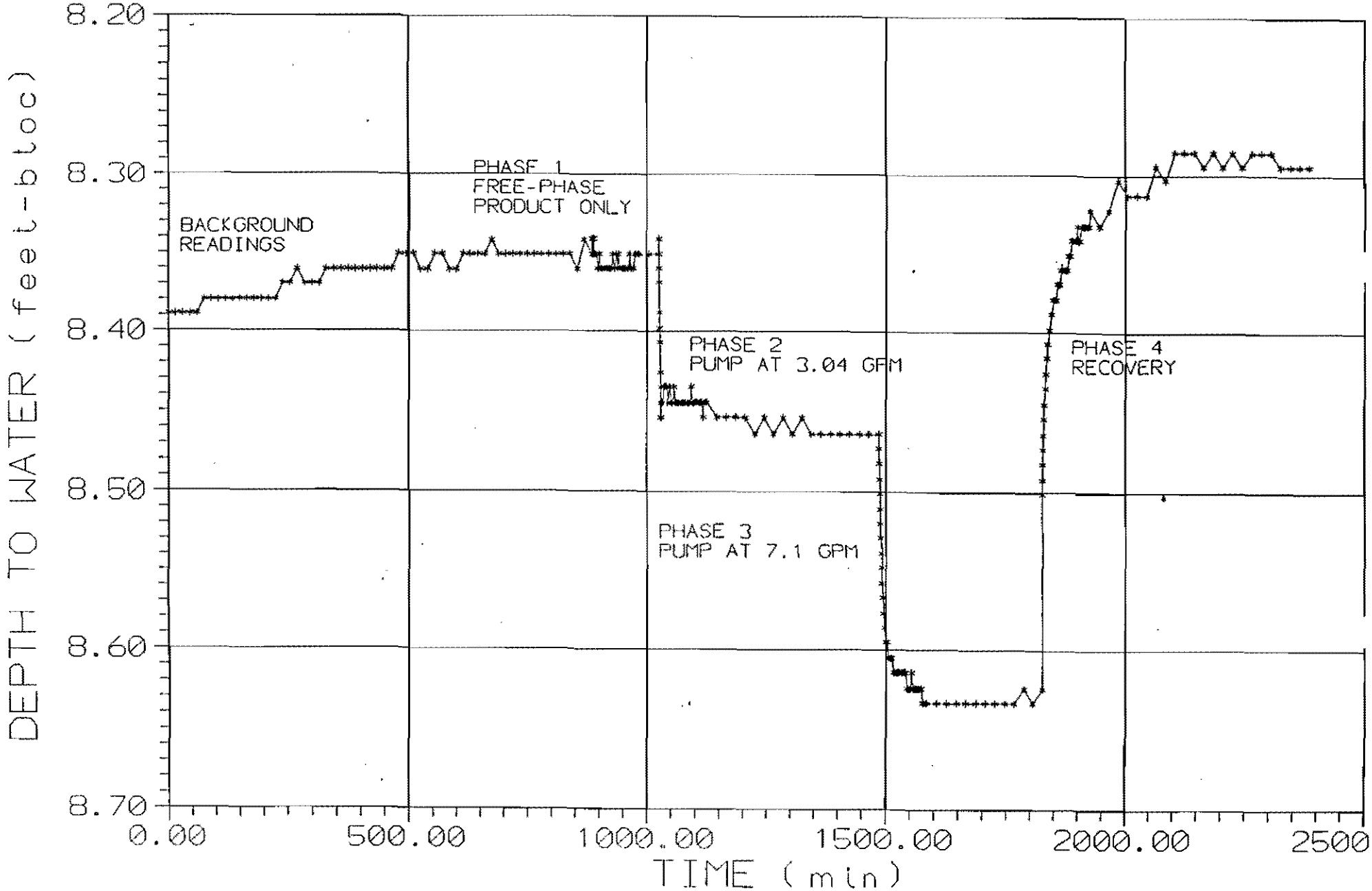


WATER LEVEL FLUCTUATIONS IN GPT-6-3 DURING PUMPING TEST

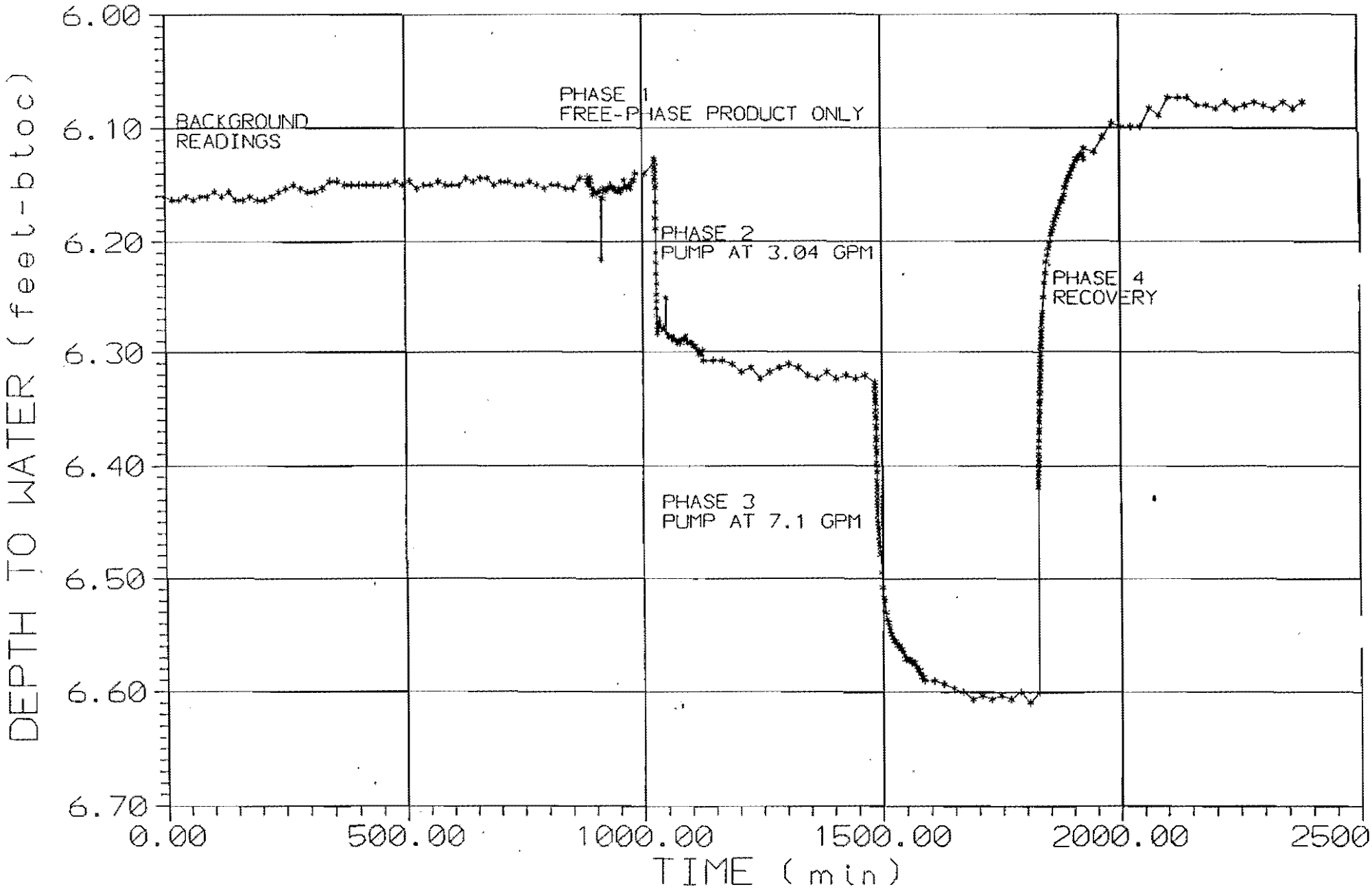



WATER LEVEL FLUCTUATIONS IN GPT-6-4 DURING PUMPING TEST
DEPTH TO WATER (feet-btoc)
8.40
8.50
8.60
8.70
8.80
0.00
500.00
1000.00
1500.00
2000.00
2500
TIME (min)
BACKGROUND READINGS
PHASE 1 FREE-PHASE PRODUCT ONLY
PHASE 2 PUMP AT 3.04 GPM
PHASE 3 PUMP AT 7.1 GPM
PHASE 4 RECOVERY

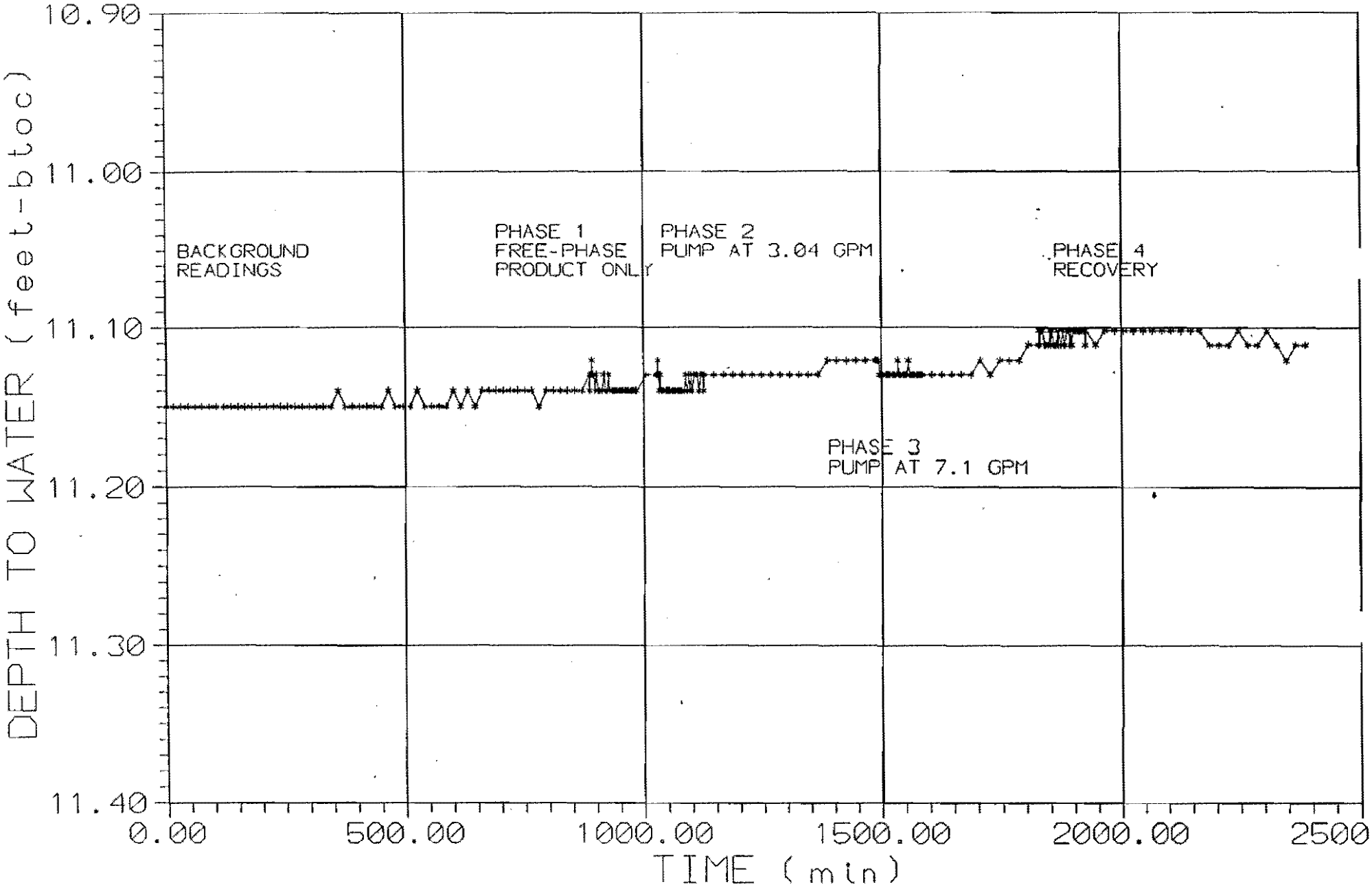
WATER LEVEL FLUCTUATIONS IN GPT-6-5 DURING PUMPING TEST



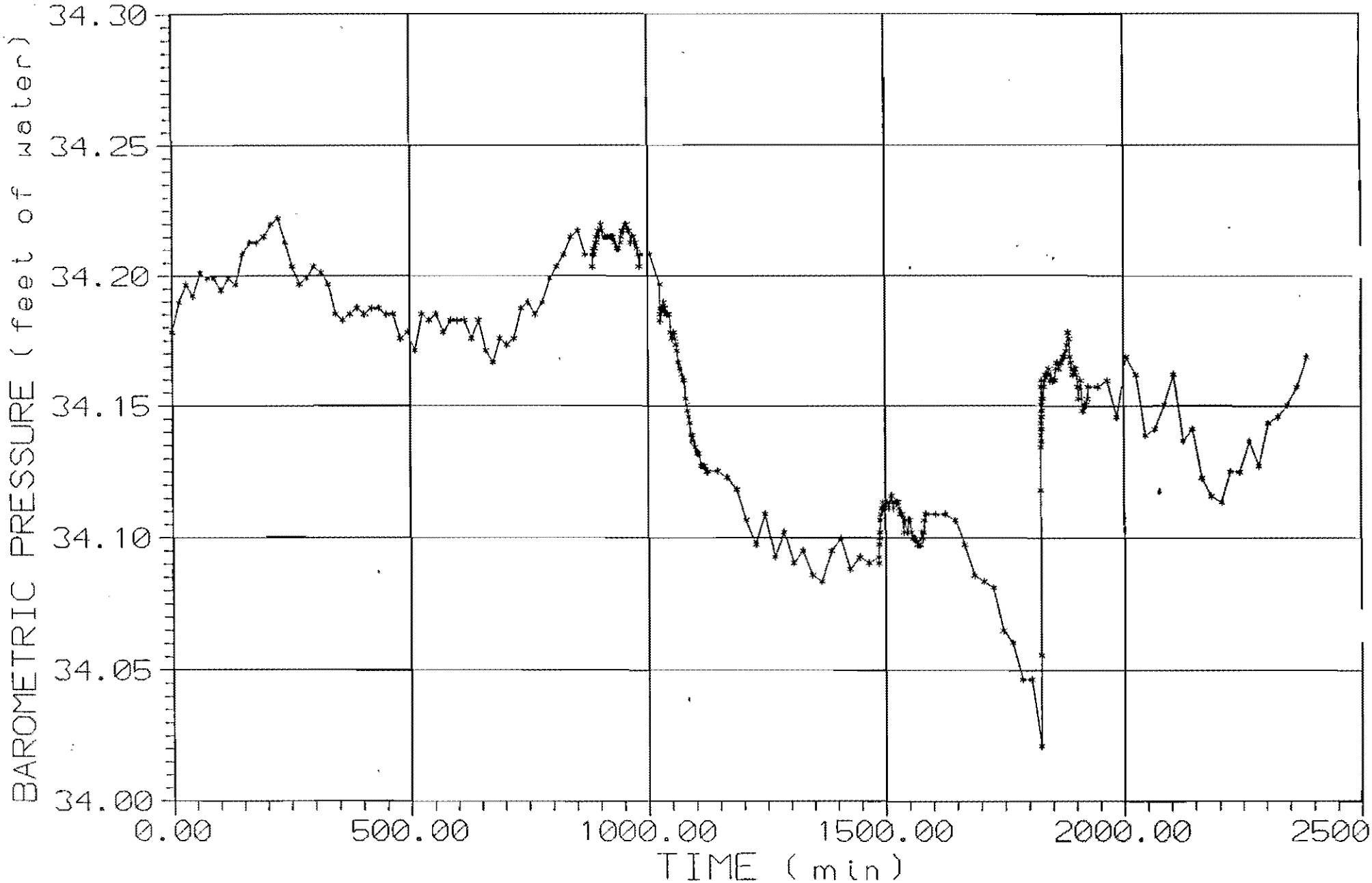
WATER LEVEL FLUCTUATIONS IN GPT-6-6 DURING PUMPING TEST



WATER LEVEL FLUCTUATIONS IN GPT-6-7 DURING PUMPING TEST



BAROMETRIC PRESSURE FLUCTUATIONS DURING THE PUMPING TEST



ATTACHMENT 4

Drum Inventory

Table A-1: Drum Inventory

DRUM NO.	MATRIX	SOURCE
1	Decon Water	
2	Grout Drum	
3	Soil Cuttings	GPT-6-6
4	Decon Water	
5	Soil Cutting	GPT-6-RW
6	Decon Water	
7	Decon Water	
8	Soil Cuttings	GPT-6-RW
9	Decon Fluids	
10	Decon Water	
11	Decon Water	
12	Soil Cuttings	Deep Hydropunch
13	Soil Cuttings	Deep Boring Hydropunch
14	Soil Cutting	GPT-6-8
15	Solid Waste	PPE
16	Solid Waste	PPE
17	Soil Cuttings	GPT-6-RW
18	Soil Cuttings	GPT-6-7
19	Soil Cuttings	GPT-6-RW
20	Soil Cuttings	GPT-6-5
21	Soil Cuttings	GPT-6-8
22	Various Fluids	2 gallons free-phase/ dissolved phase
23	Soil Cuttings	GPT-6-5
24	Empty	
25	Empty	
26	Empty	
27	Soil Cutting	Hydropunch
28	Soil Cutting	Hydropunch

Table A-1: Drum Inventory (Continued)

DRUM NO.	MATRIX	SOURCE
29	Soil Cutting	Hydropunch
30	Decon Water	
31	Soil Cuttings	GPT-6-RW, 3/4 full
32	Free-Phase/Dissolved Phase Mix	
33	Free-Phase/Dissolved Phase Mix	1/2 full