CONNECTICUT YANKEE ATOMIC POWER COMPANY

HADDAM NECK PLANT
362 INJUN HOLLOW ROAD • EAST HAMPTON, CT 06424-3099

APR 14 2005
Docket No. 50-213
CY-05-059

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D. C. 20555

Haddam Neck Plant
License Termination Plan
Supplemental Information - Results of the Unconfined Aquifer Pumping Test
Conducted in the Industrial Area

The purpose of this letter is to provide the results of an aquifer pumping test conducted in the unconsolidated aquifer at the Haddam Neck Plant (HNP). The results are included in the attached report. This test was conducted to provide additional hydrogeological characterization of the unconsolidated (overburden) aquifer at the plant as described in the Phase 2 Hydrogeologic Characterization Work Plan and noted in Section 2.3.3.1.6.2 of the HNP License Termination Plan. The work plan recommends estimation of hydraulic properties of the unconsolidated formation by inferring properties based on tidal influence, particle size distribution, and slug tests in monitoring wells.

After assessing the utility of these methods, it was determined that all of them had shortcomings (i.e., tidal influence is not expressed over a large area of the site, thus limiting its usefulness; particle size distribution analysis typically cannot account for in-situ structural conditions and is subject to high uncertainty; and previous slug tests conducted at the site were difficult to analyze due to rapid recovery). The traditional aquifer pumping test was selected to provide the best hydraulic property information for the unconsolidated formation. A test well was specifically designed and constructed to provide access to the aquifer and allow insertion of an appropriately-sized pump. The test well was located at optimal distance from existing monitoring wells and one new observation well was constructed near the pumping well. A step drawdown test was conducted to identify a sustainable pumping rate for the constant rate pumping test. The constant rate pumping test was performed for seventy-two hours. The monitoring wells were instrumented with data-logging pressure transducers and distance drawdown and recovery characteristics were recorded.

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The results of this aquifer pumping test will be used in preparing the transport simulation model and also these results were utilized in the development of the estimated zone of influence(1) required as part of the hypothetical future resident dose estimation required under the HNP License Termination Plan.

There are no regulatory commitments contained in this submittal.

If you should have any questions regarding this information, please contact me at (860) 267-3938.

Sincerely,

Gerard von Noordennen 4-14-05

Gerard P. van Noordennen Date
Regulatory Affairs Manager

Attachment: Results of the Unconfined Aquifer Pumping Test Conducted in the Industrial Area of the Haddam Neck Plant, East Hampton, Connecticut

cc: S. J. Collins, NRC Region 1, Administrator
T. B. Smith, NRC Project Manager, Haddam Neck Plan
R. R. Bellamy, NRC Region 1, Chief, Decommissioning and Laboratory Branch
E. L. Wilds, Jr., CT DEP, Director, Monitoring and Radiation Division
P. Hill, CT DEP, Waste Management Bureau
M. Rosenstein, US EPA, Region 1

(1) G. H. Bouchard (CYAPCO) letter to US NRC, "Haddam Neck Plant, License Termination Plan, Supplemental Information, Survey Areas Potentially Affected by Groundwater Contamination and Capture Zone Analysis", dated January 31, 2005.

Docket No. 50-213
CY-05-059

Attachment
Results of the Unconfined Aquifer Pumping Test
Conducted in the Industrial Area of the
Haddam Neck Plant

April, 2005

Results of the Unconfined Aquifer Pumping Test Conducted in the Industrial Area of the Haddam Neck Plant, East Hampton, Connecticut

PREPARED FOR: Connecticut Yankee Atomic Power Company

PREPARED BY: CH2M HILL

DATE: 7 April 2005

1.0 Introduction

This technical memorandum describes the results of the hydrogeologic characterization associated with the aquifer test conducted in the industrial area of the Connecticut Yankee Haddam Neck Plant (HNP) during September 2004. This aquifer test and report addresses one of the work elements of the Task 2, Phase 2 Hydrogeologic Investigation Work Plan that includes additional characterization of site hydrology and vertical and horizontal plume delineation. The specific work element addressed is: Overburden and bedrock hydrogeologic characterization through drilling, soil sampling, rock coring, downhole logging and geophysics, hydraulic conductivity testing of overburden, and transmissivity and interconnectivity of bedrock. The well installation, soil sampling, groundwater water level monitoring, and pumping activities completed as part of the test performed in the unconfined aquifer satisfies the Task 2 sub-element data requirements related to additional hydrogeologic characterization at the facility by drilling, soil sampling, and hydraulic conductivity testing of the overburden.

1.1 Purpose and Scope

The purpose of conducting an aquifer test at this study area was to acquire both quantitative and qualitative hydraulic data to determine aquifer properties and hydrogeologic conditions related to the shallow unconfined aquifer system at the HNP. The unconfined aquifer at the facility is comprised of the unconsolidated deposits and possibly the shallow bedrock hydrostratigraphic units. Data collected during testing support the calculation of hydrogeologic parameters of the shallow unconfined aquifer and help develop an enhanced understanding of hydraulic response and interconnection in both the unconsolidated deposits and the shallow bedrock hydrostratigraphic units at the facility. These data are needed to refine the facility's hydrogeologic conceptual site model (CSM) and support groundwater-modeling efforts.

The scope of the aquifer test included step and constant-rate tests conducted in a newly constructed test well (AT-1) to collect data for determining hydraulic properties. The step test was performed at incremental pump rates to obtain well yield, well or pump efficiency, observed drawdown, and calculated specific capacity for the test well. The constant-rate test involved pumping the test well at a constant withdrawal rate for seventy-two (72) hours to obtain estimates of aquifer properties including aquifer type, transmissivity, hydraulic conductivity, storativity, specific yield, and possibly aquifer boundaries. Water level data was also collected from observation wells and the Connecticut River to support the test results.

1.2 Aquifer Test Physical Setting

The HNP is located approximately twenty-one (21) miles south-southwest of Hartford at Haddam, Middlesex County, Connecticut. The HNP is comprised of approximately 525 acres located on the eastern bank of the Connecticut River. The facility is bordered to the southwest by the Connecticut River, to the northwest by the Salmon River, to the east by Salmon Cove, and to the northwest by residential areas (See Figure 1-1).

The Task 2 hydrogeologic characterization and this aquifer test study are focused on the main power station area, or industrial area, which is the center of former plant operations where the known and potential source areas and documented chemical and radiological releases are located. This area is comprised of approximately twenty-five (25) acres located on a six-hundred (600)-foot-wide terrace at an elevation of nearly twenty-one (21) feet above mean sea level (amsl) adjacent to the Connecticut River (See Figure 1-2). The radiological controlled area (RCA) situated within the industrial area includes the reactor containment building (RCB), the former heat source for the power plant, and other buildings used in the power generation process and waste storage. Most of the primary contamination sources are located in the central portion of the industrial area near the RCB.

The local geologic setting of the HNP is typical of the lower Connecticut River Basin regional geologic setting, characterized by unconsolidated glacio-fluvial sediments overlying a foliated crystalline bedrock sequence along the banks of the river. These Recent Age sediments and artificial fill placed in portions of the facility are referred to as the unconsolidated deposits and comprise the shallow water table aquifer that is the focus of this aquifer test. The geologic materials that comprise the unconsolidated deposits in the study area are clastic particles that range from boulders to clay. Bedrock in the vicinity of the HNP consists mainly of gneiss, amphibolite, and schist of Paleozoic Age, with localized Permian pegmatitic intrusions. Bedrock in the vicinity of the HNP is steeply dipping (near vertical in the study area), faulted, folded, and fractured. Local geologic mapping (London, 1989), rock coring, and borehole geophysical optical image logs (CYAPCo, 2003) conducted in the study area indicate the bedrock lithology beneath the industrial area is comprised of amphibolite, augite gneiss, and localized quartz intrusions. Groundwater in the bedrock occurs in secondary porosity features such as joints, fractures, and foliation planes in the bedrock under unconfined and possibly confined conditions in the subsurface beneath the facility.

The hydrogeologic setting of the CSM at HNP is currently defined by three primary hydrostratigraphic units: (1) the unconsolidated deposits, (2) the shallow bedrock, and (3) the deep bedrock. The aquifer materials in the unconsolidated deposits hydrostratigraphic unit are mainly sand, gravel and silt resulting from fluvial deposition. The man-made fill placed at the facility is mostly comprised of sand. The shallow bedrock hydrostratigraphic unit is defined as the upper ten (10) feet of the bedrock interval, immediately underlying the unconsolidated unit. Based on the understanding of hydrogeologic conditions at the facility developed prior to aquifer testing, wells screened across the unconsolidated deposits/bedrock interface or within the upper 10 feet of the bedrock display a similar hydraulic response to wells screened in the unconsolidated deposits. Wells screened 10 feet or deeper in the bedrock unit meet the current definition of the deep bedrock hydrostratigraphic unit. Groundwater flow in the unconsolidated deposits hydrostratigraphic unit exhibit a hydraulic response typical of porous media, while groundwater flow in the deep bedrock hydrostratigraphic unit is characteristic of fractured media. The groundwater flow properties of the shallow bedrock may be similar to those exhibited by the unconsolidated deposits because that interval may be intensely fractured or has a weathered rock component, possibly combined with relict fractures. The characterization of the hydrostratigraphic unit interconnectivity and delineation of unconfined and confined conditions in the study area is ongoing. Part of the overall objective of this aquifer test is to develop a more comprehensive understanding of the hydraulic response of the shallow bedrock and its interconnection with the unconsolidated deposits.

The topography and wetlands habitat existing before power plant construction are important components that greatly influence site conditions at the aquifer test study area. A steep, wooded upland area immediately behind the plant displays topographic relief of over three hundred (300) feet amsl adjacent to the industrial area boundary, with the lowermost thirty (30) to forty (40) feet of the hillside exposed as a vertical rock wall by the plant station area. This upland area limits the extent of the unconsolidated deposits in the river floodplain, and influences the groundwater flow paths in both the unconsolidated deposits and bedrock towards the river. Prior to plant construction, the topography over what is now the main plant area was characterized by a north-south trending rock promontory approximately four hundred (400) feet wide that projects from the steep hillside into a floodplain terrace along the river's edge. This promontory outcropped in areas toward the river south of the current location of the Turbine Building. Wetlands that were two hundred fifty (250) to three hundred (300) feet wide and extended approximately one thousand (1,000) feet northwest and southeast of the promontory were present before the plant was constructed. A terrace approximately one hundred fifty (150) to two hundred (200) feet wide separated both the wetlands and the promontory from the river.

The deposition and areal distribution of native sediments within the unconsolidated deposits across the plant property and the groundwater flow patterns within this hydrostratigraphic unit are strongly influenced by the original and modified physical setting of the HNP. The unconsolidated deposits are only a few feet thick near the RCB and increase to over eighty (80) feet thick around the rock promontory and toward the river. The stratigraphic section within the unconsolidated deposits is mainly the result of fluvial deposition, as such the sub-units will exhibit variable lithologies with limited lateral and vertical extent that tend to pinch out within a few hundred feet or less. The general stratigraphic sequence overlying bedrock in the aquifer test study area is interpreted as follows from the top to bottom:

- man-made fill
- wetland organic silt and/or fluvial deposits
- gravelly sand
- red fine sand
- glacial till

The red fine sand has the greatest areal extent of any nonlithified aquifer materials at the facility, particularly in the industrial area.

1.3 Aquifer Test Design Considerations

Several aquifer test design considerations had to be addressed before a study area location was chosen and testing could commence. Possible test locations were limited due to restrictions against contaminant mobilization from source areas, ongoing demolition activities restricted access to many areas at the facility, the presence of subsurface utilities, and subsurface foundations form local barriers to shallow groundwater flow. Since all of the wells completed in the unconsolidated deposits aquifer at the facility were installed with 2-inch inside diameter casing, a test well with a large enough inside diameter to accommodate a submersible pump necessary to conduct a full-scale aquifer test was needed. The test well should be screened across the saturated thickness of the unconfined aquifer to provide adequate stress for optimum test results. Also, at least one, preferably two observation wells screened in the unconfined aquifer were needed near the test well to provide drawdown data for time-drawdown and distance-drawdown relationships so the resulting analyses would be accurate and representative of the aquifer.

After reviewing site conditions, the area near the north side of the Turbine Building within the industrial area was determined to be the optimum location to stress the unconfined aquifer (See Figure 1-3). The current understanding of site conditions suggests this portion of the plant has no significant subsurface barriers impeding shallow groundwater flow and has some degree of hydraulic separation from the mat sump and dewatering well operations in the RCA. There was also both surface and subsurface access allowing installation of a test well and any additional observation wells needed. Groundwater monitoring wells screened in both the unconsolidated deposits and shallow bedrock hydrostratigraphic units were already in place within approximately one hundred (100) to three hundred (300) feet of test well AT-1, providing an adequate observation network. Observation well OB-25 was installed less than thirty (30) feet away from AT-1 to provide a nearby observation well to insure drawdown related to pumping would be measured during the test (See Figure 1-3). This portion of the facility is near the current delineation of SOC distribution trending toward the plant boundary by the Connecticut River, where additional characterization of the unconsolidated deposits and shallow bedrock hydrostratigraphic units and related groundwater plume status is beneficial towards developing an enhanced understanding of site conditions.

The drilling and installation of the test well AT-1 and the observation well OB-25 provided an opportunity for additional characterization of the unconsolidated deposits hydrostratigraphic unit. Aquifer test and observation well locations are shown in Figure 1-3.

Previous investigations provided data to depict subsurface site conditions, but some aspects of the stratigraphy developed from earlier site investigations deserved additional review, especially the lithology and thickness of the sub-units at the base of the unconsolidated deposits. A red brown sand and gravel sub-unit described as a glacial outwash deposit and considered to be the most potentially productive aquifer material at the facility, has been interpreted to have a limited distribution near the test study area. In addition, the basal till sub-unit is described as relatively thick (nearly twenty (20) feet) with a high percentage of gravel near the aquifer test study area as compared to some other portions of the facility. Therefore, there has been some speculation that the red brown sand and gravel sub-unit may have a greater areal extent at the facility than previous mapped. Drilling the test well confirmed the stratigraphy in the test study area, delineating the red fine sand and till sub-units at this location with no evidence of the red brown sand and gravel being present.

The geologic log and well construction diagram for AT-1 are provided in Figure 1-4. This geologic log describes man-made fill overlying approximately twenty-five (25) feet of medium- to fine-grained red sand with some gravel. Some coarse gravel was described at the base of red fine sand section suggesting the sub-unit is a fluvial deposit. Flowing sands were reported by the driller at thirty (30) feet below ground surface (bgs) indicating a saturated section in the fine red sand sub-unit that is likely a productive water-bearing interval. An abrupt transition to a dry, sandy silt with some clay and gravel was observed at approximately forty-one (41) feet bgs indicating the top of the till sub-unit. Beginning at forty-two (42) feet bgs, the clay content of the till increased to the total depth of the interval at forty-eight (48) feet bgs. The consistency of the till from 42 to 48 feet bgs was described as being firm to dense with some moisture noted. This lithology was described as being matrix supported and not considered as being aquifer materials. Therefore the well screen was installed from 16 to 41 feet bgs in the saturated thickness of the red fine sand sub-unit. By installing the screen across the saturated thickness of the unconsolidated deposits hydrostratigraphic unit, test well AT-1 is assumed to fully penetrate the shallow unconfined aquifer in the test study area for data analysis purposes. The screened interval in OB-25 was installed about the same depth as the central portion of the screen in AT-1. The test well installation provided additional characterization of the unconsolidated deposits hydrostratigraphic unit to refine the hydrogeologic CSM, meeting part of the overall objective of the aquifer test.

1.4 Stratigraphic Relationships at the Aquifer Test Study Area

Geologic cross sections A-A', B-B', C-C', and D-D' illustrate the stratigraphic relationships at the test area (See Figure 1-5 for the cross-section index map). Test well AT-1 is shown on all cross sections. Cross section A-A' (Figure 1-6) shows the stratigraphic sequence from the perspective of the uplands area to the Connecticut River showing the thickening of the unconsolidated deposits and the configuration of the top of bedrock topography. Cross section B-B' (Figure 1-7) shows the red fine sand pinching out to the north towards the upland area and to the south towards the bedrock promontory in the northern portion of the facility and the sub-unit's proximity to and interfingering with the gravelly sand sub-unit in the central portion of the industrial area. The pinch out of the red fine sand and other geologic sub-units against the remnant of the bedrock promontory and the barrier to groundwater flow by the Turbine Building foundation in the immediate vicinity of the aquifer test study area is illustrated by cross section C-C′ (Figure 1-8). The extensive lateral extent of the red fine sand sub-unit parallel to the Connecticut River at the facility can be inferred by looking at the cross-section index map shown in Figure 1-5. The stratigraphic relationships of the sub-units within the unconsolidated deposits hydrostratigraphic unit in the immediate vicinity of the test well and the two nearby observation wells are shown in cross section D-D′ (Figure 1-9). In this cross section, the groundwater flow boundary where the red fine sand and other sub-units in AT-1, OB-25, and MW-124 pinch out against the bedrock promontory and Turbine Building and the restriction to groundwater flow is illustrated.

2 Aquifer Test Methods

By conducting the aquifer test, several of the overall project objectives (Section 1) were achieved. Task-specific objectives of the test were two-fold. First, the data provide a means to analyze aquifer characteristics such as transmissivity, hydraulic conductivity, storage properties, and possible boundary conditions within the unconfined aquifer. Secondly, the test provided engineering design-focused data such as specific capacity, well efficiency, and potentiometric head response resulting from an induced pumping stress on the unconfined aquifer and a radius-of-influence.

For these aquifer test activities, wells within a two hundred fifty (250) foot radius of AT-1 were included in the study area (Figure 1-3). Water levels in the Connecticut River were also measured at a location to assist with the evaluation of test results (See Figure 1-3). Test activities included the following:

- Background monitoring: A baseline understanding of the groundwater hydrology with respect to rhythmic/non-rhythmic external influences (i.e., pumping, barometric changes, precipitation, and diurnal tidal effects) was established.
- Step-drawdown test: The well performance characteristics such as well efficiency, drawdown, and specific capacity over a range of discharge rates, and an optimum pumping rate was established.
- Constant-rate pumping tests: A seventy-two (72)-hour constant discharge-rate was maintained in AT-1 to evaluate of aquifer characteristics such as transmissivity, storage properties, and hydraulic influence.
- Recovery period: Data was collected after pumping to support the evaluation of aquifer properties.

Selected wells within the study area were designated as observation wells and outfitted with a self-contained pressure transducer/data logger (i.e., InSitu MiniTroll™) to support evaluation of baseline hydraulic conditions within the unconsolidated deposits and shallow bedrock aquifers. The observation wells were selected based on their proximity to AT-1, the hydrostratigraphic unit each represents, and the likelihood the locations were not impacted by barriers to groundwater flow and other plant operations. Observation well locations included OB-25, MW-124, MW-123, MW-104, MW-508S/D, and MW-109S/D. Observation well details are provided in Table 2-1.

Electronically measured water level readings were recorded at a linear sampling rate for the background monitoring period, pumping and recovery phases. Manual water level readings were collected periodically (at one (1) hour intervals) to validate operability/accuracy of the data logger/pressure transducer units during the pumping period. An InSitu BaroTroll™ unit measured barometric pressure. Precipitation data were collected on a twice-daily basis by the HNP control center. However, better resolution of precipitation events on an hourly basis was needed to best evaluate the data, so climatological data for the month of September 2004 was acquired from the Meriden Markham Municipal Airport approximately twenty-two (22) miles from HNP (Meriden Airport, 2004).

Baseline water level conditions were recorded for a two (2) week period in observation wells MW-124, MW-123, MW-104, MW-508S/D, and MW-109S/D. Corrections to water level changes due to tidal effects, rainfall, and barometric pressure changes were made based on fluctuations in these wells. Barometric efficiency (BE) refers to the aquifer's ability to transmit changes in atmospheric pressure. The Clark Method (Clark, 1967) was used to calculate the BE values for correcting water level records for analysis. Applying the Clark Method will compensate for water level fluctuations in response to all influences by following two rules:

1. When the change in barometric pressure (ΔB) is zero, neglect the corresponding value of changes in water level (ΔW) in obtaining the summation of incremental changes in water level ($\Sigma\Delta W$).
2. When ΔB and ΔW have like signs, add ΔW in obtaining $\Sigma\Delta W$; when ΔB and ΔW have unlike signs, subtract ΔW in obtaining $\Sigma\Delta W$. The value of ΔW is given a positive sign when water level is rising, and ΔB is given a positive sign when the atmospheric pressure is decreasing.

When ΔB and ΔW have like signs, add ΔW in obtaining $\Sigma\Delta W$; when ΔB and ΔW have unlike signs, subtract ΔW in obtaining $\Sigma\Delta W$. The value of ΔW is given a positive sign when water level is rising, and ΔB is given a positive sign when the atmospheric pressure is decreasing. The BE value derived for MW-124 was used to correct the water levels recorded in AT-1 and OB-25.

2.1 Step Test

The step-drawdown tests were performed by extracting groundwater at three to five different flow rates—each slightly greater (~ 50 to 100 percent greater) than the preceding rate. Each pumping period lasted sixty (60) minutes, for a total test time of two hundred-forty (240) minutes. Step-drawdown testing at AT-1 was conducted on 14 September 2004. Extracted groundwater was controlled with a ball valve and an electronic totalizer. The ball valve was used for gross control of the flow, and minor adjustments of flow were made with the control unit. Care was taken to closely monitor flow and to adjust the system so that constant rates were maintained to offset flow variations caused by (1) increased head due to greater drawdown and (2) power-source surge/creep caused by changes in power source efficiencies.

Flow rate was monitored with a totalizing flow meter connected in-line with the discharge piping upstream of the ball valve assembly. Volume-based flow rates were recorded periodically on a data form that included flow meter readings, elapsed time, time interval, total period flow, calculated flow rate, and other observations related to flow. Aquifer test well and pump details are provided in Table 2-2.

Step-drawdown tests are ideally suited for providing short-term aquifer yield and well performance characteristics. After analysis, performance results from the test were used to select an optimum discharge rate for constant-rate pumping testing.

AT-1 was pumped at discharge rates of approximately 0.5 gallons per minute (gpm), followed by stepped flows of 10 gpm, 15 gpm, and 29 gpm. The initial 0.5 gpm rate step was performed to record drawdown at this pumping rate to address the dose model estimate for the Resident Farmer Scenario outlined in the HNP License Termination Plan. The other three (3) steps were performed to determine the test pumping rate. The drawdown recorded for the 29-gpm step, the highest discharge rate for the available pump, was 0.25 feet. The aquifer could have been stressed at a greater rate to achieve greater drawdown. However, significant drawdown was developed by the 29 gpm step rate and was used as the test discharge rate in order to proceed with the constant-rate test.

2.2 Constant-Rate Test

Groundwater was pumped from AT-1 at a constant rate of 29 gpm over a period of three (3) days starting on 15 September 2004 at 1320 hours and ending on 18 September 2004 at 1320 hours-a total of 4,320 minutes. These test data were used for interpretation of aquifer characteristics. Rainfall was significant at the tail end of the test starting at approximately 4,000 minutes with 2.73-inches reported by the HNP control room and 3.9-inches recorded at the Meriden Airport (2004) to near the end of the test.

Recovery data were collected after completing the pumping period for MW-643UD. Recovery period water levels were monitored with the self-contained data logger/pressure transducers units (MiniTrolls™) following the same frequency of data collection (linear time) used during the pumping period.

2.3 Data Analysis and Presentation

Analysis and interpretation of the aquifer test data followed accepted industry standards using the general principle of the decision-tree thought process presented in the American Society of Testing and Materials (ASTM) guidance (ASTM, 2004). This guide covers an integral part of a series of standards that are being prepared on the in situ determination of hydraulic properties of aquifer systems by single- or multiple-well tests including selection of analytical test methods. There is not a set procedure or specific course of action for determination of aquifer properties, but rather an organized set of information to review and a series of options available to analyze and interpret aquifer test data. In summary, best professional judgement was applied to the review, test method selection, analysis, and interpretation of the aquifer test data. AQTESOLV™ software was used to analyze the step and constant-rate test data. Procedures for data analysis are provided in Analysis and Evaluation of Pumping Test Data (Kruseman and de Ridder, 1994).
Step-drawdown analysis was performed using the Hantush-Bierschenk method of analysis. Step-drawdown data from AT-1 were plotted versus time. The inverse of specific capacities from each of the successive steps was plotted versus corresponding step flow rates to develop a well performance curve. From the well performance curve, yields can be estimated for any selected drawdown. Optimum yield is thus based on achieving a desired pumping level within the well that influences an appropriate radius within the aquifer.

A number of methods were used to analyze the constant-rate pumping test results from AT-1. These included methods developed by Theis (1935), Cooper-Jacob (1946) and Neuman

(1975) for unconfined conditions. The purpose for using multiple methods was to support evaluation of the aquifer conditions. Each of these methods utilizes drawdown versus time, and results are plotted in semi-log format.

Distance drawdown plots were generated and analyzed as a comparison to the time-drawdown analyses. These distance drawdown plots provide an averaged representation of hydraulic responses that are sometimes influenced by heterogeneities and anisotropic conditions within the aquifer. Theoretically, hydraulic response within the aquifer due to radial flow to the pumping well should be logarithmically related and inversely proportional to transmissivity. The greater the drawdown in a well, the lower the transmissivity. Drawdown along any axis from a pumping well should be predictable, assuming homogeneous, isotropic conditions. Variations from a predictable trend indicate a relative level of heterogeneity and anisotropy. For example, heterogeneity and anisotropic conditions are to be expected in fractured media.

3 Aquifer Test Results

Results for the step-drawdown and constant-rate pumping tests of well AT-1 are provided and briefly discussed in the following sections. The hydrographs generated for the Connecticut River, test well AT-1, and observation wells before, during, and after pumping provide data for interpretation of drawdown and hydrogeologic conditions. Uncorrected water level data were plotted to show background river and groundwater level conditions prior to testing and extended to also show response to step, and constant-rate test pumping, and well recovery after testing. Rainfall data (Meriden Airport, 2004) were plotted to show the well response to the significant recharge event that occurred near the end of the constant-rate test pumping on 18 September 2004 associated with the remnant of the tropical storm system that produced Hurricane Francis.

3.1 Evaluation of Baseline Water Level Conditions

The baseline period is defined as from 1 September 2004 to just before the step test commenced at 1340 on 14 September 2004. These data provide useful observations of hydrogeologic conditions to assist interpretation of the aquifer test results.
The data logger/pressure transducer placed in the Connecticut River provided an overview of diurnal tidal effects that impact groundwater levels at the facility. The river water level hydrograph illustrates the two tidal cycles that occur daily (See Figure 3-1). Baseline conditions for the river were determined by the water levels recorded from 14 September 2004 to midday on 18 September 2004. After three (3) to four (4) inches of rain fell in the vicinity of the study area during the first half of 18 September 2004, water levels rose from baseline levels and did not recover to earlier water elevations until 25 September 2004. The Connecticut River hydrograph shows a rise in low tide to nearly two (2) feet higher and high tide to nearly one (1) foot higher than the baseline established prior to testing during the three days that followed the rainfall. This rise in river water levels is interpreted to result from rainfall and baseflow recharge that occurred upstream of the facility related to the significant rainfall event that was the remnant of Hurricane Francis.

Hydrographs developed for aquifer test observation wells exhibit varied hydraulic responses during the baseline period before aquifer testing commenced. The water levels shown in the observation well hydrographs are uncorrected feet of water that are measured above the pressure transducer. These water level data profiles provide the best evaluations of hydraulic response in the wells.

Tidal effects were noted by water level fluctuations in MW-508D, MW109D, and MW-109S (See Figures 3-2, 3-3, and 3-4, respectively). All three wells are located near the Connecticut River and tidal impacts are expected. MW-508D and MW-109D are screened in the shallow bedrock, which typically exhibits a hydraulic response impacted by tidal fluctuations at the facility. MW-109S is a shallow well screened in the gravelly sand sub-unit of the unconsolidated deposits. The hydrograph profiles during the baseline period in all three wells exhibit a similar trend suggesting a natural recession. The water levels in the three wells may respond to the rainfall event that took place during 8 September 2004 and 9 September 2004 by a small increase in elevation, but the hydraulic response may be explained by the rise in river water level during the same timeframe.

The hydrograph generated for MW-124 (Figure 3-5) exhibits a similar trend during the baseline period as wells MW-508D, MW-109D, and MW-109S, except there is no indication of tidal fluctuations. This observation well is screened in the red fine sand sub-unit of the unconsolidated deposits, which generally does not show tidal influence on groundwater levels in the industrial area inland from the Connecticut River boundary.

The MW-508S hydrograph (Figure 3-6) depicts a hydraulic response unlike any other well monitored for the test, exhibiting an extended, gentle slope likely related to a natural recession trend during the baseline period prior to testing. The slight rise in water level elevations on 8 September 2004 is possibly the result of a rainfall event or a rise in river water levels at that time. MW-508S is a shallow well screened primarily in the silty sand sub-unit overlying the silt and organics sub-unit at the top of the unconsolidated deposits hydrostratigraphic unit (See Figure 1-7, cross section B-B'). The silt and organics at the base of the screened interval in MW-508S may act as an aquitard, resulting in the well monitoring a perched water table in the silty sand sub-unit, possibly explaining the unique hydraulic response measured in the well.

The hydraulic response exhibited by the well MW-104S hydrograph is also unique compared to other wells (See Figure 3-7). This shallow well is screened across the unconsolidated deposits and shallow bedrock interface near the RCA. The hydraulic response recorded in the well does not show any indication of tidal impacts, but it does display more water level fluctuation than the other observation well during the baseline period. The sharp increase in water levels that occurred on 8 September 2004 is likely in response to the rainfall that occurred during the same timeframe. This step-like pattern suggests an immediate response to recharge events in this well.

The hydrograph generated for MW-123 (Figure 3-8) shows a subtle downward trend for the week's worth of data collected prior to testing. There is some indication of subtle tidal effects in the water level profiles, which is likely because the well is screened in the shallow bedrock. There is no baseline water level data available for AT-1 or OB-25 because these wells were installed several days before testing commenced.

3.2 Analysis of Drawdown

Drawdown data for both the step test and the constant-rate test are represented as time-drawdown relationships with uncorrected water level data shown on the graphs. Precipitation or rainfall that occurred during the test is also incorporated to assist data interpretation.

3.2.1 Step Test

The time-drawdown response for AT-1 and adjacent observation well OB-25 is shown in Figure 3-9. The drawdown for the 0.5 gpm step indicate minimal drawdown (approximately 0.02 feet) in AT-1 with no discernable drawdown resulting from this discharge rate measured in 0B-25 twenty-nine (29) feet away. The 10, 15, and 29 gpm steps reveal an incremental increase in drawdown from 0.50 feet and 0.1 feet at 10 gpm, 0.84 feet and 0.18

feet at 15 gpm, and 1.55 feet and 0.31 feet at 29 gpm at AT-1 and OB-25, respectively, as illustrated in Figure 3-9.

The specific capacity for AT-1 was calculated at 25 gpm/ft for the 0.5 gpm step rate, 18.52 gpm/ft at the 10 gpm step rate, 17.65 gpm/ft at the 15 gpm step rate, and 18.47 gpm/ft at the 29 gpm step rate. The step drawdown test results that were recorded for AT-1 are shown in Figure 3-10 and the AT-1 well performance test results are illustrated in Figure 3-11.

3.2.2 Constant-Rate Test

The hydrograph generated for test well AT-1 shows a pumping test response with drawdown approximately two and a half (2.5) feet resulting from the constant-rate test (See Figure 3-12). The recovery began immediately after the constant-rate test ceased and exhibits a typical response of recovery in a test well.

Hydrographs generated for observation wells OB-25 and MW-124 both illustrate a pumping test response with one and one tenth (1.1) feet and eight tenths (0.8) feet of drawdown recorded as shown in Figures 3-13 and 3-5, respectively. The recovery period was immediate upon termination of test pumping operations in both wells. The drawdown and recovery period recorded in both nearby observation wells indicates a pumping test response within this sub-unit greater than one hundred nine (109) feet from AT-1.

A subtle pumping test response was likely exhibited in the hydrographs generated for MW-508D, MW-109D, and MW-109S after the constant-rate test commenced (See Figures 3-2, 3-3, and 3-4, respectively). The response measured in these wells during the step test and approximately the first ten and a half (10.5) hours of the constant-rate test resembled a natural recession trend. However, the hydrograph in all three wells display a similar abrupt drop in water levels just before midnight of 16 September 2004. This trend that continues in the hydrographs for all three wells until test-pumping operations are terminated though the change in the water levels at this point may also result from the rainfall recharge event noted at approximately the same time. The recovery period in all wells is likely impacted by the rainfall event that occurred at the end of the test. The amplitude of the tidal fluctuations in MW-109D and MW-109S was subdued for nearly two (2) days after pumping ceased compared to the rest of the hydrograph, probably the result of the rainfall and rapid river water level rise. The hydraulic response in these suggests that the influence of pumping in AT-1 extends approximately two hundred fifty (250) towards the south and northwest in the study area. Possible hydraulic communication between the unconsolidated deposits and shallow bedrock hydrostratigraphic units is suggested by the test response in MW508D and MW109D.

Water levels recorded in observation wells MW-508S, MW-104S, and MW-123, do not indicate a pumping test response was developed in these wells during the constant-rate test pumping period, rather the hydrographs suggests hydraulic response more representative of a natural recession (See Figures 3-6, 3-7, and 3-8, respectively). In addition, the recovery periods in these three wells coincide with directly with the rainfall recharge event rather than end of pumping operations. The hydrograph generated for MW-508S shows no response to pumping but exhibits a sharp increase in water levels after the rainfall event. This hydraulic response shown in MW-508S may be the result of immediate recharge in a perched water table aquifer. The hydraulic response in MW-123 and MW-104S are interpreted to be characteristic of fractured media, as indicated by the high head response to the recharge event likely resulting from low storativity. Water levels in MW-104S exhibited a similar response during a rainfall event during the baseline-monitoring period. The hydraulic responses in MW-508S, MW-104S, and MW-123 do not indicate impact from the aquifer test pumping to the north in the shallow bedrock and to the northwest in the shallow depth intervals of the unconsolidated deposits. High clay content in dense till overlying bedrock in MW-104S and MW-123 and the silt and organics bed underlying the screen interval in MW-508S likely exhibits aquitard properties and forms a negative flow boundary impeding any hydraulic impact from pumping at AT-1.

The hydrographs developed for the constant-rate test evaluation provide adequate data to interpret hydrogeologic conditions in the study area. Based on the interpretation of water level response to pumping, wells AT-1, OB-25, MW-124, MW-109S, and MW-109D were selected for further analysis and type-curve fitting to determine aquifer properties. The radius of influence, the hydraulic interaction of the geologic sub-units within the unconsolidated deposits, and the interconnection of the unconsolidated deposits and the shallow bedrock hydrostratigraphic units in portions of the study area can be inferred from test results.

3.3 Aquifer Hydraulic Properties

A comprehensive summary of aquifer characteristics is provided in Table 3-1. The hydraulic parameters were calculated using AQTESOLV™ software. The uncorrected and corrected drawdown curves for all the test and observation wells are included as Appendix 1. The type curves generated for drawdown analysis for are provided as Appendix 2.

The hydraulic properties of the unconfined aquifer geologic sub-units are as follows:

- Red fine sand: Transmissivity associated with the aquifer-pumping test at AT-1 provided a range of values from 450 ft^2/day to 718 ft^2/day in the red fine sand sub-unit of the unconsolidated deposits. The variability of these results represents hydraulic response due to heterogeneity of the aquifer characteristics surrounding OB-25, MW-124, MW-109S, and MW-109D, and the pumping well AT-1, using multiple methods of analysis. Storativity values ranged from 0.014 (unitless) to 0.327.
- Gravelly sand: Transmissivity values of the gravelly sand sub-unit at MW-109S ranged from 772 to 854 ft^2/day using the varied methods of analysis. Storativity values ranged from 0.016 to 0.019.
- Shallow Bedrock: The transmissivity values for the shallow bedrock aquifer in MW-109D ranged from 733 to 768 ft^2/day and the storativity values ranged from 0.014 to 0.015.

The hydraulic parameters calculated do not vary widely. The aquifer properties associated with the red fine sand and gravelly sand sub-units of the unconsolidated deposits and the shallow bedrock aquifer in the vicinity of well pair MW-109S/D are very similar.

3.4 Drawdown Effects

Using the distance drawdown data, AT-1 was determined to have a well efficiency of 100 percent. The distance versus drawdown plot using the corrected water level data (See Figure 3-14) reveals a hypothetical radius of influence of more than one thousand feet from the test well AT-1 at zero (0) drawdown, which is the radial distance from AT-1 where there is no hydraulic influence from the well. In an unconfined aquifer, an actual radius of influence would extend approximately two hundred (200) to three hundred (300) feet. Based on the test results, the actual radius of influence developed by pumping in the unconfined aquifer in the study area is l likely limited by physical and hydraulic boundary conditions.

Distinct drawdown patterns, as evidenced by an apparent change in slope of the water elevation in the test and observation wells during pumping and recovery, is provided on the hydrographs for AT-1, OB-25, and MW-124. Less obvious slope changes during the pumping and recovery periods were seen on hydrographs for MW-508S, MW-109D, and MW-109S. The subtle hydraulic response in these wells during the pumping period is interpreted as the result of pumping operations because of the steepening of the water elevation profile from a probable natural recession trend. The hydraulic response exhibited in MW-508S, MW-109D, and MW-109S suggests impact from pumping at AT-1 and delineates the radius of influence developed in the unconfined aquifer test study area.

The limits of hydraulic impact from pumping in the unconfined aquifer at the study area are due to several types of boundary conditions including:

- The Connecticut River is a positive recharge boundary.
- Subsurface building foundations are negative flow boundaries.
- Unconsolidated sediments pinching out against bedrock are negative flow boundaries.

High clay content (as in the till and silt and organics geologic sub-units) providing aquitard properties in certain locales creates a negative flow boundary condition.

Modeling and continued refinement of data will establish the unconfined aquifer flow regime and characteristics.

4 Summary and Conclusions

The objectives of the unconsolidated deposits aquifer test were met. These objectives include:

- Reliable estimates of aquifer properties generated from data collected by the step test and constant-rate aquifer test. This data and the resulting interpretations are provided in this report.
- Additional characterization of the unconsolidated deposits hydrostratigraphic unit was accomplished by describing continuous split spoon samples collected during the installation of test well AT-1, providing better resolution of the nature of the red fine sand and glacial till sub-units in an area where contaminant plumes have been delineated in the northern portion of the industrial area. As a result, additional groundwater-monitoring well locations are now available in this area.
- Qualitative indications of hydraulic interconnection (or lack thereof) between various sub-units of the unconsolidated deposits and the shallow bedrock were obtained by collecting water level data during the aquifer tests.

Specific findings include:

- The radius of influence developed by the 29 gpm constant rate pumping test is interpreted to be within approximately two hundred fifty (250) feet from AT-1 based on the subtle hydraulic response in MW-508S.
- Boundary conditions limit the impact developed by pumping in the unconfined aquifer. Negative flow boundaries such as subsurface building foundations, limits of the transmissive hydrostratigraphic sub-units, and the clay content of the various hydrostratigraphic sub-units likely restrict groundwater flow and hydraulic response in certain locales in the test study area.
- Hydraulic connection between the unconsolidated deposits and shallow bedrock hydrostratigraphic units is interpreted by test results in the study area.

Hydraulic properties determined by testing are:

- Average transmissivities calculated for the red fine sand sub-unit are 656 $feet^2$/day for AT-1, 698 $feet^2$/day for OB-25, and 526 $feet^2$/day for MW-124.
- The average transmissivity calculated for the gravelly sand sub-unit is 808 $feet^2$/day.
- The average transmissivity calculated for the shallow bedrock sub-unit is 753 $feet^2$/day.

In summary, the unconsolidated aquifer test data results provide a greater understanding of hydrogeologic conditions in the industrial area at HNP. These data and the resulting interpretations allow further refinement of the hydrogeological CSM at the facility and will support groundwater modeling efforts. Executing this task completes the work sub-element requirements concerning additional hydrogeologic characterization at the facility by drilling, soil sampling, and hydraulic conductivity testing of the overburden set forth as a requirement of the Phase 2 Hydrogeologic Investigation Work Plan.

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Tables

Table 2-1
Observation Well Details

Observation Well	Total Depth (feet bgs)	Screened Interval (feet bgs)	Hydrostratigraphic Unit Monitored	Distance from Test Well (feet)
MW-104S	23	13 - 23	Unconsolidated Deposits and Shallow Bedrock	247[1]
MW-123	33.5	23.5 – 33.5	Shallow Bedrock	191.6[1]
MW-124	24	11 - 24	Unconsolidated Deposits	109.1[2]
MW-109S	24.5	14.5 – 24.5	Unconsolidated Deposits	195.7[1]
MW-109D	54.5	44.5 – 54.5	Shallow Bedrock	195.7[1]
MW-508S	20	10 - 20	Unconsolidated Deposits	227.9[1]
MW-508D	70	60 - 70	Shallow Bedrock	227.9[1]
OB-25	25	15 - 25	Unconsolidated Deposits	29.1[2]

Note:
[1] Distances estimated using GIS or CAD.
[2] Distances measured with measuring tape.

TABLE 2-2
Aquifer Test Well Components

Component	Dimension
Duration of Test	Step Test – 4 steps over 7 hours; Constant-Rate Test 72 Hours
Pumping Well (AT-1) Total Depth	41 ft bgs
Test Well Screened Interval	16 – 41 ft bgs
Hydrostratigraphic Unit	Unconsolidated Deposits
Test well casing and screen diameter	5-inches
Test well screen configuration	0.020-inch slot vee-wire wrapped
Pump Capacity	Rated 25gpm, 1/2Hp, 110Vac, Actual pumping rate 29 gpm
Pump placement	Intake at 41bgs

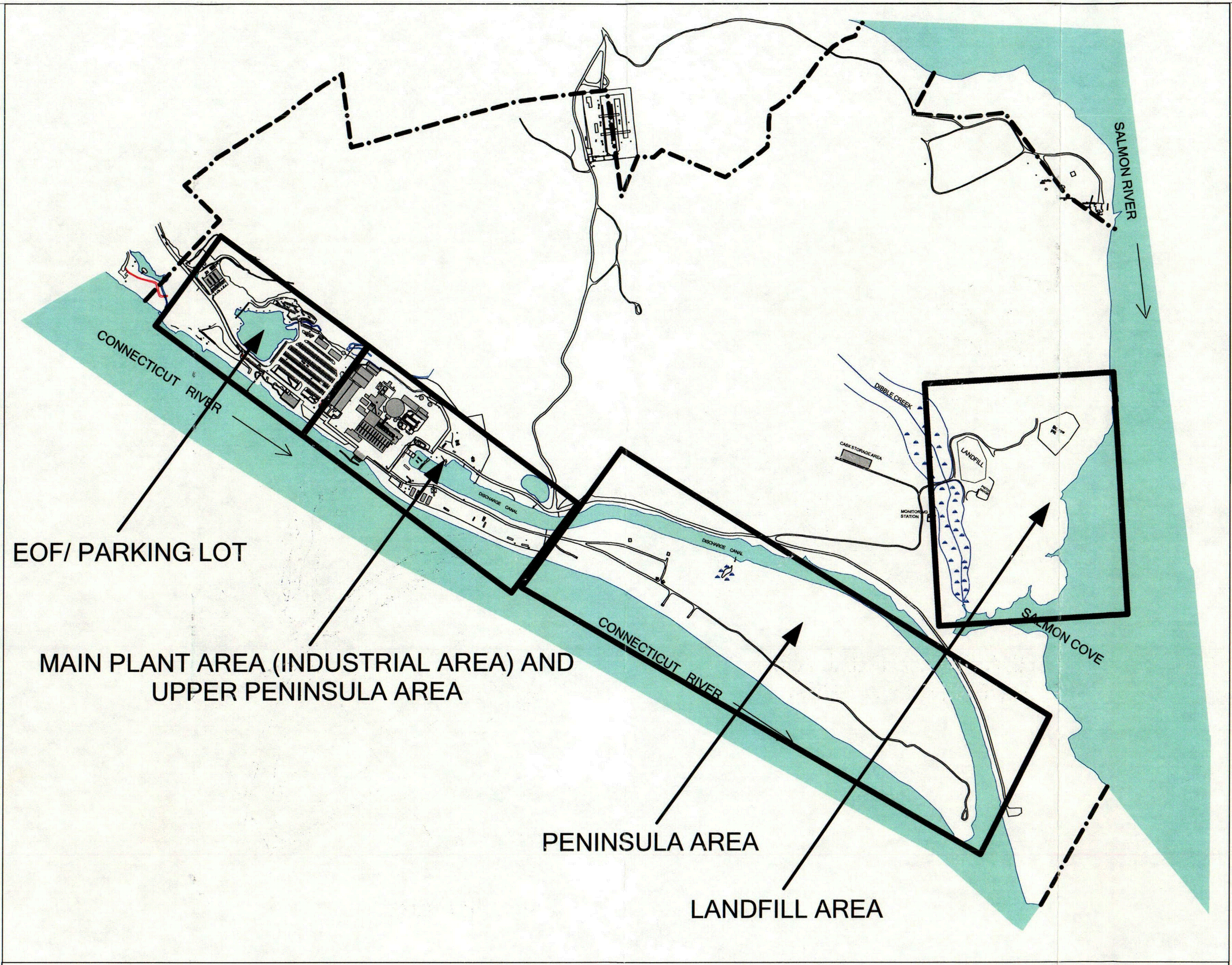
Table 3-1
AQTESOLV Test Results

Well	Screened Interval (feet)	Geologic Materials	Aquifer Thickness (feet)	Radius from Pumping Well (ft)	Orientation from Pumping Well	Method of Analysis (T, CJ, N)[1]	Transmissivity (ft^2/min)	Transmissivity (ft^2/day)	Hydraulic Conductivity (cm/sec)	Storativity (unitless)	Specific Yield (unitless)
AT-1	16 to 41	Red fine SAND	25	0.344	na	T	0.4984	718		na	na
						C-J	0.4159	599		na	na
						GeoMean		[redacted]	[redacted]		
OB-25	15 to 25	Red fine SAND	17	29.1	NE	T	0.5243	755		0.318	na
						C-J	0.4741	683		0.327	na
						N	0.4575	659		0.043	[redacted]
						GeoMean		[redacted]	[redacted]		
MW-124	11 to 24	Red fine SAND	6	109.1	NE	T	0.4797	691		0.048	na
						C-J	0.3246	467		0.056	na
						N	0.3124	450		0.014	0.061
						GeoMean		[redacted]	[redacted]		
MW-104S [2]	13 to 23	gravelly SAND overlying Till and Bedrock	11	243	N						
MW-109S	14.5 to 24.5	gravelly SAND	7	195.7	ESE	T	0.5570	802		0.019	na
						C-J	0.5359	772		0.016	na
						N	0.5928	854		0.017	0.001
						GeoMean		[redacted]	[redacted]		
MW-109D	44.5 to 54.5	shallow bedrock	38	196	ESE	T	0.5093	733		0.015	na
						C-J	0.5333	768		0.014	na
						N	0.5268	759		0.015	na
						GeoMean		[redacted]	[redacted]		
MW-123 [2]	23.5 to 33.5	shallow bedrock	17	191.6	N						
MW-508S [2]	10 to 20	silty SAND overlying SILTS & Organics (perched conditions)	19	227.9	WNW						
MW-508D [2]	60 to 70	shallow bedrock	76	227	WNW						

[1] Method of analysis: Theis (Unconfined); Cooper-Jacob (Unconfined); Neuman (Unconfined). All methods utilized AQTESOLV™ version 3.01 aquifer test analysis software by HydroSOLV, Inc.

[2] Well response appears to be impacted by natural recession of potentiometric surface; therefore, results may not be representative of true aquifer characteristics. Results not shown.

Figures



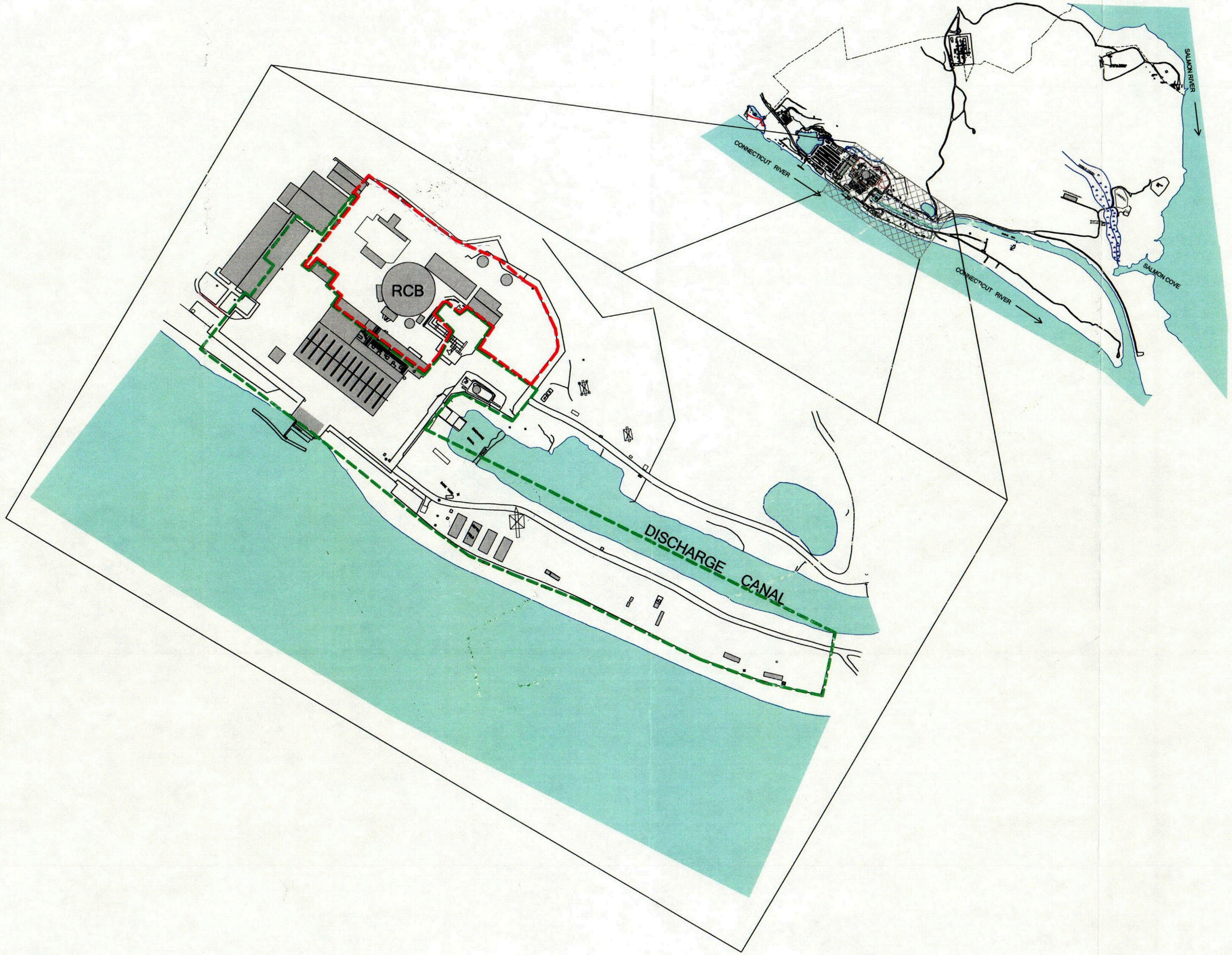
BUILDINGS
SWAMP
SURFACE WATER
PROPERTY LINE
N

CH2MHILL

FIGURE 1-1
HNP PROPERTY
CONNECTICUT YANKEE HNP
HADDAM NECK, CT

NOV2204_AQ Test_figure1-1_t.creel_HNP Property.tcw

C01



BUILDINGS
SWAMP
SURFACE WATER
INDUSTRIAL AREA BOUNDRY
RCA BOUNDRY
N

CH2MHILL

FIGURE 1-2

MAIN PLANT AREA(INDUSTRIAL AREA) AND UPPER PENINSULA AREA
CONNECTICUT YANKEE HNP
HADDAM NECK, CT

NOV2204_AQ Test_figure1-2_industial area_t.creel.tcw

C02

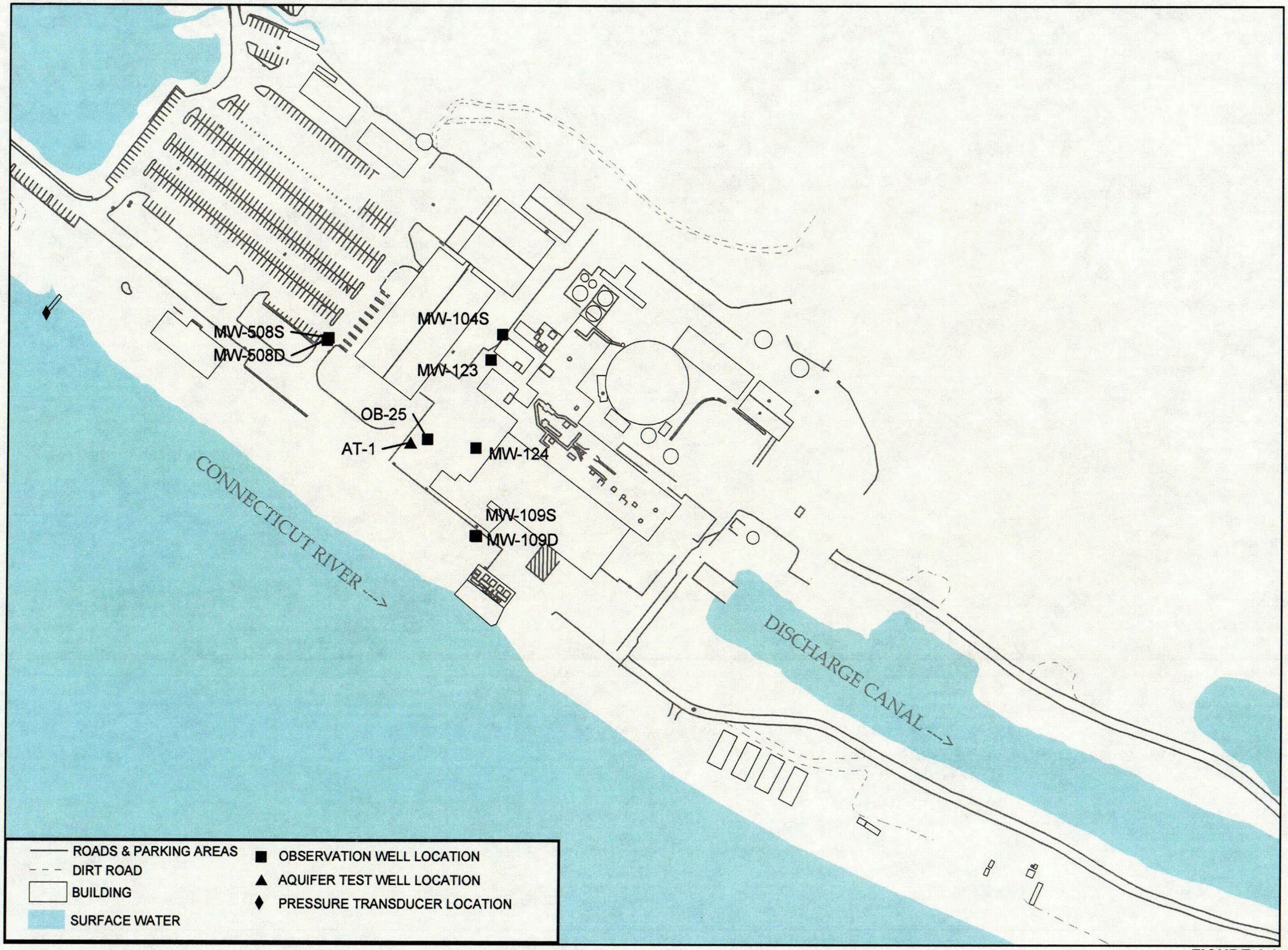


FIGURE 1-3

TEST WELL, OBSERVATION WELLS AND PRESSURE TRANSDUCER LOCATIONS THAT SUPPORT THE UNCONFINED AQUIFER TEST

CONNECTICUT YANKEE HNP

HADDAM NECK, CT

CH2MHILL

N

0 125 250 Feet

\\Boomer\H\projects3\CT_Yankee\MXD\GW_Monitoring_Report_9_04\AQUIFER_TEST_WELL_rev.mxd BBODINSO 12/02/2004

C03

Figure 1-4

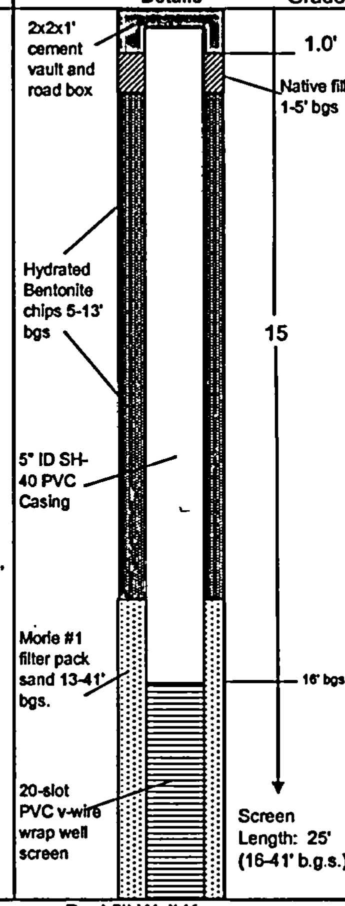
CYAPCO CY Decommissioning Project	Subsurface Log	Hole No.: AT-1 Sheet: 1 of 4	Date started: 9/7/2004 Date Finished: 9/9/2004

Client: Connecticut Yankee	Drilling method: 8 1/4" hollow stem auger (cut and wash, 4 inch inside diameter casing at depth below 32)
Location: Haddam CT.	Sampling method: Split spoon (140 lb hammer)

Project No.: P. Manager: Charles Miller	Drilling Co.: ADT Geologist: Matt Darois	Driller: Marty Harrington D. Helper: Eric Ramey Drill Rig: B-59 and F-10	Weather:

Depth (ft.)	Sample No.	Sample Depth (ft.)	Sample Blows per 6"	Sample "N"	Sample Recovery (ft.)	Sample Description
	1	4-6'	4			Light brown m to f sand fill, no odor, dry.
			6			
			7			
			14			
6				13	1.4'	
	2	6-8'	20			6-7': same as above. 7-8' f to m dark brown silty sand, trace m gravel. Buried A/B horizon (native fill), no odor, dry.
			21			
			32			
			41			
8				53	1.35'	
	3	8-10'	25			8-9.7': 1" of black organics rich sand at aprox 8'. Fine to vf red-brown silty sand with trace m-f gravel. 2 medium size amphibolite gneiss cobbles from 9-9.5', moist, no odor. 9.7-10': abrupt change in lithology to a light brown m to f sand, trace silt, poorly sorted, slight iron staining at the lithologic
			24			
			37			
			54			
				61	1.4'	
10						
	4	10-12'	22			light brown-red m to f sand, coarser and more sorted than above. Coarse gravel fragments at 10.3', dry, no odor.
			37			
			57			
			31			
12				94	1.3'	
	5	12-14'	11			Red-brown m to fine sand, well sorted, trace rounded medium gravel, dry, no odor, very loose (similar to above).
			11			
			12			
			12			
16				23	1.4	
	6	14-16'	12			Same as above.
			10			
			12			
			11			
				22	1.2	

Well Details / Grade



Sample Types:
S=Split Spoon: 2" dia.
R= Rock Core: ______
T= Shelby Tube: ______
O = ______

Backfill Well Key
Concrete
Sand
Native Fill
Bentonite

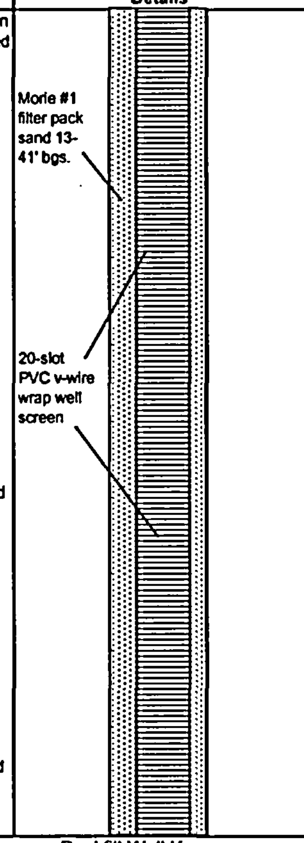
KEY: AND= 50%, SOME=49-30%, LITTLE=29-10%, TRACE=<10% C= COARSE, M= MEDIUM, F= FINE

N = ASTM D1586

CYAPCO *CY Decommissioning Project*	**Subsurface Log**	**Hole No.:** AT-1 **Sheet:** 2 of 4	**Date started:** 9/7/2004 **Date Finished:** 9/9/2004
Client: Connecticut Yankee **Location:** Haddam CT.	**Drilling method:** 8 1/4" hollow stem auger (cut and wash, 4 inch inside diameter casing at depth below 32) **Sampling method:** Split spoon (140 lb hammer)		
Project No.: **P. Manager:** Charles Miller	**Drilling Co.:** ADT **Geologist:** Matt Darois	**Driller:** Marty Harrington **D. Helper:** Eric Ramey **Drill Rig:** B-59 and F-10	**Weather:**

Depth (ft.)	Sample No.	Depth (ft.)	Blows per 6"	"N"	Recovery (ft.)	Sample Description
	7	16-18'	5			Similar to above, bottom 0.25' of spoon is wet, sub angular m to f gravel lodged in tip of shoe.
			7			
			7			
			10			
18				14	1.25'	
	8	18-20'	14			Gray-brown m to fine sand, sand is micacious (abundant feldspar frags.), trace sub angular fine gravel, saturated, no odor.
			6			
			4			
			5			
20				10	1.1'	
	9	20-22'	2			Gray m to f sand, well sorted, less feldspar-mica than above, saturated, no odor.
			2			
			5			
			6			
22				7	1.0'	
	10	22-24'	15			Same as above.
			10			
			12			
			15			
24				22	1.2'	
	11	24-26'	16			Same as above, Bottom 0.1' f to m red to light brown sand, trace silt, wet, no odor.
			26			
			21			
			20			
26				47	1.8'	
	12	26-28'	7			red-brown fine sand, firm, well sorted, wet, no odor.
			22			
			33			
			34			
28				55	1.8'	
	13	28-30'	4			Red-brown fine sand, less firm than above, well sorted, no coarser grained materials in sample.
			15			
			20			
			18			
				35	1.5'	

Well Details



Sample Types:
S=Split Spoon: 2" dia. T= Shelby Tube:
R= Rock Core: O =

N = ASTM D1586

Backfill Well Key
Concrete Native Fill
Sand Bentonite

KEY: AND= 50%, SOME=49-30%, LITTLE=29-10%, TRACE=<10% C= COARSE, M= MEDIUM, F= FINE

CYAPCO
CY Decommissioning Project

Subsurface Log

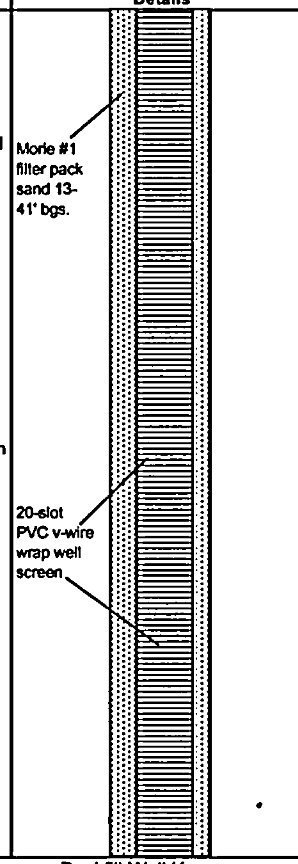
Hole No.: AT-1 | Sheet: 3 of 4
Date started: 9/7/2004 | Date Finished: 9/9/2004

Client: Connecticut Yankee
Location: Haddam CT.
Drilling method: 8 1/4" hollow stem auger (cut and wash, 4 inch inside diameter casing at depth below 32)
Sampling method: Split spoon (140 lb hammer)

Project No.:
P. Manager: Charles Miller
Drilling Co.: ADT
Geologist: Matt Darois
Driller: Marty Harrington
D. Helper: Eric Ramey
Drill Rig: B-59 and F-10
Weather:

Depth (ft.)	Sample No.	Sample Depth (ft.)	Sample Blows per 6"	Sample "N"	Sample Recovery (ft.)	Sample Description
	14	30-32'	5			Same as above.
			12			
			23			
			33			
32				35	1.5'	
						Flowing sands at aprox. 30' b.g.s. sand locked the 4.25" augers. The augers were removed from the boring and drilling was advanced using drive and wash inside 4" temp casing.
	15	32-34'	15			m to f red-brown sand, firm, trace fine subangular gravel, trace silt. Less sorted than above, no odor.
			23			
			26			
			28			
34'				49	1.1'	
	16	34-36'	18			f to m red-brown sand, some silt, some m to f rounded sub angular gravel (basalt frags.), no odor, angular sand stone coarse gravel frag in top of spoon @ aprox 34' bgs, firm.
			25			
			29			
			41			
36'				54	1.15'	
	17	36-38'	16			f to m red-brown sand, some silt, trace fine sub angular gravel, trace rounded gravel, sorted to poorly sorted, less firm than above, no odor.
			18			
			21			
			21			
38'				39	1.0'	
	18	38-40'	17			f to m silty red brown sand, some fine subangular gravel, poorly sorted, no odor. Gravel consists of basalt, red sandstone and quartz-albite frags.
			18			
			16			
			17			
40'				34	1.25'	

Well Details



Sample Types:
S=Split Spoon: 2" dia.
T= Shelby Tube:
R= Rock Core:
O =

Backfill Well Key: Concrete, Native Fill, Sand, Bentonite

KEY: AND= 50%, SOME=49-30%, LITTLE=29-10%, TRACE=<10% C= COARSE, M= MEDIUM, F= FINE

N = ASTM D1586

CYAPCO CY Decommissioning Project	**Subsurface Log**	**Hole No.:** AT-1 **Sheet:** 4 of 4	**Date started:** 9/7/2004 **Date Finished:** 9/9/2004

Client: Connecticut Yankee

Location: Haddam CT.

Drilling method: 8 1/4" hollow stem auger (cut and wash, 4 inch inside diameter casing at depth below 32)

Sampling method: Split spoon (140 lb hammer)

Project No.:

P. Manager: Charles Miller

Drilling Co.: ADT

Geologist: Matt Darois

Driller: Marty Harrington

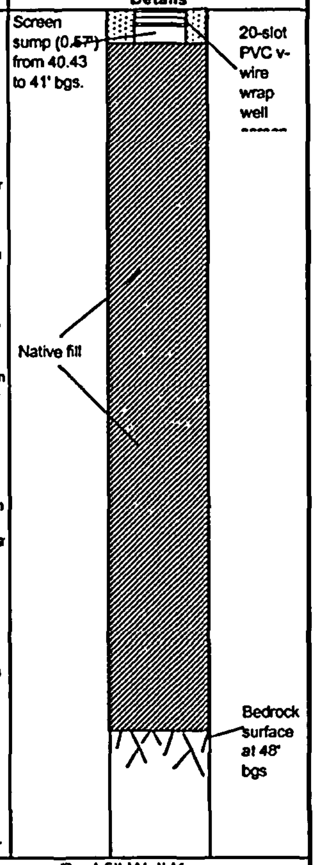
D. Helper: Eric Ramey

Drill Rig: B-59 and F-10

Weather:

Depth (ft.)	Sample No.	Sample Depth (ft.)	Sample Blows per 6"	Sample "N"	Sample Recovery (ft.)	Sample Description
	19	40-42'	10			Top 0.65' of spoon (40-41.5') silty f red-brown sand, dry. Bottom 0.5' of spoon: Abrupt change in lithology to Till, brown to Dark brown moist, abundant rounded to subangular coarse sand and fine gravel consisting of weathered gneiss and basalt frags, till is loose consisting of more course groined materials than fines, fine fraction of till is dark brown to black in color. Dark color material in till fines may be organic silts/clays.
			15			
			24			
			19			
42				39	1.15'	
	20	42-44'	26			42-43.6' bgs: same as above. Bottom of spoon transitions to a brown sandy silt some angular to subangular f to m gravel, some clay. 43.6-44' bgs: glacio-fluvial deposits consisting of 1-2" lenses of brown sandy silty, some angular to subangular f to m gravel, some clay (20-30% clayey silt) and red clayey silt (25-35% clay) lenses 1-2" thick with trace subangular medium gravel. Gravel within glacio-fluvial deposits are predominately gneiss frags, material is firm to dense, moist evidence of redox and iron staining throughout sample.
			25			
			32			
			26			
44				57	1.1'	
	21	44-46'	25			Till, light brown to olive brown sandy dense till. Abundant angular to subangular m to c gravel, abundant m cobbles, gravel and cobble fraction consists of quartz-albite and gneiss frags throughout sample. 0.1' lens of red clayey silt a aprox 44.5' bgs embedded in till, moist, till is mottled with evidence of Redox and Iron staining.
			32			
			59			
			70			
46'				91	1.1	
	22	46-48'	57			Top of spoon: Till, light gray to olive-brown till and weathered rock, abundant coarse gravel and cobble frags consisting of gneiss and albite-quartz, 0.1' layer of red-brown clayey silt at aprox 47' above albite-quartz cobble/weathered rock frag. Sample may be weathered bedrock with more resistant rock remaining as gravel and cobble frags. The matrix of the finer grained materials consists of biotite, quartz and albite (pegmatite) indicative of the regional bedrock formation. Sample is dense, moist.
			53			
			62			
			100/3"			
48'				115	1.25	

Well Details



Sample Types:

S=Split Spoon: 2" dia.

R= Rock Core:

T= Shelby Tube:

O =

N = ASTM D1586

Backfill Well Key

Concrete | Native Fill | Sand | Bentonite

KEY: AND= 50%, SOME=49-30%, LITTLE=29-10%, TRACE=<10% C= COARSE, M= MEDIUM, F= FINE

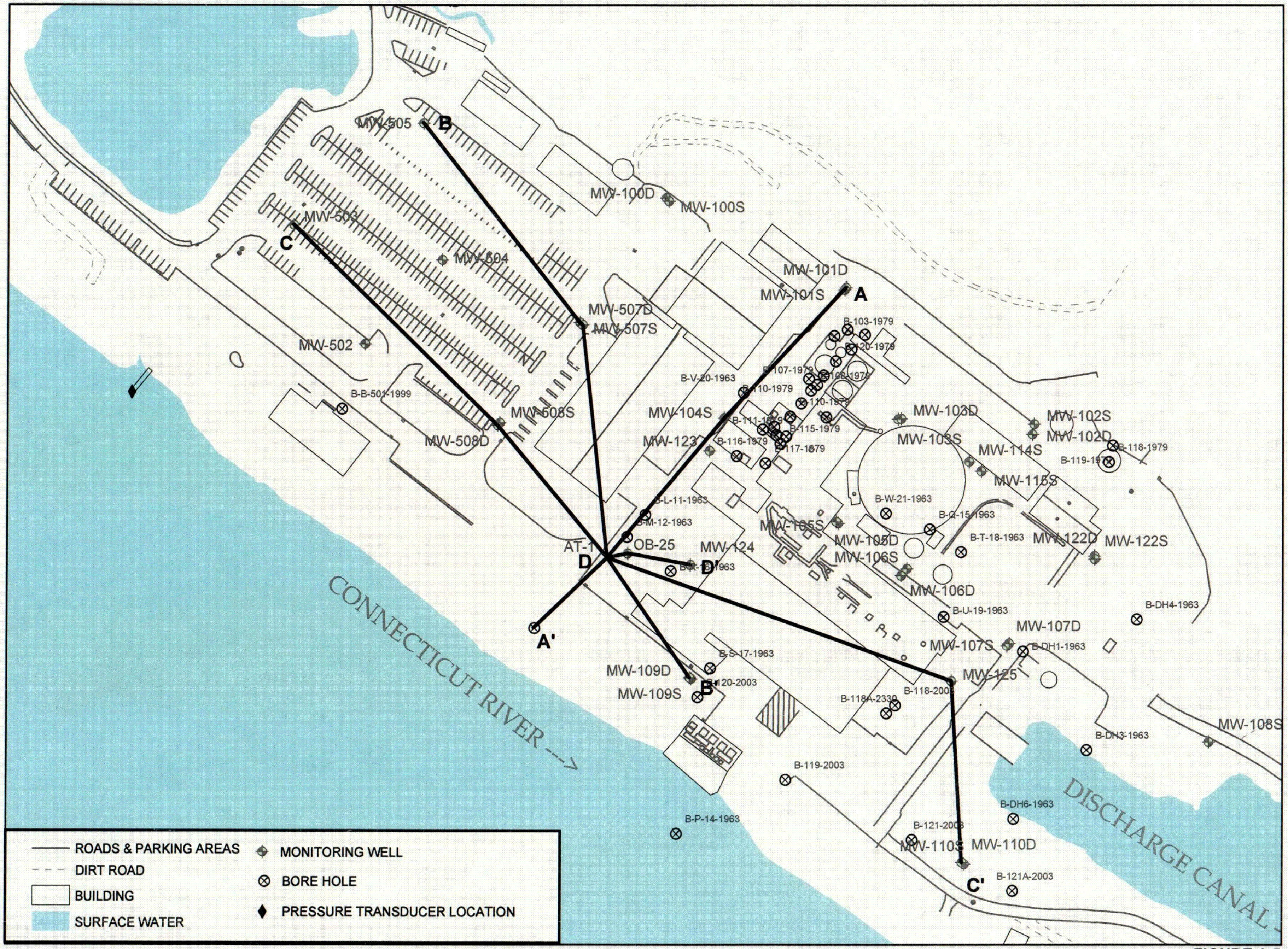


FIGURE 1-5
AQUIFER TEST CROSS SECTION INDEX MAP
CONNECTICUT YANKEE HNP
HADDAM NECK, CT

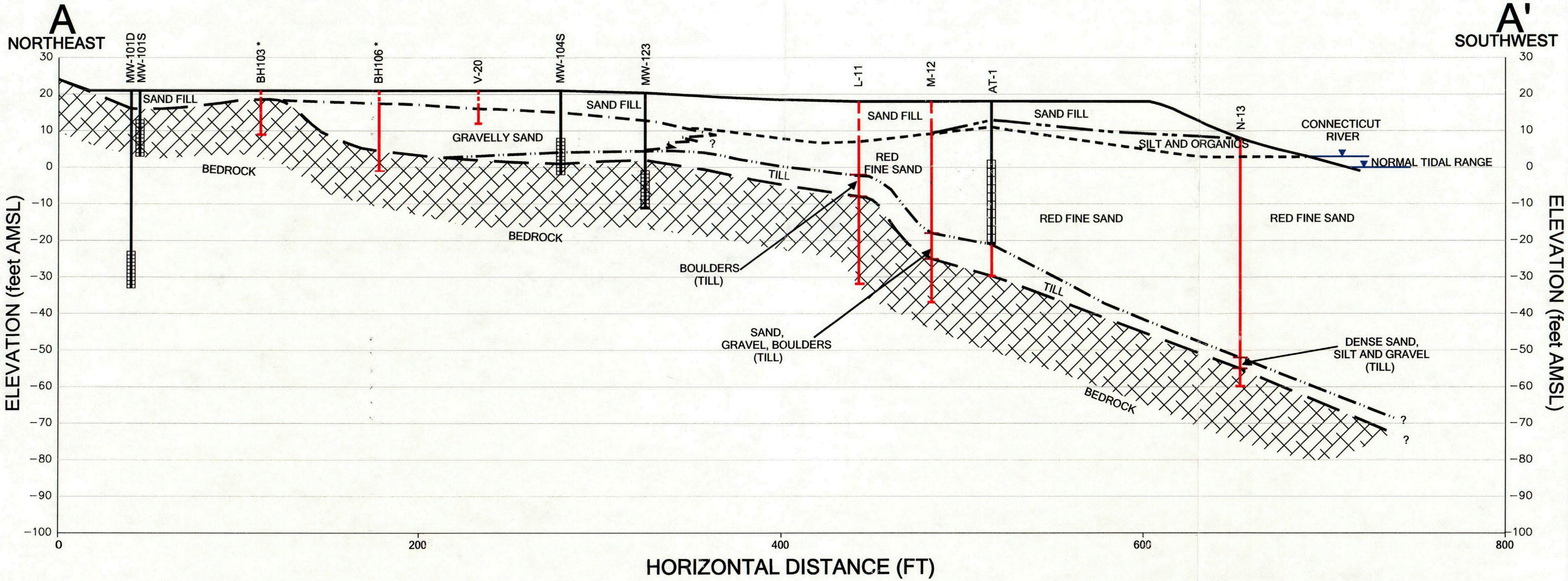
CH2MHILL

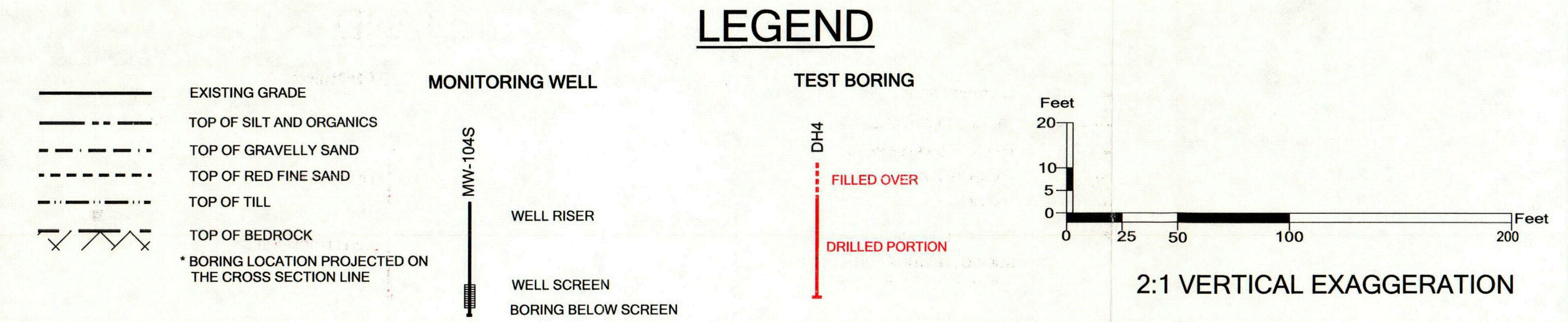
N

0 125 250 Feet

\\boomer\H\projects3\CT_Yankee\MXD\GW_Monitoring_Report_9_04\Cross_Section_Index.mxd BBODINSO 11/22/2004

C04



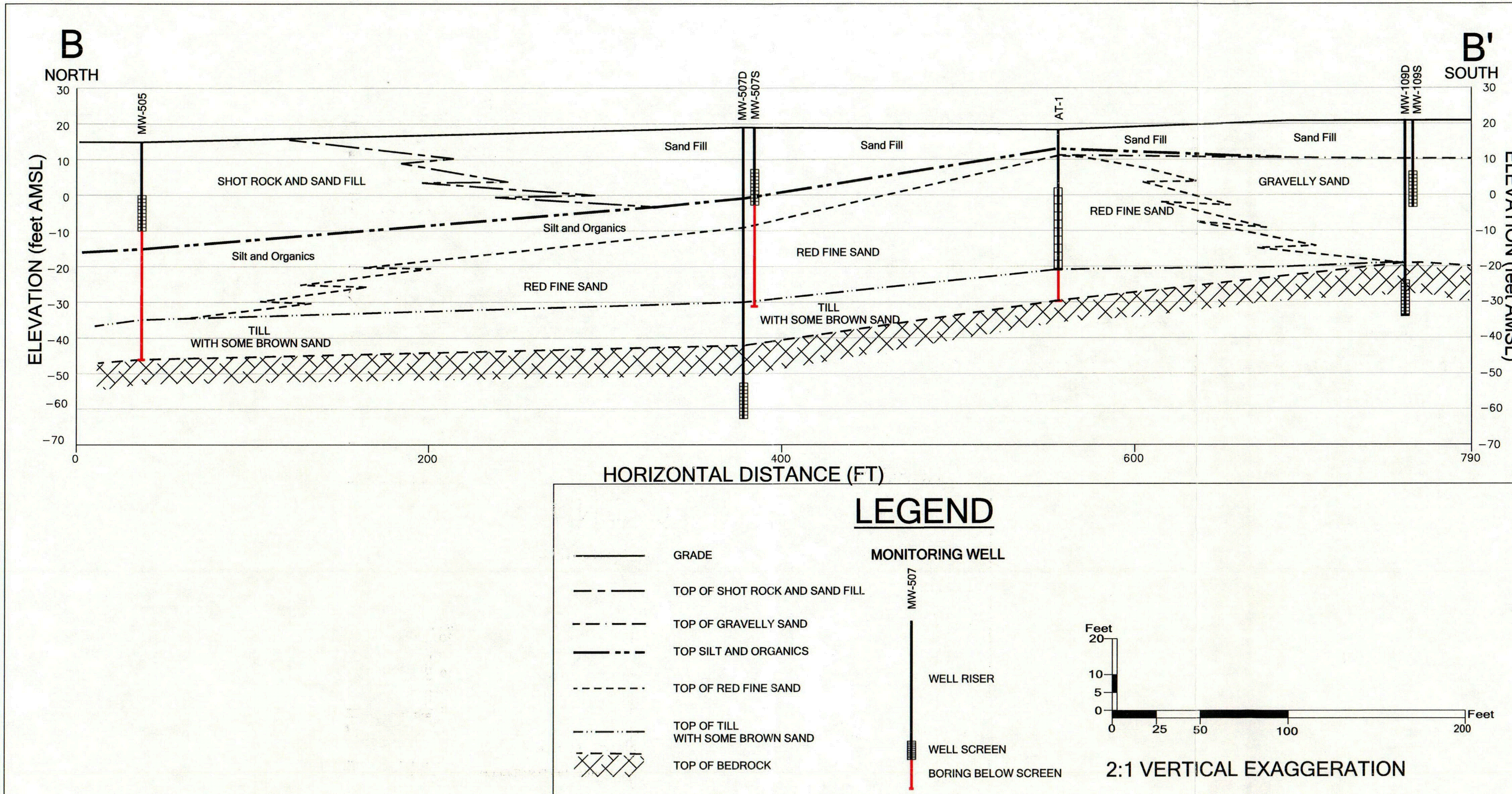


NOTES: (1) CROSS-SECTION MODIFIED FROM MALCOM PIRNIE (2002)
(2) CROSS-SECTIONS COMPILED FROM BORINGS COMPLETED DURING PHASES OF SITE INVESTIGATIONS (1963, 1998) REVISED VERSION OF L-L' DEVELOPED FOR TASK 1 REPORT (ADDITION OF AT-1) WHICH WAS INSTALLED IN SEPT 2004

FIGURE 1-6
CROSS SECTION A-A'
CONNECTICUT YANKEE HNP
HADDAM NECK, CT

12feb04_IA XS L-L'.tcw

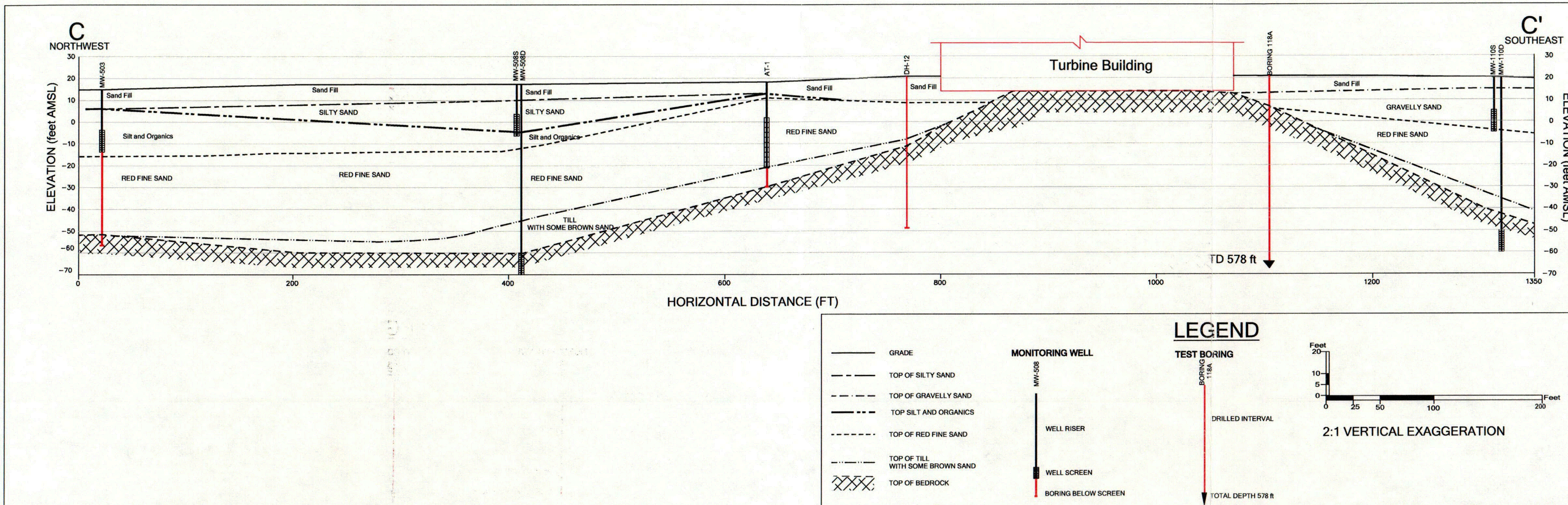
C05



NOTES: (1) CROSS SECTIONS COMPILED FROM BORINGS COMPLETED DURING SEVERAL PHASES OF SITE INVESTIGATION (1963, 1998, 2003)

FIGURE 1-7
CROSS SECTION B-B'
CONNECTICUT YANKEE HNP
HADDAM NECK, CT

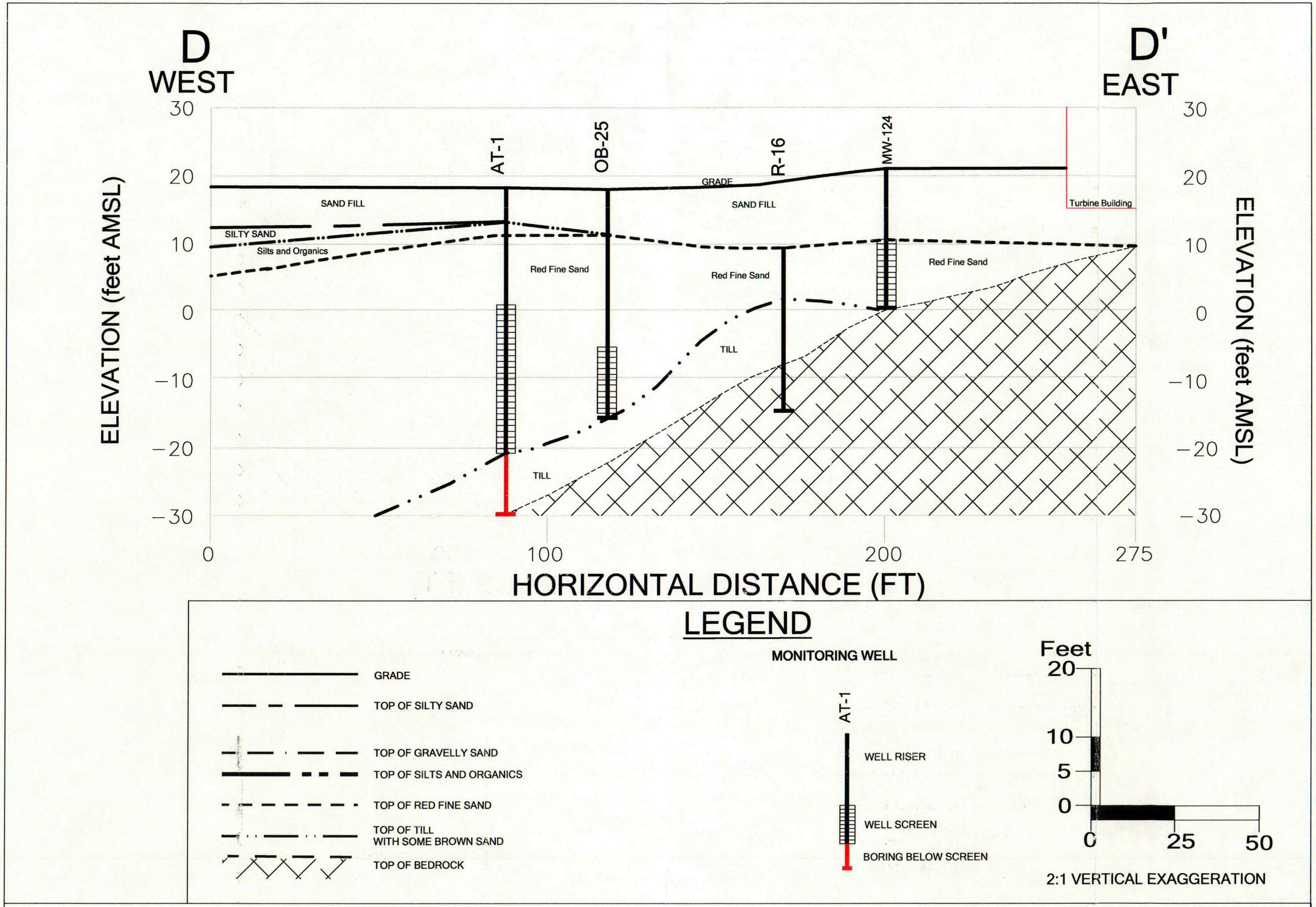
C06



NOTES: (1) CROSS SECTION MODIFIED FROM MALCOLM PIRNIE (2002)
(2) CROSS SECTIONS COMPILED FROM BORINGS COMPLETED DURING SEVERAL PHASES OF SITE INVESTIGATION (1963, 1998, 2004)
(3) BORING DH-12 WAS DRILLED PRIOR TO PLANT CONSTRUCTION WITH THE ORIGINAL GROUND SURFACE OVERLAIN WITH FILL

FIGURE 1-8
CROSS SECTION C-C'
CONNECTICUT YANKEE HNP
HADDAM NECK, CT

C07

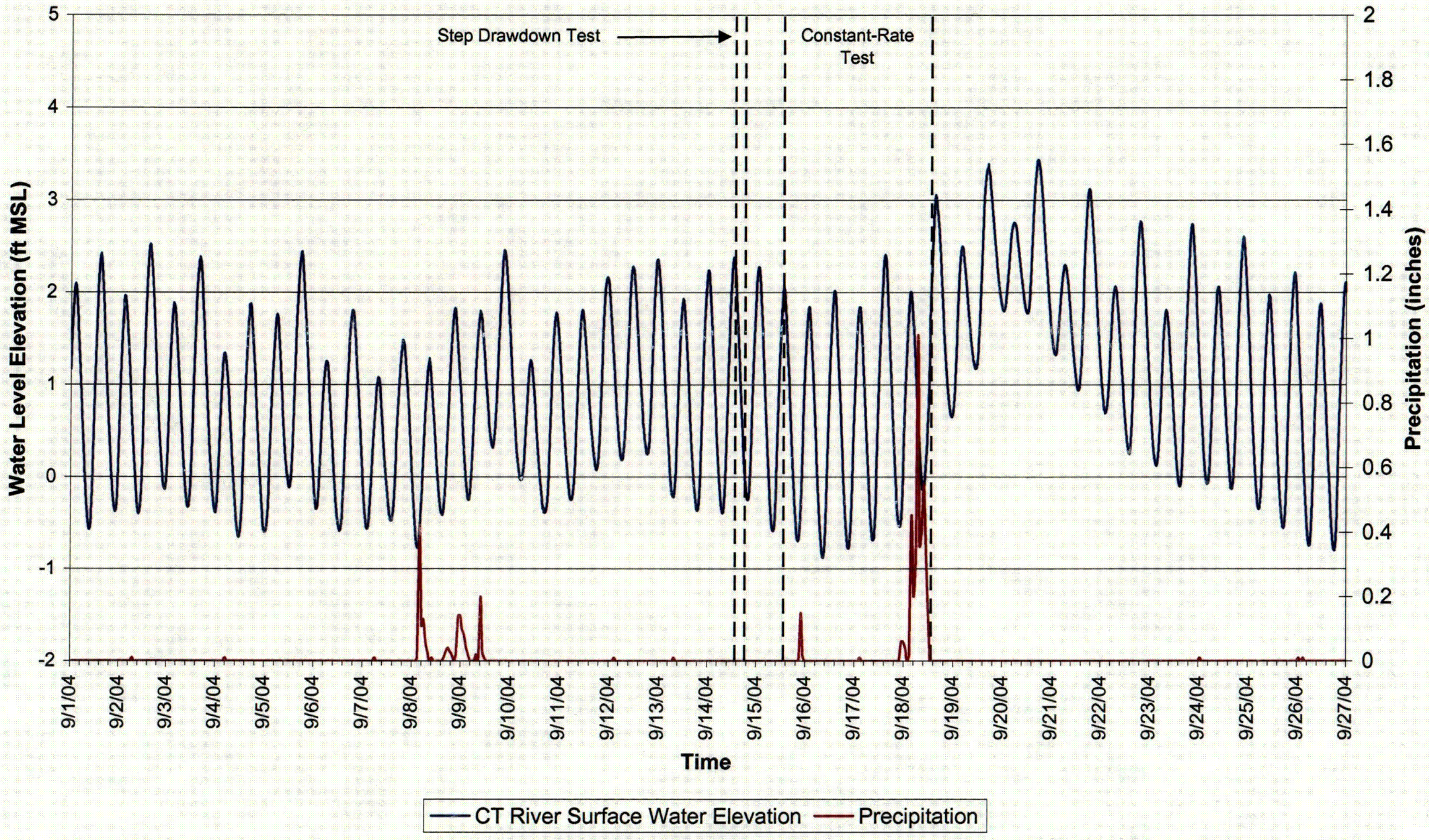


NOTES: 1) Cross section compiled from borings completed during several phases of site investigation (1963, 2003, 2004)

2) Boring R-16 was drilled prior to plant construction with original ground surface overlain with fill.

FIGURE 1-9
CROSS SECTION D-D'
CONNECTICUT YANKEE HNP
HADDAM NECK, CT

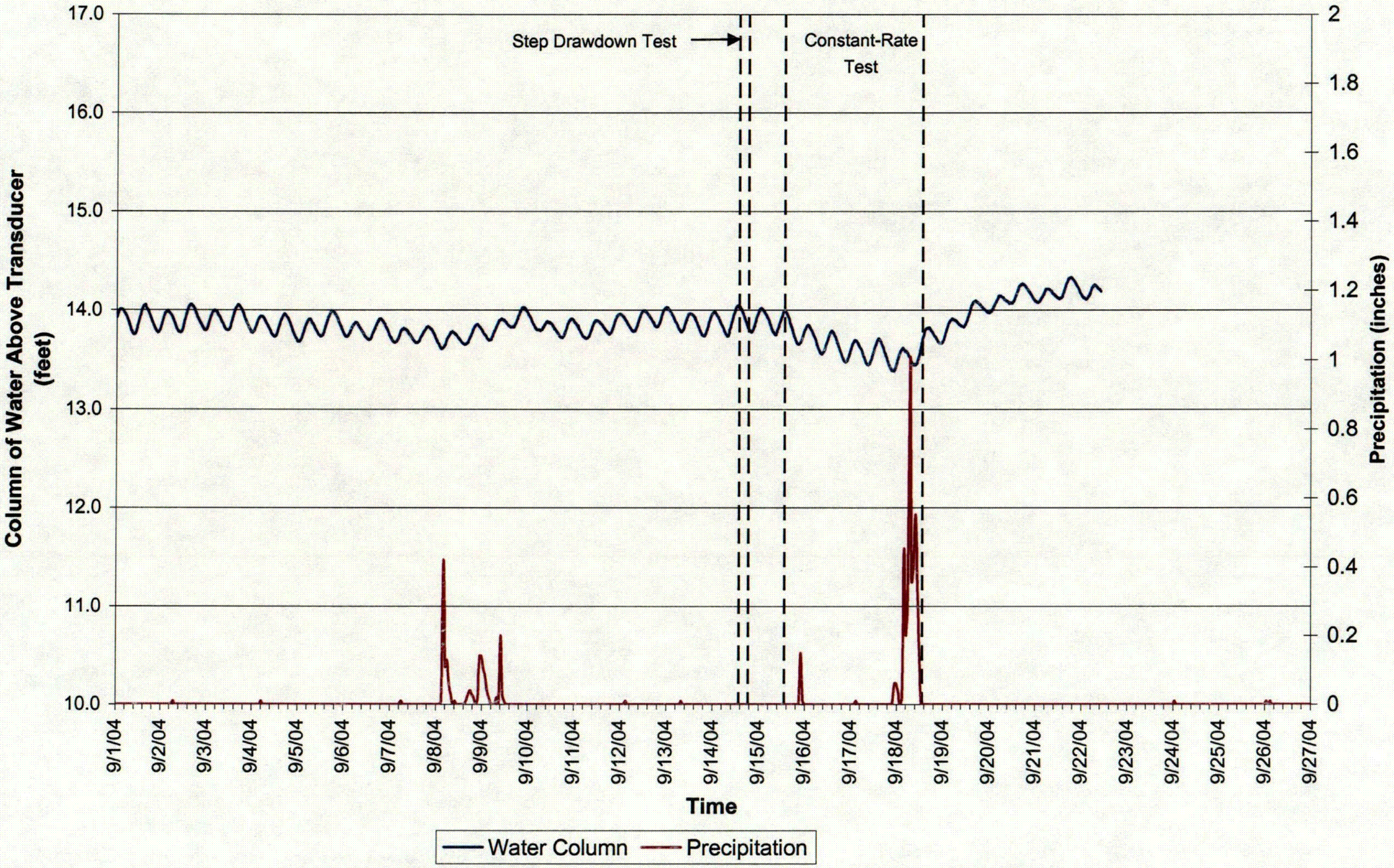
Figure 3-1
Connecticut River Water Level Elevation During Aquifer Test
September 2004



Note: September 2004 precipitation data obtained from Meriden Markham Municipal Airport approximately 20 miles west of the HNP.

C09

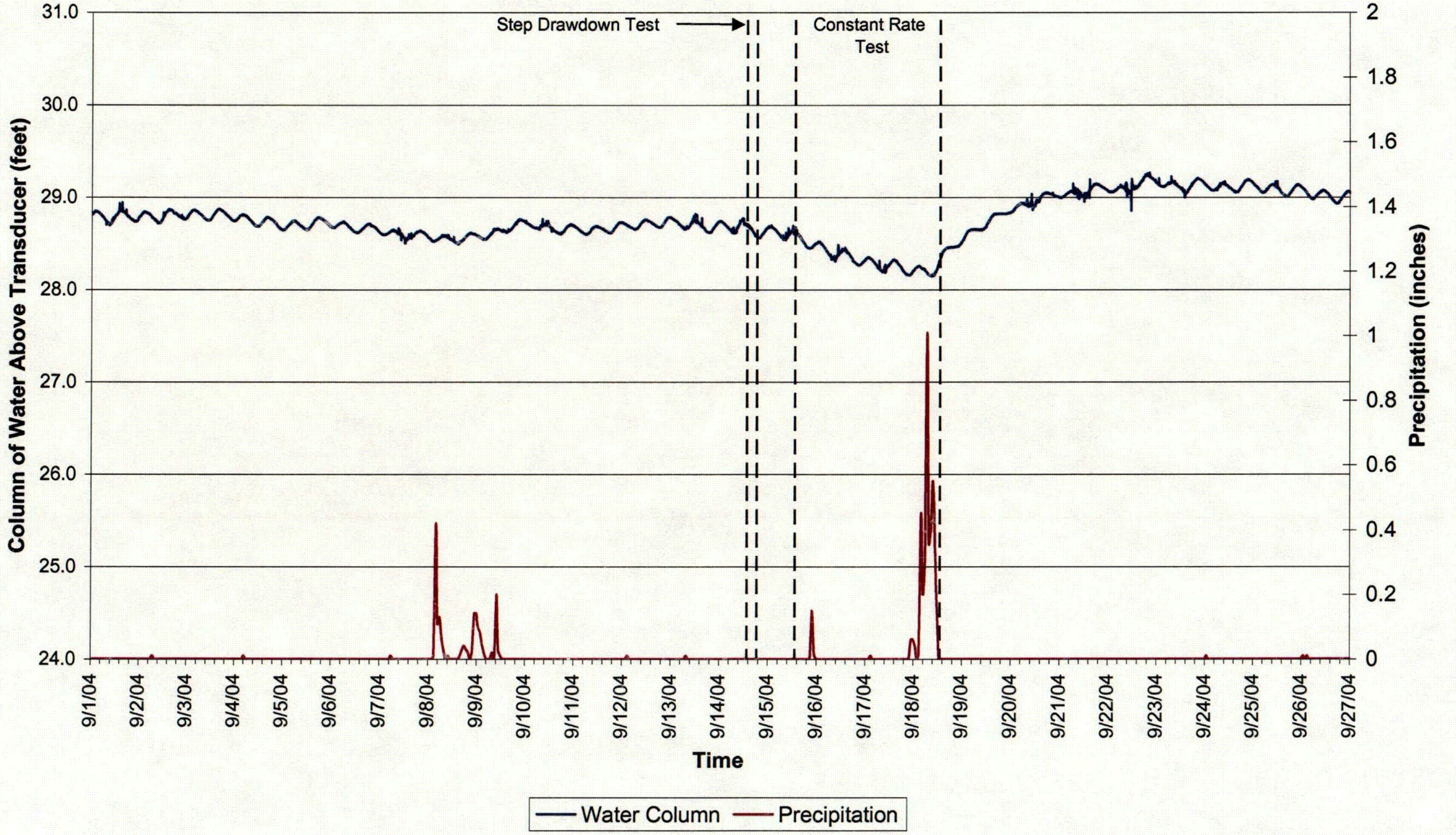
Figure 3-2
MW-508D Response to Step Drawdown and Constant-Rate Pumping Tests
September 2004



Note: September 2004 precipitation data obtained from Meriden Markham Municipal Airport approximately 20 miles west of the HNP.

C10

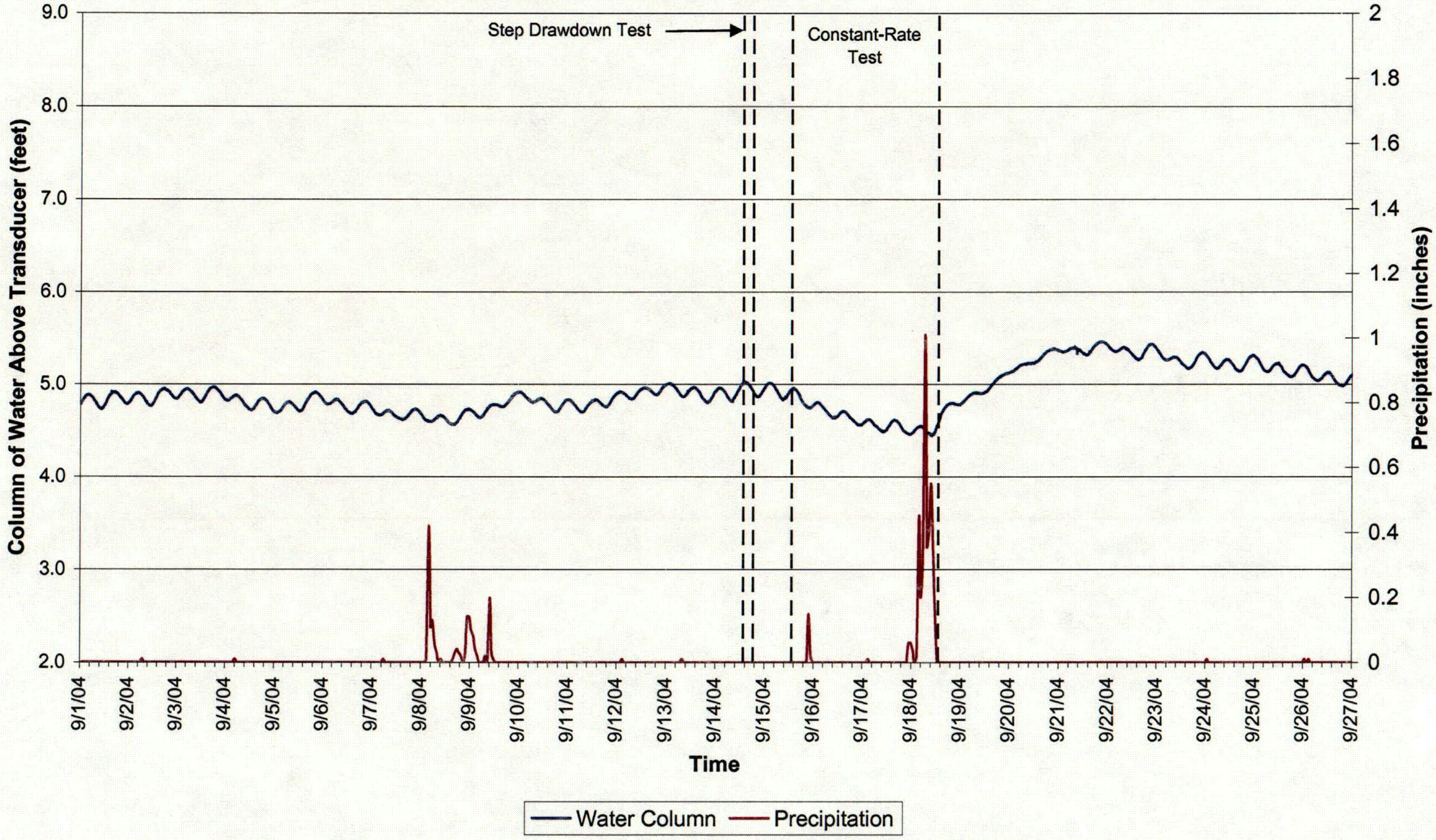
Figure 3-3
MW-109D Response to Step Drawdown and Constant-Rate Pumping Tests
September 2004



Note: September 2004 precipitation data obtained from Meriden Markham Municipal Airport approximately 20 miles west of the HNP.

C11

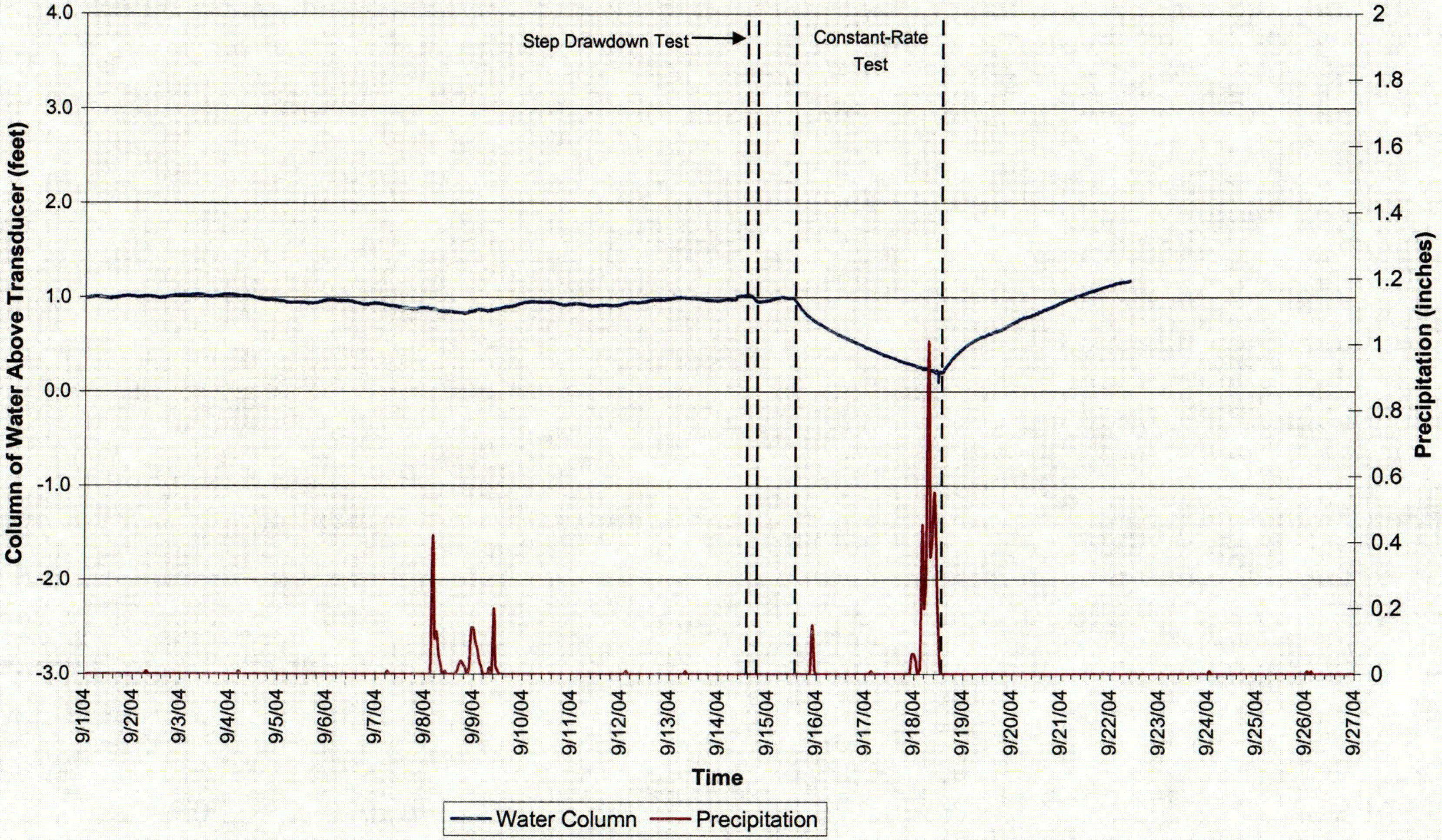
Figure 3-4
MW-109S Response to Step Drawdown and Constant-Rate Pumping Tests
September 2004



Note: September 2004 precipitation data obtained from Meriden Markham Municipal Airport approximately 20 miles west of the HNP.

C12

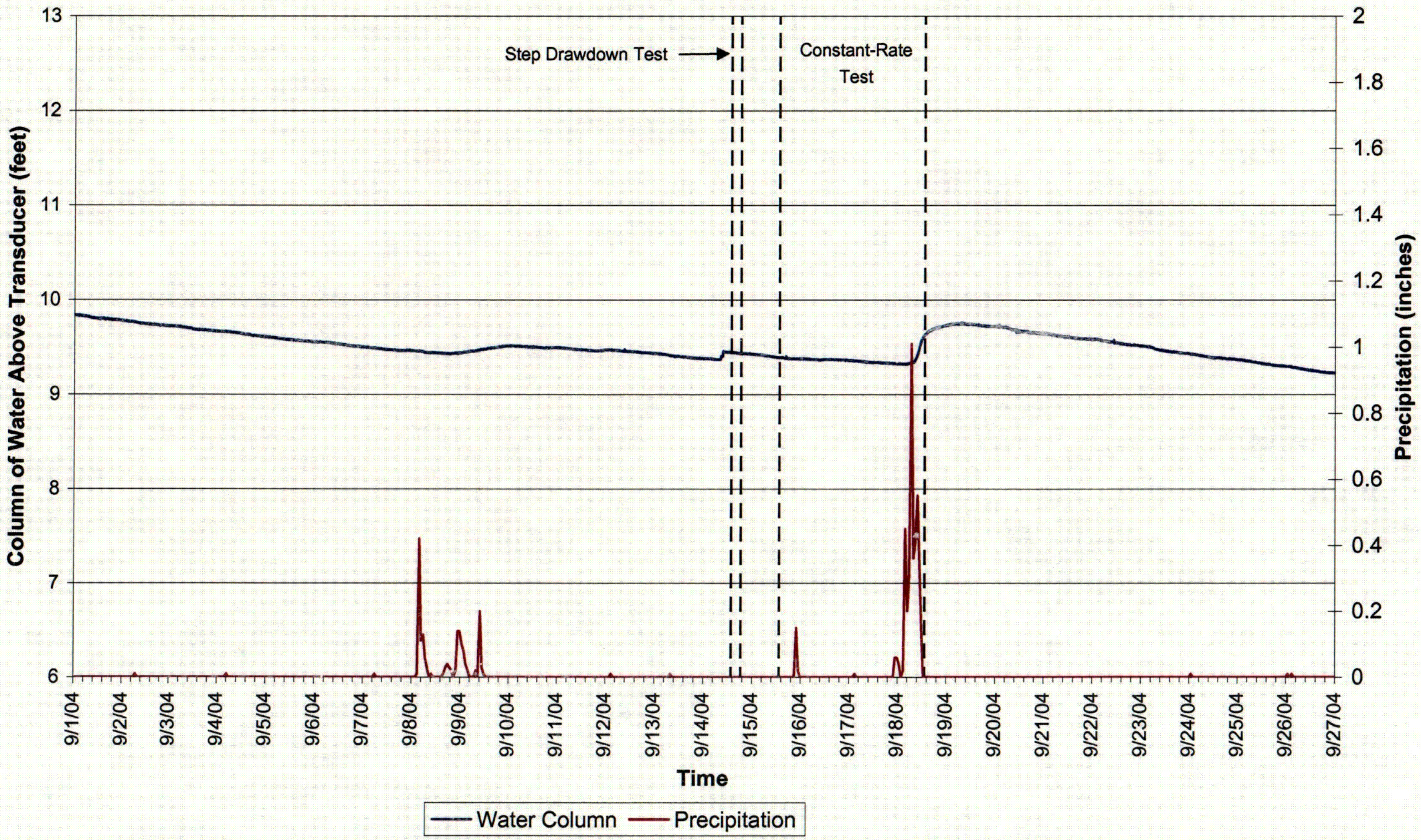
Figure 3-5
MW-124 Response to Step Drawdown and Constant-Rate Pumping Tests
September 2004



Note: September 2004 precipitation data obtained from Meriden Markham Municipal Airport approximately 20 miles west of the HNP.

C13

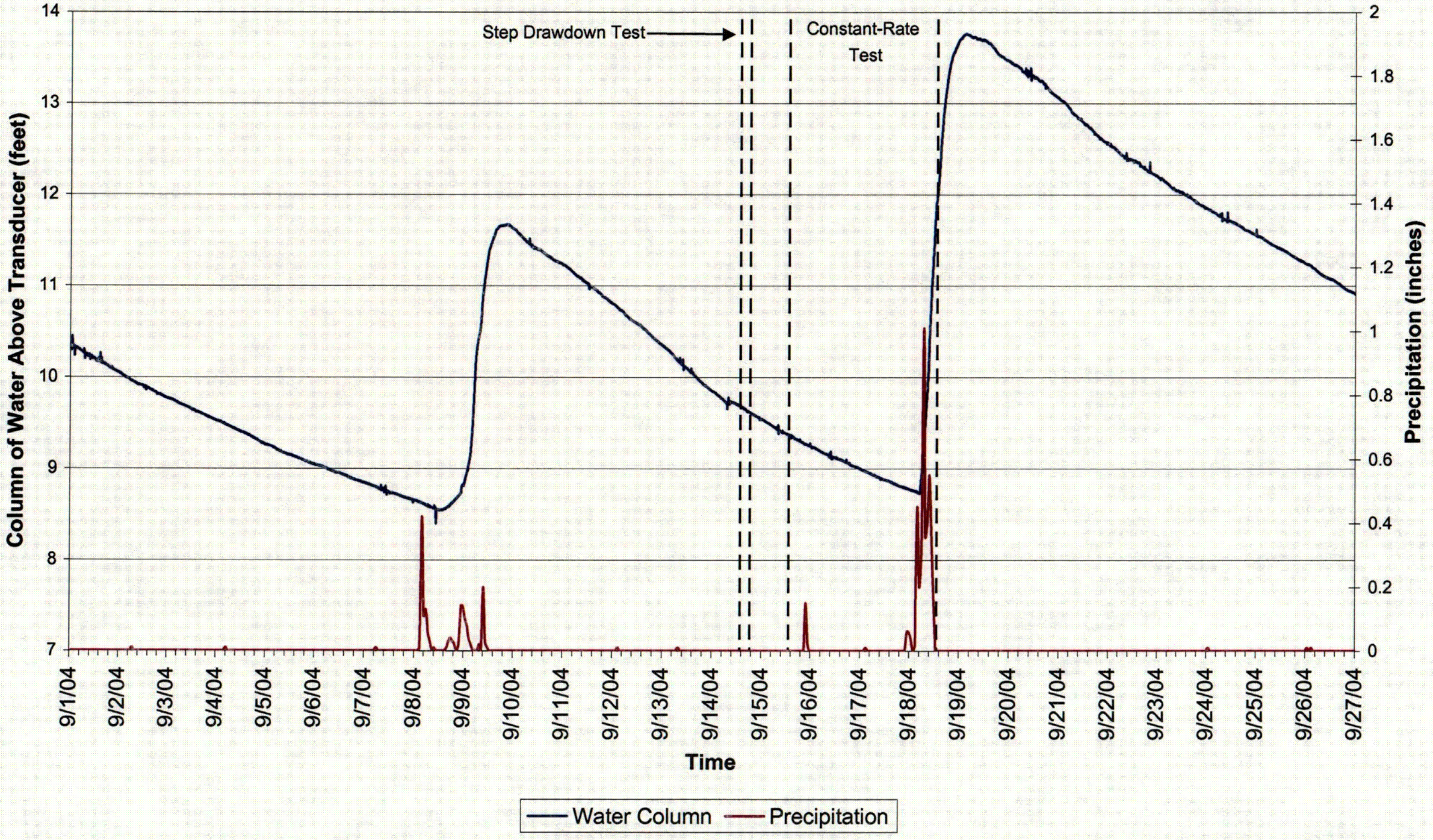
Figure 3-6
MW-508S Response to Step Drawdown and Constant-Rate Pumping Tests
September 2004



Note: September 2004 precipitation data obtained from Meriden Markham Municipal Airport approximately 20 miles west of the HNP.

C14

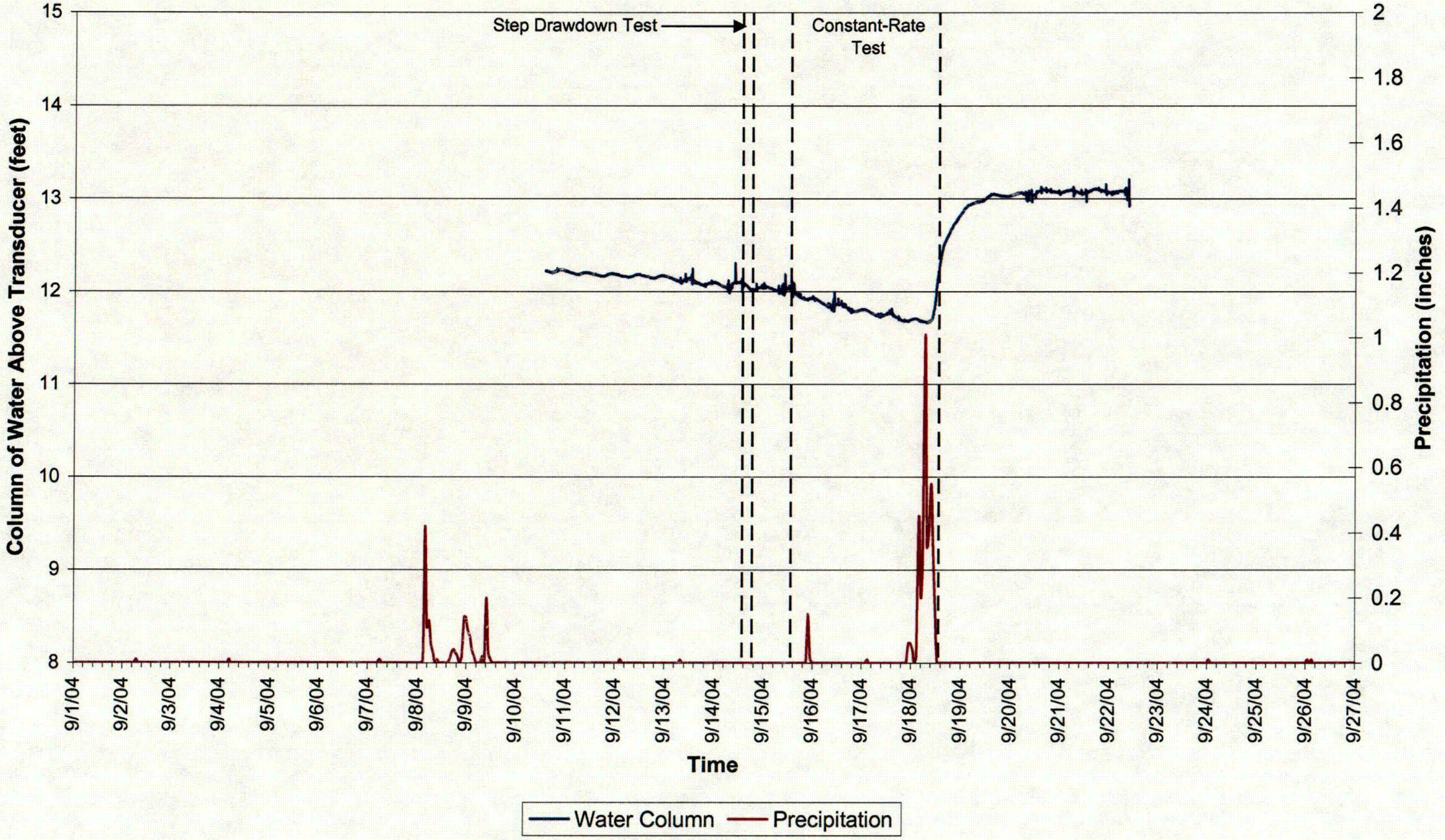
Figure 3-7
MW-104S Response to Step Drawdown and Constant-Rate Pumping Tests
September 2004



Note: September 2004 precipitation data obtained from Meriden Markham Municipal Airport approximately 20 miles west of the HNP.

C15

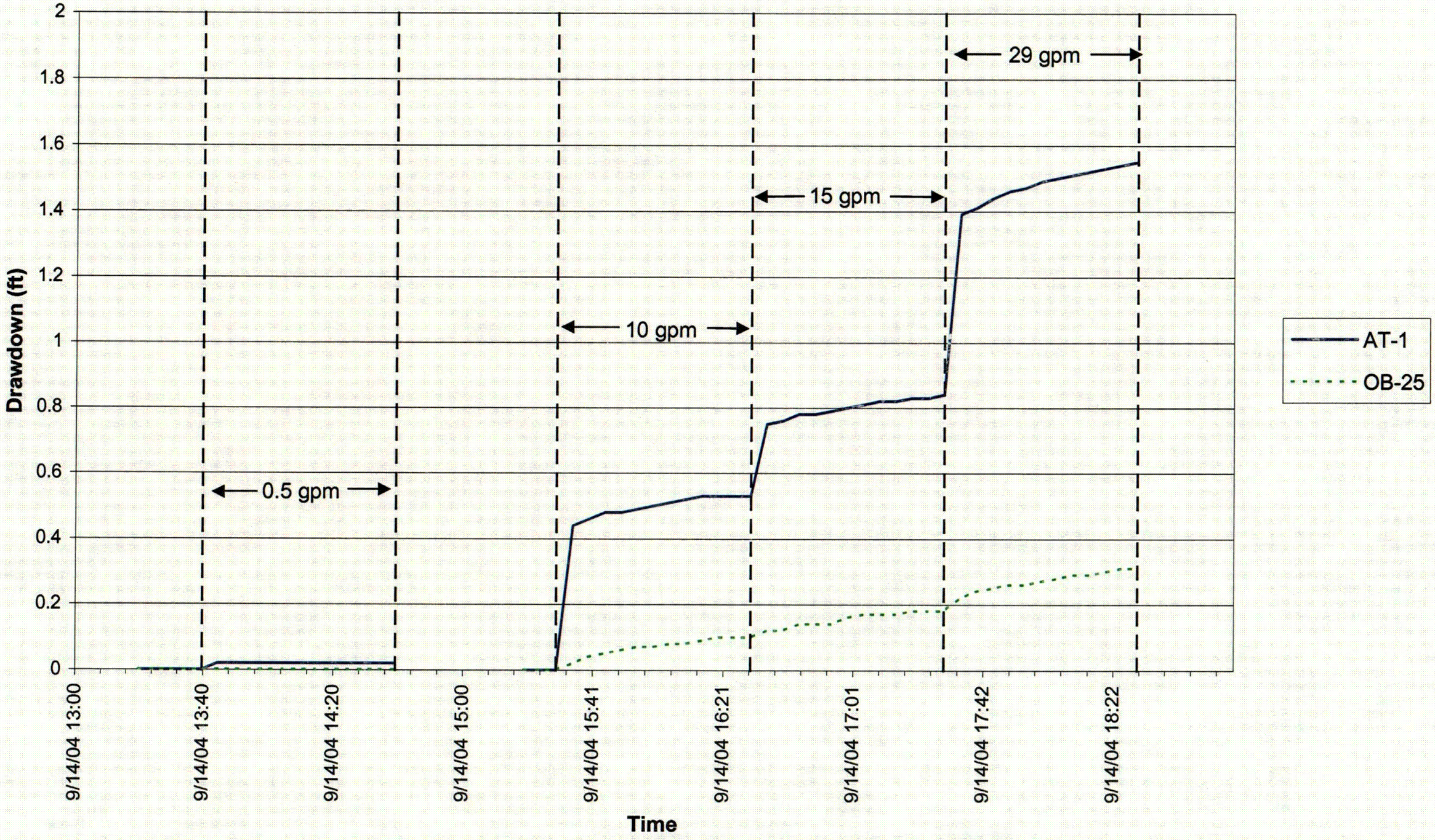
Figure 3-8
MW-123 Response to Step Drawdown and Constant-Rate Pumping Tests
September 2004



Note: September 2004 precipitation data obtained from Meriden Markham Municipal Airport approximately 20 miles west of the HNP.

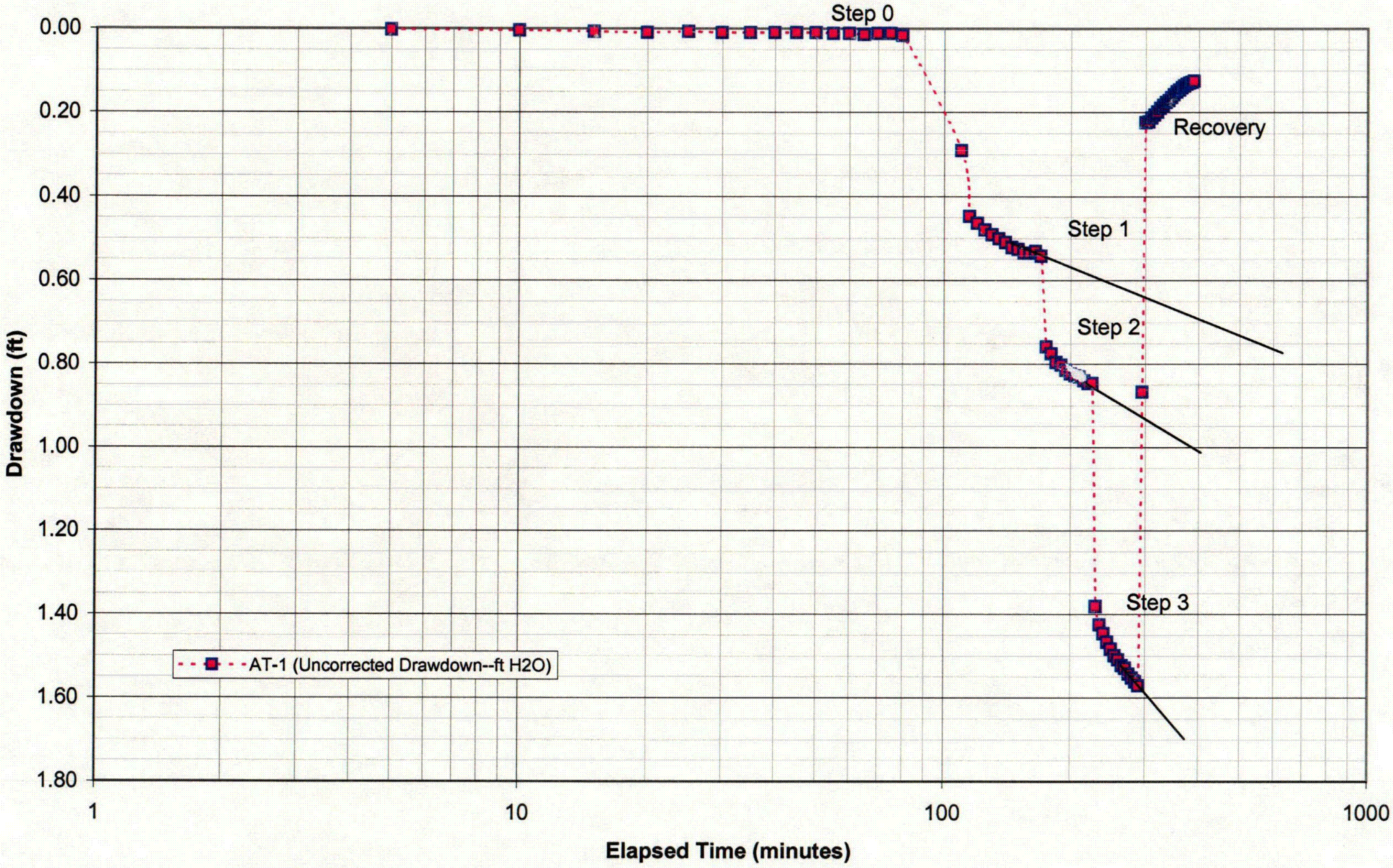
C16

Figure 3-9
Step Drawdown Test Response in AT-1 and OB-25
September 2004



C17

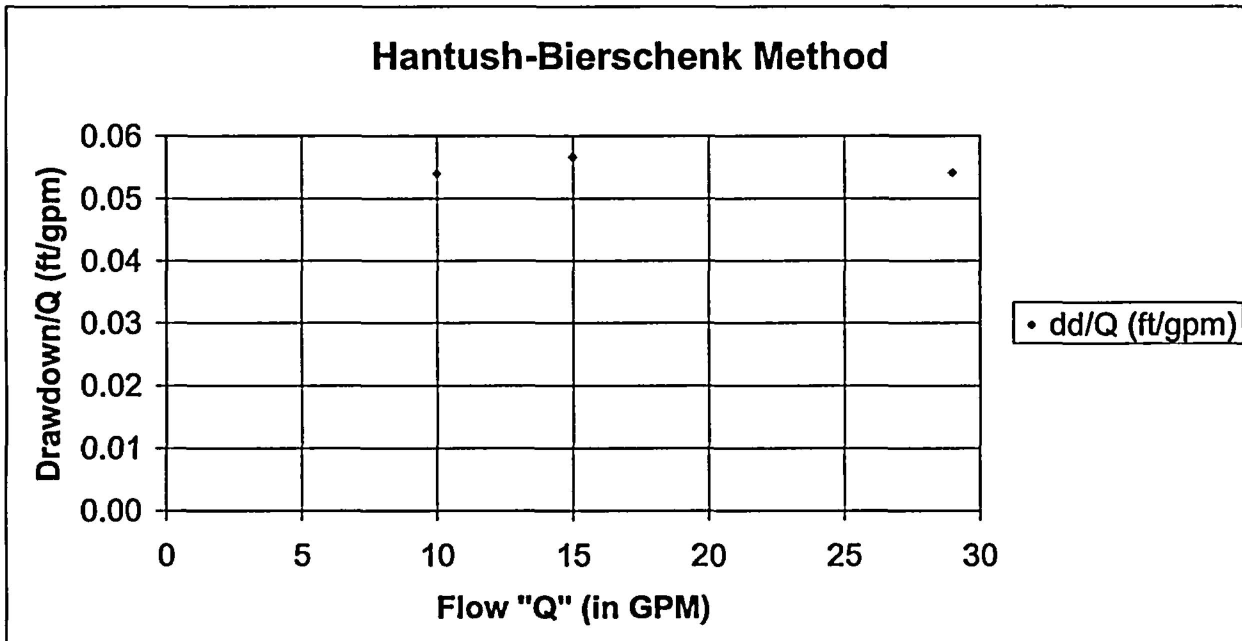
Figure 3-10
Well Performance Test Results: AT-1
Step Drawdown Test (September 14, 2004)



c18

Figure 3-11
Well Performance Test Results

	Flow Q (gpm)	Flow Q (cft/m)	Drawdown (ft)	S_c (gpm/ft)	dd/Q (ft/cft/min)	dd/Q (ft/gpm)
Step 0	0.5	0.07	0.02	25.00	0.30	0.04
Step 1	10	1.34	0.54	18.52	0.40	0.05
Step 2	15	2.01	0.85	17.65	0.42	0.06
Step 3	29	3.88	1.57	18 47	0.40	0 05



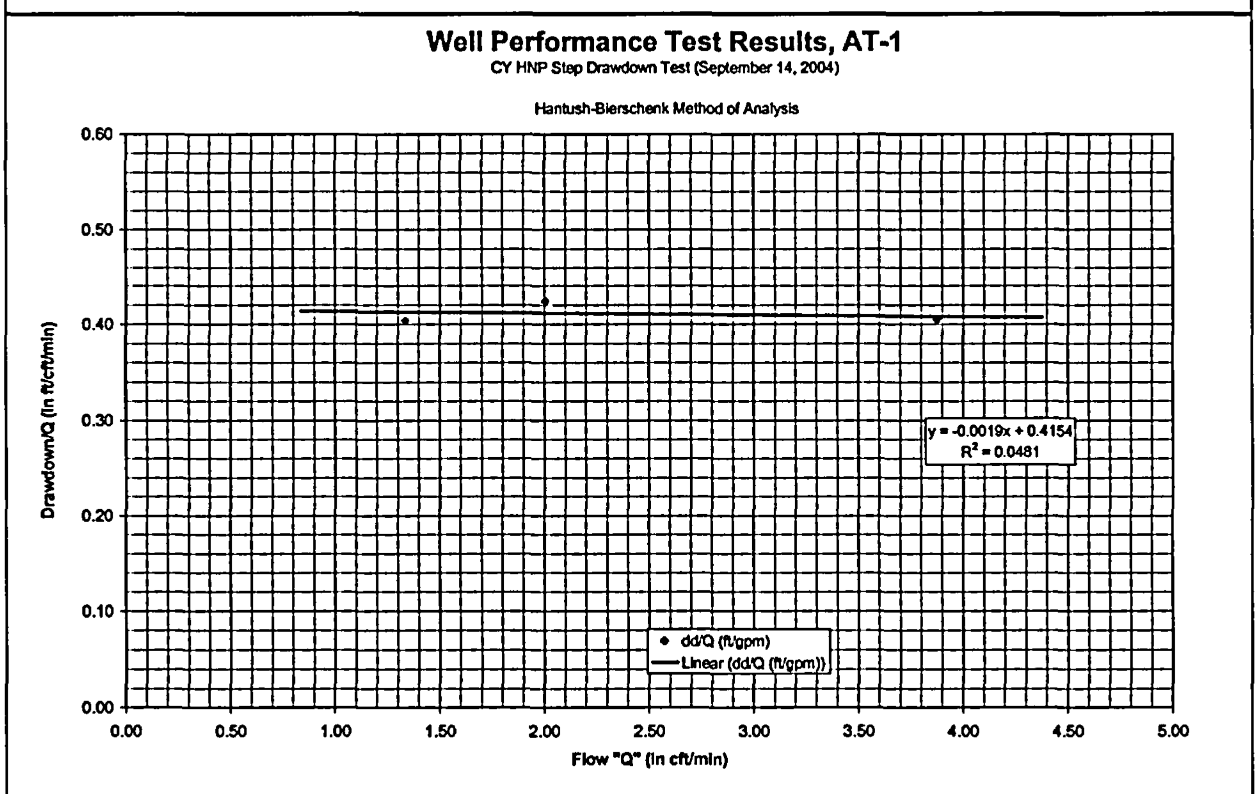
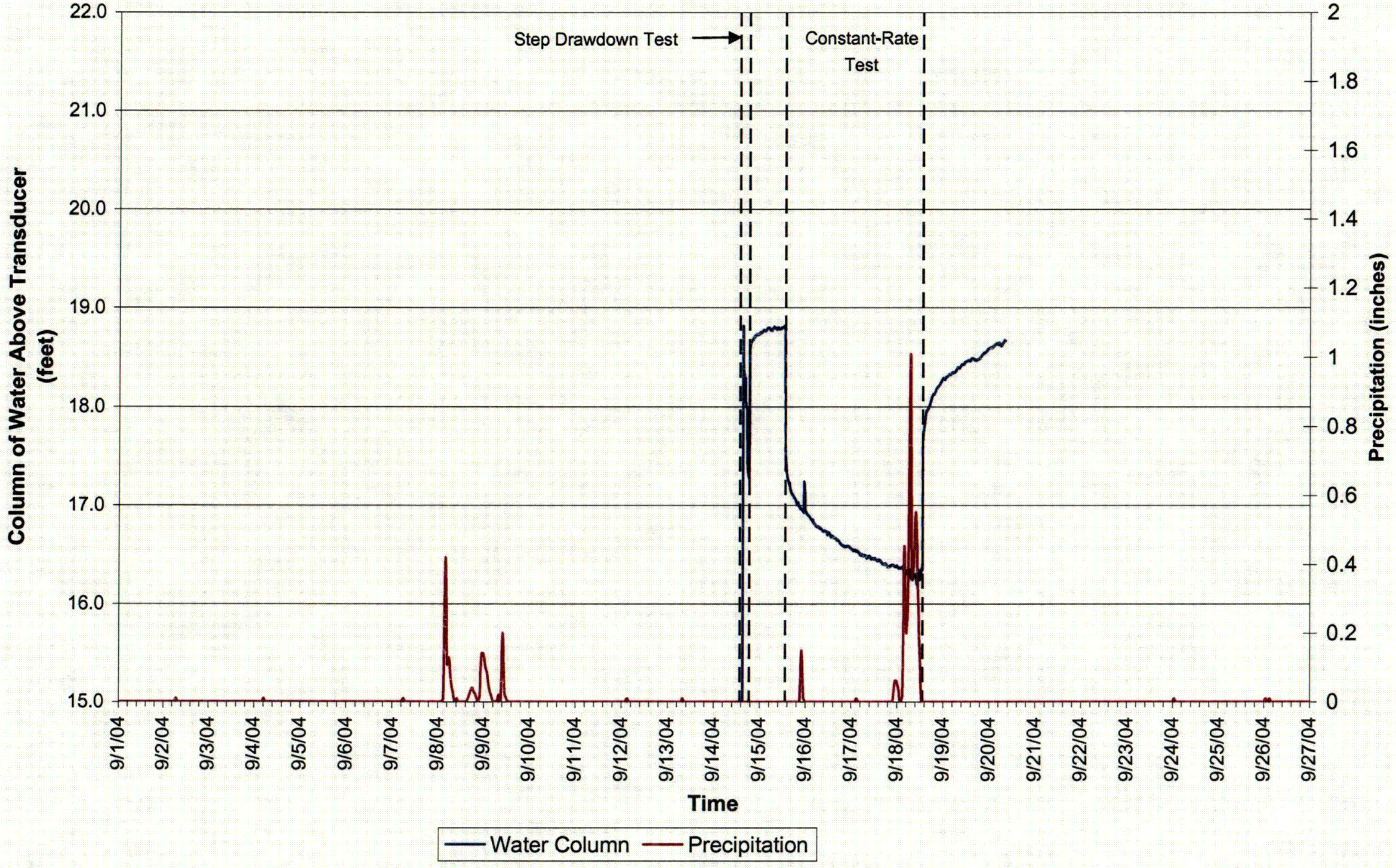


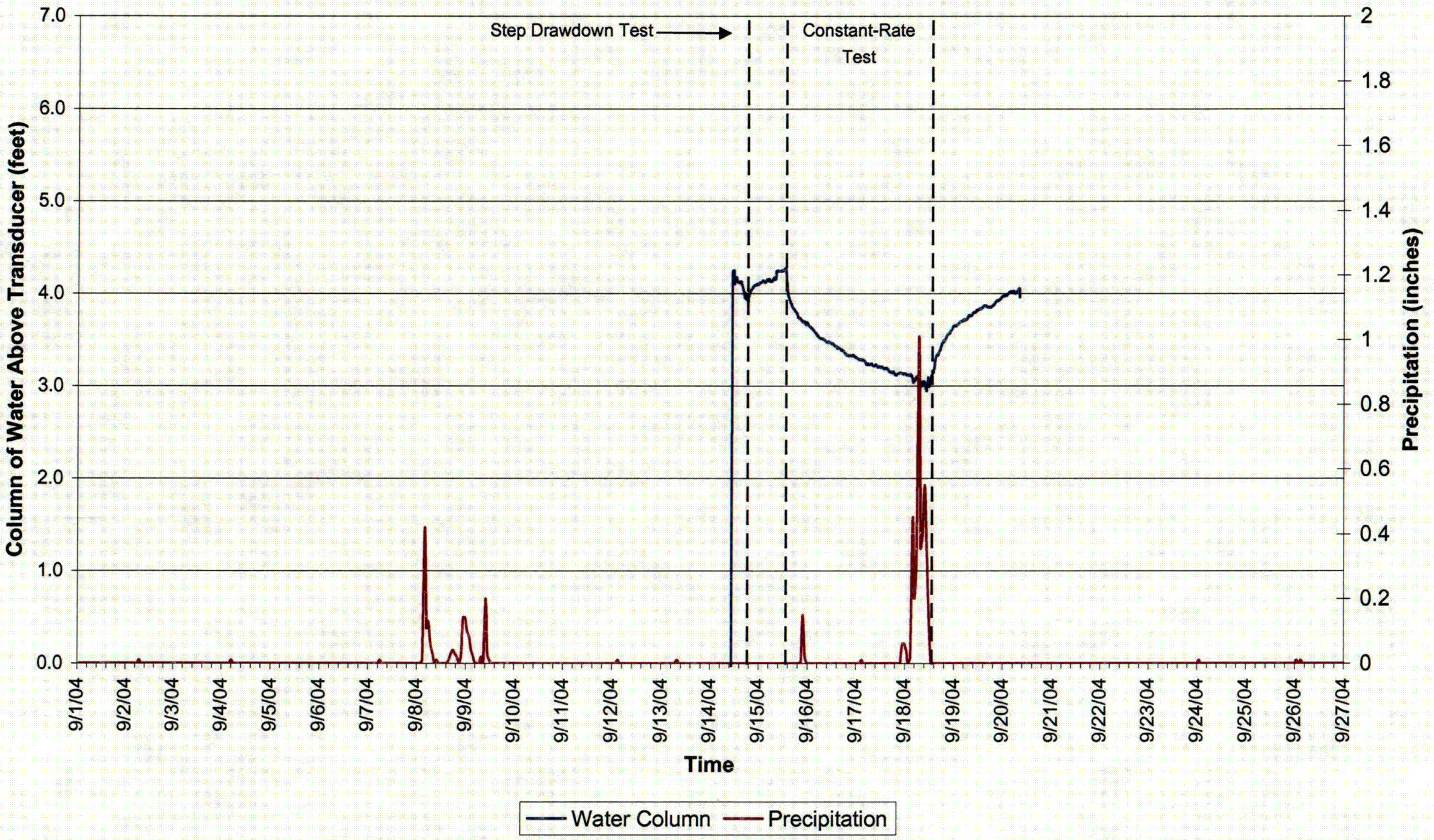
Figure 3-12
AT-1 Response to Step Drawdown and Constant-Rate Pumping Tests
September 2004



Note: September 2004 precipitation data obtained from Meriden Markham Municipal Airport approximately 20 miles west of the HNP.

C19

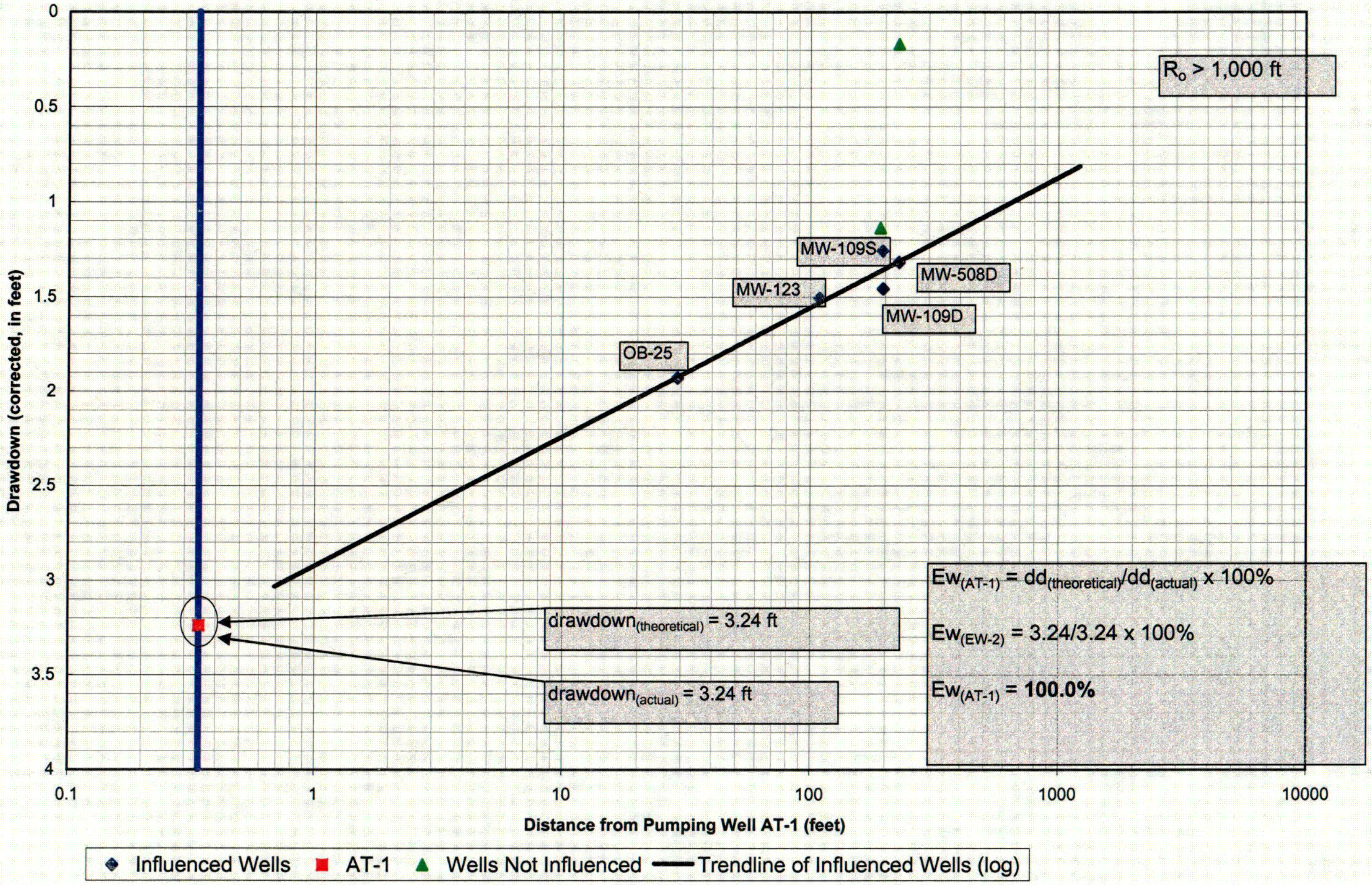
Figure 3-13
OB-25 Response to Step Drawdown and Constant-Rate Pumping Tests
September 2004



Note: September 2004 precipitation data obtained from Meriden Markham Municipal Airport approximately 20 miles west of the HNP.

C20

Figure 3-14
AT-1 Well Performance



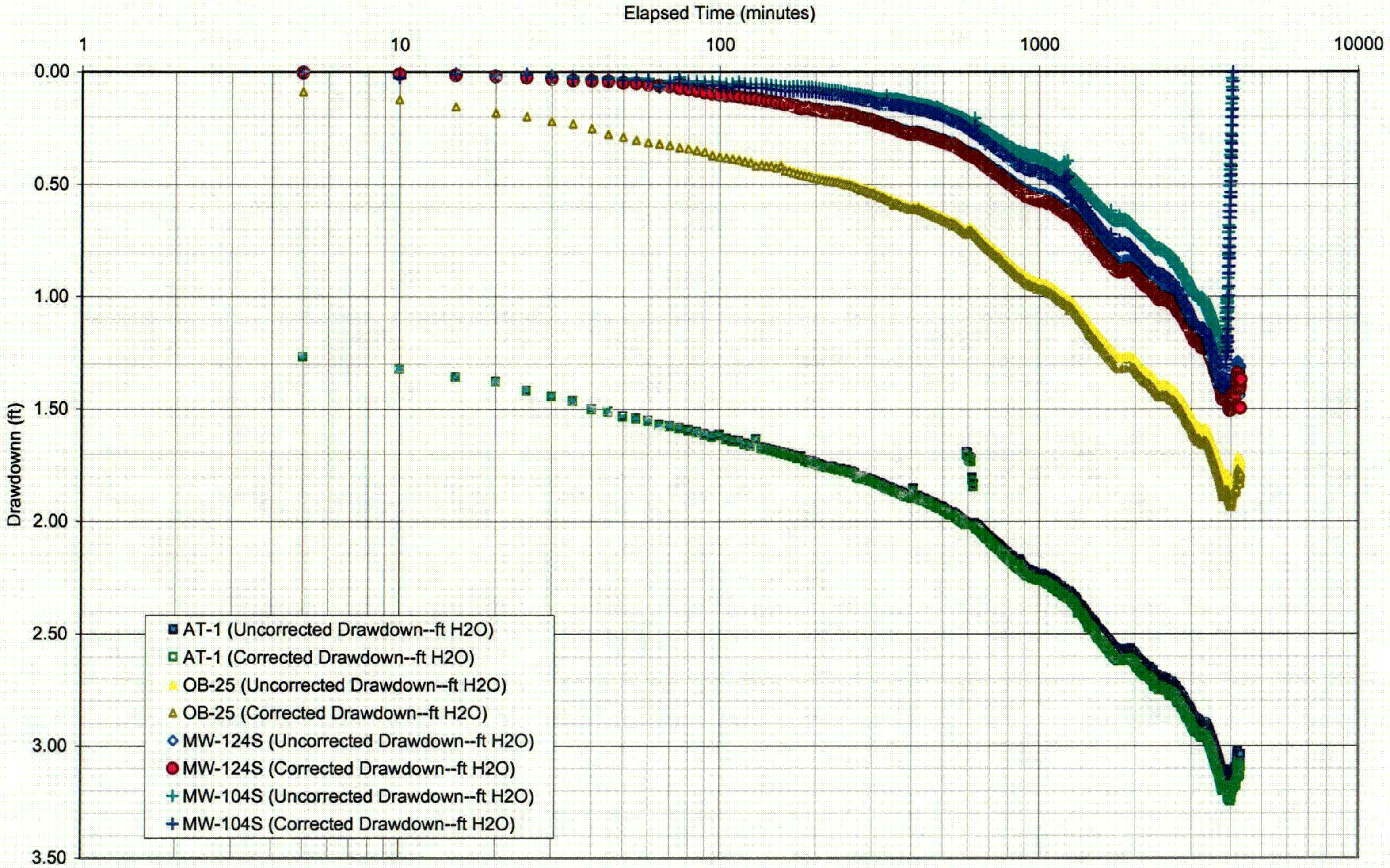
C21

Appendix 1

Uncorrected and Corrected Drawdown Curves

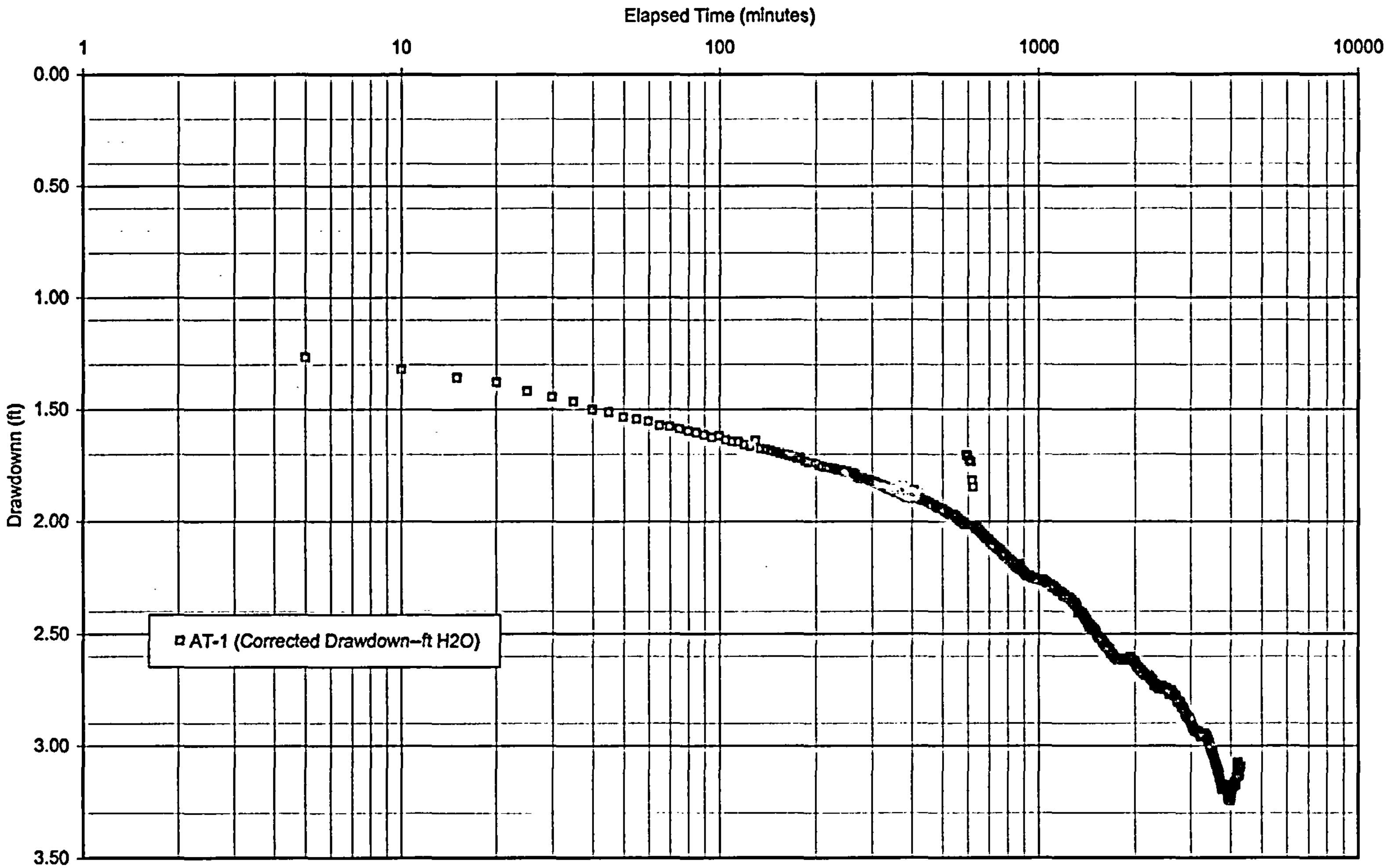
Drawdown AT-1 Pumping Test Results (AT-1, OB-25, MW-124S, and MW-104S); Uncorrected and Corrected Drawdown Comparison

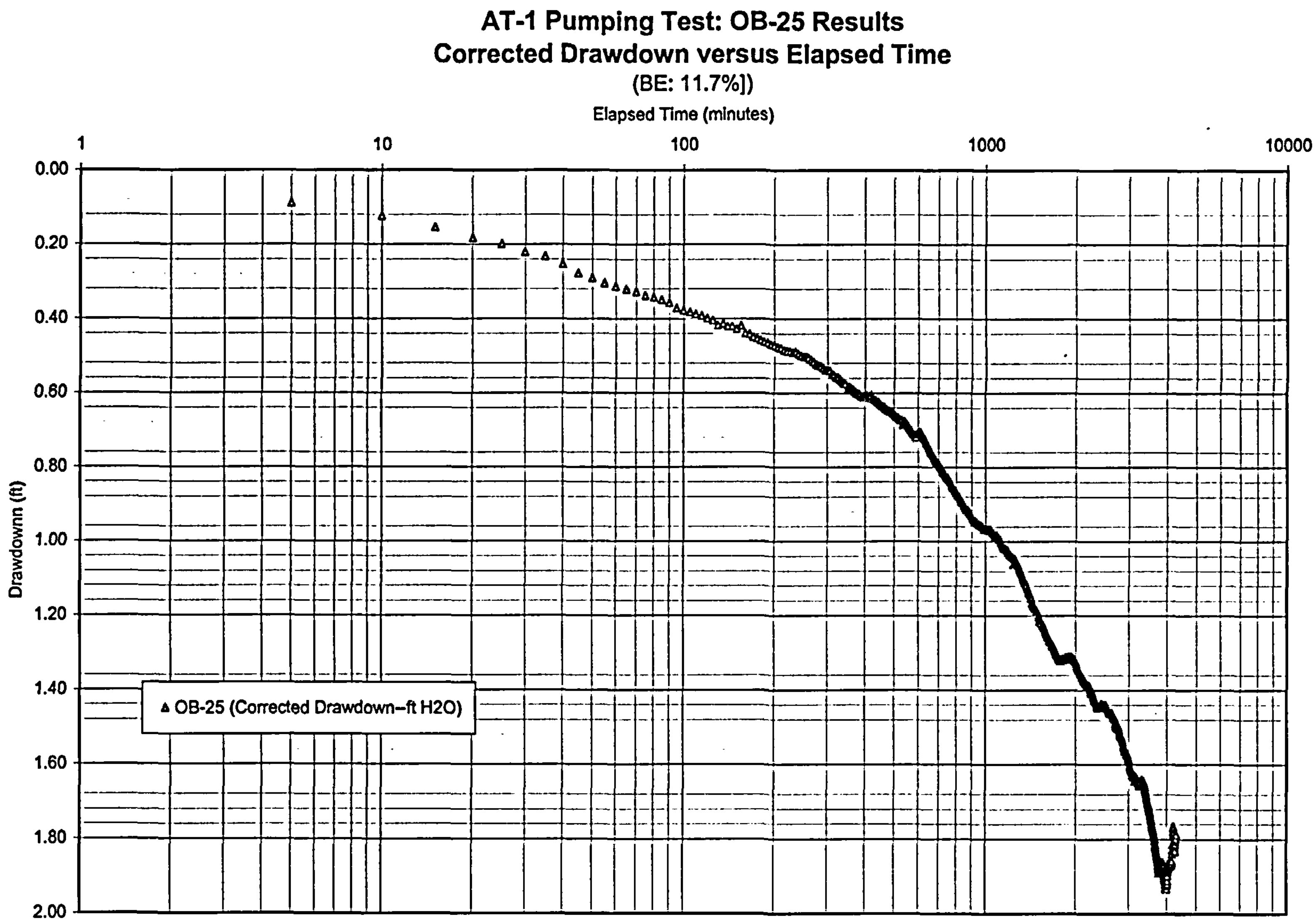
(BEs: 11.7% and 28.9%[MW-104S])



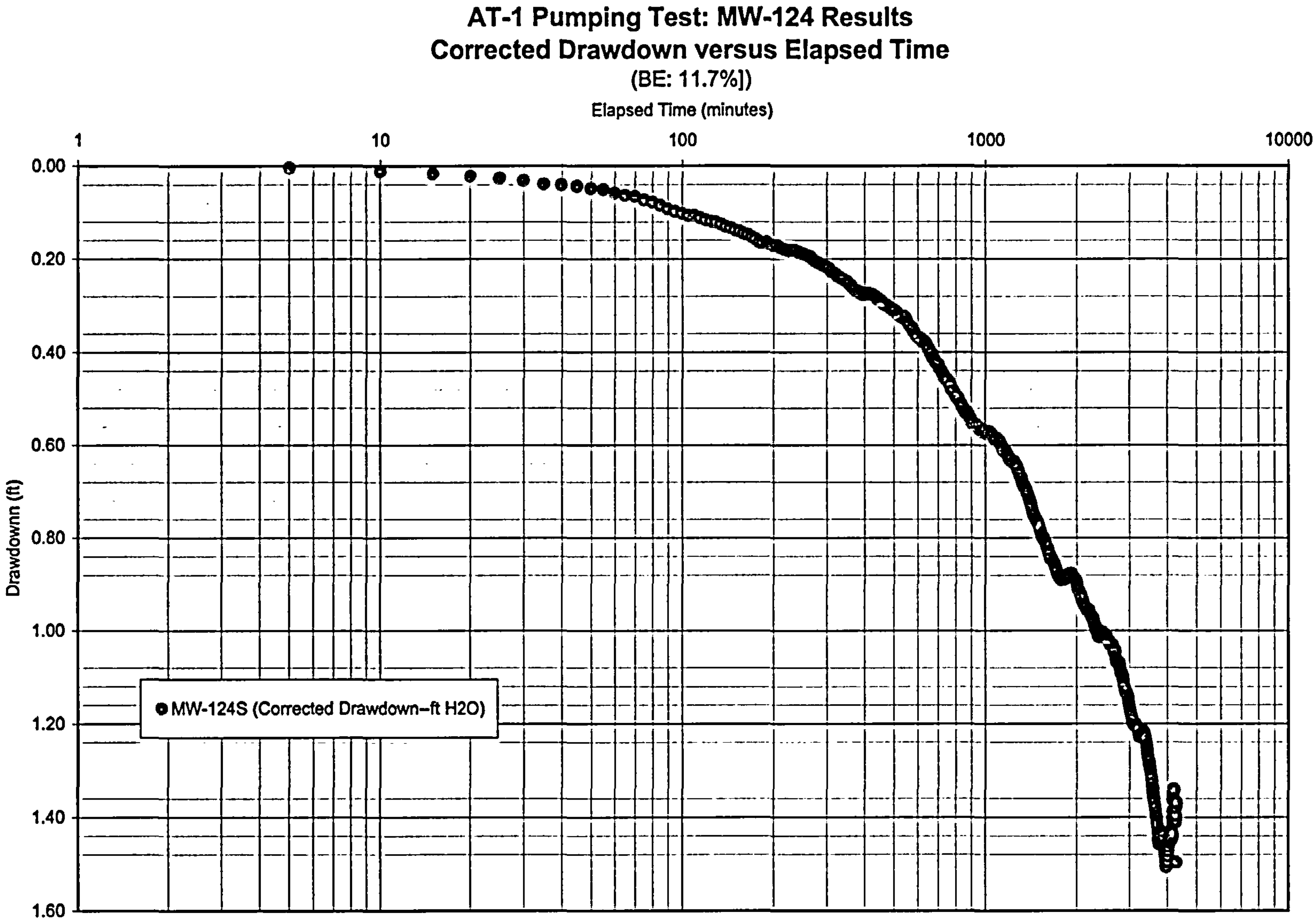
C22

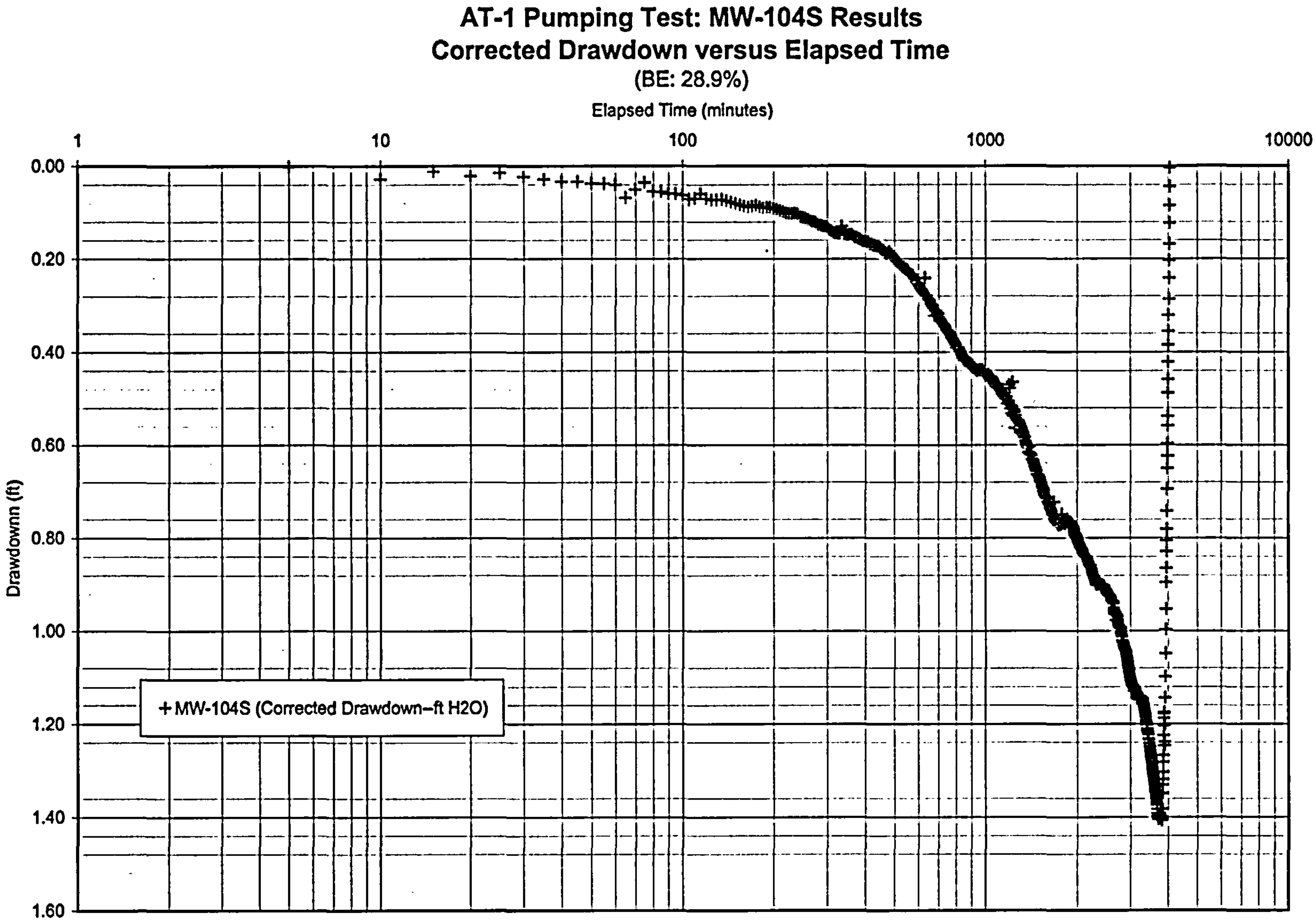
AT-1 Pumping Test: AT-1 Results
Corrected Drawdown versus Elapsed Time
(BE: 11.7%)





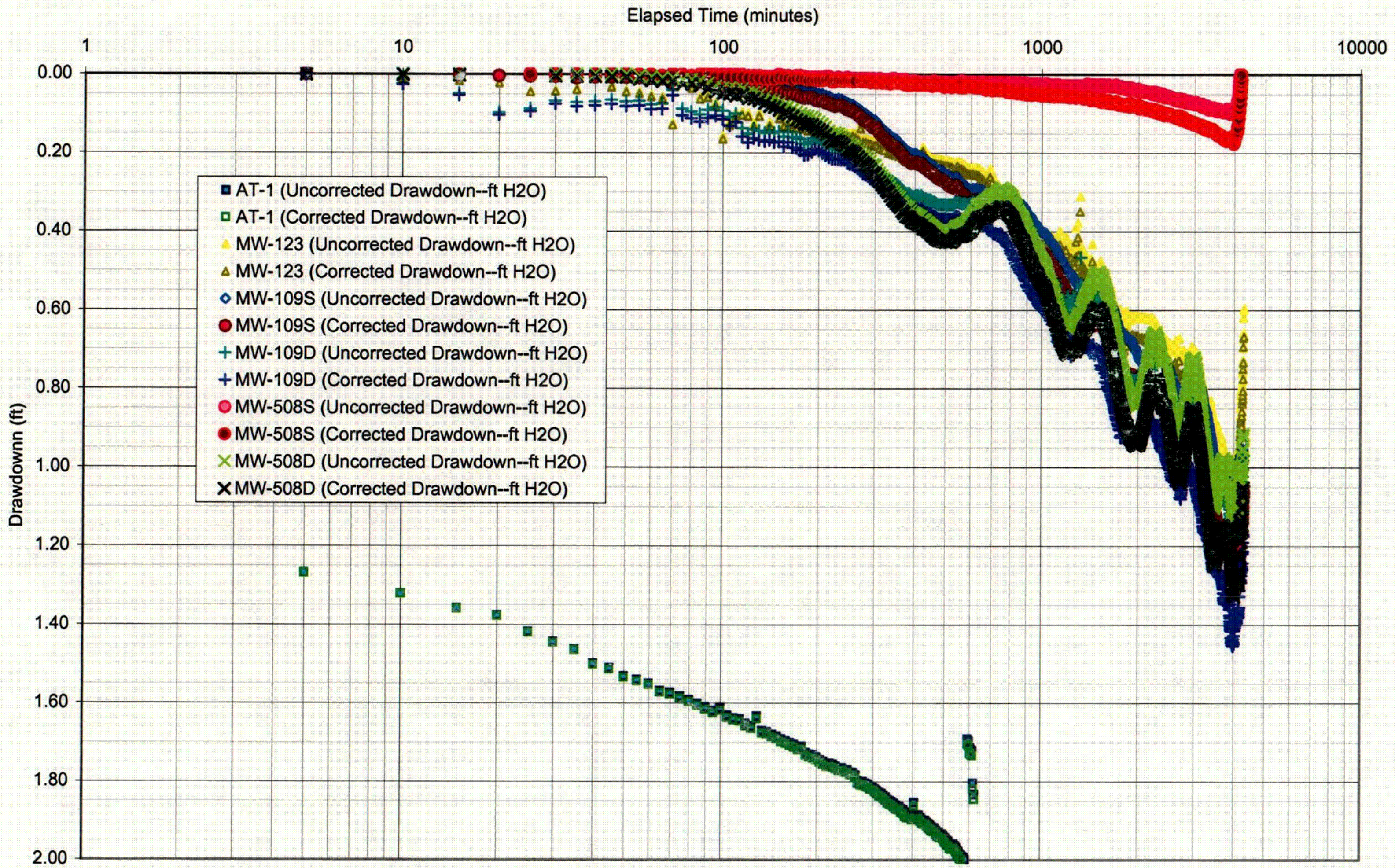
AT-1 Pumping Test: OB-25 Results
Corrected Drawdown versus Elapsed Time
(BE: 11.7%])
Elapsed Time (minutes)
1
10
100
1000
10000
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
1.80
2.00
Drawdown (ft)
OB-25 (Corrected Drawdown--ft H2O)


AT-1 Pumping Test: MW-124 Results
Corrected Drawdown versus Elapsed Time
(BE: 11.7%])
Elapsed Time (minutes)
1
10
100
1000
10000
Drawdownn (ft)
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
MW-124S (Corrected Drawdown--ft H2O)

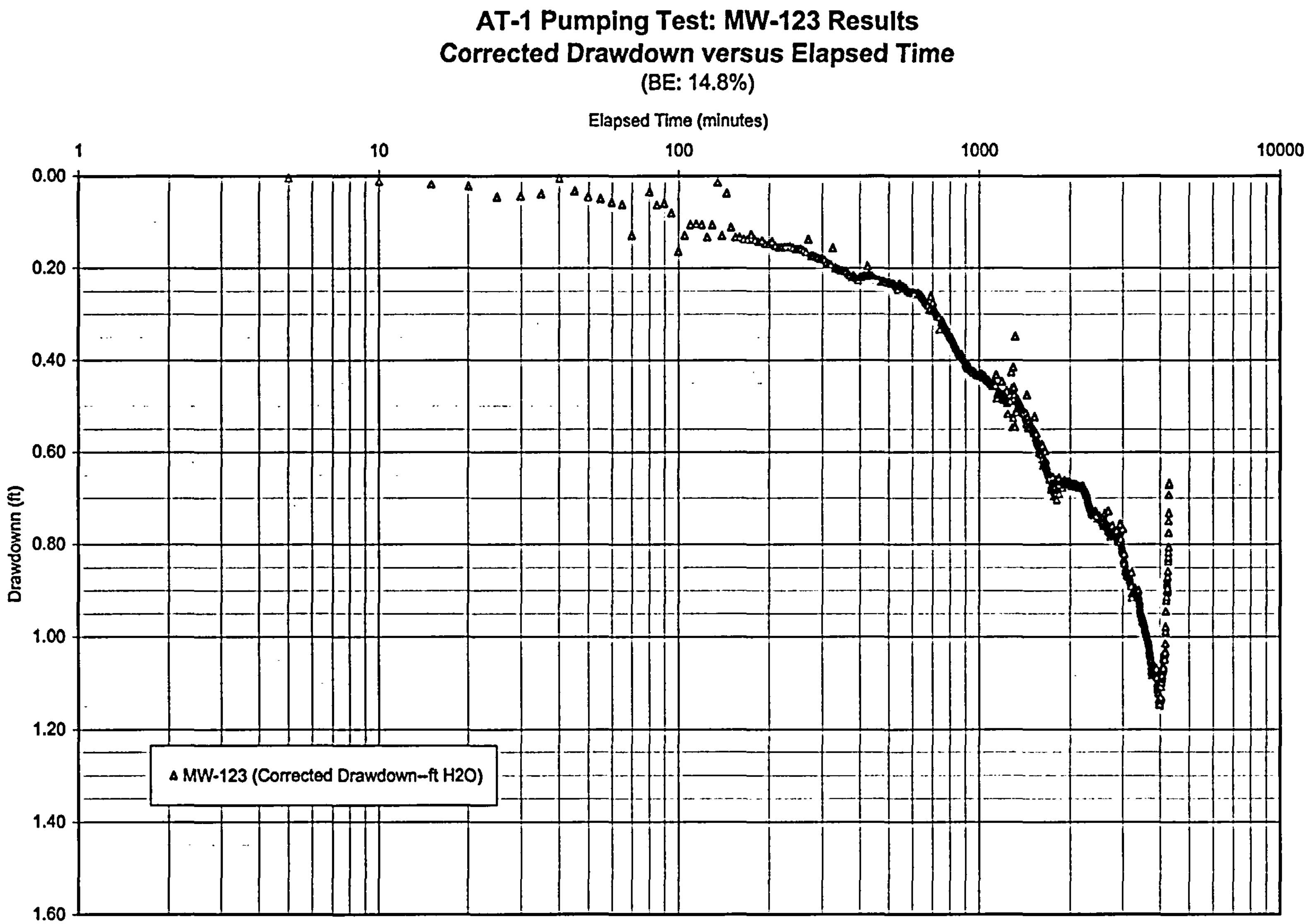

AT-1 Pumping Test: MW-104S Results
Corrected Drawdown versus Elapsed Time
(BE: 28.9%)
Elapsed Time (minutes)
1
10
100
1000
10000
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
Drawdown (ft)
+ MW-104S (Corrected Drawdown–ft H2O)

Drawdown AT-1 Pumping Test Results (AT-1 and MWs-123, -109S/D, -508S/D); Uncorrected and Corrected Drawdown Comparison

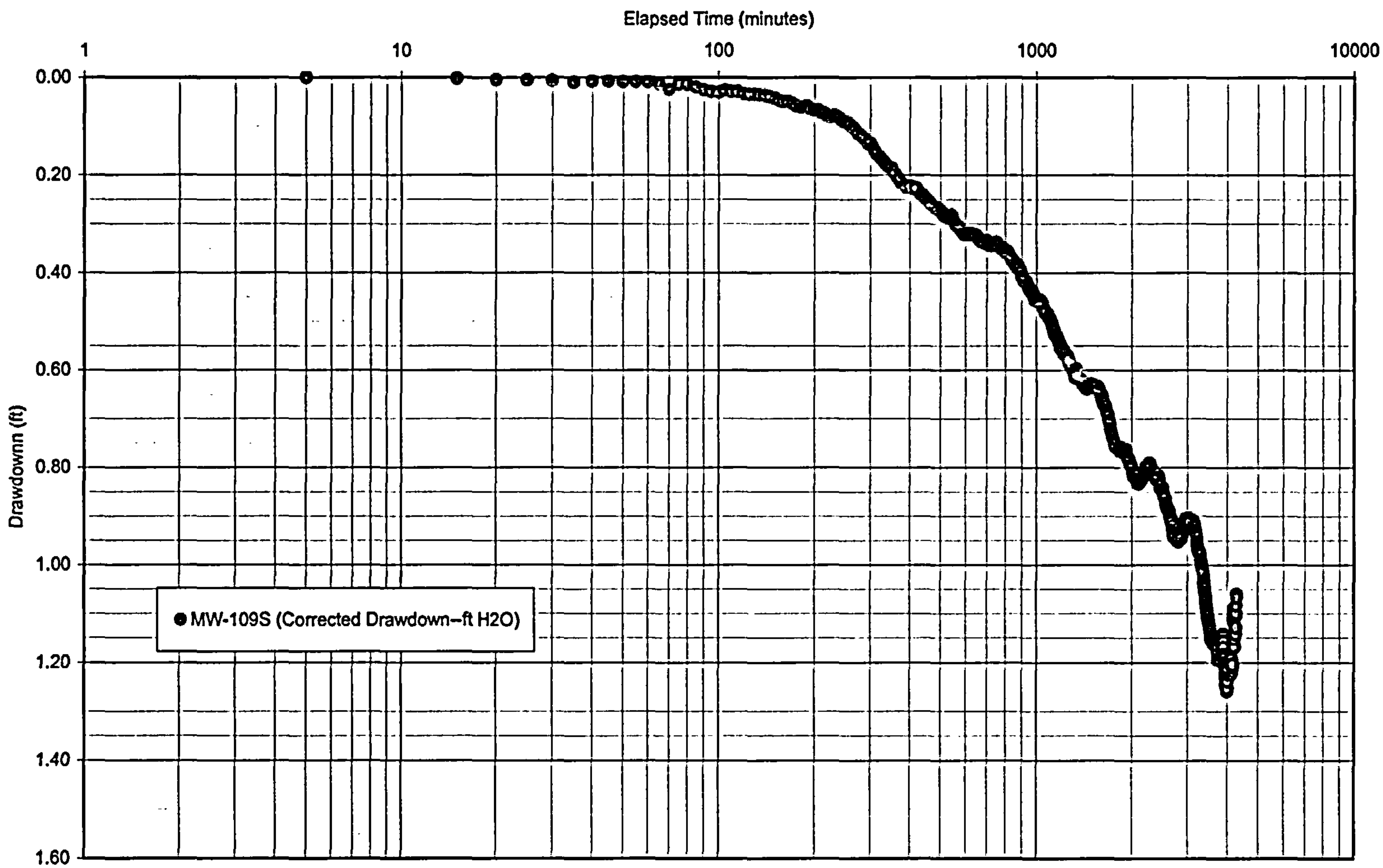
(BEs: 11.7%,14.8%,25.8%,42.4%,18.7%,&39.1%, respectively)

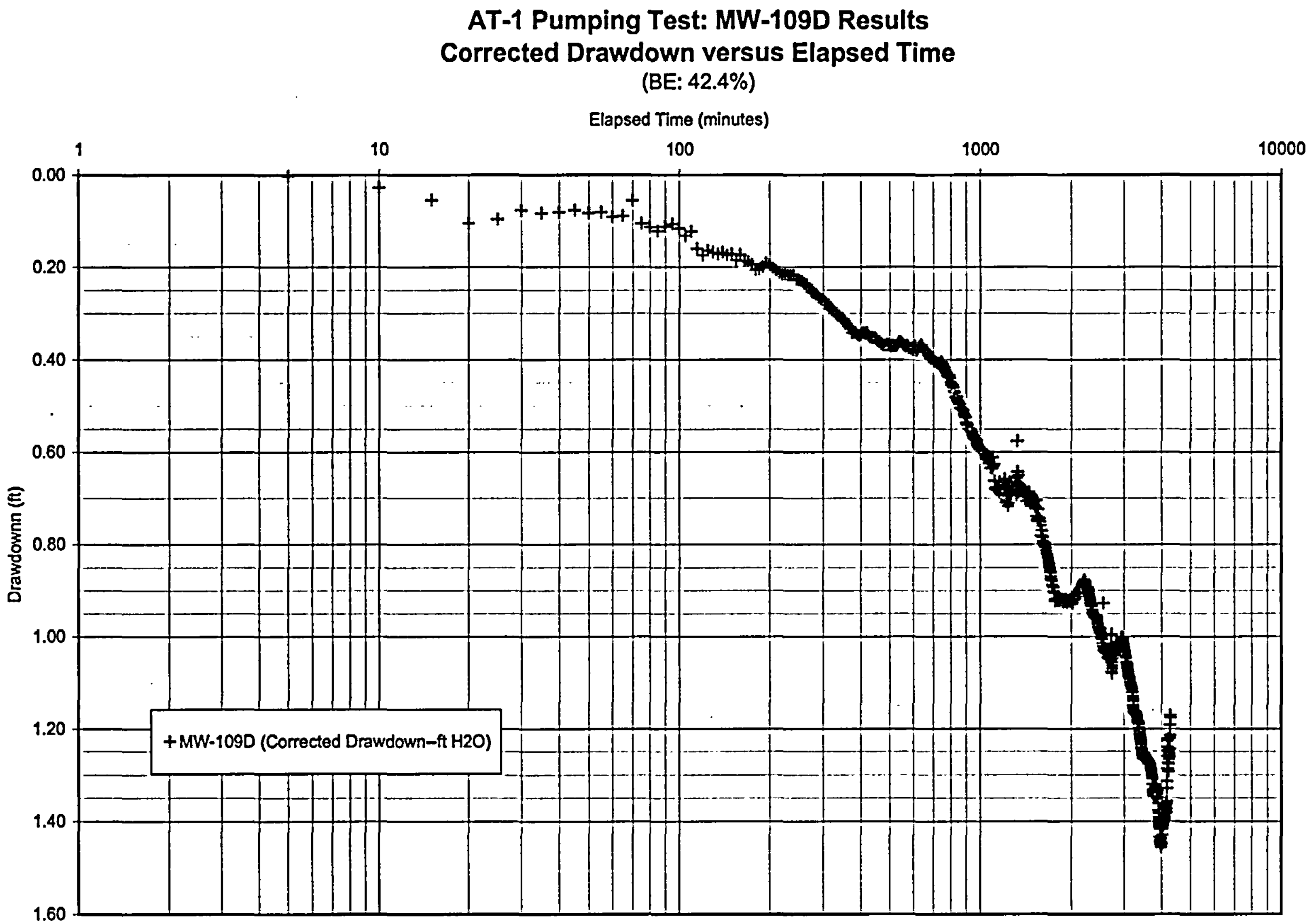


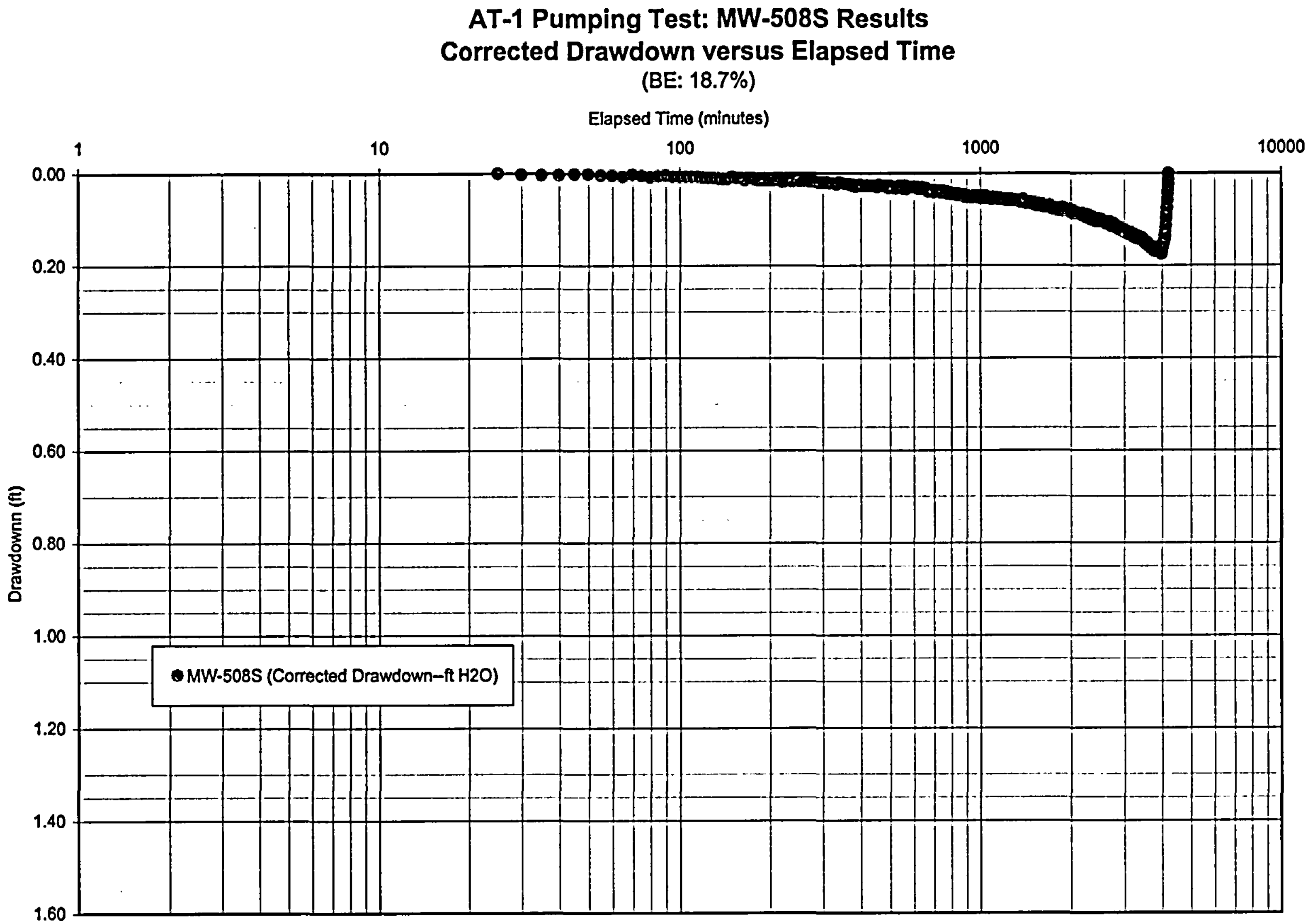
C23

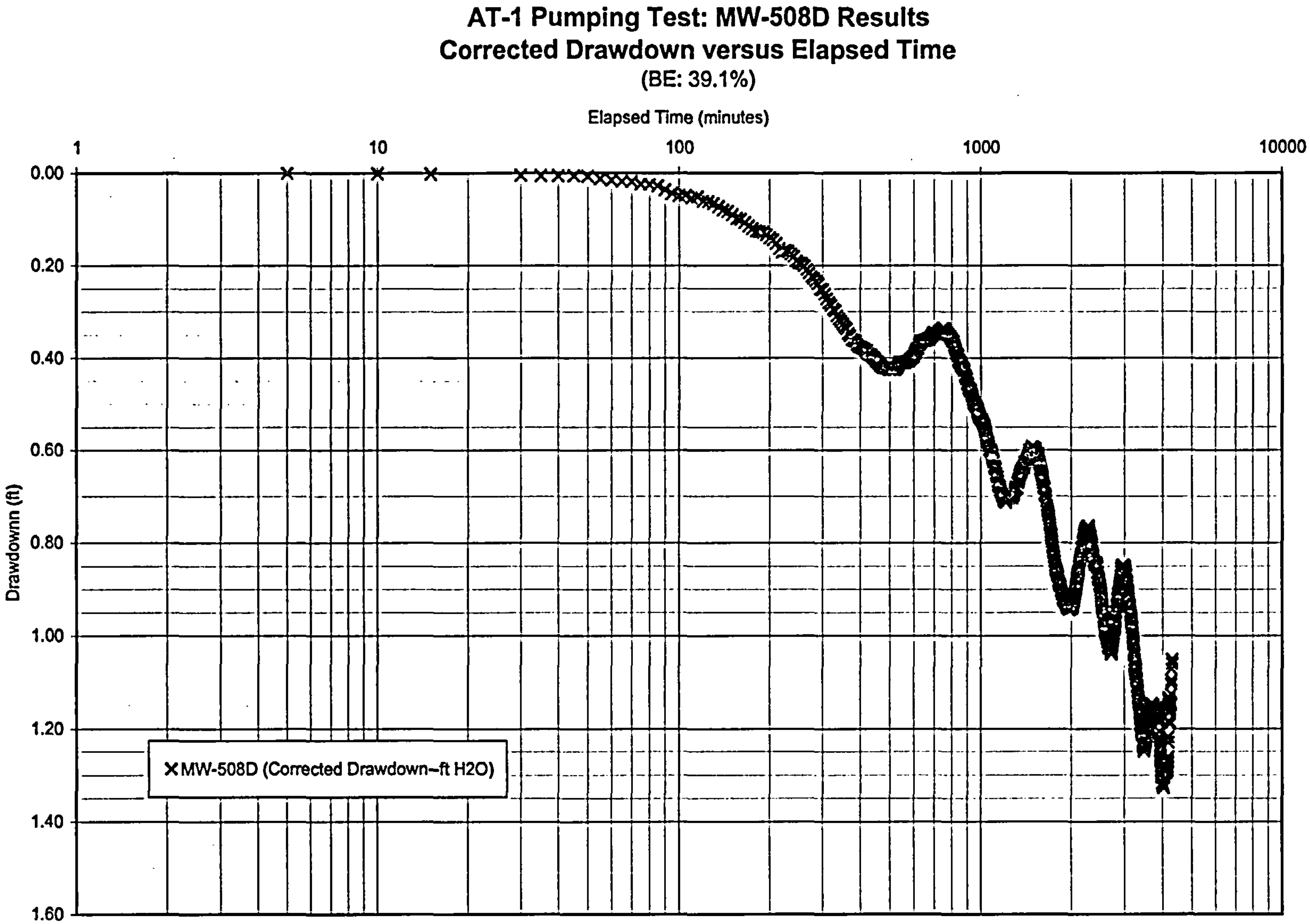

AT-1 Pumping Test: MW-123 Results
Corrected Drawdown versus Elapsed Time
(BE: 14.8%)
Elapsed Time (minutes)
1
10
100
1000
10000
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
Drawdown (ft)
MW-123 (Corrected Drawdown--ft H2O)

AT-1 Pumping Test: MW-109S Results
Corrected Drawdown versus Elapsed Time
(BE: 25.8%)



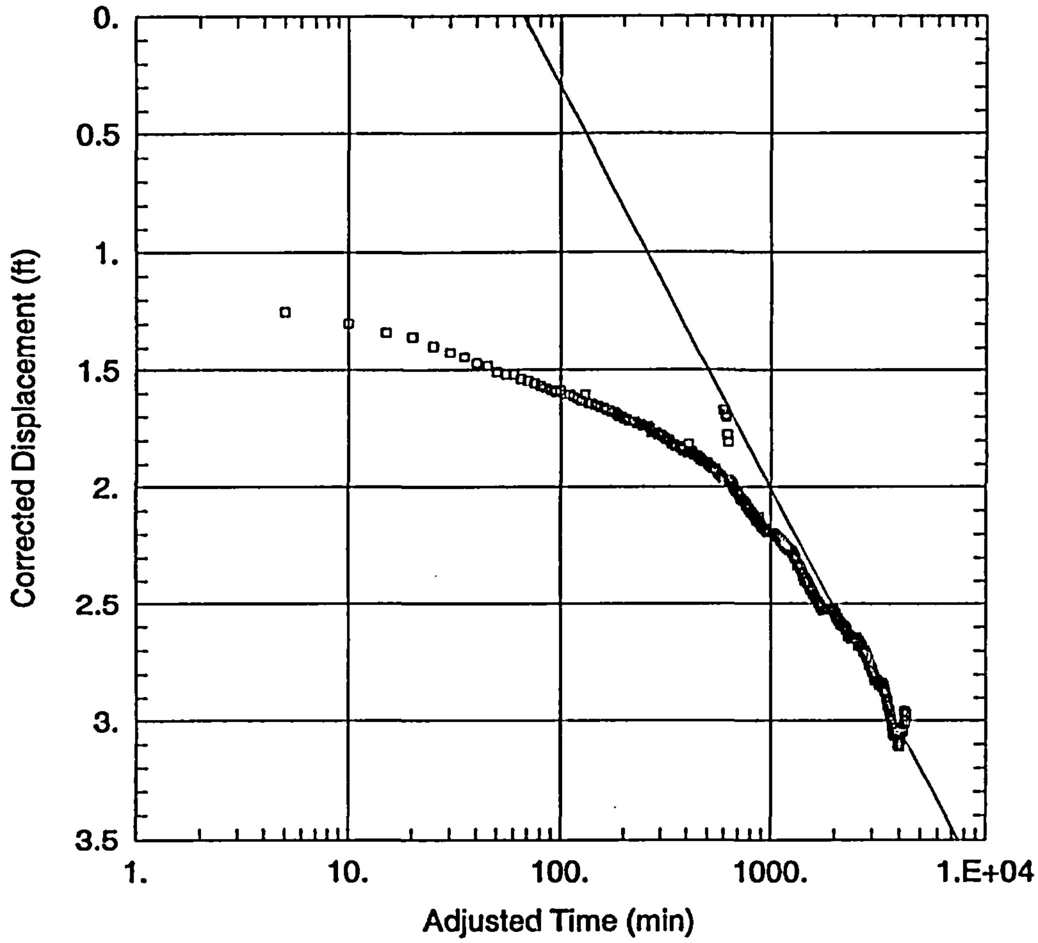

AT-1 Pumping Test: MW-109D Results
Corrected Drawdown versus Elapsed Time
(BE: 42.4%)
Elapsed Time (minutes)
1
10
100
1000
10000
Drawdown (ft)
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
+MW-109D (Corrected Drawdown--ft H2O)


AT-1 Pumping Test: MW-508S Results
Corrected Drawdown versus Elapsed Time
(BE: 18.7%)
Elapsed Time (minutes)
1
10
100
1000
10000
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
Drawdown (ft)
MW-508S (Corrected Drawdown--ft H2O)


AT-1 Pumping Test: MW-508D Results
Corrected Drawdown versus Elapsed Time
(BE: 39.1%)
Elapsed Time (minutes)
1
10
100
1000
10000
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
Drawdownn (ft)
MW-508D (Corrected Drawdown--ft H2O)

Appendix 2

Type Curves



CY HNP PUMPING TEST

Data Set: C:\...\Aqtw AT-1 (C-J).aqt
Date: 11/29/04 Time: 15:28:10

PROJECT INFORMATION

Company: CH2M HILL
Client: CY
Test Well: AT-1
Test Date: 09-15-2004

AQUIFER DATA

Saturated Thickness: 38. ft Anisotropy Ratio (Kz/Kr): 1.644

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
AT-1	0	0

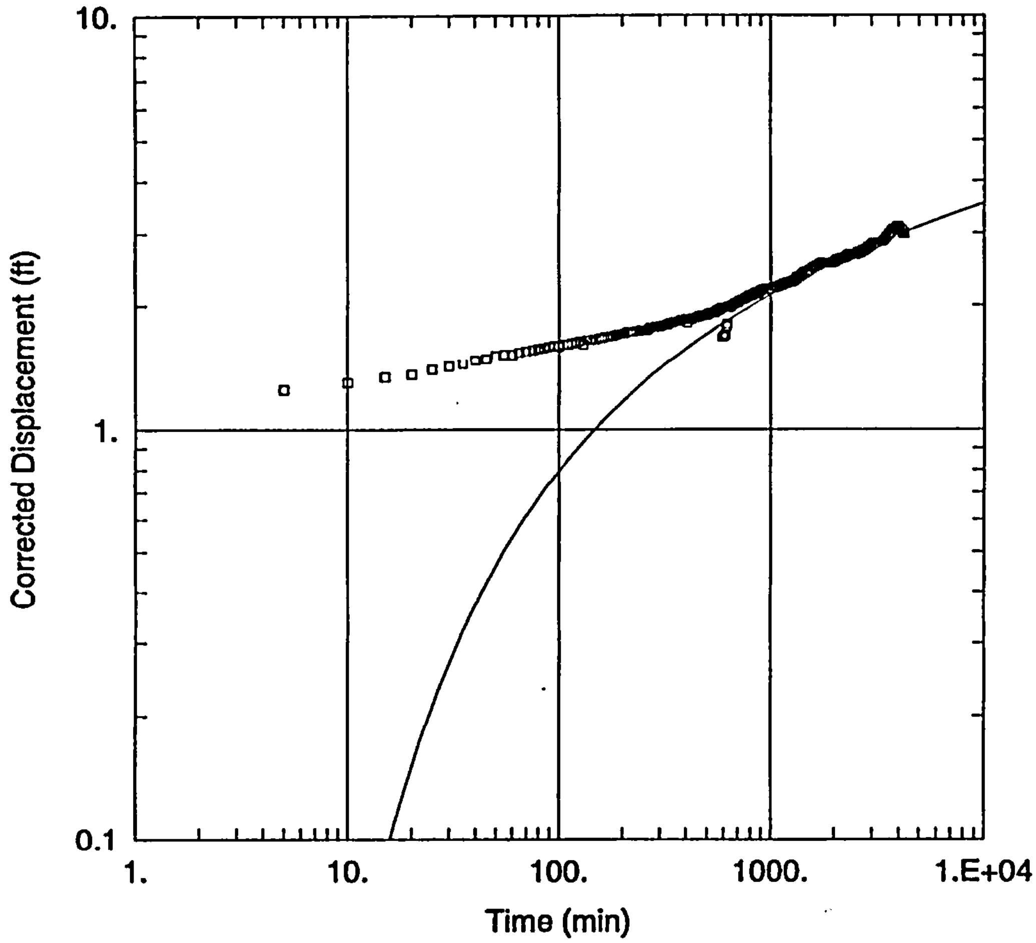
Observation Wells

Well Name	X (ft)	Y (ft)
▫ AT-1	0	0

SOLUTION

Aquifer Model: Unconfined Solution Method: Cooper-Jacob

T = 0.4159 ft^2/min S = 250.1



CY HNP PUMPING TEST

Data Set: C:\...\Aqtw AT-1 (lateTheis).aqt
Date: 11/29/04 Time: 15:28:54

PROJECT INFORMATION

Company: CH2M HILL
Client: CY
Test Well: AT-1
Test Date: 09-15-2004

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
AT-1	0	0

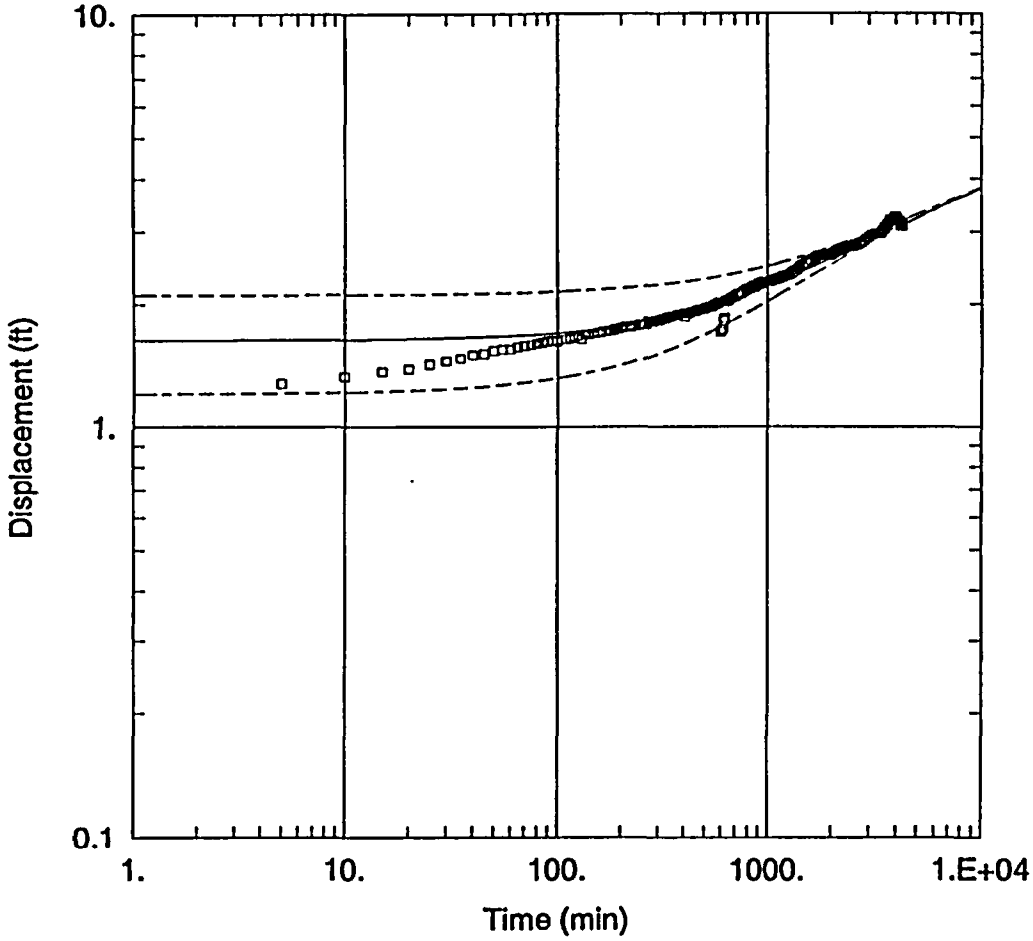
Observation Wells

Well Name	X (ft)	Y (ft)
□ AT-1	0	0

SOLUTION

Aquifer Model: Unconfined
Solution Method: Theis

T = 0.4984 ft^2/min
Kz/Kr = 1.644
S = 149.2
b = 38. ft



CY HNP PUMPING TEST

Data Set: C:\...\Aqtw AT-1 (Neuman).aqt
Date: 11/29/04 Time: 15:34:24

PROJECT INFORMATION

Company: CH2M HILL
Client: CY
Test Well: AT-1
Test Date: 09-15-2004

AQUIFER DATA

Saturated Thickness: 38. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
AT-1	0	0

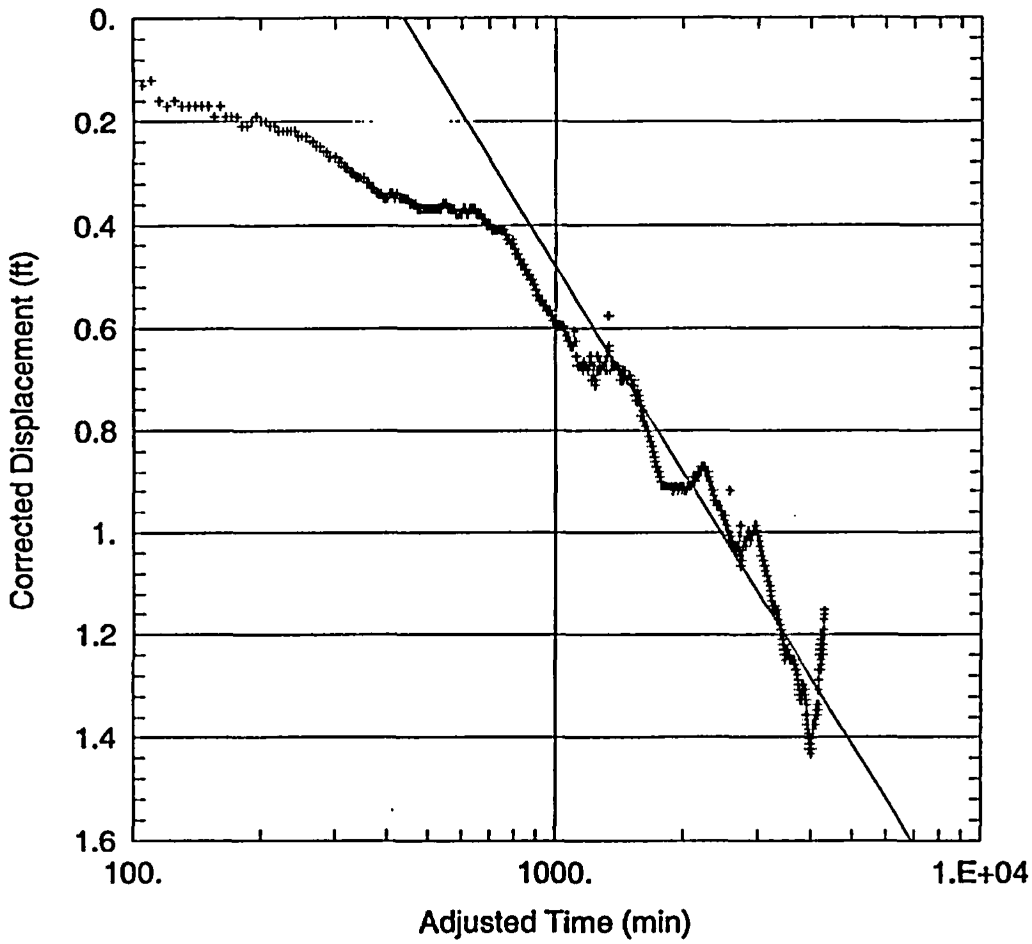
Observation Wells

Well Name	X (ft)	Y (ft)
▫ AT-1	0	0

SOLUTION

Aquifer Model: Unconfined
Solution Method: Neuman

T = 0.3661 ft^2/min
S = 0.00458
Sy = 370.3
β = 0.06



CY HNP PUMPING TEST

Data Set: C:\...\Aqtw MW-109D (C-J).aqt
Date: 11/29/04 Time: 15:34:41

PROJECT INFORMATION

Company: CH2M HILL
Client: CY
Test Well: AT-1
Test Date: 09-15-2004

AQUIFER DATA

Saturated Thickness: 38. ft
Anisotropy Ratio (Kz/Kr): 3.759E-07

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
AT-1	0	0

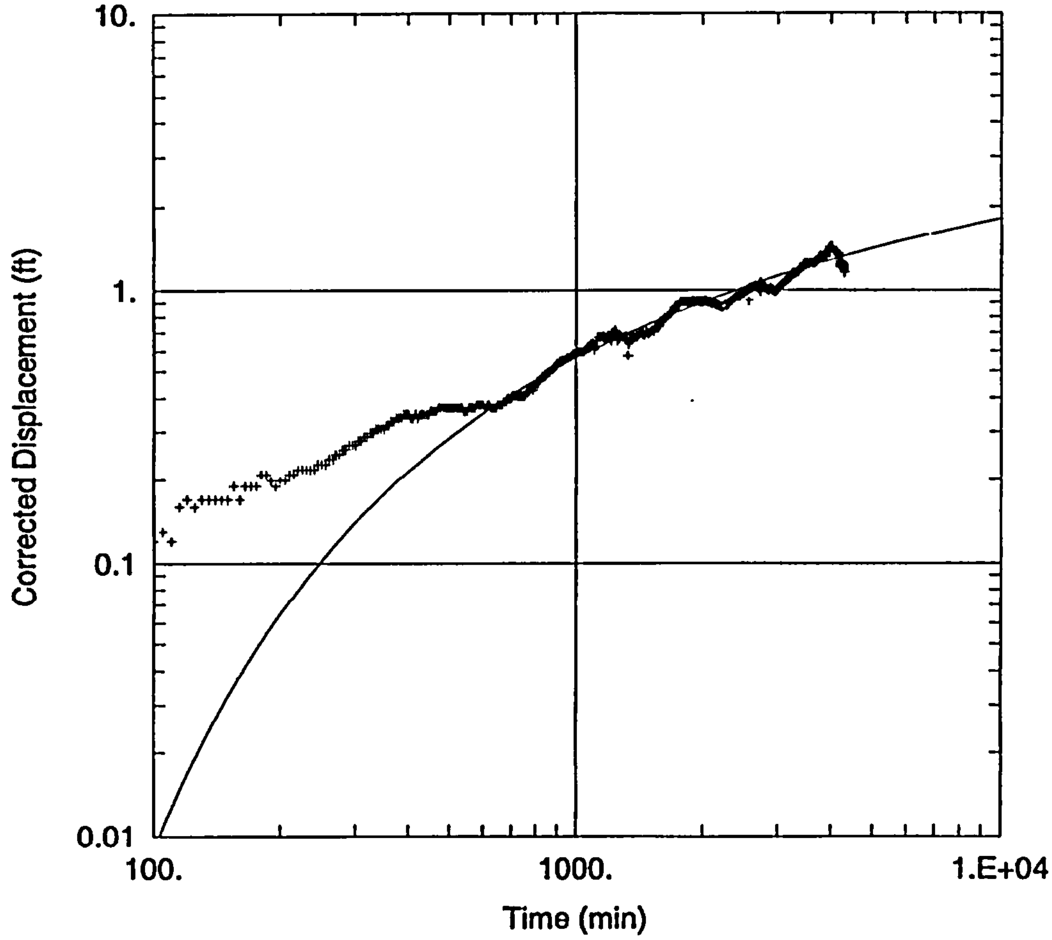
Observation Wells

Well Name	X (ft)	Y (ft)
+ MW-109D	196	0

SOLUTION

Aquifer Model: Unconfined
Solution Method: Cooper-Jacob

T = 0.5333 ft^2/min
S = 0.01358



CY HNP PUMPING TEST

Data Set: C:\...\Aqtw MW-109D (Theis).aqt
Date: 11/29/04 Time: 15:34:55

PROJECT INFORMATION

Company: CH2M HILL
Client: CY
Test Well: AT-1
Test Date: 09-15-2004

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
AT-1	0	0

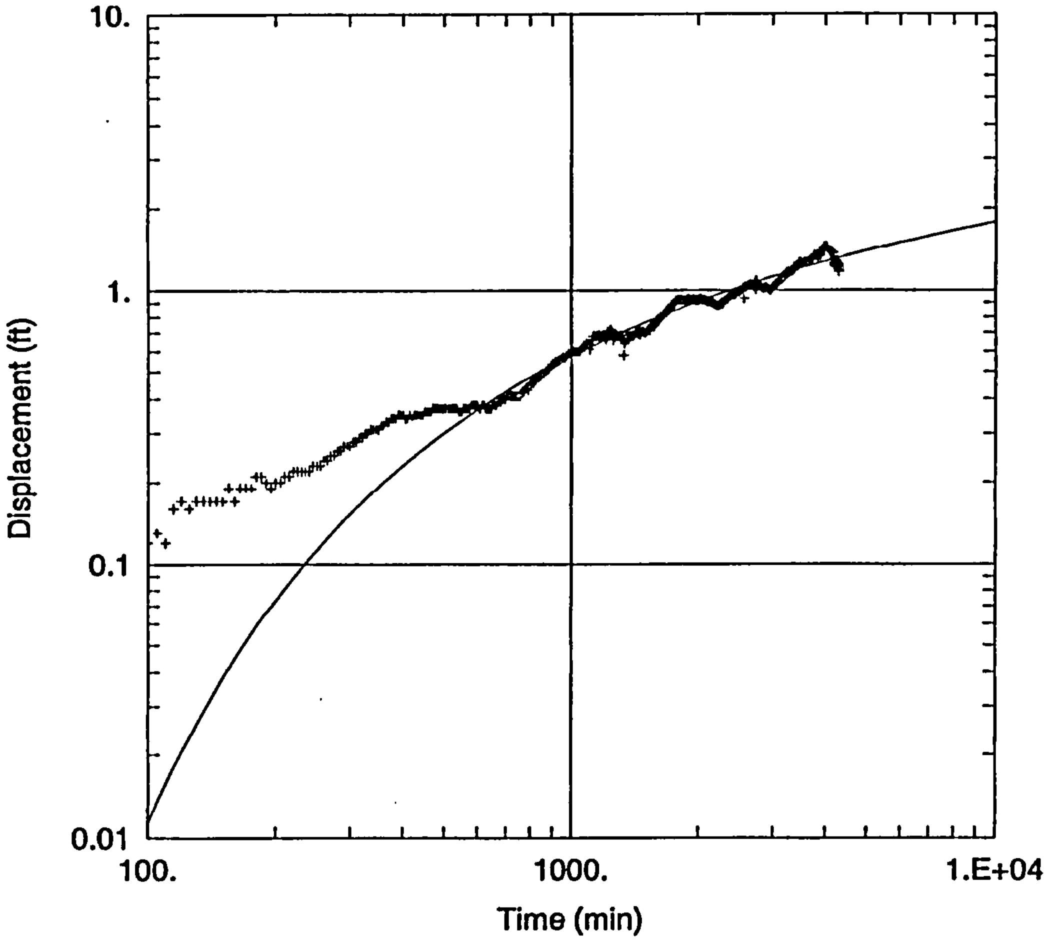
Observation Wells

Well Name	X (ft)	Y (ft)
+ MW-109D	196	0

SOLUTION

Aquifer Model: Unconfined
Solution Method: Theis

T = 0.5093 ft^2/min
S = 0.01542
Kz/Kr = 3.77E-07
b = 38. ft



CY HNP PUMPING TEST

Data Set: C:\...\Aqtw MW-109D (Neuman).aqt
Date: 11/29/04 Time: 15:35:08

PROJECT INFORMATION

Company: CH2M HILL
Client: CY
Test Well: AT-1
Test Date: 09-15-2004

AQUIFER DATA

Saturated Thickness: 38. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
AT-1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
+ MW-109D	196	0

SOLUTION

Aquifer Model: Unconfined

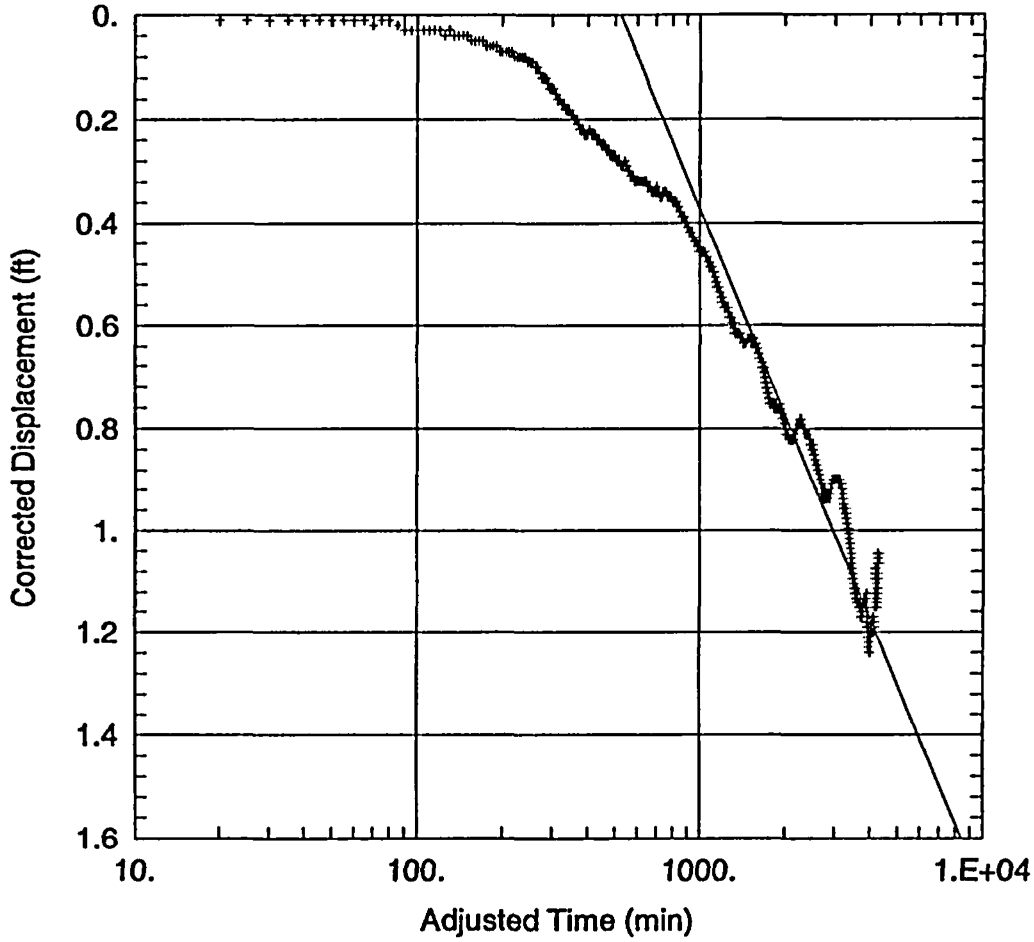
Solution Method: Neuman

T = 0.5268 ft^2/min

S = 0.01479

Sy = 0.0008868

ß = 1.E-05



CY HNP PUMPING TEST

Data Set: C:\...\Aqtw MW-109S (C-J).aqt
Date: 11/29/04 Time: 15:33:25

PROJECT INFORMATION

Company: CH2M HILL
Client: CY
Test Well: AT-1
Test Date: 09-15-2004

AQUIFER DATA

Saturated Thickness: 38. ft Anisotropy Ratio (Kz/Kr): 3.77E-07

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
AT-1	0	0

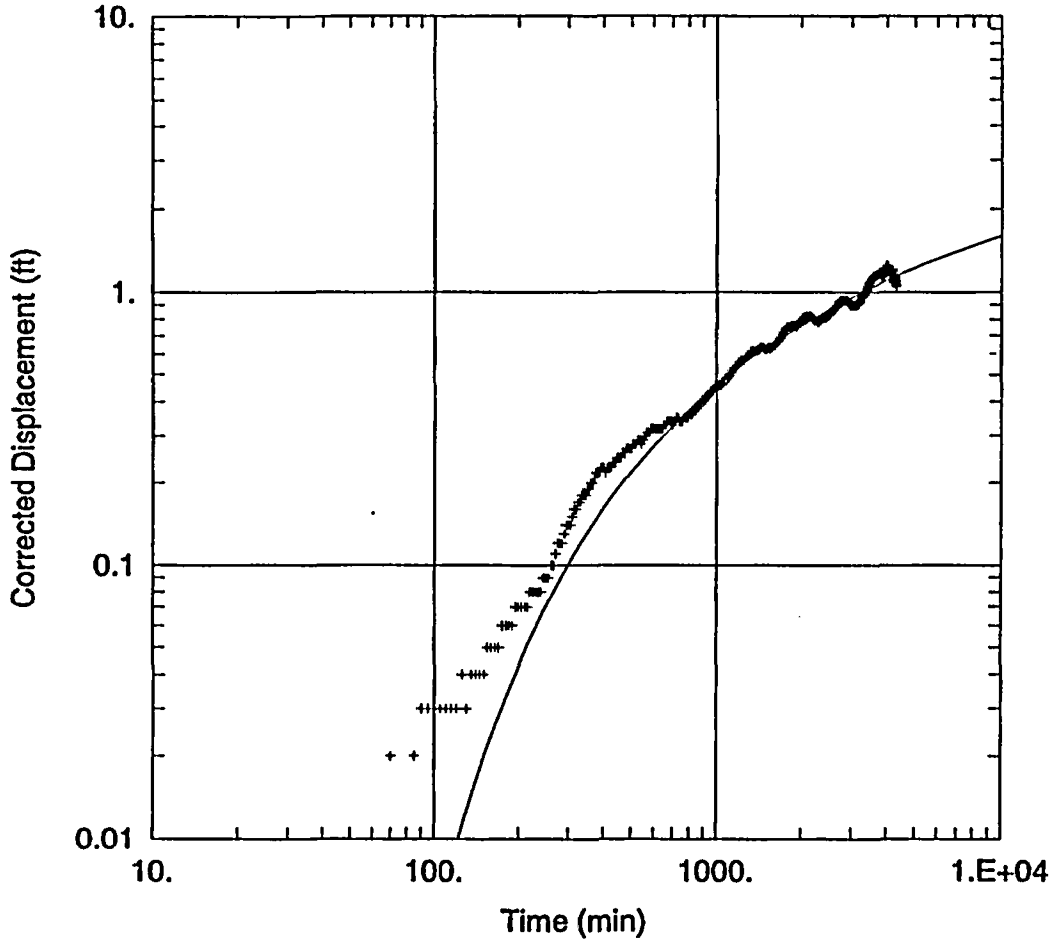
Observation Wells

Well Name	X (ft)	Y (ft)
+ MW-109S	195.7	0

SOLUTION

Aquifer Model: Unconfined Solution Method: Cooper-Jacob

T = 0.5359 ft^2/min S = 0.01643



CY HNP PUMPING TEST

Data Set: C:\...\Aqtw MW-109S (Theis).aqt
Date: 11/29/04 Time: 15:33:43

PROJECT INFORMATION

Company: CH2M HILL
Client: CY
Test Well: AT-1
Test Date: 09-15-2004

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
AT-1	0	0

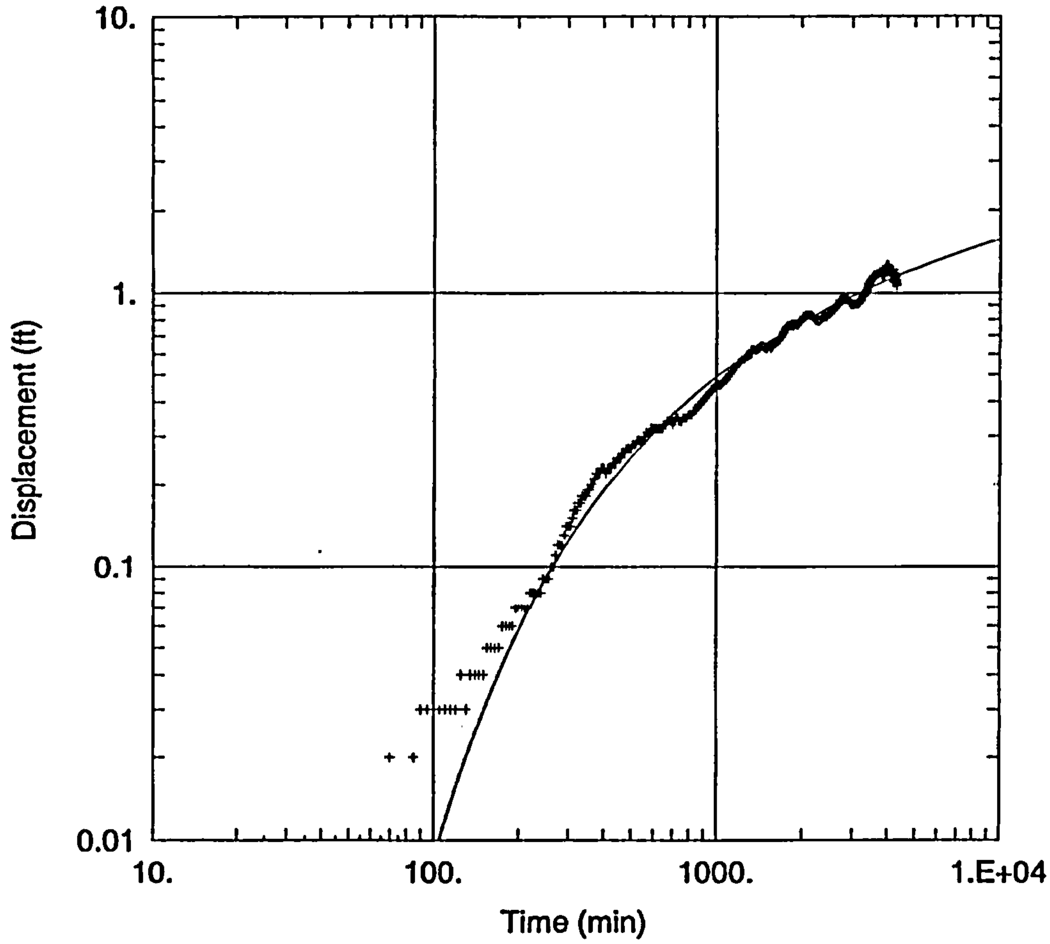
Observation Wells

Well Name	X (ft)	Y (ft)
+ MW-109S	195.7	0

SOLUTION

Aquifer Model: Unconfined
Solution Method: Theis

T = 0.557 ft^2/min
S = 0.01944
Kz/Kr = 3.77E-07
b = 38. ft



CY HNP PUMPING TEST

Data Set: C:\...\Aqtw MW-109S (Neuman).aqt
Date: 11/29/04 Time: 15:34:00

PROJECT INFORMATION

Company: CH2M HILL
Client: CY
Test Well: AT-1
Test Date: 09-15-2004

AQUIFER DATA

Saturated Thickness: 38. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
AT-1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
+ MW-109S	195.7	0

SOLUTION

Aquifer Model: Unconfined

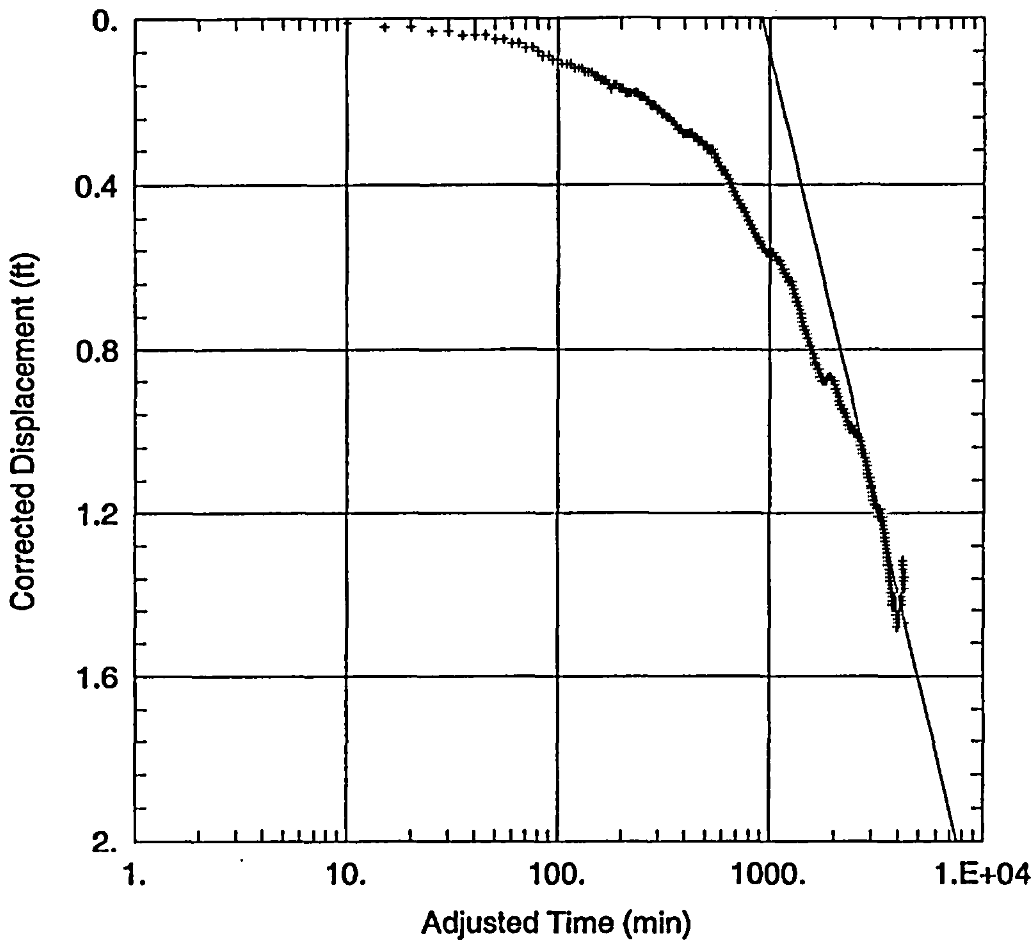
Solution Method: Neuman

T = 0.5928 ft^2/min

S = 0.01671

Sy = 0.0009417

ß = 2.5



CY HNP PUMPING TEST

Data Set: C:\...\Aqtw MW-124 (C-J visual).aqt
Date: 11/29/04 Time: 15:32:20

PROJECT INFORMATION

Company: CH2M HILL
Client: CY
Test Well: AT-1
Test Date: 09-15-2004

AQUIFER DATA

Saturated Thickness: 38. ft Anisotropy Ratio (Kz/Kr): 0.6066

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
AT-1	0	0

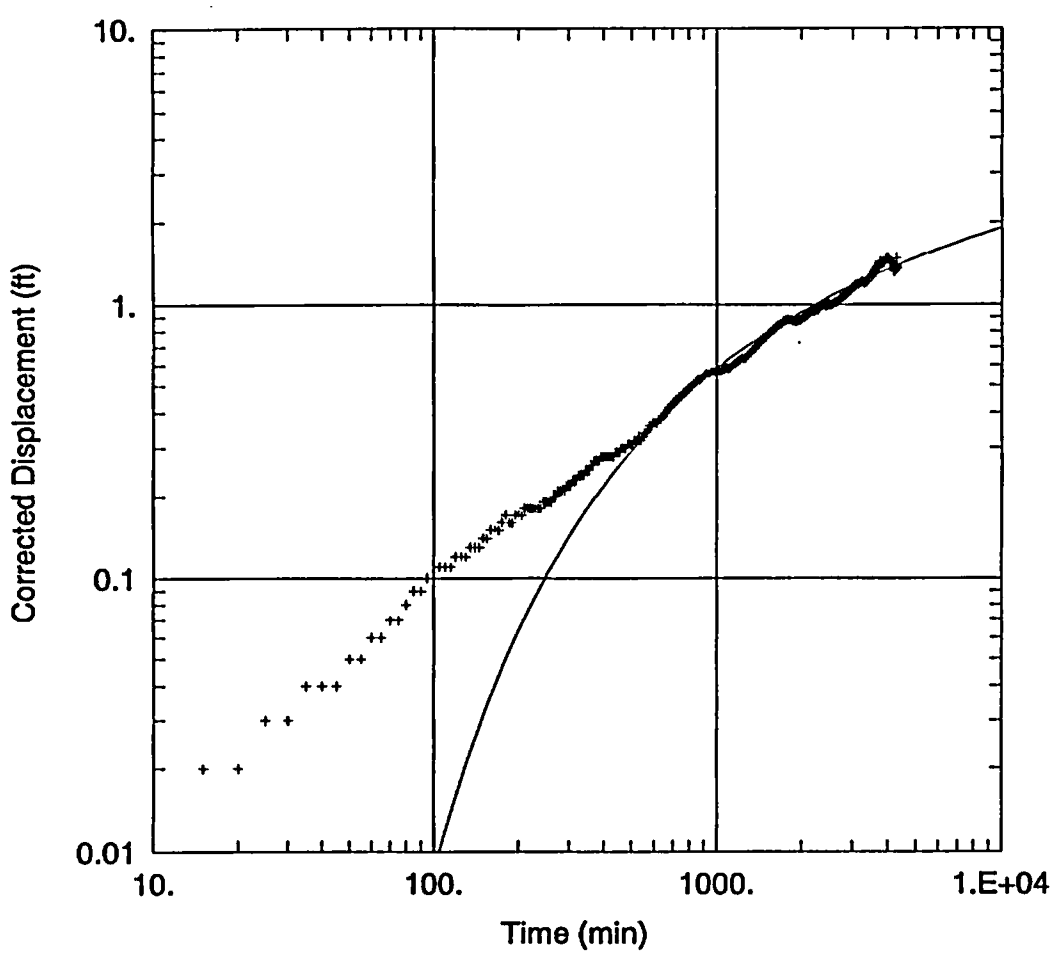
Observation Wells

Well Name	X (ft)	Y (ft)
+ MW-124S	109.1	0

SOLUTION

Aquifer Model: Unconfined Solution Method: Cooper-Jacob

T = 0.3246 ft^2/min S = 0.05622



CY HNP PUMPING TEST

Data Set: C:\...\Aqtw MW-124 (Theis visual).aqt
Date: 11/29/04 Time: 15:32:43

PROJECT INFORMATION

Company: CH2M HILL
Client: CY
Test Well: AT-1
Test Date: 09-15-2004

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
AT-1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
+ MW-124S	109.1	0

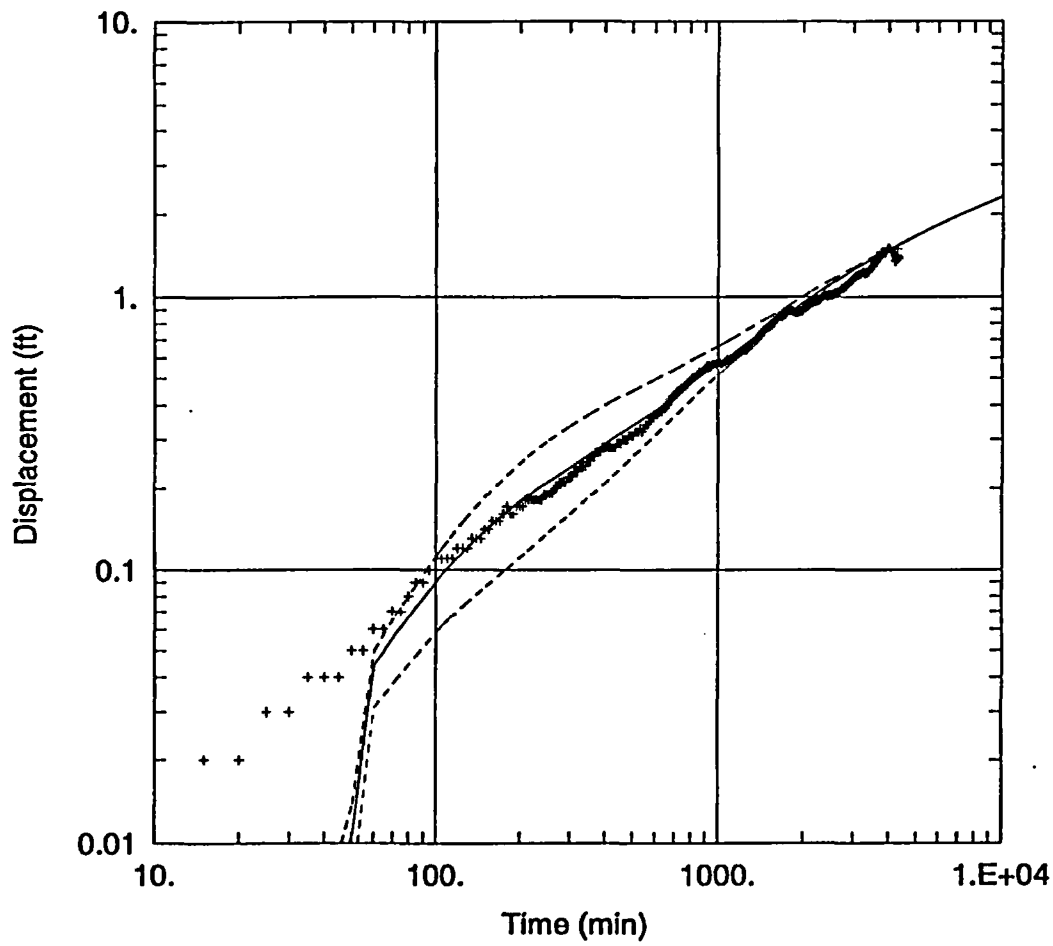
SOLUTION

Aquifer Model: Unconfined

Solution Method: Theis

T = 0.4797 ft^2/min
Kz/Kr = 0.6066

S = 0.04838
b = 38. ft



CY HNP PUMPING TEST

Data Set: C:\...\Aqtw MW-124 (Neuman visual).aqt
Date: 11/29/04 Time: 15:32:59

PROJECT INFORMATION

Company: CH2M HILL
Client: CY
Test Well: AT-1
Test Date: 09-15-2004

AQUIFER DATA

Saturated Thickness: 38. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
AT-1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
+ MW-124S	109.1	0

SOLUTION

Aquifer Model: Unconfined

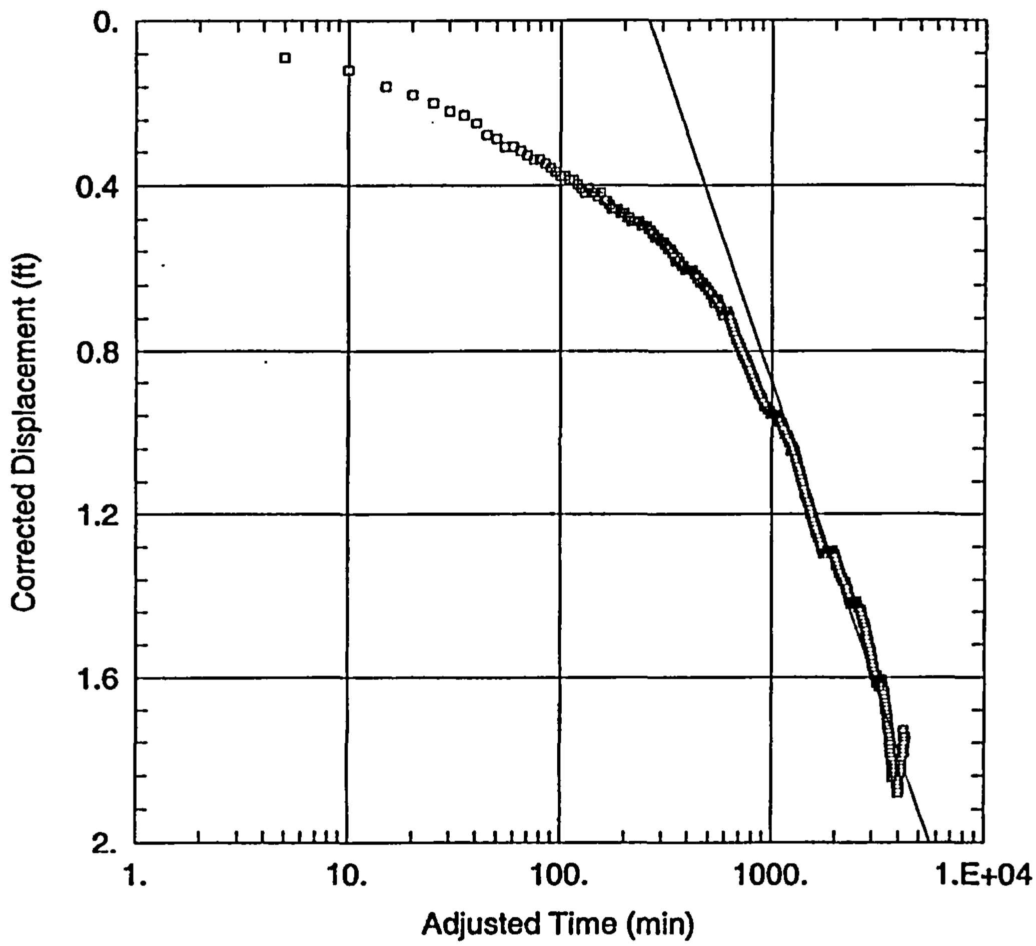
Solution Method: Quick Neuman

T = 0.3124 ft^2/min

S = 0.01393

Sy = 0.06111

ß = 2.5



CY HNP PUMPING TEST

Data Set: C:\...\Aqtw OB-25 (C-J).aqt
Date: 11/29/04 Time: 15:29:32

PROJECT INFORMATION

Company: CH2M HILL
Client: CY
Test Well: AT-1
Test Date: 09-15-2004

AQUIFER DATA

Saturated Thickness: 38. ft Anisotropy Ratio (Kz/Kr): 1.644

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
AT-1	0	0

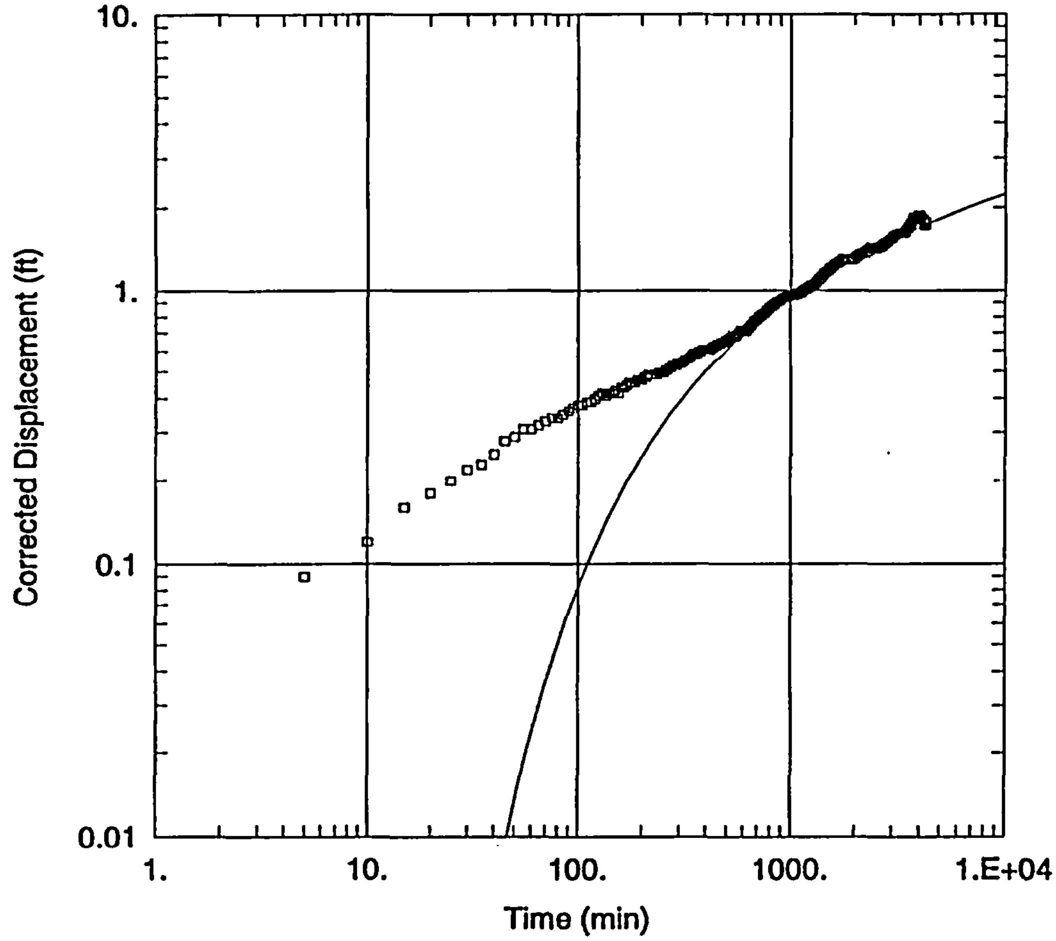
Observation Wells

Well Name	X (ft)	Y (ft)
▫ OB-25	29.1	0

SOLUTION

Aquifer Model: Unconfined Solution Method: Cooper-Jacob

T = 0.4741 ft^2/min S = 0.3265



CY HNP PUMPING TEST

Data Set: C:\...\Aqtw OB-25 (lateTheis).aqt
Date: 11/29/04 Time: 15:31:00

PROJECT INFORMATION

Company: CH2M HILL
Client: CY
Test Well: AT-1
Test Date: 09-15-2004

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
AT-1	0	0

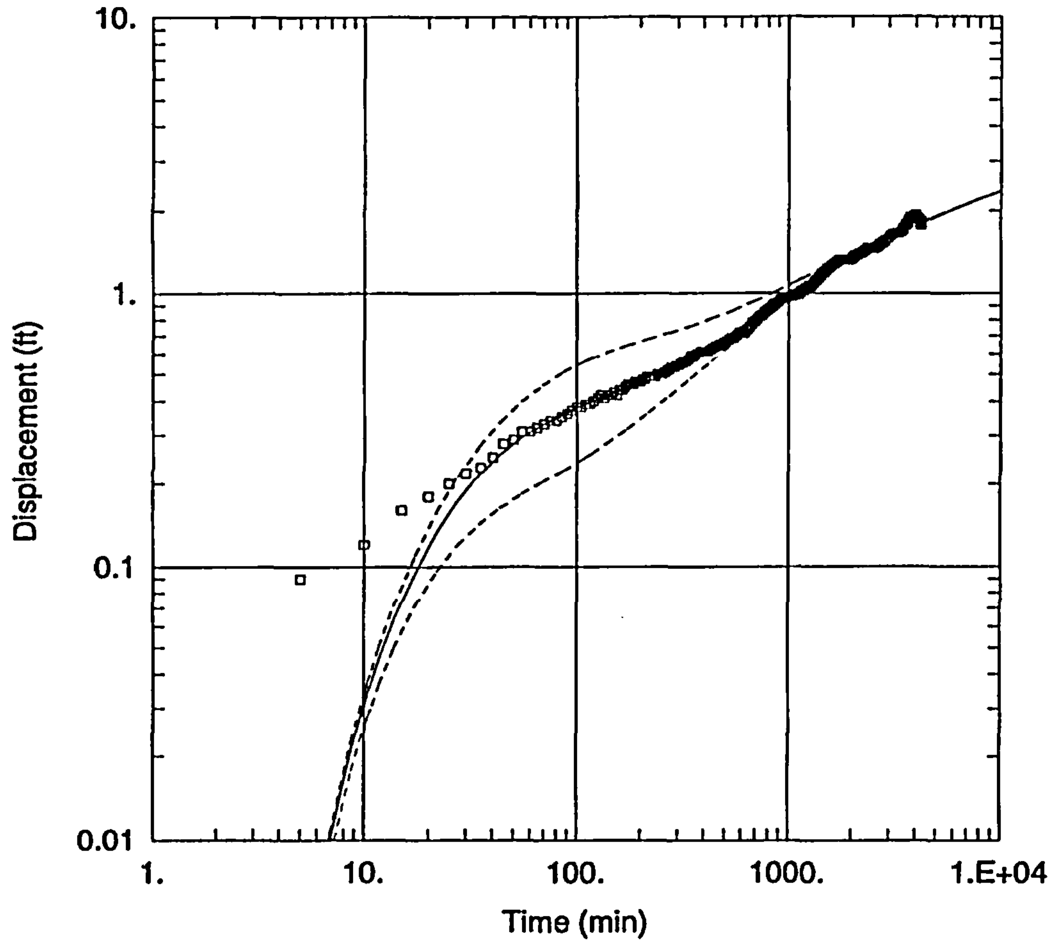
Observation Wells

Well Name	X (ft)	Y (ft)
▫ OB-25	29.1	0

SOLUTION

Aquifer Model: Unconfined
Solution Method: Theis

T = 0.5243 ft^2/min
S = 0.3178
Kz/Kr = 1.
b = 38. ft



CY HNP PUMPING TEST

Data Set: C:\...\Aqtw OB-25 (Neuman visual).aqt
Date: 11/29/04 Time: 15:31:23

PROJECT INFORMATION

Company: CH2M HILL
Client: CY
Test Well: AT-1
Test Date: 09-15-2004

AQUIFER DATA

Saturated Thickness: 38. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
AT-1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
▫ OB-25	29.1	0

SOLUTION

Aquifer Model: Unconfined

Solution Method: Neuman

T = 0.4575 ft^2/min

S = 0.04251

Sy = 0.3412

ß = 0.8