Draft
Remedial Investigation/ Feasibility Study (RI/FS) and Cleanup Action Plan Dearborn Corporate Campus Seattle, Washington

Prepared for
Wright Runstad & Company

March 11, 2002
7206-01

Prepared by
Hart Crowser, Inc.

DRAFT

Julie K. Wukelic
Principal

Michael W. Ehlebracht
Senior Associate

1910 Fairview Avenue East
Seattle, Washington 98102-3699
Fax 206.328.5581
Tel 206.324.9530

CONTENTS

CONTENTS (Continued)

Page

TABLES

FIGURES

APPENDIX A
STRATAPROBE BORING LOGS

APPENDIX B
DETAILED COST ESTIMATES

REMEDIAL INVESTIGATION/FEASIBILITY STUDY (RI/FS) AND CLEANUP ACTION PLAN DEARBORN CORPORATE CAMPUS SEATTLE, WASHINGTON

This report presents the Remedial Investigation/Feasibility Study (RI/FS) and the Cleanup Action Plan (CAP) for the proposed Building B on the Dearborn Corporate Campus property located on the north side of Dearborn Street and west of Rainier Avenue South in Seattle, Washington (Figure 1). This report has been prepared for Wright Runstad & Company (WRC) in general accordance with the Model Toxics Control Act (MTCA, WAC 173-340-360).

The proposed Building B redevelopment site is located on areas that have been identified as contaminated. The redevelopment project allows for an opportunity for cleanup to be conducted under a Prospective Purchaser Agreement (PPA) in conjunction with the development plans. This RI/FS and CAP are written with redevelopment in mind such that any cleanup action will be consistent with long-term plans for site use. Planned redevelopment for Building B will include a multi-story building with one level of below-grade parking as well as paved at-grade parking.

INTRODUCTION AND BACKGROUND

The proposed Building B redevelopment site (Site) is located on the proposed Dearborn Corporate Campus (Campus). The Site is defined by the area between South Dearborn Street and South Lane Street; and Corwin Place South and the Herzog Glass property (1300-1308 South Dearborn Street). See Figure 2 for the Site boundaries as well as the entire proposed redevelopment project boundaries. The Campus consists of nine parcels with five existing buildings. The remainder of the Campus is covered with asphalt and is used for parking or storage. The five buildings are currently being used as a training center (Goodwill), storage (Goodwill), and storage and shipping (Mar-Lac Distributing). The Herzog Glass property (not owned or retained by either Seattle Goodwill Industries (SGI) or WRC) is considered a separate facility and is currently not a part of redevelopment plans. The main Goodwill Building is also considered a separate facility (retained by SGI and not to be purchased by WRC) although major renovation of this building is part of the Dearborn Corporate Campus redevelopment project.

Historical Land Use

This section summarizes historical land use at the Building B Site and the broader Campus. Additional details on the history of the Site, proposed campus, and the surrounding area are presented in Hart Crowser (2001a) and WRC (2000). The Campus was originally part of a large brick, tile, and terra cotta manufacturing company in 1893 and 1904. Extensive soil excavation, known as the Dearborn Cut, occurred through the Campus in 1909 to construct the 12th Avenue South Bridge (Jose Rizal Bridge). The brick company was gone by 1916, and South Dearborn and South Lane Streets existed through the Campus at that time.

Two buildings were noted on the 1916 Sanborn map. The first building along the north side of Dearborn Street on the Campus appeared in 1916 (1416 South Dearborn Street, currently one of the Mar-Lac Buildings). A parking garage called the Dearborn Street Garage was located just north of the Campus but in the current location of the east end of the main Goodwill Building.

According to the 1950 Sanborn map, the Campus was developed with an auto painting shop, pattern shop and plating works, plating works company, sausage factory, refrigerator machinery and repair, service station, storage buildings, and donut factory located on the north side of South Dearborn Street and between Rainier Avenue South and the current Herzog Glass property.

By 1969, the pattern shop and plating workshops were gone from South Dearborn Street. A rag warehouse was visible in the 1969 Sanborn in the northwest corner of South Dearborn Street and Corwin Place South. The service station was gone by 1960. A large portion of the Site between South Dearborn and South Lane Street consisted of asphalt pavement used for parking.

The main Goodwill Building located directly north of the Site first appeared in the 1950 Sanborn map along the north side of South Lane Street. In the 1969 Sanborn map, the Seattle Goodwill Building had expanded to the west and north.

An auto body and repair shop (currently Herzog Glass buildings at 1300-1308 South Dearborn Street) was also located and operated on the west side of the Site until the late 1960s.

The iron and machine works shop and residences along the south side of South Weller Street were gone by that time. Apparently, a large fire destroyed a majority of these buildings and the first Goodwill Building in approximately 1945.

Review of the 1950 and 1969 Sanborn maps indicated that a laundry facility was located in the middle of the main Goodwill Building. The laundry included dry cleaning operations from the 1950s until 1997.

Proposed Land Use

The Dearborn Corporate Campus redevelopment project will consist of three new five-story office buildings fronting South Dearborn and South Lane Streets. Building A, approximately 148,000 square feet in area, will be located between 12th Avenue South (Jose Rizal bridge) and 13th Avenue South; Building B, approximately 173,000 square feet in area, will be located between the Herzog Glass building (to the west) and Corwin Place South; and Building C, approximately 182,000 square feet in area, will be located between Corwin Place South and Dearborn Place South. The buildings will include one level of below-grade parking, one level of at-grade parking, and four levels of office area. Building B and Building C are located in areas that have been identified as contaminated, thus providing an opportunity for cleanup to be conducted under a PPA in conjunction with the development plans.

Seattle Goodwill will retain ownership of the main Goodwill Building and will continue to operate its charitable retail, educational program, and administrative facilities. The renovation will provide SGI with 148,000 square feet of space.

ENVIRONMENTAL INVESTIGATIONS

Numerous environmental investigations conducted on the Campus over the past 12 years have characterized soil and groundwater conditions at the Site and the greater Campus. These investigations included soil and groundwater sampling and analysis, and UST and soil removals. Elevated concentrations of petroleum hydrocarbons, metals, and chlorinated solvents have been encountered in Campus soil and groundwater. Documents reviewed relevant to previous investigations include:

- Results of Soil and Groundwater Sampling, Herzog Glass Site (Hart Crowser 1993);
- Report of Underground Facilities Removal and Subsurface Explorations, Former Unocal Service Station (GeoEngineers 1996);
- Results of Quarterly Monitoring and Sampling, Former Unocal Service Station (GeoEngineers);
- UST Site Assessment and Independent Remedial Action Report, Herzog Glass Property (Dames and Moore 1994);

- Ecology UST Closure files, Herzog Glass;
- Summary of Environmental Investigations and Preliminary Evaluation of Remedial Options, Dearborn Corporate Campus Site (Hart Crowser 2001); and
- Final RI/FS Sampling Results, Dearborn Corporate Campus Site (Hart Crowser 2002).

Groundwater and soil data are presented in Table 1 and 2. Figure 3 presents Dearborn Corporate Campus Exploration Plan.

Herzog Glass Site (1300-1308 South Dearborn Street)

Although this site is not considered part of the "Dearborn Corporate Campus Redevelopment Property," this site is located in the middle of the redevelopment area and has had several environmental investigations conducted over the past 10 years as well as underground storage tank (UST) and petroleum-contaminated soil (PCS) removals. According to Ecology files, one 2,000-gallon diesel/bunker oil UST and petroleum-affected soils were removed in 1991. In July 1993, two gasoline USTs (4,000- and 6,000-gallon capacities) were removed. In 1994, approximately 800 tons of PCS were removed in the area of the former USTs. At the time of the PCS removal, another 2,000-gallon gasoline UST was discovered and removed. A 500-gallon fuel oil UST located inside the building was also closed in-place in 1994.

In 1995, the Washington State Department of Transportation (WSDOT) conducted additional soil removal in the area of the former storage shed (northwest portion of the property), which was being removed at the time to make way for a new storage building (existing). The PCS was limited to the upper 2.5 feet and was near a sump that was discovered during the soil excavation.

Based on the verification soil samples collected and analyzed during the duration of these UST and soil removal activities, there appears to be a limited amount of PCS still remaining under the building.

Hart Crowser performed soil and groundwater sampling and analysis in 1993, which included the installation of four groundwater monitoring wells. Hand-auger borings were also advanced inside the building to collect shallow soil samples. Hart Crowser identified shallow petroleum-affected soils and low concentrations of chlorinated volatile organics in groundwater monitoring well HC-4 (Figure 3). This same groundwater monitoring well also had elevated concentrations of chromium above the MTCA Method A cleanup level.

In 1994, Dames and Moore conducted additional soil and groundwater sampling and analysis at the site. Dames and Moore's 1994 assessment of the site confirmed the presence of chlorinated volatile organics and chromium in monitoring well MW-4 at concentrations similar to those detected by Hart Crowser. Further analysis of the chromium reportedly indicated that the chromium was present in the more toxic hexavalent form, rather than the trivalent form.

Former Unocal Gasoline Service Station (1590 South Dearborn Street)

A gas station was formerly located at the corner of South Dearborn Street and Rainier Avenue South. This property is owned by Goodwill and is located to the east across Dearborn Place. Two USTs were discovered at this site in 1994. In addition, there was also a form in Ecology's file that indicated that two to three other USTs were removed in 1990. No detailed documentation was available on the removal or closure of these USTs or their location relative to the subject property. However, GeoEngineers prepared an Underground Facilities Removal and Subsurface Explorations report on November 6, 1996. This report documents the removal of four USTs, product piping, hydraulic hoist, sumps, and building foundations. Additional soil sampling and analyses were conducted along with the installation of five groundwater monitoring wells. The five groundwater monitoring wells were sampled quarterly from 1992 to 1998 (GeoEngineers 1998). Some PCS was removed and disposed of at Regional Disposal Company's permitted landfill in Roosevelt, Washington.

Dearborn Corporate Campus Site

In support of the PPA, Hart Crowser advanced thirty-two soil borings on the Campus between April and July 2000. Eighteen of these borings were converted to "mini" or standard groundwater monitoring wells. Most of the soil borings were advanced to a depth of approximately 15 to 20 feet below ground surface. Figure 3 shows the placement of the soil borings and monitoring wells.

Groundwater samples were collected from twelve wells in April 2000 and an additional round of groundwater samples were collected in July 2000 from the twelve existing wells, six new wells, and three existing wells (MW-A, MW-B, and MW-C) on the former Unocal site. Three hand-auger borings were also advanced to a depth of 3.5 feet below the concrete floor slab in the basement of the Mar-Lac building at 1426 South Dearborn Street.

Selected soil and groundwater samples collected from the monitoring wells were analyzed for total petroleum hydrocarbons (TPH); volatile organic compounds

(VOCs); total and dissolved metals; and/or benzene, toluene, ethylbenzene, and total xylenes (BTEX). Testing results from soil and groundwater samples analyzed between April and July 2000 are presented in Tables 1 and 2, respectively. The soil sample results from the three hand-auger borings at the Mar-Lac site contained non-detectable concentrations of TPH.

Results

Soil and groundwater quality data were screened against MTCA Method A and B cleanup criteria (see Tables 1 and 2). The environmental investigation conducted on the Dearborn Corporate Campus identified the following contaminants of potential concern: petroleum hydrocarbons, BTEX compounds, chlorinated solvents, arsenic, and chromium.

Petroleum Hydrocarbons were localized within the southeast corner of the parking lot (outside of the Building B area) with detections in SP6-S2 and SP6W-S2. The only reported exceedence was 4,000 mg/kg of hydrocarbons associated with mineral spirit/Stoddard solvent-like product encountered in soil sample SP6-S2. No petroleum hydrocarbons exceeding MTCA criteria were detected in site groundwater.

BTEX Compounds. Elevated concentrations of toluene, ethylbenzene, and xylenes were encountered in the southeast corner of the Campus. Detections of BTEX compounds were reported in soil samples SP2-S3 and SP6-S2. The only screening levels exceedences were xylenes (16 mg/kg) in soil sample SP6-S2, and benzene (0.33 mg/kg) in sample SP2-S3. The only BTEX compound detected in groundwater was benzene (6.4 ug/L), in boring SP-6. This slightly exceeds the Method A Cleanup Level of 5 ug/L. BTEX compounds were not detected in groundwater or soil at the Building B Site.

Chlorinated solvents were detected at scattered locations throughout the Campus. Trichloroethene (TCE) was detected in one soil sample (SP25-S2) at a concentration (0.16 mg/kg) exceeding the screening level of 0.03 mg/kg.

Concentrations of TCE and tetrachloroethene (PCE) exceeding the MTCA Method A groundwater cleanup level (5 ug/L) were detected at Campus groundwater monitoring well SP-7. TCE and PCE were also detected at elevated concentrations in the initial sampling of well SP-11. However, a subsequent sampling event performed in July of 2000 did not detect chlorinated solvents in well SP-11. TCE was also detected in well SP-15A at 11 ug/L. Chlorinated solvents were not detected in any of the other groundwater or soil samples collected at the site.

The relatively low detected concentrations and scattered distribution of detected chlorinated solvents do not point to an obvious source within proposed excavation areas of the redevelopment site.

Metals. Dissolved arsenic concentrations in nine Campus wells exceed the groundwater screening level of 0.005 mg/L. However, arsenic was not identified as a constituent of concern in Campus soils. Most of the exceedences were encountered in wells located in the western portion of the Campus where wood and/or peat deposits were present in shallow soils.

We believe that the elevated arsenic concentrations are the result of localized oxygen-deficient (reducing) conditions caused by the presence of this natural organic material. Arsenic concentrations appeared to be strongly correlated with dissolved iron concentrations (Figure 4). Both arsenic and iron are much more soluble and mobile under oxygen-deficient conditions.

Total (unfiltered) lead concentrations in several groundwater samples exceeded screening levels. However, no dissolved (filtered) lead was detected in Campus groundwater. Based on the high suspended solids content in many of the wells sampled at the Campus, total metals concentrations are not representative of actual groundwater quality conditions. Based on the positive bias caused by the presence of suspended solids, total lead is not considered to be a constituent of concern.

Chromium has been identified as the chemical of concern on the Site. Results are discussed below in the **NATURE AND EXTENT OF CONTAMINATION** section.

Remedial Investigation Field Program

As part of this RI, an exploration and sampling program was implemented to define the vertical and northern extent of chromium-impacted soil at the site, determine the speciation of chromium previously identified, survey top of casing elevations of existing wells, and monitor groundwater elevations.

On August 30, 2001, six Strataprobe borings were advanced at locations shown on Figure 3. Borings SP-29 through SP-34 were advanced to depths of 20 to 27 feet. Groundwater was encountered at depths between 12 and 26 feet at the time of drilling. Selected soil samples were analyzed for total chromium, hexavalent chromium, volatile organic compounds, and TCLP chromium.

Results from the RI have been combined with results obtained from previous investigations on the Dearborn Corporate Campus and are discussed below in the **NATURE AND EXTENT OF CONTAMINATION** section.

PHYSICAL SUBSURFACE CHARACTERISTICS

Geology

The interpretation of the physical setting is based on current and previous field investigations performed at the Site by Hart Crowser, and data reported by Dames and Moore and GeoEngineers from investigations in areas adjacent to the Site. Figure 3, Dearborn Corporate Campus Exploration Plan, shows the locations of most of the explorations that have been performed at the Site and in the broader Campus. Figure 5 presets a cross section through the Building B Site. For reference, boring logs are included in Appendix A.

Geologic Characteristics

The Campus is relatively flat with an elevation of approximately 90 feet, and is covered with either paved parking areas or buildings. To the west of the site, across 13th Avenue, ground surface rises steeply to the northwest. The soils in this area are highly erratic, with fill materials, slide debris, and glacial till. Based on the field explorations, four general soil units were identified at the Campus, as described below.

Fill and Sandy, Silty Clay. The upper soil unit in this area varies from a silty, gravelly sand fill, to a sandy, silty clay. Some peat was encountered in HC-3 in the upper 7 feet. Brick and ash were encountered in the fill beneath the eastern portions of the Campus. The thickness of the fill and sandy, silty clay varies from about 6 to 20 feet.

Silty Sand and Gravel. This soil unit is present across most of the site, beneath the fill and sandy, silty clay. In some areas it is interbedded with sandy clay. This unit was generally encountered to depths of up to 20 feet below the ground surface.

Clayey Silt and Clayey Sand. Throughout most of the Campus a clayey sand or sandy clay with interbedded sandy silt was encountered to depths of up to 50 to 60 feet. In the southwestern part of this site, fractured clayey silt was encountered to depths up to 102 feet below the ground surface.

Gravelly Sand and Silt. Gravelly sand, with zones of till-like gravelly, silty sand, was the deepest soil unit we encountered during the exploration programs. These soils are dense to very dense, and were generally first encountered at depths from about 50 to 60 feet below the ground surface.

Groundwater Characteristics

The existing shallow groundwater monitoring wells (SP-7, SP-8, SP-11, SP-12, SP-14, SP-15A, SP-19, and SP-28) were surveyed on November 1, 2001. One round of depth to water measurements were collected by using an Actat or equivalent water level indicator. The groundwater level data are summarized in Table 3 and presented on Figure 4. Typical depth to water at the site ranges from 6 to 14 feet below ground surface, depending on location and ground surface elevation. Based on the recent water level measurements, the groundwater flow direction is to the southeast at a gradient of approximately 0.007 ft/ft.

In July 2000, Hart Crowser performed a limited aquifer characterization study. The hydraulic parameters of the upper aquifer were estimated in support of potential construction dewatering. Slug tests were conducted in selected Campus monitoring wells with results shown in Table 4. The average hydraulic conductivity was estimated to be 0.6 ft/day. With an assumed porosity of 0.25, the linear groundwater velocity through the Campus is approximately 0.017 ft/day.

NATURE AND EXTENT OF CONTAMINATION

The results of soil and groundwater quality testing are presented in this section. First, screening levels are developed to evaluate and identify chemicals of concern. Then, the nature and extent of chemicals of potential concern are discussed. Evaluation of potential impacts to human health and the environment and exposure pathways is presented in the Focused Feasibility Study (see ***Cleanup Objectives*** section).

Soil and groundwater quality data generated as part of this RI were reviewed by an environmental chemist to determine the validity of the data based on general quality control criteria. Based on this review, the analytical results were deemed acceptable for the purposes of this work. No soil or groundwater quality data collected during the RI field investigation were rejected based on data deficiencies. Laboratory certificates of analysis and data quality review from the current investigation are included in referenced documents.

Identification of Chemicals of Concern

Site characterization data collected on the Site were compared to risk-based criteria to identify chemicals of potential concern. Although the planned site use will be commercial, soil quality data were conservatively compared to Model Toxics Control Act (MTCA) Method A residential criteria when available (Ecology 2001). Although shallow groundwater beneath the site is not currently used as a drinking water source and will not likely be used as a potable water supply in the future, groundwater quality data are compared to Method A and B drinking water criteria.

Soil and groundwater screening levels for potential chemicals of concern are presented in Tables 5 and 6. Soil data for selected constituents are illustrated on Figures 6 and 7, while groundwater data are summarized on Figures 8 and 9.

Occurrence of Chemicals of Concern

This section discusses the nature and extent of chemicals of a potential concern in soil and groundwater. As discussed previously, several exceedences of soil and groundwater screening criteria were identified for the broader corporate Campus. Of these, only chromium in soil and groundwater and PCE and TCE in groundwater are considered chemicals of concern on the Site.

Soil

Elevated concentrations of chromium were encountered in soils sampled east of the Herzog Glass building and near the former plating facility. Initially, chromium speciation was not determined. Soil samples analyzed for chromium were generally collected near the water table, from depths of 7 to 10 feet.

The boundaries and vertical extent, as well as speciation, was defined by the current investigation. It was determined that the majority of chromium detections were in the trivalent form. Hexavalent chromium was detected in boring SP34 at a concentration (0.20 mg/kg) far below the MTCA Method A unrestricted cleanup level of 19.0 mg/kg. The only reported exceedence for trivalent chromium was sample SP33-S2 at 6,160 mg/kg, above the cleanup level of 2,000 mg/kg. There was no detectable concentration of hexavalent chromium in this soil sample. A TCLP analysis for chromium was conducted on this soil sample and the leachate concentration (0.35 mg/L) was well below the hazardous waste threshold of 5.0 mg/L.

Groundwater

The extent of chromium-impacted groundwater on the Site is well defined, with detected concentrations at SP-14 and SP-15A (0.061 and 3 mg/L, respectively). Chromium was only detected in groundwater in the area south of SP-19 and west of SP-11 and SP-12. Based on estimated groundwater flow directions of south to southeast, chromium-impacted soil located east of the Herzog Glass Building appears to be the source of chromium in groundwater.

Although chlorinated solvents PCE and TCE were detected in Building B groundwater, they are not considered to be constituents of concern. Based on the limited occurrences on site, lack of source, and low concentrations, chlorinated solvents are not considered a constituent of concern in the Building B area.

FOCUSED FEASIBILITY STUDY

This section presents the results of a focused Feasibility Study (FS) to evaluate remedial alternatives for soil and groundwater impacted by chromium on the Building B Site. The overall objective of this FS is to identify and compare possible remedial technologies for the Site, based on their ability to mitigate potential risks to human health and the environment. This FS was prepared in general accordance with requirements in the Washington State Model Toxics Control Act (MTCA - WAC 173-340-350 and -360).

Cleanup Objectives

The overall objective of remediation is to reduce potential risk to human health and the environment. Potential exposure pathways for soil, groundwater, and air are discussed below, along with the resulting remedial action objectives (RAOs).

Potential Exposure Pathways

Direct Contact with Soil

Chromium-impacted soils are likely to be centered around boring SP-33 at depths of approximately 4 to 8 feet below ground surface. Current direct contact pathways are limited due to the asphalt surface and the depth of contamination. Future plans include excavation of the area for building foundations and below-grade parking garage that would require removal of chromium-impacted soils.

Soil to Groundwater

The soil to groundwater exposure pathway is limited because the local groundwater is not used, or planned to be used, for drinking water supply or potable purposes. Exposure is limited, but the possibility of off-site migration of total chromium does exist. Chromium-impacted soil and groundwater are present in the southern portion of the site. Combined with a southeastern groundwater gradient, the potential exists for chromium to migrate off site across Dearborn Street.

Soil to Air

The soil to air pathway is not of concern because chromium is not volatile and the site is capped by a building and asphalt.

Direct Contact with Groundwater

Direct contact with groundwater is of limited concern because local shallow groundwater is not presently, nor planned to be, used for domestic or municipal purposes.

Groundwater to Surface Water

Groundwater to surface water exposure pathways are not of concern. There is no groundwater discharge to surface water in the area of the Dearborn Corporate Campus.

Groundwater to Air

Similar to the soil to air exposure pathway, the groundwater to air pathway is not a concern because chromium is not volatile and the site is capped.

Remedial Action Objectives (RAOs)

Risks to human health and the environment via the exposure pathways discussed above appears to be low.

FS remedial alternatives address the following RAOs for impacted soil and groundwater, based on the potential exposure pathways identified at the site:

- **Prevent Direct Contact.** Minimize direct contact with chromium-impacted soils.

- **Protect Groundwater.** Treat or remove impacted soil and groundwater to reduce concentrations in groundwater to concentrations below MTCA criteria.

- **Prevent Potential Air Impacts.** Maintaining cap to prevent the release of chromium-impacted dust.

ARARs and Applicable Regulations

Potential remedial technologies were evaluated based on their ability to meet Applicable or Relevant and Appropriate Requirements (ARARs) associated with federal, state, and regional regulations. The following ARARs have been identified:

- **Model Toxics Control Act (MTCA 70.105D RCW, Chapter 173-340 WAC).** MTCA contains detailed requirements and Washington State's expectations for cleanup of contaminated sites.

- **State Environmental Policy Act (SEPA - 43.21 RCW, Chapter 197-11 WAC).** An environmental checklist is necessary as part of any permitting activity within the City of Seattle and pursuant to MTCA.

- **Minimum Standards for Construction and Maintenance of Wells (Chapter 173-160 WAC).** This regulation contains requirements for abandonment and construction of resource protection wells.

- **Dangerous Waste Regulations (Chapter 173-403 WAC).** This regulation addresses requirements for identification and proper management of dangerous wastes. It is unlikely that impacted soils on the Dearborn Corporate Campus Site would be designated as Dangerous or Extremely Hazardous Wastes.

- **State Clean Air Act (RCW 70.94), General Regulations for Air Pollution Sources (Chapter 173-403 WAC), and Toxic Air Contaminant New Source Review Guidelines.** Emissions during any on-site treatment operations may be subject to these regulations and will require a Notice of Construction Permit from the Puget Sound Clean Air Agency (PSCAA).

- **King County Public Rules and Regulations (PUT 8-14 (PR)), Discharge of Construction Dewatering to the Sanitary Sewer.** This Public Rule sets forth the permitting, fees, and water quality requirements necessary for discharge of groundwater to the sanitary sewer during site redevelopment.

Cleanup Levels

Cleanup levels for soil and groundwater are presented in Tables 5 and 6, respectively, based on MTCA Method A cleanup levels for soil and groundwater.

Remedial Alternatives Development and Evaluation

Screening of Potentially Applicable Technologies

We considered the following technologies potentially applicable for remediation of soil and groundwater impacted by total chromium:

- Natural attenuation;
- Capping with engineering and institutional controls;
- Soil excavation and off-site disposal; and
- Pump and treat.

Technologies for remediating chromium-impacted soil and groundwater are described in Table 7 along with benefits and limitations. Table 8 presents the screening of remediation technologies based on effectiveness and implementability. Based on this evaluation, we retained the following technologies:

- Natural attenuation of chromium-impacted groundwater;
- Capping of chromium-impacted soil;
- Excavation of chromium-impacted soil; and
- Pump and treat of chromium-impacted groundwater.

Below, we develop remedial alternatives using these technologies.

Remedial Alternatives Development

We combined the retained technologies for chromium remediation into the following alternatives:

- **Alternative 1—Capping and Natural Attenuation.** Capping and natural attenuation with engineering and institutional controls;

- **Alternative 2—Excavation and Post-Excavation Monitoring.** Excavation and off-site disposal of chromium-impacted soil, followed by monitored groundwater; and

- **Alternative 3—Excavation of Soil with Groundwater Pump and Treat.** Excavation and off-site disposal of chromium-impacted soil, followed by pumping and treating chromium-impacted groundwater.

These alternatives were selected based on their ability to address the exposure pathways prior to the expected redevelopment of the site and to offer a range of mass removal and cost.

Remedial Alternatives Evaluation

The components of each selected alternative are described below. Their evaluation and comparison are presented in Table 9. A breakdown of the cost of each alternative is provided in Table 10, with detailed costs provided in Appendix B.

Alternative 1—Capping and Natural Attenuation

In this alternative, a low-permeability cap would be placed over chromium-impacted soils. The cap would reduce soil direct contact exposure risks and reduce surface water infiltration. The cap may consist of an asphalt surface similar to the one presently covering the Site.

This alternative addresses the human and environmental exposure pathways but does not reduce soil and groundwater toxicity in the near-term. A long-term groundwater monitoring program would be implemented to determine whether chromium-impacted groundwater is migrating off the Site and to assess natural attenuation over time.

Alternative 2—Excavation and Post-Excavation Monitoring

In this alternative, chromium-impacted soils on the Site would be removed and disposed of off site. The proposed excavation would result in the removal of approximately 2,500 cy of clean overburden and up to 2,000 cy of chromium-impacted soil. The amount of soil needing off-site disposal depends on further sampling and analysis to be conducted during excavation. The excavation would be backfilled with clean material. The clean overburden material may be used for backfill if geotechnically suitable.

Groundwater that is encountered during excavation may be pumped out and discharged to the sanitary sewer. Chromium concentrations present in the discharged water are likely to be below the 2.75 mg/L METRO discharge limits.

Groundwater may require treatment via settling to remove solids and meet sewer discharge criteria for total suspended solids (TSS).

This alternative addresses the human exposure pathways and reduces soil toxicity in the near-term. Impacted groundwater within excavation boundaries will be removed as part of the remedial action. Further groundwater monitoring will be necessary to assess groundwater quality following source removal.

Alternative 3—Excavation of Soil with Groundwater Pump and Treat

This alternative builds upon Alternative 2 – Excavation and Post-Excavation Monitoring. The chromium-impacted soils on the Site would be removed and disposed of off site. A pump and treat system would be designed to extract and treat chromium-impacted groundwater. Treated water would be discharged to the sanitary sewer. This alternative would limit the off-site migration of chromium-impacted groundwater.

This alternative addresses the human and environmental exposure pathways and reduces groundwater toxicity in the near-term. However, the Alternative is much more expensive than the other alternatives and would not provide proportional long-term benefits.

Preferred Remedy Selection

Based on the remedial alternative evaluation and the current plans for site redevelopment, we conclude that **Alternative 2 – Excavation and Post-Excavation Monitoring** is the preferred remedy for the chromium-impacted soil on the Site within the Dearborn Corporate Campus. This preferred remedy is protective of human health and environment and can be effectively implemented under the current redevelopment scenario for the Site.

CLEANUP ACTION PLAN

This Cleanup Action Plan (CAP) describes remedial actions that will be performed on the Building B site and was prepared in general accordance with requirements in the Washington State MTCA (WAC 173-340-380). Based on the RI/FS findings discussed above, Excavation and Post-Excavation Monitoring has been selected as the most cost-effective remedial alternative. The description, rationale, and summary of the screened alternatives evaluated are presented in detail above. Cleanup levels for soil and groundwater are presented in Tables 5

and 6, respectively, based on MTCA Method A or B cleanup levels for soil and groundwater.

The CAP for this site consists of three main components. The first component consists of establishing a sampling grid within the Building B area to isolate the hot spots of chromium-impacted soil for removal. The second component consists of the excavation and off-site disposal of chromium-impacted soils. The final component consists of groundwater compliance monitoring to verify that the excavation source control was effective at reducing off-site discharges of chromium-containing groundwater.

Sampling Grid Setup

The main contaminant of concern for the Building B site is chromium in soil and groundwater. Because chromium contamination in site soils cannot be easily defined using field screening methods (e.g., visual staining or discoloration), the site will be sampled via a grid system prior to excavation to isolate and identify the specific locations of chromium-impacted soil to be removed.

The sampling grid will be set up on 20-foot centers. Each point will be surveyed so that they can be used to define the excavation limits. Eight direct push locations will be extended in a rectangular array near sampling location SP-33. In addition, two locations under the Herzog Glass building and one location near HC-3 will be sampled. Samples will be collected at discrete depths at 2, 4, 6, 8, and 10 feet. Samples from the 2-, 6-, and 10-foot-depth intervals will initially be submitted for analysis. Based on the initial analytical results, additional samples may be submitted to further refine the remedial excavation limits. Samples will be submitted for total chromium and hexavalent chromium analysis. Based on the analytical results from the first 11 borings, up to 11 additional borings will be advanced to further refine the final remedial excavation limits. Figure 10 illustrates the conceptual grid pattern and possible excavation limits that will be used during the implementation of the CAP.

Excavation Plan

Excavation limits will be determined from the analytical data obtained from the sampling grid. Excavation boundaries will extend to the limit where a clean sample (defined as containing less than 2,000 mg/kg of total chromium and 19 mg/kg of hexavalent chromium) was collected. Based on the existing data, up to 2,000 cy of soil may be removed during the remedial action after removing 2,500 cy of clean overburden. The open excavation will be 1.5H:1V to 2H:1V slopes, depending on location and proximity to existing structures (i.e., Herzog

Glass). If groundwater is encountered during excavation, a sump will be used to collect the water before pumping it to a Baker Tank for storage. Based on analytical results of the water from the storage tank, the water will be discharged to storm or sanitary sewer.

Approximately the first 4 feet of soil will be excavated as clean overburden and stockpiled on the site. Because excavation limits will be known before the remedial action begins, chromium-impacted soils will be segregated and stockpiled separately. Both clean and chromium-impacted stockpiles will be placed on, and covered with, visqueen or an appropriate material to minimize precipitation contact and runoff. The soil from within the remedial excavation limits will be disposed of off site in a licensed disposal facility once it has been excavated, stockpiled, and profiled.

Compliance Monitoring

Compliance monitoring will be performed to confirm that human health and the environment are protected during the construction, operation, and maintenance of the cleanup action. Compliance monitoring will also be performed to confirm that the cleanup action has attained cleanup standards prescribed by the CAP and to document the long-term effectiveness of the remedial action. Compliance monitoring at the site will be performed as follows:

- **Protection Monitoring** will be implemented during construction by ensuring that site workers are appropriately trained in health and safety and that health and safety and contingency plans for encountering hazardous materials are available during construction. Soils that are obvious waste materials will be stockpiled with appropriate contact and runoff controls.

- **Performance Monitoring** will be performed on the water generated during construction dewatering. Initially the water generated will be stored temporarily in on-site storage tanks. Based on the analytical results, the water will be discharged to either the stormwater system or sanitary sewer. Additional samples will be periodically collected to determine the most efficient legal method for discharge.

- **Performance Monitoring** will be performed during construction on all soils deemed suspect during the excavation. Suspect soils will be stockpiled separately from the clean overburden. Before being disposed of, the chromium-impacted stockpiles will be characterized and profiled.

Stockpile size will be limited to 500 cubic yards. Three characterization samples will be collected from chromium-impacted stockpiles containing less than 100 cubic yards of soil and five characterization samples will be collected from stockpiles containing between 100 and 500 cubic yards of soil. Samples will be analyzed for total chromium and hexavalent chromium. Appropriate treatment and/or disposal will be performed on excavated soils exhibiting chromium concentrations that exceed cleanup criteria.

- **Confirmation Groundwater Monitoring** will be implemented to ensure the long-term effectiveness of the remedial excavation action to protect human health and the environment. After excavation and site restoration, groundwater monitoring will begin after construction is complete and monitoring points can be established. Groundwater monitoring will be performed on a quarterly basis for two years. The five wells shown of Figure 10 will be sampled as part of the compliance monitoring program. Well HC-1 will be used to evaluate upgradient groundwater quality conditions. Since existing wells will have to be abandoned and removed as part of building construction, four new wells (identified as HC-5 through HC-8) will be installed on the downgradient edges of the Building B site. Groundwater samples will be collected using low-flow sampling techniques and will be analyzed for dissolved chromium.

  Brief data reports will be prepared and submitted to Ecology after each quarterly groundwater monitoring event summarizing observed groundwater elevations, gradients, and analytical results. Following completion of the eighth quarterly groundwater monitoring event, a technical memorandum will be prepared that summarizes the results of the groundwater monitoring program. The memorandum will also provide recommendations regarding the need for additional groundwater monitoring or contingency remedial actions. Compliance with groundwater cleanup criteria will be considered attained when monitoring results are below cleanup levels for four consecutive quarters.

Points of Compliance

Soil. The determination of adequate soil treatment will be based on the remedial actions' ability to comply with the groundwater cleanup standards for the Site, to meet performance standards designed to minimize human health or environmental exposure to soils or groundwater above cleanup levels, and to provide practicable treatment of contaminated soils. Performance standards designed to minimize human and environmental exposure to soils above the cleanup levels set for the Site will include a covenant on the property which

limits the use of the Site and prohibits any activity which may interfere with the protectiveness of the remedial action.

Groundwater. The achievement of cleanup levels in groundwater will be measured at points of compliance located downgradient of the remedial excavation area (see Figure 10). Downgradient monitoring locations will be established after construction is complete.

Schedule

The schedule for implementation of the CAP will be coordinated with construction timelines that are yet to be finalized. Characterization and determination of the remedial excavation limits will be conducted prior to construction activities. These limits will then be used during construction to segregate clean soil from soil that is to be disposed of off site. Compliance groundwater monitoring will begin after construction has been completed and monitoring points are established.

Institutional Controls

Institutional controls are measures undertaken to limit or prohibit activities that may interfere with the integrity of a cleanup action or result in exposure to hazardous substances at the Site. Such measures are required to assure continued protection of human health and the environment when a cleanup action results in residual concentrations of indicator hazardous substances which exceed MTCA Methods A or B cleanup levels and where conditional points of compliance are established. These institutional controls include placement of a deed restriction on the property to preclude interfering with remedial actions implemented in this proposed CAP. At this time, no institutional controls are planned.

Determinations

Section 173-340-360(10) of the MTCA regulation states that the draft Cleanup Action Plan should include a preliminary determination that the cleanup action complies with subsections (2) and (3) of WAC 173-340-360. As specified in subsections 2 and 3, the selected cleanup action is designed to accomplish the following.

Protect Human Health and the Environment

Implementation of the preferred remedial alternative will minimize potential exposures from each of the pathways identified as being of potential concern. Excavating chromium-impacted soil from the site is the most effective alternative for minimizing direct contact.

Compliance with Cleanup Standards per WAC 173-340-700 through -760

The goal of this cleanup action is to protect groundwater quality and prevent direct contact with affected soils. The cleanup action is intended to meet cleanup standards for soil and groundwater.

Compliance with Applicable State and Federal Laws per WAC 173-340-710

The cleanup action will comply with all relevant laws and requirements, as required in Section 173-340-710 of the MTCA. A detailed analysis of federal, state, and local laws and regulations that pertain to this project is provided in the ***ARARs and Applicable Regulations*** section of this document.

Ecology will ensure that the cleanup action meets the substantive requirements of all state and local permits that apply to this project.

Provide Compliance Monitoring per WAC 173-340-410

During implementation of the remedial actions, performance monitoring will be conducted to confirm that cleanup actions have attained cleanup levels and treatment goals. After remedial actions are completed, performance monitoring will be conducted to confirm and ensure that cleanup actions have attained cleanup and performance standards. Protection monitoring will be used to ensure that human health and the environment are being adequately protected during construction and operation of the cleanup actions.

Use Permanent Solutions to the Maximum Extent Practicable per WAC 173-340-360(4), (5), (7), and (8)

Excavation is a preferred technology because it permanently removes contaminants from the site. The preferred remedy is protective of human health and the environment, can be effectively implemented, is cost-effective, and is

consistent with redevelopment plans. It is the most practicable alternative for addressing the primary exposure pathways of concern.

Short-Term Effectiveness

Short-term effectiveness [WAC 173-340-360(5)(iii)] considers how the cleanup action will impact human health and the environment during implementation and prior to achievement of cleanup levels. Measures will be taken to minimize direct contact with chromium-impacted soils during excavation. After the preferred remedial action is implemented, it will minimize human direct contact of chromium-impacted soil in a relatively short time frame.

Long-Term Effectiveness

Long-term effectiveness [WAC 173-340-360(5)(ii)] is measured in terms of the magnitude of residual risk and the adequacy and reliability of the cleanup action.

The proposed cleanup action effectively prevents human exposure over the long-term by removing the primary source of chromium. Source control will reduce the chromium concentration in groundwater over the long-term.

Permanent Reduction of Toxicity, Mobility, or Volume

Excavation and off-site disposal of chromium-impacted soil will permanently decrease the toxicity, mobility, and volume of chromium in soil. Source control will also decrease the toxicity, mobility, and mass of chromium in groundwater over the long-term.

Ability to be Implemented

Coordination of the remedial action with construction and redevelopment plans enables excavation to be easily implemented at this site.

Cleanup Cost

Cleanup costs for the selected alternatives are similar to or lower than the other alternatives evaluated (see Appendix B for detailed cost estimates).

Consider Public Concerns per WAC 173-340-600

The public will be given the opportunity to comment during a 30-day public comment period on the following completed milestones of the cleanup process

for this proposed land use. The following documents are presented for public comment:

- Remedial Investigation/Feasibility Study (RI/FS) and Cleanup Action Plan.

Ecology will consider all comments received. At the end of the comment period, Ecology will prepare a responsive summary listing each comment received and Ecology's response to the comment.

Further, the public will be given an opportunity to comment on the Remedial Design when it is submitted to Ecology.

LIMITATIONS

Work for this project was performed, and this report prepared, in accordance with generally accepted professional practices for the nature and conditions of the work completed, in the same or similar localities, at the time the work was performed. It is intended for the exclusive use of Wright Runstad & Company, for specific application to the subject property. This report is not meant to represent a legal opinion. No other warranty, express or implied, is made.

All MTCA cleanup levels included in this report are provided for comparison purposes only and are based on our understanding of cleanup levels required by Ecology for similar projects. They do not represent MTCA interpretations. By using them for comparison purposes, we are not implying that remedial actions at this site are required under MTCA. Specific MTCA interpretations may involve separate calculations and determinations upon which a range of cleanup standards may be established by Ecology.

Any questions regarding our work and this report, the presentation of the information and the interpretation of the data are welcome.

We trust that this report meets your needs.

REFERENCES

Dames and Moore 1994. UST Site Assessment and Independent Remedial Action Report, Herzog Glass Property.

Ecology 2001. Proposed Amendments to The Model Toxics Control Act Cleanup Regulation. Chapter 173-340 WAC. August 2001.

GeoEngineers 1996. Report of Underground Facilities Removal and Subsurface Explorations, Former Unocal Service Station 0166, 1590 South Dearborn Street, Seattle, Washington. November 6, 1996.

GeoEngineers 1998. Results of Quarterly Ground Water Monitoring and Sampling, April 1998, Former Unocal Service Station 1066, 1509 South Dearborn Street, Seattle, Washington, Leaky UST Incident #375414. June 10, 1998.

Hart Crowser 1993. Results of Soil and Groundwater Sampling, Herzog Glass Site, 1300 South Dearborn Street, Seattle, Washington. June 29, 1993.

Hart Crowser 2001a. Summary of Environmental Investigations and Preliminary Evaluation of Remedial Options, Dearborn Corporate Campus Site, Seattle, Washington. January 5, 2001.

Hart Crowser 2001b. Final Remedial Investigation Project Plan, Dearborn Corporate Campus, Seattle, Washington. June 26, 2001.

Hart Crowser 2002. Final RI/FS Sampling Results, Dearborn Corporate Campus, Seattle, Washington. January 12, 2002.

Wright Runstad & Company 2000. Prospective Purchaser Proposal. August 24, 2000.

F:\docs\jobs\720601\RemedialInvestigation.doc

Table 1 - Analytical Results for Soil Samples

Sample ID:	MTCA Method A	SP1-S3	SP2-S3	SP4-S2	SP6-S1	SP6-S2	SP6-S3	SP6N-S2	SP6W-S2	SP7-S3	SP8-S3	SP11-S3	SP13-S3
Sample Depth in Feet	Residential	7-10	7-10	4-7	1-4	4-7	7-10	4-7	4-7	7-10	7-10	7-10	7-10
Metals in mg/kg													
Arsenic	20		20 U	20 U		20 U						20 U	
Barium	NA		20 U	20 U		20 U						20 U	
Cadmium	2.0		1 U	1 U		1 U						1 U	
Chromium (Total)	2000(b)		20 U	20 U		20 U						20 U	
Chromium (+6)	19(a)												
TCLP Chromium													
Lead	250		5 U	**7.3**		5 U						**7.7**	
Mercury	2.0		0.01 U	0.01 U		0.01 U						0.01 U	
Selenium	NA		20 U	20 U		20 U						20 U	
Silver	NA		20 U	20 U		20 U						20 U	
NWTPH-Gx in mg/kg													
Mineral spirits/Stoddard solvent	30					**4000**							
Gasoline	30					5 U							
NWTPH-Dx in mg/kg													
Kerosene/Jet fuel	2000				20 U	20 U	20 U	20 U	**530**				
Diesel/Fuel oil	2000				20 U	20 U	20 U	20 U	20 U				
Heavy oil	2000				50 U	50 U	50 U	50 U	50 U				
NWTPH-HCID in mg/kg													
Gasoline	30	20 U	20 U	20 U		20 U				20 U	20 U	20 U	20 U
Stoddard solvent/Mineral spirits	30	20 U	20 U	20 U		D				20 U	20 U	20 U	20 U
Kensol	30	20 U	20 U	20 U		20 U				20 U	20 U	20 U	20 U
Kerosene/Jet fuel	2000	20 U	20 U	20 U		20 U				20 U	20 U	20 U	20 U
Diesel/Fuel oil	2000	50 U	50 U	50 U		50 U				50 U	50 U	50 U	50 U
Bunker C	2000	50 U	50 U	50 U		50 U				50 U	50 U	50 U	50 U
Heavy oil	2000	100 U	100 U	100 U		100 U				100 U	100 U	100 U	100 U
Volatiles in mg/kg													
Acetone													
2-Butanone													
1,1,1-Trichloroethane	2.0		0.05 U	0.05 U		0.05 U					0.05 U	0.05 U	
Trichloroethene	0.03		0.05 U	0.05 U		0.05 U					0.05 U	0.05 U	
1,1-Dichloroethane	NA		0.25 U	0.25 U		0.25 U					0.25 U	0.25 U	
Tetrachloroethene	0.05		0.05 U	0.05 U		0.05 U					0.05 U	0.05 U	
cis-1,2-Dichloroethene	NA		0.25 U	0.25 U		0.25 U					0.25 U	0.25 U	
p-Dichlorobenzene	NA		0.05 U	0.05 U		0.05 U					0.05 U	0.05 U	
o-Dichlorobenzene	NA		0.05 U	0.05 U		0.05 U					0.05 U	0.05 U	
Benzene	0.03		**0.33**	0.05 U		0.05 U					0.05 U	0.05 U	
Toluene	7.0		**0.30**	0.05 U		0.05 U					0.05 U	0.05 U	
Ethylbenzene	6.0		0.05 U	0.05 U		**4.7**					0.05 U	0.05 U	
Xylenes	9.0		0.05 U	0.05 U		**16**					0.05 U	0.05 U	
Chlorobenzene	NA		**0.25**	0.25 U		0.25 U					0.25 U	0.25 U	

Table 1 - Analytical Results for Soil Samples

Sample ID:	MTCA Method A	SP14-S3	SP15-S3	SP17-S3	SP23-S2	SP23-S3	SP25-S2	SP27-S3	SP28-S2	SP29-S1	SP29-S2	SP30-S1	SP30-S2	SP31-S1	SP31-S2
Sample Depth in Feet	Residential	7-10	7-10	7-10	4-7	7-10	4-7	7-10	4-7	12-15	16-20	12-16	16-20	12-16	16-20
Metals in mg/kg															
Arsenic	20	20 U	20 U	20 U	20 U	20 U			20 U						
Barium	NA	20 U	20 U	20 U	20 U	20 U			20 U						
Cadmium	2.0	1 U	1 U	1 U	1 U	1 U			1 U						
Chromium (Total)	2000(b)	**41**	**20**	**110**	**28**	**300**			20 U	**89**	**73.8**	**92.4**	**91.9**	**59.2**	**56.1**
Chromium (+6)	19(a)									0.14 U	0.12 U	0.11 U	0.14 U	0.12 U	0.12 U
TCLP Chromium															
Lead	250	**6.9**	5 U	**10**	5 U	5 U			**15**						
Mercury	2.0	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U			0.01 U						
Selenium	NA	20 U	20 U	20 U	20 U	20 U			20 U						
Silver	NA	20 U	20 U	20 U	20 U	20 U			20 U						
NWTPH-Gx in mg/kg															
Mineral spirits/Stoddard solvent	30														
Gasoline	30														
NWTPH-Dx in mg/kg															
Kerosene/Jet fuel	2000														
Diesel/Fuel oil	2000														
Heavy oil	2000														
NWTPH-HCID in mg/kg															
Gasoline	30	20 U		20 U	20 U	20 U		20 U							
Stoddard solvent/Mineral spirits	30	20 U		20 U	20 U	20 U		20 U							
Kensol	30	20 U		20 U	20 U	20 U		20 U							
Kerosene/Jet fuel	2000	20 U		20 U	20 U	20 U		20 U							
Diesel/Fuel oil	2000	50 U		50 U	50 U	50 U		50 U							
Bunker C	2000	50 U		50 U	50 U	50 U		50 U							
Heavy oil	2000	100 U		100 U	100 U	100 U		100 U							
Volatiles in mg/kg															
Acetone															
2-Butanone															
1,1,1-Trichloroethane	2.0						0.05 U								
Trichloroethene	0.03						**0.16**								
1,1-Dichloroethane	NA						0.25 U								
Tetrachloroethene	0.05						0.05 U								
cis-1,2-Dichloroethene	NA						0.25 U								
p-Dichlorobenzene	NA						0.05 U								
o-Dichlorobenzene	NA						0.05 U								
Benzene	0.03						0.05 U								
Toluene	7.0						0.05 U								
Ethylbenzene	6.0						0.05 U								
Xylenes	9.0						0.05 U								
Chlorobenzene	NA						0.25 U								

Table 1 - Analytical Results for Soil Samples

Sample ID:	MTCA Method A	SP32-S1	SP32-S2	SP33-S1	SP33-S2	SP33-S3	SP33-S4	SP34-S1	SP34-S2	SP34-S3	HC1-COMP	HC2-COMP	HC3-COMP
Sample Depth in Feet	Residential	12-16	16-20	0-4	4-8	12-16	16-20	4-8	12-16	18-22			
Metals in mg/kg													
Arsenic	20												
Barium	NA												
Cadmium	2.0												
Chromium (Total)	2000(b)	**40.9**	**35.8**	**96**	**6160**	**374**	**393**	**58.3**	**46.6**	**39.5**			
Chromium (+6)	19(a)	0.12 U	0.12 U		0.12 U	0.12 U	0.13 U	0.11 U	0.11 U	**0.2**			
TCLP Chromium					**0.35 mg/L**								
Lead	250												
Mercury	2.0												
Selenium	NA												
Silver	NA												
NWTPH-Gx in mg/kg													
Mineral spirits/Stoddard solvent	30												
Gasoline	30												
NWTPH-Dx in mg/kg													
Kerosene/Jet fuel	2000										20 U	20 U	20 U
Diesel/Fuel oil	2000										20 U	20 U	20 U
Heavy oil	2000										50 U	50 U	50 U
NWTPH-HCID in mg/kg													
Gasoline	30												
Stoddard solvent/Mineral spirits	30												
Kensol	30												
Kerosene/Jet fuel	2000												
Diesel/Fuel oil	2000												
Bunker C	2000												
Heavy oil	2000												
Volatiles in mg/kg													
Acetone				**0.053**									
2-Butanone				**0.007**									
1,1,1-Trichloroethane	2.0												
Trichloroethene	0.03												
1,1-Dichloroethane	NA												
Tetrachloroethene	0.05												
cis-1,2-Dichloroethene	NA												
p-Dichlorobenzene	NA												
o-Dichlorobenzene	NA												
Benzene	0.03												
Toluene	7.0												
Ethylbenzene	6.0												
Xylenes	9.0												
Chlorobenzene	NA												

U = Not detected at indicated detection limit.
Blank indicates sample not analyzed for analyte.
(a) Based on hexavalent chromium
(b) Based on trivalent chromium

Detected results presented in bold
Concentrations exceeding proposed MTCA criteria
D Detected at or above listed reporting limits.

Table 2 - Analytical Results for Water Samples

Date Sampled	MTCA A Groundwater	MTCA B Groundwater	SP-6 4/19/2000	SP-7 4/19/2000	SP-7 7/17/2000	SP-8 4/19/2000	SP-8 7/17/2000	SP-11 4/17/2000	SP-11 7/17/2000	SP-12 4/19/2000
Conventionals in mg/L										
Total Suspended Solids				3,200		1,100		360		410
NWTPH-G in mg/L										
Mineral Spirits/Stoddard Solvent	1	NA	NA	0.1 U	NA	NA	NA	NA	NA	0.1 U
Gasoline	0.8	NA	NA	0.1 U	NA	NA	NA	NA	NA	0.1 U
NWTPH-Dx in mg/L										
Kerosene/Jet Fuel	0.5	NA	0.2 U	0.2 U	NA	0.2 U	NA	NA	NA	0.2 U
Diesel/Fuel Oil	0.5	NA	0.2 U	0.2 U	NA	0.2 U	NA	NA	NA	0.2 U
Heavy Oil	0.5	NA	0.5 U	0.5 U	NA	0.5 U	NA	NA	NA	0.5 U
Volatile Organics in mg/L										
1,1,1-Trichloroethane	0.2	0.2	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0065	0.001 U	NA
Trichloroethene	0.005	0.005	0.001 U	0.0074	0.006	0.001 U	0.001 U	0.047	0.001 U	NA
1, 1-Dichloroethane	NA	0.8	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	NA
Tetrachloroethene	0.005	0.005	0.001 U	0.015	0.042	0.001 U	0.0044	0.0079	0.001 U	NA
cis-1, 2-Dichloroethene	NA	0.07	0.005 U	0.005 U	0.0044	0.005 U	0.005 U	0.02	0.027	NA
p-Dichlorobenzene	NA	0.018	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	NA
o-Dichlorobenzene	NA	0.6	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	NA
Benzene	0.005	0.005	0.0064	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Toluene	1	1	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Ethylbenzene	0.7	0.7	0.0035	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Xylenes	1	10	0.0053	0.009	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Total Metals in mg/L										
Arsenic	0.005	0.005	NA	NA	0.001 U	NA	0.0021	NA	0.019	NA
Barium	NA	0.56	NA	NA	0.047	NA	0.16	NA	0.18	NA
Cadmium	0.005	0.005	NA	NA	0.0005 U	NA	0.0012	NA	0.0011	NA
Chromium (Total)	0.05	0.05(a)	NA	NA	0.01 U	NA	0.015	NA	0.028	NA
Chromium (+6)	NA	0.05							0.005 U	
Copper	NA	0.59	NA	NA	NA	NA	NA	NA	NA	NA
Lead	0.015	NA	NA	NA	0.0014	NA	0.015	NA	0.0064	NA
Mercury	0.002	0.002	NA	NA	0.0002 U	NA	0.0002 U	NA	0.0002 U	NA
Selenium	NA	0.05	NA	NA	0.5 U	NA	0.5 U	NA	0.5 U	NA
Silver	NA	0.1	NA	NA	0.1 U	NA	0.1 U	NA	0.15 U	NA
Zinc	NA	4.8	NA	NA	NA	NA	NA	NA	NA	NA
Dissolved Metals in mg/L										
Arsenic	0.005	0.005	NA	NA	0.001 U	NA	0.0011	0.0015 U	0.016	0.0024
Barium	NA	0.56	NA	NA	0.038	NA	0.12	0.082	0.1	0.18
Cadmium	0.005	0.005	NA	NA	0.0005 U	NA	0.0005 U	0.00095	0.0005 U	0.0005 U
Chromium (Total)	0.05	0.05(a)	NA	NA	0.01 U	NA	0.01 U	0.01 U	0.01 U	0.01 U
Chromium (+6)	NA	0.05								
Copper	NA	0.59	NA	NA	0.001 U	NA	0.0014	NA	0.001 U	0.001 U
Iron	NA	NA					0.47		14	
Lead	0.015	NA	NA	NA	0.0005 U	NA	0.0005 U	0.0005 U	0.0005 U	0.0005 U
Mercury	0.002	0.002	NA	NA	0.0002 U	NA	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Nickel	NA	0.10					0.011		0.006	
Selenium	NA	0.05	NA	NA	0.5 U	NA	0.5 U	0.4 U	0.5 U	0.4 U
Silver	NA	0.1	NA	NA	0.15 U	NA	0.18 U	0.0005 U	0.15 U	0.0005 U
Zinc	NA	4.8	NA	NA	NA	NA	0.097	NA	0.011	NA

Table 2 - Analytical Results for Water Samples

Date Sampled	SP-12 7/17/2000	SP-14 4/17/2000	SP-14 7/17/2000	SP-15A 4/20/2000	SP-15A 7/17/2000	SP-19 4/19/2000	SP-19 7/17/2000	SP-21 4/18/2000	SP-21 7/17/2000	SP-23 4/18/2000
Conventionals in mg/L										
Total Suspended Solids		43								
NWTPH-G in mg/L										
Mineral Spirits/Stoddard Solvent	NA	NA	NA	0.1 U	NA	NA	NA	NA	NA	0.1 U
Gasoline	NA	NA	NA	0.1 U	NA	NA	NA	NA	NA	0.1 U
NWTPH-Dx in mg/L										
Kerosene/Jet Fuel	NA	NA	NA	0.2 U	NA	NA	NA	0.2 U	NA	0.2 U
Diesel/Fuel Oil	NA	NA	NA	0.2 U	NA	NA	NA	0.2 U	NA	0.2 U
Heavy Oil	NA	NA	NA	0.5 U	NA	NA	NA	0.5 U	NA	0.5 U
Volatile Organics in mg/L										
1,1,1-Trichloroethane	0.001 U	0.001 U	NA	**0.0074**	**0.0019**	0.001 U	0.001 U	0.001 U	NA	NA
Trichloroethene	0.001 U	0.001 U	NA	**0.059**	**0.011**	0.001 U	0.001 U	0.001 U	NA	NA
1, 1-Dichloroethane	0.005 U	0.005 U	NA	**0.048**	**0.014**	0.005 U	0.005 U	0.005 U	NA	NA
Tetrachloroethene	0.001 U	0.001 U	NA	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	NA	NA
cis-1, 2-Dichloroethene	0.005 U	0.005 U	NA	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	NA	NA
p-Dichlorobenzene	0.001 U	0.001 U	NA	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	NA	NA
o-Dichlorobenzene	0.001 U	0.001 U	NA	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	NA	NA
Benzene	0.001 U	0.001 U	NA	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	NA	0.001 U
Toluene	0.001 U	0.001 U	NA	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	NA	0.001 U
Ethylbenzene	0.001 U	0.001 U	NA	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	NA	0.001 U
Xylenes	0.001 U	0.001 U	NA	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	NA	0.001 U
Total Metals in mg/L										
Arsenic	**0.023**	0.004 U	**0.0027**	**0.0077**	0.001 U	NA	**0.027**	NA	**0.086**	0.004 U
Barium	**0.19**	**0.058**	**0.2**	**0.21**	**0.034**	NA	**0.21**	NA	**0.13**	**0.093**
Cadmium	**0.00063**	0.0005 U	**0.0011**	0.0005 U	0.0005 U	NA	**0.00096**	NA	**0.00055**	0.0005 U
Chromium (Total)	0.01 U	**0.036**	**0.15**	**2.9**	**2**	NA	**0.054**	NA	**0.014**	**0.065**
Chromium (+6)	0.025 U		0.01 U		**1.6**		0.025 U		0.025 U	
Copper	NA	NA	NA	NA	NA	NA	NA	NA	NA U	NA
Lead	0.0005 U	**0.0016**	**0.024**	**0.01**	**0.0012**	NA	**0.0053**	NA	**0.0013**	**0.011**
Mercury	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	NA	0.0002 U	NA	0.0002 U	0.0002 U
Selenium	0.5 U	0.4 U	0.5 U	0.4 U	0.5 U	NA	0.5 U	NA	0.5 U	0.4 U
Silver	0.1 U	0.0005 U	0.1 U	**0.0013**	0.1 U	NA	0.15 U	NA	0.1 U	0.0005 U
Zinc	NA	NA	NA	NA	NA	NA	NA	NA	NA U	NA
Dissolved Metals in mg/L										
Arsenic	**0.013**	0.0015 U	NA	0.0015 U	0.001 U	NA	**0.034**	NA	**0.14**	0.0015 U
Barium	**0.2**	**0.061**	NA	**0.021**	**0.018**	NA	**0.12**	NA	**0.11**	**0.03**
Cadmium	0.0005 U	**0.00064**	NA	0.0005 U	0.0005 U	NA	0.0005 U	NA	0.0005 U	**0.00055**
Chromium (Total)	0.01 U	**0.061**	NA	**3**	**2.2**	NA	0.01 U	NA	0.01 U	**0.012**
Chromium (+6)										
Copper	0.001 U	NA	NA	NA	**0.0013**	NA	0.001 U	NA	0.001 U	NA
Iron	30				0.1 U		18		52	
Lead	0.0005 U	0.0005 U	NA	0.0005 U	0.0005 U	NA	0.0005 U	NA	0.0005 U	0.0005 U
Mercury	0.0002 U	0.0002 U	NA	0.0002 U	0.0002 U	NA	0.0002 U	NA	0.0002 U	0.0002 U
Nickel	0.0027				0.019		0.0046		0.0012	
Selenium	0.5 U	0.4 U	NA	0.4 U	0.5 U	NA	0.5 U	NA	0.5 U	0.4 U
Silver	0.15 U	0.0005 U	NA	0.0005 U	0.15 U	NA	0.15 U	NA	0.15 U	0.0005 U
Zinc	**0.02**	NA	NA	NA	**0.007**	NA	**0.0085**	NA	**0.0091**	NA

Table 2 - Analytical Results for Water Samples

Date Sampled	SP-23 7/17/2000	SP-24 4/18/2000	SP-24 7/17/2000	SP-25 4/18/2000	SP-25 7/17/2000	SP-28 4/20/2000	SP-28 7/17/2000	HC-104 6/29/2000	HC-105 6/29/2000	HC-106 6/29/2000
Conventionals in mg/L										
Total Suspended Solids								14	3,800	33
NWTPH-G in mg/L										
Mineral Spirits/Stoddard Solvent	NA	NA U	NA	0.1 U	NA	0.1 U	NA	0.1 U	0.1 U	0.1 U
Gasoline	NA	NA U	NA	0.1 U	NA	0.1 U	NA	0.1 U	0.1 U	0.1 U
NWTPH-Dx in mg/L										
Kerosene/Jet Fuel	NA	0.2 U	NA	0.2 U	NA	0.2 U	NA	0.2 U	0.2 U	0.2 U
Diesel/Fuel Oil	NA	0.2 U	NA	0.2 U	NA	0.2 U	NA	0.2 U	0.2 U	0.2 U
Heavy Oil	NA	0.5 U	NA	0.5 U	NA	0.5 U	NA	0.5 U	0.5 U	0.5 U
Volatile Organics in mg/L										
1,1,1-Trichloroethane	0.0016	0.001 U	0.001 U	0.001 U	NA	NA	0.001 U	0.001 U	0.001 U	0.001 U
Trichloroethene	0.001 U	0.001 U	0.001 U	0.001 U	NA	NA	0.001 U	0.001 U	0.001 U	0.001 U
1, 1-Dichloroethane	0.007	0.005 U	0.005 U	0.005 U	NA	NA	0.005 U	0.005 U	0.005 U	0.005 U
Tetrachloroethene	0.001 U	0.001 U	0.001 U	0.001 U	NA	NA	0.001 U	0.001 U	0.001 U	0.001 U
cis-1, 2-Dichloroethene	0.005 U	0.005 U	0.005 U	0.005 U	NA	NA	0.005 U	0.005 U	0.005 U	0.005 U
p-Dichlorobenzene	0.001 U	0.001 U	0.001 U	0.0038	NA	NA	0.001 U	0.001 U	0.001 U	0.001 U
o-Dichlorobenzene	0.001 U	0.001 U	0.001 U	0.0062	NA	NA	0.001 U	0.001 U	0.001 U	0.001 U
Benzene	0.001 U	0.001 U	0.001 U	0.001 U	NA	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Toluene	0.001 U	0.001 U	0.001 U	0.001 U	NA	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Ethylbenzene	0.001 U	0.001 U	0.001 U	0.001 U	NA	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Xylenes	0.001 U	0.001 U	0.001 U	0.001 U	NA	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Total Metals in mg/L										
Arsenic	0.001 U	NA	0.017	NA	0.0048	0.0074	0.029	0.004 U	0.019	0.004 U
Barium	0.005 U	NA	0.22	NA	0.073	0.35	0.18	0.074	0.44	0.13
Cadmium	0.00082	NA	0.00092	NA	0.00053	0.00057	0.0005 U	0.0005 U	0.00078	0.0005 U
Chromium (Total)	0.01 U	NA	0.056	NA	0.01 U	0.49	0.029	0.01 U	0.14	0.01 U
Chromium (+6)	0.022							0.01 U	0.024	0.01 U
Copper	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead	0.0055	NA	0.0081	NA	0.00084	0.037	0.00054	0.0005 U	0.02	0.0005 U
Mercury	0.0002 U	NA	0.0002 U	NA	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Selenium	0.5 U	NA	0.5 U	NA	0.5 U	0.4 U	0.5 U	0.05 U	0.05 U	0.05 U
Silver	0.1 U	NA	0.1 U	NA	0.1 U	0.00058	0.1 U	0.05 U	0.05 U	0.05 U
Zinc	NA	NA	NA	NA	NA	NA	NA	0.019	0.18	0.021
Dissolved Metals in mg/L										
Arsenic	0.001 U	NA	0.001 U	NA	0.0092	0.002	0.056	0.0059	0.001 U	0.0076
Barium	0.036	NA	0.036	NA	0.069	0.089	0.19	0.071	0.067	0.12
Cadmium	0.0005 U	NA	0.0005 U	NA	0.0005 U	0.00089	0.0005 U	0.0005 U	0.0005 U	0.0005 U
Chromium (Total)	0.023	NA	0.01 U	NA	0.01 U	0.01 U	0.023	0.01 U	0.01 U	0.01 U
Chromium (+6)							0.025 U	0.01 U	0.01 U	0.01 U
Copper	0.0016	NA	0.0015	NA	0.0019	NA	0.0013	0.001 U	NA	NA
Iron	0.1 U		0.1 U		15		25			
Lead	0.0005 U	NA	0.0005 U	NA	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U
Mercury	0.0002 U	NA	0.0002 U	NA	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Nickel	0.018		0.0069		0.0045		0.0052			
Selenium	0.5 U	NA	0.5 U	NA	0.5 U	0.4 U	0.5 U	0.05 U	0.05 U	0.05 U
Silver	0.15 U	NA	0.15 U	NA	0.15 U	0.0005 U	0.18 U	0.01 U	0.01 U	0.01 U
Zinc	0.004 U	NA	0.0053	NA	0.0056	NA	0.013	0.01 U	0.01 U	0.01 U

Table 2 - Analytical Results for Water Samples

Date Sampled	HC-107S 6/29/2000	HC-107D 6/29/2000	HC-112W 6/29/2000	MW-A 6/29/2000	MW-B 6/29/2000	MW-C 6/29/2000
Conventionals in mg/L						
Total Suspended Solids	**810**	**55**	**340**	**14**	**160**	**6**
NWTPH-G in mg/L						
Mineral Spirits/Stoddard Solvent	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Gasoline	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
NWTPH-Dx in mg/L						
Kerosene/Jet Fuel	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Diesel/Fuel Oil	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Heavy Oil	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Volatile Organics in mg/L						
1,1,1-Trichloroethane	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Trichloroethene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
1, 1-Dichloroethane	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Tetrachloroethene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
cis-1, 2-Dichloroethene	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
p-Dichlorobenzene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
o-Dichlorobenzene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Benzene	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Toluene	**0.063**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Ethylbenzene	**0.0051**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Xylenes	**0.018**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Total Metals in mg/L						
Arsenic	0.004 U	0.004 U	**0.007**	0.004 U	**0.0067**	0.004 U
Barium	**0.11**	**0.063**	**0.2**	**0.018**	**0.082**	**0.018**
Cadmium	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U
Chromium (Total)	0.01 U	0.01 U	**0.031**	0.01 U	**0.027**	0.01 U
Chromium (+6)	**0.017**	0.1 U	**0.014**	0.01 U	0.005 U	0.005 U
Copper	NA	NA	NA	NA	NA	NA
Lead	**0.0013**	0.0005 U	**0.0053**	0.0005 U	**0.004**	0.0005 U
Mercury	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Selenium	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Silver	0.05 U	0.05 U	0.05 U	0.05 U	0.01 U	0.01 U
Zinc	**0.03**	**0.085**	**0.088**	**0.051**	**0.036**	0.01 U
Dissolved Metals in mg/L						
Arsenic	**0.0035**	**0.0012**	**0.0066**	0.001 U	**0.0015**	**0.0012**
Barium	**0.096**	**0.029**	**0.097**	**0.015**	**0.018**	**0.016**
Cadmium	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U
Chromium (Total)	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Chromium (+6)	0.01 U	0.1 U	0.01 U	0.01 U	0.005 U	0.005 U
Copper	NA	NA	NA	NA	NA	NA
Iron						
Lead	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U
Mercury	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Nickel						
Selenium	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Silver	0.01 U	0.01 U	0.01 U	0.01 U	0.05 U	0.05 U
Zinc	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U

U Not detected at detection limit indicated.

NA Not Analyzed

Detected results in bold

Concentrations exceeding MTCA Groundwater criteria

(a) Based on hoxavalent chromium

Table 3 - Groundwater Elevation Data from November 1, 2001

	Top of Casing (TOC) Elevation in Feet (1)	Depth to Water below TOC in Feet	Groundwater Elevation in Feet (1)
SP-23	90.45	12.13	78.3
SP-15A	88.94	10.84	78.1
SP-14	89.10	dry at 14.92	dry at 74.18
SP-12	90.18	13.83	76.4
SP-11	89.45	10.89	78.6
SP-28	90.11	12.3	77.8
SP-19	89.25	11.28	78.0
SP-8	88.57	10.79	77.8
SP-7	86.61	9.41	77.2

(1) Elevations based on a datum of 90 feet at HC-104.

Table 4 -Hydraulic Conductivity Calculation - for Wells in Unconfined Aquifers by Bouwer & Rice (1976)

	HC-104	HC-104	HC-105	HC-105	HC-106	HC-106	HC-107S	HC-107D	HC-107D	HC-112
Well Depth	**30** ft	**30** ft	**15** ft	**15** ft	**15** ft	**15** ft	**15** ft	**30** ft	**30** ft	**15** ft
Screen Length	**5** ft	**5** ft	**10** ft	**10** ft	**5** ft	**5** ft	**10** ft	**5** ft	**5** ft	**10** ft
Depth to Screen	**25** ft	**25** ft	**5** ft	**5** ft	**10** ft	**10** ft	**5** ft	**25** ft	**25** ft	**5** ft
Depth to Aquitard	**35** ft	**35** ft	**20** ft	**20** ft	**20** ft	**20** ft	**20** ft	**35** ft	**35** ft	**20** ft
Depth to Water	**13.23** ft	**13.23** ft	**7.42** ft	**7.42** ft	**6.72** ft	**6.72** ft	**7.36** ft	**8.75** ft	**8.75** ft	**6.45** ft
Depth to Sandpack	**23** ft	**23** ft	**3** ft	**3** ft	**8** ft	**8** ft	**3** ft	**23** ft	**23** ft	**3.5** ft
H	21.77 ft	21.77 ft	12.58 ft	12.58 ft	13.28 ft	13.28 ft	12.64 ft	26.25 ft	26.25 ft	13.55 ft
n	**0.25**	**0.25**	**0.25**	**0.25**	**0.25**	**0.25**	**0.25**	**0.25**	**0.25**	**0.25**
r_c	**0.083** ft	**0.083** ft	**0.083** ft	**0.083** ft	**0.083** ft	**0.083** ft	**0.083** ft	**0.083** ft	**0.083** ft	**0.083** ft
r_w	**0.333** ft	**0.333** ft	**0.333** ft	**0.333** ft	**0.333** ft	**0.333** ft	**0.333** ft	**0.333** ft	**0.333** ft	**0.333** ft
r_eff	0.083 ft	0.083 ft	0.182 ft	0.182 ft	0.083 ft	0.083 ft	0.182 ft	0.083 ft	0.083 ft	0.182 ft
L_e	5 ft	5 ft	7.58 ft	7.58 ft	5 ft	5 ft	7.64 ft	5 ft	5 ft	8.55 ft
L_w	16.77 ft	16.77 ft	7.58 ft	7.58 ft	8.28 ft	8.28 ft	7.64 ft	21.25 ft	21.25 ft	8.55 ft
y1	**0.11** ft	**0.048** ft	**0.065** ft	**0.05** ft	**0.6** ft	**0.4** ft	**0.12** ft	**0.95** ft	**0.9** ft	**0.43** ft
t1	**0** sec	**0** sec	**0** sec	**0** sec	**0** sec	**0** sec	**0** sec	**0** sec	**0** sec	**0** sec
y2	**0.008** ft	**0.005** ft	**0.004** ft	**0.002** ft	**0.05** ft	**0.08** ft	**0.05** ft	**0.1** ft	**0.09** ft	**0.04** ft
t2	**810** sec	**810** sec	**610** sec	**410** sec	**300** sec	**200** sec	**2100** sec	**2620** sec	**2000** sec	**1450** sec
L_e/r_w	15	15	22.74	22.74	15	15	22.92	15	15	25.65
A	2.0	2.0	2.2	2.2	2.0	2.0	2.2	2.0	2.0	2.3
B	0.3	0.3	0.4	0.4	0.3	0.3	0.4	0.3	0.3	0.4
C	1.4	1.4	1.7	1.7	1.4	1.4	1.7	1.4	1.4	1.8
Fully Penetrating Well										
ln(R_e/r_w)	2.684	2.684	2.350	2.350	2.303	2.303	2.356	2.804	2.804	2.449
K in cm/s	1.8E-04 cm/s	1.6E-04 cm/s	7.1E-04 cm/s	1.2E-03 cm/s	4.0E-04 cm/s	3.9E-04 cm/s	6.5E-05 cm/s	5.1E-05 cm/s	6.8E-05 cm/s	2.4E-04 cm/s
Soil Description	Silty, Sandy GRAVEL		Silty to clayey SAND		Silty F-M SAND		Fill	Slightly silty, gravelly SAND		Sandy SILT and F-M SAND

Bold values to be entered manually.

A, B, and C coefficients are calculated using regression equations of Van Rooy, 1988.

Table 5 - Proposed Cleanup Criteria for Constituents of Potential Concern in Soil

Compound	MTCA Method A Residential (Unrestricted)
Metals in mg/kg	
Arsenic	20
Chromium (Total)	2000
Chromium (+6)	19
NWTPH-Gx in mg/kg	
Mineral Spirits/Stoddard Solvent	30

Table 6 - Proposed Cleanup Criteria for Constituents of Potential Concern in Groundwater

Compound	MTCA A Groundwater
NWTPH-G in mg/L	
Mineral Spirits/Stoddard Solvent	1
Volatile Organics in mg/L	
Trichloroethene	0.005
Tetrachloroethene	0.005
Benzene	0.005
Xylenes	1
Metals in mg/L	
Arsenic	0.005
Chromium (Total)	0.05

Table 7 - Remedial Technology Descriptions

Remedial Technology	Description	Benefits	Limitations
Natural attenuation	Relies on natural *in situ* sorption and dispersion of contaminants	■ Easily implemented - monitoring required but no active construction costs ■ Does not disrupt site use	■ Slow; would require monitoring for many years
Capping with engineering and institutional controls	Involves placement of a reduced-permeability cap to decrease infiltration.	■ Demonstrated technology, easily implementable ■ Prevents human exposure ■ Low maintenance	■ Does not remove contamination ■ May limit future site uses
Soil excavation	Contaminated soil is removed and disposed of off site	■ Fast remediation time frame ■ Removes all accessible contamination ■ Coordination with planned development	■ Shoring and dewatering requirements expensive
Pump and Treat	Contaminated groundwater is extracted, treated, and discharged to sanitary sever.	■ Limits off-site contaminant migration	■ Expensive equipment with high operational and maintenance costs

Table 8 – Remedial Technologies Screening

Technology	Effectiveness	Implementability	Cost	Screening Result
Natural attenuation	Medium	High	Low	Retained.
Capping with engineering and institutional controls	Medium	High	Low	Retained.
Excavation and Off-site Disposal	High	Medium	High	Retained.
Pump and Treat	Medium	Low	High	Retained as potentially part of a remedial alternative. Rejected as a stand-alone option.

Table 9 - Detailed Evaluation of Remedial Alternatives

Criterion	Capping and Natural Attenuation with Engineering and Institutional Controls	Excavation and Post-Excavation Monitoring	Excavation with Pump and Treat of Chromium-Impacted Groundwater
Protection of Human Health and the Environment	This alternative reduces soil and groundwater toxicity over the very long term using natural attenuation.	This alternative removes chromium-impacted soil and may remove chromium-impacted groundwater present within the excavation.	This alternative removes impacted groundwater and limits off-site migration of contaminants after soil excavation.
Meets ARARs	Complies with ARARs	Complies with ARARs	Complies with ARARs
Short-Term Effectiveness	Very low due to low groundwater velocities and sorption/dispersion mechanisms, but eliminates exposure pathways.	Excavation is a highly effective means of elimination the chromium source zone.	In addition to excavation, pump and treat removes the majority of dissolved contaminants within a few pore volumes being flushed.
Long-Term Effectiveness	Soil and groundwater toxicity will be reduced by natural attenuation over the very long term.	This alternative reduce the mobility by disposing of impacted soils in a permitted landfill.	This alternative has the same long-term effectiveness as Excavation and Natural Attenuation.
Permanent Reduction of Toxicity/ Mobility/ Volume	Natural Attenuation mechanisms will result in permanent reduction of contaminant mass.	This alternative reduces the chromium mobility by disposing of impacted soils in a permitted landfill.	Success of this alternative is dependent on the long-term desorption of contaminants into groundwater. Contaminant mobility is not certain.
Implementability	Capping and Natural Attenuation is readily implementable; monitoring points already exist on site.	Excavation is a readily implementable technology - especially since contaminant source zone corresponds to future building footprint and redevelopment plans.	Extensive aquifer characterization, remediation design, installation, and system optimization necessary. Also, requires water treatment facilities.
Cost Estimate (1)	$293,800	$716,000	$899,000
Restoration Time Frame	Likely greater than 5 years.	Excavation will likely occur over a couple of months. Natural attenuation may take several years.	The majority of the dissolved contaminant mass will be removed within the first year; however, low level contaminant concentrations may persist for years.
Community Acceptance	Moderate due to the length of remediation which is mitigated by the lack of negative short-term impacts.	Moderate due to the heavy activity from excavation.	Moderate due to extensive infrastructure, associated noise, and site disturbance.

Table 9 - Detailed Evaluation of Remedial Alternatives

Criterion	Capping and Natural Attenuation with Engineering and Institutional Controls	Excavation and Post-Excavation Monitoring	Excavation with Pump and Treat of Chromium-Impacted Groundwater
Use of Preferred Technology	Natural attenuation relies on sorption and dispersive mechanisms to reduce chromium concentrations and does not prevent off-site migration of contaminants.	Excavation ranks low in the Ecology hierarchy of preferred technologies. However, is an immediate solution that corresponds with site redevelopment plans.	Ranks moderate on the Ecology hierarchy of preferred technologies. Removes contaminant mass; however, technology is not cost effective.

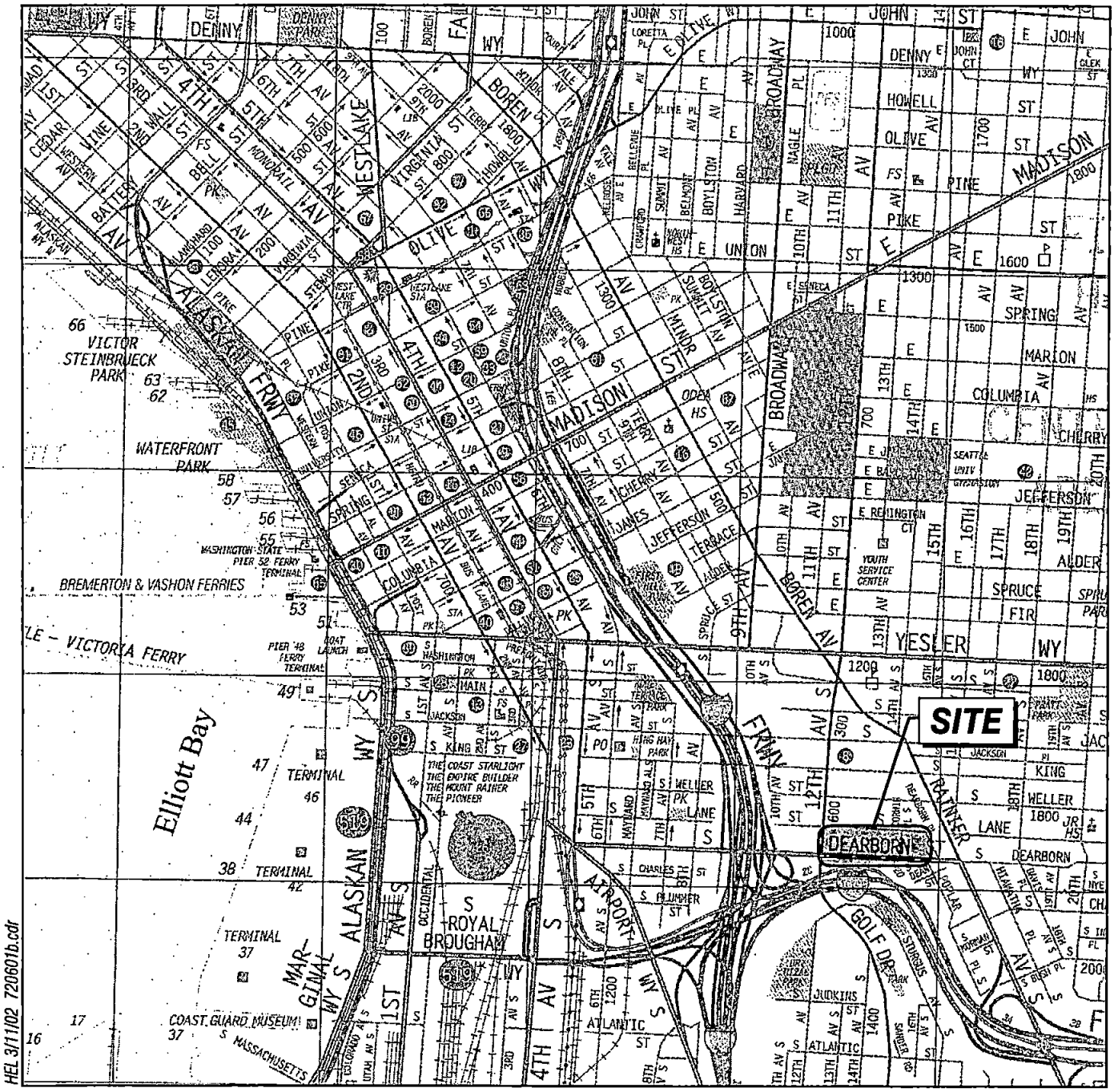
(a) These costs are order of magnitude estimates suitable for alternatives comparison.

Table 10 - Comparison of Total Cost of Remedial Alternatives

	Alternative 1 Capping and Natural Attenuation	**Alternative 2** Excavation and Natural Attenuation	**Alternative 3** Excavation and Pump-and-Treat
Duration of Active Remediation in Years	<1	<1	5
Total Project Duration in Years	21	11	6
Capital Cost	$ 28,800	$ 513,000	$ 652,000
Monitoring and O&M Cost	$ 450,000	$ 264,000	$ 276,000
Closure Cost	$ 38,400	$ 38,400	$ 32,000
Total Cost of Alternative	*$ 517,200*	*$ 815,400*	*$ 960,000*
Total Present Value of Alternative	**$ 293,800**	**$ 716,000**	**$ 899,000**

Note: Present value based on discount rate of 7 percent

Vicinity Map



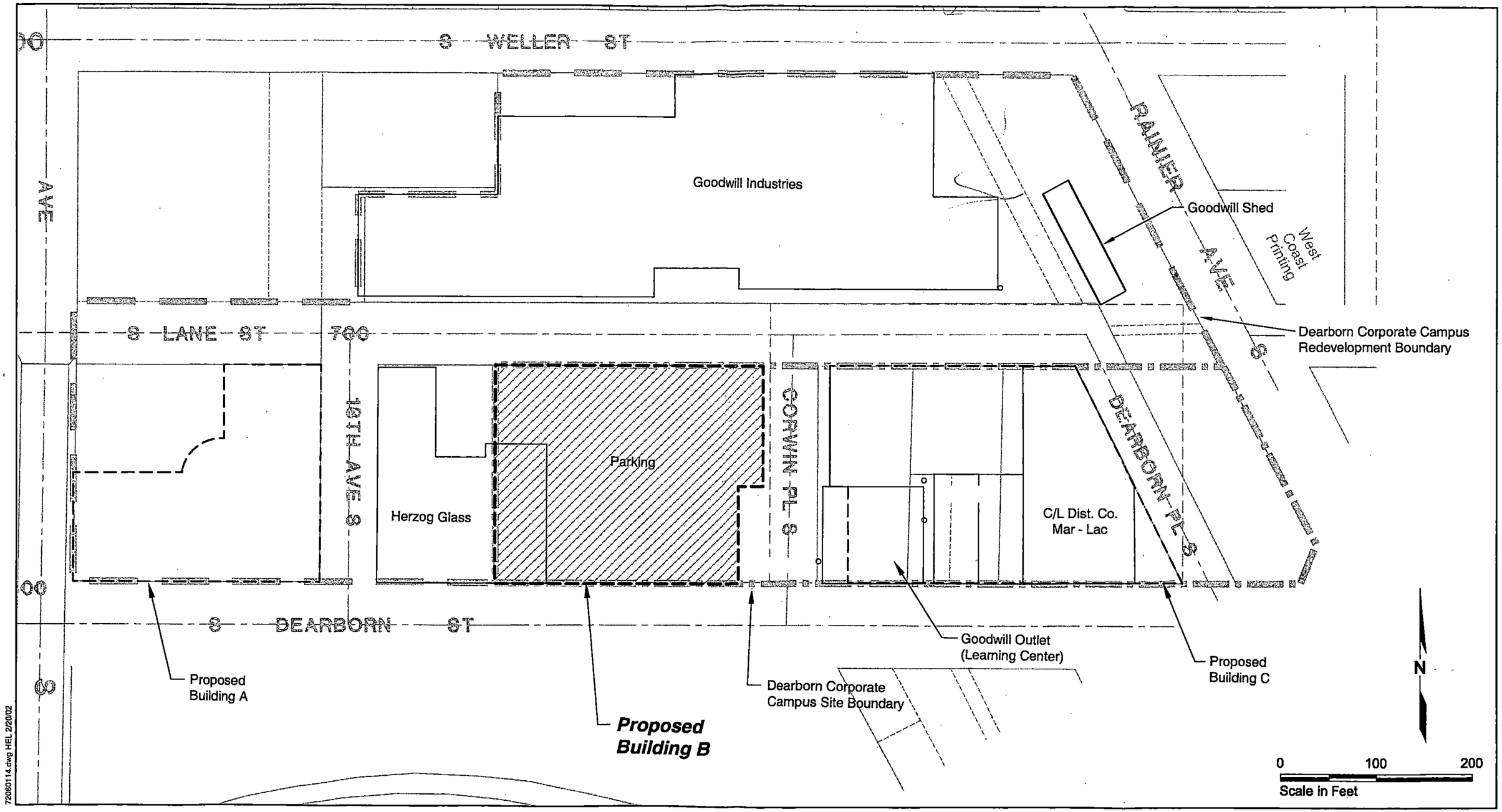
HEL 3/11/02 7206601b.cdr

HARTCROWSER

7206-01 3/02

Figure 1

Dearborn Corporate Campus Site Plan
Proposed Building B



Legend:

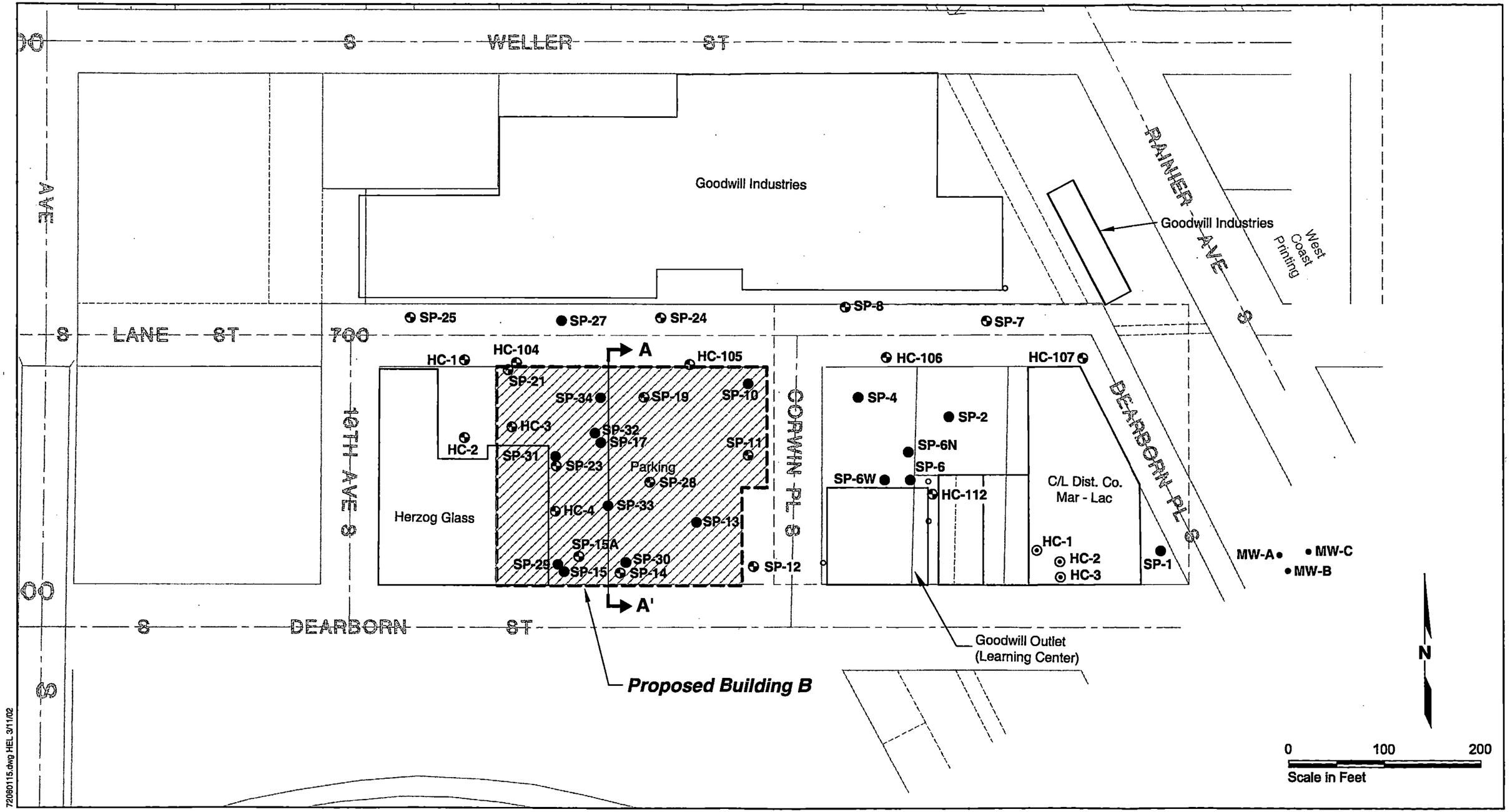
- Approximate Location of Proposed Features
- Approximate Location of Existing Features

HARTCROWSER

7206-01 *2/02*

Figure 2

Dearborn Corporate Campus Existing Exploration Plan
Proposed Building B



72060115.dwg HEL 3/11/02

Legend:

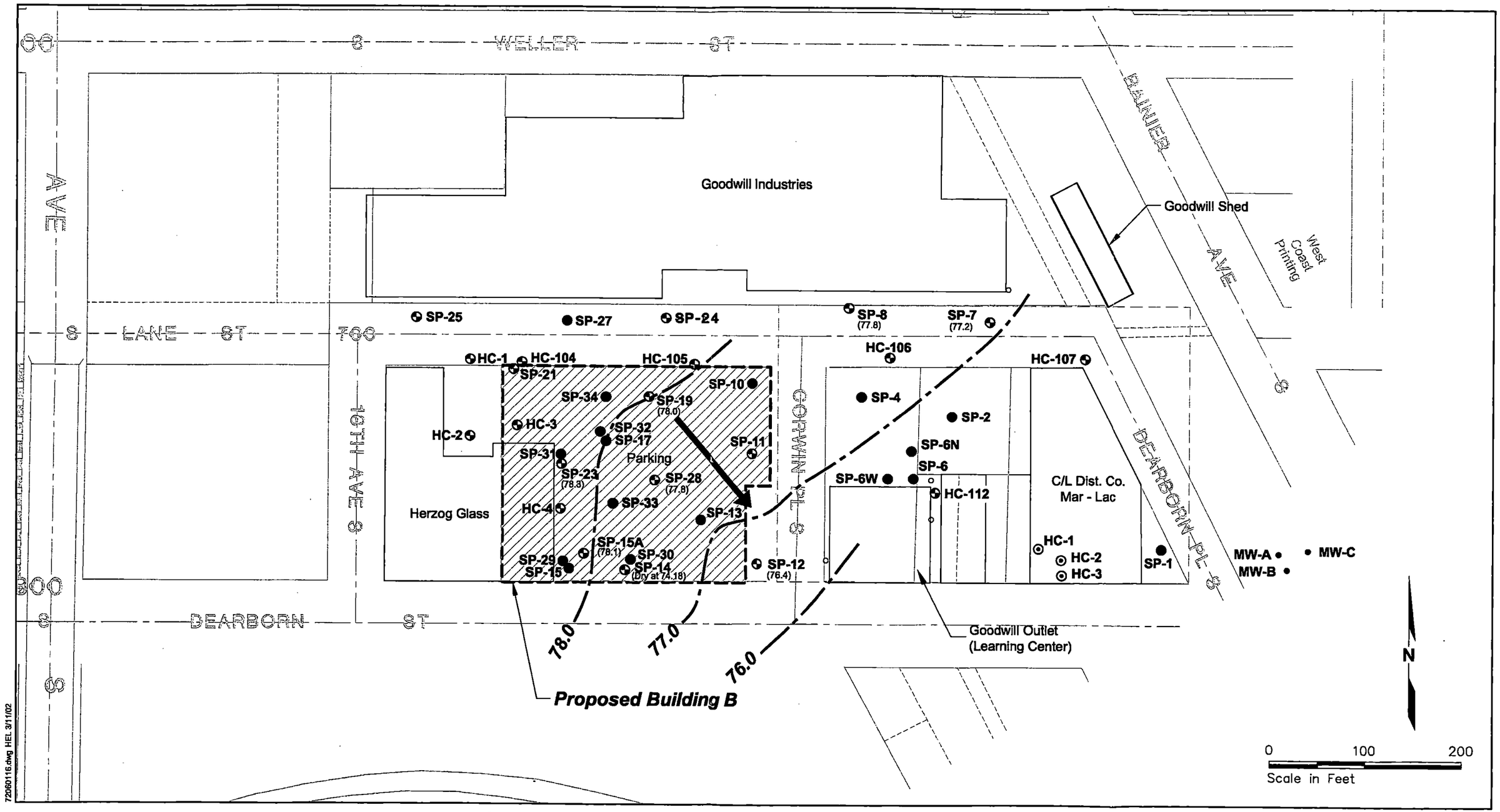
- ● **SP-30** Stratoprobe Boring (Hart Crowser)
- ⊕ **SP-14** Monitoring Well (Hart Crowser)
- • **MW-A** Monitoring Well (GeoEngineers)
- ⊙ **HC-1** Hand-Auger Boring (Hart Crowser)
- **A** / **A'** Generalized Subsurface Cross Section Location and Designation

HARTCROWSER

7206-01 *2/02*

Figure 3

Groundwater Elevation Contour Map
Proposed Building B



7206O116.dwg HEL 3/11/02

Legend:

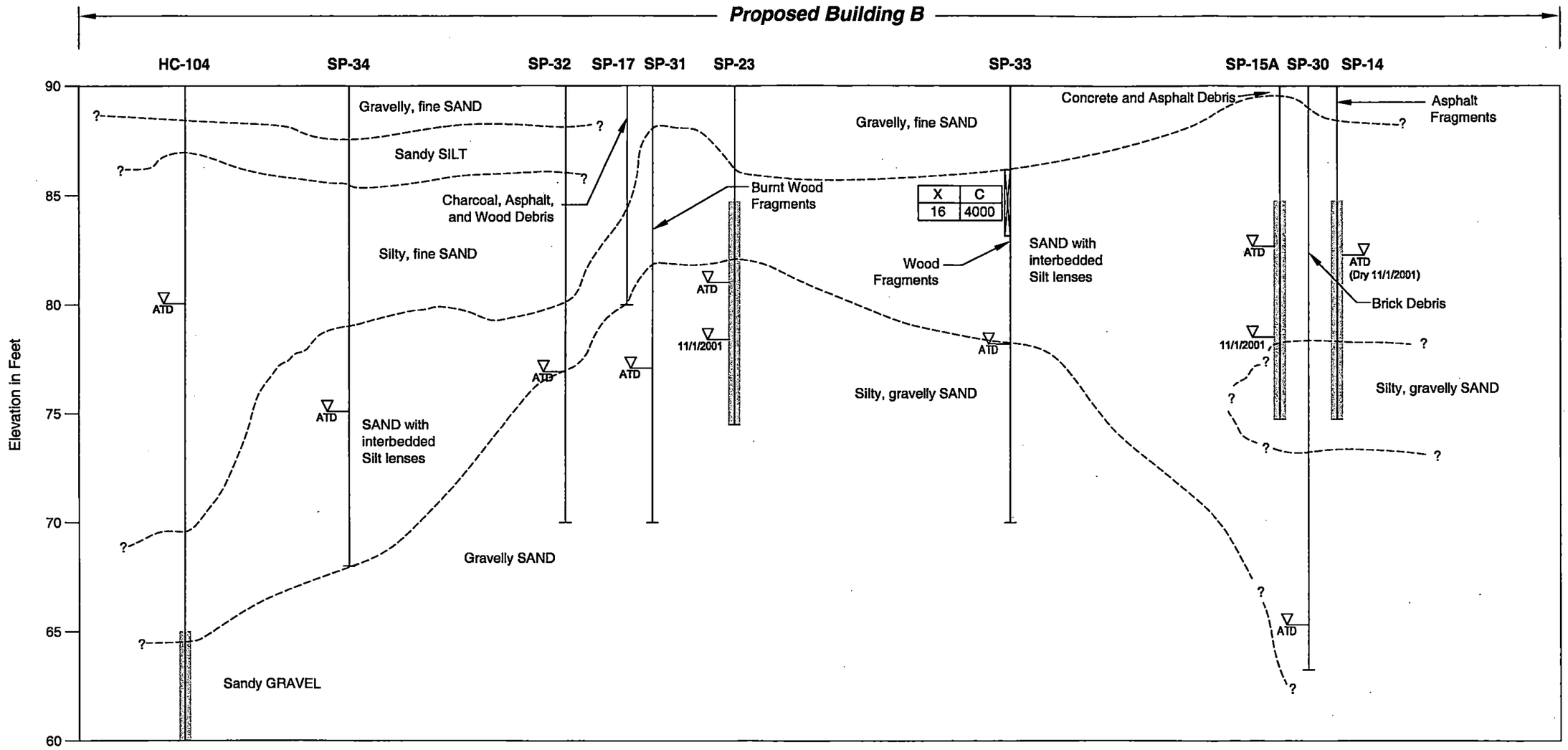
● SP-30	Stratoprobe Boring (Hart Crowser)	⊙ HC-1	Hand-Auger Boring (Hart Crowser)
⊕ SP-14	Monitoring Well (Hart Crowser)	(77.8)	Groundwater Elevation in Feet
• MW-A	Monitoring Well (GeoEngineers)	76.0	Approximate Groundwater Elevation Contour in Feet
		→	Groundwater Flow Direction

HARTCROWSER

7206-01 *2/02*

Figure 4

Subsurface Cross Section A-A'
Chemical Exceedences in Soil



X Xylene in mg/kg

C Chromium (Total) in mg/kg

HC-104 Exploration Number

Exploration Location

ATD Water Level

Sample Location

Screened Interval

Horizontal Scale in Feet
0 20 40
0 5 10
Vertical Scale in Feet
Vertical Exaggeration x 4

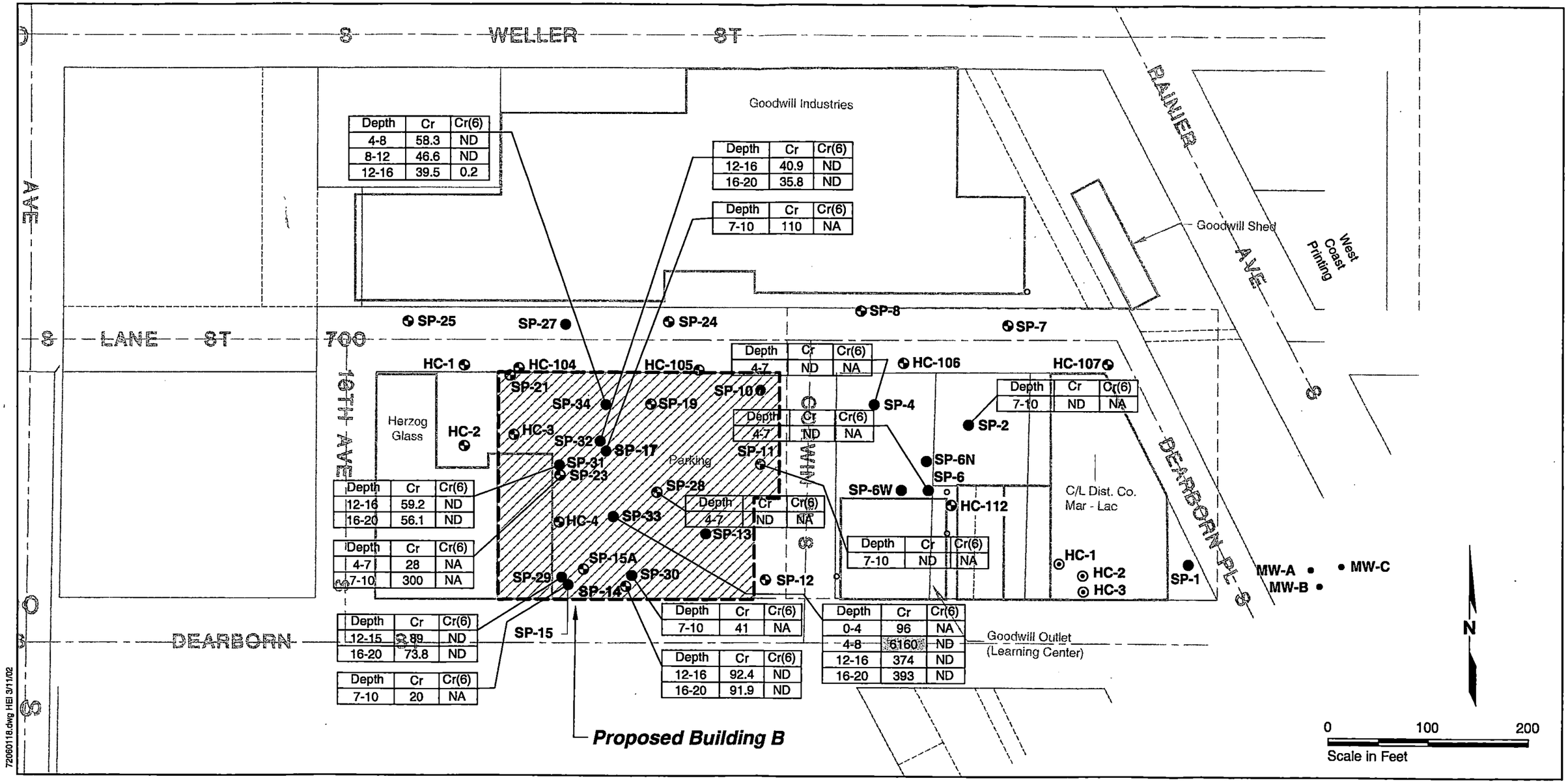
72060117.dwg HEL 3/11/02

HARTCROWSER

7206-01 2/02

Figure 5

Summary of Soil Quality Data
Total Chromium and Hexavalent Chromium
Proposed Building B



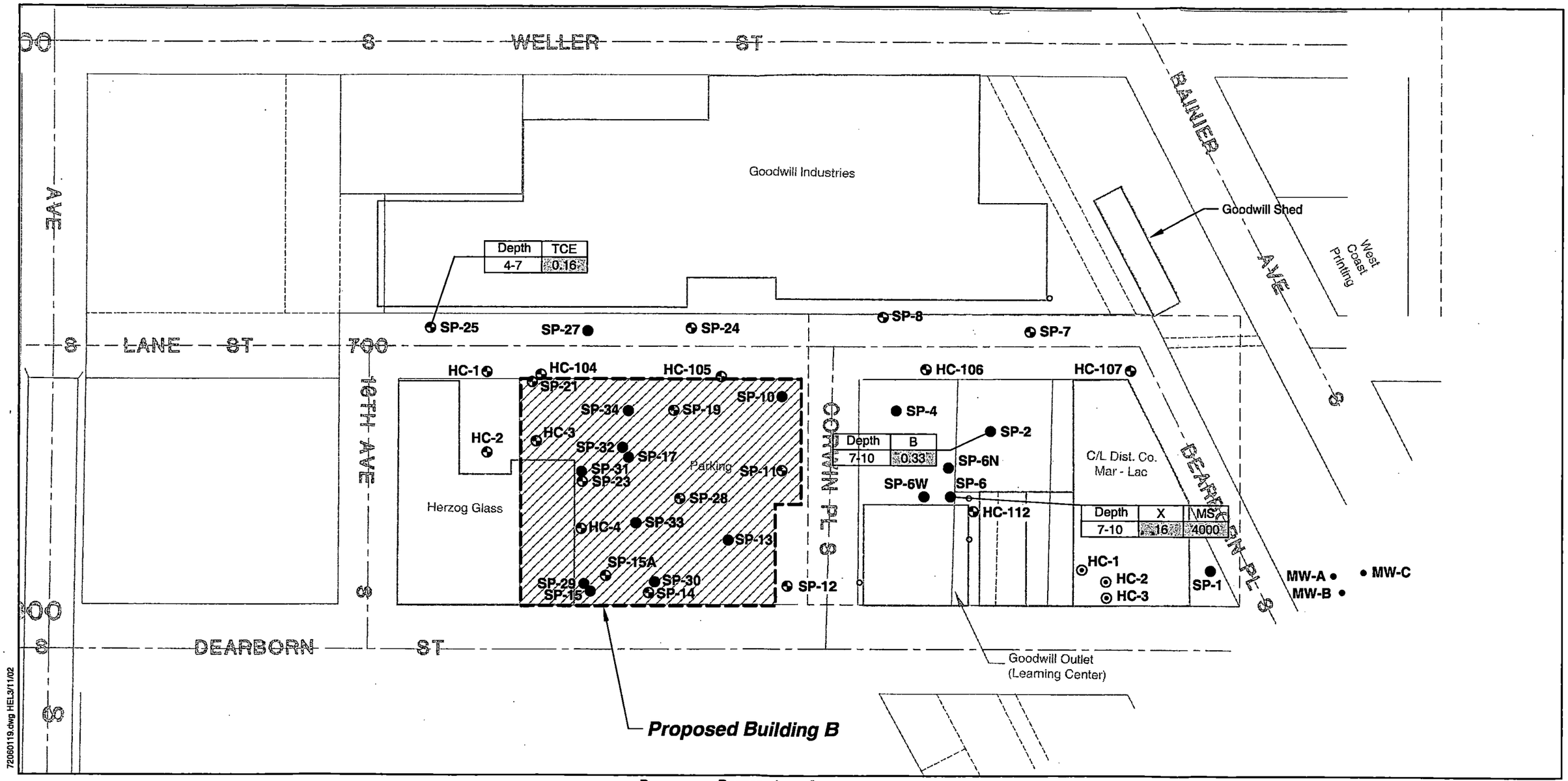
Exploration Location and Number

- ● **SP-2** Strataprobe Boring (Hart Crowser)
- ⊕ **HC-4** Monitoring Well (Hart Crowser)
- • **MW-A** Monitoring Well (Geo Engineers)
- ⊙ **HC-1** Hand-Auger Boring (Hart Crowser)

Cr	Total Chromium in mg/kg
Cr(6)	Hexavalent Chromium in mg/kg
ND	Not Detected
NA	Not Analyzed
6160	Shaded Results Exceed Applicable MTCA Soil Cleanup Levels
4-8	Depth in Feet below Ground Surface

HARTCROWSER
7206-01 2/02
Figure 6

Summary of Soil Quality Data
Volatile Organics Excedences
Proposed Building B



Exploration Location and Number

●SP-2	Strataprobe Boring (Hart Crowser)
⊕HC-4	Monitoring Well (Hart Crowser)
•MW-A	Monitoring Well (Geo Engineers)
⊙HC-3	Hand Auger Boring (Hart Crowser)

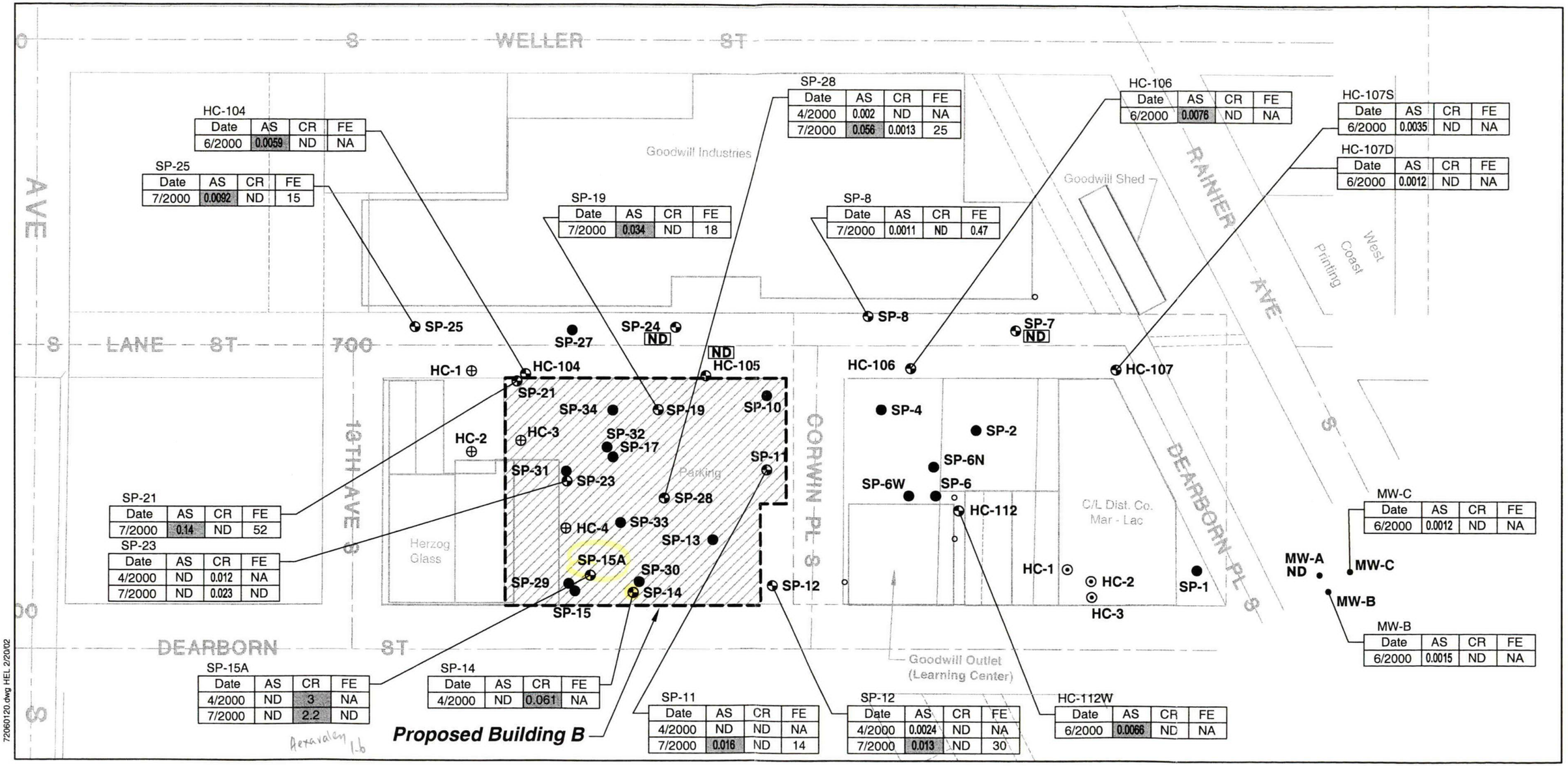
B	Benzene in mg/kg
X	Xylene in mg/kg
MS	Mineral Spirits/Stoddard Solvent in mg/kg
TCE	Trichloroethene in mg/kg
0.33	Shaded Results Exceed Applicable MTCA Soil Cleanup Levels
4-7	Depth in Feet below Ground Surface

HARTCROWSER

7206-01 *2/02*

Figure 7

Summary of Groundwater Quality Data
Dissolved Metals
Proposed Building B



HC-104

Date	AS	CR	FE
6/2000	0.0059	ND	NA

SP-25

Date	AS	CR	FE
7/2000	0.0092	ND	15

SP-19

Date	AS	CR	FE
7/2000	0.034	ND	18

SP-28

Date	AS	CR	FE
4/2000	0.002	ND	NA
7/2000	0.056	0.0013	25

SP-8

Date	AS	CR	FE
7/2000	0.0011	ND	0.47

HC-106

Date	AS	CR	FE
6/2000	0.0076	ND	NA

HC-107S

Date	AS	CR	FE
6/2000	0.0035	ND	NA

HC-107D

Date	AS	CR	FE
6/2000	0.0012	ND	NA

SP-21

Date	AS	CR	FE
7/2000	0.14	ND	52

SP-23

Date	AS	CR	FE
4/2000	ND	0.012	NA
7/2000	ND	0.023	ND

SP-15A

Date	AS	CR	FE
4/2000	ND	3	NA
7/2000	ND	2.2	ND

SP-14

Date	AS	CR	FE
4/2000	ND	0.061	NA

SP-11

Date	AS	CR	FE
4/2000	ND	ND	NA
7/2000	0.016	ND	14

SP-12

Date	AS	CR	FE
4/2000	0.0024	ND	NA
7/2000	0.013	ND	30

HC-112W

Date	AS	CR	FE
6/2000	0.0066	ND	NA

MW-C

Date	AS	CR	FE
6/2000	0.0012	ND	NA

MW-B

Date	AS	CR	FE
6/2000	0.0015	ND	NA

Exploration Location and Number

- **SP-2** Strataprobe Boring
- **SP-8** Strataprobe Monitoring Well
- **HC-109** HSA Monitoring Well
- **HC-4** Previous Monitoring Well (Hart Crowser)
- **MW-A** Previous Monitoring Well (Geo Engineers)
- **HC-1** Previous Hand Auger Boring (Hart Crowser)

- AS Arsenic (mg/L)
- CR Total Chromium (mg/L)
- FE Iron (mg/L)
- **ND** Not Detected
- **NA** Not Analyzed
- 2.2 Shaded Results Exceed Applicable MTCA Groundwater Cleanup Levels

0 100 200
Scale in Feet

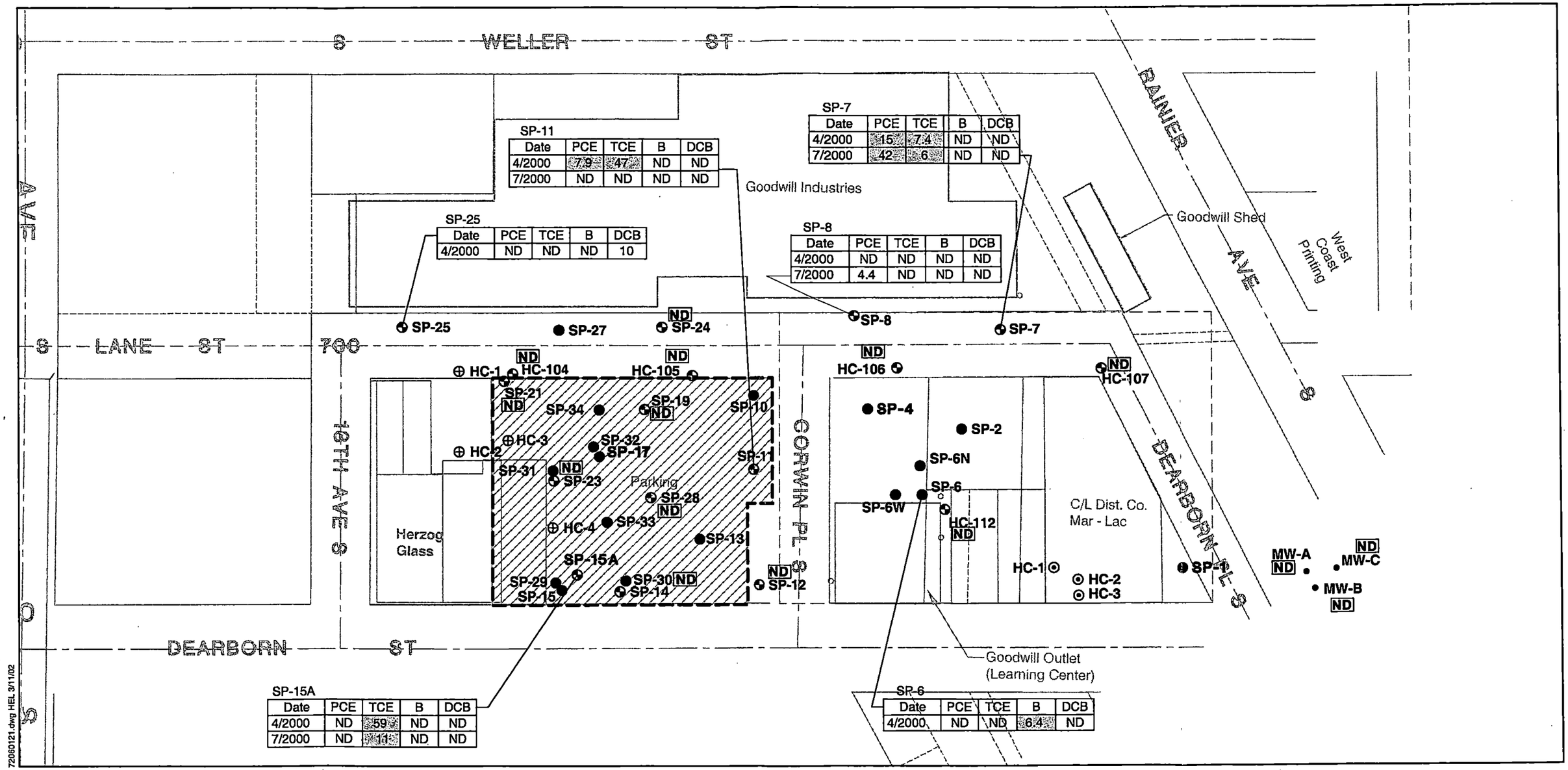
N

HARTCROWSER

7206-01 *2/02*

Figure 8

Summary of Groundwater Quality Data
Volatile Organics
Proposed Building B



72060121.dwg HEL 3/11/02

Exploration Location and Number

● SP-2	Strataprobe Boring
◒ SP-8	Strataprobe Monitoring Well
◒ HC-109	HSA Monitoring Well
⊕ HC-4	Previous Monitoring Well (Hart Crowser)
• MW-A	Previous Monitoring Well (Geo Engineers)
⊙ HC-1	Previous Hand-Auger Boring (Hart Crowser)

PCE	Tetrachloroethene in ug/L
TCE	Trichloroethene in ug/L
B	Benzene in ug/L
DCB	Total Dichlorobenzenes in ug/L
ND	Not Detected
11	Shaded Results Exceed Applicable MTCA Groundwater Cleanup Levels

0 100 200
Scale in Feet

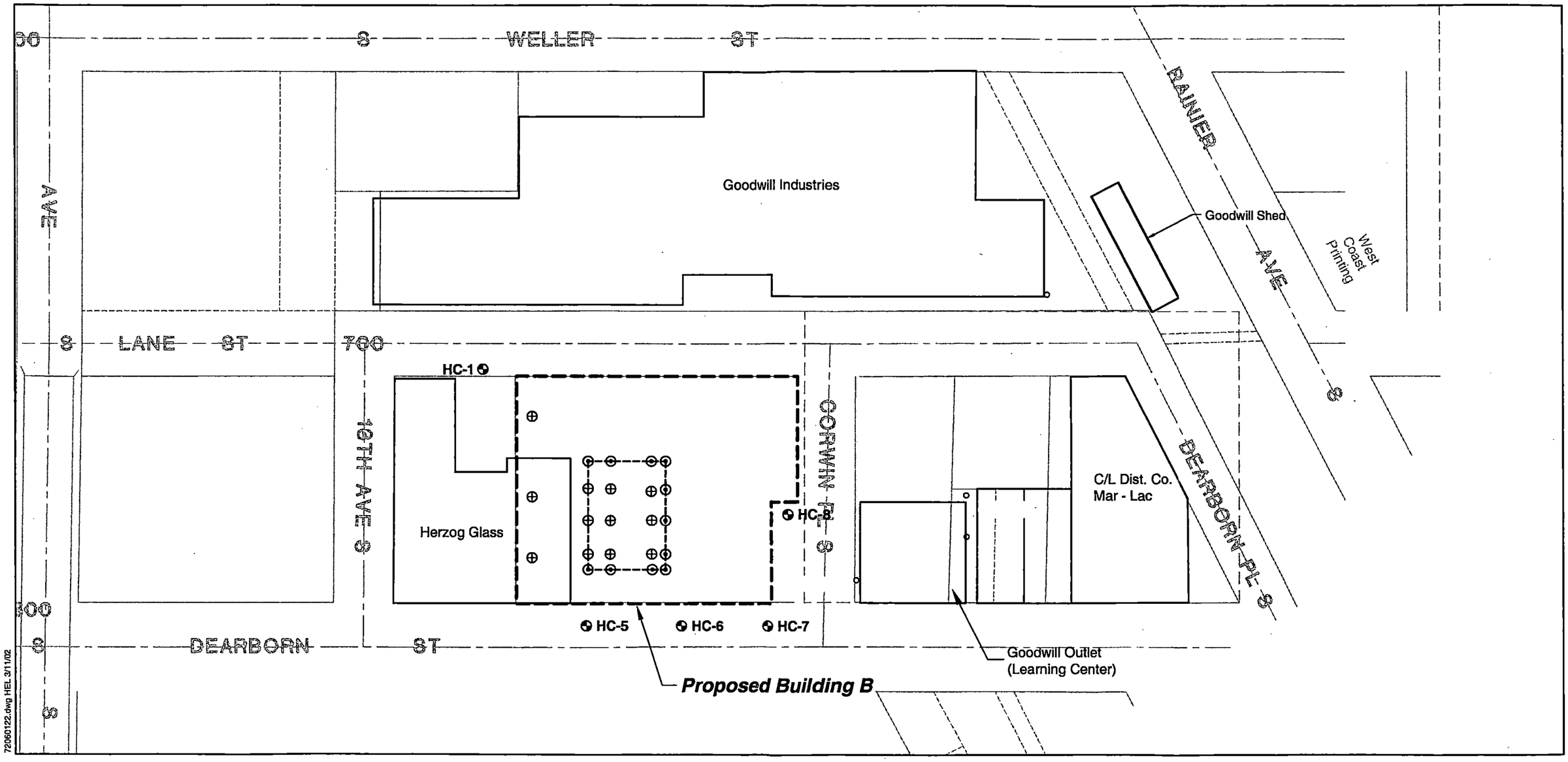
N

HARTCROWSER

7206-01 2/02

Figure 9

Dearborn Corporate Campus Cleanup Action Plan
Excavation Limits, Conceptual Sampling Grid, and Monitoring Locations
Proposed Building B



Exploration Location and Number

- HC-5 Proposed Monitoring Wells for Long-Term Monitoring
- ⊕ Proposed Initial Sampling Grid
- ⊙ Proposed Secondary Sampling Grid (Based on Initial Grid)
- -------- Inferred Excavation Limit

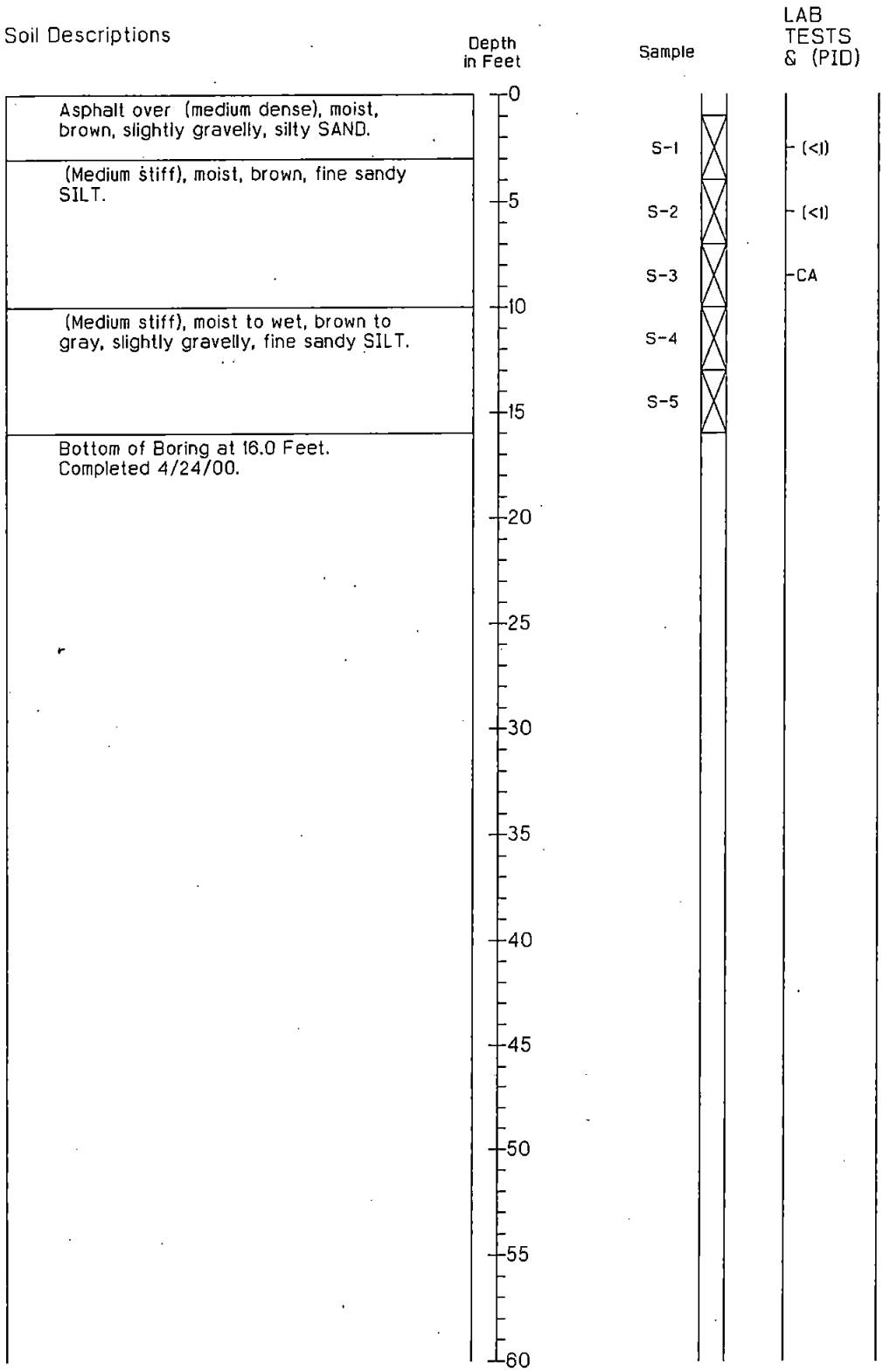
N

0 100 200
Scale in Feet

HARTCROWSER
7206-01 3/02
Figure 10

APPENDIX A
STRATAPROBE BORING LOGS

Boring Log SP-1



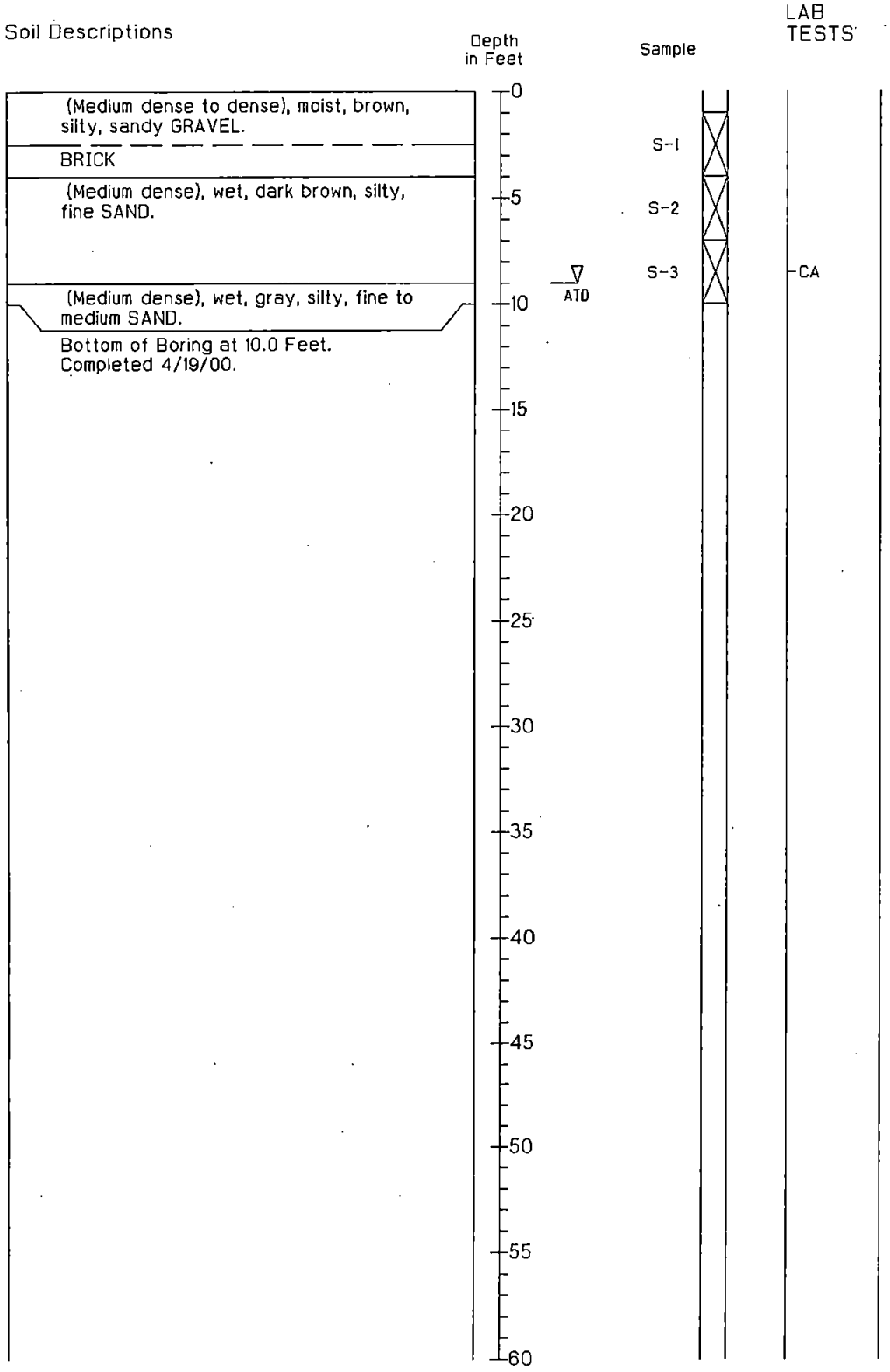
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

J-7206-01 4/00

Figure A-2

Boring Log SP-2



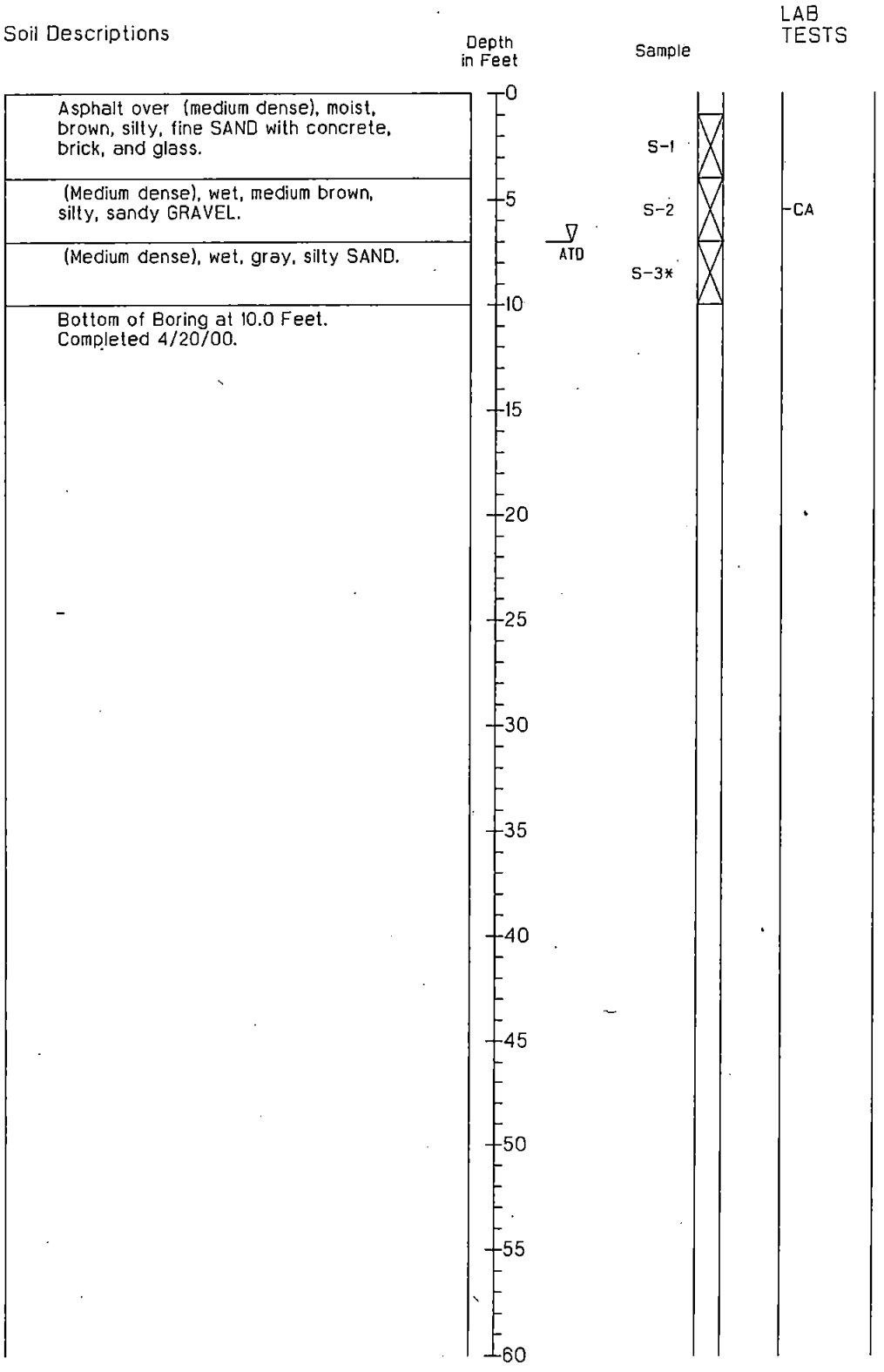
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

J-7206-01 4/00

Figure A-3

Boring Log SP-4



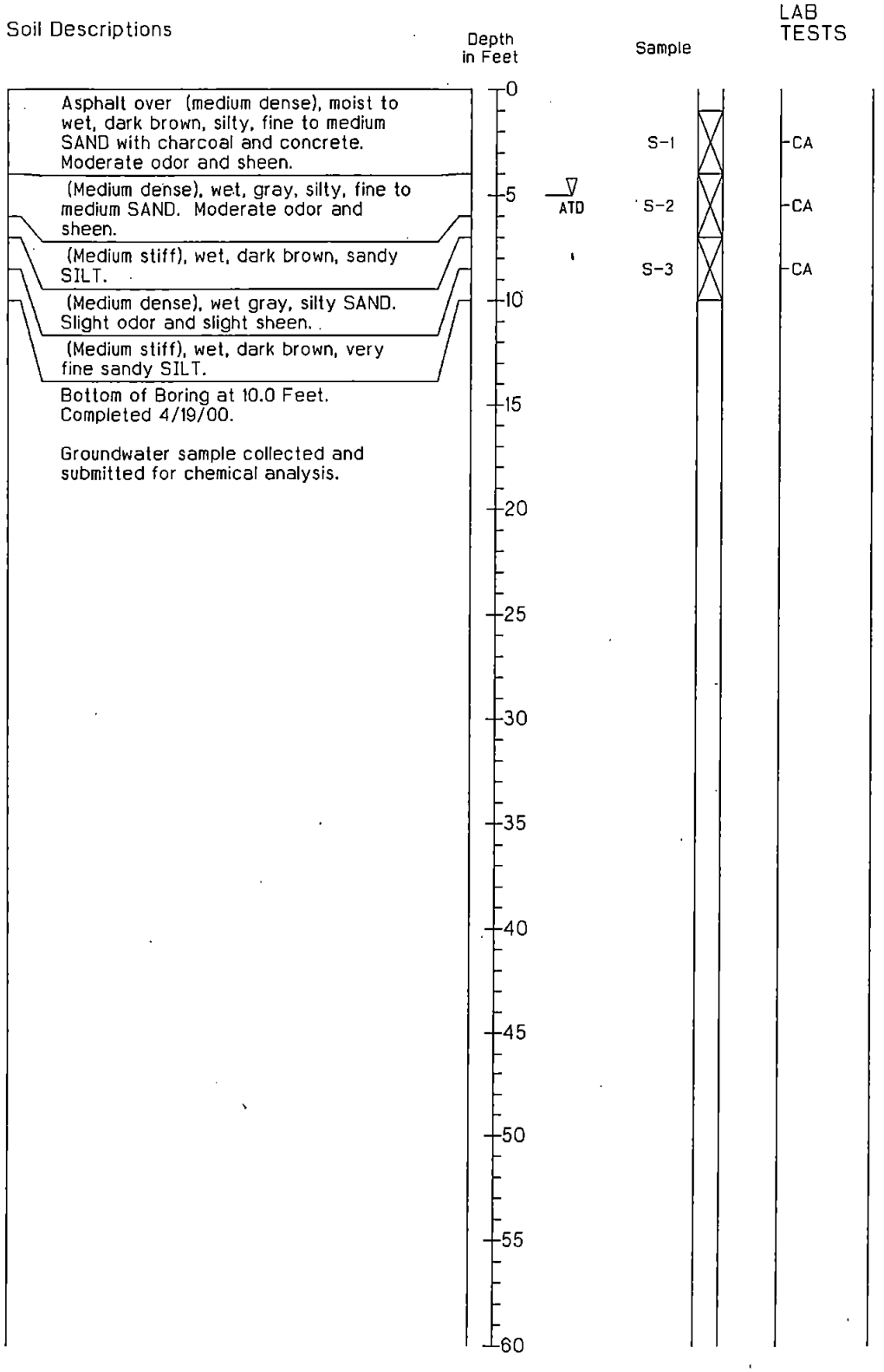
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

J-7206-01 4/00

Figure A-4

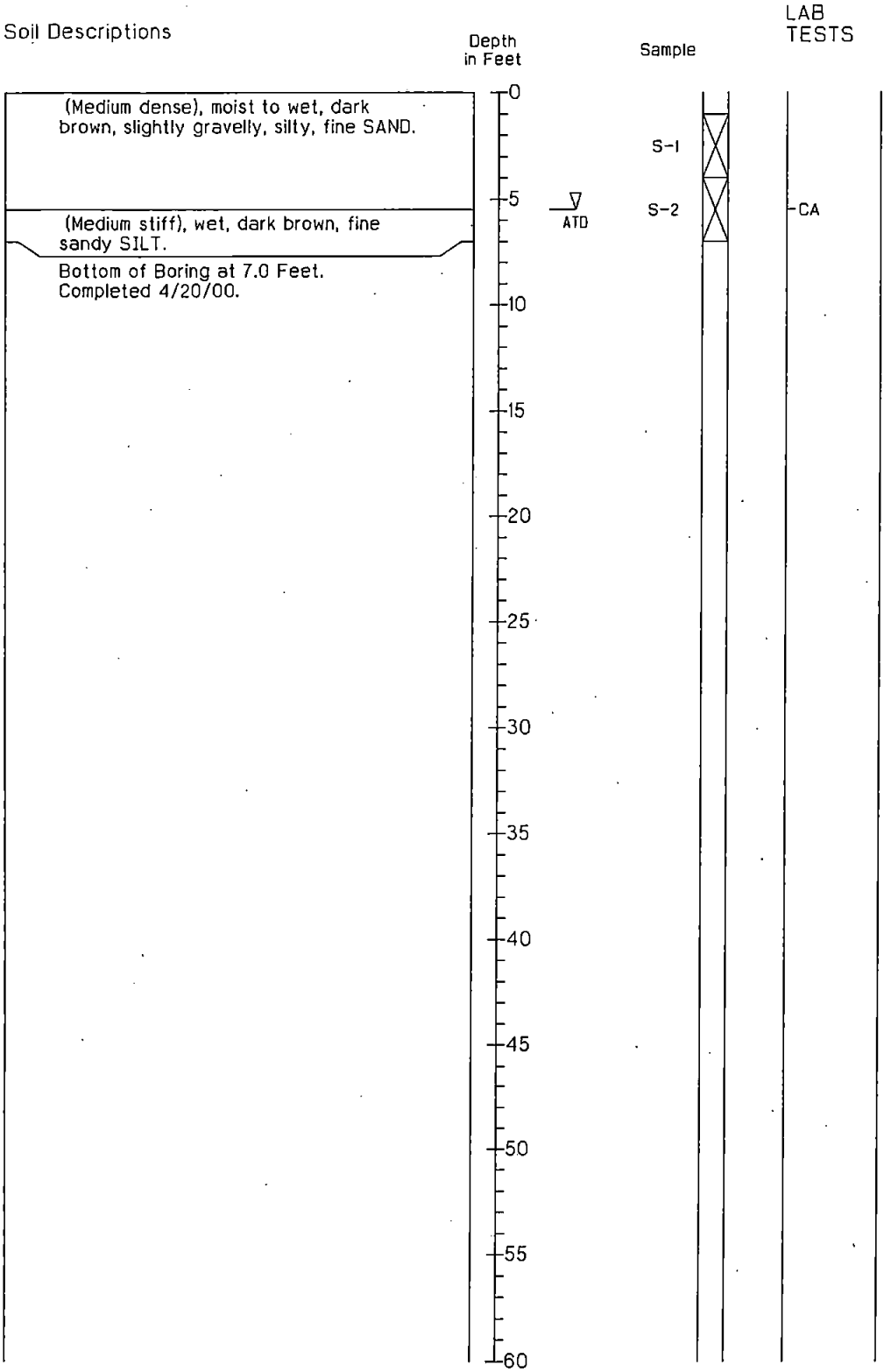
Boring Log SP-6



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER
J-7206-01 4/00
Figure A-5

Boring Log SP-6N



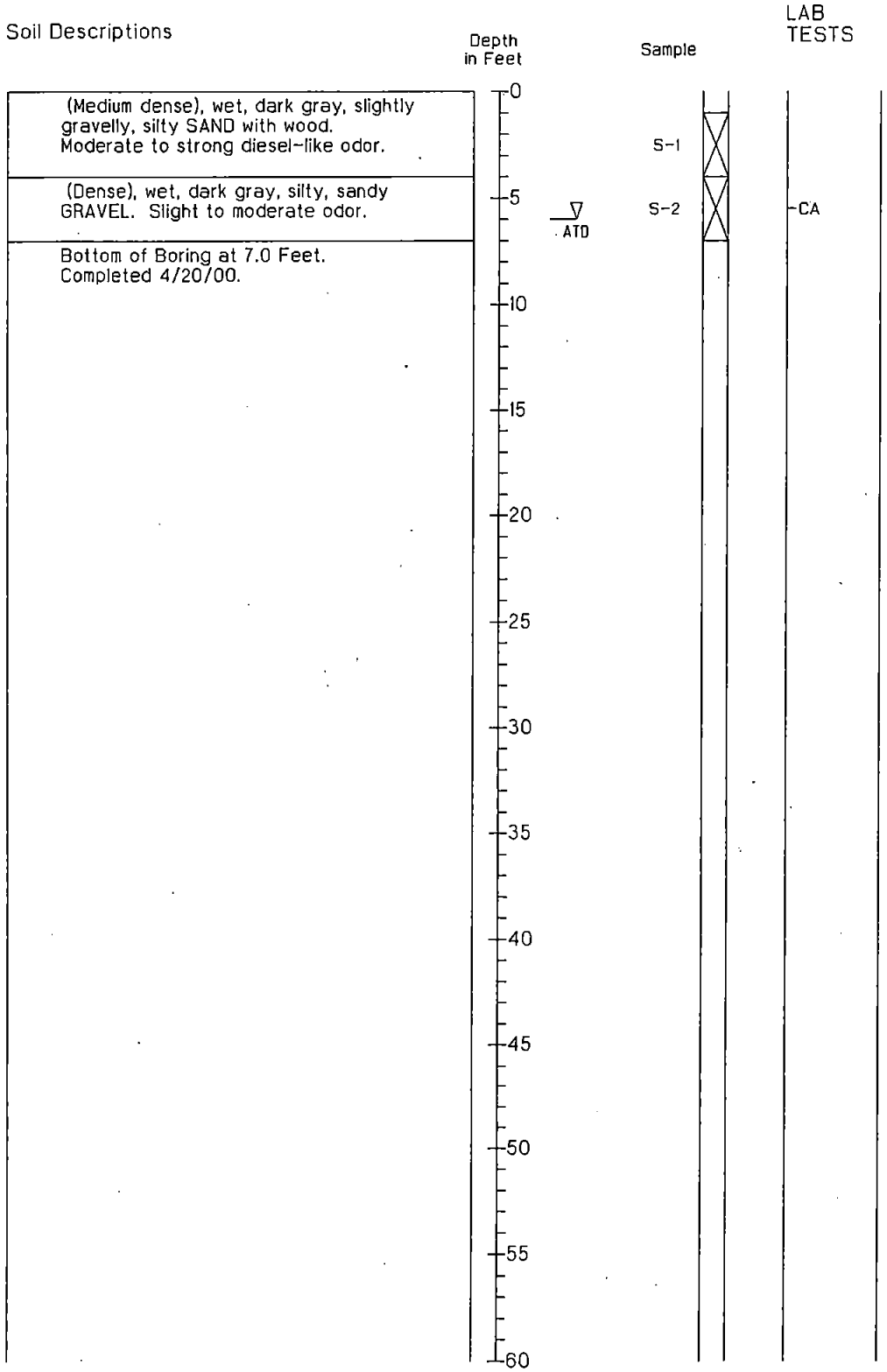
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

J-7206-01 4/00

Figure A-7

Boring Log SP-6W



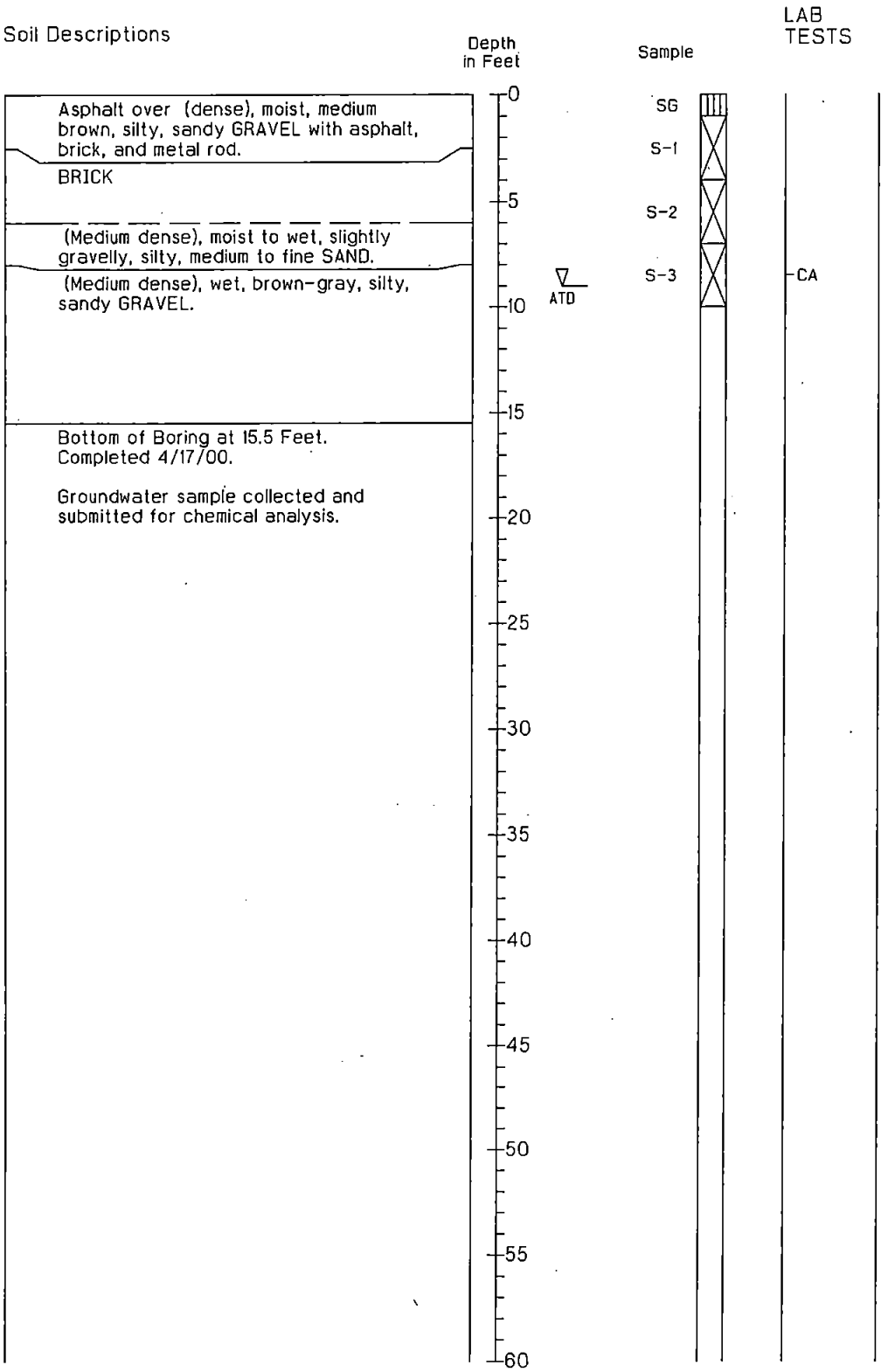
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

J-7206-01 4/00

Figure A-6

Boring Log SP-7



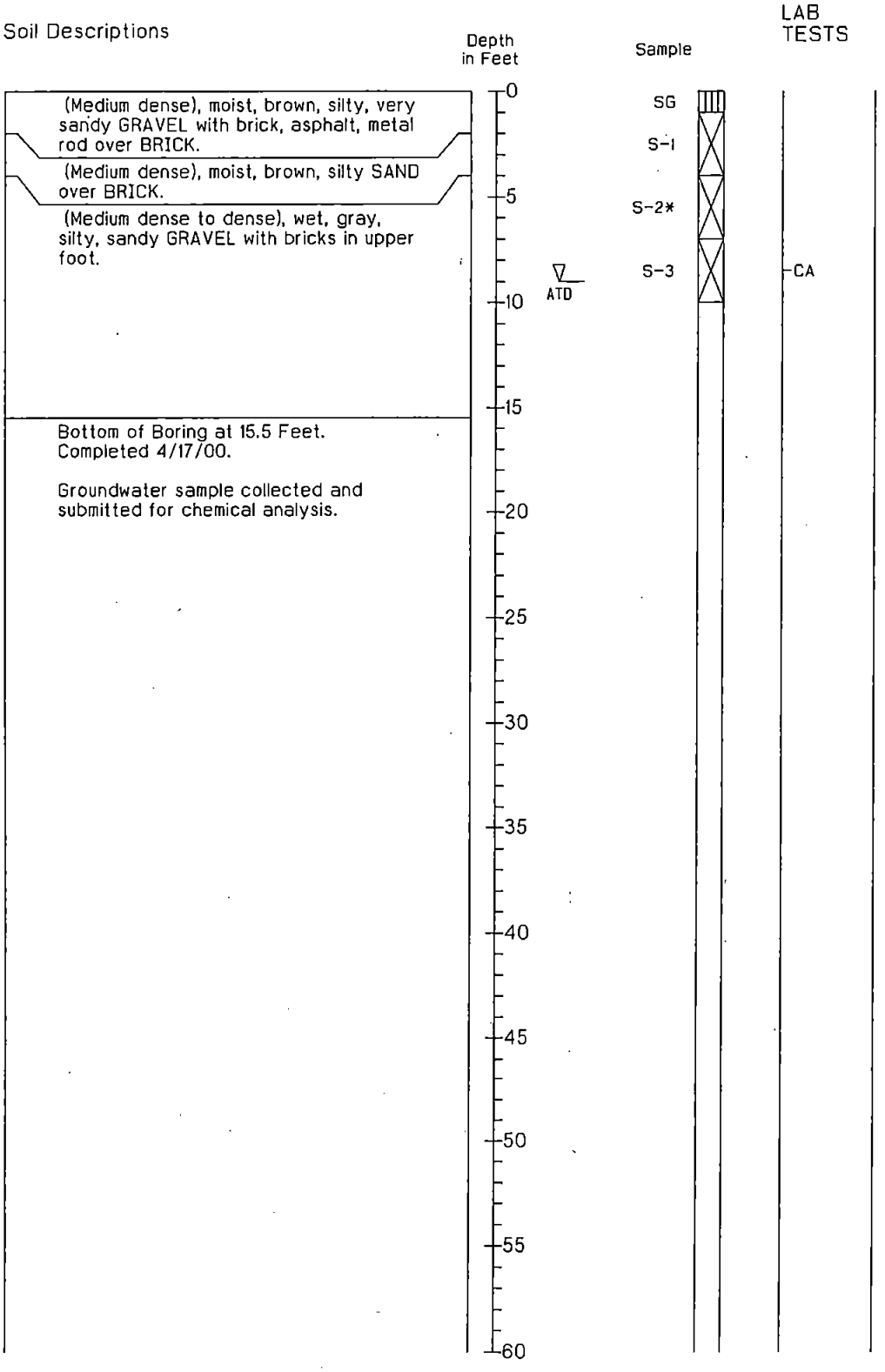
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

J-7206-01 4/00

Figure A-8

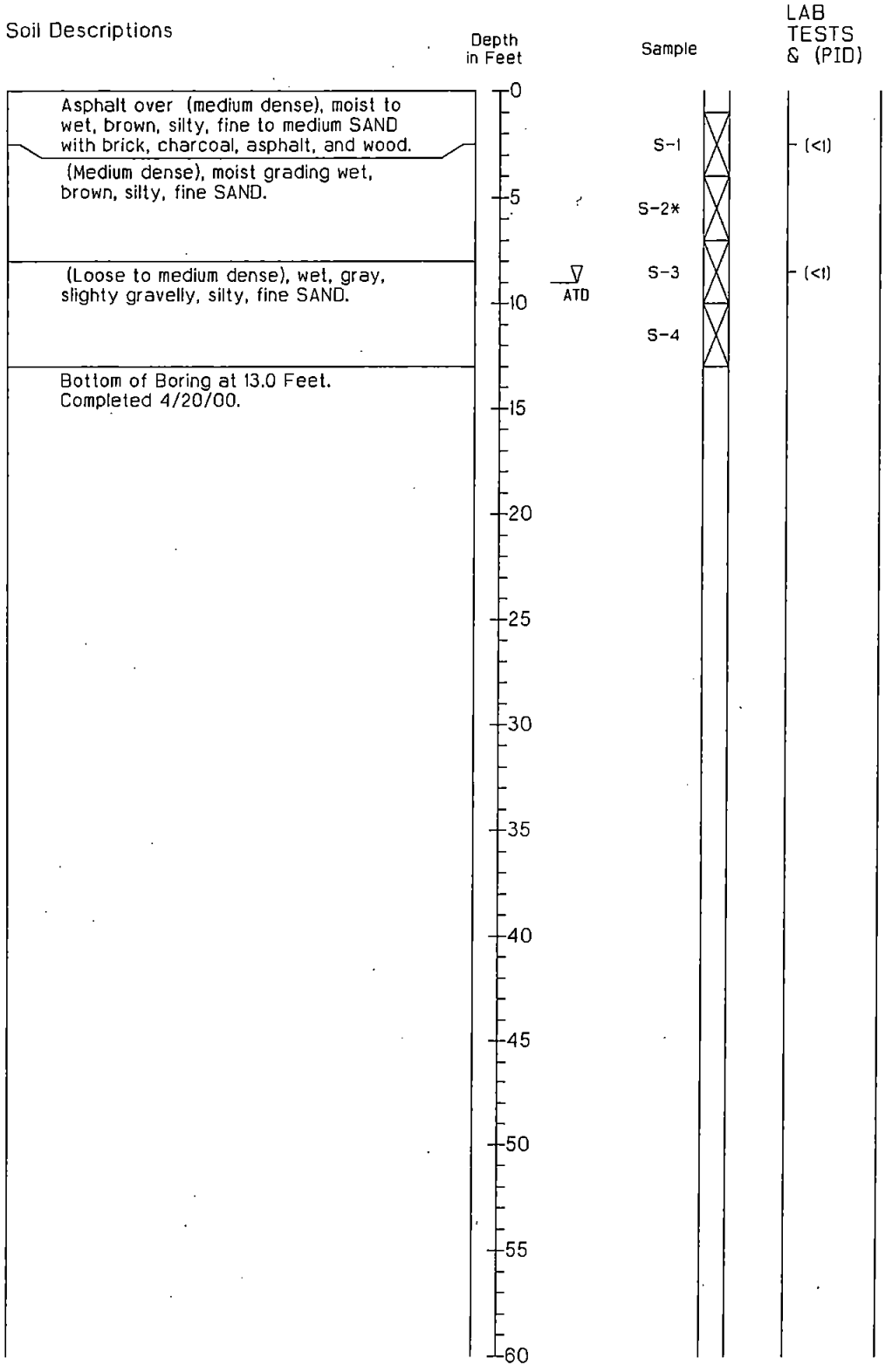
Boring Log SP-8



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER
J-7206-01 4/00
Figure A-9

Boring Log SP-10



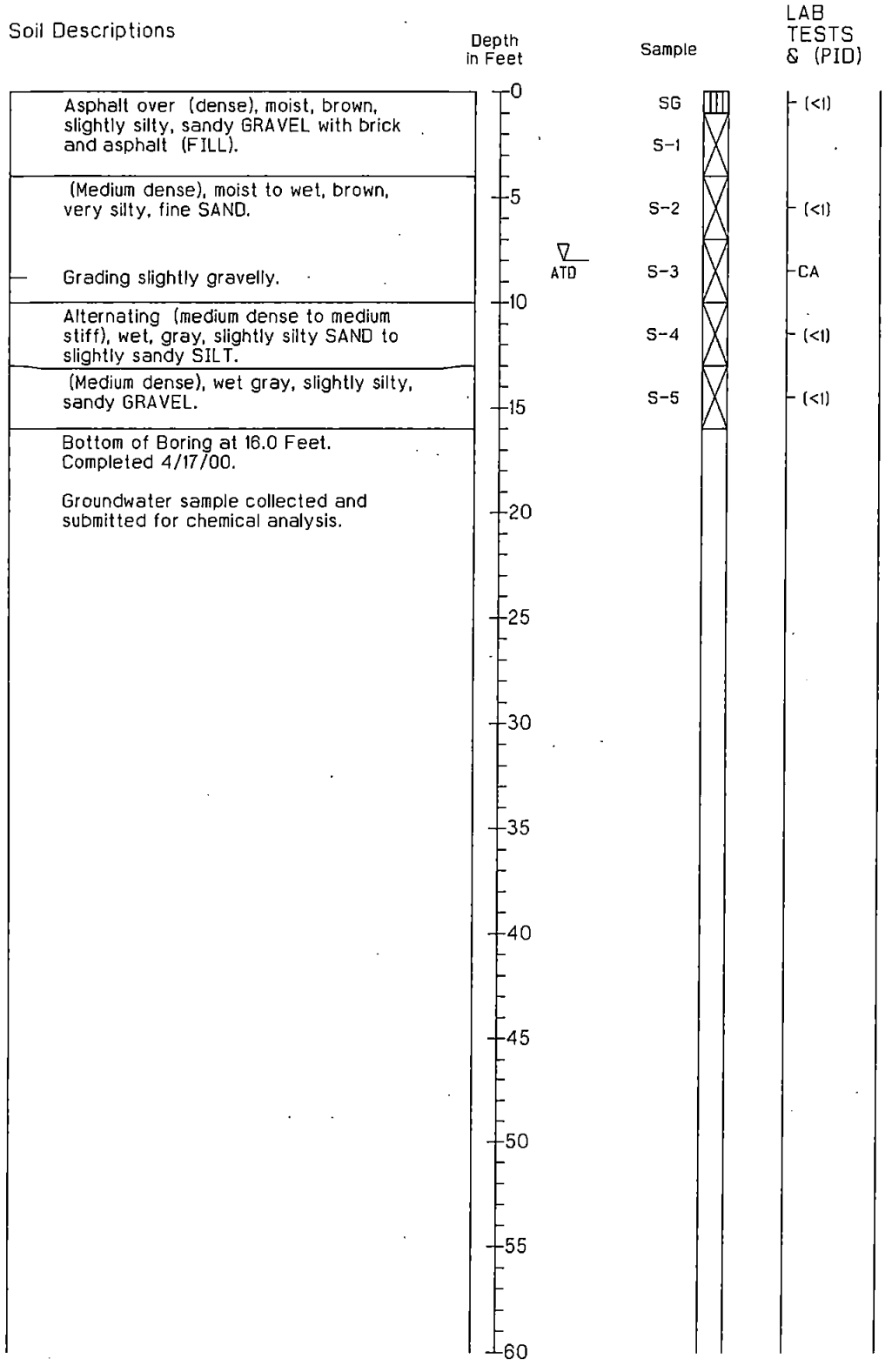
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

J-7206-01 4/00

Figure A-10

Boring Log SP-11



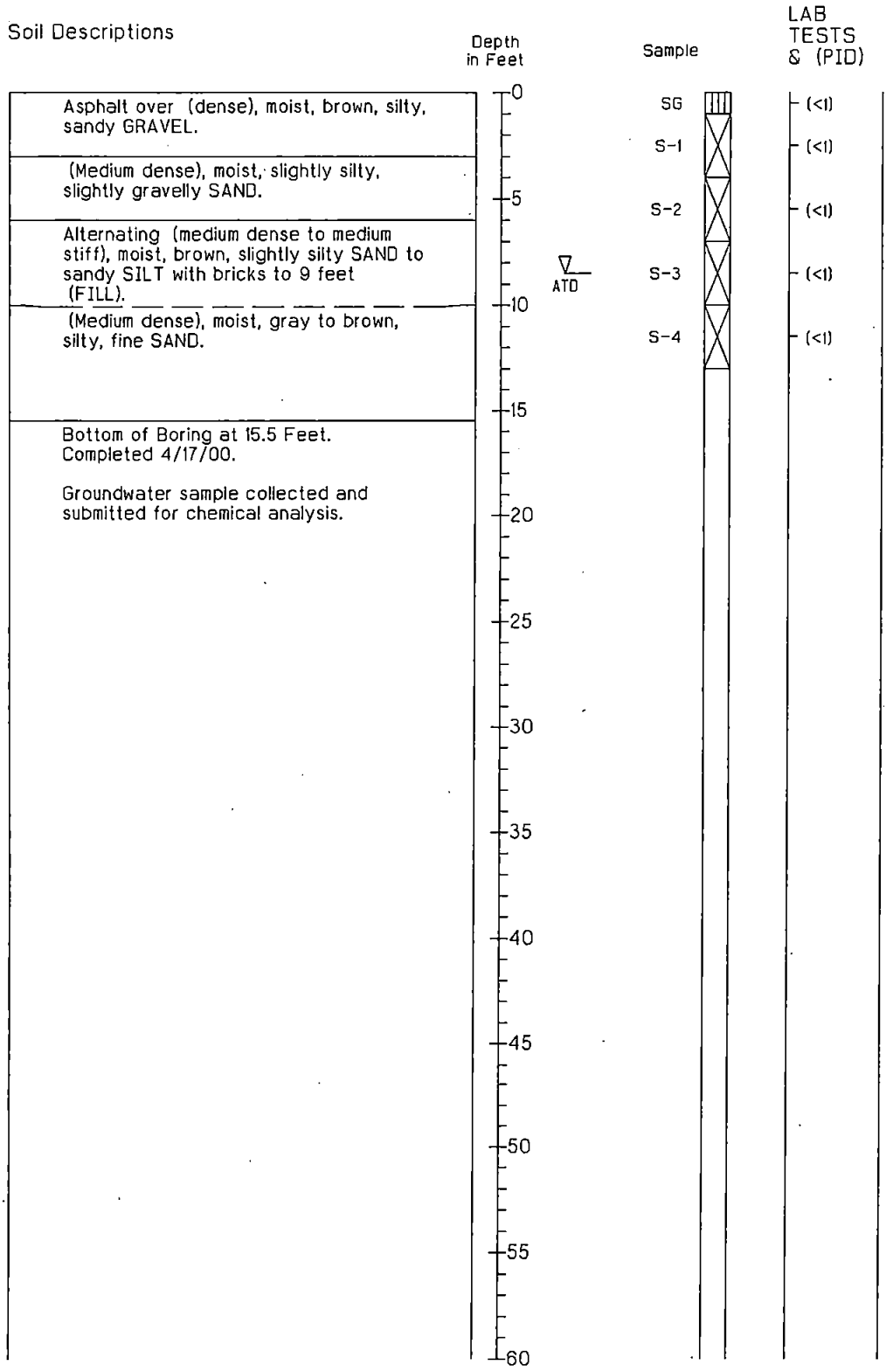
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

J-7206-01 4/00

Figure A-11

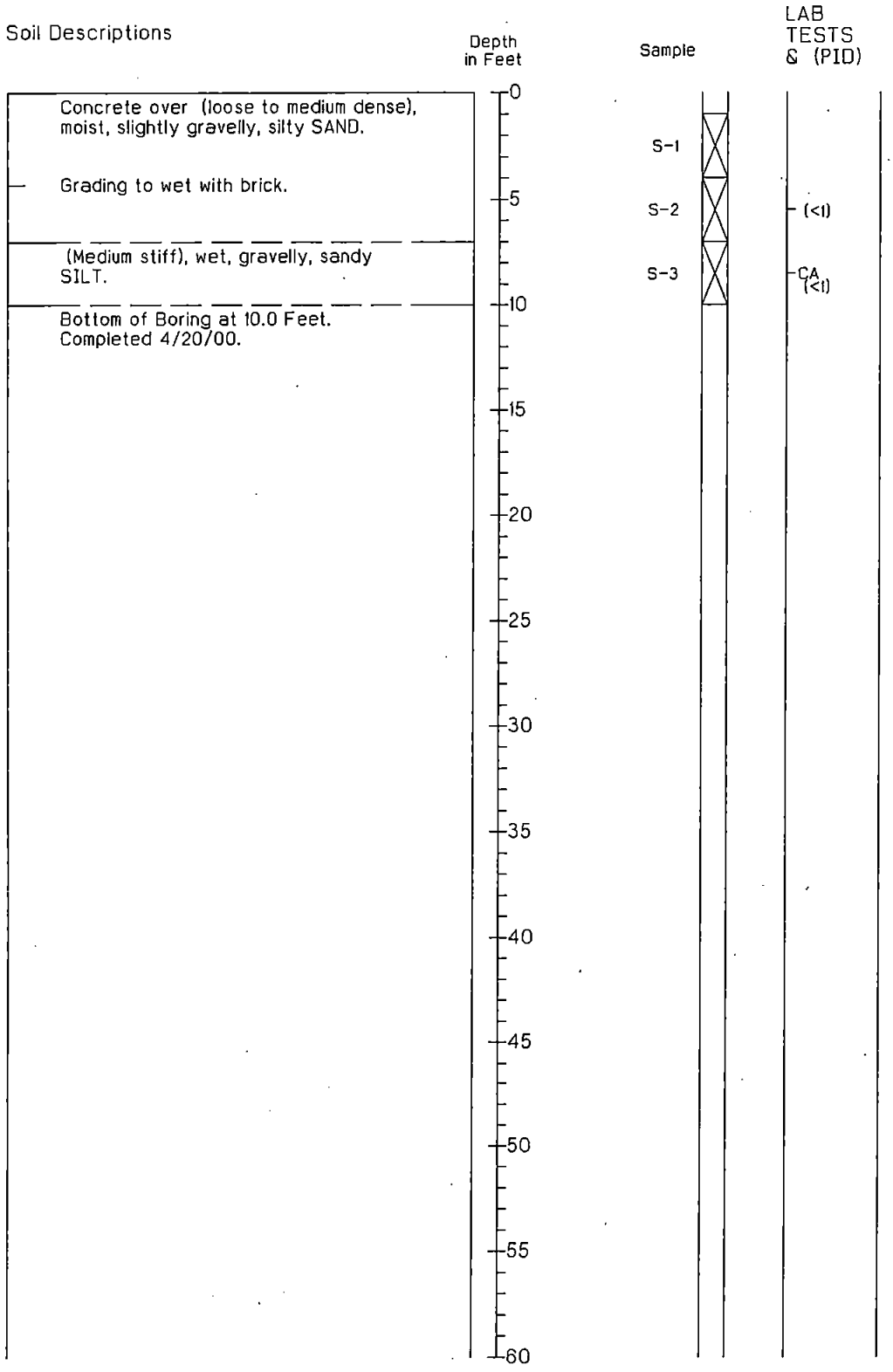
Boring Log SP-12



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER
J-7206-01 4/00
Figure A-12

Boring Log SP-13



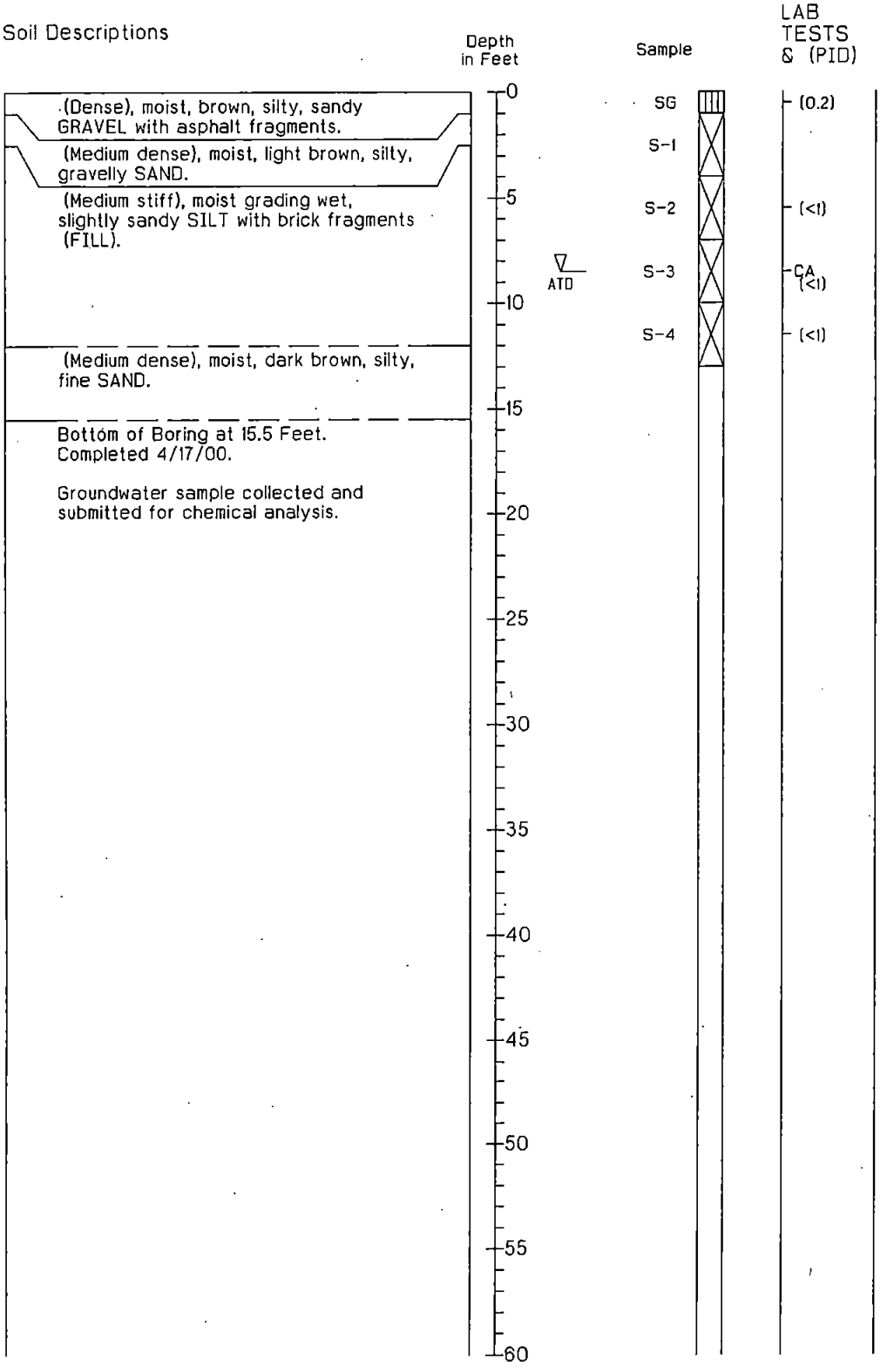
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

J-7206-01 4/00

Figure A-13

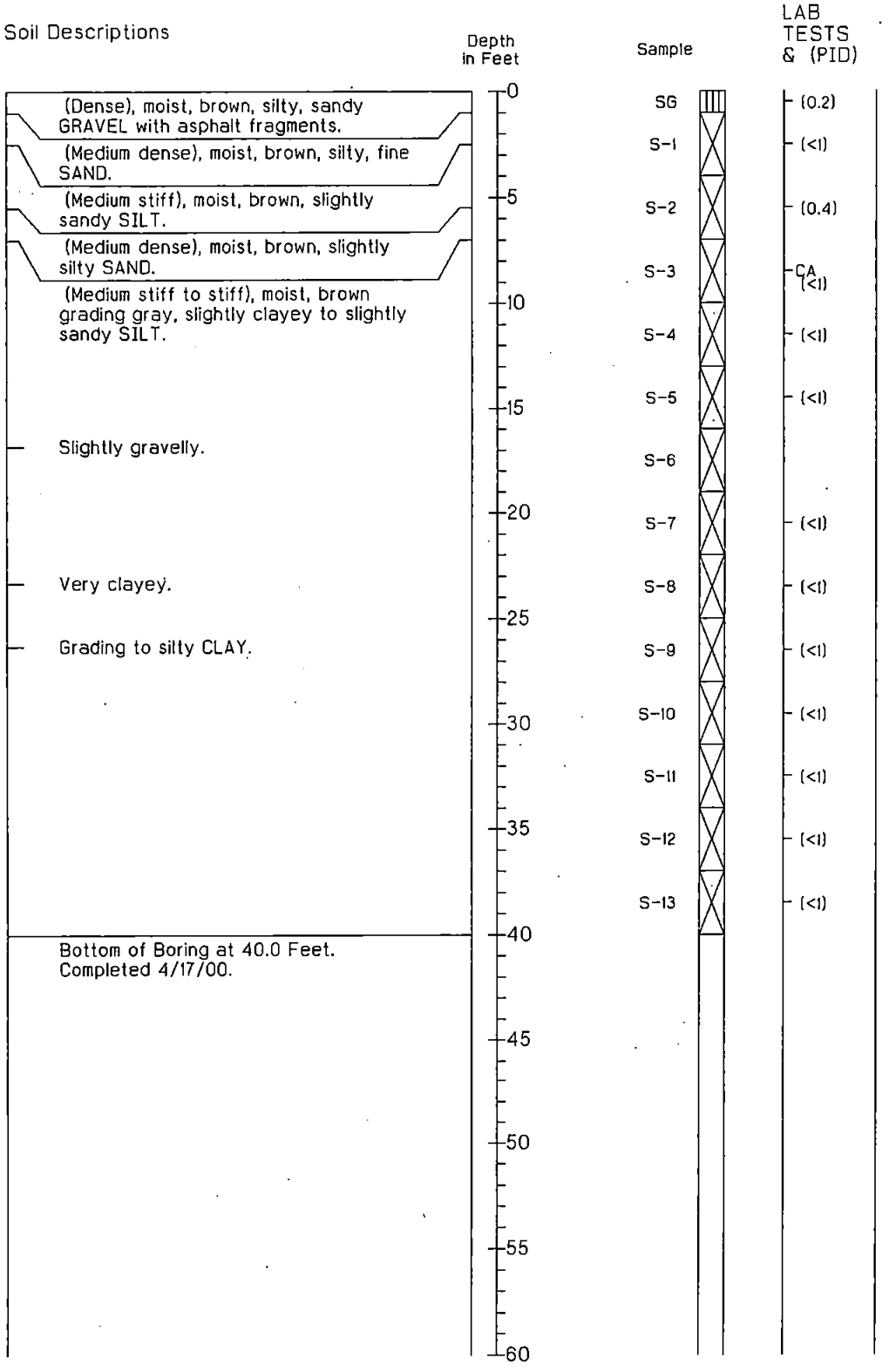
Boring Log SP-14



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER
J-7206-01 4/00
Figure A-14

Boring Log SP-15



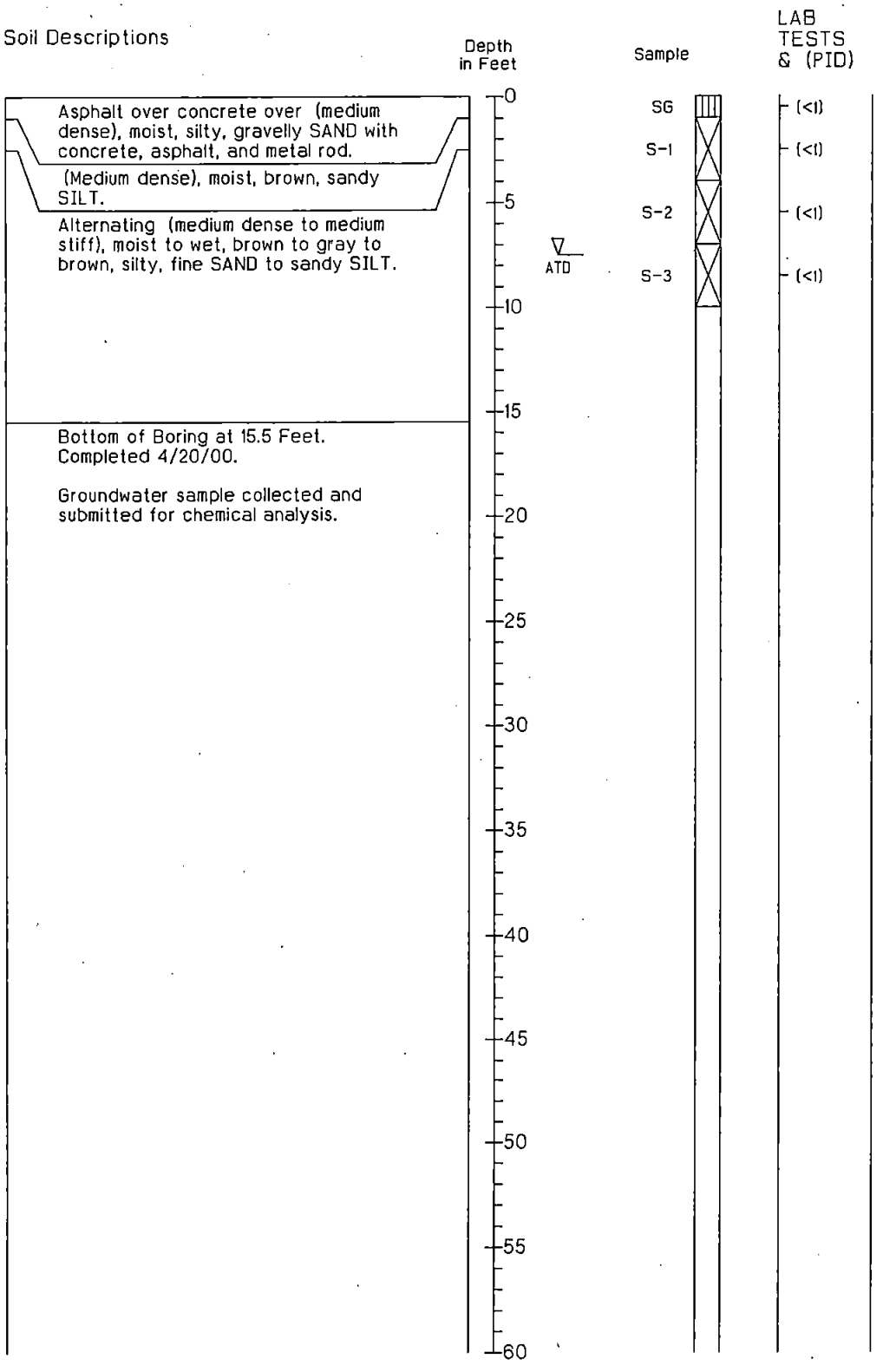
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

J-7206-01 4/00

Figure A-15

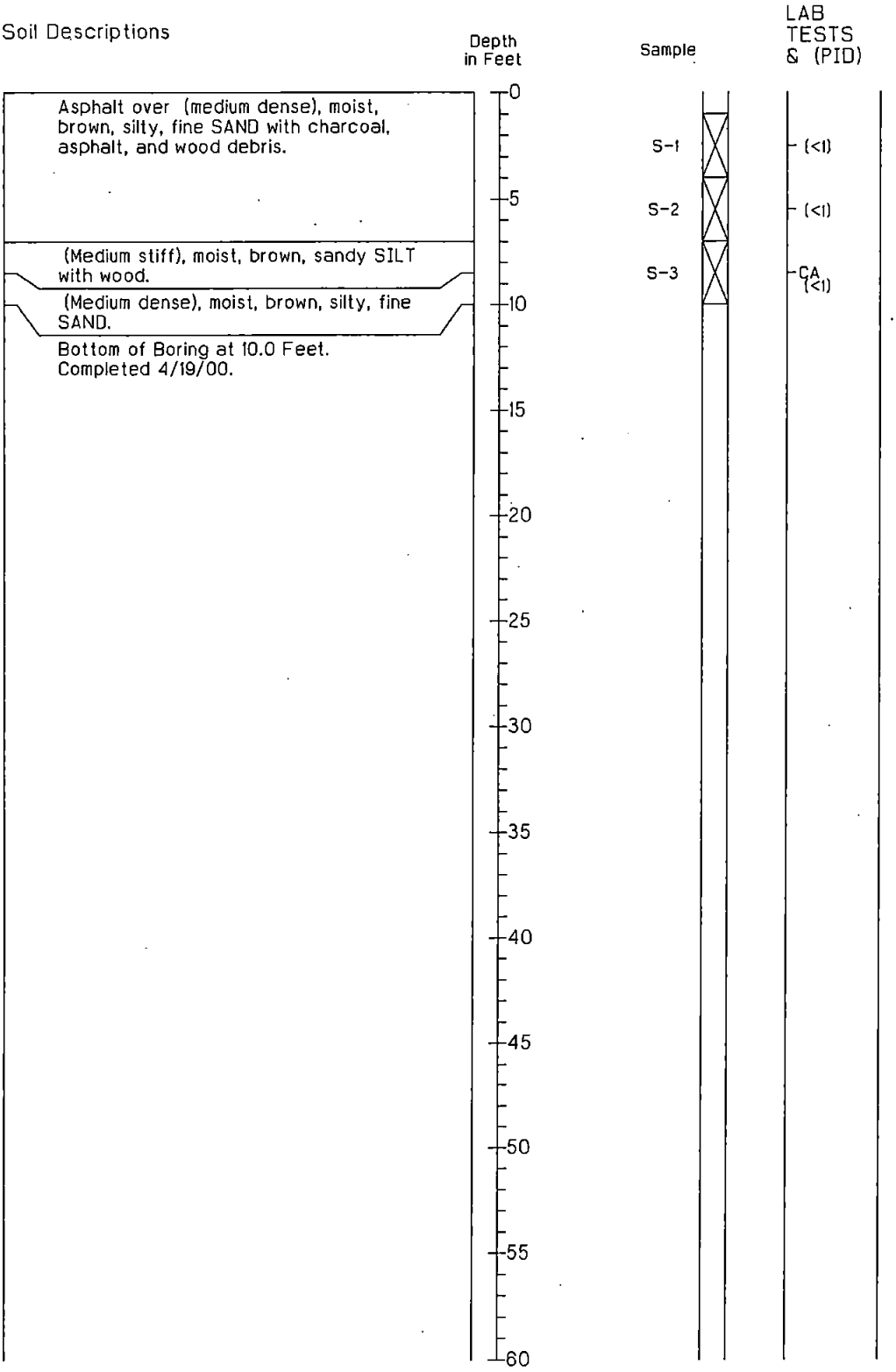
Boring Log SP-15A



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER
J-7206-01 4/00
Figure A-16

Boring Log SP-17



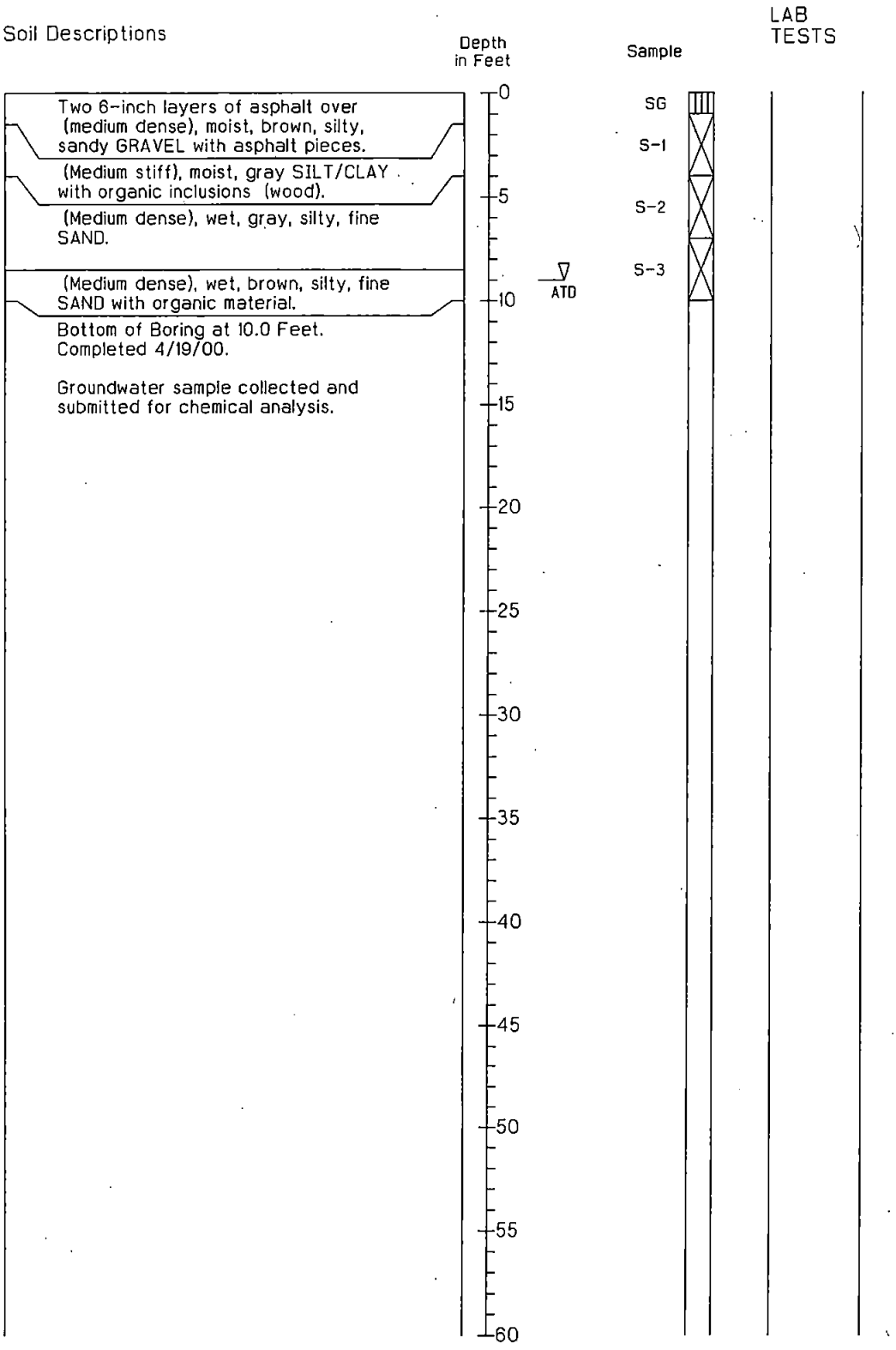
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

J-7206-01 4/00

Figure A-17

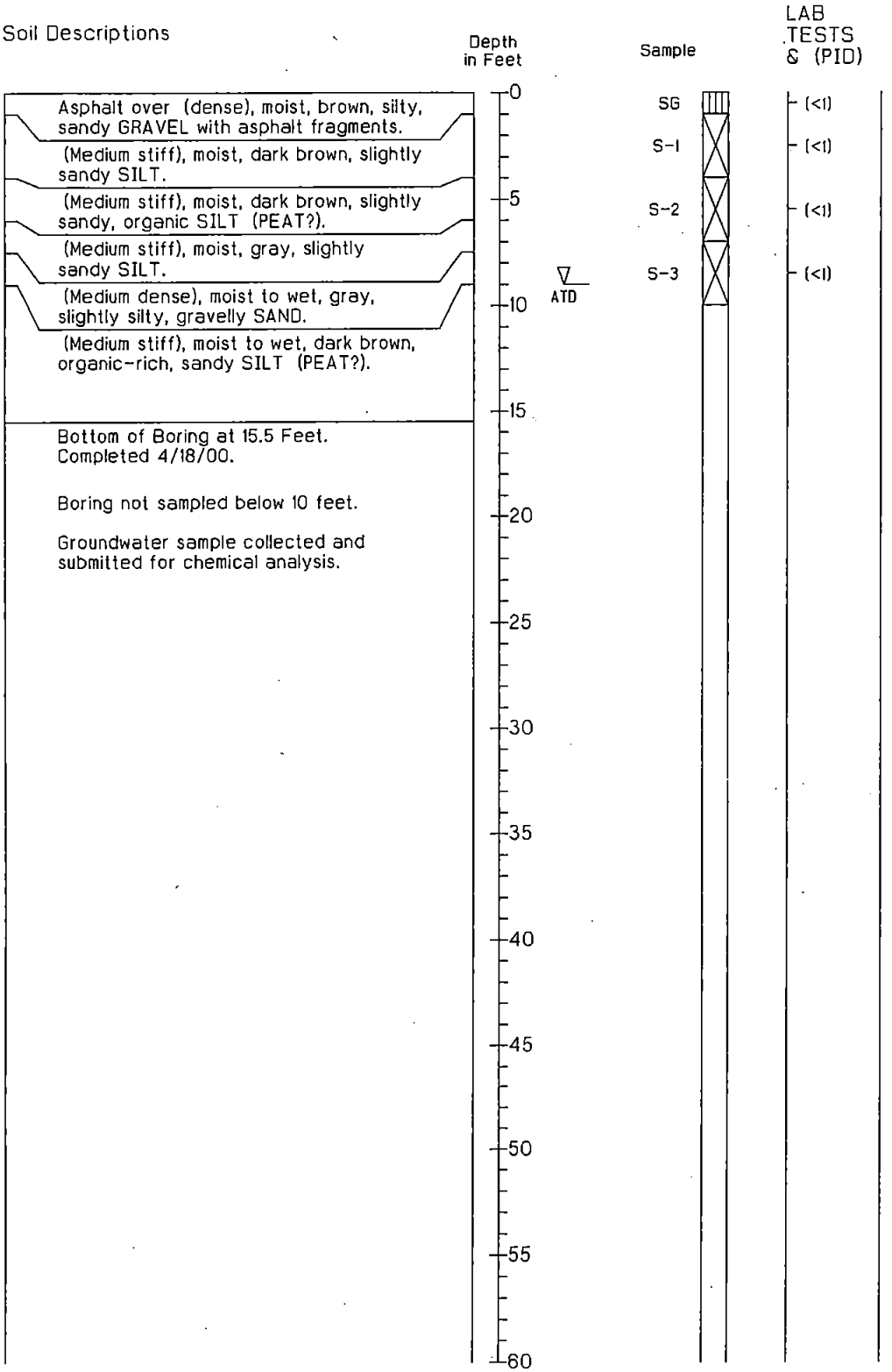
Boring Log SP-19



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER
J-7206-01 4/00
Figure A-18

Boring Log SP-21



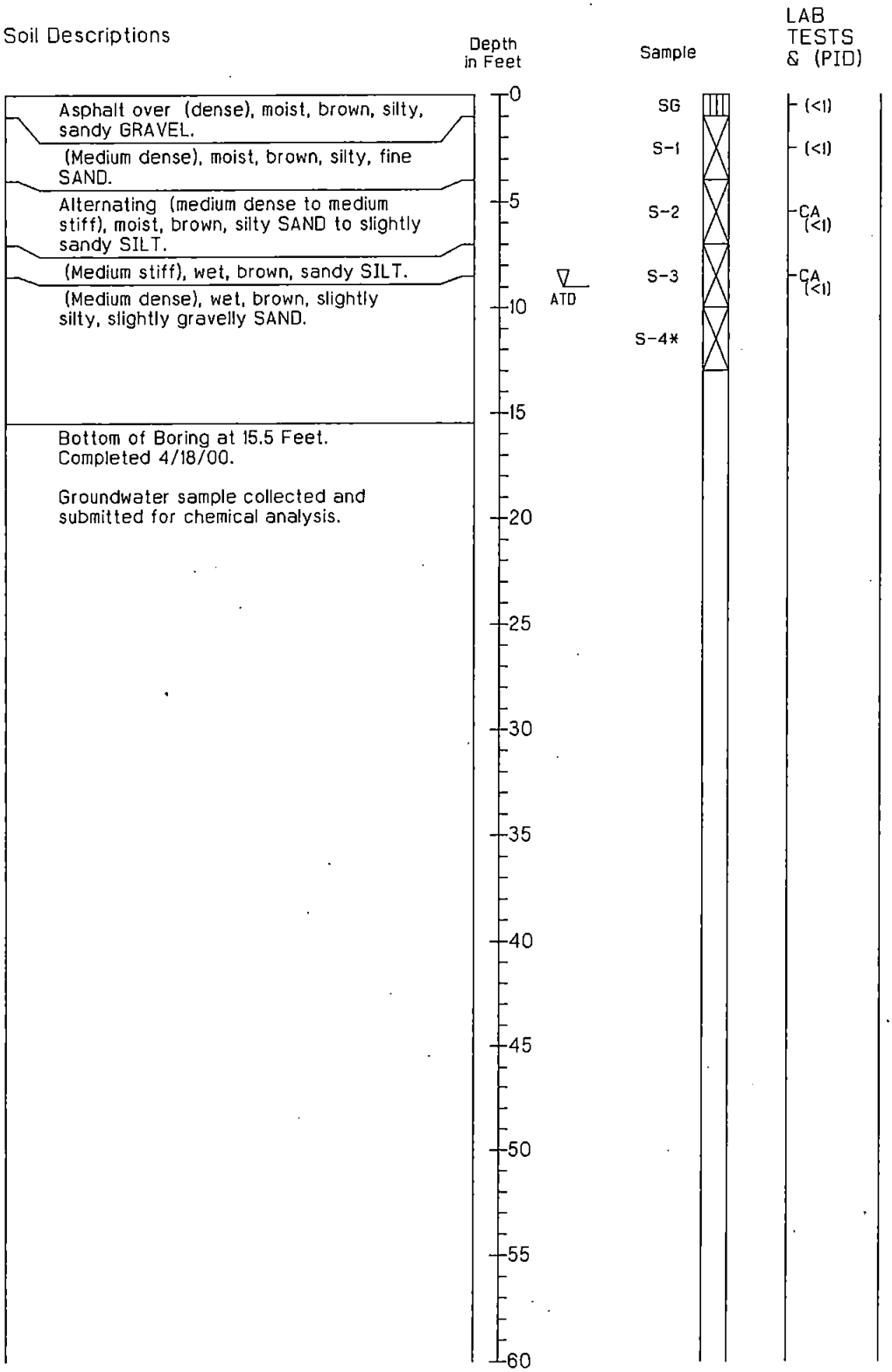
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

J-7206-01 4/00

Figure A-19

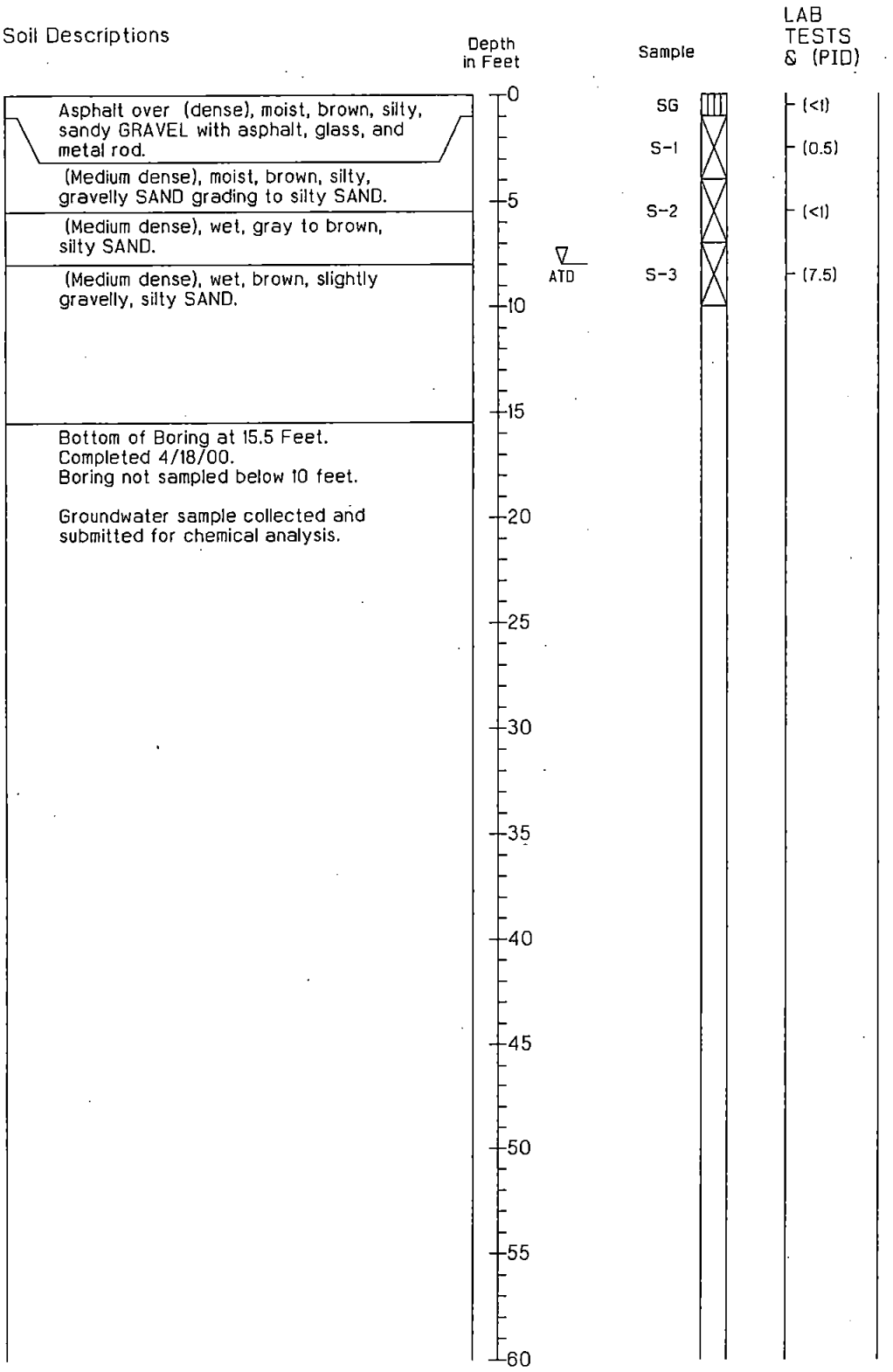
Boring Log SP-23



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER
J-7206-01 4/00
Figure A-20

Boring Log SP-24



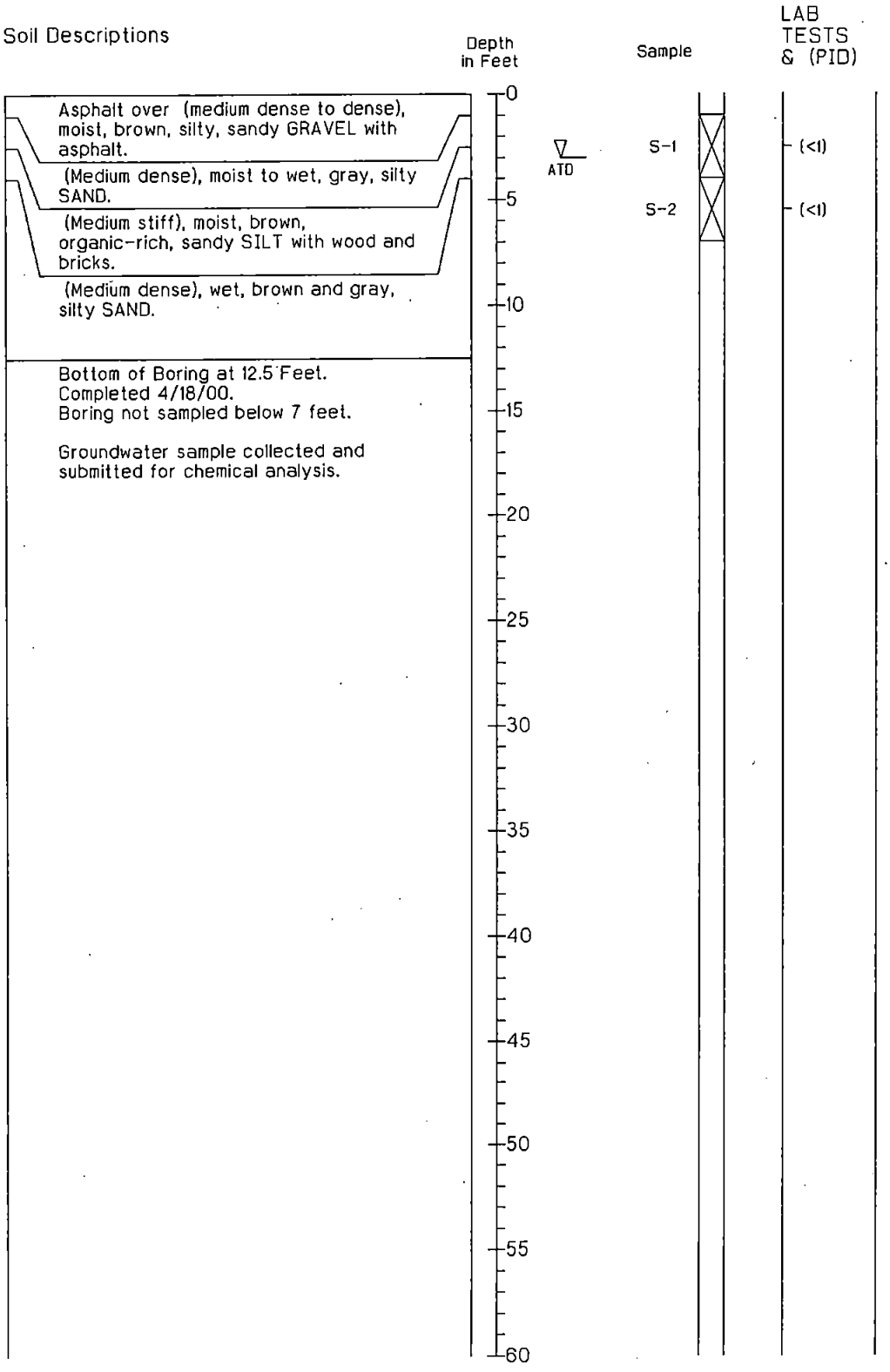
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

J-7206-01 4/00

Figure A-21

Boring Log SP-25



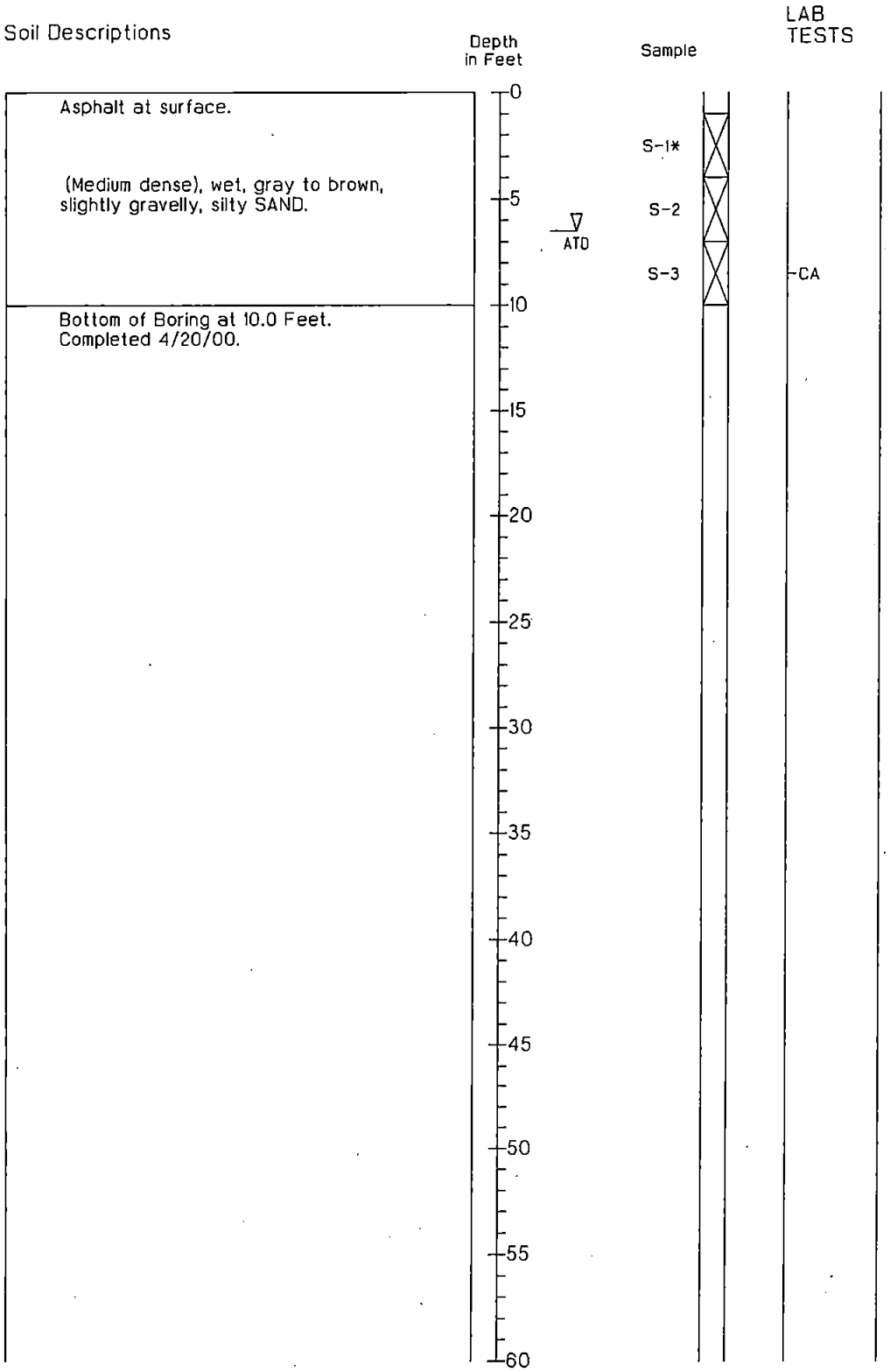
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

J-7206-01 4/00

Figure A-22

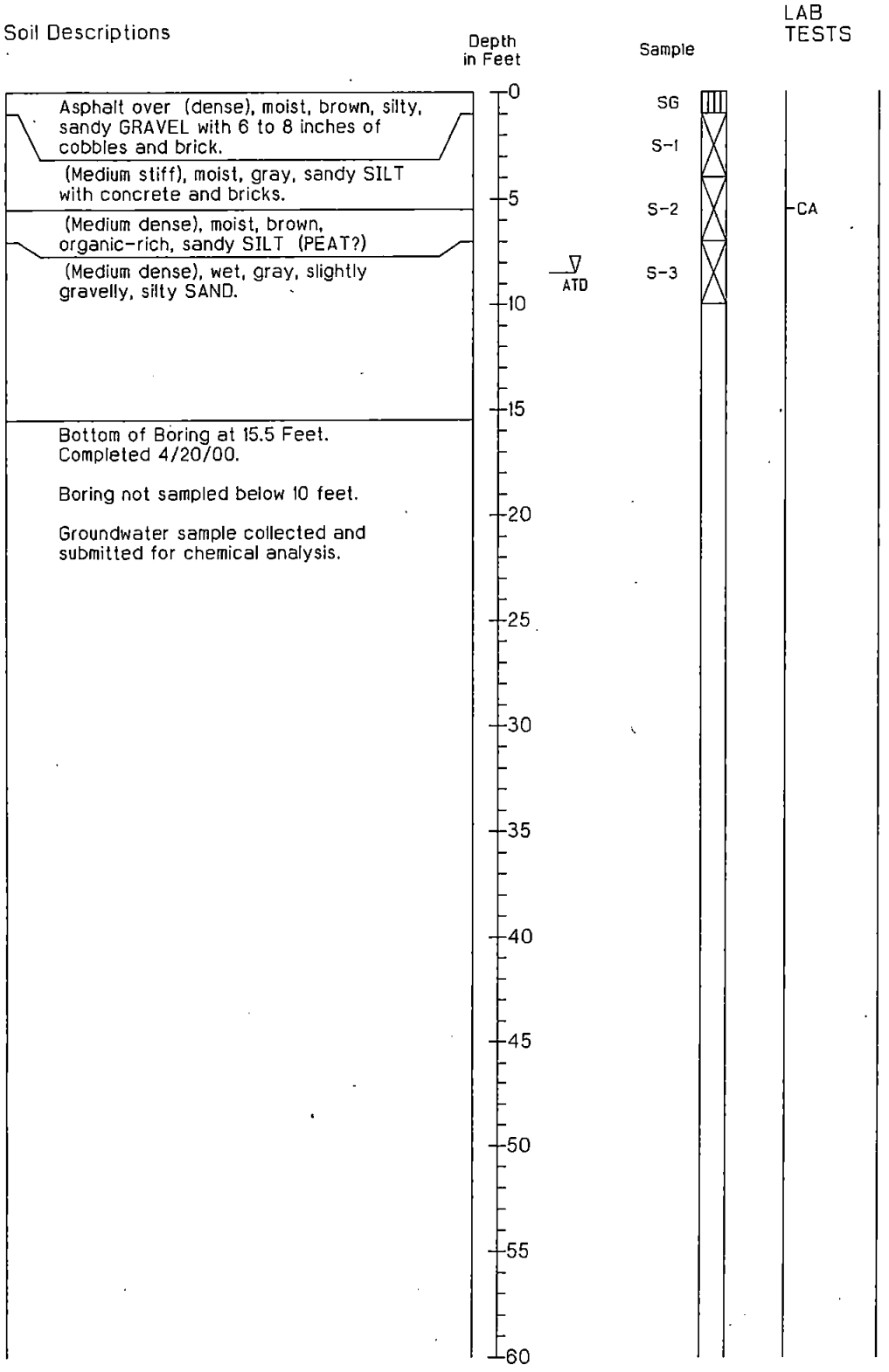
Boring Log SP-27



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER
J-7206-01 4/00
Figure A-23

Boring Log SP-28



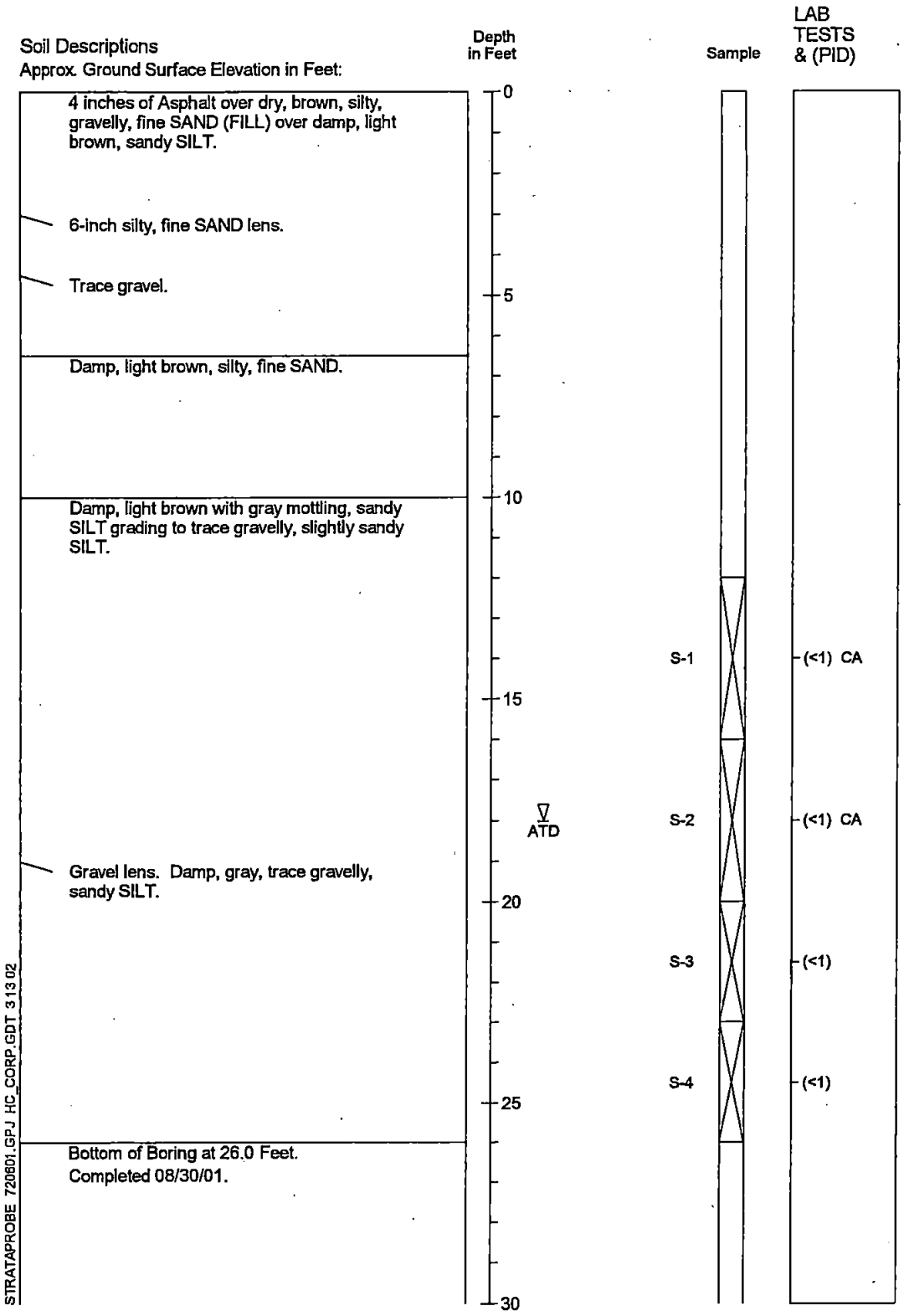
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

J-7206-01 4/00

Figure A-24

Strataprobe Boring Log SP29



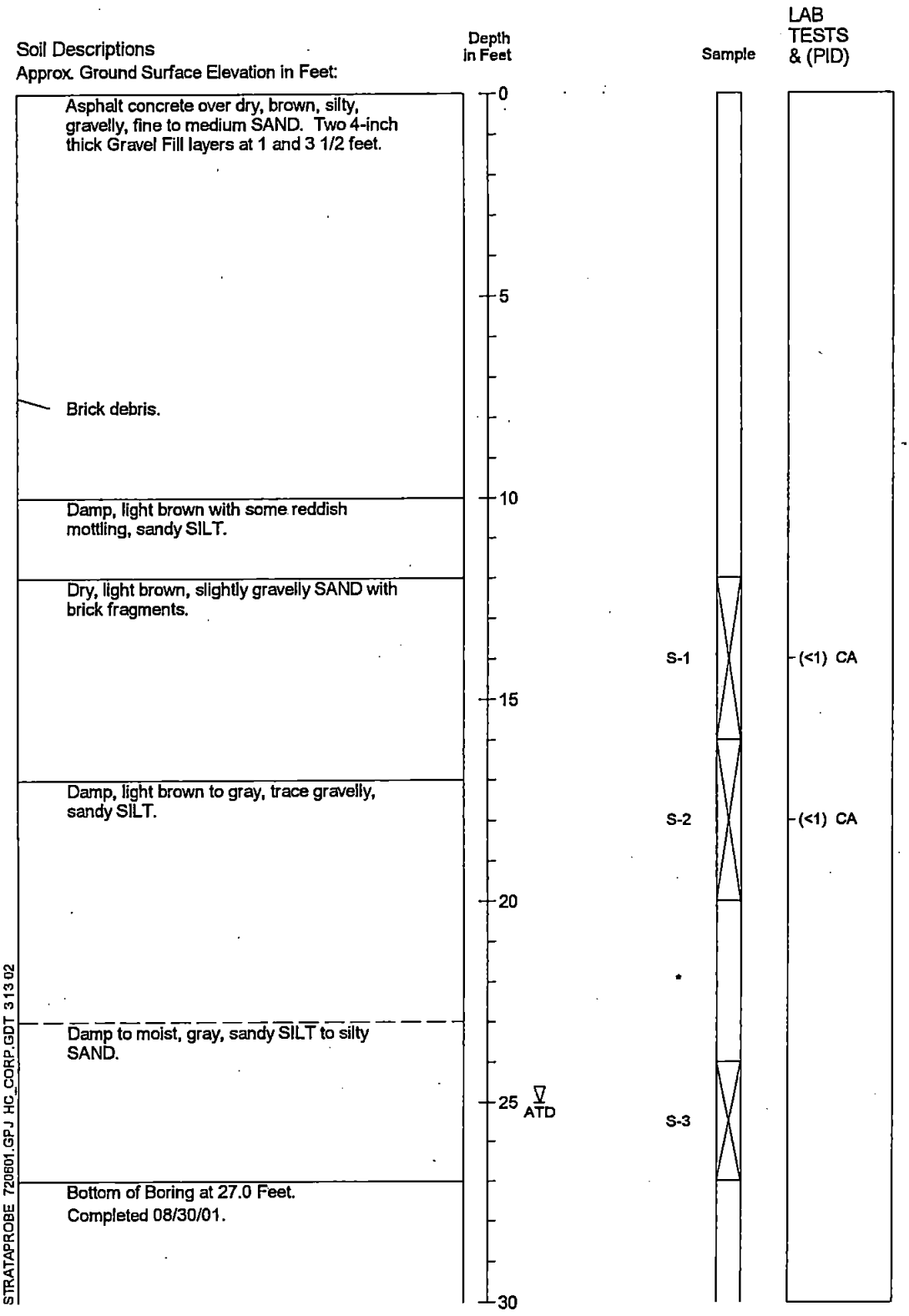
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

7206-01 08/01

Figure A-2

Strataprobe Boring Log SP30



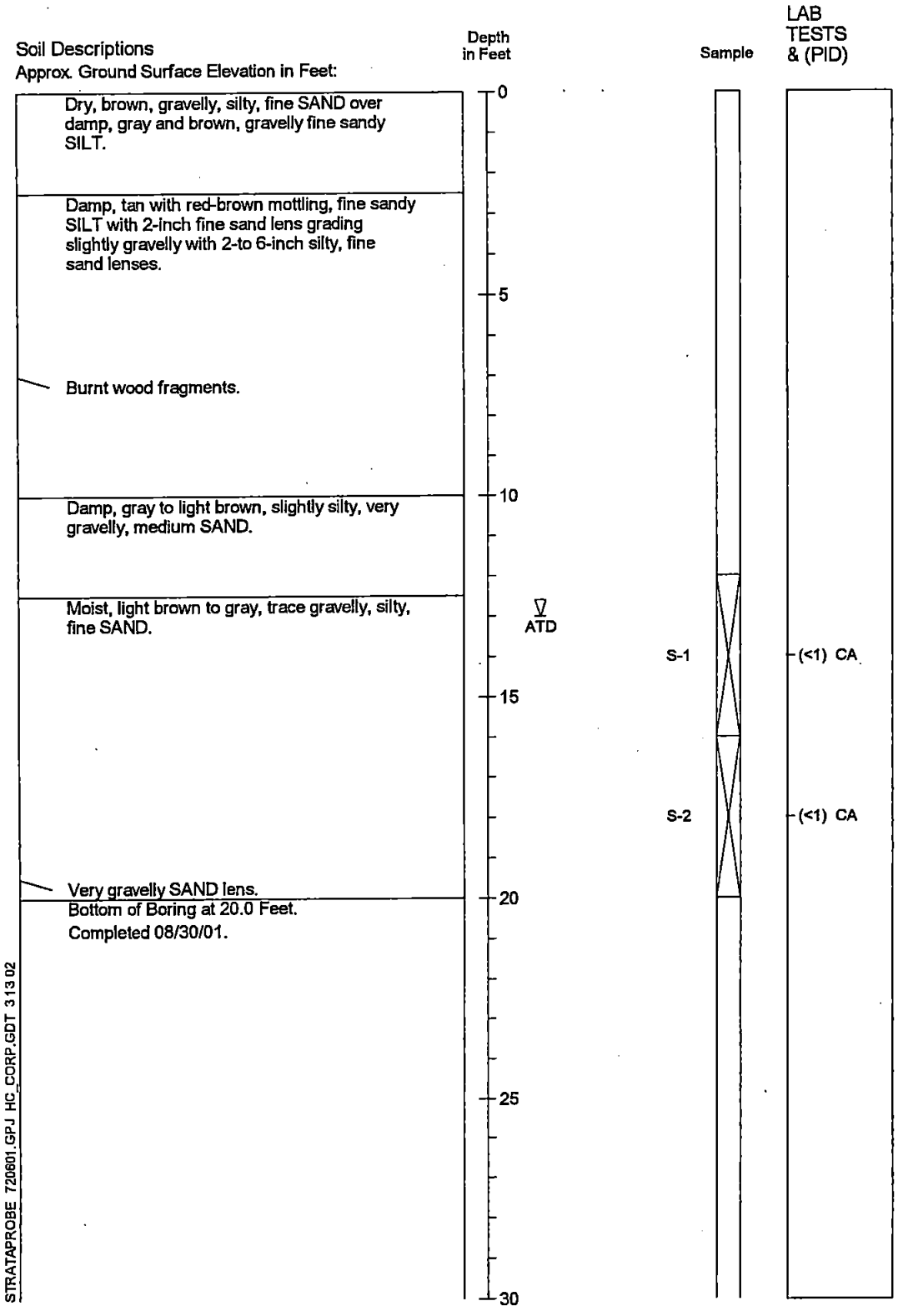
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

7206-01 08/01

Figure A-3

Strataprobe Boring Log SP31



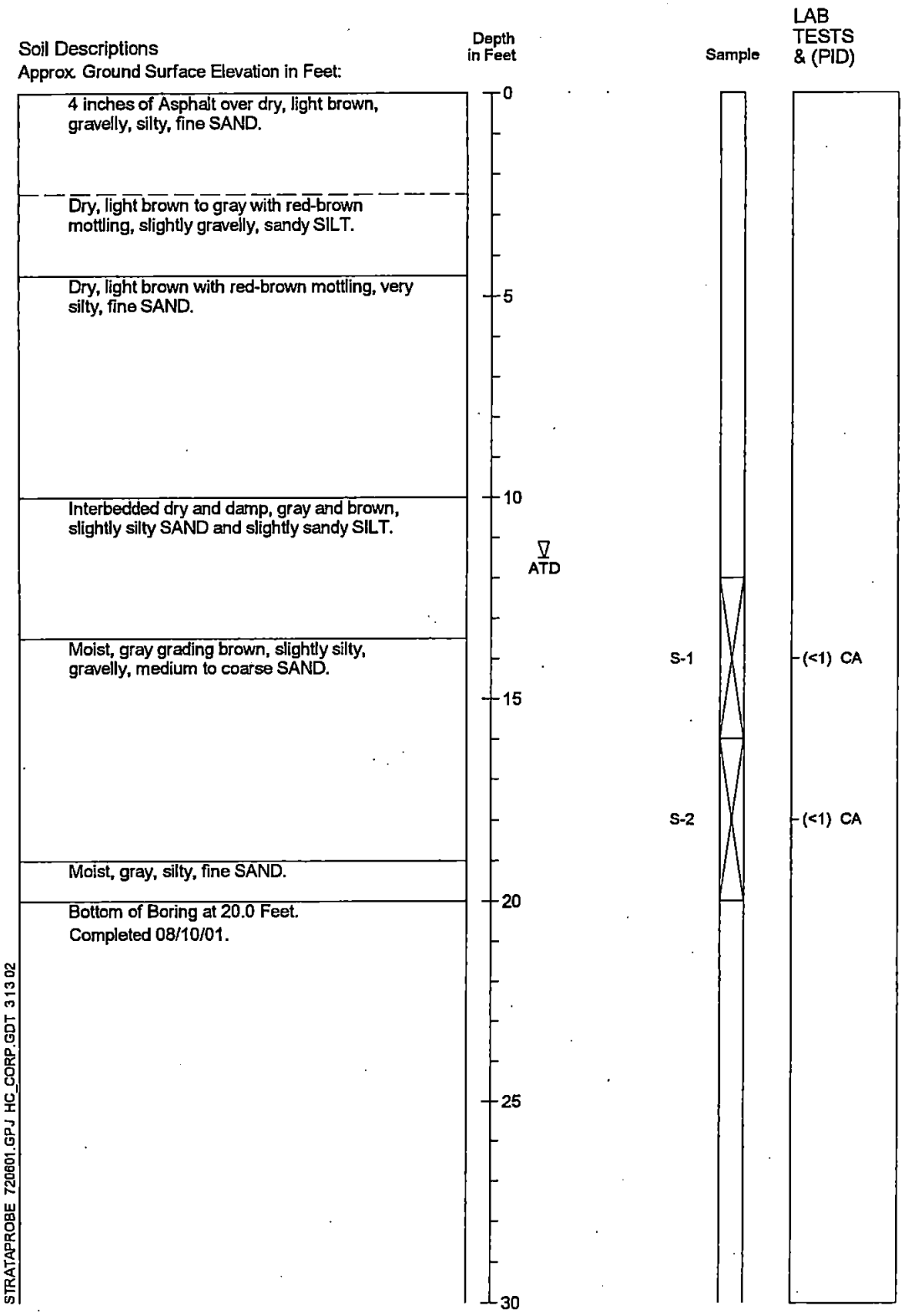
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

7206-01 08/01

Figure A-4

Strataprobe Boring Log SP32



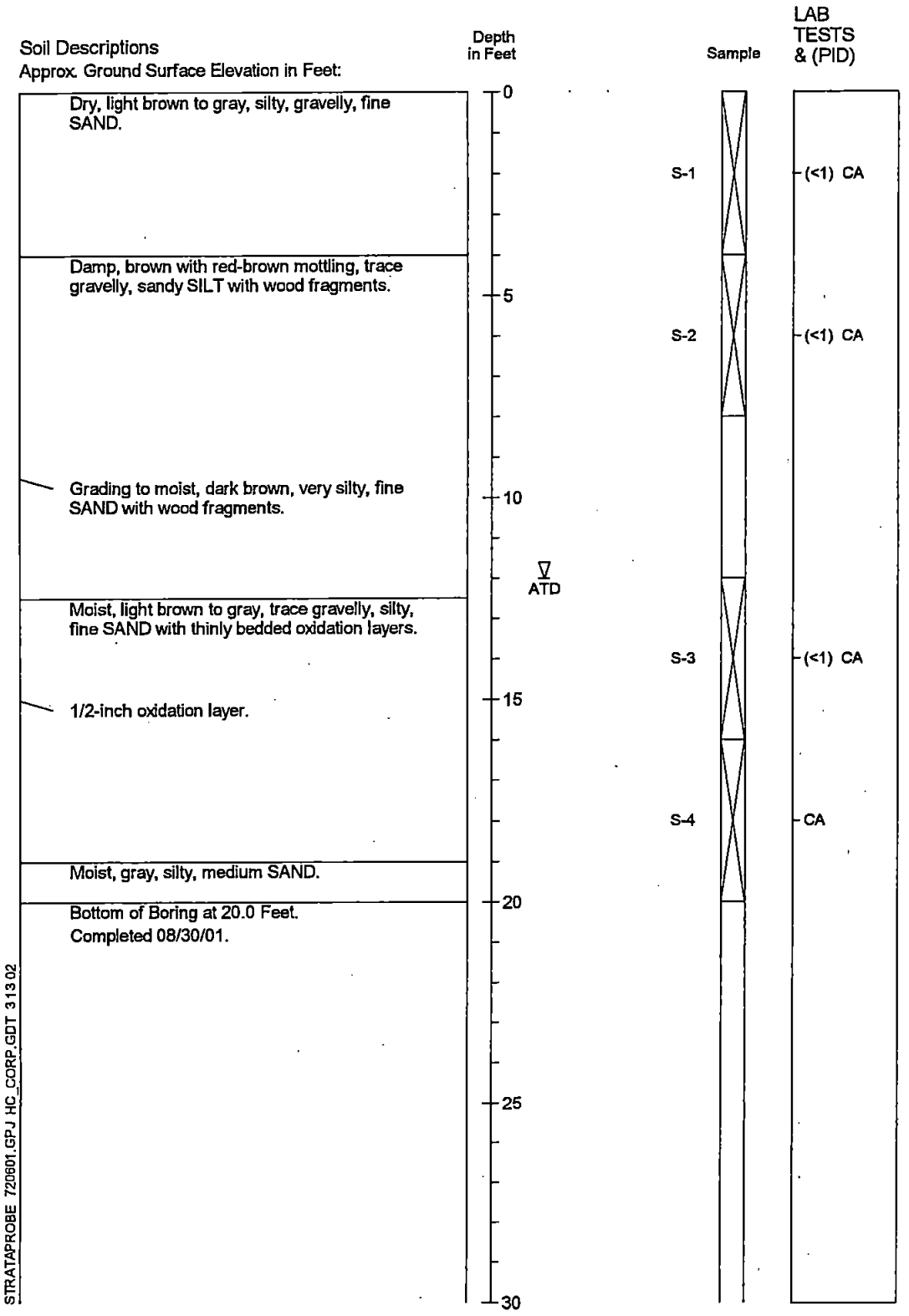
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

7206-01 08/01

Figure A-5

Strataprobe Boring Log SP33



STRATAPROBE 720601.GPJ HC_CORP.GDT 3 13 02

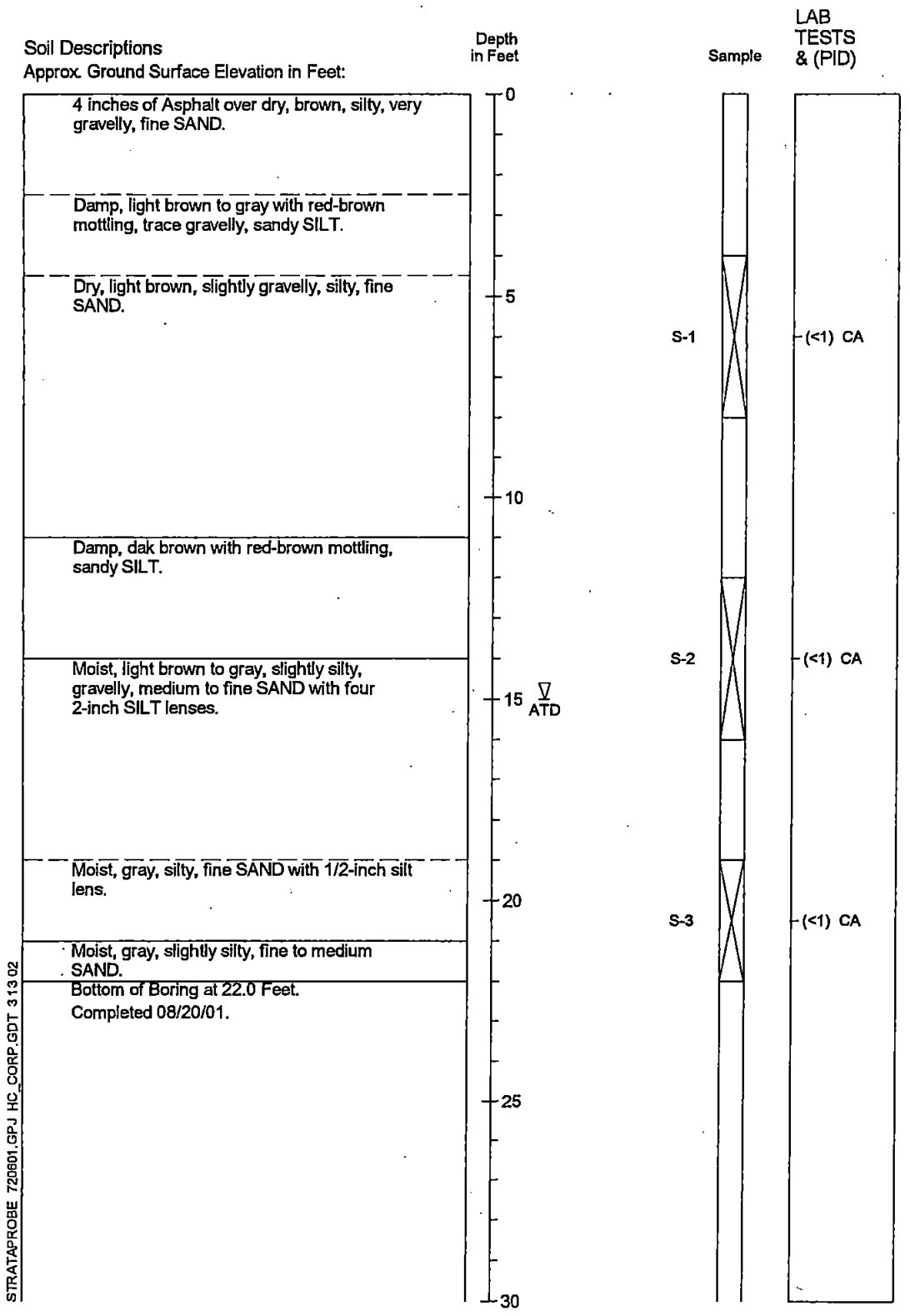
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

7206-01 08/01

Figure A-6

Strataprobe Boring Log SP34



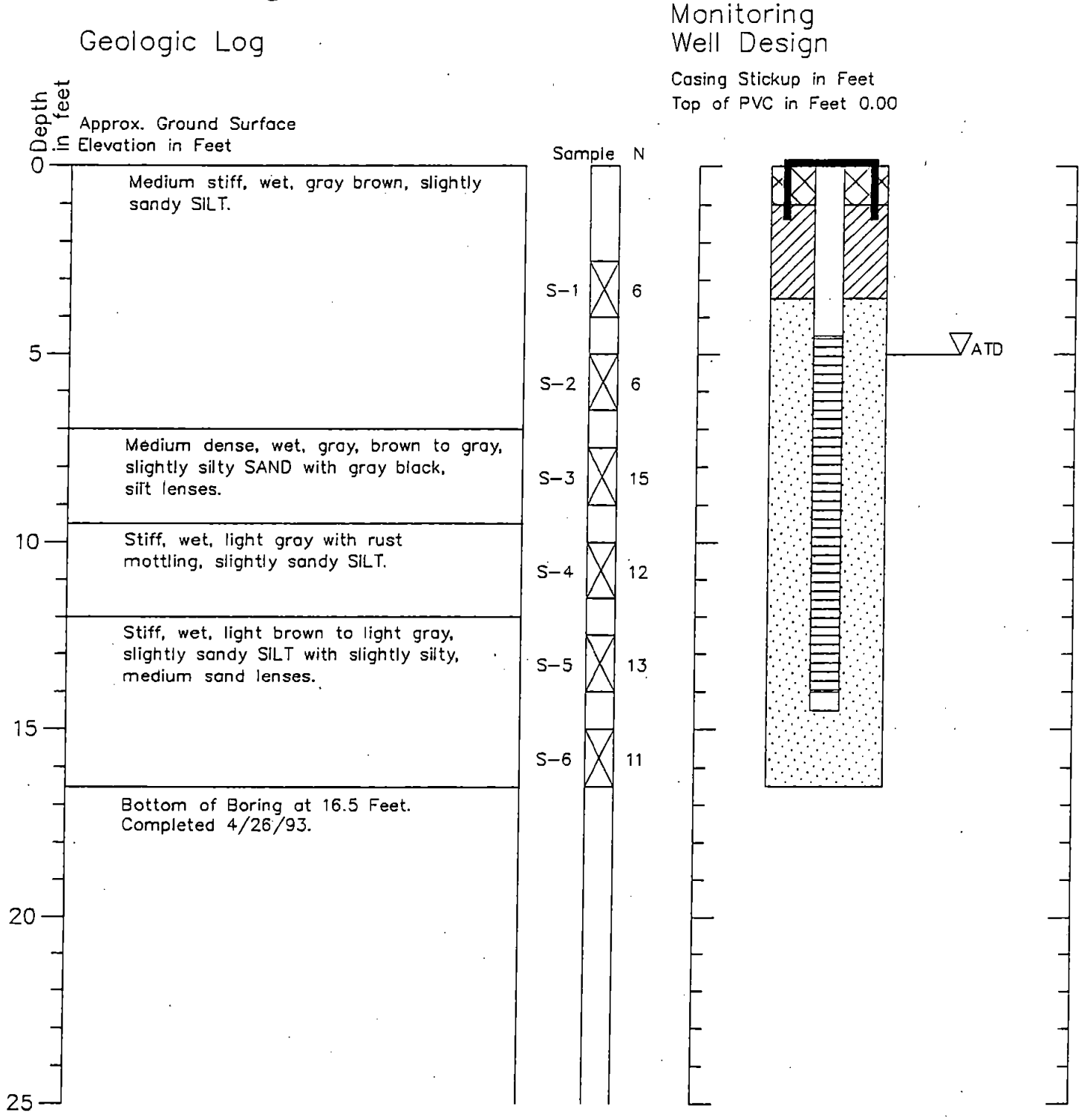
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

7206-01 08/01

Figure A-7

Boring Log and Construction Data for Monitoring Well HC-1



1. Refer to Figure A–1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

J-3836 4/93

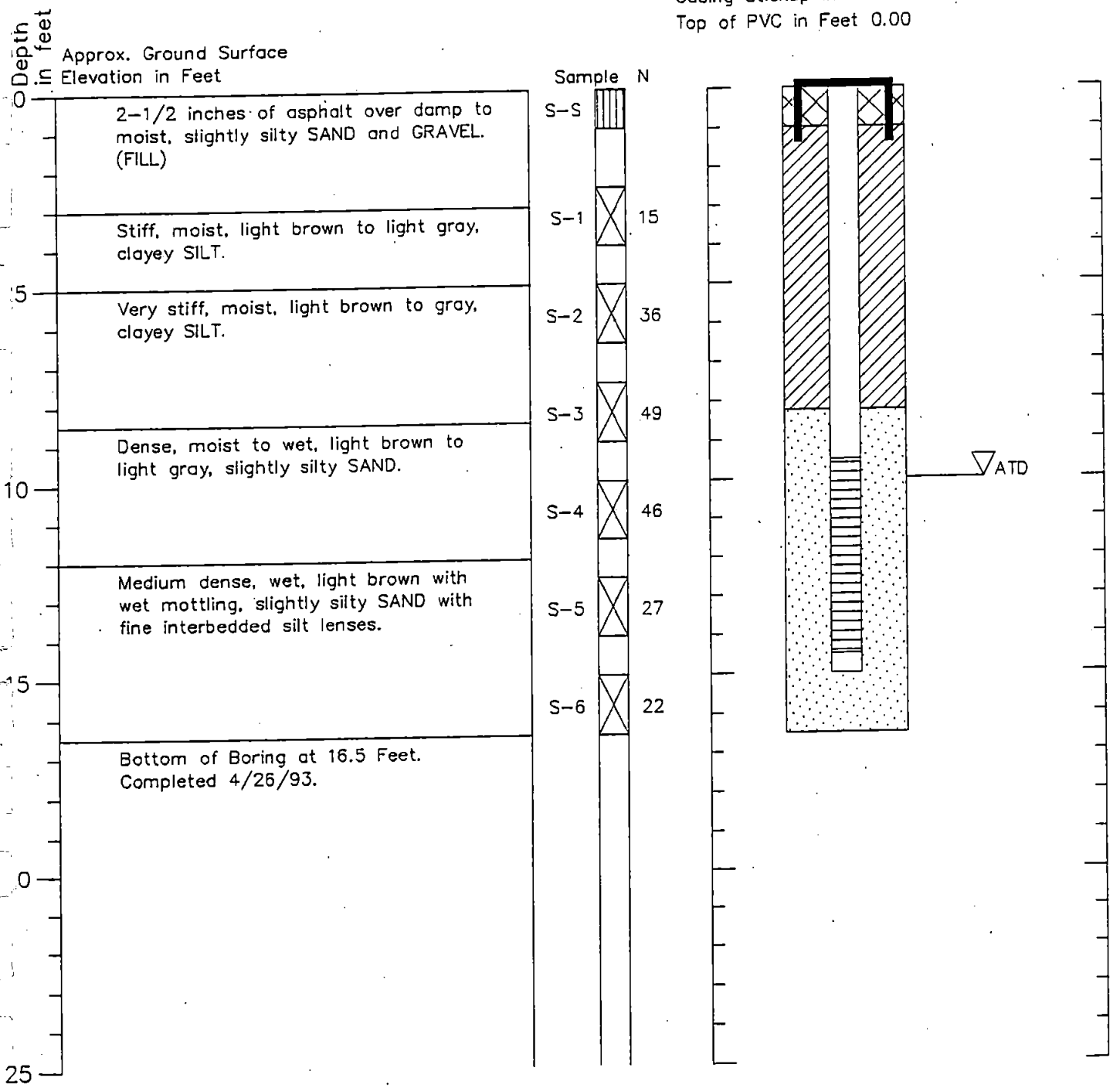
Figure A-2

Boring Log and Construction Data for Monitoring Well HC-2

Geologic Log

Monitoring Well Design

Casing Stickup in Feet
Top of PVC in Feet 0.00



1. Refer to Figure A–1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

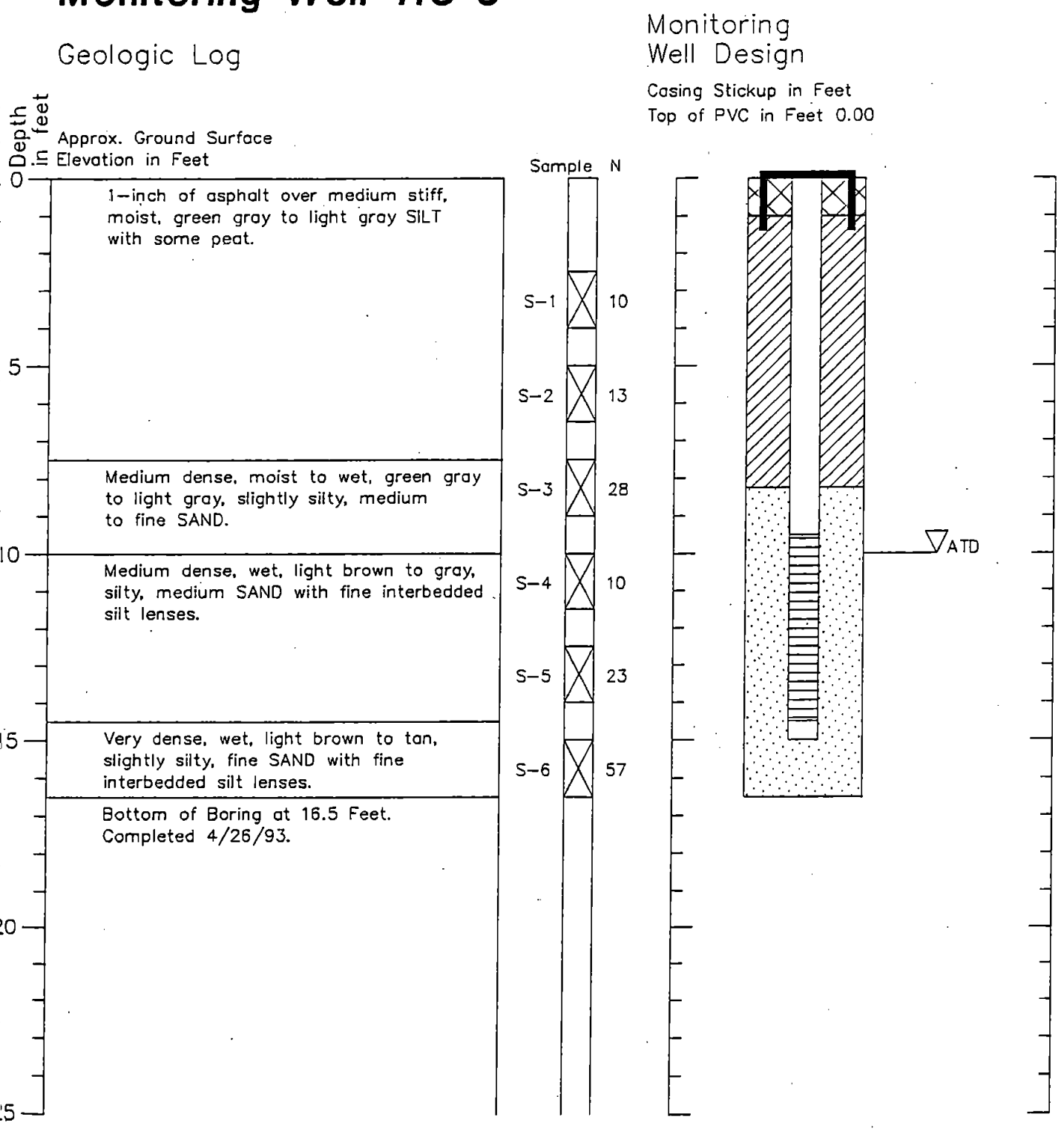
HARTCROWSER

J-3846 4/93

Figure A-3

Appendix B

Boring Log and Construction Data for Monitoring Well HC-3



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

J-3846 4/93

Figure A-4

Appendix A

Boring Log and Construction Data for Monitoring Well HC-4

Geologic Log

Approx. Ground Surface Elevation in Feet

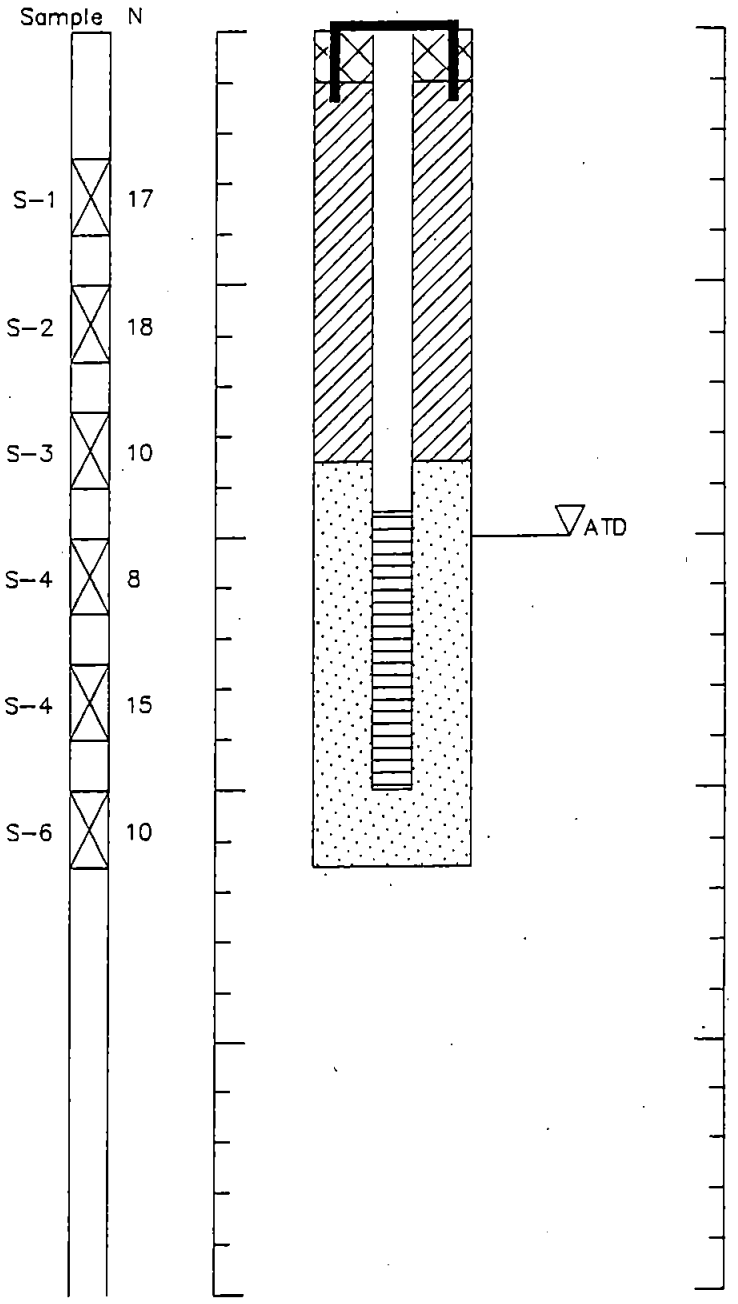
6 inches of asphalt over stiff, moist, light brown to gray, slightly sandy SILT with fine interbedded sand lenses.

Medium dense, moist to wet, light brown to gray, silty, fine SAND with fine interbedded silt lenses.

Bottom of Boring at 16.5 Feet Completed 4/27/93.

Monitoring Well Design

Casing Stickup in Feet
Top of PVC in Feet 0.00

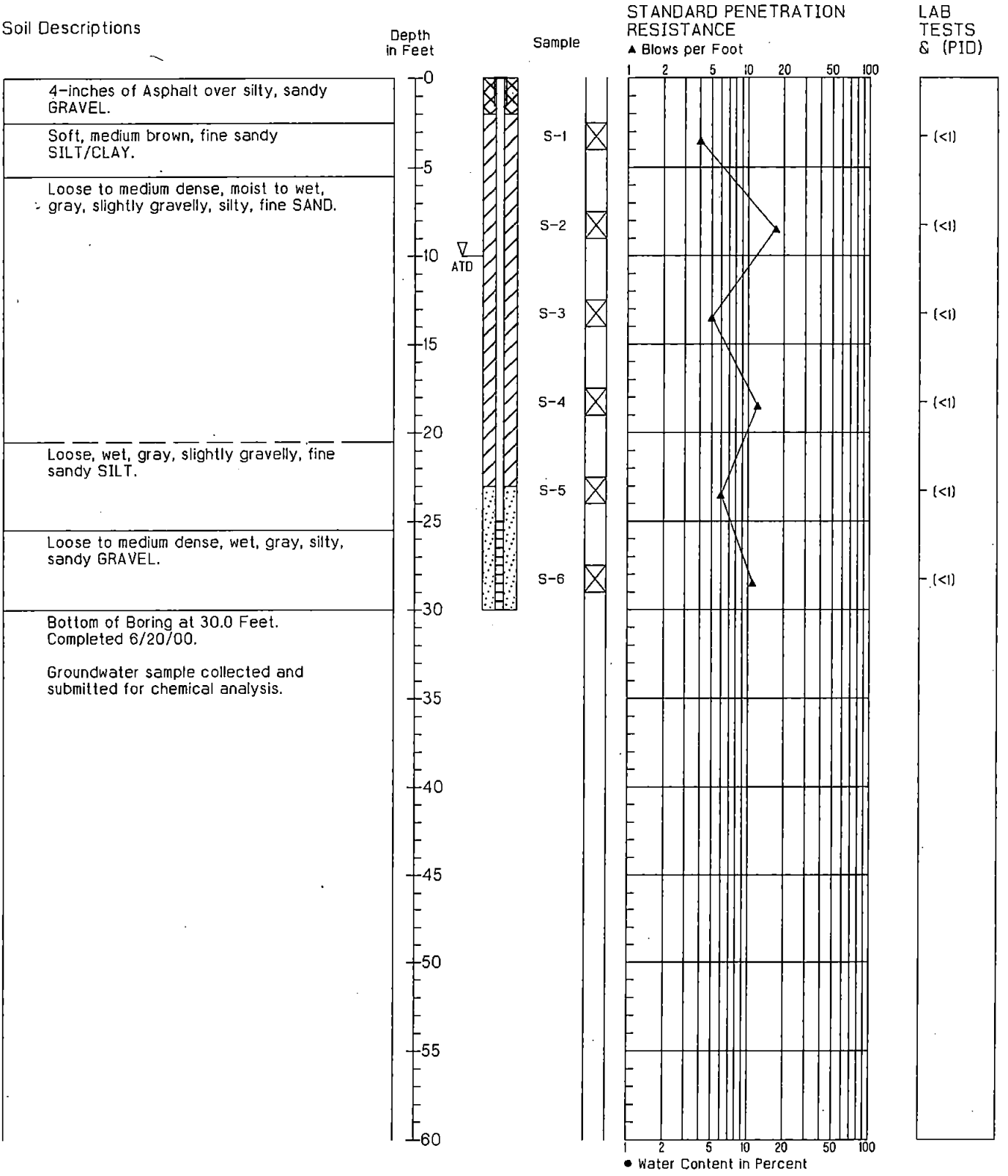


1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER
J-3846 4/93

Figure A-5

Boring Log HC-104



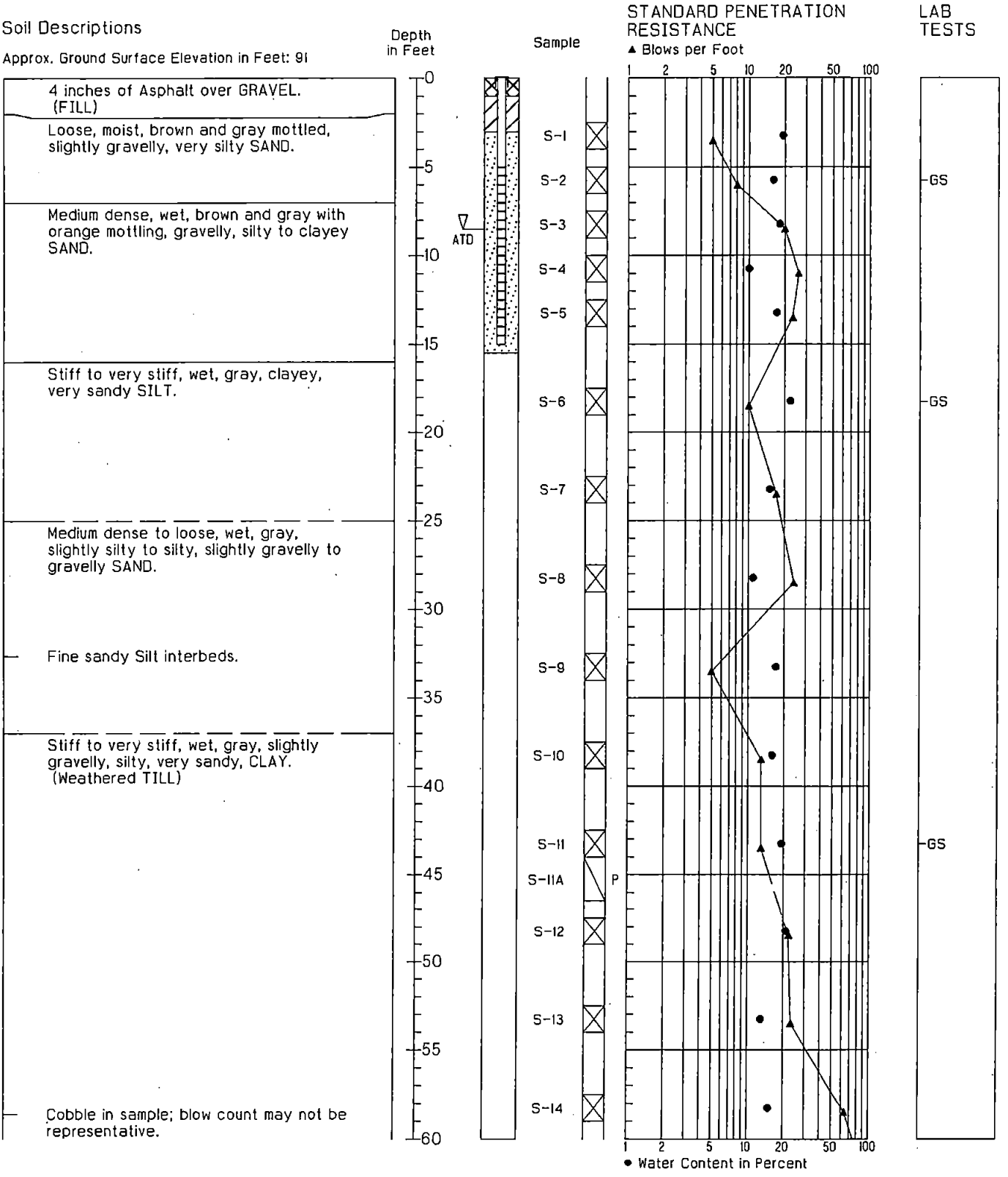
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

J-7206-01 6/00

Figure A-25

Boring Log HC-105



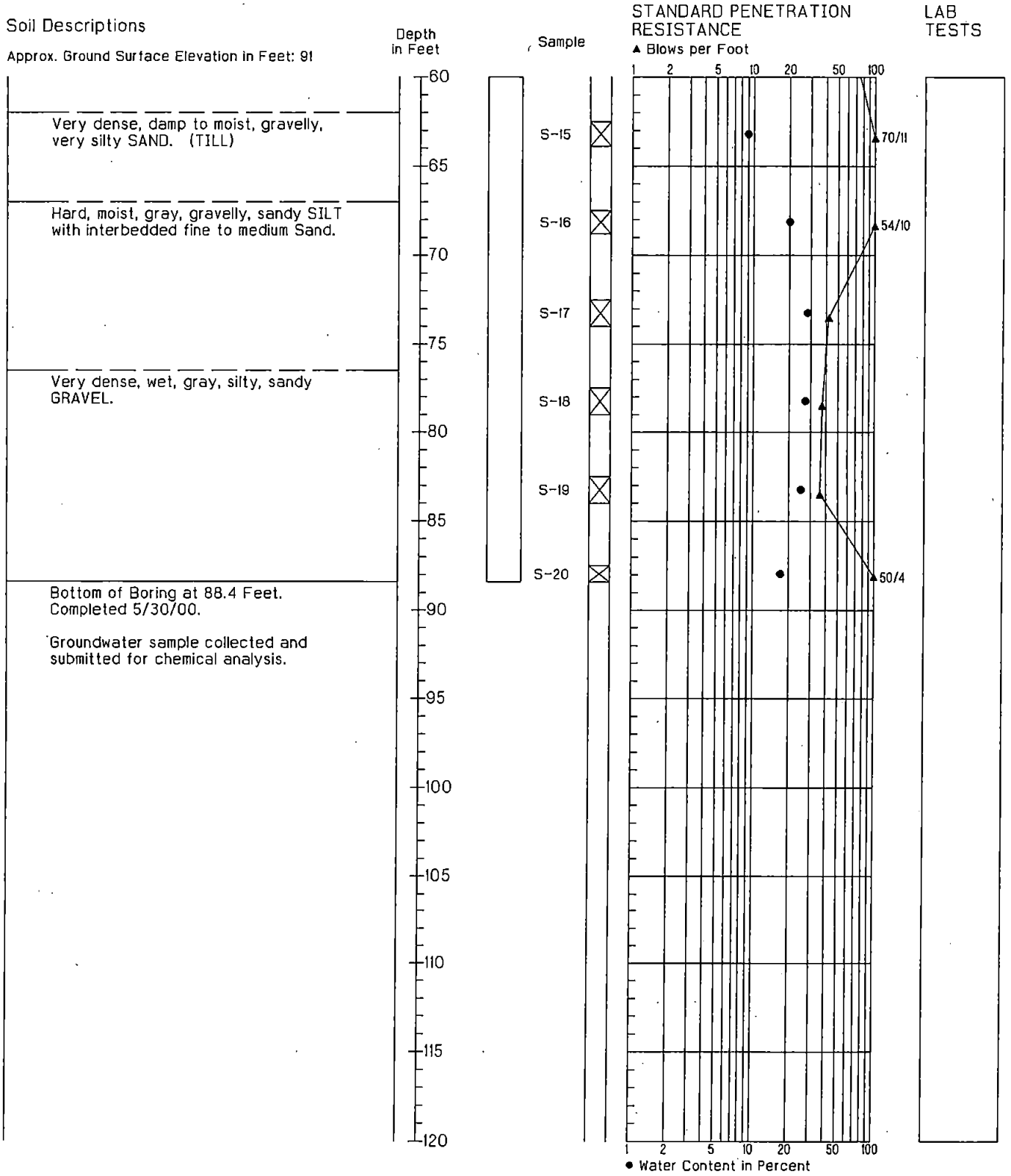
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

J-7206-01 8/00

Figure A-26 1/2

Boring Log HC-105



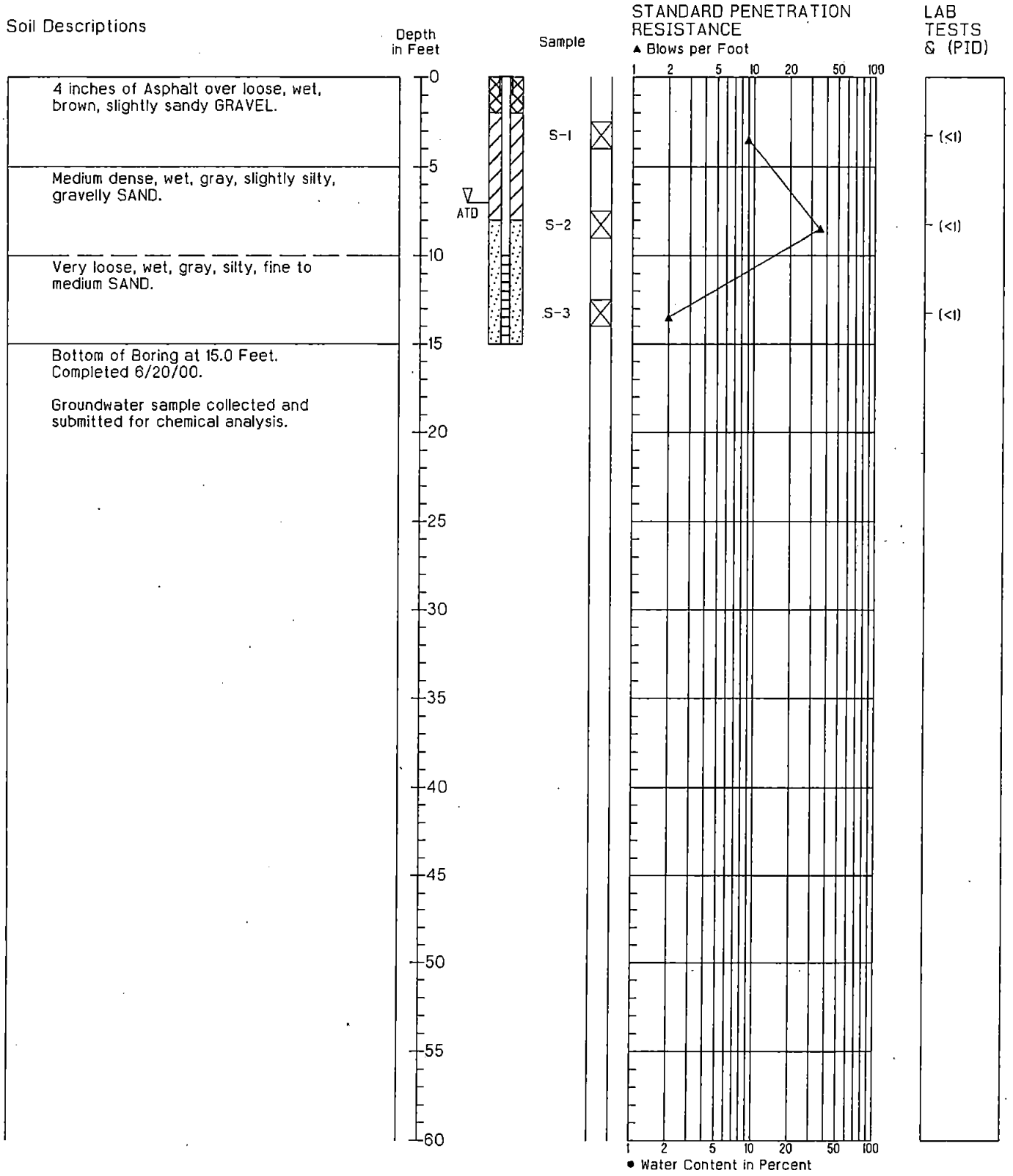
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

J-7206-01 8/00

Figure A-26 2/2

Boring Log HC-106



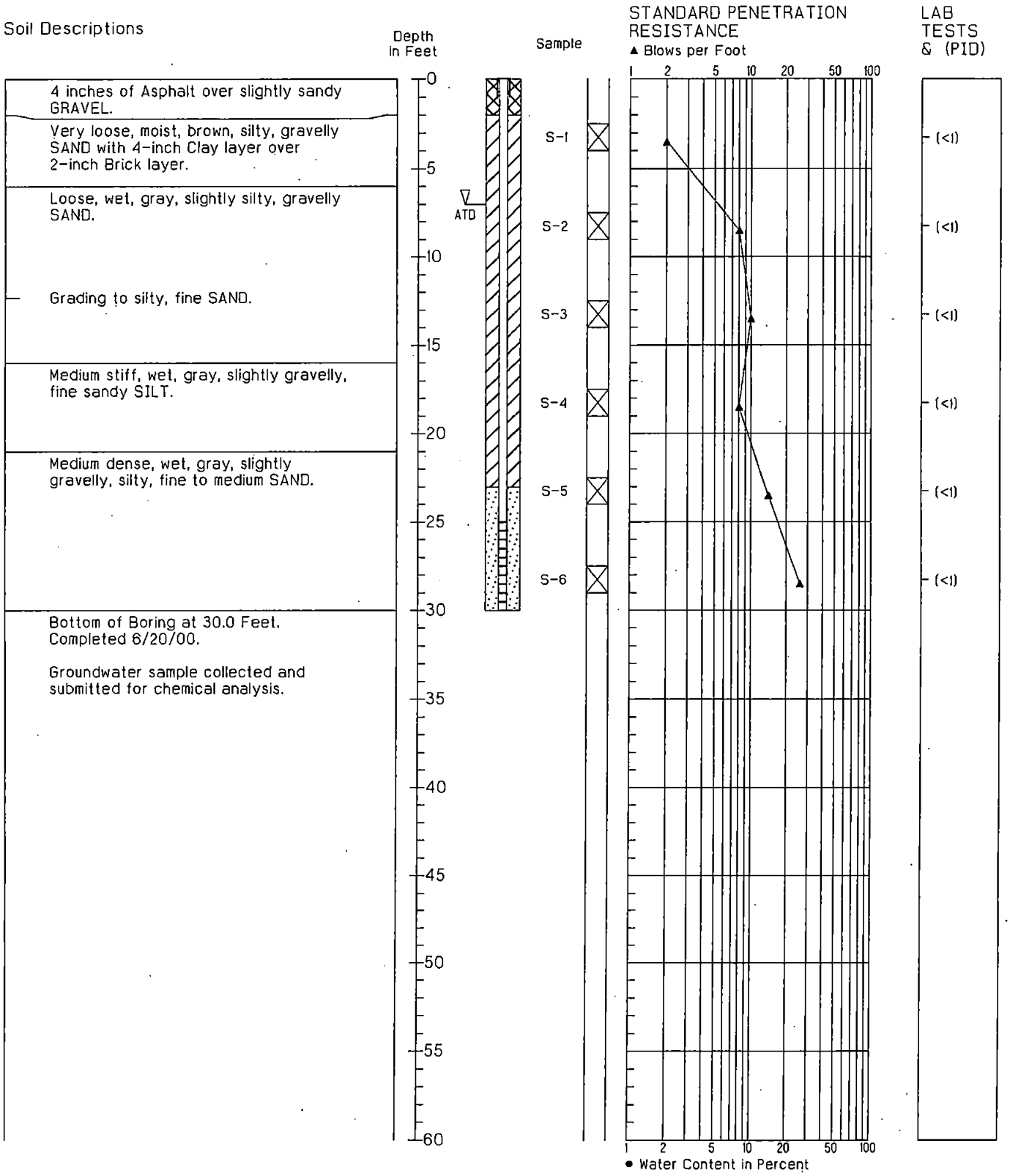
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

J-7206-01 6/00

Figure A-27

Boring Log HC-107



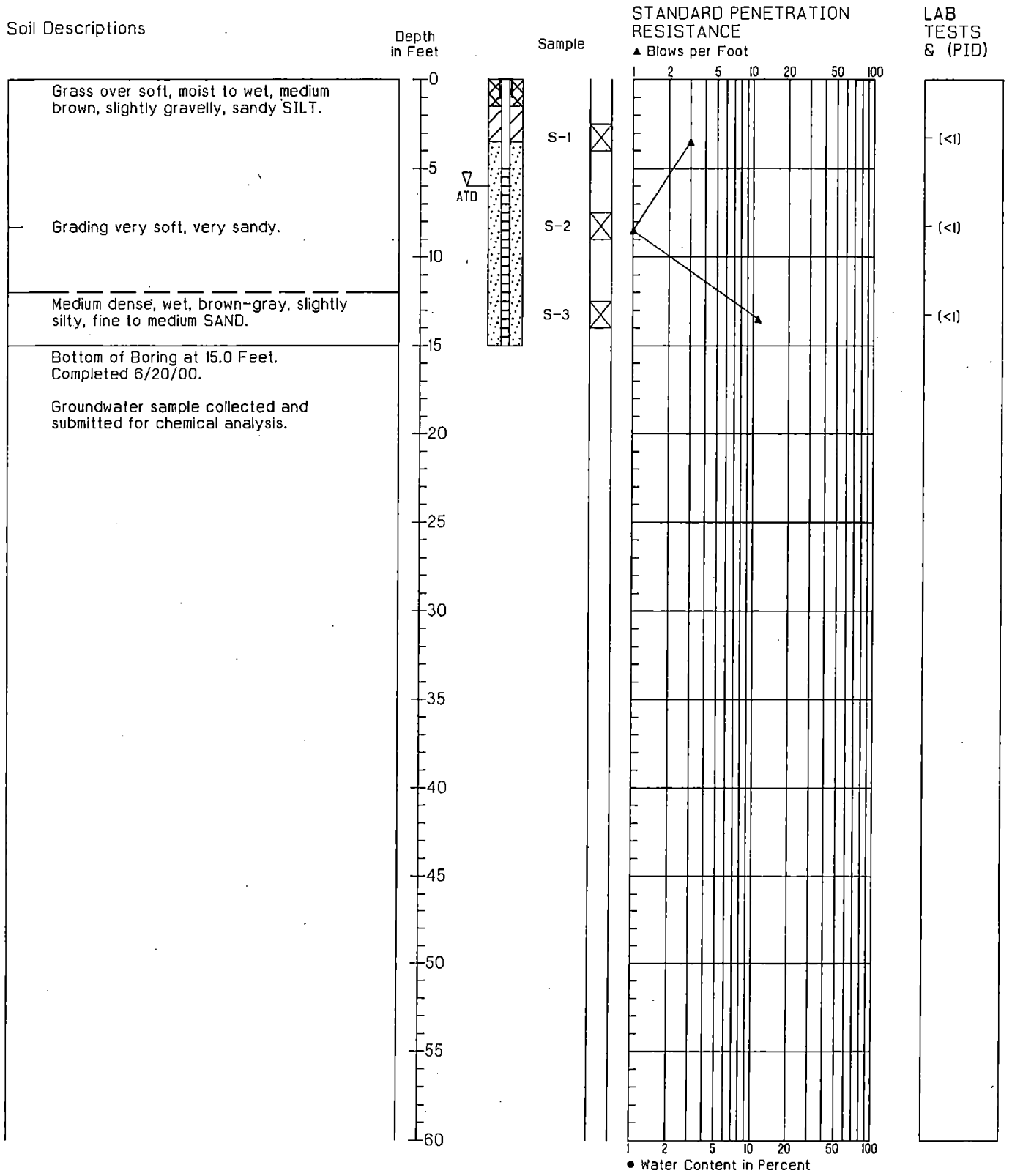
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

J-7206-01 6/00

Figure A-28

Boring Log HC-112



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

J-7206-01 6/00

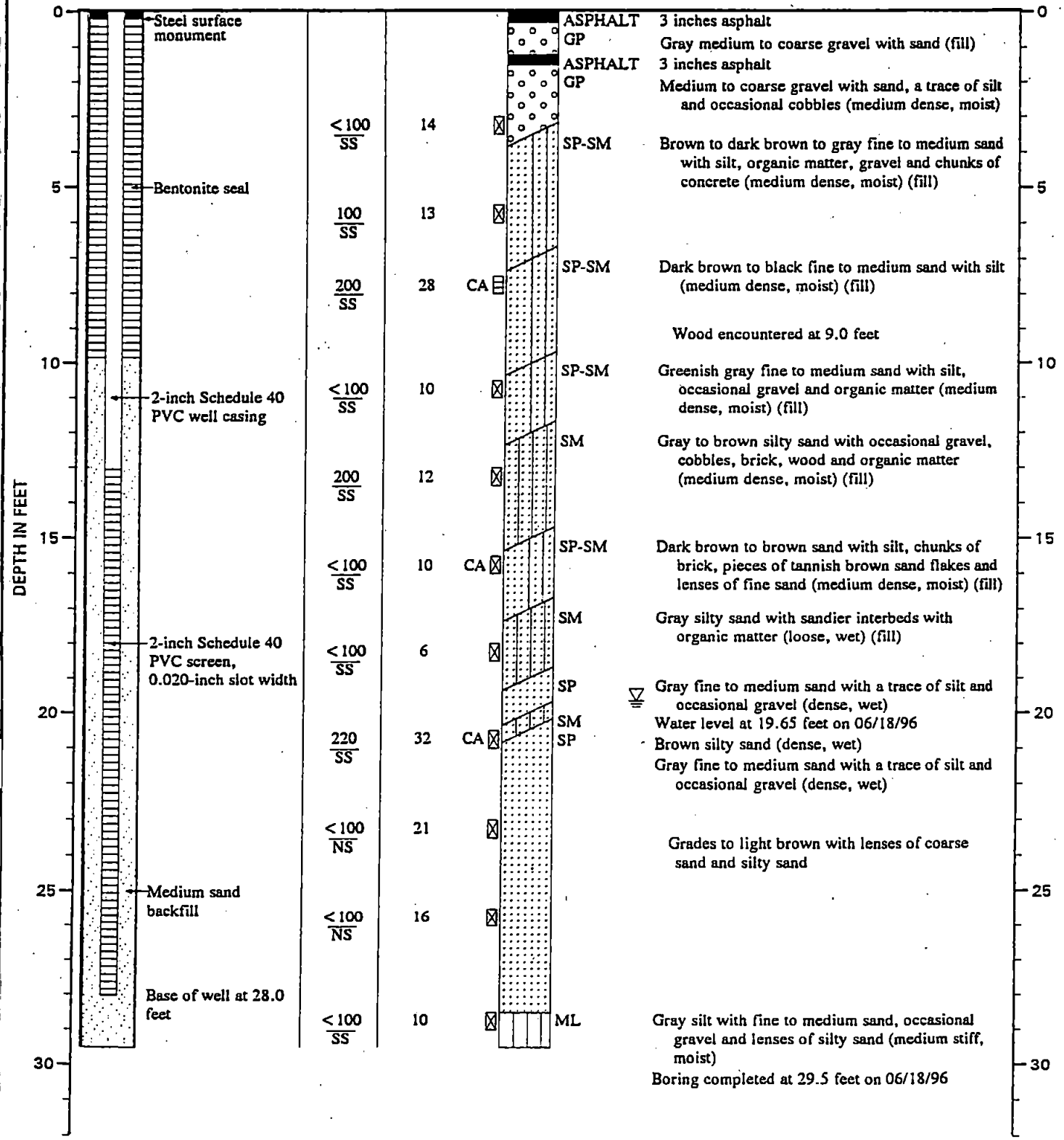
Figure A-29

MONITORING WELL MW-1

WELL SCHEMATIC

Casing Elevation (ft.): 98.60

Casing Stickup (ft.):



Note: See Figure B- 2 for explanation of symbols

Geo Engineers

LOG OF MONITORING WELL

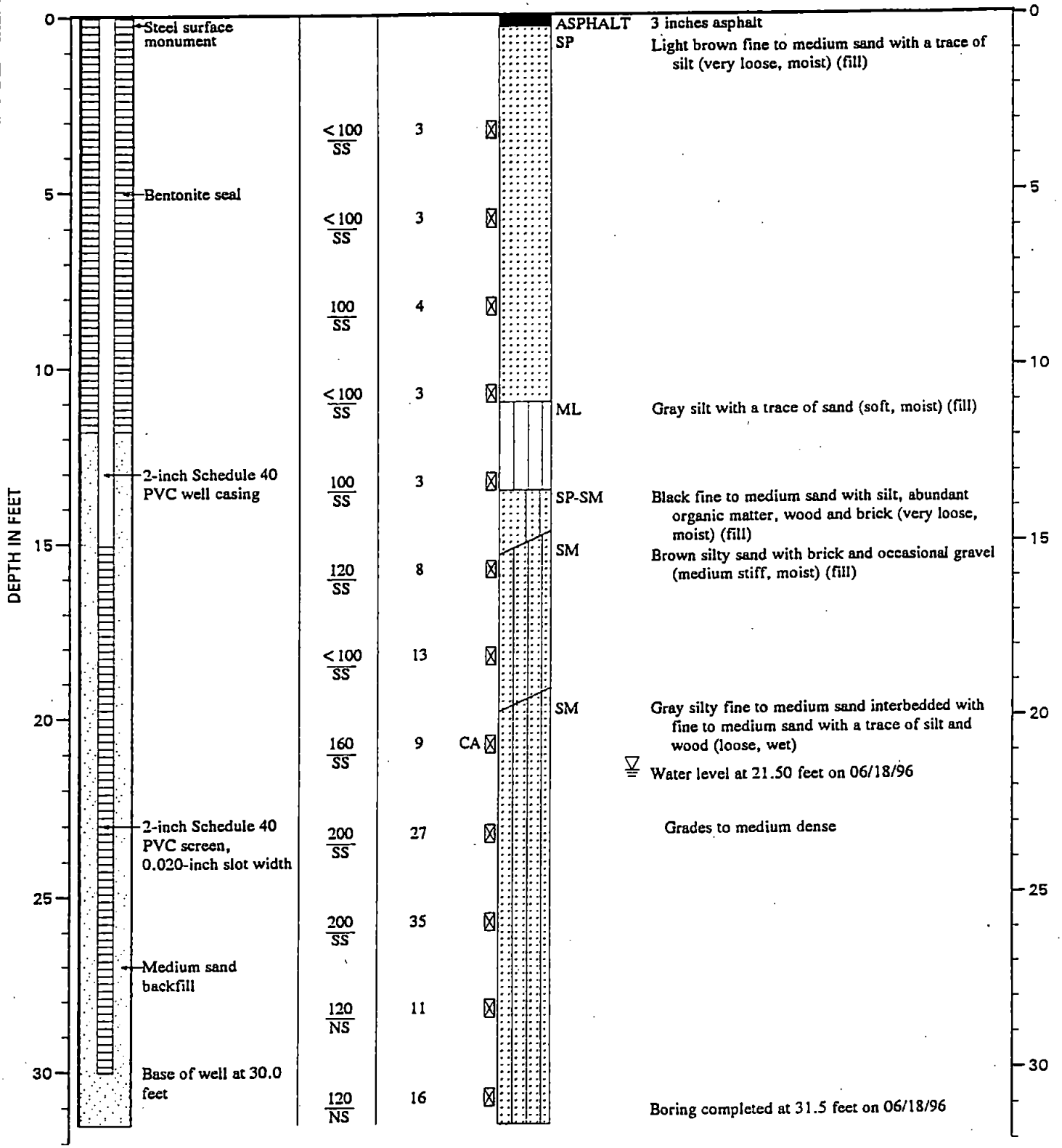
FIGURE B-6

MONITORING WELL MW-2

WELL SCHEMATIC

Casing Elevation (ft.): 100.56

Casing Stickup (ft.):



Note: See Figure B- 2 for explanation of symbols

Geo Engineers

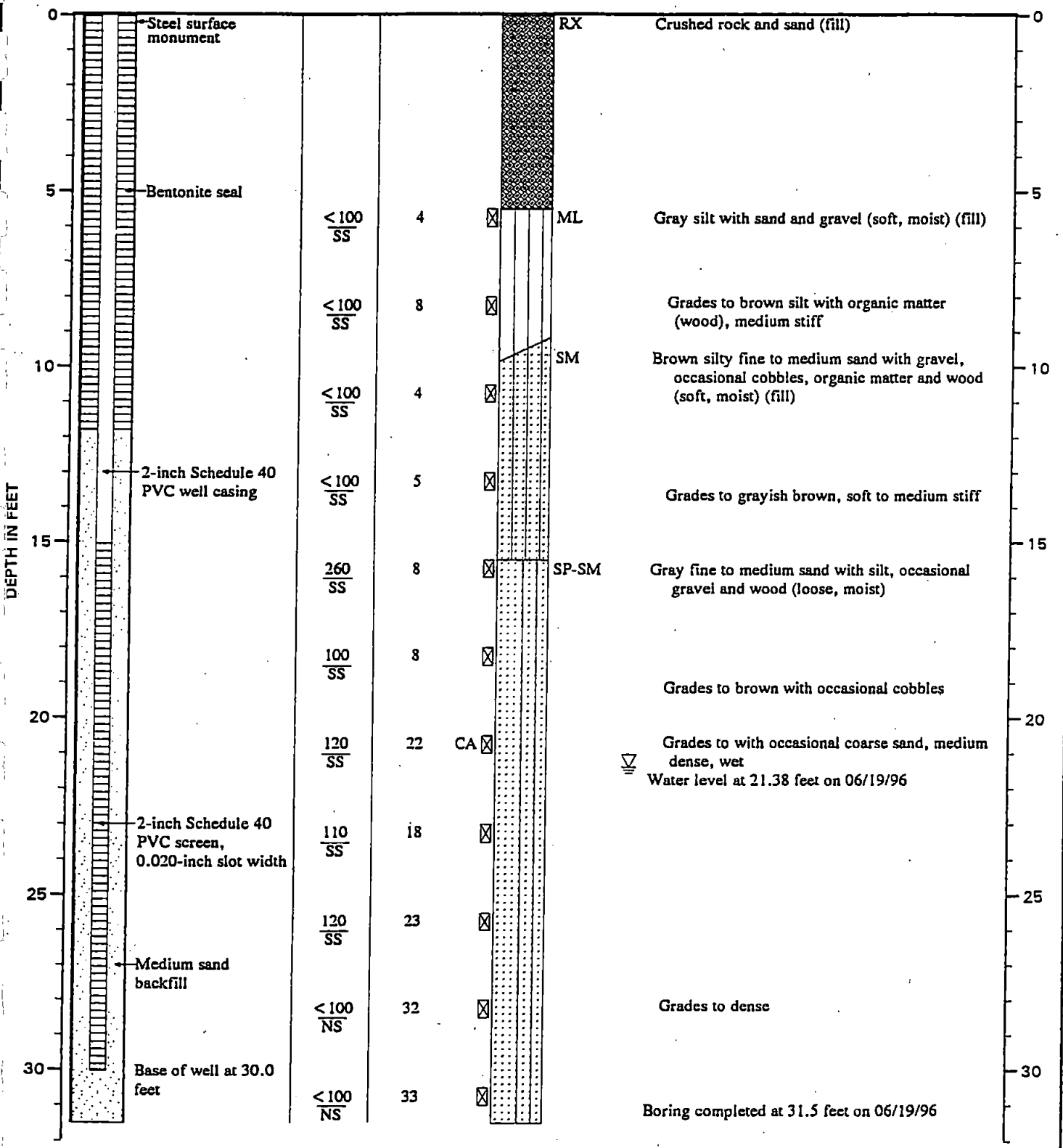
LOG OF MONITORING WELL

FIGURE B-7

MONITORING WELL MW-5

WELL SCHEMATIC

Casing Elevation (ft.): 103.70
Casing Stickup (ft.):



Note: See Figure B- 2 for explanation of symbols

Geo Engineers

LOG OF MONITORING WELL

FIGURE B-10

APPENDIX B
DETAILED COST ESTIMATES

Table B-1 - Cost Estimate for Alternative 1: Capping and Natural Attenuation

Site:	Building B Redevelopment	Description:	Alternative 3 consists of capping chromium-impacted soil to limit direct contact with affected soils and reduce surface water infiltration. Site is currently paved; this alternative includes repair of pavement. Remediation of chromium-impacted soil and groundwater left in place will be by monitored natural attenuation. Projected timeframe for this alternative is 20 years.
Location:	Seattle, Washington		
Phase:	Feasibility Study (-30% to +50%)		
Base Year:	2000		

CAPITAL COSTS:

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Cap repair					
Mobilization	1	LS	1000	$ 1,000	Paving equipment
Patch asphalt	1	LS	5000	$ 5,000	Assume less than 20% of area needs repair
SUBTOTAL				$ 6,000	
Project management and design	1	LS	15,000	$ 15,000	Includes design report and monitoring plan
Construction oversight	1	LS	3,000	$ 3,000	
Contingency	20%			$ 4,800	10% bid + 10% scope
TOTAL CAPITAL COST				**$ 28,800**	

ANNUAL MONITORING COSTS, YEARS 1 TO 10:

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Groundwater monitoring and inspection	4	EA	3,000	$ 12,000	4 wells quarterly
Cap maintenance	1	LS	1,000	$ 1,000	patching
Project management and reporting	1	LS	10,000	$ 10,000	Annual monitoring report
Contingency	20%			$ 4,600	10% bid + 10% scope
TOTAL ANNUAL MONITORING COST				**$ 27,600**	

ANNUAL MONITORING COSTS, YEARS 11 TO 20:

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Groundwater monitoring and cap inspection	2	EA	3,000	$ 6,000	4 wells twice a year
Cap maintenance	1	LS	1,000	$ 1,000	patching
Project management and reporting	1	LS	7,500	$ 7,500	Annual monitoring report
Contingency	20%			$ 2,900	10% bid + 10% scope
TOTAL ANNUAL MONITORING COST				**$ 17,400**	

CLOSURE COSTS:

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Confirmation groundwater monitoring	4	Qtr	3,000	$ 12,000	4 wells quarterly
Project management and reporting	1	LS	20,000	$ 20,000	Includes Ecology interaction
Contingency	20%			$ 6,400	10% bid + 10% scope
TOTAL CLOSURE COST				**$ 38,400**	

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	DISCOUNT RATE	PRESENT VALUE
Capital Cost	0	$ 28,800	7%	$ 28,800
Annual Monitoring Cost	1 to 10	$ 276,000	7%	$ 194,000
Annual Monitoring Cost	11 to 20	$ 174,000	7%	$ 62,000
Closure Cost	21	$ 38,400	7%	$ 9,000
		$ 478,800		$ 293,800
TOTAL PRESENT VALUE OF ALTERNATIVE				**$ 293,800**

Notes

Cost of protecting, replacing, or rerouting utilities not included.

Assumptions

In-place density of soil to be 1.6 tons per cubic yard

No buildings will be built over affected area.

Table B-2 - Cost Estimate for Alternative 2: Excavation and Natural Attenuation

Site: Building B Redevelopment
Location: Seattle, Washington
Phase: Feasibility Study (-30% to +50%)
Base Year: 2002

Description: Alternative 1 consists of excavating all chromium-impacted soil. Remediation of chromium- and chlorinated solvent-impacted groundwater left in place will be by monitored natural attenuation. Projected remediation time frame for this alternative is 10 years.

CAPITAL COSTS:

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Site Preparation					
Permits	1	LS	7,500	$ 7,500	Sewer discharge and grading permits
Pre-excavation soil sampling	1	LS	25,000	$ 25,000	grid of soil borings to determine extent of contaminated soil
Monitoring well abandonment	4	EA	250	$ 1,000	wells within excavation footprint
Mobilization, site setup, security	1	LS	12,000	$ 12,000	Construction equipment, facilities, fencing
SUBTOTAL				$ 45,500	
Excavation					
Asphalt removal	1,700	SY	4.11	$ 6,987	3 inches (Means, 2000)
Asphalt disposal	300	ton	30	$ 9,000	3 inches asphalt
Dewatering	1	LS	20,000	$ 20,000	Pump base of excavation, remove solids, sewer discharge
Excavation of contaminated soils	2000	CY	6	$ 12,000	Maximum depth 10 feet
Excavation of clean soils	2500	CY	6	$ 15,000	overburden and sideslope soils
Stockpile soils	4,500	CY	5	$ 22,500	Stockpile on property based on pre-excavation sampling
Disposal of contaminated soil	3,200	ton	40	$ 128,000	Transportation and disposal by Waste Management
SUBTOTAL				$ 197,500	
Site Restoration					
Import clean fill	3200	ton	16	$ 51,200	Structural
Backfill and compaction	4500	CY	6	$ 27,000	Machine compaction
Asphalt replacement	1,700	SY	14.76	$ 25,092	Includes base course (Means, 2000)
Monitoring well replacement	6	EA	2500	$ 15,000	includes downgradient wells
SUBTOTAL				$ 118,292	
Project management and design	20%			$ 32,758	Includes biddable plans and specs
Construction oversight	10%			$ 16,379	
Contingency	25%			$ 102,607	15% scope + 10% bid
TOTAL CAPITAL COST				**$ 513,000**	

ANNUAL MONITORING COSTS:

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Groundwater monitoring	4	Qtr	3,000	$ 12,000	Four wells quarterly
Project management and reporting	1	LS	10,000	$ 10,000	Annual monitoring report
Contingency	20%			$ 4,400	10% scope + 10% bid
TOTAL ANNUAL MONITORING COST				**$ 26,400**	

CLOSURE COSTS:

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Confirmation groundwater monitoring	4	Qtr	3,000	$ 12,000	Four wells quarterly
Project management and reporting	1	LS	20,000	$ 20,000	Includes Ecology interaction
Contingency	20%			$ 6,400	10% scope + 10% bid
TOTAL CLOSURE COST				**$ 38,400**	

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	DISCOUNT RATE	PRESENT VALUE
Capital Cost	0	$ 513,000	7%	$ 513,000
Annual Monitoring Cost	1 to 10	$ 264,000	7%	$ 185,000
Closure Cost	11	$ 38,400	7%	$ 18,000
		$ 777,000		$ 716,000
TOTAL PRESENT VALUE OF ALTERNATIVE				**$ 716,000**

Notes
Cost of protecting, replacing, or rerouting utilities not included.

Assumptions
Up to 140,000 gallons of contaminated water will be removed and discharged to the sanitary sewer (maximum groundwater infiltration rate 5 gpm).
In-place density of soil to be 1.6 tons per cubic yard
Excavation will not impact Herzog Glass building if present at time of work.
Proposed excavation footprint includes 1.5H:1V sidewall slope to base of excavation from building.
Clean overburden can be used as backfill

Table B-3 - Cost Estimate for Alternative 3: Excavation and Pump-and-Treat

Site: Building B Redevelopment
Location: Seattle, Washington
Phase: Feasibility Study (-30% to +50%)
Base Year: 2002

Description: Alternative 3 consists of excavating all chromium-impacted soil. Remediation of chromium- and chlorinated solvent-impacted groundwater left in place will be by pump-and-treat. Projected timeframe for this alternative is 5 years.

CAPITAL COSTS:

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Site Preparation					
Permits	1	LS	7,500	$ 7,500	Sewer discharge and grading permits
Pre-excavation soil sampling	1	LS	25,000	$ 25,000	grid of soil borings to determine extent of contaminated soil
Monitoring well abandonment	4	EA	250	$ 1,000	wells within excavation footprint
Mobilization, site setup, security	1	LS	12,000	$ 12,000	Construction equipment, facilities, fencing
SUBTOTAL				$ 45,500	
Excavation					
Asphalt removal	1,700	SY	4.11	$ 6,987	3 inches (Means, 2000)
Asphalt disposal	300	ton	30	$ 9,000	3 inches asphalt
Dewatering	1	LS	20,000	$ 20,000	Pump base of excavation, remove solids, sewer discharge
Excavation of contaminated soils	2000	CY	6	$ 12,000	Maximum depth 10 feet
Excavation of clean soils	2500	CY	6	$ 15,000	overburden and sideslope soils
Stockpile soils	4,500	CY	5	$ 22,500	Stockpile on property based on pre-excavation sampling
Disposal of contaminated soil	3,200	ton	40	$ 128,000	Transportation and disposal by Waste Management
SUBTOTAL				$ 197,500	
Site Restoration					
Import clean fill	3200	ton	16	$ 51,200	Structural
Backfill and compaction	4500	CY	6	$ 27,000	Machine compaction
Asphalt replacement	1,700	SY	14.76	$ 25,092	Includes base course (Means, 2000)
Monitoring well replacement	6	EA	2500	$ 15,000	includes downgradient wells
SUBTOTAL				$ 118,292	
Groundwater Treatment System					
Mobilization	1	LS	3000	$ 3,000	
Bag Filter	1	EA	2000	$ 2,000	Solids removal. Includes pump.
Equilization tank	1	EA	2500	$ 2,500	1,000 gallon
Treatment shed	1	EA	5000	$ 5,000	
Extraction wells	6	EA	4000	$ 24,000	4-inch diameter, wire-wrapped screens
Submersible pumps	6	EA	2000	$ 12,000	
Flow meter and controls	1	EA	10000	$ 10,000	includes pressure transducers
Piping	1	LS	20000	$ 20,000	Wells to treatment system; includes trenching beneath sidewalk
Electrical and control labor	1	LS	12000	$ 12,000	
Sewer permit	1	LS	1430	$ 1,430	King County
SUBTOTAL				$ 91,930	
Project management and design	10%			$ 45,322	Includes biddable plans and specs
Construction oversight	5%			$ 22,661	
Contingency	25%			$ 130,301	15% scope + 10% bid
TOTAL CAPITAL COST				**$ 652,000**	

ANNUAL O&M AND MONITORING COSTS:

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Pump-and-treat maintenance	2628	1000 gal	6	$ 15,768	includes power and bag filter changeout
Sewer disposal fees	2628	1000 gal	5.39	$ 14,165	operations and capacity charge
Groundwater monitoring	2	EA	3,000	$ 6,000	Four wells twice a year
Project management and reporting	1	LS	10,000	$ 10,000	Annual monitoring report
Contingency	20%			$ 9,187	10% scope + 10% bid
TOTAL ANNUAL COST				**$ 55,100**	

CLOSURE COSTS:

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Confirmation groundwater monitoring	4	Qtr	3,000	$ 12,000	Four wells quarterly
Project management and reporting	1	LS	20,000	$ 20,000	Includes Ecology interaction
Contingency	20%			$ 6,400	10% scope + 10% bid
TOTAL CLOSURE COST				**$ 32,000**	

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	DISCOUNT RATE	PRESENT VALUE
Capital Cost	0	$ 652,000	7%	$ 652,000
Annual O&M Cost	1 to 5	$ 276,000	7%	$ 226,000
Closure Cost	6	$ 32,000	7%	$ 21,000
		$ 928,000		$ 899,000
TOTAL PRESENT VALUE OF ALTERNATIVE				**$ 899,000**

Notes
Cost of protecting, replacing, or rerouting utilities not included.

Assumptions
In-place density of soil to be 1.6 tons per cubic yard
Excavation will not impact Herzog Glass building if present at time of work.
Proposed excavation footprint includes 1.5H:1V sidewall slope to base of excavation from building.
Clean overburden can be used as backfill
5 gpm combined flowrate for pump and treat system.
Discharge to sewer system without chemical treatment.

Table B-4 - Cost Estimate for Alternative 2: Excavation and Natural Attenuation in Conjunction with Redevelopment

Site: Building B Redevelopment
Location: Seattle, Washington
Phase: Feasibility Study (-30% to +50%)
Base Year: 2002

Description: Alternative 1 consists of excavating all chromium-impacted soil in conjunction with site redevelopment. Remediation of chromium- and chlorinated solvent-impacted groundwater left in place will be by monitored natural attenuation. Costs include only incremental remediation costs.Projected timeframe for this alternative is 10 years.

CAPITAL COSTS:

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Site Preparation					
Permits	1	LS	2,000	$ 2,000	Sewer discharge permit
Pre-excavation soil sampling	1	LS	25,000	$ 25,000	grid of soil borings to determine extent of contaminated soil
Monitoring well abandonment	4	EA	250	$ 1,000	wells within excavation footprint
SUBTOTAL				$ 28,000	
Excavation					
Dewatering	1	LS	5,000	$ 5,000	Sampling and sanitary sewer discharge fees
Stockpile soils	2,000	CY	5	$ 10,000	Segregation of contaminated from non-contaminated
Disposal of contaminated soil	3,200	ton	40	$ 128,000	Transportation and disposal by Waste Management
SUBTOTAL				$ 143,000	
Site Restoration					
Monitoring well installation	4	EA	2500	$ 10,000	downgradient of building
SUBTOTAL				$ 10,000	
Project management and design	1	LS	25,000	$ 25,000	Includes interaction with developer, architect, and contractor
Construction oversight	1	LS	10,000	$ 10,000	
Contingency	25%			$ 54,000	15% scope + 10% bid
TOTAL CAPITAL COST				**$ 270,000**	

ANNUAL MONITORING COSTS:

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Groundwater monitoring	4	Qtr	3,000	$ 12,000	Four wells quarterly
Project management and reporting	1	LS	10,000	$ 10,000	Annual monitoring report
Contingency	20%			$ 4,400	10% scope + 10% bid
TOTAL ANNUAL MONITORING COST				**$ 26,400**	

CLOSURE COSTS:

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Confirmation groundwater monitoring	4	Qtr	3,000	$ 12,000	Four wells quarterly
Project management and reporting	1	LS	20,000	$ 20,000	Includes Ecology interaction
Contingency	20%			$ 6,400	10% scope + 10% bid
TOTAL CLOSURE COST				**$ 38,400**	

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	DISCOUNT RATE	PRESENT VALUE
Capital Cost	0	$ 270,000	7%	$ 270,000
Annual Monitoring Cost	1 to 10	$ 132,000	7%	$ 93,000
Closure Cost	11	$ 38,400	7%	$ 18,000
		$ 402,000		$ 381,000
TOTAL PRESENT VALUE OF ALTERNATIVE				**$ 381,000**

Notes

Cost of protecting, replacing, or rerouting utilities not included.

Costs of non-environmental activities, including demolition and excavation, not included.

Assumptions

140,000 gallons of contaminated water will be removed and discharged to the sanitary sewer. If site were clean, water would be discharged to storm sewer.

In-place density of soil to be 1.6 tons per cubic yard